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Report on the individual review of the inventory submission of Sweden 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 annual inventory submission of Sweden, 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.

* 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"
B_o	maximum methane-producing capacity
BOD	biochemical oxygen demand
C	carbon
C_2F_6	hexafluoroethane
CF_4	tetrafluoromethane
CH_4	methane
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
COD	chemical oxygen demand
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"
CP	commitment period
CPR	commitment period reserve
CRF	common reporting format
CSC	carbon stock change
DBH	diameter at breast height
DLF	disposal loss factor
DOC	degradable organic carbon
EF	emission factor
ERT	expert review team
EU	European Union
EU ETS	European Union Emissions Trading System
FAOSTAT	statistical database of the Food and Agriculture Organization of the United Nations
F_{COD}	annual amount of digestate from co-digesters
$F_{IND-COM}$	factor for industrial and commercial co-discharged protein into the sewer system
F_{ON}	total amount of organic nitrogen fertilizer applied to soils other than by grazing animals
F_{PRP}	annual amount of urine and dung nitrogen deposited by grazing animals on pasture, range and paddock
$Frac_{GASCOD}$	fraction of digestate from co-digesters that volatizes as ammonia and nitrogen oxides
$Frac_{GASF}$	fraction of synthetic fertilizer nitrogen that volatilizes as ammonia and nitrogen oxides
$Frac_{GASG}$	fraction of nitrogen from grazing animals that volatilizes as ammonia and nitrogen oxides
$Frac_{GASM}$	fraction of applied organic nitrogen fertilizer materials and of urine and dung nitrogen deposited by grazing animals that volatilizes as ammonia and nitrogen oxides
$Frac_{LEACH-(H)}$	fraction of all nitrogen added to or mineralized in managed soils in regions where leaching or run-off occurs that is lost through leaching and run-off
F_{SN}	annual amount of synthetic fertilizer applied to soils
GE	gross energy intake
GHG	greenhouse gas

GWP-100	100-year global warming potential values
HFC	hydrofluorocarbon
ICBM	introductory carbon balance model
IE	included elsewhere
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
LULUCF	land use, land-use change and forestry
N	nitrogen
N_2O	nitrous oxide
NA	not applicable
NCV	net calorific value
NE	not estimated
Nex	nitrogen excretion
NF_3	nitrogen trifluoride
NFI	national forest inventory
NIR	national inventory report
NO	not occurring
NO_X	nitrogen oxides
PFC	perfluorocarbon
PLF	product life factor
QA/QC	quality assurance/quality control
Revised 1996 IPCC Guidelines	*Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*
SEF	standard electronic format
SF_6	sulfur hexafluoride
SMED	Swedish Environmental Emissions Data
SO_2	sulfur dioxide
SOC	soil organic carbon
SWDS	solid waste disposal site(s)
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"
Wetlands Supplement	*2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*
XPS	extruded polystyrene

I. Introduction

1. This report covers the review of the 2023 inventory submission of Sweden, 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 Roman Payo and Claudia do Valle (secretariat). Table 1 provides information on the composition of the ERT that conducted the review for Sweden.

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

Area of expertise	*Name (Party)*
Generalist	Nagmeldin Elhassan (Sudan), Melanie Hobson (United Kingdom)
Energy	Afif Charbel (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 Sweden resolve identified findings, including issues[1] designated as problems.[2] Other findings, and, if applicable, the encouragements of the ERT to Sweden to resolve related issues, are also included in this report.

4. A draft version of this report was communicated to the Government of Sweden, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

5. Annex I presents the annual GHG emissions of Sweden, 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.

[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 Sweden

Assessment			*Issue/problem ID#(s) in table 3 or 5*[a]
Date of submission	Original submission: NIR, 6 April 2023; CRF tables (version 1), 6 April 2023; SEF tables (SEF-CP1-2022 and SEF-CP2-2022), 6 April 2023		
Review format	Centralized		
Source of GWP-100	IPCC Fifth 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	L.4, L.7, L.10, L.11
	(c) Development and selection of EFs?	Yes	I.14, I.15, I.16, L.1, L.14, L.16, L.17, L.20, W.5, W.8
	(d) Collection and selection of AD?	Yes	E.4, E.7, I.1, I.8, W.9
	(e) Reporting of recalculations?	Yes	E.5, E.6, I.4
	(f) Reporting of a consistent time series?	No	
	(g) Reporting of uncertainties, including methodologies?	No	
	(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.8, W.10, W.12
	(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	I.8, W.10, W.12
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?	No	
	Have any issues been identified related to the national registry:		
	(a) Overall functioning of the national registry?	No	
	(b) Performance of the functions of the national registry and the adherence to technical standards for data exchange?	No	
	Have any issues been identified related to the reporting of information on assigned amount units, 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 standard independent assessment report?	No	

Assessment		*Issue/problem ID#(s) in table 3 or 5*[a]
CPR	Was the CPR reported in accordance with decision 18/CP.7, annex; decision 11/CMP.1, annex; and decision 1/CMP.8, paragraph 18?	Yes
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 11 May 2023,[3] and had not been resolved by the time of publication of the report on the review of the Party's 2023 inventory 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 Sweden

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
General			
G.1	Notation keys (G.6, 2022) Convention reporting adherence	(a) Include justification for the insignificance of emissions for category 2.G; (b) Report HFC-125 and HFC-143a emissions for subcategory 2.F.1.d as "NO" for 2000–2002 if emissions did not occur in those years.	(a) Addressing. See ID# I.8 below. (b) Resolved. Sweden reported HFC-125 and HFC-143a emissions for category 2.F.1.d transport refrigeration (disposal) for 1990–2002 as "NO" in CRF table 2(II).B-H (sheet 2). During the review, Sweden explained that no refrigerated trailers and refrigerated trucks were equipped with the R404a cooling systems (i.e. with HFC-125 and HFC-143a as refrigerant fluids) from 1990 to 1992, 30 per cent of refrigerated trucks and refrigerated trailers had R404a in their cooling systems in 1993–1994, and 100 per cent of refrigerated trucks and refrigerated trailers had R404a in their cooling systems from 1995 onward. This means that emissions from disposal did not occur for 1990–2002 and increased significantly between 2004 and 2005 since the lifespan of the equipment is 10 years (see ID# I.13 in table 5).
G.2	Other (G.3, 2022) (G.5, 2020) Comparability	(a) Complete the empty cells of CRF table 6 by including either the indirect CO_2 and N_2O emissions or the correct notation keys in accordance with paragraph 37 of the UNFCCC Annex I inventory reporting guidelines; (b) Include in the NIR information about indirect CO_2 and N_2O emissions in order to improve transparency.	(a) Not resolved. Sweden continued to report blank cells for indirect CO_2 emissions from the IPPU, agriculture, LULUCF and waste sectors and for the sector "other" in CRF table 6, as well as for indirect N_2O emissions for the sector "other". The ERT considers that the recommendation has not yet been addressed because the Party did not use notation keys or include the required information in CRF table 6 for the cases mentioned above. During the review, the Party clarified that this information will be reported in the 2024 inventory submission. (b) Resolved. The Party provided information on the reporting of indirect CO_2 and N_2O emissions in its NIR (section 9, p.438).
G.3	Uncertainty analysis (G.2, 2022) (G.4, 2020) Convention reporting adherence	Include in the NIR an uncertainty analysis for 1990 (the base year under the Convention).	Resolved. The Party provided a summary of the results of the uncertainty analysis for 1990 and 2021 in its NIR (section 1.7.1, pp.56–58), with more detail provided in annex 7 to the NIR. The overall uncertainty for 1990 emissions is reported to be ±14.2 per cent excluding LULUCF. When including LULUCF, the uncertainty increases to ±53 per cent for 1990.

[3] FCCC/ARR/2022/SWE.

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
Energy			
E.1	Fuel combustion – reference approach – CO_2 – liquid fuels (E.7, 2022) Transparency	Include in the NIR the results of continued efforts to address the discrepancies between the reference and sectoral approaches for liquid fuels and the challenges in using data from the new questionnaires used with data providers along with the outcomes of work on resolving quality issues in the data sources used for estimating GHG emissions.	Addressing. The Party reported in its NIR (annex 4, section 4.5.3, p.186) that the projects aimed at reducing the differences between the reference and the sectoral approaches were not prioritized, but that it will pursue projects aimed at reducing the differences and improve the description of the remaining differences in the 2024 inventory submission (NIR, annex 4, section 4.7, p.194). The Party provided in its NIR (annex 4, section 4.4.1.2) an analysis of the differences between the approaches for liquid fuels and stated in the NIR (section 3.2.1, p.112) that the fuel consumption according to the sectoral approach is consistent with the official energy statistics for fuel consumption. The ERT noted that the differences in CO_2 emissions between the approaches for liquid fuels reported in the NIR (annex 4, section 4.4.1.2) and CRF table 1.A(c) were not identical. For example, in NIR figure A4.2 (annex 4, p.174), the relative difference between the approaches for 1990 is approximately –1 per cent, whereas in CRF table 1.A(c) it is –9 per cent, or for 2002 the value in NIR figure A4.2 is approximately +1 per cent, whereas in CRF table 1.A(c) it is –1.4 per cent. During the review, the Party clarified that the EFs used to calculate stored carbon in the reference approach as presented in the NIR (figure A4.2) were not identical to those used for the reporting of stored carbon in the reference approach as presented in CRF table 1.A(c), but that it will use the same EFs for the reporting in the NIR and CRF table 1.A(c) for its 2024 inventory submission. The Party stated that it will review the process for preparing the documentation in the NIR and correct it for the next inventory submission. The ERT considers that the recommendation has not yet been fully addressed because the Party did not include in the NIR the results of the ongoing efforts to reduce the discrepancies between the reference and sectoral approaches for liquid fuels.
E.2	International navigation – residual fuel oil – CO_2 (E.6, 2022) (E.5, 2020) (E.8, 2019) Convention reporting adherence	Correct the erroneous values of residual fuel oil consumption reported in CRF table 1.A(b) for the entire time series; and improve QC to ensure that data used in the CRF tables are consistent throughout.	Resolved. The ERT noted that the error in the value of residual fuel oil consumption for 2017 – the original cause of this recommendation – has been corrected by the Party. In its 2020 inventory submission, the Party, together with the national agency providing the Swedish energy balance, improved the methodology for estimating residual fuel oil for marine bunkers. The ERT notes that, since the improvement, the values of residual fuel oil consumption for 2019–2021 have been identical in CRF table 1.D.2 (sectoral approach) and table 1.A(b) (reference approach). On the other hand, the ERT notes that inconsistencies between CRF table 1.D.2 and table 1.A(b) regarding residual fuel oil consumption from 1990 to 2018 remain (see ID# E.4 in table 5).
E.3	International navigation – CO_2, CH_4 and N_2O – all fuels (E.8, 2022) Transparency	Include in the NIR information explaining that data harmonization work was carried out after the 2010 study mentioned in NIR section 3.2.2, that fuel use by navigation is based on sales statistics and split into domestic and international navigation, and	Resolved. The ERT commends the Party for describing the methodology used for splitting fuel consumption between domestic and international navigation in the NIR (section 3.2.19.2, p.162, and annex 2, section 2.1.14, p.50). The data harmonization work for NCVs for liquid fuels after the 2010 study (in order that the GHG inventory contains the same values as those reported to the International Energy Agency) is also

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
		that the NCVs for fuels have been harmonized so that the GHG inventory contains the same values as those reported to the International Energy Agency.	described in annex 4 to the NIR in the analysis of differences between the reference and sectoral approaches (NIR section 4.4.1.2, p.176).
IPPU			
I.1	2.A.3 Glass production – CO_2 (I.7, 2022) Convention reporting adherence	Report the AD available in CRF table 2(I).A-H (sheet 1) and explain in the documentation box and in the NIR why the AD are not complete.	Addressing. The Party did not include the requested AD in CRF table 2(I).A-H (sheet 1), nor did it provide any explanation in the documentation box. It reported the AD as "NA". In the NIR (p.214), the Party explained that the amounts of container glass, flat glass, manual glass and glass wool produced are attributed to different processes, and hence it is not appropriate to sum up and report these data as AD in the CRF tables. However, AD are presented in the NIR (table 4.2.7, p.215). During the review, the Party stated that it will include the sum of the different AD in the CRF tables in the 2024 inventory submission.
I.2	2.B.5 Carbide production – CO_2 (I.8, 2022) Transparency	Explain in more detail the methodology used to estimate CO_2 emissions from carbide production (category 2.B.5) in the NIR.	Resolved. The Party explained in detail the methodology used in its NIR, namely that a tier 1 methodology using the IPCC default EF is applied (see NIR table 4.3.3). The Party also stated in its NIR (p.225) that emissions associated with calcium carbide are now allocated in accordance with the 2006 IPCC Guidelines: emissions from lime calcination are reported in category 2.A.2 lime production, while CO_2 emissions from calcium carbide production (where CO_2 emissions arise as a result of combusting carbide furnace gas generated during the calcium carbide production process) and emissions from using calcium carbide (acetylene production and use) are reported in the IPPU sector under category 2.B.5.b. The NIR also explains that CO_2 emissions from carbide production and their allocation had been revised for the 2021 annual submission (section 4.3.5.3, p.228). The information provided by the Party during the 2022 review to explain why the recalculated CO_2 emissions for this category increased differently for different years was included in the 2023 NIR. The ERT considers that the information provided in the NIR is complete and transparent and thus that the recommendation has been resolved.
I.3	2.B.5 Carbide production – CO_2 (I.9, 2022) Transparency	Report AD as a sum of produced carbide and carbide used for acetylene production in CRF table 2(I).A-H (sheet 1) and explain this way of reporting AD in the documentation box and in the NIR.	Resolved. The Party reported AD for carbide production under category 2.B.5.b in CRF table 2(I).A-H (sheet 1) and it explained in its NIR (p.228) that the AD were the sum of the carbide produced and the carbide used for acetylene production.
I.4	2.C.1 Iron and steel production – CO_2 (I.4, 2022) (I.7, 2020) (I.17, 2019) (I.17, 2017)	Report on any recalculations to emissions and AD across the time series for sources in the energy and IPPU sectors affected by the integrated steelworks (i.e. subcategories 1.A.1.a, 1.A.1.c, 1.A.2.a, 1.B.1.c and	Not resolved. The Party provided a detailed explanation of the differences between the sectoral and reference approach in its NIR (section 3.2.1, p.113) and noted that, in general, the differences observed between the reference approach and the sectoral approach have decreased since the last submission. In the NIR (annex 4, section 4.4.2, p.179), the Party stated that it is continuously making efforts to reduce the discrepancies

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
	Convention reporting adherence	2.C.1.b) (as a result of harmonization of the data).	for solid fuels through cooperation with the Swedish Energy Agency and the steelworks operators. During the review, the Party clarified that it would revise the NIR chapter on the reference and sectoral approaches in the future, focusing on the comparability of the different sources of AD, and referred to the NIR (section 3.2.1 and annex 4) on what has been done to address the issue. The ERT considers that the recommendation has not yet been addressed because the Party did not report recalculations of emissions and AD across the time series for categories in the energy and IPPU sectors affected by the harmonization of data in the integrated steelworks.
I.5	2.C.1 Iron and steel production – CO_2 (I.10, 2022) Transparency	(a) Provide information in the NIR on the mass-balance approach applied, including the list of raw materials taken into account for the estimation of CO_2 emissions from iron ore pellet production; (b) Transparently report a description of the pellet production process indicating the allocation of energy-related emissions; (c) Collect information on the carbon content both in raw materials and in pellet production, reporting them as national totals if necessary to protect confidential information, in order to explain the low value of the IEF reported in CRF table 2(I).A-H (sheet 2) for estimating CO_2 emissions from pellet production for 2020 under subcategory 2.C.1.e.	(a) Resolved. The Party reported in its NIR (section 4.4.1.2.5, p.244) that the amounts of bentonite, organic binder, olivine, quartzite, limestone and dolomite used for the production of iron ore pellets and the corresponding CO_2 emissions are collected from the EU ETS and are reported by companies and facilities. The Party described in its NIR (p.242) the detailed mass-balance approach used to verify the data on emissions reported to the EU ETS for the production of pig iron (category 2.C.1.b). During the review, the Party clarified that it does not make an equivalent mass balance for pellet production (category 2.C.1.e) as made for pig iron. Process-related emissions are estimated from the EU ETS data. Only process-related CO_2 emissions have the EU ETS as a data source, while energy-related emissions (CO_2, CH_4 and N_2O, all reported in the energy sector) are based on fuel statistics. The ERT noted that this information is also included in the NIR (p.244) and considered that this recommendation has been fully addressed. (b) Not resolved. The Party did not include a description of the pellet production process in the NIR. During the review, the Party provided information on the allocation of energy-related emissions (emissions from the use of light and heavy fuel oil and hard coal are reported in category 1.A.2.g of the energy sector). During the review, the Party clarified that only CO_2 process-related emissions are sourced from the EU ETS, while energy-related emissions are based on fuel statistics. The ERT considers that the recommendation has not yet been addressed because a description of the pellet production process was not included in the NIR. (c) Addressing. The Party reported in its NIR (table 4.4.6, p.244) a list of all inputs and outputs (pellets), with their average, minimum and maximum carbon content. However, the Party did not explicitly explain in the NIR why the IEF (0.004 kt/kt) reported in CRF table 2(I).A-H (sheet 2) is lower than the default EF of 0.03 in the 2006 IPCC Guidelines (vol. 3, chap. 4, table 4.1, p.4.25). During the review, the Party explained that it suspects that the default EF in the 2006 IPCC Guidelines corresponds to total CO_2 emissions (i.e. both process- and energy-related CO_2 emissions) and if this EF is used it would lead to a large overestimation of the process-related emissions in category 2.C.1.e. The Party also provided data that demonstrate that the IEFs, when including both process- and energy-related emissions, are closer to the defaults in the 2006 IPCC Guidelines. The ERT considers that this recommendation has not yet been fully

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
			addressed, as Sweden did not include in the NIR information that explains the low value of the IEF reported in CRF table 2(I).A-H (sheet 2)
I.6	2.C.1 Iron and steel production – CO_2 (I.11, 2022) Transparency	Provide in the NIR information explaining that the high CO_2 IEF for 2019 (0.80 t/t) was due to the extensive use of carbon-rich residues (i.e. with a high carbon content) instead of the iron ore pellets used in pig iron production in 2018 and 2020 (IEFs of 0.53 and 0.60 t/t respectively).	Resolved. The Party reported in its NIR (section 4.4.1.1.2, p.237) that the significant increase in the IEF is explained by a disturbance in the production process at one of the facilities in 2019, which hindered the possibility of selling energy-rich process gases to external consumers and led to the gases being flared. Additionally, the Party explained that there was no process disturbance in 2020 to cause a low CO_2 IEF that year. The ERT considers that the recommendation has been fully addressed.
I.7	2.D.1 Lubricant use – CO_2 (I.12, 2022) Transparency	Provide in the NIR information on the causes of the declining trend in lubricant use in the country since 2013.	Not resolved. The Party reported in its NIR (section 4.5.1, p.264) that the amount of lubricant used has declined in recent years and that no specific explanation for the trend has been found. During the review, the Party explained that it had not yet found an explanation for the trend but that since AD for the last year of the time series (2021 in the 2023 inventory submission) are not available, the actual AD for 2021 will be used for the next inventory submission, and will show an increase to approximately the 2019 level, indicating a break in the decline. The ERT considers that the recommendation has not yet been addressed because the Party did not include a description in the NIR of the investigation to explain the decline.
I.8	2.G.2 SF_6 and PFCs from other product use – SF_6 and PFCs (I.13, 2022) Completeness	(a) Investigate the occurrence of SF_6 or PFC emissions from military applications (subcategory 2.G.2.a) and report its findings in the NIR, and estimate and report SF_6 and PFC emissions if applicable, for the entire time series; (b) Estimate and report SF_6 emissions from accelerators (subcategory 2.G.2.b) or, if it considers these emissions insignificant, demonstrate that the likely level of emissions is below the significance threshold established in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	(a) Addressing. The Party reported in its NIR (section 4.8.2.1, p.300) that it has no specific information on military applications or systems using SF_6 or heat transfer fluids in high-powered electronics applications using PFCs. During the review, the Party explained that it had searched for information by contacting the company that manufactures military aircraft in the country but had not received answers regarding the use of SF_6. The Party also looked for information on the Internet and in the environmental reports of aircraft manufacturers and manufacturers of associated equipment, but no data were found to be available. The ERT considers that the recommendation has not yet been fully addressed because the Party did not report the findings of its investigation in the NIR. (b) Addressing. The Party reported in its NIR (section 4.8.2.1, p.300) that it has no data on the total number and type of accelerators in the country. The Party also indicated in the NIR that emissions of SF_6 are very small (less than 1 kg per year for the biggest accelerator in the country). The ERT considers that the recommendation has not been fully addressed because the Party did not demonstrate in its NIR that the likely level of SF_6 emissions from all accelerators is below the significance threshold established in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines and below 500 kt CO_2 eq.

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
Agriculture			
A.1	3.A.1 Cattle – CH_4 (A.10, 2022) Transparency	(a) Correct the equation for GE in the NIR; (b) Provide information on gross energy in silage and concentrate respectively.	(a) Resolved. The Party corrected the equation for GE in the NIR (section 5.2.2.1.1, p.316). (b) Not resolved. The Party did not provide information on GE in silage and concentrate respectively in its NIR. During the review, the ERT observed that information on GE in silage and concentrate is available in Bertilsson (2016) but that this information was not included in the NIR.
A.2	3.A.1 Cattle – CH_4 (A.11, 2022) Transparency	Correct in the NIR (section 5.2.2.1.1) the description of the unit of Conc_F and Silage_F in the equation for fatty acid content in feed.	Resolved. The Party corrected the description of the unit of Conc_F and Silage_F in the equation for fatty acid content in feed in the NIR (section 5.2.2.1.1, p.315).
A.3	3.A.1 Cattle – CH_4 (A.12, 2022) Transparency	Report the population of heifers, bulls and steers by age used to derive the CH_4 EFs in order to improve the transparency of the calculations.	Addressing. During the review, the Party noted that a clarification on the assumptions of the population composition for heifers, bulls and steers was reported in the NIR (section 5.2.2.1.3, p.317). The Party reported in its NIR (p.317) that the assumed age composition for bulls and steers is 85 per cent between one and two years and 15 per cent above two years; for heifers, the corresponding figures are 70 and 30 per cent respectively. During the review, the Party also clarified how the proportion of calves raised for meat aged <3 months that are assumed not to be emitting enteric methane is calculated. The NIR (table 5.5, p.318) presents aggregate data on the population of calves, but not on the number of calves used to calculate enteric emissions. However, the ERT considers that this recommendation has not yet been fully addressed because the population of male and female calves used to calculate enteric emissions is not reported in the NIR and it is not possible to reconstruct the emissions reported in the CRF tables using the information provided in the NIR (in NIR tables 5.5 (population data) and 5.3 and 5.4 (EFs)). Table 5.5 does report populations of calves, heifers and steers but does not report the populations in different age classes in a way that enables the emissions to be accurately reconstructed.
A.4	3.B Manure management – N_2O (A.4, 2022) (A.9, 2020) Transparency	Explain that manure used in co-digestion is omitted from CRF table 3.B(b) and provide the fraction of manure co-digested for the aggregate categories of dairy cattle, non-dairy cattle and swine along with the disaggregated values currently provided in NIR table 5.14.	Resolved. The Party reported the fraction of manure co-digested for the aggregate categories of dairy cattle, non-dairy cattle and swine in its NIR (table 5.14, p.324). Sweden also explained in its NIR (p.322) that manure emissions from on-farm digesters are accounted for in the agriculture sector, while emissions from co-digesters are excluded from the agriculture sector and are therefore not reported in CRF table 3.B(b) but are accounted for in the waste sector instead. The ERT therefore considers this issue as resolved.
A.5	3.B.4 Other livestock – N_2O (A.6, 2022) (A.11, 2020) Transparency	Justify that the Nex rate applied for reindeer is appropriate to national circumstances compared with the default value and the higher value previously used in the NIR.	Resolved. The Party reported in its NIR (table 5.17, p.326) that a Nex value of 5.4 kg N/head/year was used and noted as a comment: "2019 refinement, typical animal mass 64 kg". The NIR (section 5.3.2, p.322) states that the Nex value for reindeer is calculated using the methodology and data from the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (chap. 10, table 19, equation

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			10.30) with the assumption (from the Sami parliament) that the slaughter weight represents half the live weight, hence the average reindeer weight was estimated to be 64 kg. During the review, the Party clarified that the figure of the typical animal mass of 64 kg was calculated using statistics on the distribution of the different types of reindeer in the herd, slaughter statistics provided by the Sami parliament (available at https://www.sametinget.se/statistik/renslakt/detaljer and https://www.sametinget.se/statistik/renhjorden) and the assumption confirmed by the Sami parliament that the slaughter weight represents half the live weight. The ERT considers that the recommendation has been addressed since the related information provided in the NIR reflects the national circumstances, as explained in the NIR.
A.6	3.D.a.2.c Other organic fertilizers applied to soils – N_2O (A.13, 2022) Convention reporting adherence	Report the N in other organic fertilizers applied to soils consistently between the NIR and CRF tables.	Resolved. The Party reported the N in other organic fertilizers applied to soils consistently between the NIR and CRF tables. For example, for 2020, the Party reported in its NIR (table 5.22, p.335) "Other organic fertilizers applied to soils (excluding digestate from animal manure)" as 6,974 t N and "Animal manure digestate from co-digester applied to soils" as 2,911 t N, which sum (accounting for rounding) to the 9,885,388 kg N reported in CRF table 3.D for category 3.D.a.2.c.
A.7	3.D.b Indirect N_2O emissions from managed soils – N_2O (A.14, 2022) Transparency	(a) Explain, in NIR sections 5.4.2.2.1 and 5.4.2.2.2, that the digestate from co-digesters is included in the calculation of indirect N_2O emissions for categories 3.D.b.1 and 3.D.b.2; (b) Correct the equation reported in the NIR for estimating N_2O emissions from atmospheric deposition to: $N_2O\text{-}N = [(F_{SN} \times Frac_{GASF}) + (F_{ON} \times Frac_{GASM}) + (F_{COD} \times Frac_{GASCOD}) + (F_{PRP} \times Frac_{GASG})] \times EF_4$.	(a) Addressing. The Party reported in its NIR (section 5.4.2.2.1, p.341) that "the annual amount of digestate from animal manure from co-digester applied to soil" is included in the calculation of volatilized N from agricultural inputs of N and included the amount of N in digestate from animal manure co-digesters as shown in NIR table 5.30 (p.343). However, no information on the inclusion or exclusion of digestate from co-digesters was included in the NIR (section 5.4.2.2.2, p.343) to address nitrogen leaching and run-off. During the review, the Party clarified that "nitrogen in digestate from animal manure in co-digester is included in the calculation of $Frac_{LEACH-(H)}$". The Party further stated that the text will be updated in the 2024 NIR. (b) Resolved. The Party corrected the equation reported in its NIR (p.341) for estimating N_2O emissions from atmospheric deposition.
A.8	3.G Liming – CO_2 (A.9, 2022) (A.15, 2020) Accuracy	Estimate CO_2 emissions from liming by applying the recommended method from figure 11.4 in the 2006 IPCC Guidelines (vol. 4). If the Party continues to use the tier 1 method, explain in the NIR why a recommended method from the 2006 IPCC Guidelines has not been followed as required by paragraph 11 of the UNFCCC Annex I inventory reporting guidelines.	Resolved. The Party reported in its NIR (pp.345–346) that it used the tier 1 method from the 2006 IPCC Guidelines together with default EFs to estimate emissions for this category and that emissions from liming are minor and do not justify the time and resources needed to estimate them using a tier 2 method with country-specific EFs. Furthermore, it was stated that a tier 2 method would calculate emissions that are likely to be less than emissions estimated using the tier 1 method (2006 IPCC Guidelines, vol. 4, chap. 11, section 11.3.1, p.11.27) and liming would then no longer be a key category. During the review, the Party clarified that since its emissions from liming are just above the threshold for being a key category, it has chosen to follow the text in the 2006 IPCC Guidelines, which states that actual CO_2 emissions from liming are expected to be less than the emissions estimated using the tier 1 approach (which assumes that all C in

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			applied lime is emitted as CO_2 in the year of application) because the amount of CO_2 emitted after liming depends on site-specific influences and the transportation of dissolved inorganic C through rivers and lakes to the ocean. The Party noted that the potential advantages of developing tier 2 EFs are too small to warrant a diversion of resources that could be better used elsewhere. The ERT considers that the recommendation has been addressed as required by paragraph 11 of the UNFCCC Annex I inventory reporting guidelines.
A.9	3.G Liming – CO_2 (A.15, 2022) Convention reporting adherence	Correct the equation for calculating CO_2 emissions from limestone and dolomite reported in the NIR by adding opening and closing brackets around the parameters for limestone and dolomite before multiplying them by the CO_2/C conversion factor.	Resolved. The Party reported in its NIR (section 5.4.3.2, p.346) the correct equation for calculating CO_2 emissions from limestone and dolomite.
LULUCF			
L.1	4. General (LULUCF) – CO_2 (L.1, 2022) (L.8, 2020) Accuracy	Justify the use of the country-specific EF of 0.12 CO_2-C/ha/year for DOC emissions from drained organic soils for forest land, cropland and grassland for the temperate region on the basis of national circumstances or, alternatively, apply the default EF for DOC from the Wetlands Supplement (table 2.2) for the temperate region while collecting new information.	Not resolved. The Party reported in its NIR (annex 3, pp.129–132) that country-specific EFs (t CO_2-C/ha/year) developed from a model (Wallin et al., 2021) were used for forest land and grassland to estimate off-site CO_2 emissions of DOC from drained organic soils in forest land (0.07 t CO_2-C/ha/year for boreal, 0.08 t CO_2-C/ha/year for temperate) and grassland (0.04 t CO_2-C/ha/year for boreal, 0.09 t CO_2-C/ha/year for temperate), while the IPCC default value of 0.12 t CO_2-C/ha/year for boreal from the Wetlands Supplement (table 2.2) was used for cropland and land-use conversions. The ERT noted that the Party did not modify the Wallin et al. (2021) model or provide adequate documentation in the NIR, nor did it justify in the NIR why the selected default EF for cropland for the boreal zone of 0.12 t CO_2-C/ha/year is representative when Sweden has both temperate and boreal climate zones. The ERT considers that the recommendation has not yet been resolved because the Party did not provide justification as to why the Wallin et al. (2021) model is representative of national circumstances for forest land and grassland or, alternatively, did not use the default EFs exclusively in accordance with the appropriate climate zone. During the review, the Party clarified that it plans to resolve the issue for the 2024 inventory submission by firstly revisiting the Wallin et al. (2021) study and justifying why the country-specific EFs are representative of forest land and grassland, and secondly by improving the justification for using default EFs for the boreal zone despite Sweden having both temperate and boreal climate zones. The Party also clarified that according to Lindgren and Lundblad (2014, p.34) the EF for boreal drained organic soils is more appropriate for Swedish conditions than the default for the temperate zone.
L.2	4. General (LULUCF) (L.2, 2022) (L.9, 2020)	Report comparable information on areas of land conversion across CRF table 4.1 and CRF tables 4.A–4.F. If there are remaining inconsistencies, provide a detailed	Addressing. The Party reported in its NIR (section 6.2.8, p.360) that land use in CRF table 4.1 is based on the extrapolation of complete NFI sampling plots from 1990–2017 and that there is no IPCC guidance on the extrapolation of these areas into annual values

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	Convention reporting adherence	explanation for the difference in the areas reported in CRF table 4.1 and background CRF tables 4.A–4.F.	for CRF tables 4.A–4. F. As a result, the Party reported in its NIR (p.488) that inconsistencies between CRF table 4.1 and CRF tables 4.A–4.F persist. The ERT noted the Party's explanation and the inconsistencies among CRF tables. For example, CRF table 4.D reported the area of forest land conversion to other wetlands in 2020 as 67.22 kha and in 2021 as 71.53 kha, but CRF table 4.1 reported annual land conversion from forest land to wetlands as "NO". During the review, the Party acknowledged the inconsistencies between CRF table 4.1 and CRF tables 4.A–4.F. However, the Party noted that the land areas reported in CRF tables 4.A–4.F describe areas converted to other uses for up to 20 years per land-use category, but the areas reported in CRF table 4.1 describe annual transferred areas between land-use categories. Thus, the areas reported in CRF tables 4.A–4.F (e.g. forest land converted to wetlands) are not the same as the areas reported in CRF table 4.1, but the total area is the same in all tables (in the previous example, the sum of wetlands remaining wetlands and all the conversions to wetlands from forest land, cropland, grazing land, settlements and other land). The Party acknowledged that the actual transfers to be reported in CRF table 4.1 for the last four years of the time series cannot be directly estimated from a multiannual periodic survey, but that it is aware of this issue and has tried to solve it by trial and error, and that it will explain this approach in its next inventory submission. The Party also noted that the IPCC recommends periodic surveys using a five-year inventory cycle but gives no guidance on how to report the land-use matrix. The Party also indicated that it will review the use of notation keys in CRF table 4.1 for its next inventory submission. The ERT notes the challenge faced by the Party to report the four most recent years of land conversions and suggests that the Party explore the use of alternative methods of extrapolation, such as the Food and Agriculture Organization of the United Nations' *Global Forest Resources Assessment 2020: Guidelines and Specifications* for the years in the time series for which complete NFI data are unavailable. During the review, the Party stated that it would explore different options for improving the reporting of the four most recent years of land conversions but that the use of the *Global Forest Resources Assessment 2020: Guidelines and Specifications* may not result in more accurate estimates. The ERT considers that the recommendation has not yet been addressed because the Party did not provide consistent information on land conversions across CRF table 4.1 and CRF tables 4.A–4.F or provide in its NIR a detailed explanation of the difference in land areas reported in CRF table 4.1 and CRF tables 4.A–4.F.
L.3	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.19, 2022) Transparency	Improve the transparency of estimators used for upscaling plot data on page 120 of annex 3 to the NIR.	Not resolved. The Party did not improve the transparency of the estimators used for upscaling plot data in its NIR (annex 3, pp.113–114). The Party indicated in its NIR (p.558) that the recommendation from the previous review was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory.

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			During the review, the Party clarified that the first estimator (area weight) weights the sample in the design-based approach, explaining what area each sample unit represents. The ratio estimator, however, is used to upscale plot data to estimate either CSCs or land-use change area. The ERT considers that the recommendation has not yet been addressed because the Party did not improve the transparency of the estimators used for upscaling plot data, for example by incorporating in the NIR the clarifications that the Party provided during the review.
L.4	4. General (LULUCF) – CO_2 (L.20, 2022) Accuracy	Explain in the NIR for forest land and grassland why double counting of emissions or removals from mineral soils between land conversion categories and land remaining land categories is negligible despite the combination of tier 1 or tier 2 methods for land conversion categories and tier 3 methods for land remaining land categories or revise the estimates in order to avoid double counting of emissions or removals between the "land converted to" categories in the early years of the reporting period and the "land remaining land" categories in the later years of the reporting period.	Not resolved. The Party did not report in its NIR why double counting of emissions or removals from mineral soils is negligible despite the combination of tier 1 or tier 2 methods. The Party reported in its NIR (annex 3, section 3.2.1.10, pp.137–140) that country-specific EFs and removal factors were used for calculating the SOC stock change in mineral soils associated with land-use changes. The ERT noted that the Party is using a tier 2 method where for most conversions the factors were based on average SOC stocks in forest land (45 t C/ha), forest on former agricultural soils (87 t C/ha), cropland (100 t C/ha) and grassland (110 t C/ha), with transition periods or assumptions of SOC gains or losses for certain land uses (e.g. forest land converted to cropland increases by 20 per cent over 20 years). However, for conversions from cropland to grassland, and from settlements or other land to either cropland or grassland, the factors were based on the tier 3 estimated average net emissions or removals for 1990–2021 for cropland remaining cropland (for settlement or other land converted to cropland and cropland converted to grassland) and for grassland remaining grassland (for settlement or other land converted to grassland). The ERT noted that no explanation was provided and that estimates were not revised because the potential double counting appears to be negligible. During the review, the Party clarified that it is planning to address the issue in the 2024 inventory submission by improving the explanation of the method but will not revise the methodology. In addition, the Party clarified that NFI plots for land remaining land and converted land are considered separately and a land conversion effect in the soil C stock 21 years after the land-use change is covered in the measurement of the plots of the land remaining land and is reflected in the estimation of CSC for the land remaining land. The ERT agrees with this rationale. However, the ERT considers that the recommendation has not yet been addressed because the Party did not provide in the NIR information explaining why double counting of CSC from mineral soils in the land remaining land and land converted to other land-use categories is negligible, nor has the Party revised the estimates in order to avoid the potential double counting.
L.5	Land representation – CO_2, CH_4 and N_2O (L.21, 2022) Transparency	Better describe the assumptions used for land-use changes between 1970 and 1990 in the NIR, for example by providing one representative land-transition matrix for that period.	Not resolved. The Party did not provide a better description of the assumptions used for land-use changes between 1970 and 1990 in its NIR. The Party reported in its NIR (p.551) that the recommendation from the previous review report was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory.

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			During the review, the Party clarified that it plans to describe the assumptions used for land-use changes between 1970 and 1990 transparently in the 2024 inventory submission.
L.6	4.A Forest land – CO_2 (L.22, 2022) Transparency	(a) Better explain why the Party reports small trees <100 mm in DBH as constant net removals in the NIR (the ERT notes that, according to the good practice guidance in the 2006 IPCC Guidelines (vol. 4, chap.4, p.4.72), Parties can choose to report the removals associated with small trees (understory) as zero);	(a) Not resolved. The Party did not explain the rationale behind the assumption of constant carbon net removals from small trees (i.e. trees <100 mm in DBH) for every reported year. The Party also indicated in its NIR (p.556) that the recommendation from the previous review report was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory. During the review, the Party clarified that CSCs in small trees are estimated using regression. The Party also noted that it is planning to improve the transparency of the reporting.
		(b) Explain how the Party avoids double counting when small trees reach 100 mm DBH.	(b) Not resolved. The Party did not explain in its NIR how the double counting of net removals from small trees is avoided when they reach 100 mm DBH. The Party also indicated in its NIR (p.556) that the recommendation from the previous review report was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory. During the review, the Party clarified that sample trees are measured individually and included in the estimation of living biomass only after they reach 100 mm. The ERT notes that the potential concern of double counting net removals in the estimation is not resolved by the fact that small trees are excluded from the accounting procedure, as explained by the Party during the review. The ERT considers that the recommendation has not yet been addressed because the Party did not provide in its NIR additional information on the assumption that the annual net removals from small trees remain constant over the entire time series, regardless of the age structure and management practice.
L.7	4.A Forest land – CO_2 (L.23, 2022) Accuracy	(a) Provide in the NIR the time series for each deadwood and litter subcomponent separately so that the model estimates can be transparently distinguished from the measurements;	(a) Not resolved. The Party did not include the time series for the different deadwood and litter subcomponents in its NIR. The Party indicated in its NIR (pp.554–555) that the recommendation from the previous review report was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory. During the review, the Party clarified that the time series for the different deadwood and litter subcomponents will be included in the 2024 inventory submission.
		(b) Reconsider its litterfall models, either verifying them against independent measurements or reverting to a simpler tier 1 or tier 2 approach (the ERT notes that litterfall estimates are likely to result in minor CSCs and that a higher-tier approach is therefore probably not mandatory because the contribution in emissions and removals could be considered not substantial).	(b) Not resolved. The Party did not provide additional information in its NIR on the reconsideration of the models applied to estimate litterfall, either by verifying them against independent measurements or by reverting to a simpler tier 1 or tier 2 approach. The ERT noted that the Party reported in its NIR (pp.375–376 and annex 3, pp.121–122) the same information as in its 2022 NIR. The Party also indicated in its NIR (pp.554–555) that the recommendation from the previous review report was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory. During the review, the Party clarified that

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			a review of the regression models used for the annual litter fall component is under way, together with a consultation on their validity from a statistical point of view.
L.8	4.A.1 Forest land remaining forest land – CO_2 (L.24, 2022) Transparency	Categorize the Party's method for estimating deadwood and coarse litter in land conversions as tier 3 and describe how the estimates at the category level are distributed to subcategories and the exceptions (for stumps and litter) to this general rule.	Not resolved. The Party did not provide information in its NIR to address the recommendation from the previous review report. The Party reported in its NIR (pp.349–350) the method for estimating deadwood and coarse litter in land conversions as tier 2, which is the same as reported in the 2022 NIR (p.360). The Party indicated in its 2023 NIR (p.544) that the recommendation was addressed in annex 3.2 to the NIR (pp.118–121). However, no additional information was provided on how the estimates at the category level are distributed to categories and the exceptions (for stumps and litter) in relation to the IPCC land-use categories (forest land and cropland). During the review, the Party clarified that it is working on this issue and it will evaluate the tier levels and the estimation methods to resolve this issue for the 2024 inventory submission.
L.9	4.A.1 Forest land remaining forest land – CO_2 (L.25, 2022) Transparency	Improve the documentation of the Party's interpolation and extrapolation procedure of CSCs in the NIR.	Resolved. The Party explained that the estimation of CSCs in living biomass for the last four years of the time series was made using trend extrapolation for the 36 land-use categories, including forest land remaining forest land (NIR, p.375, and annex 3, pp.114–115). Moreover, the Party provided additional information on the interpolation of the plot data between consecutive inventories (NIR, p.366, and annex 3, p.116). The ERT considers that the recommendation has been fully addressed.
L.10	4.A.1 Forest land remaining forest land – CO_2 (L.26, 2022) Accuracy	(a) Examine the reason for the systematic overestimation of "projected" net removals (reported values for years y–4 to y) compared with "actual" net removals when the NFI is complete; (b) Investigate whether the extrapolation of not yet remeasured plots can be improved; (c) Report the findings in the NIR.	(a) Not resolved. The Party did not report in its NIR information regarding the reason for the systematic overestimation of "projected" net removals compared with "actual" net removals when the NFI is complete. The Party indicated in its NIR (p.550) that the recommendation from the previous review report was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory. During the review, the Party clarified that it plans to improve its reporting so that extrapolated data will better match the final measured data. The Party noted that the projected (trend extrapolated) method suggested in the 2006 IPCC Guidelines may produce either overestimates or underestimates if the real trend changes. (b, c) Not resolved. The Party did not report in its NIR whether the extrapolation of plots that had yet to be remeasured can be improved. The Party indicated in its NIR (p.550) that the recommendation from the previous review report was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory. During the review, the Party clarified that it is looking into potential ways to improve the accuracy of its reporting by either visiting all 30,000 sample plots in key years (e.g. 2025), which would result in a significant additional cost, or by simulating growth for the 24,000 sample plots remeasured between years one and four with the help of the Heureka simulation model. The Party is planning a pilot study to address this issue. As for (a) above, the Party

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			noted that the projected (trend extrapolated) method suggested in the 2006 IPCC Guidelines may produce either overestimates or underestimates if the real trend changes.
L.11	4.A.1 Forest land remaining forest land – CO_2 (L.27, 2022) Transparency	(a) Report harvest statistics in the NIR, for example using the same figure as NIR figure 2.38 (displaying total emissions/removals for, inter alia, living biomass); (b) Validate reported numbers of changes in living biomass by, for example, using the default biomass gain–loss method from the 2006 IPCC Guidelines (vol. 4, chap. 4.2.1.1).	(a) Not resolved. The Party did not report in its NIR any harvest statistics. The Party reported in its NIR (pp.552–553) that the recommendation from the previous review report was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory. The ERT noted that the Party included a link to the national harvest statistics in its NIR (footnote 284, p.351). However, the information could not be retrieved from that link, but was found at another one (https://www.skogsstyrelsen.se/statistik/statistik-efter-amne/avverkning/). This information shows an increasing trend in felling, consistent with the FAOSTAT data. The ERT considers that the recommendation has not yet been addressed because the Party did not include harvest statistics in its NIR in accordance, for example, with NIR figure 2.38 (p.95). (b) Not resolved. The Party did not report in its NIR the validation results for the reported CSC values in living biomass. The Party indicated in its NIR (pp.552–553) that the recommendation from the previous review report was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory. During the review, the Party clarified that it plans to validate the reporting of CSC values in living biomass using the default biomass gain–loss method in the 2006 IPCC Guidelines. The Party noted that a comparison should also include growth estimated as a running average.
L.12	4.A.1 Forest land remaining forest land – CO_2 (L.28, 2022) Transparency	(a) Clarify in the NIR that the NFI cycle is five years for living biomass but 10 years for the other pools; (b) Clarify the reason for the recalculations for deadwood and litter in forest land performed between the 2020 and 2022 annual submissions in its NIR; (c) Demonstrate that recategorized land-use changes are the reason for the recalculations in grassland, e.g. by reporting the share of "requalified" grassland plots between two annual submissions when substantial recalculations are performed for years of the time series that are more than 12 years before the respective submission year.	(a) Resolved. The Party explained in its NIR (p.362) that the data reported in the inventory for the living biomass and deadwood pools are based on the NFI cycle (five years), but that the data for the litter and SOC pools are based on the Swedish Forest Soil Inventory cycle (10 years). (b) Resolved. The Party explained in its NIR (p.388) that recalculations for deadwood and litter in forest land performed over the entire time series were due to the incorporation of information from reinventoried sample plots from the Swedish Forest Soil Inventory. (c) Not resolved. The Party did not report in its NIR additional information to explain the substantial recalculations in the grassland category or to demonstrate that recategorized land-use changes are the reason for the recalculations in this category. The Party indicated in its NIR (pp.553–554) that the recommendation from the previous review report was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory. During the review, the Party reiterated that the issues could not be addressed for the 2023 inventory submission.

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
L.13	4.A.2 Land converted to forest land (L.8, 2022) (L.12, 2020) Transparency	When reporting in the NIR on CSC due to the conversion of wetlands and other land to forest land, distinguish between conversion due to natural causes and conversion due to human activities, and include the information provided during the review.	Not resolved. The ERT noted that the Party reported CSCs resulting from the conversion of wetlands and other land to forest land. The Party used NFI sampling data for land representation and explained in its NIR (pp.367–368) that only land conversion due to human activities is identified as land converted to new land use in the GHG inventory. The ERT considers that the recommendation has not yet been fully addressed because the Party did not provide information in the NIR on CSC due to the conversion of wetlands and other land to forest land, nor did it distinguish between conversion due to natural causes and conversion due to human activities. During the review, the Party clarified that it is working on the issue and is planning to resolve it for the 2024 inventory submission.
L.14	4.A.2 Cropland converted to forest land – CO_2 (L.29, 2022) Accuracy	Either reconsider the EFs used for litter and soils on cropland converted to forest land and cropland converted to grassland or transparently document a plausible reason for the deviation from the default values in the 2006 IPCC Guidelines.	Not resolved. The Party reported in its NIR (annex 3, table A3:2.13, p.140) that the CSC factors for cropland converted to forest land are –0.26 t C/ha/year (mineral soils) and 0.3 t C/ha/year (litter), which are the same values as reported in its 2022 annual submission. For cropland converted to grassland, the Party updated the CSC factor to 0.053 t C/ha/year for mineral soils, with a reference indicating that this corresponds to the estimated average net emissions from mineral soils on cropland remaining cropland for 1990–2021. The ERT did not identify new information in the NIR providing transparent documentation of a plausible reason for the deviation compared with the CSC factors resulting from the default carbon reference stocks and/or soil stock change factors in the 2006 IPCC Guidelines. During the review, the Party confirmed that it is working on the issue and plans to resolve it in the 2024 inventory submission by adding more information in the NIR. The ERT considers that the recommendation has not yet been addressed because the Party did not reconsider the EFs used for litter and soils on cropland converted to forest land and cropland converted to grassland or provide in a transparent manner the necessary documentation (e.g. extracted summarized results from scientific papers) in the NIR that justifies the EFs used for litter and mineral soils on cropland converted to forest land and cropland converted to grassland.
L.15	4.B.1 Cropland remaining cropland – CO_2 (L.30, 2022) Transparency	Demonstrate in the NIR that the ICBM model has been verified against independent measurements of CSCs in cropland over a sufficient number of sites and is representative of the heterogeneity in soils, climatic conditions and cropping practices in the Party (the ERT notes that one of several options that could consider to address this recommendation is including in the NIR several graphs (e.g. measured versus simulated CSCs) or figures containing numerical data in order to support this verification).	Addressing. The Party reported in its NIR (annex 3, p.130) that the new ICBM version and parameter values used were derived using more than two decades of new data from the original calibration site, and that the new version considers more accurately the higher humification rate (2.6 times) of below-ground crop residues than above-ground crop residues, which is also in accordance with the results of Swedish long-term field experiments. Furthermore, the Party also noted that two adjustments had been made in the AD, as well as in the implementation of new allometric functions for leys, and in improvements in the time series of manure input to the model. The ERT welcomes the above-mentioned improvements but notes that documentation verifying the current version of the ICBM and its ability to represent the heterogeneity in soils, climatic conditions and cropping practices in the Party is still missing from the NIR. During the review, the Party clarified that it is working on the issue and plans to resolve it in the 2024 inventory submission by adding more information in the NIR. The ERT

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
			considers that the recommendation has not yet been fully addressed because the Party did not provide explicit information on how the ICBM has been verified against independent measurements of CSCs in cropland and whether it is representative of the heterogeneity in soils, climatic conditions and cropping practices in the Party, which may be illustrated by including in the NIR graphics of representative areas with measured versus simulated CSC together, or as a minimum including numerical data that supports the verification of the ICBM.
L.16	4.B.2 Grassland converted to cropland – CO_2 (L.31, 2022) Accuracy	Justify how differences in national averages for different land categories to estimate the soil CSCs in land conversions compares plots with similar characteristics as recommended by the 2006 IPCC Guidelines (vol. 4, chap. 2, p.2.38), or update CSCs for land conversions, in particular if any substantial differences compared with the default EFs (e.g. land-use factor parameters; vol. 4, chap. 5, p.5.17) cannot be adequately justified.	Not resolved. The Party reported in its NIR (annex 3, table A3:2.13, p.140) the CSC factors used to calculate changes in carbon pools on land in conversion. CSCs in mineral soils on grassland converted to cropland are estimated by using a CSC factor of –0.5 t C/ha/year based on country-specific soil carbon reference stocks of 110 t/C/ha for grassland and 100 t/C/ha for cropland and a default transition period of 20 years. The soil carbon reference stocks are based on national averages of measured soil carbon stock from the NFI and the Swedish National Soil Inventory for cropland and grassland. In the previous review, the ERT questioned whether the national averages are truly representative of the areas undergoing conversion between cropland and grassland and noted that the 2006 IPCC Guidelines (vol. 4, chap. 2, p.2.38) recommend comparing plots with similar characteristics, such as histories and management, as well as similar topographic position, soil physical properties and geographical proximity, when deriving soil carbon stocks. The previous ERT therefore recommended the Party either to justify the use of the CSC factors or to update the factors used for these conversions. During the review, the Party clarified that it is working on addressing these issues and plans to resolve them in the 2024 inventory submission by adding more information in the NIR that justifies the country-specific CSC factors. The ERT considers that the recommendation has not yet been addressed because the Party did not provide any further information in the NIR that substantiates the use of national averages of soil carbon reference stocks for different land categories based on comparison of plots with similar characteristics as recommended by the 2006 IPCC Guidelines, nor has the Party updated the CSC factors for land conversions used in the estimates.
L.17	4.C.2 Cropland converted to grassland – CO_2 (L.32, 2022) Accuracy	Reconsider the EF used for CSCs in mineral soils in cropland converted to grassland and revise the information in the NIR that the EF used to estimate CSCs in mineral soils in cropland converted to grassland is the same as the EF for cropland remaining cropland or transparently justify in its NIR why the EF for cropland remaining cropland is appropriate.	Not resolved. The Party reported in its NIR (annex 3, table A3:2.13, p.140) the CSC factor (0.053 t/C/ha) used to calculate CSCs in mineral soils in cropland converted to grassland, which is based on the national average CSC factor for mineral soils in cropland remaining cropland estimated by the ICBM model for 1990–2021. During the review, the Party clarified that, in accordance with the extensive study published in Karltun et al. (2015) (which was mistakenly referred to as Karltun et al. (2017) in the NIR), very small changes can be expected in the soil carbon stocks on these land-use conversions (i.e. cropland to grassland), and that the Party therefore considers the CSC factors representative and credible. The ERT considers that the recommendation has not yet been addressed because the Party neither provided adequate information in the NIR that justifies using the same EF for estimating CSCs in mineral

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
			soils in cropland converted to grassland as the average CSC factor for mineral soils in cropland remaining cropland nor revised the methodology used.
L.18	4.E.2 Land converted to settlements – CO_2 (L.33, 2022) Transparency	(a) Explain in the NIR that the percentage losses for SOC on cropland or grassland converted to settlements reported in the NIR (annex 3, p.143) were not related to an intrinsic feature of the initial land use, but rather that had been able to quantify the share of the converted area that had severely been disturbed (e.g. with roads and car parks representing severe disturbances, and gardens representing minor disturbances) on the basis of satellite images; (b) Provide information on the share of the area that has been severely disturbed for each subcategory under land converted to settlements.	(a) Not resolved. The Party reported in its NIR (annex 3, p.139) that, based on the study published in Karltun et al. (2015), 30 and 90 per cent of carbon stock is assumed to be lost over a 20-year transition period when cropland or grassland is converted to settlements respectively. These numbers were reported as the land area affected by the land-use change; however, the Party did not note that the above-mentioned percentage losses were the share of the converted land area that had been severely disturbed, based on satellite images. Furthermore, the Party reported in its NIR (pp.548–549) that the issue was not considered in the 2023 inventory submission. The ERT considers that it is not clear why the percentage of the share of the converted land was used as the percentage of the loss of carbon stock. The ERT notes that Karltun et al. (2015) contains an analysis of how much carbon loss occurs for the different types of conversion to settlements. The ERT considers that information about the share of converted land that has been severely disturbed; the ratio of carbon loss in each land conversion to certain subcategories of settlements that have been severely disturbed, such as roads, power lines and actual settlements; and the share of land converted to certain subcategories of settlements that have been severely disturbed is missing from the NIR. During the review, the Party clarified that it is working on these issues and is planning to resolve them by improving transparency in the 2024 inventory submission. (b) Addressing. The Party reported in its NIR (annex 3, p.139) that Karltun et al. (2015) was the basis of the applied methodology. It also reported that 30 and 90 per cent of carbon stock is assumed to be lost over a 20-year transition period when cropland or grassland is converted to settlements respectively. However, Karltun et al. (2015) provides no information on the percentage of cropland and grassland converted to settlements that results in carbon stock loss nor on what percentage of carbon stock is lost upon conversion. The ERT noted that Karltun et al. (2015) only provides a ratio of forest land converted into different categories of settlements (roads (45 per cent), power lines (14 per cent) and actual settlements (41 per cent)), with varying percentages given for loss of litter and carbon stock on forest land converted to different categories of settlements. The ratio of settlement types for cropland or grassland converted to settlements is not provided in Karltun et al. (2015). During the review, the Party clarified that it is working on these issues and is planning to resolve them in its 2024 inventory submission. The ERT considers that the recommendation has not yet been addressed because the Party did not report in the NIR information on the share of the area that has been severely disturbed for cropland or grassland converted to settlements.
L.19	4.F.2 Land converted to other land – CO_2 (L.34, 2022) Transparency	(a) Document in the NIR the method used to derive the EFs for the subcategories under land converted to other land;	(a) Not resolved. The Party provided the CSC factors used to calculate changes in the SOC of mineral soils associated with land converted to other land from forest land, grassland, wetlands and settlements in its NIR (annex 3, table A3:2.13, p.140). However, the Party did not provide information on the methods used to derive these factors in the relevant section of its NIR (annex 3, section 3.2.1.10, pp.137–140). During

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
		(b) In particular, because under "other land" as defined by the Party, subcategories with heterogeneous carbon stocks (e.g. "high mountains with grass", "bare rock", "ice" and "quarries") are aggregated, document the different types of conversions from "other land" to other land-use categories and how the EFs accurately reflect those conversions.	the review, the Party clarified the above-mentioned CSC factors for mineral soils as follows: the –0.04 t C/ha/year EF for forest land converted to other land is based on the assumption that the initial carbon stock of forest land is 45 t C/ha, that 3 per cent of the plots that experience a land-use change experienced SOC loss associated with land-use change and that the affected plots lose SOC at the same level as the average for forest land converted to settlements. The 0.21 t C/ha/year EF for grassland converted to other land is assumed to be the same as the EF for grassland remaining grassland; the footnote in NIR table A3:2.13 is incorrect. The use of 0 for EFs for wetlands and settlements converted to other land is on the basis of the assumption in Karltun et al. (2015) that the soil for these conversions is unchanged. The ERT considers that the inclusion of the above-mentioned information in its NIR would resolve this issue. (b) Not resolved. The Party did not report in its NIR information on how the different types of "other land" were considered when estimating the CSC factors for mineral soils for land conversions from "other land" to other land-use categories. During the review, the Party clarified that some land conversions, such as conversions between forest land and the other land subcategory "high mountains with grass", do not cause significant change in the SOC.
L.20	4.G.2 Paper and paperboard – CO_2 (L.35, 2022) Comparability	Investigate the possibilities for adjusting the two-year IPCC default half-life for paper instead of including recycling in the inflow (the ERT notes that the effect on the net estimate is, however, likely to be minor).	Not resolved. The Party reported in its NIR (p.378) that the inflow of carbon to the paper products pool includes paper from recovered paper and that the default half-life of two years is used. The Party also indicated in its NIR (p.558) that the recommendation from the previous review report was not considered as it had not received the final annual review report for the 2022 annual submission at the time of the preparation of the GHG inventory. During the review, the Party informed the ERT that it acknowledged this matter and it plans to resolve the issue in the 2024 inventory submission.
Waste			
W.1	5.B Biological treatment of solid waste – CH_4 and N_2O (W.11, 2022) Transparency	(a) Include in the NIR information on the value of moisture content (65 per cent); (b) Correct NIR table 7.21 so that the values reported and amounts indicated in the column headings are in the same units (kt or t).	(a) Resolved. The Party updated the information on the moisture content in the NIR (section 7.3.1.2.3, p.419), which was defined to be 65 per cent. The ERT commends the Party for its effort to increase the transparency of the NIR. (b) Resolved. The Party revised its NIR table 7.21 (p.419) and included the same units (t) in the column headings for the values reported.
W.2	5.D Wastewater treatment and discharge – N_2O (W.4, 2022) (W.3, 2020) (W.4, 2019) Transparency	Describe more transparently in the NIR the methodologies used for the estimation of N_2O emissions from wastewater, along with the AD and EFs used. Specifically, explain that direct emissions are estimated on the basis of available statistics on N in the influent of large wastewater treatment plants	Resolved. The Party included information on the available data on the measured amount of N in the influent to large wastewater treatment plants in the NIR (section 7.5.1.2.6, p.432), which includes referenced N influent and discharge of N from large wastewater treatment plants. In the NIR (section 7.5.1.2.5, p.432), the Party included information on a country-specific EF of 0.0074 kg N_2O-N/kg N in the influent, which was based on studies from six wastewater treatment plants. The Party described how these statistics were used to estimate the N influent to small wastewater treatment plants in the NIR (p.433). The ERT considers that the recommendation has been fully addressed.

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
		and a country-specific EF of 0.0074 kg N_2O-N/kg N in the influent.	
W.3	5.D.1 Domestic wastewater – CH_4 (W.6, 2022) (W.5, 2020) (W.5 2019) Transparency	Explain that CH_4 generation from anaerobic digestion of sludge treatment is estimated on the basis of total organics in wastewater removed, the amount of sludge generated and the CH_4 potential of the sludge, and that 4 per cent of CH_4 generation is assumed to be emitted.	Resolved. The 2023 NIR includes a description stating that CH_4 from anaerobic digestion is calculated on the basis of the rate of BOD removed as sludge and that 62 per cent of the five-day BOD is removed as sludge in larger facilities and 50 per cent is removed as sludge in on-site treatment facilities (section 7.5.1.2.1, p.429). The NIR also reports that the emissions are estimated to be between 4 and 7 per cent of the CH_4 generated from sludge treatment. The ERT considers that the recommendation from the previous ERT has been addressed.
W.4	5.D.1 Domestic wastewater – CH_4 (W.12, 2022) Transparency	(a) Include the parameters used for estimating BOD in the NIR, especially the values for per capita BOD and additional industrial load, and provide justification in cases where those values differ from the default values in the 2006 IPCC Guidelines; (b) Justify the use of different EFs for industrial load for organic matter and N.	(a) Not resolved. The NIR does not include the parameters used for estimating BOD in wastewater. During the review, the Party provided an internal document (*Comments on Table 4D1 Domestic Wastewater Treatment and Discharge (methane).docx*) that details the parameters and calculations used for domestic wastewater treatment. The document states that 70 g BOD/person/day was used in 1990 and that 60 g BOD/person/day was used in all subsequent years. The document further states that 15 per cent of the wastewater in [centralized] municipal wastewater treatment plants was added by industry. The document also describes the rationale behind the above-mentioned estimates that 62 per cent and 50 per cent of BOD is removed as sludge. The Party explained that it will make efforts to improve the transparency of the information in its 2024 inventory submission. (b) Addressing. The previous ERT identified that the parameters (EFs) for the industrial load to domestic wastewater (I), for organic matter (BOD) and for $F_{IND-COM}$ (2006 IPCC Guidelines, vol. 5, chap. 6, equations 6.3 and 6.8) had different values in the 2022 NIR (1.15 and 1.25). In the 2006 IPCC Guidelines, the default value for both I and $F_{IND-COM}$ is 1.25. The current ERT identified that, in the 2023 NIR (p.433), the Party stated that the parameter for the industrial load of N to domestic wastewater is the equivalent of $F_{IND-COM}$, and that this factor has a default value of 1.25 (which matches the default value for $F_{IND-COM}$ in the 2006 IPCC Guidelines (vol. 5, chap. 6, p.6.25)). The 2023 NIR does not include the parameter I for industrial inputs of BOD to domestic wastewater or a justification for the value used. During the review, the Party provided an internal document (*Comments on Table 4D1 Domestic Wastewater Treatment and Discharge (methane).docx*) that includes the parameter I for additional industrial organic (BOD) inputs, which in that document is estimated to be 15 per cent (or 1.15). This value differs from the default value of 25 per cent (1.25) found in the 2006 IPCC Guidelines (vol. 5, chap. 6, p.6.14). No details or justification for the value of the parameter were provided in the NIR or in the document shared during the review. The ERT notes that this parameter is still different from the EF $F_{IND-COM}$ for industrial inputs of N in the 2023 NIR. The Party recognized the need for further investigation of the

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
			parameters for the additional industrial load. The Party explained that it will make efforts to improve the transparency of the information in its 2024 inventory submission.
W.5	5.D.1 Domestic wastewater – CH_4 (W.13, 2022) Accuracy	Revise the country-specific B_o value using either a new country-specific value that corresponds to the observed CH_4 generation or the IPCC default value and recalculate its emission estimates accordingly.	Not resolved. The Party did not revise the country-specific B_o value by using a new country-specific value or by using the IPCC default value. During the review, the Party provided an internal document (*Comments on Table 4D1 Domestic Wastewater Treatment and Discharge (methane).docx*) that summarizes in detail the methods employed for calculating CH_4 emissions from domestic wastewater. The document, however, does not include further elaboration on how the national parameter for B_o was obtained. The internal document includes a statement, as does the NIR, that the B_o in the 2006 IPCC Guidelines is incorrect and that "theoretically; 1 kg BOD (or degradable COD) gives 0.35 m^3 CH_4. Based on the specific weight of CH_4 this gives 0.25 kg CH_4/ kg BOD". However, the document provided does not include a reference citation or a rationale for this theoretical value. During the review, the Party noted that it is investigating its country-specific value of B_o. The ERT notes that the unit values used in the NIR and in the provided document (0.35 m^3/kg BOD) differ from the units presented in other published values, such as 0.35 kg CH_4/kg five-day BOD (Lexmond and Zeeman, 1995) or 0.25 kg CH_4/kg COD (Doorn et al., 1997).

[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] Reports on the reviews of the 2018 and 2021 annual submissions of Sweden were not available at the time of this review. Therefore, 2018 and 2021 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 Sweden, 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 Sweden

ID#	*Previous recommendation for issue*	*Number of successive reviews issue not addressed*[a]
General		
G.2	Complete the empty cells of CRF table 6 by including either the indirect CO_2 and N_2O emissions or the correct notation keys in accordance with paragraph 37 of the UNFCCC Annex I inventory reporting guidelines.	3 (2020–2023)
Energy	No issues identified.	

ID#	*Previous recommendation for issue*	*Number of successive reviews issue not addressed*[a]
IPPU		
I.4	Report on any recalculations to emissions and AD across the time series for sources in the energy and IPPU sectors affected by the integrated steelworks (i.e. subcategories 1.A.1.a, 1.A.1.c, 1.A.2.a, 1.B.1.c and 2.C.1.b) (as a result of harmonization of the data).	5 (2017–2023)
Agriculture	No issues identified.	
LULUCF		
L.1	Justify the use of the country-specific EF of 0.12 CO_2-C/ha/year for DOC emissions from drained organic soils for forest land, cropland and grassland for the temperate region on the basis of national circumstances or, alternatively, apply the default EF for DOC from the Wetlands Supplement (table 2.2) for the temperate region while collecting new information.	3 (2020–2023)
L.2	Report comparable information on areas of land conversion across CRF table 4.1 and CRF tables 4.A–4.F. If there are remaining inconsistencies, provide a detailed explanation for the difference in the areas reported in CRF table 4.1 and background CRF tables 4.A–4.F.	3 (2020–2023)
L.13	When reporting in the NIR on CSC due to the conversion of wetlands and other land to forest land, distinguish between conversion due to natural causes and conversion due to human activities, and include the information provided during the review.	3 (2020–2023)
Waste	No issues identified.	

[a] Reports on the reviews of the 2018 and 2021 annual submissions of Sweden have not yet been published. Therefore, 2018 and 2021 were not included when counting the number of successive years for this table. In addition, as the reviews of the Party's 2015 and 2016 annual submissions were conducted together, they are not considered successive reviews and 2015/2016 is counted as one year.

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 Sweden that are additional to those identified in table 3.

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

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
General			
G.3	Inventory management	The ERT noted that during the review Sweden took a while to respond to some questions raised by the ERT. The ERT considered that this could be in part due to the Party not having multiple accounts with access to the online system for questions and answers. During the review, Sweden explained that it has implemented an	Not an issue/problem

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		internal quality check process in which answers to questions from the ERT are initially compiled by national experts within SMED and these responses then undergo internal review by the Swedish Environmental Protection Agency. The Party suggested that its arrangements for responding to questions from the ERT may result in a slightly longer response time, but it believes that these arrangements are an important step for ensuring accurate responses. Given that multiple experts from different agencies are involved in the process of preparing draft answers and their review, the Party considers that setting up numerous accounts in the virtual team room could pose logistical challenges. The Party suggested that it will explore ways to enhance the efficiency of its internal quality checks in order to improve the response times during the review and noted that some questions arrived later than expected before the start of the review week. The ERT encourages Sweden to enhance the speed at which it responds to questions from the ERT during the review week.	
G.4	QA/QC and verification	The Party reported in its NIR (section 1.3.1, p.39) that it is the responsibility of SMED to maintain and develop an internal quality system, as described in the framework contract between the Swedish Environmental Protection Agency and the experts doing the work. The SMED quality system is described in a detailed manual. The manual is updated annually and lists all QC steps that must be undertaken during inventory work (for tier 1 and, where appropriate, tier 2 methodologies). It also includes descriptions of roles and responsibilities, databases and models, work manuals for each CRF category and documented procedures for uncertainty and key source analyses, and procedures for handling and responding to the UNFCCC review of the Swedish inventory. During the review, Sweden clarified that tier 2 methodologies and source-specific QA procedures for tier 3 methodologies are described in the QC checklists (appendix 5 to the manual) and in the work documentation (appendix 4 to the manual). The ERT encourages Sweden to make clear reference to the tier 3 QA/QC procedures provided in the manual for each sector where appropriate in its NIR.	Not an issue/problem
Energy			
E.4	International navigation – residual fuel oil and gas/diesel oil – fuel consumption	The ERT noted that the reported residual fuel oil consumption of marine bunkers is different in CRF table 1.D.2 (sectoral approach) and CRF table 1.A(b) (reference approach) for 1990–2018. For example, residual fuel oil consumption for 2005 and 2018 is 78,032 TJ and 55,044 TJ in CRF table 1.A(b) but 78,530 TJ and 54,604 TJ in CRF table 1.D.2. During the review, the Party explained that after the methodological change in 2018, the data suppliers of the Swedish energy balance (which is the basis for the estimates reported in CRF table 1.A(b)) did not revise the whole time series of residual fuel oil consumption backwards, as was done for the GHG inventory, owing to the less strict QC requirements regarding time-series consistency. The Party noted that it will explain clearly in the NIR of its next inventory submission why the data reported cannot be fully harmonized. The ERT also noted inconsistencies between CRF table 1.D.2 and CRF table 1.A(b) for gas/diesel oil consumption for 1990–2015. For example, gas/diesel oil consumption for 2005 and 2015 is 7,755.88 TJ and 31,352.04 TJ in CRF table 1.A(b) but 7,224.49 TJ and 32,810.15 TJ in CRF table 1.D.2. During the review, the Party explained that the methodological change in 2018 not only affected residual fuel oil but also gas/diesel	Yes. Convention reporting adherence

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
		oil. In contrast to the GHG inventory, the data suppliers of the Swedish energy balance did not revise the whole time series of gas/diesel oil consumption backwards owing to the less strict QC requirements regarding time-series consistency. The ERT understands that harmonizing input data with third-party data suppliers, such as national statistical agencies, that provide energy balances is a difficult process, especially given the limited capacity of inventory compilers to change statistics prepared by independent national agencies. The ERT recommends that the Party either harmonize the data for 1990–2018 regarding marine bunker fuels (residual fuel oil and gas/diesel oil) reported in the reference approach (CRF table 1.A(b)) with the sectoral approach (CRF table 1.D.2) or include a detailed explanation in the NIR on why the data cannot be harmonized.	
E.5	1.A.2.c Chemicals – all fuels – CO_2, CH_4, N_2O	The Party reported in its NIR (p.134) that there was a reallocation of emissions from carbide furnace gas from category 2.B.5 carbide production to category 1.A.2.c chemicals owing to the results of a project that investigated the allocation of emissions to stationary combustion or process emissions. The Party also reported in its NIR (p.136) that some of the recalculations were the result of revising the CO_2 EFs for several fuels and reallocating emissions from IPPU to category 1.A.2.c owing to the split of stationary and process emissions from one company. The ERT noted that the recalculation led to an increase in emissions in category 1.A.2.c of around 80 kt CO_2 for most years (with a minimum of –7 kt CO_2 in 2019 and a maximum of 217 kt CO_2 in 2000). However, according to the NIR (section 4.3.5.5, p.229), no recalculation occurred in category 2.B.5. The ERT noted that there was no recalculation of emissions for category 2.B.5, although the AD were revised for all years of the time series (from "NA" in the 2022 annual submission to values in the 2023 inventory submission). During the review, the Party clarified that there was a reallocation of emissions from category 2.B.10 other (chemical industry) to category 1.A.2.c. However, the study forming the basis for the reallocation was considered to be confidential and could not be shared with the ERT. The Party explained that the reallocation was due to more detailed information becoming available from one plant that allowed a split between energy-related and process-related emissions. Previously, all emissions were allocated to category 2.B.10 owing to a lack of information on the emissions. The Party also explained that it aims to explain the reallocation of emissions between IPPU and category 1.A.2 and to clarify which information is confidential as transparently as possible in the NIR of its 2024 inventory submission. The ERT noted that the increase in CO_2 emissions reported in category 1.A.2.c approximately matched the corresponding decreases in CO_2 emissions in category 2.B.10 for 1990–1999. However, there is no such correspondence for later years. For example, in 2000 CO_2 emissions increased in category 1.A.2.c by 216.5 kt, while in category 2.B.10 they only decreased by 111.2 kt; in 2018 CO_2 emissions decreased by 1.7 kt in category 1.A.2.c but decreased by 34.9 kt in category 2.B.10. During the review, the Party explained that some of the recalculations were the result of the revision of the CO_2 EFs and explained the remaining differences. The ERT also noted that recalculations for category 1.A.2.c predominantly affected emissions from liquid fuels; however, according to annex 2 to the NIR (p.70) and the corresponding reference (Josefsson Ortiz et al. (2022)), the CO_2 EF of liquid fuels has not significantly changed. The ERT recommends that the Party provide detailed information in the NIR on the recalculations made between the 2022 and 2023 inventory submissions for category 1.A.2.c for liquid fuels to allow an understanding of the reallocation of emissions from IPPU to category 1.A.2.c and the accuracy of this reallocation. If the information is considered to be confidential, the ERT recommends that the Party clearly state	Yes. Transparency

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		which information is confidential and cannot be provided but explain the recalculation as transparently as possible given the circumstances.	
E.6	1.A.2.d Pulp, paper, print – all fuels – CO_2, CH_4, N_2O	The Party reported in its NIR (p.138) that a major revision of EFs for several fuel types and the split of liquefied natural gas from natural gas resulted in recalculations in category 1.A.2.d, with a total decrease in emissions for the two most recent recalculated years of 0.25 kt CO_2 eq for 2019 and 0.17 kt CO_2 eq for 2020. However, the ERT noted that the recalculations for 1990–2020 resulted in an average decrease in emission estimates of 35 kt CO_2 eq for 1990–2020, with a maximum decrease of 132.66 kt CO_2 eq in 1991 and a minimum decrease of 0.09 kt CO_2 eq in 2018. During the review, the Party clarified that the change in EFs for other fossil fuels was the main reason for the recalculation for the years prior to 2013. There was also a reallocation of fuels from other fossil fuels to biomass. This contributed to the observed changes, in particular from 2013 onward. In addition, there was a reallocation of methanol from biomass to other fossil fuels for 2018–2020 since it was discovered that the methanol was not of biogenic origin. The Party explained that it will work to improve the explanations for the recalculations in the NIRs of its next inventory submissions. The ERT recommends that the Party explain and provide detailed information in the NIR on the recalculations made between the 2022 and 2023 inventory submissions for this category, specifically information on the change in EFs for other fossil fuels for the years prior to 2013; the reallocation of fuels from other fossil fuels to biomass, in particular from 2013 onward; and the reallocation of methanol from biomass to other fossil fuels for 2018–2020 based on the discovery that the methanol was not of biogenic origin.	Yes. Transparency
E.7	1.A.3.b Road transportation – biomass – CH_4 and N_2O	During the review, the Party explained that CH_4 and N_2O emissions (but not CO_2 emissions) from biofuels, estimated with the model for road transport, are reported under fossil fuels (e.g. diesel oil, gasoline and natural gas) and that this approach is applied for all vehicle types under category 1.A.3.b road transportation. Noting that the 2006 IPCC Guidelines (vol. 2, chap. 3.2.1.1, p.3.13) state that the combustion of biofuels generates anthropogenic CH_4 and N_2O that should be calculated and verified in emission estimates, and that without the separation of emission estimates of biofuels such emission estimates cannot be compared across Parties and transparency is reduced (even though total emissions are accounted for), the ERT recommends that the Party report CH_4 and N_2O emissions from the use of biofuels separately under biomass for all vehicle types (i.e. cars, light-duty trucks, heavy-duty trucks and buses, and motorcycles) under category 1.A.3.b road transportation.	Yes. Comparability
E.8	1.A.3.b.ii Light-duty trucks – biomass – CH_4 and N_2O	According to the AD values reported for category 1.A.3.b.ii light-duty trucks in CRF table 1.A(a) (sheet 3), biomass was consumed from 1998 onward (e.g. 7,271.26 TJ (NCV) in 2021). The Party reported CO_2 emissions from biomass in this vehicle category from 1998 onward, but reported CH_4 and N_2O emissions from biomass for 1998–2015 as "IE, NO" and CH_4 and N_2O emission estimates for 2016 onward. During the review, the Party explained that the notation key "NO" for 1998–2015 represents that no biogas was used in those years and that light-duty trucks started using biogas in 2016. For "IE", the Party explained that ethanol and biodiesel have been blended into fossil gasoline and fossil diesel oil respectively since 1998 and that the CH_4 and N_2O emissions from blended biofuels are reported under gasoline and diesel oil, as appropriate, hence "IE" is reported for biomass. The Party also explained that this approach is applied for all	Yes. Transparency

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		vehicle types under category 1.A.3.b road transportation. The Party indicated that it will delete the notation key "NO" for 1998–2015 for CH_4 and N_2O emissions from category 1.A.3.b.ii light-duty trucks and will explain in the NIR that biogas was not used in category 1.A.3.b.ii light-duty trucks in those years, and that it will aim to report CH_4 and N_2O from biomass separately for all vehicle categories under category 1.A.3.b road transportation in its 2025 inventory submission. The ERT recommends that the Party explain in the NIR that biogas was not used for light-duty trucks in 1998–2015. Noting that the Party reports CH_4 and N_2O emissions from biomass for categories 1.A.3.b.i cars and 1.A.3.b.iii heavy-duty trucks and buses from the combustion of biomass other than the blending of liquid fuels with biofuels (e.g. the combustion of biogas), the ERT also recommends that the Party add a table with AD of the different types of biofuel per vehicle category and year in the NIR in order to clarify the consumption of different types of biomass in road transportation.	
IPPU			
I.9	2.A.2 Lime production – CO_2	The Party reported in its NIR (p.213) that in 2015 a review of category 2.A.2 lime production was made, in which two data sources (the EU ETS and the Swedish Lime Association) were compared, and it was determined that the best available data source for this category is the EU ETS. Sweden also reported in its NIR (p.213) that the main reason for concluding that the EU ETS is the best available data source is that data from the Swedish Lime Association often arrives too late to be used in the compilation and reporting of the GHG inventory. Additionally, the ERT noted that the NIR (figure 4.2.3, p.213) shows a divergence in the values of the three data sources used (the EU ETS, the Swedish Lime Association and Statistics Sweden), which has been increasing over the past few years. For example, for 2020 there is a difference of approximately 300 kt of lime production between Statistics Sweden and the Swedish Lime Association and a difference of 100 kt between the EU ETS and the Swedish Lime Association. During the review, the Party stated that it trusts the reliability of the reported values from the EU ETS since the data are verified. The Party also stated that it believes that Statistics Sweden includes calcium hydroxide in its data set, which does not result in CO_2 emissions, and that using this data for category 2.A.2 lime production would lead to an overestimation of emissions. The Party stated that it will assess the option of using the data from Statistics Sweden and the Swedish Lime Association in future inventory submissions. The ERT recommends that the Party investigate the data differences between the EU ETS, the Swedish Lime Association and Statistics Sweden and include in the NIR information on the results of this investigation and the reason for the increasing divergence of the three data sources.	Yes. Transparency
I.10	2.A.3 Glass production – SO_2 and NO_X	The Party reported in its NIR (section 4.2.3.1, p.214) that the total emissions of SO_2 and NO_X from the float glass production furnace that ceased operations in 2013 are allocated to category 2.A.3 glass production, since a separation into energy-related and process-related emissions is not possible. However, the ERT could not locate the indicated emissions of SO_2 and NO_X in CRF table 2(I) (sheet 1). During the review, the Party clarified that since the CRF tables do not allow SO_2 and NO_X emissions to be reported in category 2.A.3, these emissions are reported in category 2.A.4, and that NO_X and SO_2 emissions from float glass production have not been reported since 2013, when the facility emitting NO_X shut down, and	Not an issue/problem

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		this will be clarified in the NIR of the Party's next inventory submission. Additionally, in 2012 emissions of NO_X and SO_2 from float glass production comprised about 2 per cent of emissions in category 1.A.2 and a majority of emissions in category 2.A.3. The allocation of emissions to the IPPU sector may affect comparability; however, this allocation was necessary in order to ensure that the total emissions were correctly reported. The ERT encourages the Party to indicate in the NIR the category in which the NO_X and SO_2 emissions from float glass production are included and to provide clear information on the effect of not separating the energy-related and process-related NO_X and SO_2 emissions, as this raises comparability issues across the energy and IPPU sectors.	
I.11	2.B.10 Other (chemical industry) – CO_2	The Party stated in its NIR (section 4.3.10.1, p.231) that, according to the 2006 IPCC Guidelines (vol. 3, chap. 3, section 3.9.1, p.3.57), emissions from the combustion of fuels produced within a facility (internal make-up gases) and emissions from feedstock fuels should be allocated to the source category in the IPPU sector, except when the fuels are used in another source category (e.g. district heating). Sweden also stated that it followed the recommendations of the 2006 IPCC Guidelines as far as possible, but that exceptions were made for some facilities since the CO_2 process emissions are difficult to separate from the combustion emissions reported in the energy sector. In those cases, all emissions are reported in the energy sector. The ERT noted that the use of "IE" does not make it clear which categories of the IPPU sector are impacted by "specific plants" and that no assessment of the comparability across categories due to the impact of allocating these emissions to the energy sector was carried out. During the review, the Party clarified that some process emissions were allocated to the energy sector (category 1.A.2.c chemicals) owing to difficulties with separating energy-related emissions from process-related emissions, and this may affect comparability across categories to some extent, but that this allocation is necessary in order to ensure that total emissions are correctly reported. The Party also explained that, while data confidentiality prevents a quantification of the effect on comparability in the NIR, it can clarify that the allocation affects comparability. The ERT recommends that the Party clarify which CRF categories include specific plants' emissions that are identified with notation key "IE". The ERT also recommends that the Party include in its NIR an explanation as to how confidentiality prevents the effect on comparability of emissions across category 2.B.10 and category 1.A.2.c chemicals from being quantified.	Yes. Transparency
I.12	2.C.3 Aluminium production – PFCs	The ERT noted that the production of aluminium reported for 2021 in CRF table 2(I).A-H (sheet 2) for category 2.C.3 aluminium production is 115.86 kt and the production of aluminium reported in table 2(II).B-H (sheet 1) for by-product emissions of CF_4 and of C_2F_6 is 115.86 t (i.e. 1,000 times lower). As a result, the IEFs calculated in CRF table 2(II).B-H (sheet 1) (45.12 kg CF_4/t and 5.46 kg C_2F_6/t) are two orders of magnitude greater than expected (the IPCC default for the centre-worked prebake process is 0.4 kg CF_4/t and 0.04 kg C_2F_6/t (2006 IPCC Guidelines, vol. 3, chap. 4, table 4.15)). The same issue occurs for all years in the time series. During the review, the Party clarified that information on the amount of aluminium produced should be reported in table 2(I).A-H (sheet 2) in kt, while in table 2(II).B-H (sheet 1) the information should be reported	Yes. Convention reporting adherence

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		in t. Confusion over the use of units for the amount of aluminium produced led to the errors in table 2(II).B-H (sheet 1). The Party stated that it will rectify the issue in its 2024 inventory submission. The ERT recommends that the Party correct the amount of aluminium produced associated with PFC emissions reported in CRF table 2(II).B-H (sheet 1) to the required unit (t) so that the reported IEFs reflect the correct units.	
I.13	2.F.1 Refrigeration and air conditioning – HFCs	The ERT noted that the 2022 review report included a recommendation for the Party to report HFC-125 and HFC-143a emissions for category 2.F.1.d transport refrigeration (disposal) as "NO" for 2000–2002 if emissions did not occur in those years (see ID# G.1 in table 3). In accordance with this, Sweden reported HFC-125 and HFC-143a emissions for category 2.F.1.d transport refrigeration (disposal) for 1990–2002 as "NO" in CRF table 2(II).B-H (sheet 2). During the review, Sweden explained that no refrigerated trailers and refrigerated trucks were equipped with the R404a cooling systems (i.e. with HFC-125 and HFC-143a as refrigerants) during 1990–1992, 30 per cent of refrigerated trucks and refrigerated trailers had R404a in their cooling systems during 1993 and 1994, and 100 per cent had R404a in their cooling systems from 1995 onward. This means that emissions from disposal did not occur for 1990–2002 and increased significantly between 2004 and 2005 since the lifespan of the equipment is 10 years. The ERT recommends that the Party explain in its NIR the use of HFC-125 and HFC-143a in the estimates reported for the time series, including for 1990–1992, 1993–1994 and 1995 onward, and provide justification for the use of notation key "NO" for reporting these emissions for 1990–2002 for category 2.F.1.d transport refrigeration (disposal).	Yes. Transparency
I.14	2.F.1 Refrigeration and air conditioning – HFCs and PFCs	The Party reported in its NIR (table 4.7.4, p.285) that for category 2.F.1.d transport refrigeration the EF for emissions from stocks is 20 per cent for 1993–1994, and 7 per cent for 2005–2021. For heat pumps reported under category 2.F.1.f, the EF for emissions from stocks decreased from 10 per cent in 1990 to 1 per cent in 1999 onward. For the other categories under 2.F.1, the PLF is assumed constant (e.g. for category 2.F.1.a commercial refrigeration, the applied PLF for all years is 10 per cent, while for category 2.F.1.c industrial refrigeration it is 7 per cent for all years). The Party explained in the NIR (p.281) that Sweden had legal measures in place as early as the 1980s to limit and prevent HFC and PFC leakage, which explains the comparatively low PLF. As the legal framework was already in place in 1990 and most probably affects all categories, it was not clear to the ERT why the PLF should show a further decline from 1990 onward, and why only the categories 2.F.1.d transport refrigeration and 2.F.1.f heat pumps are showing a decline, whereas the PLF for the other categories is constant. During the review, the Party clarified that for categories other than transport refrigeration and heat pumps there are no country-specific EFs available and therefore the default EF in the 2006 IPCC Guidelines is used throughout the time series. The Party indicated that the information source used to estimate the EF for transport refrigeration and heat pumps is most likely expert judgment made in collaboration with relevant trade associations and manufacturers; however, the underlying documentation is not available. The ERT recommends that the Party include information in the NIR on references and underlying assumptions for the EFs for all categories, in particular on how the legal framework put in place since the 1980s affected the	Yes. Transparency

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		EFs for emissions from stocks for transport refrigeration and heat pumps. If the applied EF for emissions from stocks and their decline cannot be substantiated, the ERT recommends that the Party apply the default EFs for emissions from stocks provided in the 2006 IPCC Guidelines (vol. 3, chap. 7, table 7.9) for all years.	
I.15	2.F.1 Refrigeration and air conditioning – HFCs and PFCs	The Party listed in its NIR (section 4.7.1) all categories of category 2.F.1 but did not list separately the specific sources of AD for calculating emissions for the different applications reported under this category. The ERT noted that the source of AD (fluorinated gases in imported equipment and in nationally produced equipment) used for estimating emissions from domestic refrigeration is not clearly referenced in the NIR and no information is provided regarding the assumptions made for the AD (e.g. if actual data are used or if data were extrapolated to cover all relevant amounts). By comparing the reported amounts filled into newly manufactured products and the total annual stock increase, it can be deduced that about 25 per cent of the new stock is imported, and that 75 per cent of new equipment is produced nationally, but the distinction between what comprises actual data and what comprises interpolated data is not clear. Also, the ERT noted that the data reported for the average annual stock of HFC-134a in CRF table 2(II).B-H(sheet 2) are not fully consistent with the PLF factor of 1 per cent referenced in the NIR; it seems that for the calculation of stock for 2003 onward a PLF of <1 per cent (ranging from 0.1–0.9 per cent) was applied. However, emissions were calculated correctly from stocks applying a PLF of 1 per cent. During the review, the Party explained that AD for household refrigerators for the 1990s were obtained from the trade association responsible for compiling aggregated information on the sale of refrigerators and freezers in Sweden. For the years after 1999, a constant number was assumed (450,000 units/year). The assumption that 75 per cent of the total number was manufactured in Sweden is based on expert judgment. The Party also explained that emissions from installed quantities are calculated with an EF (PLF) of 1 per cent for the entire time series, but HFC-134a was gradually replaced by propane until it was fully replaced in 2008. The ERT notes that the replacement of HFC-134a by a different gas is for new equipment and does not affect the existing stock. For 2009 no decommissioning is reported, thus the decrease in stock from 2009 to 2010 is solely due to emissions from existing stock. The Party reported 223.22 t HFC-134a as stock for 2009, and 222.83 t for 2010, which is a reduction of 0.1 per cent, whereas the Party noted that a 1 per cent reduction was applied. The ERT recommends that the Party review its calculation of emissions from stocks, particularly the application of the 1 per cent PLF, and include in the NIR the additional information on AD used for estimating emissions from household refrigerators, including clarification that the AD for household refrigerators were obtained from the trade association and an explanation of the assumption made regarding the number of units sold.	Yes. Accuracy
I.16	2.F.1 Refrigeration and air conditioning – HFCs	The Party reported declining PLFs for light-duty vehicles and passenger cars under category 2.F.1.e mobile air conditioning from 15 per cent (from 1990 to 1999) to 5 per cent (from 2011 to 2021), in its NIR (table 4.7.5, p.287). In its NIR (p.286), the Party references a study as the source of the parameters for 2010 onward. However, no reference to the source of the values used for 1990–1999 was provided and the ERT did not find an explanation on the declining values of PLFs across the time series in the NIR. During the review, the Party clarified that PLFs are based on information provided by a national car manufacturer that estimated the annual HFC leakage to be 7–20 g, which corresponds to an annual HFC leakage of approximately 1–3 per cent. Based on this information, which is from 2011, it was suggested that the yearly operation EF (i.e. PLF) in Sweden be lowered to 7.5 per cent for 2010 and to 5 per cent for 2011 onward,	Yes. Accuracy

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		compared with a value of 15 per cent used for 1990–1999; for 2000, 12 per cent is suggested to be used, and 10 per cent is suggested to be used for 2001–2009. The leakage factor is assumed higher than the estimate by the national car manufacturer in order to avoid an underestimation of the leaked emissions because of accidents and increased wear due to age. The Party also explained that according to Kindbom et al. (2001), reference is made to the 2006 IPCC Guidelines for the selection of a leakage factor for the 1990s. For these years, the average of the specified range was selected: 15 per cent. Contact was made with the industry in preparing Kindbom et al. (2001) and it is stated in the report that the industry was working to reduce the operational leakage and that the operational leakage had been improved and reduced. Therefore, a leakage factor of 10 per cent was applied from 2001 to 2009. The leakage factor for 2000 is interpolated for 1999 to 2001. The model assumes that the leakage factors used can be applied to all passenger cars manufactured in Sweden. The ERT recommends that the Party review the option of decreasing PLFs from 15 per cent, which is the average of the IPCC default range, to 10 per cent, which is a PLF based on expert judgment, and review a potential additional decrease from 10 to 5 per cent, also based on expert judgment, and provide supporting documentation on the applicability of the PLFs. The ERT also recommends that the Party include in the NIR additional information on the selection of PLFs for the different periods in the time series.	
I.17	2.F.1 Refrigeration and air conditioning – HFCs	The Party reported the amounts of HFC-134a filled into newly manufactured cars and the average annual stocks for mobile air conditioning in CRF table 2(II).B-H (sheet 2). The ERT noted that reported stock for 2021 is lower than the sum of the stock for 2020 (the amounts filled into new vehicles in 2020 minus disposal for 2020, considering emissions from stocks, disposal and recovery). The ERT did not find in the NIR a detailed explanation of the calculation of the stock, particularly on how the export of used cars affects the reported stock. During the review, the Party clarified that the sums of the stock in 2020 and the amount filled in 2021 and the subtracted emissions during manufacturing, from stock and disposal, as well as recovery for 2020, correspond to 99 per cent of stock for 2021, but not 100 per cent. The Party confirmed that the export of cars is not the reason for this deviation but did not provide an explanation for the deviation. The ERT recommends that the Party include in the NIR detailed information on how the stock of HFC-134a in the air conditioning of cars is calculated, particularly by providing an explanation of the observed deviation.	Yes. Transparency
I.18	2.F.2 Foam blowing agents – HFCs	The Party reported in CRF table 2(II).B-H (sheet 2) emissions from the production of closed cell foam (XPS) containing HFC-134a from 1996 to 2007 (for 2008 onward, the Party reported “NO”) and disposal emissions from 2008 to 2019 (for the years prior to 2008 and for 2020 and 2021, the Party reported “NO”). DLFs applied in the estimates for HFC-134a range from 75 per cent for 2008 to 52 per cent for 2019 (for 2015 the DLF applied is 60 per cent). During the review, the Party clarified that the DLFs decreased because in recent years the requirements for recapture during disposal have become stricter. The Party also explained that, while there is no specific regulation or legislation concerning the disposal of XPS containing HFCs, XPS containing HFCs is classified as hazardous waste and the management of such waste is covered by the waste regulation. This includes requirements that hazardous waste must be sorted and handled separately from other waste. Since 2015, article 12(5) of the EU 517/2014 regulation on fluorinated greenhouse gases requires that foam be labelled as containing fluorinated gas. The ERT notes that the provided reference for the legal measure in place since 2015	Yes. Transparency

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		does not imply a further decrease of the DLFs after 2015, but acknowledges that the applied factor of 60 per cent might be appropriate, as owing to the regulation all HFC-containing XPS has to be disposed of separately. To assume that the legal framework is not 100 per cent effective is reasonable, as there may be problems with the labelling of XPS that has been in stock for a long time. The ERT recommends that the Party include in its NIR information on the DLFs used in the estimations for the entire series. The ERT also recommends that the Party provide supporting evidence or a rationale for the decreasing DLFs applied after 2015.	
I.19	2.F.2 Foam blowing agents – HFCs	The Party reported in CRF table 2(II).B-H (sheet 2) emissions from the production of closed cell foam (XPS) containing HFC-134a from 1996 to 2007 (for 2008 onward, the Party reported "NO") and disposal emissions from 2008 to 2019 (for the years prior to 2008 and for 2020 and 2021, the Party reported "NO"). Table 4.7.10 of the NIR (pp.291–292) presents the annual leakage rates for HFC-134a used in XPS. The ERT noted that the last production of closed cell foam containing HFC-134a is reported for 2007, thus all XPS from this production is assumed to be disposed of after 12 years, and in 2019 the HFC-134a stocks should be zero. However, there are still stocks reported for 2020 and 2021 in CRF table 2(II).B-H (sheet 2) (e.g. for 2021 the reported average annual stocks amount to 348.51 t HFC-134a). In the NIR (table 4.7.9, p.290), it is stated that the lifetime of the closed cell foam is more than 12 years. In the NIR (p.292), it is stated that the lifetime of XPS is several decades, which is in line with the default value of 50 years provided in the 2006 IPCC Guidelines (vol. 3, chap. 7, table 7.6). Also, the ERT deduced from the data that after 12 years about 33 per cent (the sum of the leakage factors of years 1–12) of the HFC-134a initially contained in the foam is emitted, thus about 67 per cent should remain in products at decommissioning after 12 years. The ratio of the reported amounts of HFC-134a in disposed products to the initial amounts 12 years before ranges from 1 per cent for 2019 disposal to 38 per cent for 2009 disposal. The ERT understands that exports of XPS are considered, which is indicated in the NIR (p.290), thus the amounts of HFC-134a reported as remaining in products at decommissioning in CRF table 2(II).B-H (sheet 2) (e.g. for 2009: 2.95 t HFC-134a) are related to the annual increase in stocks (e.g. the increase in stocks from 1996 to 1997 is 44 t: 48.52 t HFC-134a stock in 1997 minus 4.2 t stock in 1996). The ERT assumes that HFC-134a contained in exported foams is not added to the stock, and also that emissions from manufacture are not added to the stock, thus the calculated increase in average annual stocks should only refer to HFC-134a in new XPS used in the country. The resulting ratio of the amounts reported as remaining in products at decommissioning to the annual increase in stock ranges from 7 to 16 per cent, compared with 67 per cent deduced from the information in the NIR; the Party did not provide further information on assumptions made concerning the lifetime to explain this deviation in its NIR. During the review, the Party clarified that in the model it is assumed that 20 per cent of the XPS products have a lifetime of 12 years. The remaining 80 per cent have a significantly longer lifetime of more than 50 years. So, for 80 per cent of the XPS produced using HFC-134a there is still leakage from stock, and this will remain the case for a long time. The ERT recommends that the Party include in the NIR the information on assumptions made for the lifetime of XPS foams (i.e. that in the model it is assumed that 20 per cent of the XPS products have a lifetime of 12 years,	Yes. Transparency

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		and that the remaining 80 per cent have a significantly longer lifetime of more than 50 years, so there will still be leakage from stock for a long time).	
Agriculture			
A.10	3. Agriculture	The Party reported in the agriculture chapter in its NIR various tables providing data for the most recent three years instead of the most recent 10 years. The ERT noted that this is not in line with paragraph 48 of the UNFCCC Annex I inventory reporting guidelines, which request that the base year, the most recent 10 years and any previous years since the base year ending with 0 or 5 (1990, 1995, 2000, etc.) be reported. During the review, the Party clarified that it will make an effort to address this issue. However, the Party noted that the agriculture chapter in the NIR includes 19 tables with time-series data and adding six more lines in every table will increase the NIR by approximately three pages but may not improve its comprehensibility. The Party also noted that the data requested are also presented in the CRF tables. The ERT encourages the Party to update the tables of the NIR with the time series of emissions to include the most recent 10 years instead of the most recent three years in line with paragraph 48 of the UNFCCC Annex I inventory reporting guidelines.	Not an issue/problem
A.11	3.D.a.6. Cultivation of organic soils (i.e. histosols) – N_2O	The Party reported values on areas of organic soils in CRF tables 3.D, 4.B and 4.C. The ERT noted that the figure reported for organic soils in CRF table 3.D is not equal to the amount reported for organic soils in cropland in CRF table 4.B and grassland in CRF table 4.C. For example, for 2021 Sweden reported 113.84 kha (113,840.16 ha) for the area of cultivated organic soils under category 3.D.a.6, while also reporting area figures for organic soils in total cropland and total grassland as 115.69 kha and 49.64 kha respectively. The total of the latter two figures adds up to 165.33 kha, which is not equal to the amount reported for category 3.D.a.6 (113.84 kha). During the review, the Party clarified that the area of cropland reported in category 3.D.a.6 is cropland remaining cropland and land converted to cropland on organic soils (113.84 kha). The Party did note a mismatch in the total area of total drained organic soils on cropland in CRF table 4.B (115.69 kha), which was stated owing to a slightly different assessment of the area (i.e. due to rounding of the NFI data). The Party stated that it would correct this inconsistency in its next inventory submission. The area of drained organic grassland soils is not cultivated and is therefore not included under category 3.D.a.6. The ERT recommends that the Party provide detailed information in the NIR on drained organic grassland soils that are stated as not being cultivated and as a result not included in the calculation. The ERT also recommends that the Party address the inconsistency in the areas of organic soils reported in CRF table 3.D and the areas reported in cropland in CRF table 4.B and grassland in CRF table 4.C (e.g. for 2021 Sweden reported 113,840.16 ha (113.84 kha) for the area of cultivated organic soils (category 3.D.a.6), while reporting area figures for organic soils in total cropland and total grassland as 115.69 kha and 49.64 kha respectively (i.e. a total of 165.33 kha)).	Yes. Transparency

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
LULUCF			
L.21	Land representation – CO_2, CH_4 and N_2O	The Party reported in its NIR (p.358) that wetlands in Sweden were assumed to be unmanaged, except for areas of peat extraction. However, the Party reported in its CRF table 4.1 all wetlands remaining wetlands under unmanaged wetlands and used notation key "NA" for managed wetlands. The ERT noted that this is not in accordance with the UNFCCC Annex I inventory reporting guidelines because notation key "NA" is not applicable for land on which activities exist, such as the wetland areas of peat extraction. The ERT considered the proper notation key to be "IE" if disaggregated reporting of areas from a certain land use is not possible. During the review, the Party clarified that the area data for peat extraction originates from data from the peat industry. Although this area is properly reflected in CRF table 4.D, it is not possible to reflect this area in the calculation of the land-use matrix in CRF table 4.1, which is constructed based on the NFI. The Party also expressed the view that using notation key "IE" for managed wetlands remaining wetlands would be reasonable. The Party indicated that it will address this issue in its next inventory submission. The ERT recommends that the Party report consistent areas of peat extraction under managed wetlands remaining managed wetlands in CRF tables 4.1 and 4.D or, if this is not possible, use notation key "IE" for managed wetlands remaining wetlands in CRF table 4.1.	Yes. Convention reporting adherence
L.22	Land representation – CO_2, CH_4 and N_2O	The Party reported different total national areas in the NIRs of its 2022 and 2023 inventory submissions. The Party reported 45,142 kha in the NIR of its 2022 inventory submission (table 6.3, p.368) and 45,136 kha in the NIR of its 2023 inventory submission (table 6.3, p.359). However, the total national area is reported as constant (45,133.18 kha) in CRF table 4.1 for all reporting years in the 2023 inventory submission. The Party did not provide an explanation of why the total national area is not consistent between NIR table 6.3 and CRF table 4.1 nor the reasons why the total national area is not the same for each submission. During the review, the Party clarified that the total national area is estimated using both temporary and permanent sample plots from the NFI, while the official reporting is based on permanent plots, which is the basis for tracking the trend and generating the land-use change matrix. The Party also acknowledged that there is a small difference in the estimated total national area and the area reported in the NIR but stated that all land areas are reported. In addition, the Party clarified that the change in the national area is the result of incorrect coordinates for some sample plots and land rise from the sea in the northern coastal zone. When a change in the land area is identified, the land area is recalculated for the entire time series in each submission to maintain the time-series consistency and the latest land area is reflected in its NIR. The Party indicated that it would aim to improve the explanation in the NIR of its next inventory submission. The ERT recommends that the Party explain in its NIR the difference between the total national area and the area reported in CRF table 4.1 and how the total national area changed in response to the incorrect coordinates for some sample plots and land rise from the sea, and how the reported total national area changed in the inventory submissions from previous years.	Yes. Transparency

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
Waste			
W.6	5.A Solid waste disposal on land – CH_4	Tables 7.2–7.17 of the NIR (pp.397–413) present the AD of waste disposed of in landfills (quantity and DOC). The NIR describes discontinuities in the AD for types of waste between time periods owing to changing sources and waste category definitions over time. The ERT found that the consistency of the time series of solid waste disposal data was difficult to review because the AD for the solid waste disposed of in landfills are spread over 15 tables in the NIR, with changes in format between the tables. Furthermore, the AD for solid waste disposed of in landfills could not be matched with corresponding values in the CRF tables (see ID# W.7 below). For example, the entire time series of total waste disposed of in landfill (1952–2021) could not easily be determined from the data presented in the NIR, nor could the total or average DOC of waste landfilled. During the review, the Party shared with the ERT a table containing the amounts of all types of waste landfilled at SWDS, including the DOC of these types. The Party indicated that it will address this issue in its next inventory submission. The ERT recommends that the Party include a single comprehensive synthesis table in its NIR, such as total solid waste or DOC disposed of in landfill by year. The ERT encourages the Party to include a synthesis figure showing the time series of solid waste disposal AD.	Yes. Transparency
W.7	5.A.1 Managed waste disposal sites – CH_4	Tables 7.2–7.17 of the NIR (pp.397–413) present quantities of waste disposed of in landfills and the DOC of the waste types. The ERT noted that the waste quantities disposed of in landfills and the DOC presented in the NIR do not match the values reported in CRF table 5.A. For example, the "Total deposited waste (excl. mining waste)" in table 7.2 of the NIR (p.397) does not match the "Annual solid waste at SWDS" in CRF table 5.A; similarly for table 7.3 of the NIR (p.398). Also, NIR table 7.2 (p.397) reports that 5,563 kt total solid waste was disposed of in 1990, whereas CRF table 5.A reports that 3,723 kt was disposed of in SWDS in 1990. Table 7.3 (p.398) reports that 4,414 kt of solid waste (excluding mining waste) was disposed of in 2021, whereas CRF table 5.A reports that 580 kt was disposed of in 2021. During the review, the Party clarified that the annual waste disposed of at SWDS reported in CRF table 5.A for 1990–2005 is the sum of deposited municipal solid waste and deposited sludge from the wastewater handling and pulp industry containing DOC reported in the NIR (table 7.2, p.397), and that the annual waste at SWDS reported in CRF table 5.A for 2006–2021 is based on data presented in the NIR (table 7.3, p.398). The Party indicated that the reason the sum presented in table 7.3 in the NIR does not equal the amount of annual waste at the SWDS reported in the CRF tables for 2006–2021 is because the sludge in table 7.3 is reported as dry matter, while the sludge reported in the CRF tables is in wet weight. Given the lack of transparency of the information in the NIR, the ERT was unable to evaluate the accuracy of the values in CRF table 5.A based on the NIR. The Party indicated that it would provide a better explanation in the NIR of its next inventory submission as to which waste data are reported in CRF table 5.A. The ERT recommends that the Party include in the NIR a clear description of the AD presented in the NIR, and that tables showing annual solid waste disposal in the NIR align with the data presented in the CRF tables, with enough detail provided to allow readers to replicate the AD reported in the CRF tables and to understand the data presented in the CRF tables with greater clarity and transparency.	Yes. Transparency

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
W.8	5.A.1 Managed waste disposal sites – CH_4	The ERT noted that the DOC value for garden waste (0.17) reported in the NIR (table 7.7, p.403) is based on the Revised 1996 IPCC Guidelines (vol. 3, chap. 6, table 6.3). The 2006 IPCC Guidelines (vol. 5, chap. 2, table 2.4) present an updated default DOC estimate for yard and garden waste (0.20, wet weight). During the review, the Party indicated that it will update the DOC value for garden waste from 0.17 (from the Revised 1996 IPCC Guidelines) to 0.20 (from the 2006 IPCC Guidelines) in its 2024 inventory submission. The ERT recommends that the Party either use in its estimates the DOC for garden waste (0.20, wet weight) from the 2006 IPCC Guidelines (vol. 5, chap. 2, table 2.4) instead of DOC = 0.17 from the Revised 1996 IPCC Guidelines and explain the recalculation made in the NIR or, if using the latter, justify why DOC = 0.17 better reflects its national circumstances.	Yes. Accuracy
W.9	5.A.1 Managed waste disposal sites – CH_4	The NIR (p.400) includes some details on the burning of waste at landfills before 1976. It indicates that no information is available on the fraction of waste that was burned; however, the NIR indicates that 311 of the 847 landfills (36.7 per cent of landfills) practised open burning in 1975. This ratio of the number of landfills burning waste on site is extended to the total amount of waste burned at landfills, specifically: "An assumption is…made that before 1976, 37 per cent of all deposited household waste was burned" (NIR, p.400). This assumption implies that 100 per cent of the waste disposed of at landfills that practised open burning was combusted. During the review, the Party indicated that, in general, the landfills only burned a fraction of the burnable waste, and that this practice was limited to only being used for waste that was easily burned. It further explained that historical data on the quantities of waste disposed of in landfills for 1952–1979 are based on assumptions and expert judgment that are difficult to verify since written sources are scarce. Sweden further clarified that further reassessment of this issue would also have to be made by expert judgment and would face the same verification issues. The ERT acknowledges that precise estimates of the fraction of waste burned (at sites that burned waste) may be challenging to estimate. Nonetheless, given the indication that only a portion of waste was combusted, the currently applied assumption that 100 per cent of waste was burned (at sites that did burn waste) is inaccurate. It is the opinion of the ERT that effort should be made to provide a best estimate or a new expert judgment of the proportion combusted at these sites and that this would contribute to the transparency and accuracy of the NIR. The ERT recommends that the Party revise the assumed fraction of waste burned at SWDS that did burn waste before 1976 (100 per cent), revise the historical estimates of waste burned at landfills, recalculate emissions accordingly and explain the recalculation in its NIR.	Yes. Accuracy
W.10	5.B.1 Composting – CH_4 and N_2O	The Party reported in its NIR (p.416) that emissions from home composting are not estimated. The ERT found in publicly available publications (Ermolaev et al., 2014) that home composting is widely used for biological household waste in Sweden, with more than 10 per cent of all biologically treated food waste home composted. During the review, the Party provided additional information, including preliminary estimates of home composting of food waste for 2021 (31,120 t wet weight), showing that total emissions (CH_4 and N_2O) were 5.46 kt CO_2 eq, which is equal to 0.01 per cent of the national total GHG emissions of Sweden (without LULUCF), which totalled 47,816.70 kt CO_2 eq in 2021. However, the ERT noted that paragraph 18(b)(i) of the conclusions and recommendations from the 19th meeting of GHG inventory lead reviewers[b] indicates that the	Yes. Completeness

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
		significance threshold defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines applies at the category/subcategory level where the notation key "NE" may be used in the CRF tables. The ERT concluded that the significance threshold cannot be applied to just home composting, since home composting is part of category 5.B.1 and not a category in the CRF tables. The ERT recommends that the Party estimate and report CH_4 and N_2O emissions from home composting under category 5.B.1 composting for all applicable years of the time series.	
W.11	5.D Wastewater treatment and discharge – CH_4	The NIR (p.430) indicates that the method for estimating CH_4 generation from anaerobic wastewater treatment is based on energy production. However, information about the data source for biogas production was missing from the NIR, cited only as "statistical information on generated energy". The NIR (p.430) also indicates that emissions are estimated based on a percentage loss from the energy recovery process. However, it is unclear whether flared biogas was included in the estimation of CH_4 generation, and whether emissions from biogas flaring were included in the estimates. During the review, the Party clarified that the energy production data are from the Swedish Energy Agency's annual statistical report and provided a table with data and calculations of biogas energy production, including flaring and energy recovery. The Party shared a spreadsheet with the ERT that demonstrated that flared biogas (reported as GWh from the data source) was considered in the estimates of CH_4 generation. The Party also clarified that the CH_4 from flaring and recovery is calculated based on the energy production and uses the NCV. The Party indicated that it would include this information in its next inventory submission. The ERT recommends that the Party improve the transparency of the NIR by including a citation to the data source of the biogas production energy AD and providing a synthesis of the AD that were shared with the ERT during the review, showing the time series of biogas production and including a description of how the CH_4 generation was determined and the conversion equation or parameters (from GWh to mass CH_4) used.	Yes. Transparency
W.12	5.D.1 Domestic wastewater – CH_4	In the NIR (section 7.5, p.427), it is stated that CH_4 emissions from septic tanks were omitted from the inventory, based on an assumption that CH_4 generation in septic tanks is unlikely to occur below 15 °C because methanogens are not active, and because the annual average air temperature in Sweden is 4.8 °C. The ERT notes that the discussion presented in the 2006 IPCC Guidelines (vol. 5, chap. 5, p.6.7) on the impact of temperature on methanogenesis refers to the effect of temperature on methanogenesis in lagoons, not in septic tanks. According to the 2006 IPCC Guidelines, for lagoons, "Below 15°C, significant CH_4 production is unlikely because methanogens are not active and the lagoon will serve principally as a sedimentation tank". The 2006 IPCC Guidelines (vol. 5, chap. 6.2.2, table 6.3) do not include specific provision for the impact of temperature on methanogenesis in septic tanks; the CH_4 conversion factor (agriculture) for septic tanks is 0.5 (vol. 5, chap. 6.2.2, table 6.3). The ERT considers that omitting emissions from septic tanks results in an underestimation of the emissions reported in the inventory. During the review, the Party provided additional information and example calculations, citing two documents (JTI, 2008; Leverenz et al., 2010). The ERT reviewed the documents cited by the Party and noted that JTI (2008) mentioned that CH_4 production from sludge is limited to depressed temperatures (between 5 and 20 °C), though it did not provide further evidence on the subject. Leverenz et al. (2010) states that the temperature inside a septic tank depends on water use in the house as well as seasonal temperature variations, that septic tanks do experience seasonal temperature variations and that, even in cold months, CH_4 generation does occur,	Yes. Completeness

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		albeit at lower rates. Leverenz et al. (2010) notes that the reduced degradation in colder months can be offset by higher decomposition during warmer months. The ERT concluded that the references shared by the Party, notably Leverenz et al. (2010), seem to indicate that methanogenesis remains possible in septic systems (albeit potentially at lower rates) if septic tank temperatures are low. The references refute what the Party reported in the NIR, which is that CH_4 emissions from septic tanks can be omitted based on an assumption that CH_4 generation in septic tanks is unlikely to occur if mean annual temperatures are below 15 °C. Furthermore, the ERT notes that while the annual average temperature in Sweden might be 4.8 °C, regional differences may exist and temperatures during summer rise above 15 °C, at which times emissions may occur. The ERT commends the Party for the effort to provide additional references but still considers that the additional information does not specifically provide evidence that there is no methanogenesis occurring in septic tanks due to cool ambient air temperatures. The ERT recommends that the Party improve the completeness of the GHG inventory by including in the calculations for category 5.D.1 the CH_4 emissions for septic tanks taking into consideration the 2006 IPCC Guidelines and explain the recalculation in the NIR or provide evidence in the NIR that demonstrates that CH_4 emissions from septic tanks do not occur in the country.	

[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.

[b] See document FCCC/SBSTA/2022/INF.3, annex.

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 Sweden in its 2023 inventory submission

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

Table I.1
Total greenhouse gas emissions and removals for Sweden, 1990–2021
(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	25 142.83	71 478.31	NA	NA
1995	30 685.79	73 326.17	NA	NA
2000	20 143.14	68 349.11	NA	NA
2010	14 087.65	64 375.65	NA	NA
2015	7 145.30	53 557.22	NA	NA
2020	4 927.41	46 214.03	NA	NA
2021	6 105.87	47 816.70	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 Sweden, 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	57 509.90	8 297.44	5 049.23	5.95	510.94	NO	104.85	NO
1995	59 506.17	8 232.41	4 841.24	128.72	478.29	NO	139.34	NO
2000	54 930.07	7 658.11	4 574.92	725.37	338.22	NO	122.42	NO
2010	53 120.37	5 833.33	4 123.63	1 063.67	169.24	NO	65.40	NO
2015	43 418.74	5 058.33	3 935.14	1 058.55	31.69	NO	54.77	NO
2020	36 686.49	4 588.71	3 953.38	888.59	58.65	NO	38.21	NO
2021	38 524.79	4 519.68	3 850.11	840.83	41.69	NO	39.61	NO
Percentage change 1990–2021	**–33.0**	**–45.5**	**–23.7**	**14 034.4**	**–91.8**	**NA**	**–62.2**	**NA**

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

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

	Energy	*IPPU*	*Agriculture*	*LULUCF*	*Waste*	*Other*
1990	52 272.03	7 427.72	7 646.31	–46 335.48	4 132.25	–
1995	54 147.79	7 699.13	7 551.74	–42 640.39	3 927.52	–
2000	49 362.26	8 117.52	7 319.96	–48 205.97	3 549.37	–
2010	47 342.36	8 162.27	6 736.43	–50 288.00	2 134.59	–
2015	38 068.74	7 227.29	6 767.50	–46 411.93	1 493.70	–
2020	31 962.96	6 377.51	6 796.75	–41 286.62	1 076.81	–
2021	33 174.94	6 976.00	6 673.59	–41 710.84	992.17	–
Percentage change 1990–2021	**–36.5**	**–6.1**	**–12.7**	**–10.0**	**–76.0**	**NA**

Notes: (1) Sweden did not report emissions or removals for the sector other (sector 6); the corresponding cells in the CRF tables were left blank; (2) Sweden 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 categories for which estimation methods are included in the 2006 IPCC Guidelines that were 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 are:

(a) 2.G.2 SF_6 and PFCs from other product use – SF_6 and PFCs (see ID# I.8 in table 3);

(b) 5.B.1 composting – CH_4 and N_2O (see ID# W.10 in table 5);

(c) 5.D.1 domestic wastewater – CH_4 (see ID# W.12 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/.

IPCC. 2019. *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*. E Calvo Buendia, K Tanabe, A Kranjc, et al. (eds.). Geneva: IPCC. Available at https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html.

B. UNFCCC documents

Annual review reports

Reports on the individual reviews of the 2014, 2015, 2016, 2017, 2019, 2020 and 2022 annual submissions of Sweden, contained in documents FCCC/ARR/2014/SWE, FCCC/ARR/2015/SWE, FCCC/ARR/2016/SWE, FCCC/ARR/2017/SWE, FCCC/ARR/2019/SWE, FCCC/ARR/2020/SWE and FCCC/ARR/2022/SWE 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/630411.

Annual status report for Sweden for 2023. Available at https://unfccc.int/sites/default/files/resource/asr2023_SWE.pdf.

C. Other documents used during the review

Responses to questions during the review were received from Emma Carlén (Swedish Environmental Protection Agency), including additional material on the methodology and assumptions used. The following references may not conform to UNFCCC editorial style as some have been reproduced as received:

Bertilsson J. (2016). Updating Swedish EFs for cattle to be used for calculations of greenhouse gases. Report 292. Department of Animal Nutrition and Management. Swedish University of Agricultural Sciences.

Doorn M, Strait R, Barnard W and Eklund B (1997). Estimates of Global Greenhouse Gas Emissions from Industrial and Domestic Wastewater Treatment, EPA-600/R-97-091, 1997, U.S. Environmental Protection Agency, Office of Research and Development: Washington, DC.

Ermolaev E, Sundberg C, Pell M and Jönsson H. (2014). Greenhouse gas emissions from home composting in practice. Bioresource Technology, Volume 151, pp.174-182. Available at https://doi.org/10.1016/j.biortech.2013.10.049.

Food and Agriculture Organization of the United Nations' *Global Forest Resources Assessment 2020: Guidelines and Specifications* FRA 2020 of Food and Agriculture Organization of United Nations. Available at https://www.fao.org/3/I8699EN/i8699en.pdf.

Josefsson Ortiz C, Guban P, Mawdsley I, Yaramenka K (2022). Updated CO2 emission factors for stationary combustion of LNG and blast furnace gases in Sweden. SMED report 7. Available at https://urn.kb.se/resolve?urn=urn:nbn:se:naturvardsverket:diva-10374.

JTI, 2008. Eveborn, Baky, Norén and Palm, 2008. JTI-rapport 41, 2008: Erfarenheter och kunskapsläge vid tömning av slamavskiljare (JTI-rapport (diva-portal.org)). JTI – Institutet för jordbruks- och miljöteknik.

Karltun, E, Nilsson, T, Lundblad, M (2015). Litter and soil carbon stock changes in connection to land-use changes – a method assessment for the Swedish LULUCF carbon inventory.

Kindbom K, Haeger Eugensson M and Persson K (2001). Kartläggning och beräkning av potentiella och faktiska utsläpp av HFC, FC och SF6 i Sverige. IVL report B 1428. (In Swedish).

Leverenz HL, Tchobanoglous G and Darby JL (2010). Evaluation of Greenhouse Gas Emissions from Septic Systems. Water Environment Research Foundation, co-published by IWA Publishing. Available at https://decentralizedwater.waterrf.org/documents/DEC1R09/DEC1R09.pdf.

Lexmond MJ and Zeeman G (1995). Potential of controlled anaerobic wastewater treatment in order to reduce the global emissions of the greenhouse gases methane and carbon dioxide. Dutch National Research Programme on Global Air Pollution and Climate Change. Potential of controlled anaerobic wastewater treatment in order to reduce the global emissions of the greenhouse gases methane and carbon dioxide. Wageningen: Vakgroep Milieutechnologie, 1995. 40 p. Report No. 410 100 104 (1995).

Lindgren A and Lundblad M (2014). Towards new reporting of drained organic soils under the UNFCCC – assessment of emission factors and areas in Sweden. SLU. Department of Soil and Environment, report 14. Uppsala (Sweden).

Swedish Energy Agency's annual statistical report on production of biogas and digestate for 2021 (Statistical report). Publication pending. https://www.scb.se/EN0124-en.

Wallin M, Bishop K, Fölster J, Löfgren S, Lundblad M (2021). Koncentration och export av TOC från dikad organogen mark. En rumsligt upplöst modell för nationell skattning. SMED report 17-2021.