Report on the individual review of the inventory submission of Ukraine submitted in 2023*

Note by the expert review team

Summary

Each Party included in Annex I to the Convention must submit an annual inventory of emissions and removals of greenhouse gases for all years from the base year (or period) to two years before the inventory due date (decision 24/CP.19). Parties included in Annex I to the Convention that are Parties to the Kyoto Protocol also report supplementary information under Article 7, paragraph 1, of the Kyoto Protocol with the inventory submission due under the Convention. This report presents the results of the individual review of the 2023 inventory submission of Ukraine, conducted by an expert review team in accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories" and the "Guidelines for review under Article 8 of the Kyoto Protocol", as appropriate. The review took place from 11 to 15 September 2023 in Bonn.

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* In the symbol for this document, 2023 refers to the year in which the inventory was submitted, not to the year of publication.

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Contents

Abbreviations and acronyms

2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
AD	activity data
Article 8 review guidelines	"Guidelines for review under Article 8 of the Kyoto Protocol"
C	carbon
CaO	calcium oxide
CH_4	methane
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
Convention reporting adherence	adherence to the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories"
COPERT	software tool for calculating road transport emissions
CORINE	Coordination of Information on the Environment programme
CRF	common reporting format
CSC	carbon stock change
DOC	degradable organic carbon
DOM	dead organic matter
EF	emission factor
ERT	expert review team
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	statistical database of the Food and Agriculture Organization of the United Nations
$F_{IND-COM}$	factor for industrial and commercial inputs of nitrogen to wastewater
GDP	gross domestic product
GHG	greenhouse gas
GWP-100	100-year global warming potential values
HFC	hydrofluorocarbon
HWP	harvested wood products
IE	included elsewhere
IEA	International Energy Agency
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
ISW	industrial solid waste
LPG	liquefied petroleum gas
LULUCF	land use, land-use change and forestry
MCF	methane correction factor
MgO	magnesium oxide
MMS	manure management system(s)
MSW	municipal solid waste
N	nitrogen
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NF_3	nitrogen trifluoride
NIR	national inventory report
NO	not occurring
PFC	perfluorocarbon

QA/QC	quality assurance/quality control
SEF	standard electronic format
SF_6	sulfur hexafluoride
SIAR	standard independent assessment report
SOC_{REF}	reference soil organic carbon stocks
SSSU	State Statistics Service of Ukraine
UNFCCC Annex I inventory reporting guidelines	"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories"
UNFCCC review guidelines	"Guidelines for the technical review of information reported under the Convention related to greenhouse gas inventories, biennial reports and national communications by Parties included in Annex I to the Convention"
VS	volatile solids
Wetlands Supplement	*2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*

I. Introduction

1.   This report covers the review of the 2023 inventory submission of Ukraine, organized by the secretariat in accordance with the UNFCCC review guidelines, particularly part III thereof, namely the "UNFCCC guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention" (annex to decision 13/CP.20), and the Article 8 review guidelines (adopted by decision 22/CMP.1 and revised by decision 4/CMP.11). The review took place from 11 to 15 September 2023 in Bonn and was coordinated by Claudia do Valle and Roman Payo (secretariat). Table 1 provides information on the composition of the ERT that conducted the review for Ukraine.

Table 1
Composition of the expert review team that conducted the review for Ukraine

Area of expertise	Name (Party)
Generalist	Nagmeldin Elhassan (Sudan), Melanie Hobson (United Kingdom)
Energy	Charbel Afif (Lebanon), Jordon Kay (Canada), Joseph Peter Lovie-Toon (Australia), Regine Röthlisberger (Switzerland), Renata Patricia Soares Grisoli (Brazil), Gudrun Stranner (Austria)
IPPU	Geneviève LeBlanc-Power (Canada), Clemencio Nhamtumbo (Mozambique), Farryn Bianca Sherman (South Africa), Alexander Valencia (Colombia), Manuela Wieser (Austria)
Agriculture	Kadir Aksakal (Türkiye), Abdulkadir Bektas (Türkiye), Andreas Wilkes (New Zealand), Hiromi Yoshinaga (Japan)
LULUCF	Signe Kynding Borgen (Denmark), Matthew Jones (Australia), Erwin Moldaschl (Austria), Yasna Rojas Ponce (Chile), Atsushi Sato (Japan), Despoina Maria Vlachaki (Greece), Dorji Wangdi (Bhutan), Lyon Young (Australia)
Waste	Peter Norman Brown (United Kingdom), Emil Laurin (Canada), Gustavo Barbosa Mozzer (Brazil), Nkanyiso Ndlovu (Zimbabwe), Raphaëlle Pelland St-Pierre (Canada), Hiroyuki Ueda (Japan)
Lead reviewers	Melanie Hobson and Alexander Valencia

2.   The basis of the findings in this report is the assessment by the ERT of the Party's 2023 inventory submission in accordance with the UNFCCC review guidelines and the Article 8 review guidelines.

3.   The ERT has made recommendations that Ukraine resolve identified findings, including issues[1] designated as problems.[2] Other findings, and, if applicable, the encouragements of the ERT to Ukraine to resolve related issues, are also included in this report.

4.   A draft version of this report was communicated to the Government of Ukraine, which provided no comments.

5.   Annex I presents the annual GHG emissions of Ukraine, including totals excluding and including LULUCF, indirect CO_2 emissions, and emissions by gas and by sector.

II. Summary and general assessment of the Party's 2023 inventory submission

6.   Table 2 provides the assessment by the ERT of the Party's 2023 inventory submission with respect to the tasks undertaken during the review. Further information on the issues identified, as well as additional findings, may be found in tables 3 and 5.

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[1] Issues are defined in decision 13/CP.20, annex, para. 81.
[2] Problems are defined in decision 22/CMP.1, annex, paras. 68–69, as revised by decision 4/CMP.11.

Table 2
Summary of review results and general assessment of the 2023 inventory submission of Ukraine

Assessment			Issue/problem ID#(s) in table 3 or 5[a]
Date of submission	Original submission: NIR, 18 May 2023; CRF tables (version 1), 18 May 2023; SEF tables, 18 May 2023		
Review format	Centralized		
Source of GWP-100	IPCC Fourth Assessment Report		
Application of the requirements of the UNFCCC Annex I inventory reporting guidelines and the Wetlands Supplement (if applicable)	Have any issues been identified in the following areas:		
	(a) Identification of key categories?	No	
	(b) Selection and use of methodologies and assumptions?	Yes	E.11, I.8, I.13, I.14, L.10, L.21, L.23, W.3, W.7, W.8
	(c) Development and selection of EFs?	Yes	E.2, L.11, W.10, W.11
	(d) Collection and selection of AD?	Yes	I.10, A.7, A.9, L.2, L.6, L.9, L.16, L.18, L.22, L.24
	(e) Reporting of recalculations?	No	
	(f) Reporting of a consistent time series?	Yes	E.4, I.4, I.13, L.7, L.8
	(g) Reporting of uncertainties, including methodologies?	Yes	L.4, L.5
	(h) QA/QC?		QA/QC procedures were assessed in the context of the national system (see supplementary information under the Kyoto Protocol below)
	(i) Missing categories, or completeness?[b]	Yes	I.9
	(j) Application of corrections to the inventory?	No	
Significance threshold	For categories reported as insignificant, has the Party provided sufficient information showing that the likely level of emissions meets the criteria in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines?	No	A.4, A.6
Description of trends	Did the ERT conclude that the description in the NIR of the trends for the different gases and sectors is reasonable?	Yes	
Supplementary information under the Kyoto Protocol	Have any issues been identified related to the following aspects of the national system:		
	(a) Overall organization of the national system, including the effectiveness and reliability of the institutional, procedural and legal arrangements?	No	
	(b) Performance of the national system functions?	Yes	G.1, G.2, G.3
	Have any issues been identified related to the national registry:		
	(a) Overall functioning of the national registry?	NA	
	(b) Performance of the functions of the national registry and the adherence to technical standards for data exchange?	NA	
	Have any issues been identified related to the reporting of information on assigned amount unites, certified emission reductions, emission reduction units and removal units and on discrepancies in accordance with decision 15/CMP.1, annex, chapter I.E, in conjunction with decision 3/CMP.11, taking into consideration any findings or recommendations contained in the SIAR?	NA	

Assessment		Issue/problem ID#(s) in table 3 or 5[a]
Commitment period reserve	Was the commitment period reserve reported in accordance with decision 18/CP.7, annex; decision 11/CMP.1, annex; and decision 1/CMP.8, paragraph 18?	NA
Response from the Party during the review	Has the Party provided the ERT with responses to the questions raised, including the data and information necessary for assessing conformity with the UNFCCC Annex I inventory reporting guidelines and any further guidance adopted by the Conference of the Parties?	Yes
Recommendation for an exceptional in-country review	On the basis of the issues identified, does the ERT recommend that the next review be conducted as an in-country review?	No
Questions of implementation	Did the ERT list any questions of implementation?	No

[a] Further information on the issues identified, as well as additional findings, may be found in tables 3 and 5.
[b] Missing categories for which methods are provided in the 2006 IPCC Guidelines may affect completeness and are listed in annex II.

III.   Status of implementation of recommendations included in the previous review report

7.   Table 3 compiles the recommendations from previous review reports that were included in the most recent previous review report, published on 1 March 2022,[3] and had not been resolved by the time of publication of the report on the review of the Party's 2021 annual submission. The ERT has specified whether it believes the Party had resolved, was addressing or had not resolved each issue or problem by the time of publication of this review report and has provided the rationale for its determination, which takes into consideration the publication date of the most recent previous review report and national circumstances.

Table 3
Status of implementation of recommendations included in the previous review report for Ukraine

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
General			
G.1	National system (G.5, 2021) (G.7, 2019) Convention reporting adherence	Submit the annual GHG inventory by 15 April each year.	Addressing. During the previous review, Ukraine clarified that an annual step-by-step planning process has been developed and followed in accordance with the 2006 IPCC Guidelines, but that the deadlines were not met owing to the optimization of the Party's central executive government bodies' system and the coronavirus disease 2019 pandemic. Ukraine submitted its 2023 inventory (NIR and CRF tables) on 18 May 2023, which is not in accordance with the deadline of 15 April set in paragraph 3 of decision 24/CP.19. During the review, the Party clarified that it was not able to comply with its plan to develop and submit its 2023 submission before 15 April because of difficulties with data collection and the current national circumstances, which caused a shortfall on the energy system. While recognizing the national circumstances of Ukraine, the ERT considers that the recommendation has not yet been addressed because the Party did not comply with the deadline set in paragraph 3 of decision 24/CP.19 for its 2023 inventory submission.
G.2	National system (G.7, 2021) Convention reporting adherence	Prepare and report in the next annual inventory submission an action plan detailing the steps, time frames, responsibilities, and human and financial resources required for addressing the issues identified in the LULUCF sector.	Addressing. Ukraine did not report in the NIR an action plan as requested by the previous ERT. During the review, the Party provided a plan aimed at addressing the issue of data collection for forest land. In particular, the plan was focused on restoring the time series of data on forest areas from the forest accounting performed since 1988. However, consistent land representation was not part of the plan owing to lack of sources of data in Ukraine to enable it to establish consistent land-use matrices for the entire time series. The ERT considers that the recommendation has not yet been fully addressed because, although the Party prepared a plan, it does not address all issues with

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[3] FCCC/ARR/2021/UKR. The ERT notes that the report on the review of Ukraine's 2022 annual submission has not been published yet owing to insufficient funding for the review process. As a result, the latest previously published annual review report reflects the findings of the review of the Party's 2021 annual submission.

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
			the reporting of the LULUCF sector (e.g. land representation), which are related to the performance of the national system and the institutional arrangements for preparing the national GHG inventory.
G.3	National system (G.7, 2021) Transparency	Report on the progress of implementation of the action plan for the LULUCF sector in subsequent annual submissions.	Not resolved. Ukraine did not report on the progress of implementation of the action plan in the NIR (see ID# G.2 above). During the review, the Party explained that the item of the plan related to establishing a procedure for collecting data from the Ukrainian State Project Forest Inventory Production Association, or Ukrderzhlisproekt, was implemented until February 2022, when the occupation of Irpin (Kyiv region) began. Consistent land representation is not part of the plan owing to lack of sources of data in Ukraine to enable it to establish consistent land-use matrices for the entire time series. Efforts were made to use the freely available data and capacity of the Ministry of Environmental Protection and Natural Resources of Ukraine to produce a land-use matrix, but the quality was low (see ID# L.6 below). The Party explained that it was assured that it would receive assistance to develop a LULUCF monitoring and reporting system based on best practices from the European Union, particularly as part of activities under the International Climate Initiative of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety related to developing a historical land-use matrix and enhancing the capacity of Ukraine to produce such data on a regular basis. Unfortunately, the project was postponed several times for procedural reasons, but it is expected to be launched in early 2024 and to help in addressing most of the recurring reporting issues in the LULUCF sector through establishment of a strong foundation of reliable data on land areas.

The ERT notes that the Party continues to face difficulties in implementing the plan and considers that the recommendation has not yet been fully addressed because information on the progress of implementation of the plan, including challenges faced, was not included in the NIR. |
| G.4 | Notation keys (G.8, 2021) Convention reporting adherence | Ensure that the total national aggregate of estimated emissions for all gases and categories considered insignificant remains below 0.1 per cent of national total GHG emissions, in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines, and include that information in the NIR. | Addressing. Ukraine explained during the review that there were two categories for which emissions were considered insignificant, namely 5.C.2 open burning of waste (CO_2, CH_4 and N_2O) and 3.B.2.5 leaching and run-off from MMS (N_2O). The Party reported in the NIR (p.261) that emissions for open burning of solid waste (category 5.C.2) were estimated at 40.27 kt CO_2 eq, which is less than 0.05 per cent of national total emissions (163.63 kt CO_2). For category 3.B.2.5, the Party reported in the NIR (p.181) that there is no national factor of N losses due to run-off and leaching during solid and liquid storage, and the ERT confirms that if there is no default EF, this is not a mandatory category. However, the information provided in the NIR is not clear enough to enable the ERT to evaluate the significance threshold and whether the total national aggregate of emissions for all categories considered insignificant remains below 0.1 per cent of the national total GHG emissions (as per the UNFCCC |

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
			Annex I inventory reporting guidelines, para. 37(b)). The Party could have included in its NIR a section or table listing the categories considered insignificant and the likely level of emissions for each category (indicating the approximate AD and default EF), showing that emissions are below 0.05 per cent of the national total and do not exceed 500 kt CO_2 eq. In addition, the ERT noted that the Party indicated that categories 3.D.a.2.b (sewage sludge applied to soils) and 3.G (liming) are also considered insignificant (see ID#s A.4 and A.6 below) without providing information in the NIR on the likely level of emissions.
G.5	Notation keys (G.9, 2021) Accuracy	Either estimate and report indirect CO_2 emissions in CRF table 6 or update the reporting of indirect CO_2 emissions in CRF table 6 by using the correct notation key (e.g. "NE") in accordance with paragraph 37 of the UNFCCC Annex I inventory reporting guidelines.	Resolved. Ukraine updated the notation key used to report indirect CO_2 emissions in CRF table 6 to "NE".
G.6	Uncertainty analysis (G.10, 2021) Convention reporting adherence	Include in the NIR an uncertainty analysis for the base year under the Convention (1990).	Resolved. Ukraine reported in its NIR (section 1.6, p.48) uncertainty estimates for the base year (1990). See also annex 7 to the NIR, tables A7.3 and A7.4 (pp.541–547).
Energy			
E.1	Fuel combustion – reference approach – solid fuels – CO_2 (E.1, 2021) (E.8, 2019) Convention reporting adherence	Correct the unit (i.e. from TJ to kt) used to report solid fuels in CRF table 1.A(b).	Not resolved. Ukraine continued to report TJ as the unit in column D of CRF table 1.A(b), although the numerical values reported for production, import, export and stock change of solid fuels correspond to kt. During the review, the Party indicated that it faced technical difficulties in changing the unit using the CRF Reporter. The Party indicated that it expects the correction to be implemented for the next inventory submission using different reporting software.
E.2	1.A Fuel combustion – sectoral approach – liquid fuels – CO_2 (E.2, 2021) (E.1, 2019) (E.2, 2017) (E.8, 2016) (E.11, 2015) (31, 2014) Accuracy	Develop and use country-specific CO_2 EFs for liquid fuels (i.e. residual fuel, diesel oil, LPG, petroleum coke and refinery gases), which have a significant share in the fuel mix of stationary combustion.	Addressing. Ukraine reported in the NIR (table A2.4, p.326) the carbon content factors and net calorific values for diesel oil, LPG and motor gasoline, and described in annex A2.6.3 (p.336) the methodology used to determine the country-specific CO_2 EFs for liquid fuels. The Party indicated in the NIR (annex A2.5, p.326) that a country-specific CO_2 EF for refinery gases has not been considered since refinery gases are reported under other oil products in national statistics. The Party included in the improvement plan in the NIR (annex A8.2, p.566) developing a country-specific CO_2 EF for residual fuel. During the review, the Party explained that no financing for developing a country-specific CO_2 EF for residual fuel oil and petroleum coke had been allocated.

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
E.3	1.A.2.f Non-metallic minerals – liquid fuels – CO_2 (E.19, 2021) Transparency	Investigate and provide in the NIR a detailed explanation of the sector-specific drivers behind the significant inter-annual changes in AD across the time series.	Not resolved. Ukraine did not provide in the NIR an explanation of the drivers behind the significant inter-annual changes in AD that caused the reduction of the CO_2 IEF for liquid fuels. In CRF table 1.A(a)s2, the CO_2 IEF reported for 2017 is 73.50 t/TJ, decreasing to 66.43 t/TJ for 2018, 65.68 t/TJ for 2019 and 64.12 t/TJ for 2020–2021. The AD increased from 144.21 TJ for 2017 to 4,049.48 TJ for 2021. During the review, the Party clarified that the change in IEF is due to the increased use of LPG under liquid fuels in the category since 2018 and the significant increase in AD is explained by the redistribution of consumption between liquid, solid and gaseous fuels, which is confirmed by statistics.
			The ERT considers that the recommendation has not yet been fully addressed because the Party did not include in the NIR a detailed explanation of the sector-specific drivers behind the significant inter-annual changes in AD across the time series.
E.4	1.A.3.b Road transportation – LPG – CO_2, CH_4 and N_2O (E.4, 2021) (E.11, 2019) Consistency	Demonstrate that the use of different data sources for 1990–2015 and 2016 onward result in consistent CO_2, CH_4 and N_2O emission estimates across the time series.	Addressing. Ukraine did not demonstrate in the NIR how time-series consistency is ensured for LPG under category 1.A.3.b.i (cars). During the previous review the Party added some information to the NIR explaining the different data sources and the surrogate method used. The Party used different data sources for 1990–2015 and for 2016 onward, and the large increase in AD observed between 2015 and 2016 remains (AD for 2016 are 57 per cent higher than those for 2015). The Party reported in its NIR (section 3.2.9.2.3, p.78) that, owing to changes to its statistical forms in 2016, fuel volumes for 2016–2021 were calculated by surrogate method on the basis of data for 2015. During the review, the Party clarified that IEA data on fuel consumption for road transport and off-road transport were used as surrogate parameters. The Party also stated that in 2021 a scientific research programme was financed for calculating emissions from road transportation using COPERT instead of the surrogate method, but the programme could not continue owing to national circumstances.
E.5	1.A.3.d Domestic navigation – liquid fuels – CO_2 (E.5, 2021) (E.4, 2019) (E.23, 2017) Transparency	Include in the NIR documentation of the observed trends in cargo for national and international navigation, particularly for 2012 onward.	Resolved. Ukraine reported in its NIR (figure 3.11, p.80) on the observed trends in cargo and emissions for domestic navigation for 2000–2021, and stated in its NIR (p.80) that fluctuations in navigation are due to fluctuations in the economy.
E.6	1.B.1.c Other (solid fuels) – solid fuels – CO_2 and CH_4 (E.9, 2021) (E.13, 2019) Transparency	Improve the information on allocation of CH_4 emissions from coal bed CH_4 flaring.	Addressing. Ukraine added some information to the previous NIR, but the ERT considers that the Party did not improve the information provided in the NIR on the allocation of CH_4 emissions from coal bed CH_4 flaring. The Party explained in the NIR (section 3.3.1.4, p.89) that CO_2 emissions from coal bed CH_4 flaring are allocated under category 1.B.1.c (other solid fuels), but did not clarify

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
			whether CH_4 emissions are also included. In CRF table 1.B.1 the Party reported emissions of both CO_2 and CH_4 from coal bed CH_4 flaring under category 1.B.1.c (other solid fuels) (see also ID# E.7 below). In addition, although Ukraine corrected the reference to equation 1.4.5 to equation 5.2 of the 2006 IPCC Guidelines, as informed during the previous review, the ERT could not find in the guidelines any equation 5.2 (2006 IPCC Guidelines, vol. 2, chap. 5) and noted chapter 5, volume 2, of the 2006 IPCC guidelines refers to CO_2 transport, injection and geological storage, rather than fugitive emissions.
E.7	1.B.1.c Other (solid fuels) – solid fuels – CO_2 and CH_4 (E.10, 2021) (E.13, 2019) Transparency	Investigate whether double counting now occurs for coal bed CH_4 flaring between categories 1.B.1.c and 1.A.1.c (i.e. clarify whether the flaring emissions reported under category 1.A.1.c in the 2017 submission were removed from category 1.A.1.c with the reporting of flaring under category 1.B.1.c) and report in the NIR on the findings.	Not resolved. Ukraine did not report in the NIR on any investigation of possible double counting and did not explicitly report in the NIR whether or not double counting between categories 1.A.1.c and 1.B.1.c is occurring. During the review, the Party stated that there is no double counting, that table 3.19 in the NIR (p.88) shows the division between flaring and recovery AD, and that in 2021 the amount of CH_4 recovered was 32.53 kt and CH_4 flared was 12.55 kt. However, the ERT could not confirm that double counting is not occurring because in NIR table 3.19 the Party made reference to "boiler and flaring" to report the emissions for the mine Sukhodolska Vostochnaya PJSC Krasnodonugol and "gasifier" for the mines O.Zasyadko, Scheglovska Hlyboka m/a Donbass and No.22 Komunarska m/a Donbass.
			The ERT considers that the Party could split NIR table 3.19 into two tables, one for flared CH_4 under category 1.B.1.c and the other for recovered CH_4 under category 1.A.1.c, to help to resolve this issue.
E.8	1.B.2.a Oil – CO_2, CH_4 and N_2O (E.11, 2021) (E.7, 2019) (E.25, 2017) Transparency	Include an explanation in the NIR for the choice of CO_2, CH_4 and N_2O EFs for estimating emissions for the oil category, including documentation of the current state of the oil industry infrastructure.	Addressing. Ukraine included in the NIR (section 3.3.2.1.1, p.92) a description of the oil industry, but no information on the current state of the oil industry infrastructure (i.e. the technology employed) was provided. During the review, the Party clarified that the only refinery in operation in 2012–2021 (which ceased operations in June 2022) had a depth of oil refining of 81.5 per cent and produced gasoline and diesel oil EURO-5. The Party confirmed that it used default CO_2, CH_4 and N_2O EFs for developing countries for estimating emissions for this category, but indicated that default EFs for developed countries might be applicable for the Kremenchuk oil refinery in the future following the gradual implementation of essential upgrades.
			The ERT considers that the recommendation has not yet been fully addressed because the Party did not include the above-mentioned information provided during the review in the NIR.
E.9	1.B.2.a Oil (E.12, 2021) (E.14, 2019) Transparency	Include in the NIR the information that a large quantity of oil transits through the country (i.e. it is not sourced from Ukraine and not transformed or used in Ukraine) and that oil is transported only by	Resolved. Ukraine indicated in the NIR (section 3.3.2.1.2, p.90) that transportation of oil is carried out only by pipeline. During the review, the Party clarified that less than 0.01 per cent of oil is transported through the country by means other than pipeline.

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
		pipeline and not by any other sources mentioned in the 2006 IPCC Guidelines.	
E.10	1.B.2.b Natural gas – CO_2 and CH_4 (E.14, 2021) (E.16, 2019) Transparency	Improve the transparency of reporting for this category by including in the NIR the explanation for the decreasing trend observed in the natural gas transmission (compared with production increases) that was provided during the review.	Not resolved. Ukraine indicated in NIR annex 8 (information on improvements in the NIR, p.552) that the amount of natural gas produced is much lower than the amount transited, but did not provide a clear explanation of the trends and drivers for natural gas transmission in the relevant section of the NIR. During the review, the Party stated that fugitive emissions for category 1.B.2.b transmission and storage of natural gas are estimated on the basis of data on losses provided by the statistics agency, and the value of the losses depends on the state of the gas transmission system, accident rate, upgrades, etc., which contribute to the trend in natural gas transmission.
E.11	1.B.2.b Natural gas – CO_2 and CH_4 (E.15, 2021) (E.18, 2019) Accuracy	Revise emission estimates for the exploration, production and processing of natural gas using a tier that is in accordance with the 2006 IPCC Guidelines (vol. 2, figure 4.2.1).	Not resolved. Ukraine did not revise the emission estimates for this key category (CO_2 (level) and CH_4 (level and trend)). In the NIR (section 3.3.2.2.2, p.92) the Party indicated that it used default EFs for CO_2 and CH_4 (tier 1) to estimate emissions for this category. The ERT noted that the Party did not explain the national circumstances that justify the use of tier 1 for this category as per paragraph 11 of the UNFCCC Annex I inventory reporting guidelines (see also ID# E.13 below). During the review, the Party explained that it is planning to determine country-specific EFs whenever funding is available (see NIR section 3.3.2.7, p.94, and annex A8.2, p.566, on planned improvements).
E.12	1.B.2.b Natural gas – CO_2 and CH_4 (E.16, 2021) (E.18, 2019) Convention reporting adherence	Develop a category-specific improvement plan, detailing the plan in the NIR.	Resolved. Ukraine included in the planned improvements in the NIR (section 3.3.2.7, p.94, and annex A8.2, p.566) information that improvement is planned for category 1.B.2.b by developing country-specific CH_4 and CO_2 EFs during 2024–2026.
E.13	1.B.2.b Natural gas – CO_2 and CH_4 (E.20, 2021) Transparency	Improve the transparency of the information in the NIR by including all relevant contextual information on natural gas exploration, production and processing industries, which should justify the choice of method for estimating emissions.	Not resolved. Ukraine did not include in the NIR specific information on national circumstances to justify the use of tier 1 default EFs for CO_2 and CH_4 for natural gas exploration, production and processing industries in order for the ERT to evaluate the accuracy of emission estimates (see also ID# E.11 above). During the previous review, the Party explained that in 2017 the majority (99.8 per cent) of natural gas produced in the country was from conventional onshore sources (with 0.2 per cent from offshore sources in the Black Sea), and that, of the natural gas produced, 0.26 per cent was coal seam CH_4 and 99.74 per cent was conventional natural gas. However, neither this information nor any additional information justifying the national circumstances that prohibit the use of a recommended method in accordance with paragraph 11 of the UNFCCC Annex I inventory reporting guidelines was added in the NIR.
E.14	1.B.2.c Venting and flaring – all gases	Enhance the transparency of the plans to improve the national inventory by including a detailed description	Addressing. Ukraine included in the planned improvements in the NIR (section 3.3.2.7, p.94, and annex A8.2, p.566) information that improvement is planned

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
	(E.17, 2021) (E.19, 2019) Transparency	of the planned improvement for estimating natural gas venting emissions.	for category 1.B.2.c by developing country-specific CH_4 and CO_2 EFs during 2024–2026. However, the Party did not provide further detail. During the review, the Party indicated that the plan is focused on developing country-specific CH_4 and CO_2 EFs once financing is available.

IPPU

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
I.1	2. General (IPPU) – HFCs, PFCs and SF_6 (I.7, 2021) Transparency	Improve the transparency of the information reported by including in the NIR a dedicated section on categories 2.B.9 (fluorochemical production) and 2.G.2 (SF_6 and PFCs from other product uses), documenting the absence of the AD and emissions for these categories.	Resolved. Ukraine included a section in its NIR for categories 2.B.9 (fluorochemical production) and 2.G.2 (SF_6 and PFCs from other product uses), documenting the lack of AD and emission estimates for these categories (see NIR sections 4.3.9 and 4.8.2, pp.118 and 157, respectively).
I.2	2. General (IPPU) – CO_2 and N_2O (I.8, 2021) Transparency	Provide in the NIR an explanation of the observed trends in AD and the drivers behind the significant inter-annual changes for key categories 2.B.2 (nitric acid production) and 2.A.2 (lime production).	Resolved. Ukraine provided an explanation in the NIR of the trends in AD and the drivers behind the significant inter-annual changes regarding category 2.A.2 (lime production) for 1990/1991, 2010/2011 and 2013/2014 (section 4.2.2.1, p.100); and for category 2.B.2 (nitric acid production) for 2006/2007, 2008/2009, 2010/2011, 2012/2013 and 2018/2019 (section 4.3.2.1, p.110).
I.3	2.A.1 Cement production – CO_2 (I.9, 2021) Transparency	Include in the NIR information on the annual plant-specific CaO content for the whole time series and an explanation of how the national CO_2 EF for clinker was derived, including information on the MgO content in clinker and the share of CaO derived from a non-carbonate source.	Resolved. Ukraine included detailed information on the annual plant-specific CaO content in clinker for the whole time series, such as 66.09 per cent for 2019 (see NIR table A3.1.1.2, p.350), and explained that the national CO_2 EF for clinker was derived using a tier 2 method, giving 2021 as an example; that is, taking into account the CaO (65.94 per cent) and MgO (1.34 per cent) content of the clinker as well as the share of CaO and MgO of non-carbonate raw material components (1.35 and 0.00 per cent respectively), which were obtained from enterprises-producers (see NIR section 4.2.1.2, p.99).
I.4	2.B.2 Nitric acid production – N_2O (I.10, 2021) Consistency	(a) Ensure the time-series consistency of the estimates of N_2O emissions from nitric acid production for medium-pressure units by using the methods suggested in the 2006 IPCC Guidelines (vol. 1, chap. 2.2.4, pp.2.12–2.16); (b) Report the N_2O EFs used across the time series for estimated emissions for medium-pressure units if they are not all based on measured data.	(a) Addressing. Ukraine explained in the NIR (section 4.3.2.2, p.111) that the default EF of 7 kg/t was applied for 1990–2008 because direct measurements at the four medium-pressure plants were not undertaken. In 2009, direct measurements were taken at one plant after the installation of the abatement equipment and an EF of 4.5 kg/t was derived and used for all medium-pressure plants (see NIR annex 3, table A3.1.1.6, p.357). However, the ERT believes that there is still a consistency issue because the EF applied for the four medium-pressure plants was calculated based on data from a single plant with an abatement system in 2009, while the other three plants did not have abatement systems installed at that time (see ID# I.8 in table 5). (b) Resolved. Ukraine provided in the NIR (annex 3, table A3.1.1.6, p.357) the N_2O EFs used across the time series for medium-pressure units.
I.5	2.B.8 Petrochemical and carbon black production	(a) Use the CH_4 EF of 0.06 kg/t for carbon black produced that is provided in the 2006 IPCC	Resolved. (a) Ukraine revised the CH_4 emission estimates and applied the default CH_4 EF of 0.06 kg/t for category 2.B.8.f (carbon black) in accordance

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
	– CO_2 and CH_4 (I.11, 2021) Accuracy	Guidelines (vol. 3, table 3.24, p.3.80) for the default process or justify the use of the CH_4 EF of 28.7 kg/t for carbon black produced for estimating CH_4 emissions for category 2.B.8.f carbon black;	with the 2006 IPCC Guidelines. The ERT noted that the Party still reported in the NIR the CH_4 EF of 28.7 kg/t, but during the review the Party clarified that this is a typographical error and that the value used for the estimation was 0.06 kg CH_4/t. The ERT confirmed that the CH_4 emission estimates were recalculated between the 2021 and 2022 submissions.
		(b) Provide a transparent description of the production processes and feedstock used for the production of carbon black, methanol and vinyl chloride monomer and, if necessary, correct the parameters used in accordance with the 2006 IPCC Guidelines (vol. 3, chap. 3.9.2.2).	(b) Ukraine provided a transparent description of the process and feedstock used for producing carbon black, methanol and vinyl chloride monomer in the NIR (section 4.3.8.1, p.116). The description of the parameters was clear and in accordance with the 2006 IPCC Guidelines (see NIR table 4.16, p.117).
I.6	2.D.1 Lubricant use – CO_2 and CH_4 (I.12, 2021) Consistency	(a) Ensure the time-series consistency of the emission estimates by applying the same data source for the entire time series, or, if this is not possible, apply a splicing technique from the 2006 IPCC Guidelines (vol. 1, chap. 5.3.3), or provide the supporting information that the IEA and SSSU data sets use the same source;	Resolved. (a) Ukraine ensured time-series consistency by applying IEA data for the entire time series (see NIR annex 8, p.555), except for 2021, for which a splicing technique (extrapolation) was used to derive the AD (see NIR section 4.5.1.2, p.128). The Party revised the estimates of CO_2 for 1998–2019 as the data source was changed from SSSU and national research to IEA.
		(b) Include the information provided during the review to explain the significant inter-annual changes in lubricant use over the time series (e.g. for 1996, 1997, 1998 and 2007).	(b) Ukraine reported in its NIR (section 4.5.1.1, p.128) that inter-annual changes between 1996, 1997 and 1998 were due to the start of lubricant imports into the country. The Party clarified that the change in 2007 was due to the increase in production and imports during the year.
Agriculture			
A.1	3. General (agriculture) – CO_2, CH_4 and N_2O (A.1, 2021) (A.2, 2019) (A.17, 2017) Convention reporting adherence	Improve the QC checks to ensure that all tables referred to in the text of the NIR actually exist in the NIR and contain the information stated (e.g. table A3.2.3.6 should have contained data on percentage crude protein but did not, and milk production should have been presented in table A3.2.3.8 but this table does not exist).	Resolved. Ukraine corrected the NIR and consistency between tables 5.5 (p.169) and 5.6 (p.171) and annex A3.2 was ensured. The Party deleted the reference in section 5.2.2 (p.167) to the non-existent table A3.2.3.8; and table A.3.2.2.6 (p.399) provides information on milk production and fat content as referenced in table 5.5. In addition, the Party reported consistently the references in the NIR (p.180) to crude protein content in table A3.2.3.7 (p.435).
A.2	3.B.1 Cattle 3.B.3 Swine – CH_4 (A.3, 2021) (A.12, 2019) (A.10, 2017) (A.23, 2016) Transparency	Include in the NIR relevant information on the reported MMS (e.g. how manure is handled, mechanically separated and stored, and the emptying frequencies of the lagoons/manure stores and field application) (the description should include a mass balance for all handled manure based on excreted VS in each MMS and indicate whether or not the manure is covered by a crusting layer).	Addressing. Ukraine reported details on the kinds of MMS that are used by various types of livestock owner and their methane conversion factor values in its NIR (section 5.3.2.1, table 5.10, p.177), and indicated whether or not the manure is covered by a crusting layer. The Party also reported that the storage period of all types of manure depends on the structure, humidity and technology of its storage: 4–8 months for cattle manure and 8–12 months for swine manure. In addition, the choice of cattle and swine MMS is determined by the specific feasibility study and, finally, is a typical indicator of farm specialization and capacity (see NIR section 5.3.2.1, p.178). However, the Party did not provide the mass balance for all handled manure based on excreted VS

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			in each MMS. In response to a previous encouragement (A.7, 2021) for the Party to add to the NIR, for this issue, a category-specific planned improvement, the timeline for a study on distribution of cattle and swine manure and MMS distribution (added in 2023 NIR section 5.3.6, p.186), the Party indicated that a relevant study or research will be added to the list of high-priority improvements, but national circumstances currently prevent the required research from being conducted and no date can be provided for when it will take place.
A.3	3.B.3 Swine – CH$_4$ (A.8, 2021) Convention reporting adherence	Revise the allocation per MMS for swine in CRF table 3.B(a)s2.	Resolved. Ukraine reported in CRF table 3.B(a)s2 the distribution of MMS per climate type (for swine it is 100 per cent).
A.4	3.D.a.2.b Sewage sludge applied to soils – N$_2$O (A.9, 2021) Convention reporting adherence	Clearly justify in the NIR why the emissions from the use of sewage sludge as organic fertilizer are considered to be insignificant and use notation key "NE" in CRF table 3.D in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Addressing. Ukraine updated CRF table 3.D and reported "NE" for category 3.D.a.2.b (sewage sludge applied to soils). The previous ERT considered that emissions from sewage sludge used as organic fertilizer are likely to be below the threshold of significance, but the Party did not provide justification of the likely level of emissions in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. In the NIR (section 5.5.6, p.196) and during the review, the Party explained that it plans to collect more data and improve the reporting on this issue. The ERT considers that it is important to verify whether emissions are indeed insignificant given the increased amount of sludge composted as reported under the waste section (see NIR table 7.27, p.276).
A.5	3.G Liming – CO$_2$ (A.6, 2021) (A.21, 2019) (A.31, 2017) Transparency	Conduct an assessment of the proportion of inert materials in ground lime and document the results in the NIR; and, if ground lime is considered to include inert materials, revise the CO$_2$ emissions for the entire time series, excluding the portion of the inert materials in ground lime.	Addressing. Ukraine recalculated CO$_2$ emissions for the entire time series in the 2018 submission in accordance with the recommendation of the previous ERT. Regarding the assessment of the proportion of inert material in ground lime, the Party reported in its NIR (section 5.8, pp.198–199, and annex 8, p.557) that national statistics do not include data about the kinds of liming fertilizer used for liming acidic agricultural soils (collected data cover total weight of lime materials). Therefore, information about actual kinds of liming fertilizer, the amounts applied and the content of inert materials in them is not available for all report periods. The Party applied a tier 1 approach, the default EF of 0.12 t CO$_2$-C/t limestone and expert judgment on content (85 per cent active substance and 15 per cent inert material). The ERT notes that the Party has not yet demonstrated that the estimated proportion of inert materials in ground lime matches that proposed in the expert judgment across the time series, as suggested by the previous ERT.
A.6	3.G Liming – CO$_2$ (A.10, 2021)	Include information in the NIR in order to justify the decision not to estimate emissions from this source, and report emissions for this category as "NE" in	Addressing. Ukraine updated CRF table 3.G-I and reported "NE" for AD for dolomite under this category. The Party reported in its NIR (section 5.8.2, p.199) that dolomite is used as liming material, but the amount is insignificant

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
	Convention reporting adherence	CRF table 3.G-I in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	and it is impossible to identify or calculate it. The previous ERT considered that emissions from dolomite use are likely to be below the threshold of significance, but the Party did not provide justification of the likely level of emissions in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines (see ID#s G.4 and A.5 above).
A.7	3.H Urea application – CO_2 (A.11, 2021) Accuracy	(a) Revise the AD used for the estimation of emissions for this category to ensure consistency across the time series, in particular the approach used to fill the gaps for the years for which no information is available from national sources or FAOSTAT, to ensure that there is no underestimation of emissions; (b) Make sure that national data sources cover all uses of urea on soils under the agriculture sector, in particular for uncultivated grassland, and update the emission estimates for categories 3.H and 3.D accordingly.	(a) Addressing. Ukraine did not revise the AD for this category. The Party included more information in the NIR (section 5.9.2, p.200) on the sources of AD (for 1990–2001 and 2005–2007, expert judgment; for 2002–2004 and 2008–2011, FAO; for 2012–2017, interpolation; and for 2018 onward, national statistical data). The Party explained that the large difference between FAO data and the national statistical data for 2018 onward is due to FAO data coming from questionnaires and/or national sources or United Nations Comtrade data (see https://comtradeplus.un.org/). However, during the review, the Party recognized that the AD used for 2018 onward were not correctly calculated and that actually the national statistical data are aligned with the FAO data as given below and emissions estimates will be revised in the next submission:

(a) continued:

- National statistical data for 2018–2021 (596,375.11, 619,103.69, 698,142.80 and 698,423.30 t respectively);

- FAO data for 2018–2021 (596,375.00, 619,104.00, 698,143.00 and 698,423.00 t respectively).

The ERT considers that, once the Party has updated the AD for 2018 onward, the issue related to the difference between FAO data and national statistical data will be resolved. The ERT also considers that, as the FAO data and the national statistics are aligned, the values used for 2002–2004 and 2008–2011 will be consistent with the values for 2018 onward. During the review, the Party explained that, for 1990–2001 and 2005–2007 (for which the Party applied expert judgment), it assumed a coefficient calculated as a share of the total annual amount of the applied N fertilizer. For 1990–1999, the coefficient of 0.2 (calculated as a share of the total annual amount of the applied N fertilizer) was based on FAO data from 1990–1991 for the former Soviet Union and this coefficient was used to estimate AD for 1992–1999 as well. For 2001–2002 and 2005–2007, the Party used a coefficient of 0.5 based on expert judgment. During the review, the Party clarified that it will improve the estimates by considering for 2000–2001 the 0.2 coefficient as an extrapolation of 1990–1991 data and interpolate the values for 2005–2007.

(b) Resolved. Ukraine confirmed in the NIR (section 5.9.2, p.201) that the national information on agricultural crops includes the use of urea fertilizer on grassland and cropland. Therefore, there is no need to recalculate emissions for categories 3.H and 3.D.

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
LULUCF			
L.1	4. General (LULUCF) – CO_2 (L.1, 2021) (L.1, 2019) (L.2, 2017) (L.3, 2016) (L.4, 2015) (67, 2014) Convention reporting adherence	For the model used to calculate the net changes in soil organic matter in mineral soils, verify the model's outputs with measurements annually conducted in the country.	Addressing. Ukraine reported a comparison between estimates calculated using its tier 3 national methodology and the tier 1 IPCC methodology for N-content of crop residue in its NIR (section 6.3.4 and table 6.11, pp.223–224), which was also included in the 2019 and 2021 submissions. For the current NIR the Party updated the EFs reported in table 6.11, which shows reduced differences between the estimates calculated using the tier 1 method and the national tier 3 method compared with the 2021 submission (from 28 to 13 per cent for above-ground residues and from 45 to 34 per cent for below-ground residues). The NIR also recognizes a strong need to improve the EFs for cropland, and this is therefore included in the improvement plan in annex A8.2 to the NIR. During the review, the Party clarified that the updates to the EFs reported in NIR table 6.11 were due to updated SSSU data being used for the tier 1 calculations. The Party noted in the NIR (annex A8.2, pp.566–567) the need for further scientific research, but there is no available funding for this.
			The ERT considers that the recommendation has not yet been fully addressed because the Party has not been able to perform the scientific research required to verify the model outputs with measurements.
L.2	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.2, 2021) (L.2, 2019) (L.30, 2017) Accuracy	Enhance data collection on the other land uses under which organic soils are reported and on their status, either drained or rewetted or, for wetlands only, natural conditions, and supplement the current data gaps with available ancillary data and expert judgment to ensure that no systematic errors affect the estimates of GHG emissions in the time series of each land-use category.	Not resolved. Ukraine reported in NIR tables 6.5 (p.218), 6.9 (p.222) and 6.13 (p.226) that all organic soils are drained, with no explanation for this assumption, with an acknowledgement in annex A8.2 (pp.566–567) that more accurate data will be possible to obtain once new soil-type and land-use maps are available. During the review, the Party clarified that information on organic soils is limited, with information available for drained soils only. The Party also explained that the planned overlay of the soil-type map with the land-use map has been delayed, but is still expected to take place in future.
			The ERT considers that the recommendation has not yet been addressed because the Party has not been able to develop the overlay of the soil-type map and land-use map and no specific steps have been taken to resolve the issue since 2021.
L.3	4. General (LULUCF) (L.3, 2021) (L.4, 2019) (L.5, 2017) (L.7, 2016) (L.18, 2015) Transparency	Enhance the information reported in the NIR to improve transparency and include, for each estimated category, the verification of outputs (i.e. GHG estimates), if any, noting that the verification of outputs is mandatory for tier 3 estimates.	Addressing. Ukraine reported in its NIR (section 6.3.6, p.224) that improved verification methods are needed for the tier 3 national methodology beyond the reported comparison to tier 1 IPCC estimates included in the most recent NIRs. The Party reported in annex A8.2 to the NIR (pp.566–567) that scientific research is still required. During the review, the Party clarified that there is no available funding to perform this work. The ERT noted some changes in NIR table 6.11 (see ID# L.1 above). However, no enhanced information related to the verification of tier 3 estimates was included in the NIR.

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
			The ERT considers that the recommendation has not yet been fully addressed because the Party did not describe the intended verification process in the NIR.
L.4	4. General (LULUCF) (L.5, 2021) (L.24, 2019) Convention reporting adherence	Improve the documentation of uncertainty estimates reported in NIR table 6.10, particularly when expert judgment is involved; and describe in the NIR the methodology used to calculate total uncertainty, in accordance with good practice to document any expert judgment (2006 IPCC Guidelines, vol. 1, chap. 2, annex 2A.1).	Addressing. Ukraine reported in its NIR (section 6.2.3, p.218) that the total uncertainty of emissions and removals for forest land is 44 per cent. The Party listed the uncertainties for the forest land category in the NIR (table 6.6, pp.218–219), which includes a combination of IPCC default and calculated and expert judgment uncertainty values. The ERT noted that the total uncertainty value for forest land was revised. However, there is no information in the NIR on how the assumptions of the expert judgment were derived. During the review, the Party clarified that lack of systematic uncertainty estimation by different data providers and the need to adjust some data to include the entire country's territories necessitate the estimation of uncertainty on the basis of expert judgment. The Party clarified that some uncertainty information was received via official letter, but most of it was received in the form of expert opinion based on expert knowledge or practice. The ERT considers systematization of the information provided by experts (via official letter and expert opinion) to be important in order to improve the documentation of uncertainty.
			The ERT considers that the recommendation has not yet been fully addressed because the Party has not improved the documentation of uncertainty when expert judgment is involved and did not describe in the NIR the methodology used to calculate total uncertainty, in accordance with good practice to document any expert judgment (2006 IPCC Guidelines, vol. 1, chap. 2, annex 2A.1).
L.5	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.37, 2021) Transparency	Describe in the NIR the methodology used to calculate total uncertainty for grassland and cropland, in accordance with good practice on documenting any expert judgment (2006 IPCC Guidelines, vol. 1, chap. 2, annex 2A.1).	Addressing. The Party reported in its NIR (section 6.3.3, p.223, and section 6.4.3, p.226) uncertainties of 92 and 330 per cent for cropland and grassland respectively. The ERT acknowledges that the uncertainties of GHG emissions from cropland and grassland were revised for the 2023 inventory submission. Calculations of combined uncertainties were performed using approach 1 (propagation of error) from the 2006 IPCC Guidelines (vol. 1, chap. 3). The Party used a value of uncertainty of 6 per cent for AD based on expert judgment (see NIR tables 6.10 and 6.14). However, in the NIR there is no documentation of any expert judgment. During the review, the Party clarified that the standard uncertainty of SSSU data is 5 per cent. Since the data were adjusted to include the occupied territories of Ukraine that were not included in the State statistics, the uncertainty was also adjusted. The expert estimation of the AD is based on the inclusion of the occupied territories in the GHG inventory estimations.
			The ERT considers that the recommendation has not yet been fully addressed because the Party did not include information in the NIR on any expert

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
			judgment in accordance with good practice, in particular related to uncertainty of AD. The ERT considers that the information provided during the review on uncertainty of AD should be included in the next NIR.
L.6	Land representation – CO_2, CH_4 and N_2O (L.6, 2021) (L.5, 2019) (L.7, 2017) (L.33, 2016) Accuracy	Collect sufficient data on the land area and changes in the land area, verify the conversions between land-use categories and demonstrate how the accuracy of land representation has improved, clearly documenting the AD used for the sector in the NIR.	Not resolved. Ukraine reported that it has not further investigated alternative data sources for monitoring land-area changes in the NIR (section 6.1.1, p.205) since the work undertaken for the 2019 submission (section 6.1.2). The Party reported in the NIR (p.546) that it is seeking funding to improve the representation of land areas. While the Party took action to find an alternative method for identifying land representation spatially for the 2019 submission, the data from these investigated sources were found to be poor. During the review, the Party clarified that it was assured that it would receive help to develop a LULUCF monitoring and reporting system based on best practices from the European Union, particularly through a project under the International Climate Initiative of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety for developing a historical land-use matrix and enhancing the capacity of Ukraine to produce such data on a regular basis. The project has been postponed several times for procedural reasons, but is expected to launch in early 2024. The Party additionally stated that it is considering using CORINE land-cover data sets for land representation.
			The ERT considers that the recommendation has not yet been addressed because the Party has no specific steps in place for resolving the land representation issue.
L.7	Land representation – CO_2, CH_4 and N_2O (L.7, 2021) (L.6, 2019) (L.31, 2017) Consistency	Report annual land-conversion areas in CRF table 4.1 and report cumulated 20-year conversion areas in CRF tables 4.A–4.F, which requires the calculation of annual land use and land-use change matrices for 1971–1989.	Addressing. Ukraine reported annual areas of land-use change in CRF table 4.1. However, CRF tables 4.A–4.F require the calculation of annual land use and land-use change matrices for 1971–1989. This leads to a systematic error throughout the time series affecting land remaining and land-use change categories. During the review, the Party acknowledged this as an issue and stated that work to develop land-use matrices for this period is ongoing, which will be delivered following completion of the work on land representation based on spatial analysis.
			The ERT considers that the recommendation has not yet been fully addressed because, while annual areas of land-use change were reported in CRF table 4.1, CRF tables 4.A–4.F still require the annual land use and land-use change matrices to be calculated for 1971–1989.
L.8	Land representation – CO_2, CH_4 and N_2O (L.8, 2021) (L.7, 2019) (L.31, 2017) Consistency	Ensure that in any year X of the GHG inventory time series (1) the area (AX) of any land remaining category A is the area of A in the previous year (AX – 1) minus the area of A converted in year X to all other land-use categories (A to OLUX) plus the area converted to A from all other land-use categories 20	Not resolved. Ukraine reported in CRF table 4.1 the final area of forest land (managed) for 2018 as 10,654.16 kha. However, the initial area reported in CRF table 4.1 for forest land (managed) for 2019 is 10,653.05 kha. Similarly, the final area reported for 2018 for other land is 905.95 kha and the initial area reported for other land in CRF table 4.1 for 2019 is 905.80 kha. The same is true for grassland (managed) and wetlands (unmanaged). During the review, the

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
		years before (OLU to AX – 20) (i.e. AX = AX – 1 – A to OLUX + OLU to AX – 20); and (2) the area of any land converted category B to A (B to AX) is the cumulated area converted to category A from B (B to A) in the 20-year time period from year X to year X–19 (i.e. B to AX = $\sum_{X-19}^{X}$ B to A).	Party clarified that this discrepancy in CRF table 4.1 occurs due to the combination of data used from the State Service of Ukraine for Geodesy, Cartography and Cadastre, which reports total areas as at 1 January each year but does not reflect the actual transitions between land-use categories. The Party stated that this issue will likely be addressed through future use of geospatial data, but with currently available data this difference is unavoidable.
L.9	Land representation – CO_2, CH_4 and N_2O (L.38, 2021) Accuracy	Reclassify the areas of other land to a land use that is more representative of the land category, where land-use conversion from other land to forest land, cropland and grassland has taken place.	Not resolved. Ukraine reported in its NIR (section 6.1.1, p.206) that the other land category is classified in the statistical reporting form 16-zem as "open land without vegetation or with little vegetation" and is described as land not included in other categories (rocks, sand, solonchaks and other land). The ERT considers that, based on this definition, it is unlikely that other land could be converted to forest land, cropland or grassland. During the review, the Party stated that it wants to solve the problem by conducting the in-depth work on improving land representation. The ERT recognizes that this recommendation is aligned with that in ID# L.6 above, but nevertheless considers that the Party could reclassify the areas of other land to a land use that is more representative of the land category using the best available data or assumptions (e.g. not using the assumption of land-use changes from other land to forest land, cropland or grassland and adapting the land-use matrix based on national circumstances).
L.10	4.A Forest land – CO_2 (L.11, 2021) (L.9, 2019) (L.9, 2017) (L.14, 2016) (L.27, 2015) Accuracy	Revise the calculations of GHG emissions and removals from forest land in mineral soils following the methods presented in the 2006 IPCC Guidelines and implement sector-specific QC procedures to ensure the accuracy of the estimates reported across the time series.	Not resolved. Ukraine did not revise the estimates applying stratification of lands by climate zone and soil type as per IPCC good practice for assigning proper SOC_{REF} values to land under conversion. During the review, the Party explained that it used a tier 1 method and default EFs for estimating land converted to forest land as per equation 2.25 of the 2006 IPCC Guidelines (vol. 4, chap. 2, p.2.30) and clarified that work is planned to define land-use categories using a geographic information system as reported in its NIR (annex A8.1, p.562, and annex A8.2, p.566). The Party explained that using a geographic information system would allow proper assignment of soil types to land-use conversions and subsequently the selection of more accurate SOC_{REF} values. Until more accurate data are available, the Party will continue using the tier 1 method.
L.11	4.A Forest land – CO_2 (L.12, 2021) (L.10, 2019) (L.32, 2017) Accuracy	Recalculate nationwide CSC factors for biomass increments and for DOM net changes, stratified by forest type, ecological region and age class, by compiling available information in the country, and, where feasible, by collecting novel data through a national forest inventory system; and, while new CSC factors are being calculated, and noting that Ukraine referenced the use of a 2017 Buksha et al. report in its 2017 annual submission,	Addressing. Ukraine reported in its NIR (section 6.2.2, pp.220–221) that the work to deliver consistent time-series estimations for the living biomass pool has been completed, which led to revisions of carbon stock gain estimations for 1990–2004. The Party acknowledged in its NIR (section 6.2.2, p.221, and annex A8.2) the need for scientific research to estimate country-specific DOM EFs. During the review, the Party clarified that the time required to undertake this research cannot be estimated for various reasons, including the current national circumstances. The Party also explained during the review that it did not use table 3.9 from the 2017 report by Buksha et al., clarifying that a tier 1

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
		use data contained in table 3.9 of that report for biomass increments as stratified by age class and main forest species, together with an age-class distribution for the entire time series 1990–2016, and revise the DOM CSC factors and method to ensure time-series consistency.	method and default EFs will be applied for CSC in the DOM pool until a country-specific EF is available.
L.12	4.A Forest land – CO_2 (L.16, 2021) (L.31, 2019) Transparency	Improve the explanation in the NIR regarding how the correction factors for estimating carbon loss from disturbances were derived and what the implications may be of using a constant value for the factor.	Addressing. Ukraine still needs to further improve its explanation regarding the correction factors. The Party applied the recommendation from the previous review report by averaging the actual data to calculate a correction factor. In its NIR (annex A3.3.1, p.484), Ukraine reported that the correction factors were derived by overlapping data on timber losses due to disturbances for 2014–2017 with data on areas of disturbance and average wood stock. During the review, the Party stated that the discussion regarding the use of a constant correction factor is included in annex A3.3.1 to the NIR. The Party clarified the reasons for some of the regional differences in correction factors (including vegetation type, climatic zone and national circumstances) and that, where no disturbances are reported, no correction is applied. The ERT considers that this explanation is useful to improve transparency and could be included in the next NIR. In addition, the Party did not explain the implications of the use of a constant value. It clarified during the review that it was unclear what the alternative methods are that the application of current data and correction factors could be measured against. The ERT considers that an explanation should be provided of the impact of the use of a constant correction factor on the results, but a comparison against alternative methods is not necessary, as the ERT understands that there are no alternative methods available to the Party.
L.13	4.A Forest land – CO_2 (L.35, 2021) Transparency	Describe in the next NIR the additional causes for the large change in the estimated emissions for 2003–2006 relative to the other years in the time series.	Resolved. Ukraine recalculated emissions for forest land for its 2022 submission by reviewing the losses for biomass (see ID# L.14 below). The ERT noted that with this recalculation the time series is consistent and there are no large changes in the estimated emissions for 2003–2006.
L.14	4.A Forest land – CO_2, CH_4 and N_2O (L.40, 2021) Accuracy	Follow equation 2.11 of the 2006 IPCC Guidelines (vol. 4, chap. 2) and report all losses for biomass in CRF table 4.A, regardless of whether or not the losses are associated with timber for HWP production.	Resolved. Ukraine reported all losses for biomass in CRF table 4.A following equation 2.11 of the 2006 IPCC Guidelines (vol. 4, chap. 2). The Party also provided information on the losses in its NIR (section 6.2.2, p.217, and annex A3.3.1, p.483).
L.15	4.A.1 Forest land remaining forest land – CO_2, CH_4 and N_2O (L.18, 2021) (L.12, 2019) (L.11, 2017) (L.34, 2016) Transparency	Include clear definitions of managed and unmanaged forest land and an explanation of how unmanaged forest land is detected in the land representation and, if necessary, revise the distribution of forest land between managed and unmanaged.	Addressing. Ukraine reported in its NIR (section 6.2.1, p.215) the definitions of managed and unmanaged forest land. However, it did not explain how unmanaged forest land is detected in the land representation. During the review, the Party provided additional information and referred to order 161 of the Ministry of Ecology and Natural Resources of Ukraine from 18 May 2018 (see https://zakon.rada.gov.ua/laws/show/z0707-18#Text), which defines the methodology for identifying unmanaged forest. The ERT considers that this

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
			information should be included in the NIR. The ERT notes that the resolution of this issue is closely related to ID# L.6 above.
L.16	4.A.1 Forest land remaining forest land – CO_2 (L.19, 2021) (L.34, 2019) Accuracy	Correct the value for the area of forest land remaining forest land in 2015 reported in CRF table 4.A from 10,370.69 to 10,373.36 kha.	Not resolved. Ukraine did not correct the area of forest land remaining forest land reported in CRF table 4.A for 2015, which is still reported as 10,370.69 kha instead of 10,373.36 kha. During the previous review the Party acknowledged that an error had occurred, and that the area would be revised. During this review, the Party explained that the area reported in different tables was checked and that the error identified in NIR table A3.3.1 was corrected. However, this issue was not related to NIR table A3.3.1 (a similar table to table A3.3.1 was not reported in the 2017 or 2018 NIRs); the original recommendation relates to the difference in the AD reported for 2015 (total area for forest land remaining forest land) in CRF table 4.A between the 2019 submission (which was slightly lower) and the 2017 and 2018 submissions, which the Party acknowledged was an error.
			The ERT considers that the Party should clarify the reasons for the difference in the AD for 2015 between the 2019 submission onward (10, 370.69 kha) and previous submissions (10,373.36 kha) by explaining whether the value of 10,370,69 kha is a reporting error or an updated value after verifying national statistical data for the 2019 submission, concluding that the AD of 10,370.69 for 2015 is the correct one.
L.17	4.A.1 Forest land remaining forest land – CO_2 (L.20, 2021) (L.35, 2019) Consistency	Ensure the time-series consistency of the estimates of gains in living biomass on forest land remaining forest land, including in relation to data on forest age classes and the assumptions for stand age.	Resolved. Ukraine ensured the time-series consistency of the estimates of gains in living biomass. The Party explained in its NIR (section 6.2.2, pp.215–217) that additional data were collected to adjust available data for 1988, 1996 and 2002. For the calculation of the estimates of gains in living biomass, it was decided not to take into account the data from 2002 (which was an outlier in the previous annual submission). Thus, carbon stock gains for 1990–1995 and 1997–2004 were interpolated on the basis of data for 1988, 1996 and 2005 (see NIR figure 6.6, p.217).
L.18	4.B Cropland – CO_2 and N_2O (L.21, 2021) (L.13, 2019) (L.14, 2017) (L.16, 2016) (L.29, 2015) Accuracy	Enhance data collection on the use under which organic soils are reported, and supplement the current data gaps with available ancillary data and expert judgment, where needed, to ensure that no systematic errors affect the estimates of GHG emissions in the time series.	Addressing. Ukraine has not enhanced the collection of data on the use under which organic soils are reported. The ERT acknowledged the ongoing efforts of the Party to improve data on land representation, as noted by the ERT during the 2019 review cycle. However, no progress has been made and the method applied to identify the representation of land-use categories has not been enhanced, which is necessary to improve the reporting of organic soils under land-use categories. The Party reported in the NIR (annex A8.2, pp.566–567) planned improvement work to produce updated organic soil and land-use maps.
			During the review, the Party clarified that, owing to a number of postponements, the procedural processes for the land-use maps took longer than anticipated, with the expected start date for the project now in 2024. For the soil

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
			maps, further research is required as the suitability of the maps needs to be confirmed by the developers of the land-use maps.
L.19	4.B Cropland – CO$_2$ (L.22, 2021) (L.37, 2019) Transparency	Include the information on the land-use categories under cropland (arable land, fallow land and gardens) provided to the ERT during the review, namely that (1) the Party does not have information on the spatial distribution of lands because this information depends on the completion of the work on land representation; and (2) for fallow land, it does not have a specific methodology for estimating the effect on CSCs of abandoning previously actively used cropland; however, because on such lands natural processes of restoration of carbon stocks are occurring, it considers its assumption does not overestimate carbon removals.	Resolved. The ERT notes that item (1) of the recommendation was resolved by Ukraine in the 2021 NIR through the inclusion of information that the country has no information about the spatial distribution of lands (arable land, fallow land and gardens). This information is also included in the 2023 NIR (section 6.3.2, p.220). The ERT considers that item (2) of the recommendation has also been resolved because the Party explained in its 2023 NIR (section 6.3.2, p.220) that it does not perform calculations for fallow land owing to a lack of reliable input data and methodology consistent with the national methodology for estimating CSC in mineral soils for managed cropland.
L.20	4.B.1 Cropland remaining cropland – CO$_2$, CH$_4$ and N$_2$O (L.41, 2021) Transparency	(a) Describe in more detail in the NIR the changes to crop structure, harvest volumes of specific crop types and volume of fertilizer application to transparently justify the large inter-annual changes in emissions, and provide information on the drivers behind these changes in comments beneath a figure presenting the time series (e.g. revised figure 6.2). (b) Report in the NIR the years where SSSU alters its methodology for data collection and describe the methods that the inventory team applies to ensure time-series consistency when these data-collection methods are changed.	Not resolved. (a) Ukraine presented large inter-annual variations in emissions for cropland remaining cropland in CRF table 4.B for 2007/2008, 2010/2011 and 2012/2013 but did not include in the NIR additional information to explain these inter-annual variations or the drivers behind them. During the review, the Party made reference to figures 6.2 – Structure of areas of crops grown on cropland (p.204) and 6.3 – Fertilizer input to cropland (p.205) and table 6.8 – Harvesting volumes of agricultural crops (p.221), but the ERT could not find any reference or explanation for the inter-annual variation in the years mentioned above or an update to figure 6.2 to show the years where the large variations in emissions occur. In response to a question from the ERT, the Party explained that the AD for these years were reported in annex A3.3.2 to the NIR (tables A3.3.15–A3.3.17, pp.503–505) and the main drivers of these variations are crop harvest volumes, application of fertilizer and changes in crop type. The ERT considers that the Party should include this information in the NIR, making clear reference to the years of the inter-annual variations and explaining the drivers. The Party could consider including a note to figure 6.2 to explain these inter-annual variations and expand it to show the years in which the large variations occur. (b) During the review, the Party explained that, while there were some changes made to the reporting forms regarding the level of detail for some crops by the data-collection agency (SSSU), the crop types are stable, and it is not possible to separate and report every year on any changes to the methodology of data collection by SSSU as this information is not kept by either SSSU or the inventory team. The Party outlined that a QC procedure comparing the data used in the inventory with data from FAOSTAT found low levels of difference.

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
L.21	4.C.1 Grassland remaining grassland – CO_2 (L.24, 2021) (L.15, 2019) (L.34, 2017) Accuracy	Use subdivisions of managed grassland to report those areas of grassland that are not subject to changes in management activities or for which management activities do not result in net emissions or net removals of GHGs.	Not resolved. Ukraine did not subdivide managed grassland into areas of grassland that are not subject to changes in management activities or for which management activities do not result in net emissions or net removals. The Party clarified in the NIR (section 6.4.1, p.224) that it considers all grassland to be managed following the revision of approaches to defining managed and unmanaged grassland. The ERT noted that the Party mentioned both grazing or moving land and grass harvesting being used to determine CSC in soil organic matter in the NIR (section 6.4.2, p.225). The ERT also noted that it is important to have subdivisions of managed land for more accurate reporting of emissions. During the review, the Party clarified that there is currently no reliable classification of grassland in the national legislation that would allow it to divide all grassland into managed and unmanaged, and noted that it was unclear how such a subdivision could be organized to resolve this issue.

The ERT considers that the recommendation has not yet been addressed because the Party has no definitions of subcategories of managed grassland. The ERT also considers that the Party could distinguish between the categories of grazing or moving land and grass harvesting and explain how the differences in these lands affect the associated EF. |
| L.22 | 4.D.1 Wetlands remaining wetlands – CO_2 and N_2O (L.28, 2021) (L.16, 2019) (L.19, 2017) (L.18, 2016) (L.32, 2015) Accuracy | Enhance the data collection on the drainage status of peat production sites once abandoned; supplement the current data gaps with available ancillary data and expert judgment, where needed; and estimate GHG emissions in sites for peat production which, although abandoned, are still under drainage to ensure that no errors affect the GHG emission trend. | Addressing. Ukraine did not report emissions from abandoned peat extraction sites that are still under drainage. The Party reported in its NIR (section 6.5, p.226) that peat extraction areas have reduced significantly since 1990 but no further information on the status of peat production sites, once a site has been abandoned, is included in the NIR. During the review, the Party explained that the initial search for information demonstrated that there is limited information on the status of lands previously drained, including peat extraction sites, and clarified that the work to collect information on the status of these lands is ongoing and that it is seeking assistance from experts with knowledge of management of peat extraction sites. The ERT noted that emissions from abandoned peatlands should be reported following the 2006 IPCC Guidelines (vol. 4, section 7.2.1, p.7.8) as long as the land is not converted to another use.

The ERT considers that improvements to land representation (see ID# L.6 above) could help to resolve this issue concerning data collection. |
| L.23 | 4.D.2 Land converted to wetlands – CO_2, CH_4 and N_2O (L.29, 2021) (L.17, 2019) (L.35, 2017) Accuracy | Report all land converted to wetlands under the organic soils subdivision and discount such areas from the original land-use category area of drained organic soils. | Addressing. Ukraine reported all areas of land converted to wetlands as occurring in mineral soils since its 2019 submission and justified this approach by explaining that "conversion to wetland happens in mineral soils with the reasoning that the areas of organic soils in Forest land, Cropland and Grassland are rather stable" (see 2019 NIR, p.226). However, the ERT noted that the Party reported in the 2023 NIR (table A3.2.5.4, p.443) the annual area of managed and drained organic soils, which shows a decline from 488,000 ha in 2012 to 471,602 ha in 2021. During the review, the Party acknowledged that it |

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
			is possible that land-use changes also occur on organic soils and that the resolution of this issue is connected to the improvement of land representation (see ID# L.6 above).
L.24	4.F Other land – CO_2 (L.30, 2021) (L.19, 2019) (L.25, 2017) (L.22, 2016) (L.36, 2015) Comparability	Revise the classification of category 66 ("dry open lands with special vegetation cover"), noting that category 66 appears to more closely match the definition of the IPCC category grassland than other land.	Not resolved. Ukraine revised the statistical reporting form 16-zem and category 66 is no longer used. However, it is still unclear what the land previously classified as category 66 has been reclassified as and how the updated 16-zem form has addressed the issue of grassland being incorrectly identified as other land throughout the time series. During the review, the Party clarified that the new statistical form does not contain any category that would have the same description as the old category 66, that the revision of historical data is not reasonable at the moment (see NIR annex A8.1, p.563), and that this recommendation will be addressed once the work on the use of a geographic information system to deliver more accurate land-use representation has been completed.
L.25	4.F.2.1 Forest land converted to other land – CO_2 and N_2O (L.31, 2021) (L.21, 2019) (L.27, 2017) (L.24, 2016) (L.38, 2015) Transparency	Subdivide and report separately deforested areas between those that did contain trees and those that did not contain trees before deforestation; and report in the NIR a table where, for each carbon pool, the standing carbon stocks before deforestation and after deforestation are reported for those lands that did contain trees before deforestation.	Not resolved. Ukraine described the method used to allocate land representation in the NIR (section 6.1). As spatial data are not used in its approach, the Party has been unable to implement the recommendation. During the review, the Party clarified that, when data on conversion of forest to other land uses are collected (almost all forest in Ukraine is managed under the supervision of the central body of executive power or the State agencies), the amount of wood removed from the deforested area is also provided on a regional basis. Therefore, it is impossible to separate specific plots of deforestation. The Party also clarified that deforestation is not driven by any preference for stocked or unstocked areas but rather by the need for land management. The Party did not include in the NIR a table demonstrating for each carbon pool where the standing carbon stocks before deforestation and after deforestation are reported for the land that contained trees before deforestation.
L.26	4.G HWP – CO_2 (L.32, 2021) (L.41, 2019) Transparency	Explain in the NIR the methodology used for estimating emissions from HWP, including the splicing technique, the use of GDP data and the World Bank as the source of the GDP data, and the use of 2010 prices.	Addressing. Ukraine reported in the NIR (section 6.8.2, p.235) that the data on production of wood-based panels and paper and paperboard were taken from the FAO database, which does not have information for 1990–1991. The Party indicated that it applied a splicing technique using national GDP data to estimate HWP production for those years. The Party added more information to the NIR (figures 6.9–6.10, p.236) showing the estimation of wood panel production and paperboard production based on GDP. However, those figures are not enough to understand the methodology used for estimating emissions from HWP, including the splicing technique and the use of GDP data, and the World Bank GDP data and how they were applied to derive AD for 1990–1991. The Party did not explain whether the GDP from the World Bank data applied is in "2010 prices" or if the Party updated the GDP considering the different index provided by the World Bank (e.g. constant 2015 United States dollars).

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
Waste			
W.1	5. General (waste) – CO_2, CH_4 and N_2O (W.1, 2021) (W.1, 2019) (W.7, 2017) Transparency	Improve the description in the NIR of the solid waste management practices in the country, including landfilling of MSW (with and without CH_4 recovery), composting, incineration, recycling and management of hazardous waste.	Resolved. Ukraine reported in its NIR (section 7.2.2.2, pp.242–244) a description of the waste management practices in the country, including management of hazardous waste, landfilling of MSW, recycling, composting and incineration. It also provided in the NIR (section 7.2.2.4, pp.248–250) background information on use of CH_4 at MSW landfills, describing the evolution of this practice over time.
W.2	5. General (waste) – CO_2, CH_4 and N_2O (W.2, 2021) (W.2, 2019) (W.8, 2017) Transparency	Revise the schematic representation of waste treatment (NIR figure 7.3) by including all categories (in all relevant sectors), the sources of each type of waste, ways of treatment and final destination, particularly of sludge from wastewater treatment.	Addressing. Ukraine reported in its NIR (section 7.2.2.2, p.244) a revised version of figure 7.3 to provide an overview of the waste management practices in Ukraine. More information was presented in this version of the figure than in the 2021 NIR on the treatment and disposal routes for waste. However, it was not clear to the ERT where or how the flow of sludge was included in the figure. The ERT noted a value of 47.596 kt industrial waste, pointing towards typical disposal routes for sewage sludge, and asked the Party whether this amount refers to sewage sludge excluding incinerated or composted sludge and if it includes both municipal and industrial sewage sludge. The ERT also noted that the Party reported a detailed description of sludge treatment and disposal routes in its NIR (section 7.5.2.1, figure 7.11, p.270) and that sections 7.5.2.2.3 and 7.2.2.2 highlight that sewage sludge is almost never disposed to solid waste disposal sites. During the review, the Party clarified that the 47.596 kt is the total value of all industrial waste that was disposed according to the specified disposal operations as shown in figure 7.3 (codes D2, D3, D4, D6, D7, D8, D9).
			The ERT considers that the recommendation has not yet been fully addressed because the Party did not include the sources, ways of treatment and destination of sludge from wastewater treatment in NIR figure 7.3. The ERT is of the view that adding a footnote to figure 7.3 that refers to the sections of the NIR where more details are presented on sludge treatment and disposal routes would resolve this issue.
W.3	5.A Solid waste disposal on land – CH_4 (W.3, 2021) (W.4, 2019) (W.2, 2017) (W.10, 2016) Accuracy	Continue to further investigate MSW, taking into consideration the fact that the sampling should be conducted in several typical cities in each season and that the methods, frequency of sampling and implications for the time series should be documented with a view to developing a country-specific EF for the category.	Not resolved. Ukraine applied default values for DOC from the 2006 IPCC Guidelines in response to a previous recommendation from 2016, which noted that the country-specific DOC values were not representative of the entire country as the sampling research was conducted in only one city and only during the autumn. The waste composition for 2014–2021 is based on data from 2013. During the review, the Party clarified that systematic research on the morphological composition of MSW in Ukraine has not been conducted. The Party indicated that research on more recent MSW composition is included in the NIR improvement plan (section A.8.2, p.567) and will be implemented between the 2024 and 2026 inventory submissions. The Party noted some recent expert assessments that the MSW composition in Ukraine is similar to that of Eastern European countries (Czechia, Poland, Slovakia, Baltic States,

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
			etc.) but not similar enough to be used for Ukraine's GHG inventory (section 7.2.2.3, p.246). Therefore, a country-specific EF for the category has not yet been developed.
W.4	5.D Wastewater treatment and discharge – CH$_4$ (W.10, 2021) Transparency	Improve the transparency of the NIR by reporting a complete sludge balance, including the total amount produced (from domestic and industrial wastewater) and the amount sent to each of the different treatments (landfill, composting, incineration and agriculture), specifying under which categories the related emissions are accounted for.	Addressing. Ukraine included more information in the NIR (section 7.5.2.2.3, p.276) by including the additional table 7.27 showing the sewage sludge balances. However, the Party did not include in table 7.27 the disposal of sewage sludge to land after treatment at sludge-drying beds, or specify under which categories the related emissions are accounted for, or that emissions were not accounted for under any category. During the review, the Party clarified that it does not account for emissions from disposal of sewage sludge to land after treatment at sludge-drying beds owing to the absence of relevant methodology and EFs from the 2006 IPCC Guidelines. The ERT notes that there is a significant amount of sludge being composted and it is not clear where the corresponding emissions are reported (see NIR table 7.27, p.276).
			The ERT considers that, even if the Party does not account for emissions from disposal of sewage sludge to land after treatment, AD should be presented in the sludge balance, or a footnote included to explain why the data have been omitted.
W.5	5.D Wastewater treatment and discharge – N$_2$O (W.11, 2021) Convention reporting adherence	Report consistent data on population and protein consumption under additional information in CRF table 5.D and NIR table 7.26.	Resolved. Ukraine reported consistent data on population and protein consumption between the NIR (section 7.5.3.2.1, table 7.30, p.279) and CRF table 5.D (under additional information).

[a] References in parentheses are to the paragraph(s) and the year(s) of the previous review report(s) in which the issue or problem was raised. Issues are identified in accordance with paras. 80–83 of the UNFCCC review guidelines and classified as per para. 81 of the same guidelines. Problems are identified and classified as problems of transparency, accuracy, consistency, completeness or comparability in accordance with para. 69 of the Article 8 review guidelines in conjunction with decision 4/CMP.11.

[b] The report on the review of the 2022 annual submission of Ukraine was not available at the time of this review. Therefore, the recommendations reflected in this table are taken from the 2021 annual review report. For the same reason, 2018, 2020 and 2022 are excluded from the list of review years in which issues could have been identified.

IV. Issues and problems identified in three or more successive reviews and not addressed by the Party

8. In accordance with paragraph 83 of the UNFCCC review guidelines, the ERT noted that the issues and/or problems included in table 4 have been identified in three or more successive reviews, including the review of the 2023 inventory submission of Ukraine, and had not been addressed by the Party by the time of publication of this review report.

Table 4
Issues and/or problems identified in three or more successive reviews and not addressed by Ukraine

ID#	Previous recommendation for issue	Number of successive reviews issue not addressed[a]
General		
G.1	Submit the annual GHG inventory by 15 April each year.	3 (2019–2023)
Energy		
E.1	Correct the unit (i.e. from TJ to kt) used to report solid fuels in CRF table 1.A(b).	3 (2019–2023)
E.2	Develop and use country-specific CO_2 EFs for liquid fuels (i.e. residual fuel, diesel oil, LPG, petroleum coke and refinery gases), which have a significant share in the fuel mix of stationary combustion.	7 (2014–2023)
E.4	Demonstrate that the use of different data sources for 1990–2015 and 2016 onward result in consistent CO_2, CH_4 and N_2O emission estimates across the time series.	3 (2019–2023)
E.6	Improve the information on allocation of CH_4 emissions from coal bed CH_4 flaring.	3 (2019–2023)
E.7	Investigate whether double counting now occurs for coal bed CH_4 flaring between categories 1.B.1.c and 1.A.1.c (i.e. clarify whether the flaring emissions reported under category 1.A.1.c in the 2017 submission were removed from category 1.A.1.c with the reporting of flaring under category 1.B.1.c) and report in the NIR on the findings.	3 (2019–2023)
E.8	Include an explanation in the NIR for the choice of CO_2, CH_4 and N_2O EFs for estimating emissions for the oil category, including documentation of the current state of the oil industry infrastructure.	4 (2017–2023)
E.10	Improve the transparency of reporting for this category by including in the NIR the explanation for the decreasing trend observed in the natural gas transmission (compared with production increases) that was provided during the review.	3 (2019–2023)
E.11	Revise emission estimates for the exploration, production and processing of natural gas using a tier that is in accordance with the 2006 IPCC Guidelines (vol. 2, figure 4.2.1).	3 (2019–2023)
E.14	Enhance the transparency of the plans to improve the national inventory by including a detailed description of the planned improvement for estimating natural gas venting emissions.	3 (2019–2023)
IPPU	No issues identified.	

ID#	Previous recommendation for issue	Number of successive reviews issue not addressed[a]
Agriculture		
A.2	Include in the NIR relevant information on the reported MMS (e.g. how manure is handled, mechanically separated and stored, and the emptying frequencies of the lagoons/manure stores and field application) (the description should include a mass balance for all handled manure based on excreted VS in each MMS and indicate whether or not the manure is covered by a crusting layer).	5 (2016–2023)
A.5	Conduct an assessment of the proportion of inert materials in ground lime and document the results in the NIR; and, if ground lime is considered to include inert materials, revise the CO_2 emissions for the entire time series, excluding the portion of the inert materials in ground lime.	4 (2017–2023)
LULUCF		
L.1	For the model used to calculate the net changes in soil organic matter in mineral soils, verify the model's outputs with measurements annually conducted in the country.	7 (2014–2023)
L.2	Enhance data collection on the other land uses under which organic soils are reported and on their status, either drained or rewetted or, for wetlands only, natural conditions, and supplement the current data gaps with available ancillary data and expert judgment to ensure that no systematic errors affect the estimates of GHG emissions in the time series of each land-use category.	4 (2017–2023)
L.3	Enhance the information reported in the NIR to improve transparency and include, for each estimated category, the verification of outputs (i.e. GHG estimates), if any, noting that the verification of outputs is mandatory for tier 3 estimates.	6 (2015–2023)
L.4	Improve the documentation of uncertainty estimates reported in NIR table 6.10, particularly when expert judgment is involved; and describe in the NIR the methodology used to calculate total uncertainty, in accordance with good practice to document any expert judgment (2006 IPCC Guidelines, vol. 1, chap. 2, annex 2A.1).	3 (2019–2023)
L.6	Collect sufficient data on the land area and changes in the land area, verify the conversions between land-use categories and demonstrate how the accuracy of land representation has improved, clearly documenting the AD used for the sector in the NIR.	5 (2016–2023)
L.7	Report annual land-conversion areas in CRF table 4.1 and report cumulated 20-year conversion areas in CRF tables 4.A–4.F, which requires the calculation of annual land use and land-use change matrices for 1971–1989.	4 (2017–2023)
L.8	Ensure that in any year X of the GHG inventory time series (1) the area (AX) of any land remaining category A is the area of A in the previous year (AX − 1) minus the area of A converted in year X to all other land-use categories (A to OLUX) plus the area converted to A from all other land-use categories 20 years before (OLU to AX − 20) (i.e. AX = AX − 1 − A to OLUX + OLU to AX − 20); and (2) the area of any land converted category B to A (B to AX) is the cumulated area converted to category A from B (B to A) in the 20-year time period from year X to year X–19 (i.e. B to AX = $\sum_{X-19}^{X}$ B to A).	4 (2017–2023)
L.10	Revise the calculations of GHG emissions and removals from forest land in mineral soils following the methods presented in the 2006 IPCC Guidelines and implement sector-specific QC procedures to ensure the accuracy of the estimates reported across the time series.	6 (2015–2023)

ID#	Previous recommendation for issue	Number of successive reviews issue not addressed[a]
L.11	Recalculate nationwide CSC factors for biomass increments and for DOM net changes, stratified by forest type, ecological region and age class, by compiling available information in the country, and, where feasible, by collecting novel data through a national forest inventory system; and, while new CSC factors are being calculated, and noting that Ukraine referenced the use of a 2017 Buksha et al. report in its 2017 annual submission, use data contained in table 3.9 of that report for biomass increments as stratified by age class and main forest species, together with an age-class distribution for the entire time series 1990–2016, and revise the DOM CSC factors and method to ensure time-series consistency.	4 (2017–2023)
L.12	Improve the explanation in the NIR regarding how the correction factors for estimating carbon loss from disturbances were derived and what the implications may be of using a constant value for the factor.	3 (2019–2023)
L.15	Include clear definitions of managed and unmanaged forest land and an explanation of how unmanaged forest land is detected in the land representation and, if necessary, revise the distribution of forest land between managed and unmanaged.	5 (2016–2023)
L.16	Correct the value for the area of forest land remaining forest land in 2015 reported in CRF table 4.A from 10,370.69 to 10,373.36 kha.	3 (2019–2023)
L.18	Enhance data collection on the use under which organic soils are reported, and supplement the current data gaps with available ancillary data and expert judgment, where needed, to ensure that no systematic errors affect the estimates of GHG emissions in the time series.	6 (2015–2023)
L.21	Use subdivisions of managed grassland to report those areas of grassland that are not subject to changes in management activities or for which management activities do not result in net emissions or net removals of GHGs.	4 (2017–2023)
L.22	Enhance the data collection on the drainage status of peat production sites once abandoned; supplement the current data gaps with available ancillary data and expert judgment, where needed; and estimate GHG emissions in sites for peat production which, although abandoned, are still under drainage to ensure that no errors affect the GHG emission trend.	6 (2015–2023)
L.23	Report all land converted to wetlands under the organic soils subdivision and discount such areas from the original land-use category area of drained organic soils.	4 (2017–2023)
L.24	Revise the classification of category 66 ("dry open lands with special vegetation cover"), noting that category 66 appears to more closely match the definition of the IPCC category grassland than other land.	6 (2015–2023)
L.25	Subdivide and report separately deforested areas between those that did contain trees and those that did not contain trees before deforestation; and report in the NIR a table where, for each carbon pool, the standing carbon stocks before deforestation and after deforestation are reported for those lands that did contain trees before deforestation.	6 (2015–2023)
L.26	Explain in the NIR the methodology used for estimating emissions from HWP, including the splicing technique, the use of GDP data and the World Bank as the source of the GDP data, and the use of 2010 prices.	3 (2019–2023)

Waste

ID#	Previous recommendation for issue	Number of successive reviews issue not addressed[a]
W.2	Revise the schematic representation of waste treatment (NIR figure 7.3) by including all categories (in all relevant sectors), the sources of each type of waste, ways of treatment and final destination, particularly of sludge from wastewater treatment.	4 (2017–2023)
W.3	Continue to further investigate MSW, taking into consideration the fact that the sampling should be conducted in several typical cities in each season and that the methods, frequency of sampling and implications for the time series should be documented with a view to developing a country-specific EF for the category.	5 (2016–2023)

[a] Reports on the reviews of the 2018, 2020 and 2022 annual submissions of Ukraine have not yet been published. Therefore, 2018, 2020 and 2022 were not included when counting the number of successive years for this table.

V. Additional findings made during the individual review of the Party's 2023 inventory submission

9. Table 5 presents findings made by the ERT during the individual review of the 2023 inventory submission of Ukraine that are additional to those identified in table 3.

Table 5
Additional findings made during the individual review of the 2023 inventory submission of Ukraine

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
General		No general findings additional to those included in table 3 were made by the ERT during the review.	
Energy			
E.15	1.A.3 Transport – all fuels – CO_2, CH_4 and N_2O	In CRF table 1.A(a)s3 Ukraine reported AD and emissions for the following source categories and fuels as "NA" for the entire time series: 1.A.3.b (road transportation – gaseous fuels and other fossil fuels); 1.A.3.c (railways – solid fuels, gaseous fuels and other fossil fuels); 1.A.3.d (domestic navigation – gasoline, lubricants and gaseous fuels); and 1.A.3.e.i (pipeline transport – liquid fuels, solid fuels and other fossil fuels).	Yes. Comparability
		The ERT noted that "NA" in this context means that the fuel being combusted does not produce emissions. During the review, the Party acknowledged that "NO" should have been used to report these emissions sources and explained that it will correct the notation key for the next inventory submission.	
		The ERT recommends that the Party report "NO" for categories 1.A.3.b (road transportation – gaseous fuels and other fossil fuels); 1.A.3.c (railways – solid fuels, gaseous fuels and other fossil fuels); 1.A.3.d (domestic navigation – gasoline, lubricants and gaseous fuels); and 1.A.3.e.i (pipeline transport – liquid fuels, solid fuels and other fossil fuels) in CRF table 1.A(a)s3.	
E.16	1.A.3 Transport – all fuels – CO_2, CH_4 and N_2O	Ukraine did not describe in its NIR how it used the surrogate method to estimate emissions for categories 1.A.3.b (road transportation) and 1.A.3.e.ii (off-road vehicles and other machinery). The Party reported in its NIR (pp.78,	Yes. Transparency

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
		80 and 325) that, owing to changes to its statistical forms in 2016, AD for fuel consumption for these categories in 2016–2021 were calculated by surrogate method using data from 2015.	
		During the review, the Party clarified that emissions for these source categories were estimated for 1990–2015 using national fuel consumption statistics and COPERT, and by surrogate method for 2016 onward. IEA data on fuel consumption for road transport and off-road transport purposes were used as surrogate parameters and the surrogate method was applied for each fuel type separately. In 2021 a scientific research programme was financed in order to calculate emissions for these categories using COPERT instead of by surrogate method, but the programme had to stop due to national circumstances.	
		The ERT recommends that the Party transparently report in the NIR how it used the surrogate method, including why the method was chosen to resolve the data gaps over other methods described in the 2006 IPCC Guidelines (vol. 1, chap. 5), a description of the source and nature of the surrogate parameters and its approach to ensuring time-series consistency.	
IPPU			
I.7	2.B.2 Nitric acid production – N_2O	Ukraine explained in the NIR (p.111) that nitric acid is produced by five companies using two techniques: four plants have medium-pressure units, and one plant has a low-pressure unit. The Party explained that N_2O emissions from the low-pressure plant were estimated using a default EF (5 kg N_2O/t nitric acid) from the 2006 IPCC Guidelines (vol. 3, chap. 3, table 3.3, p.3.33). In response to a question from the ERT, the Party clarified that the low-pressure plant stopped producing nitric acid in 2014, and therefore related emissions from this plant were not reported for 2015 onward. The ERT considers that this information should be included in the NIR to improve the transparency of the emission estimates.	Yes. Transparency
		The ERT recommends that Ukraine explain in the NIR that emission estimates for this category do not include data from the low-pressure plant from 2015 onward because the plant ceased production of nitric acid in 2014.	
I.8	2.B.2 Nitric acid production – N_2O	Ukraine explained in the NIR (p.111) that four of the plants producing nitric acid are medium-pressure units. The Party provided information on the status of abatement at the medium-pressure plants during the review. For one plant, abatement has been installed since 2009, and emissions were measured in that year and the estimated EF was applied for 2009–2021; for the second plant, an abatement system was installed in 2011 and dismantled in 2013; for the other two plants, no abatement system is in place.	Yes. Accuracy
		Although the Party measured direct emissions only for 2009 and only for one plant, it applied the same EF for all four medium-pressure plants for the entire time series. However, two medium-pressure plants have no abatement system installed and one had no abatement system installed since 2013. The ERT considers that the EF is not suitable for estimating emissions for all four plants and that the Party should collect quantitative or semi-quantitative information on production volume or production capacity to derive a weighted average from measured EFs and default EFs for applying to the total production volume and correct the emission estimates (see ID# I.4 in table 3).	
		The ERT recommends that Ukraine revise the assumption made for the EF applied for medium-pressure plants and update the emission estimates across the time series accordingly.	

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
I.9	2.B.7 Soda ash production – CO_2	Ukraine reported in its NIR (section 4.3.7, p.116) that there is one plant in the country producing soda ash, which uses the Solvay process and thus does not produce CO_2 emissions. The Party justified not estimating these emissions in the NIR (p.116), stating that, as carbon is captured and reused in the process, the CO_2 emissions have not been estimated, which does not go against the requirements of the 2006 IPCC Guidelines according to research published in 2013 on determining GHG emissions in the chemical industry. In CRF table 2(I).A-Hs1 the Party reported "NO" for emissions from this source. However, the ERT noted that the 2006 IPCC Guidelines (vol. 3, chap. 3, pp.3.55–3.56) state that in theory the process is neutral (emissions are equal to zero), yet in application the calcination of limestone in coke would produce more CO_2 than is required for the process of soda ash production and that CO_2 emissions from a stand-alone soda ash production plant should be estimated using a simple mass balance of the complete process.	Yes. Completeness
		During the review, the Party clarified that, since the soda ash production plant is situated in the Autonomous Republic of Crimea, data on limestone and coke consumption could not be obtained. The Party stated that to improve transparency a mass balance will be used to determine the CO_2 emissions once data become available.	
		The ERT recommends that Ukraine estimate CO_2 emissions from soda ash production taking into consideration the guidance provided in the 2006 IPCC Guidelines (vol. 3, chap. 3, pp.3.55–3.56).	
I.10	2.F.1 Refrigeration and air conditioning – HFCs	The ERT noted that the HFC-134a amounts reported as filled into new manufactured products for transport refrigeration (category 2.F.1.d) do not correlate with the amounts reported as stock (e.g. for HFC-134a the sum of amounts filled into new equipment for 2000–2013 amounts to 15.7 t, and considering the IEFs for the product manufacturing factor of 2 per cent and for the product life factor of 15 per cent, the stock in 2014 would amount to 12.1 t, whereas the reported stock is 6.3 t).	Yes. Accuracy
		During the review, the Party indicated that there was an error in the calculation of the stock, and that it will correct the calculations for the next inventory submission.	
		The ERT recommends that Ukraine correct the calculation of average annual stocks for HFC-134a for transport refrigeration for the entire time series for the next inventory submission.	
I.11	2.F.1 Refrigeration and air conditioning – HFCs	Ukraine listed in NIR table 4.30 (p.138) disposal EFs (80 per cent for category 2.F.1.a; 70 per cent for category 2.F.1.b; 100 per cent for category 2.F.1.c; and 50 per cent for category 2.F.1.d). However, according to CRF table 2(II)B-Hs2, the disposal loss factors applied are 100 per cent for all categories. The ERT assumed that the values listed in NIR table 4.30 refer to the parameter "initial charge remaining" as included in the 2006 IPCC Guidelines (vol. 3, chap. 7, table 7.9). During the review, the Party confirmed that the factors listed in NIR table 4.30 refer to "initial charge remaining" and not to "disposal EFs".	Yes. Transparency
		The ERT recommends that Ukraine correctly reference the parameter "initial charge remaining" in NIR table 4.30.	
I.12	2.F.1 Refrigeration and air conditioning – HFCs	Ukraine explained in its NIR (p.138) that R-404a is the main refrigerant used for industrial refrigeration, with a blend composition of 44, 4 and 52 per cent for HFC-125, HFC-134a and HFC-143a respectively. However, for industrial refrigeration the amounts reported for HFC-134a exceed the amounts for HFC-125 and HFC-143a. Additionally, the reported amounts for new fillings and stock of HFC-125 and HFC-143a, which correspond to the only relevant blend R-404a, do not correlate with the aforementioned blend composition. Furthermore, emissions from HFC-125 are reported for 2001 onward, whereas emissions from HFC-143a are reported for 2003 onward.	Yes. Transparency

During the review, the Party explained that, according to data obtained from the State Customs Service of Ukraine, the share of refrigerants contained in imported industrial refrigeration equipment from year to year was approximately 60 per cent for HFC-134a and 40 per cent for R-404a, plus in some years there was a separate delivery of HFC-143a and HFC-125 refrigerants in containers for additional charging of equipment. Industrial refrigeration equipment in 2000–2001 was supplied in small quantities and contained HFC-143a and HFC-134a as refrigerants. Imports of refrigeration equipment containing HFC-125 began in 2002, and containing R-404a in 2004.

A similar issue regarding commercial refrigeration was clarified during the review (the ERT noted that reported stocks of HFC-125 and HFC-143a, which arise from the use of the only relevant blend R-404a, do not correlate with the aforementioned blend composition, whereas the amounts for new filling of equipment do correlate with the blend composition (for all years except 2012–2013)). The Party explained that the calculation of the amount of stock in commercial refrigeration was performed in accordance with data obtained from the State Customs Service of Ukraine, which stated that from year to year the most significant imports were supplies of equipment containing HFC-134a, R-404a and also HFC-507a (50 per cent each of HFC-125 and HFC-143a). In some years, such as 2012–2013, there was a separate delivery of HFC-143a and HFC-125 refrigerants in containers used for new filling of equipment.

The ERT recommends that Ukraine include the additional information provided during the review regarding blends used and import of blends and pure HFCs for industrial and commercial refrigeration in its next NIR.

I.13	2.F.1 Refrigeration and air conditioning – HFCs	Ukraine reported, in CRF table 2(II)B-Hs2, 782.32 t HFC-134a as average annual stock for mobile air conditioning in 2013, while 721.52 t was reported for 2014. No decommissioning was reported for those years.	Yes. Accuracy

During the review, the Party explained that the decrease in stock was due to reduced imports of HFC-containing vehicles and the fall in production of vehicles with HFC-134a air-conditioning systems. The ERT noted, however, that decreasing imports and decreasing new production do not result in a decrease in stock, but only lower the annual increase, as average annual stocks refer to the overall refrigerant amounts for all vehicles operating in the country (export or decommissioning of vehicles would result in a decrease in stock). The ERT assumes that annual emissions from stock have been subtracted from estimates, thus assuming that cars are not serviced and refilled (which, after a few years, will lead to a dysfunction of the air-conditioning system).

The ERT recommends that Ukraine review its assumption concerning refilling and the application thereof in the calculation and report on the results of this review in its next NIR.

I.14	2.F.1 Refrigeration and air conditioning – HFCs	Ukraine reported in CRF table 2(II)B-Hs2 decommissioning of mobile air-conditioning systems from 2015 onward. NIR table 4.28 presents the parameters used for calculating amounts remaining in products at decommissioning: a disposal EF for all mobile air-conditioning subcategories of 70 per cent. The ERT noted that, if relating the increase of average annual stocks reported in CRF table 2(II)B-Hs2 (e.g. increase in stock in 1998–1999: 3.98 – 2.39 = 1.59 t HFC-134a, which refers to the new amounts of refrigerant added to the stock in 1999) to the amounts reported as remaining in products at decommissioning (in this example for 2016 as this is the year in which, according to the assumptions of the Party, new cars from 1999 are decommissioned: 0.98 t HFC-134a), the calculated share of initial charge remaining is 62 per cent (versus 70 per cent presented in NIR table 4.28). For the other years, the factor ranges between 50 and 59 per cent, but the default range in the 2006 IPCC Guidelines is 0–50 per cent.	Yes. Accuracy

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
		During the review, the Party clarified that emissions from disposal are calculated only for automobile transport, the disposal EF of 50 per cent as initial charge remaining was used in accordance with the 2006 IPCC Guidelines (vol. 3, chap. 7, table 7.9, p.7.52) and that the factor can range from 50 to 59 per cent as amounts filled into new manufactured equipment also include amounts used in railways, which have a longer lifetime and are thus not yet decommissioned. However, according to the understanding of the ERT, if not all amounts added, for example, in 1999 to the mobile air-conditioning stock are disposed in 2016, the factor for initial charge remaining would be lower than applied for the amounts disposed, thus lower than 50 per cent.	
		The ERT recommends that Ukraine review the values and its assumptions for initial charge remaining for mobile air-conditioning in cars and the application thereof and recalculate emissions, if necessary. The ERT also recommends that the Party update the text in the NIR accordingly in the next inventory submission.	
I.15	2.F.4 Aerosols – HFCs	In CRF table 2(II)B-Hs2, Ukraine reported HFC-134a filled into new manufactured products under category 2.F.4.a (metered dose inhalers) for 2003 onward, but emissions from manufacturing were reported as "NO". During the review, the Party clarified that emissions from manufacturing are included with emissions from stock.	Yes. Comparability
		The ERT recommends that Ukraine report emissions of HFC-134a from manufacturing separately from stock or report the correct notation key "IE" for manufacturing in CRF table 2(II)B-Hs2 and indicate in the NIR and in CRF table 9 that emissions from manufacturing are included with emissions from stock.	
Agriculture			
A.8	3.A.4 Other livestock – CH_4	Ukraine reported the CH_4 EFs for enteric fermentation of rabbits and fur-bearing animals in its NIR (annex A3.2.8, table A3.2.8.3, p.450) as 0.7 and 0.25 kg CH_4/head respectively. The ERT noted that the 2006 IPCC Guidelines do not provide EFs for rabbits or poultry and there is no information about the estimation of the EFs for rabbits and fur-bearing animals for enteric fermentation in the Party's NIR or CRF tables.	Yes. Transparency
		During the review, the Party clarified that EFs for rabbits and fur-bearing animals were estimated on the basis of expert opinion, which considers a correction factor based on a weight ratio of 0.75 of animals with a similar digestive system (rabbits – scaling EF from horses; and fur-bearing animals – scaling EF from swine). All EFs used are reported in the NIR (annex A3.2.8, table A3.2.8.3). The Party informed the ERT that it will provide detailed relevant information in the next NIR since there is currently an inaccuracy in the explanation of the EFs for rabbits and fur-bearing animals.	
		The ERT recommends that Ukraine explain in the NIR how the EFs for enteric fermentation for rabbits and fur-bearing animals were estimated and provide documentation that supports the expert judgment (e.g. country-specific studies, research articles, etc.) in the next inventory submission.	
A.9	3.D.b.2 N leaching and run-off – N_2O	Ukraine reported in its NIR (chap. 5, p.195) that N_2O emissions from leaching and run-off of introduced or deposited N were estimated using equation 11.10 of the 2006 IPCC Guidelines (vol. 4, chap. 11, p.11.21). The values of the parameters used in the equation are given in CRF table 3.D and in the NIR (table A3.2.8.7, p.458).	Yes. Accuracy
		The ERT reproduced the emission estimates for N_2O from leaching and run-off and found different values (e.g. for 2021 the value was 20,838.91 t N_2O instead of the 20,834.55 t N_2O reported by the Party). During the review, the Party clarified that an error occurred because the total AD for N input from organic N fertilizers to cropland and	

grassland were reported for N input from manure applied to soils and as a result the AD for the former were reported twice.

The ERT recommends that Ukraine correct the error in the AD and recalculate the emission estimates for N_2O for the entire time series for its next inventory submission.

LULUCF

No findings for the LULUCF sector additional to those included in table 3 were made by the ERT during the review.

Waste

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
W.6	5. General (waste) – CO_2, CH_4 and N_2O	Ukraine provided in its NIR (figure 7.3, p.244) a detailed diagram showing waste management practices in 2021 and quantities of waste transferred, treated or disposed. The ERT observed that the value in the diagram for MSW generation (10,466.9 kt) is 17.34 per cent lower than the sum of collected MSW (911.8+10,417.6+1,213.1+110.9+ 8.8 = 12,663.2 kt). In addition, the sum of the values for industrial waste streams (36.9+52.3+936.2+75.2+ 288,592.4+47.6 = 289,740.6 kt) is 40.58 per cent lower than the value for industrial waste generation (487,613.5 kt). Moreover, the value for MSW collected for incineration (110.9 kt) appears to have been omitted from the values for incinerator activity (936.2+52.3 = 988.5 kt, which comes from "treatment"). During the review, the Party clarified that (1) it misreported the amount of waste collected as generated, and some differences between totals for MSW collection and total MSW processing are to be expected due to the data being reported to the Party independently by operators; (2) owing to temporary storage of industrial waste, total industrial waste generation is not expected to equal total industrial waste disposal in any given year; (3) the value presented for incineration is the total reported by the operator, which includes MSW incinerated. The ERT recommends that Ukraine provide more information in the NIR on the differences between waste generated, collected and disposed for both MSW and industrial waste. In addition, the ERT recommends that the Party add more information to figure 7.3 or text in the NIR with information on the waste flow for industrial waste, including for temporary storage of industrial waste, clarifying qualitative or quantitative expected differences between estimates for waste generation, collection and disposal.	Yes. Transparency
W.7	5.A Solid waste disposal on land – CH_4	Ukraine reported in its NIR (figure 7.3, p.244) the waste management flow for MSW and ISW: a large proportion of MSW and a small quantity of organic ISW is disposed to MSW landfills and dumps, and the AD presented in the NIR are consistent with the AD reported in CRF table 5.A under categories 5.A.1 and 5.A.2. Most ISW is disposed separately to "specially engineered landfill", "deposit into or onto land" or "permanent storage", but AD are not reflected in the CRF tables under categories 5.A.1 and 5.A.2. The Party did not include in the NIR or the CRF tables a justification for omitting CH_4 emissions relating to these separate disposal operations for ISW from category 5.A. During the review, the Party confirmed that emissions from disposal of ISW to "specially engineered landfill", "deposit into or onto land" and "permanent storage" were not included in the CH_4 emission estimates for category 5.A. The Party provided supplementary data, which include the quantities of ISW by waste type disposed to landfill. The ERT noted that most of the omitted categories were described as mineral waste or otherwise inert types of waste, and considers that a DOC of 0 is suitable for many of the types of waste omitted from the industrial landfill AD, but notes that some fractions such as soils and dredging spoils, and construction waste might have a non-zero DOC.	Yes. Accuracy

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
		The ERT recommends that Ukraine evaluate the DOC content of the ISW landfilled, particularly for soils, dredging spoils and mineral waste from construction and demolition, where non-zero DOC values could be chosen from the 2006 IPCC Guidelines (vol. 5, chap. 2, table 2.5), and estimate CH_4 emissions for this portion of waste.	
W.8	5.A Solid waste disposal on land – CH_4	Ukraine provided during the review a spreadsheet with the emission calculations for CH_4 from MSW landfilled, in which the Party applied a constant MCF value for 2010 onward. However, NIR table 7.4 (p.245) presents different values for the MCF for this period.	Yes. Accuracy
		During the review, the Party stated that the values in NIR table 7.4 are wrong, but the correct ones were the constant values used in the calculation. However, observing the numbers and the trends of the MCF values reported in NIR table 7.4 and the MCF values reported in the previous NIR, it seems that the Party is able to calculate MCF values for 2010 onward. The ERT considers that using updated MCF values instead of constant values would improve the emission estimates for this category.	
		The ERT recommends that Ukraine investigate the possibility of updating the MCF values for 2010 onward and revise the CH_4 emission estimates accordingly. If Ukraine concludes that the values reported in NIR table 7.4 are incorrect, the ERT recommends that the Party correct those values.	
W.9	5.A.2 Unmanaged waste disposal sites – CO_2 and CH_4	Ukraine reported in its NIR (section 7.2.2.2, p.242) that, according to official data, (a) more than 20,000–27,000 unauthorized dumps are created each year, (b) about 26,800 unauthorized dumps were detected in 2021 and (c) 25,500 of them were liquidated. The Party, in its NIR (figure 7.3, p.244), in the illegal dumping box, states that 99.9 per cent are liquidated each year (corresponding to a total of 1,214.1 kt waste from this source in 2021). The Party also reported in its NIR (p.241) that "estimation of the mass of landfilled waste also includes the illegal MSW landfills and that the share of the mass of landfilled waste consists of 10–15 per cent from collected and subsequently landfilled MSW". The ERT noted that, on the basis of the text in the NIR (p.242), the unauthorized dumps being liquidated for 2021 were around 95 per cent, not matching the information presented in NIR figure 7.3. The ERT also found it unclear how the assumption used to calculate the quantity of waste coming from illegal dumping was developed and justified (not according to official statistics).	Yes. Transparency
		During the review, the ERT asked the Party to provide details of how the quantity of waste coming from illegal dumping and unauthorized dumps is calculated and assessed for the whole time series and justifications and data sources for those assumptions. The Party clarified that official statistics report the number of created and liquidated unauthorized dumps, but do not report on the amount (by mass or weight) of illegally generated and liquidated MSW. The Party also indicated that, as stated in the NIR (p.241), the share of the mass of illegally dumped waste is 10–15 per cent of the officially collected and subsequently landfilled MSW, but it did not provide any additional information on the assumption.	
		The ERT recommends that Ukraine increase the transparency of the NIR by including justification for the assumption about the mass of illegally dumped waste. The ERT also recommends that the Party harmonize the information presented in the NIR text with that in NIR figure 7.3 regarding the creation, detection and liquidation of unauthorized dumps.	
W.10	5.D.1 Domestic wastewater – CH_4 and N_2O	Ukraine reported in its NIR (section 7.5.3.2.1, p.279) a value of 1 for $F_{IND-COM}$, but the 2006 IPCC Guidelines default value for $F_{IND-COM}$ is 1.25 (vol. 5, chap. 6, section 6.3.1.3). In the NIR the Party justified the value of 1 for $F_{IND-COM}$ by stating "took into account in 5.D.2. and has no influence on estimates". However, this is not in	Yes. Accuracy

		accordance with the 2006 IPCC Guidelines (vol. 5, sections 6.2.2.3 and 6.3.1.3) because $F_{IND-COM}$ is for activities outside the scope of the methodology for category 5.D.2 (industrial wastewater) (such as grocery stores and butchers), so using a value of 1, or omitting a scaling factor without using a country-specific method to account for co-discharging of industrial wastewater to municipal wastewater management systems, represents an underestimation in the estimates.	
		During the review, the Party clarified that the calculations were carried out according to the procedure outlined in a study of CH_4 and N_2O emissions from wastewater treatment and the development of methods for determining national EFs, in which this correction factor was not taken into account. The Party stated that these coefficients will be taken into account in the next inventory submission.	
		The ERT recommends that Ukraine apply the default scaling factor of 1.25 for $F_{IND-COM}$ to municipal wastewater AD in accordance with the 2006 IPCC Guidelines (vol. 5, sections 6.2.2.3 and 6.3.1.3) or use an alternative method for addressing the co-discharge of wastewater from non-residential users.	
W.11	5.D.1 Domestic wastewater – CH_4	Ukraine reported an MCF default value from the 2006 IPCC Guidelines (vol. 5, table 6.3, p.6.13) for latrines of 0.1 in its NIR (section 7.5.2.2.3, table 7.26, p.275). The accompanying text states that the reason for selecting the lowest default value for latrines from the 2006 IPCC Guidelines is the lack of reliable data on the types of latrine in Ukraine. However, the 2006 IPCC Guidelines provide a range of default values for latrines by condition (0.1–0.7). The NIR does not provide justification or a source for the scientific evidence referred to in the text, including for information reported on groundwater, which is the most important criterion for selecting the MCF. Moreover, according to NIR table 7.26, an MCF of 0.1 was chosen for cesspools, but no explanation or justification was provided for this choice.	Yes. Accuracy
		During the review, the Party provided information on latrines in Ukraine to justify the selection of this MCF: family size is small (3–5 persons); the groundwater table is lower than the latrine; and Ukraine's climate can be classified as dry. The information provided by the Party is not reflected in the NIR. In addition, the Party explained that cesspools in Ukraine can be considered the same as latrines.	
		The ERT further noted that, in the NIR (section 7.5.2.2.3, p.275), the MCF for "centralized systems – insufficiently treated" is set at 0.2, the lowest default value in the 2006 IPCC Guidelines for "centralized, aerobic treatment plant – not well managed, overloaded". However, the ERT does not consider the explanation provided in the NIR for selecting the value of 0.2 to be reasonable.	
		The ERT recommends that Ukraine revise the MCF values applied for latrines, cesspools and centralized systems and recalculate emissions or properly justify the MCF values used in the emission estimates.	

[a] Recommendations made by the ERT during the review are related to issues as defined in para. 81 of the UNFCCC review guidelines or problems as defined in para. 69 of the Article 8 review guidelines.

VI. Questions of implementation

10. No questions of implementation were identified by the ERT during the individual review of the Party's 2023 inventory submission.

Annex I

Overview of greenhouse gas emissions and removals as reported by Ukraine in its 2023 inventory submission

Tables I.1–I.3 provide an overview of the total GHG emissions and removals as reported by Ukraine.

Table I.1
Total greenhouse gas emissions and removals for Ukraine, base year–2021
(kt CO_2 eq)

	Total GHG emissions and removals excluding indirect CO_2 emissions		Total GHG emissions and removals including indirect CO_2 emissions[a]	
	Total including LULUCF	Total excluding LULUCF	Total including LULUCF	Total excluding LULUCF
1990	911 393.97	942 800.47	NA	NA
1995	529 982.34	562 107.58	NA	NA
2000	405 004.99	427 917.24	NA	NA
2010	398 348.95	407 345.75	NA	NA
2015	338 908.73	319 166.58	NA	NA
2020	317 632.04	318 034.95	NA	NA
2021	341 489.13	327 258.77	NA	NA

[a] The Party did not report indirect CO_2 emissions in CRF table 6.

Table I.2
Greenhouse gas emissions and removals by gas for Ukraine, excluding land use, land-use change and forestry, 1990–2021
(kt CO_2 eq)

	CO_2[a]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3
1990	706 226.89	182 891.68	53 446.07	NO	235.82	NO	0.01	NO
1995	390 072.11	139 031.65	32 825.68	NO	178.06	NO	0.07	NO
2000	285 674.21	118 324.34	23 786.81	15.73	115.74	NO	0.42	NO
2010	294 365.79	84 818.39	27 381.34	743.86	26.67	NO	9.71	NO
2015	223 787.57	61 552.63	33 005.09	801.65	NO	NO	19.64	NO
2020	206 823.85	71 698.74	37 717.52	1 751.50	NO	NO	43.35	NO
2021	210 153.30	71 536.71	43 618.80	1 901.02	NO	NO	48.94	NO
Percentage change 1990–2021	**−70.2**	**−60.9**	**−18.4**	**NA**	**NA**	**NA**	**641 194.7**	**NA**

[a] Ukraine did not report indirect CO_2 emissions in CRF table 6.

Table I.3
Greenhouse gas emissions and removals by sector for Ukraine, 1990–2021
(kt CO_2 eq)

	Energy	IPPU	Agriculture	LULUCF	Waste	Other
1990	725 319.33	118 198.83	86 842.92	31 406.50	12 439.38	NO
1995	431 377.13	58 156.32	60 607.71	32 125.24	11 966.41	NO
2000	311 340.84	67 453.09	37 334.68	22 912.26	11 788.63	NO
2010	286 384.30	74 714.99	33 520.89	8 996.80	12 725.58	NO
2015	210 824.99	56 415.15	39 378.00	19 742.15	12 548.44	NO
2020	207 988.43	56 002.11	41 687.10	402.90	12 357.30	NO
2021	209 744.24	58 359.40	47 017.37	14 230.36	12 137.75	NO
Percentage change 1990–2021	**−71.1**	**−50.6**	**−45.9**	**−145.3**	**−2.4**	**NA**

Notes: (1) Ukraine did not report emissions or removals for the sector other (sector 6); (2) Ukraine did not report indirect CO_2 emissions in CRF table 6.

Annex II

Additional information to support findings in table 2

Missing categories that may affect completeness

The only category for which an estimation method is included in the 2006 IPCC Guidelines that was reported as "NE" or for which the ERT otherwise determined that there may be an issue with the completeness of the reporting in the Party's inventory is category 2.B.7 soda ash production (CO_2) (see ID# I.9 in table 5).

Annex III

Reference documents

A. Reports of the Intergovernmental Panel on Climate Change

IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. S Eggleston, L Buendia, K Miwa, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl.

IPCC. 2014. *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*. T Hiraishi, T Krug, K Tanabe, et al. (eds.). Geneva: IPCC. Available at https://www.ipcc.ch/publication/2013-supplement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories-wetlands/.

B. UNFCCC documents

Annual review reports

Reports on the individual reviews of the 2014, 2015, 2016, 2017, 2019 and 2021 annual submissions of Ukraine, contained in documents FCCC/ARR/2014/UKR, FCCC/ARR/2015/UKR, FCCC/ARR/2016/UKR, FCCC/ARR/2017/UKR, FCCC/ARR/2019/UKR and FCCC/ARR/2021/UKR respectively.

Other

Aggregate information on greenhouse gas emissions by sources and removals by sinks for Parties included in Annex I to the Convention. Note by the secretariat. Available at https://unfccc.int/documents/510888.

Annual status report for Ukraine for 2023. Available at https://unfccc.int/sites/default/files/resource/asr2023_UKR.pdf.

C. Other documents used during the review

Responses to questions during the review were received from Igor Onopchuk (National Center for GHG Emission Inventory of Ukraine), including additional material on the methodology and assumptions used.

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