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Report on the individual review of the annual submission of Germany submitted in 2022*

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 are also required to 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 2022 annual submission of Germany, conducted by an expert review team in accordance with the "Guidelines for review under Article 8 of the Kyoto Protocol". The review took place from 10 to 15 October 2022 in Bonn.

* In the symbol for this document, 2022 refers to the year in which the inventory was submitted, not to the year of publication.

Contents

Abbreviations and acronyms

2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
AAU	assigned amount unit
AD	activity data
Annex A source	source category included in Annex A to the Kyoto Protocol
AR	afforestation and reforestation
Article 8 review guidelines	"Guidelines for review under Article 8 of the Kyoto Protocol"
C	carbon
CER	certified emission reduction
CH_4	methane
CM	cropland management
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
Convention reporting adherence	adherence to the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories"
CPR	commitment period reserve
CRF	common reporting format
CSC	carbon stock change
DOM	dead organic matter
EF	emission factor
ERT	expert review team
ERU	emission reduction unit
EU	European Union
EU ETS	European Union Emissions Trading System
F-gas	fluorinated gas
FM	forest management
FMRL	forest management reference level
GHG	greenhouse gas
GM	grazing land management
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
IE	included elsewhere
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
IPCC good practice guidance	*Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*
IPPU	industrial processes and product use
k	methane generation rate
KP reporting adherence	adherence to the reporting guidelines under Article 7, paragraph 1, of the Kyoto Protocol
KP-LULUCF	activities under Article 3, paragraphs 3–4, of the Kyoto Protocol
Kyoto Protocol Supplement	*2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol*
LULUCF	land use, land-use change and forestry
MCF	methane correction factor
N	nitrogen
N_2O	nitrous oxide
NA	not applicable

NCV	net calorific value
NE	not estimated
NEU	non-energy use
Nex	nitrogen excretion
NF_3	nitrogen trifluoride
NFI	national forest inventory
NIR	national inventory report
NMVOC	non-methane volatile organic compound
NO	not occurring
NO_X	nitrogen oxides
PFC	perfluorocarbon
QA/QC	quality assurance/quality control
RMU	removal unit
RV	revegetation
SCR	selective catalytic reduction
SEF	standard electronic format
SF_6	sulfur hexafluoride
SIAR	standard independent assessment report
SOC	soil organic carbon
SOC_{REF}	reference soil organic carbon stocks
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"
WDR	wetland drainage and rewetting
Wetlands Supplement	*2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*

I. Introduction

1. This report covers the review of the 2022 annual submission of Germany, organized by the secretariat in accordance with the Article 8 review guidelines (adopted by decision 22/CMP.1 and revised by decision 4/CMP.11). In accordance with the Article 8 review guidelines, this review process also encompasses the review under the Convention as described in the UNFCCC review guidelines, particularly in 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). The review took place from 10 to 15 October 2022 in Bonn and was coordinated by Sevdalina Todorova (secretariat). Table 1 provides information on the composition of the ERT that conducted the review for Germany.

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

Area of expertise	*Name*	*Party*
Generalist	Giorgi Mukhigulishvili	Georgia
	Harry Vreuls	Netherlands
Energy	André Amaro	Portugal
	Brooke Elizabeth Perkins	Australia
IPPU	Stanford Mwakasonda	United Republic of Tanzania
	Ann Marie Ryan	Ireland
Agriculture	Richard German	United Kingdom
	Mahmoud Medany	Egypt
	Ben Morrow	New Zealand
LULUCF and KP-LULUCF	Atsuko Hayashi	Japan
	Yasna Rojas Ponce	Chile
	Valentyna Slivinska	Ukraine
Waste	Chart Chiemchaisri	Thailand
	José Manuel Ramírez García	Spain
Lead reviewers	Giorgi Mukhigulishvili	
	Harry Vreuls	

2. The basis of the findings in this report is the assessment by the ERT of the Party's 2022 annual submission in accordance with the UNFCCC review guidelines and the Article 8 review guidelines.

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

4. A draft version of this report was communicated to the Government of Germany, 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 Germany, including totals excluding and including LULUCF, indirect CO_2 emissions, and emissions by gas and by sector, and

[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.

contains background data on emissions and removals from KP-LULUCF, if elected by the Party, by gas, sector and activity.

6. Information to be included in the compilation and accounting database can be found in annex II.

II. Summary and general assessment of the Party's 2022 annual submission

7. Table 2 provides the assessment by the ERT of the Party's 2022 annual 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.

Table 2
Summary of review results and general assessment of the 2022 annual submission of Germany

Assessment			*Issue/problem ID#(s) in table 3 or 5*[a]
Date of submission	Original submission: NIR, 14 April 2022; CRF tables (version 1), 8 April 2022; SEF tables (SEF-CP1-2021, SEF-CP2-2021), 8 April 2022		
Review format	Centralized		
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	I.13, L.1, L.2, KL.2
	(c) Development and selection of EFs?	Yes	W.1, W.3, W.7
	(d) Collection and selection of AD?	Yes	E.6, I.2
	(e) Reporting of recalculations?	No	
	(f) Reporting of a consistent time series?	Yes	E.15, I.4
	(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	E.13, L.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?	Yes	
Description of trends	Did the ERT conclude that the description in the NIR of the trends for the different gases and sectors is reasonable?	No	E.16
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	

Assessment			*Issue/problem ID#(s) in table 3 or 5*[a]
	(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 AAUs, CERs, ERUs and RMUs and on discrepancies in accordance with decision 15/CMP.1, annex, chapter I.E, in conjunction with decision 3/CMP.11, taking into consideration any findings or recommendations contained in the SIAR?	No	
	Have any issues been identified in matters related to Article 3, paragraph 14, of the Kyoto Protocol, specifically problems related to the transparency, completeness or timeliness of the reporting on the Party's activities related to the priority actions listed in decision 15/CMP.1, annex, paragraph 24, in conjunction with decision 3/CMP.11, including any changes since the previous annual submission?	No	
	Have any issues been identified related to the following reporting requirements for KP-LULUCF:		
	(a) Reporting requirements of decision 2/CMP.8, annex II, paragraphs 1–5?	No	
	(b) Demonstration of methodological consistency between the reference level and reporting on FM in accordance with decision 2/CMP.7, annex, paragraph 14?	Yes	KL.4, KL.5
	(c) Reporting requirements of decision 6/CMP.9?	No	
	(d) Country-specific information to support provisions for natural disturbances in accordance with decision 2/CMP.7, annex, paragraphs 33–34?	NA	
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?	No	G.1
Adjustments	Has the ERT applied any adjustments under Article 5, paragraph 2, of the Kyoto Protocol?	No	
	Has the Party submitted a revised estimate to replace a previously applied adjustment?	NA	Germany does not have a previously applied adjustment
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 III.

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

8. Table 3 compiles the recommendations from previous review reports that were included in the most recent previous review report, published on 29 April 2021,[3] and had not been resolved by the time of publication of the report on the review of the Party's 2020 annual submission. The ERT has specified whether it believes the Party had resolved, was addressing or had not resolved each issue or problem by the time of publication of this review report and has provided the rationale for its determination, which takes into consideration the publication date of the most recent previous review report and national circumstances.

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

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
General			
G.1	CPR (G.3, 2020) (G.5, 2018) (G.5, 2016) (G.6, 2015) KP reporting adherence	Annually review, and if necessary update, the information in the NIR with respect to the calculation of the CPR, ensuring that it is calculated on the basis of the most recent information.	Not resolved. The Party reported in its NIR (section 12.5, p.855) that the CPR is calculated as 90 per cent of Germany's assigned amount (3,592,699,888 t CO_2 eq) pursuant to Article 3, paragraphs 7 bis, 8 and 8 bis, of the Kyoto Protocol. However, the Party did not report the value of 100 per cent of eight times its most recently reviewed inventory (i.e. the emissions excluding LULUCF and including indirect CO_2, in the submission currently under review). Both values are needed to ensure that the reported CPR is the lower of the two. During the review, the Party confirmed to the ERT that in the current submission the emissions for 2020 were 728,737,653 t CO_2 eq. Eight times this amount is 5,829,901,226 t CO_2 eq. The CPR is therefore 3,233,429,900 t CO_2 eq, being 90 per cent of the Party's assigned amount, as this is the lower of the two values. The ERT concludes that this potential problem of a mandatory nature does not influence the Party's ability to fulfil its commitments for the second commitment period of the Kyoto Protocol and therefore this issue was not included in the list of potential problems and further questions raised.
G.2	CRF tables (G.7, 2020) (G.11, 2018) Comparability	Report indirect CO_2 and N_2O emissions from the energy, IPPU and waste sectors, as well as indirect CO_2 emissions from the LULUCF sector, if appropriate, as "NE" in CRF table 6.	Resolved. The Party reported indirect N_2O emissions from the energy, IPPU and waste sectors and indirect CO_2 emissions from all sectors as "NE" in CRF table 6.
G.3	Further improvements (identified by the Party) (G.10, 2020)	Improve QC procedures to ensure that all category-specific issues that are identified as issues that need potential further improvement are included in the table for	Resolved. The Party reported in its NIR (section 10.4, p.782) the development of a new checklist to ensure that required category-specific improvements are included in the inventory plan. This checklist was used during the preparation of the current submission. During the review, the Party provided the ERT with an example from the actual

[3] FCCC/ARR/2020/DEU. The ERT notes that the report on the review of Germany's 2021 annual submission has not been published yet owing to insufficient funding for the review process. As a result, the latest previously published annual review report reflects the findings of the review of the Party's 2020 annual submission.

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
	Convention reporting adherence	planned improvements of the inventory (NIR table 510 in the 2020 submission).	checklist used. Table 476 (corresponding to table 510 in the 2020 submission) provides a compilation of the planned improvements completed and reported in the NIR, as well as pending improvements by category. References to the table are provided in the section on category-specific planned improvements in each sectoral chapter.
Energy			
E.1	Feedstocks, reductants and other NEU of fuels – solid fuels – CO_2 (E.4, 2020) Comparability	Report in CRF table 1.A(d) estimates of emissions from NEU of fuels and/or use the appropriate notation keys in line with paragraph 37 of the UNFCCC Annex I inventory reporting guidelines (e.g. "NA" instead of "NE" when no emissions are expected from NEU of a fuel).	Addressing. The Party changed the notation key used in CRF table 1.A(d) for coal tar NEU for 2013–2020 from "NE" to "NA", as no emissions from the NEU of the fuel were expected. The Party did not explain in its NIR the use of "NE" in CRF table 1.A(d) for other bituminous coal, coke oven/gas coke and lignite, although for coke oven/gas coke the category in which the emissions are reported is specified in the table. Further, it did not include in its NIR information about any planned improvements to its reporting in CRF table 1.A(d). During the review, the Party clarified that it is still working on resolving this issue. It explained that the information provided in CRF table 1.A(d) on the NEU of fuels was based on expert judgment but acknowledged that appropriate documentation supporting that judgment had not been provided in the NIR. Even though the NEU of fuels exists in the country, Germany explained that it was not possible to calculate and report related emissions, leading to the use of "NE". The ERT noted that the 2006 IPCC Guidelines (vol. 3, chap. 1, p.1.17) explain that potential CO_2 emissions may be calculated using "CS" (country-specific) or "D" (default) carbon content values for feedstocks and other NEU. The default EFs are presented in the 2006 IPCC Guidelines (vol. 2, chap. 1, table 1.3). The Party stated during the review that it would consider the option of reporting CO_2 emissions from the NEU of the fuels listed by applying the default EFs from the 2006 IPCC Guidelines and including the emissions in CRF table 1.A(d) in its next submission, as long as national circumstances allow such an approach.
E.2	1.A Fuel combustion – sectoral approach – all fuels – CO_2, CH_4 and N_2O (E.2, 2020) (E.7, 2018) Transparency	Include in the NIR the main assumptions used in establishing the provisional energy balance.	Addressing. The Party reported a separate section on its energy balance, including its structure and methodology, in annex 2 to the NIR, and a general explanation as to how the provisional energy balance is compiled in NIR section 18.4.1.1.8 (pp.879–881). It also provided information on national statistical surveys used to prepare the energy balance (NIR table 532, p.882). This included the data sources used for the 2019 and 2018 energy balances (tables 530 and 531 respectively, p.880) and the data on primary consumption made available every three months (p.880). However, the Party did not provide adequate explanations in its NIR for the assumptions used in the provisional 2020 national energy balance, nor did it reproduce the previous explanations on assumptions used that were provided during the 2020 review for the provisional 2018 balance. During the review, Germany clarified that the statistics cover a large part of the national energy balance (including public power production, the steel industry and transport).

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
			Where final statistics are not available, those parts of the national energy balance are calculated using primary energy consumption data. The Party further explained that several improvements to the statistics are now made on a monthly basis, which will allow the timely delivery of certain statistical information, and that any missing data will be estimated by the German Federal Statistical Office. The ERT considers that the recommendation has not yet been fully addressed because the Party has not provided a clear list of the primary assumptions used to estimate the preliminary national energy balance in the most recent inventory.
E.3	1.A Fuel combustion – sectoral approach – gasoline – CO_2 (E.5, 2020) Transparency	Include in the NIR an explanation of the adjustment made to the CO_2 EF for gasoline, which resulted in a CO_2 EF that is higher than the IPCC default value and among the highest IEFs reported by Parties for all categories in which gasoline is used.	Not resolved. The Party did not include in its NIR an explanation as to why its CO_2 EF for fossil-based gasoline consumed for road transportation (75.28 t/TJ in 2020) was higher than the upper value of the default range in the 2006 IPCC Guidelines (vol. 2, chap. 3, table 3.2.1) (73.00 t/TJ). During the review, the Party confirmed that it had not yet updated its NIR to explain the use of the high CO_2 EF; however, it did state that the EF increased from about 73 t/TJ in 1990–2014 to more than 75 t/TJ in 2015–2020 because of the incorporation of a revised NCV published in 2001 by the Working Group on Energy Balances (43.54 kJ/kg was used for 1990–2014 and 42.28 kJ/kg for 2015–2020) (see https://ag-energiebilanzen.de/wp-content/uploads/2022/04/Heizwerte2005bis2020.pdf), while the underlying EF in kg CO_2/kg fuel remained the same. The Party also provided a reference to a publication by Warncke and Gschrey (2021) containing analyses on the deviation of the EF used for gasoline. The ERT considers that the recommendation has not yet been addressed because the Party has not justified in its NIR the use of a CO_2 EF that is higher than the upper value of the default range in the 2006 IPCC Guidelines.
E.4	1.C CO_2 transport and storage – gaseous fuels – CO_2 (E.3, 2020) (E.5, 2018) (E.18, 2016) (E.17, 2015) Comparability	Complete the blank cell for CO_2 captured for domestic storage and for storage in other countries using the appropriate notation key in CRF table 1s2.	Resolved. The Party reported in CRF table 1s2 "NO" for CO_2 captured for domestic storage and for storage in other countries. The ERT considers that the recommendation has been fully addressed because the Party corrected CRF table 1s2 with the notation key that reflects the national circumstances described in the NIR (section 3.2.4, p.166, and table 477, p.799).
IPPU			
I.1	2.A.1 Cement production – CO_2 (I.1, 2020) (I.10, 2018) Transparency	Include in the NIR a description of the methodology used for estimating bypass dust, and use the bypass dust estimates of the German Cement Works Association in future submissions, if they are deemed suitable by the Party, rather than the default EF of the IPCC for bypass dust.	Resolved. The NIR contains a description of the methodology used for estimating bypass dust and a justification for the use of the bypass dust estimates of the German Cement Works Association (section 4.2.1, pp.291–294). The NIR (section 4.2.1.2, p.292) describes the source of information and basis for the assumptions related to bypass dust estimation. The Party also explained the percentage change of bypass dust from 1 to 2 per cent in 2009, which was questioned during the previous review.

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
I.2	2.A.4 Other process uses of carbonates – CO_2 (I.16, 2020) Accuracy	Either verify the decreasing emission trend and large inter-annual variation in emissions for 2016–2018 for subcategory 2.A.4.b (other uses of soda ash) and justify it in the NIR or recalculate the reported emissions to ensure time-series consistency.	Addressing. In its 2020 submission, the Party reported large inter-annual variations in CO_2 emissions for subcategory 2.A.4.b between 2016–2017 and 2017–2018 (–39.6 per cent and –65.6 per cent respectively) in CRF table 2(I)A-Hs1 and a significant decrease in emissions between 2016 and 2018. The Party has recalculated emissions for the category for 2017–2018 since its 2021 submission, resolving the time-series inconsistency (inter-annual change revised to –0.2 per cent for 2016–2017 and –7.2 per cent for 2017–2018). The recalculations (see the 2021 NIR, section 4.2.4.2.2., p.301, and current NIR, section 4.2.4.2.2, p.307) since 2017, however, are based on an earlier foreign-trade balance because the export figure provided by the German Federal Statistical Office for 2017 onward was very high and could not be explained, and thus requires further investigation by the relevant manufacturer and the Office. Pending that investigation, the Party used AD that were estimates, produced using an average value for the five preceding years of export data which was subtracted from the quantity produced plus the imports. During the review, the Party clarified that, despite its best efforts, the necessary data for restructuring the soda ash calculation were not available for the current submission but the updated data will be included in its next submission. The ERT concluded that, even if the approach taken leads to an underestimation of the emissions, the difference for this subcategory, with the highest emissions being 245.33 kt CO_2 eq in 2013, will be well below the significance threshold for application of an adjustment in accordance with decision 22/CMP.1, annex, paragraph 80(b), in conjunction with decision 4/CMP.11 (364.37 kt CO_2 eq in 2020), and therefore this issue relating to accuracy was not included in the list of potential problems and further questions raised. The ERT considers that the recommendation has not yet been fully addressed because the Party was still working on the accuracy of the AD time series at the time of submitting its inventory.
I.3	2.B.2 Nitric acid production – N_2O (I.5, 2020) (I.16, 2018) Transparency	Include in the NIR the type of technology used to control emissions at nitric acid plants.	Resolved. The Party reported in its NIR (section 4.3.2.2, p.314) that the reduction technologies used to control emissions are SCR and a technology for the combined removal of NO_X and N_2O called EnviNO_X, and the latter reduces N_2O emissions by over 99 per cent. It also reported that catalytic decomposition reduces both N_2O and ammonia emissions, and that one installation has been retrofitted with a second waste-gas-treatment system (SCR).
I.4	2.B.3 Adipic acid production – N_2O (I.8, 2020) (I.4, 2018) (I.9, 2016) (I.9, 2015) Consistency	Report on how time-series consistency was ensured, given the use of different methods in the time series.	Addressing. The original recommendation was linked to the lack of information on the method used to calculate emissions from one of the three plants under the category which started operating in 2002, for which it is reported that continuous measurements have been conducted since 2013, but without information on how its emissions were estimated for 2002–2012. The Party reported in its NIR (section 4.3.3.2, p.316) the approach used to estimate emissions from the plant prior to 2013. Although the NIR does not show the use of measurements for reporting emissions across the entire time series and states that a tier 2 approach was used for 1990–2012, CRF Reporter shows

ID#	*Issue/problem classification[a, b]*	*Recommendation from previous review report*	*ERT assessment and rationale*
			that a tier 3 methodology was used for 1990–2020. The ERT noted that no recalculations have been implemented for the category since the 2015/2016 submission. The Party stated in NIR section 4.3.3.3 (p.316) that emissions from the plant were not recalculated retroactively to 2002 because non-comparable emission values are involved. The ERT considers that the recommendation has not yet been fully addressed because the Party reported tier 3 as the method used for 1990–2020 in the CRF tables but stated in the NIR that a tier 2 approach was used for 1990–2012, and did not explain how the applied methods across the time series can be considered to be consistent.
I.5	2.C.2 Ferroalloys production – CO_2 (I.17, 2020) Transparency	Include in the NIR information on the source of AD for 1990–1994 used to estimate CO_2 emissions from ferroalloys production.	Resolved. In its NIR (section 4.4.2.2, p.341), the Party clarified that production figures from the German Federal Statistical Office were used for 1990–1994 but that, since 1995, these production figures have not been included in national production statistics and data from the British Geological Survey have been used instead.
I.6	2.C.3 Aluminium production – SF_6 (I.11, 2020) (I.20, 2018) Transparency	Include in the NIR the explanation that the aluminium plant was redesigned, resulting in a reduction in the SF_6 EF for secondary aluminium, and explain in detail how the change in the EF was justified, whether by confidential measurement results and/or by a measurement protocol, and that the measurement protocol was checked and verified by a third party.	Resolved. The Party reported in the NIR (section 4.4.3.2, p.344) that, on the basis of confidential measurement records certified by the pertinent permit authority, the SF_6 EF for aluminium foundries for 1999–2008 was reduced to 3 per cent. Using structural conversions, the EF was further reduced to 1.5 per cent, as of 2009. Germany stated that the value was also confirmed by confidential measurement reports that have been approved by the licensing authority.
I.7	2.D.1 Lubricant use – CO_2 (I.18, 2020) Accuracy	Correct the error in CO_2 and NMVOC emissions from stationary lubricant use for 2011 in CRF table 2(I)s2.	Resolved. The Party corrected the error involving a decimal place for CO_2 and NMVOC emissions from stationary lubricant use for 2011 and reported in CRF table 2(I)s2 CO_2 emissions of 186.64 kt and NMVOC emissions of 24.01 kt from stationary lubricant use for 2011 in its 2021 and current submissions, which are consistent with the other values reported in the time series.
I.8	2.D.2 Paraffin wax use – CO_2 (I.19, 2020) Comparability	Include an explanation of the AD used for category 2.D.2 (paraffin wax use) in CRF table 2(I).A-Hs2 (e.g. in the documentation box) to prevent misinterpretation of the reported IEF.	Resolved. An explanation of the AD and CO_2 emission calculation used for category 2.D.2 (paraffin wax use) was included in CRF table 2(I).A-Hs2 in the documentation box, stating that a biogenic fraction is not included in the reported CO_2 emissions. During the review, the Party further clarified that the N_2O emissions in CRF table2(I).A-Hs2 include the biogenic wax fraction of 15 per cent whereas the CO_2 emissions do not contain that biogenic fraction. As the IEFs are automatically calculated (emissions/AD), at least one IEF will be incorrect if the AD are included in the CRF tables and so the Party reported "NA" in the tables and included the AD and an explanation in the NIR (section 4.5.2, p.357).
I.9	2.E.3 Photovoltaics – SF_6 (I.20, 2020) Comparability	Update CRF table 2(II).B-Hs1 such that the appropriate notation key is reported for all years where SF_6 emissions from	Addressing. The Party updated CRF table 2(II).B-Hs1 with "NA" for AD and emissions, reported for all years where SF_6 emissions from photovoltaics did not occur (i.e. 1990–2002 and 2014 onward).

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
		photovoltaics are not occurring (i.e. 1990–2002 and 2014 onward).	During the review, the ERT stated that "NO" should be used for related AD and emissions, as the Party confirmed that there was no production of solar cells in Germany in 1990–2002 and from 2014 onward. Germany agreed that "NO" is more suitable in this instance and will change the notation key in the next submission. The ERT considers that the recommendation has not yet been fully addressed because the Party did not use the appropriate notation key, "NO", for years where SF_6 emissions from photovoltaics did not occur.
I.10	2.G.3 N_2O from product uses – N_2O (I.21, 2020) Accuracy	Correct the error that arose from manual data entry by reporting N_2O emissions from anaesthetic use, explosives, semiconductor production, and propellant for pressure and aerosol products rather than reporting these emissions as "C" (confidential) for 1990–2002.	Resolved. The error due to manual data entry of N_2O emissions from anaesthetic use, explosives, semiconductor production, and propellant for pressure and aerosol products for 1990–2002 was corrected. The Party reported in CRF table 2(I).A-Hs2 those emissions of N_2O for 1990–2002 (ranging from 6.81 kt N_2O in 1990 to 3.33 kt N_2O in 2002) instead of "C" (confidential).
Agriculture			
A.1	3. General (agriculture) (A.6, 2020) Transparency	Improve the information on the AD trends by including in the NIR an explanation of how German reunification, which led to structural changes in the country, has impacted the population of dairy cattle (a decrease of 11.4 per cent from 1990 to 1991) and swine (a decrease of 16.3 per cent from 1990 to 1991) and the associated enteric fermentation emissions at the beginning of the reporting period.	Resolved. The Party reported in its NIR (section 5.1.3.2.3, p.459) on the way that structural changes in the agricultural sector following German reunification affected the numbers of animals at the beginning of the 1990s.
A.2	3.A.1 Cattle – CH_4 (A.3, 2020) (A.11, 2018) Transparency	Improve the transparency of reporting by including in the NIR, or in a supplementary publication referenced in the NIR (such as Haenel et al. (2018)), more information on the performance indicators (e.g. weight, weight gain, milk yield) used to calculate metabolizable energy (MJ per animal per year) and dry matter intake (kg dry matter per animal per year) of suckling cows, and explain how the changes in energy required for activity at pasture contribute to the values of metabolizable energy and dry matter intake of suckling cows.	Resolved. The Party reported in its NIR (sections 5.1.3.3–5.1.3.5, pp.461–466) details regarding CH_4 emissions from cattle, including suckling cows, and stated that, as a result of QA measures and the availability of updated input data, numerous changes were carried out with respect to the 2021 submission that have affected the input data, including the data on performance, energy requirements and feed intake. Data on performance indicators such as average animal weight or milk yield are provided in the NIR (tables 220–221, p.462) and the NIR refers to an external document for further details on the suckling cow model (Vos et al., 2022, chap. 4.7). Among the main changes in the applied new model is the complete update of energy requirements and feed intake models for suckling cows, adjusted in keeping with the dairy cow model (NIR section 5.1.3.3, p.461).

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
A.3	3.A.1 Cattle – CH_4 (A.4, 2020) (A.12, 2018) Transparency	Improve the transparency of reporting by including in the NIR, or in a supplementary publication referenced in the NIR (such as Haenel et al. (2018)), an updated explanation of categories of energies taken into consideration in the estimates of metabolizable energy, including time spent on pasture.	Resolved. The Party reported in its NIR (sections 5.1.3.3–5.1.3.5, pp.461–466) a list of the performance data used to obtain estimates of metabolizable energy for cattle. Germany also provided a reference to a supplementary publication (Vos et al., 2022), which presents further details on the calculation of metabolizable energy for all livestock categories (NIR p.462). The time spent on pasture (as a percentage of the year) is included in NIR table 569 (pp.939–942).
A.4	3.B.3 Swine – N_2O (A.7, 2020) Transparency	Report free-range pigs as "IE" in CRF table 3.B(b) in accordance with the UNFCCC Annex I inventory reporting guidelines, and clarify in the NIR that free-range pigs are not excluded from the inventory but that their numbers are captured under other management systems.	Resolved. The reporting in CRF table 3.B(b) is in accordance with the UNFCCC Annex I inventory reporting guidelines. The Party reported in CRF table 3.B(b) "IE" for swine manure in pasture range and paddock. Germany reported in its NIR (section 5.1.3.6.4, p.469) that, as the free-range management of swine ("pasture") plays an insignificant role in the country, any excretions on pasture are included under other housing systems. Free-range pigs are not included as a sub-item under swine in the CRF table but the NIR explains that they are included in the total number of pigs.
A.5	3.D.a.2.c Other organic fertilizers applied to soils and 3.D.b Indirect N_2O emissions from managed soils – N_2O (A.8, 2020) Transparency	Provide detailed information in the NIR or in supplementary material on how direct and indirect N_2O emissions resulting from the application of biowaste onto managed soils are included in the country-specific N_2O EF used by the Party and how this EF compares with the default EFs from the 2006 IPCC Guidelines (vol. 4, chap. 11).	Addressing. Germany reported in its NIR (sections 7.3.1.2, pp.725–727, and 7.3.2.2, pp.729–731) information on N_2O emissions from the application of biowaste (compost and digestate) to soils. In the agriculture chapter of the NIR (section 5.5.1, p.514) and during the review, the Party referred to these sections in the waste chapter (chap. 7). The information in the NIR (pp.727 and 731) shows the disaggregated EFs for storage, use and mineralization of biowaste. The NIR (p.727) also includes a comparison with the default N_2O EF for composting in the 2006 IPCC Guidelines (vol. 5, chap. 4.1.3.1) but not a comparison with the default N_2O EFs for direct and indirect N_2O emissions. The ERT considers that the recommendation has not been fully addressed, as the country-specific EF has not been compared with the default EFs for N_2O emissions from agricultural soil in the 2006 IPCC Guidelines (vol. 4, chap. 11, tables 11.1 and 11.3). It is also not clear in the NIR whether indirect N_2O emissions from the application of biowaste (from volatilization of ammonia and NO_X or leaching and run-off) are included in the N_2O EFs provided.
A.6	3.D.a.2.c Other organic fertilizers applied to soils and 3.D.b Indirect N_2O emissions from managed soils – N_2O (A.8, 2020) Transparency	Remove the statement "they can be neglected, since the nitrogen they include is organically bound and mineralizes very slowly" from the NIR.	Resolved. The statement "they can be neglected, since the nitrogen they include is organically bound and mineralizes very slowly" is not included in the current NIR.
LULUCF			
L.1	4. General (LULUCF) – CO_2 and N_2O	Ensure that the new reporting system is capable of detecting and reporting SOC	Not resolved. The Party reported in its NIR (section 6.1.2.1, pp.538–551) that for CSCs and N stock changes in mineral soils the stock-difference methodology from the 2006

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
	(L.8, 2020) Accuracy	changes associated with changes in the use and management of land with different soil types and climate conditions at a minimum.	IPCC Guidelines (vol. 4, chap. 2.2.1) was used together with the country-specific parameters. Germany also reported in NIR table 336 (p.540) the national mean carbon stock in mineral soils obtained for each land-use category and subcategory to be used for the calculation of CSCs in mineral soils without stratification, which allows for the detection of SOC changes associated with changes in the management of land with different soil types and climate conditions. During the review, the Party clarified that it has been working on this recommendation and will report on it in its next submission. The improvements to its reporting of emissions from mineral soils, including the use of a different programming language for the reporting model, which has improved performance and enabled the inclusion of carbon stocks by region, have been completed and soil data by region will be used for the next submission. The changes are based on comprehensive maps developed from the inventory data for carbon and N stocks, as well as the C/N ratios of mineral soils under forests, cropland and grassland. The maps for cropland and grassland were obtained by ensemble learning using boosted regression trees and support vector machines, considering 34 covariates (e.g. landscape-related, topographic, geological, hydrological, pedological and climatic). The regional disaggregation of the data on forest soils was based on the 72 legend units of the soil map of Germany and the results of the forest soil monitoring. In addition, the Yasso model (soil carbon model) will be used in the 2023 submission to derive changes in the carbon stocks of forest soils at the regional level on an annual basis. During the review, the Party also provided additional information on the comparison of SOC stock change estimates based on the results for two major land-use change categories by area in 2020 (cropland converted to grassland (1.5 Mha) and grassland converted to cropland (1.2 Mha)) reported in the current submission and those prepared for the next submission, where the recommendation regarding changes in the use and management of land with different soil types and climate conditions will be implemented. The ERT considers that the recommendation has not yet been addressed because the Party did not report SOC changes associated with changes in the use and management of land with different soil types and climate conditions at a minimum in its 2022 submission.
L.2	4. General (LULUCF) – CO_2 and N_2O (L.8, 2020) Accuracy	Until the new reporting system is fully implemented, apply a method consistent with good practice, as defined by the 2006 IPCC Guidelines (vol. 4, chap. 2.3.3.1), for estimating SOC changes. For instance, a set of SOC_{REF} values stratified by climate zone and soil type using SOC measurements taken in forest land, and grassland under natural	Not resolved. The Party did not apply a methodology consistent with the 2006 IPCC Guidelines (vol. 4, chap. 2.3.3.1), namely applying SOC_{REF} values stratified by climate zone and soil time. During the review, the Party explained that it has been working on this recommendation (see ID# L.1 above) and will report on it in its next submission.

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		conditions, if any, could be calculated. (Thus, if the SOC_{REF} values calculated are within the uncertainty range of the IPCC default values, the IPCC default stock change factors could be applied. Then, the SOC for each combination of land use and management system, as stratified by climate and soil type, could be calculated and formulation B of equation 2.25 from the 2006 IPCC Guidelines (vol. 4, box 2.1) could be applied to estimate the annual net SOC change associated with each change in the use and/or management of land.)	The ERT considers that the recommendation has not been addressed because the Party did not report SOC changes consistently with the 2006 IPCC Guidelines in terms of stratification by climate zone and soil type.
L.3	4.A Forest land – CO_2 (L.9, 2020) Transparency	Report complete information, including, where practicable, a flow chart that clearly presents in a visual format all steps and data used in the calculation of the SOC change in mineral soils, in order to demonstrate that the calculated SOC change is not biased by changes in forest area over time.	Not resolved. The Party reported in its NIR (sections 6.1.2.1.3, p.543, and 6.4.2.5.4, pp.629–630) the methodology used to estimate the net SOC increment in mineral soils in forest land, which was reported as 0.41 t C/ha. The methodology is based on a comparison of the total forest SOC determined from two consecutive national forest soil inventories. The Party did not report any additional information that improved the transparency of the steps and data used in the calculation of the SOC change in mineral soils in order to demonstrate that the calculated SOC change is not biased by changes in forest area over time. During the review, the Party clarified that the calculated SOC change in mineral soils is not affected by changes in forest area because the results are area-based and represent a specific soil volume regardless of the extent to which the forest has changed. The carbon content was calculated using bulk density, fine earth material (< 2 mm), layer thicknesses and SOC concentrations. In order to calculate area-based values, bulk density and soil depth were used. The temporal and spatial variations of the modelled SOC stocks depend on initial conditions, boundary conditions and the mean value of the national forest soil inventory plots covering the specific stratum. The initial conditions include the SOC stocks at the first measurement and their distribution in the respective model pools. The boundary conditions include climate variables and the biomass input. Changes in forest area were not considered in the applied SOC model. The ERT considers that the recommendation has not been addressed because the Party did not report complete, transparent information in the NIR, including, where practicable, a flow chart that clearly presents in a visual format all steps and data used in the calculation of the SOC change, in order to demonstrate that the calculated SOC change is not biased by changes in forest area over time.
L.4	4.A Forest land – CO_2	Reconcile in each year the total CSC reported under the Convention and under the	Resolved. The Party reported in CRF tables 4.A–4.E reconciled CSCs for biomass and DOM for each year comparable with the reporting under the Kyoto Protocol using data

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	(L.10, 2020) Accuracy	Kyoto Protocol for each of the biomass and DOM carbon pools.	from the NFIs and considering that forest land converted to other land uses continues to be reported under deforestation for the whole reporting period under the Kyoto Protocol.
L.5	4.A Forest land – CO_2 (L.10, 2020) Accuracy	Reconcile the total CSC reported for biomass and DOM in any period between two subsequent NFIs with the total CSC calculated across the period as the difference between the total carbon stock of the two subsequent NFIs.	Resolved. The Party reconciled the total CSC for biomass and DOM for the whole time series using subsequent NFIs in CRF tables 4.A–4.E as documented in the NIR (sections 6.4.2.1–6.4.2.4, pp.611–626) (see also ID# L.4 above).
L.6	4.A Forest land – CO_2 and N_2O (L.11, 2020) Accuracy	Reconcile in each year the total CSC reported under the Convention and under the Kyoto Protocol for each of the biomass and DOM carbon pools.	Resolved. The Party reported in CRF table 4.A reconciled estimates of CSC in the biomass and DOM carbon pools for forest land remaining forest land and land converted to forest land for the whole time series and reconsidered forest area reported under the Convention and its Kyoto Protocol to ensure consistency. For instance, for 2020, the total forest area reported under the Convention is 11,018.307 kha (forest land remaining forest land: 10,821.294 kha; land converted to forest land: 196.383 kha) and under the Kyoto Protocol the total forest area is equal to that reported under the Convention (FM: 10,692.488 kha; AR: 325.819 kha). The Party also reported updates and recalculations in its NIR (section 6.1.2, p.538), including the map for determining AD regarding designation of land use and land-use change, and adjustment of the land-use matrix over time; and parameters used in the estimation of above-ground and below-ground forest biomass and deadwood.
L.7	4.A Forest land – CO_2 and N_2O (L.11, 2020) Accuracy	Reconcile the total CSC reported for biomass and DOM in any period between two subsequent NFIs with the total CSC calculated across the period as the difference between the total carbon stock of the two subsequent NFIs.	Resolved. The Party reconciled total CSC for biomass and DOM for the whole time series using subsequent NFIs and reported updated information in CRF table 4.A as documented in the NIR (section 6.4.2) (see also ID# L.6 above).
L.8	4.B Cropland – CO_2 (L.12, 2020) Accuracy	Apply good practice, as set out in the 2006 IPCC Guidelines (vol. 4., chaps. 2 and 5), for estimating changes in forest biomass carbon stocks in order to estimate annual emissions and removals associated with biomass CSCs in short-rotation plantations.	Resolved. The Party reported for the first time in its NIR (sections 6.1.2.3.4, pp.558–559, and 6.1.2.3.5.5, pp.567–569) and CRF table 4.B CSCs for biomass in short-rotation plantations at the time at which they occur for the whole time series, considering the complete growth cycle, which is in line with the 2006 IPCC Guidelines (vol. 4., chaps. 2 and 5).
L.9	4.B.1 Cropland remaining cropland – CO_2 (L.13, 2020) Completeness	Report annual estimates of net CSCs of perennial biomass by applying the tier 1 method from the 2006 IPCC Guidelines (vol. 4, chap. 5.2.1.1) or any other method that is consistent with good practice, including approaches developed by other EU member States (the ERT notes that the limited	Resolved. The Party reported for the first time in its NIR (sections 6.1.2.3.4 and 6.1.2.3.5, pp.558–569) and CRF table 4.B annual estimates of net CSCs for each perennial cropland subdivision, such as hops, vineyards, orchards, short-rotation plantations, tree nurseries and Christmas tree plantations, at the time at which they occur for the whole time series, following the gain–loss method of the 2006 IPCC Guidelines (vol. 4, chap. 5.2.1.1) and considering the complete growth cycle of various plants and

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		availability of relevant data experienced by Germany is also experienced by other European countries).	understorey vegetation that were determined and modelled as a function of rotation cycles and operational duration, using country-specific carbon stock data.
L.10	4.B.1 Cropland remaining cropland and 4.C.1 Grassland remaining grassland – CO_2 (L.14, 2020) Convention reporting adherence	Provide verification of reported estimates by applying the default methodology in the 2006 IPCC Guidelines (vol. 4, chaps. 2, 5 and 6, and equation 2.25) to estimate SOC changes in cropland remaining cropland and grassland remaining grassland associated with changes in land management.	Not resolved. The Party reported in its NIR (section 6.1.2.1.1, p.539) that for mineral soils with no use or name change, in land-use categories 4.B–4.F, it is assumed that carbon inputs into the soil and carbon extractions from the soil are equal in size, so the systems remain in equilibrium. Germany also reported the changing trend in organic fertilizers and crop residues for 1990–2019 in NIR figure 70 (p.655). However, the Party did not report any information on the verification of reported estimates by applying the default methodology in the 2006 IPCC Guidelines (vol. 4, chaps. 2, 5 and 6, and equation 2.25) to estimate SOC changes in cropland remaining cropland or grassland remaining grassland associated with land management changes. During the review, Germany provided additional information regarding the equilibrium status of agricultural soils under the remaining land-use subcategories in cropland and grassland. According to the information provided for cropland, 800 permanent observation areas were selected to justify the assumptions used for cropland. The selection of permanent observation areas was based on criteria such as soil representation, land-use representation, anthropogenic impact, integration into existing or planned measuring networks, long-term availability and representativeness. Using the results of the long-term soil monitoring of the permanent observation areas, the Party demonstrated that over a 12-year period (1997–2010) around 76 per cent of permanent observation areas showed no SOC change, around 13 per cent showed an SOC decrease and around 11 per cent showed an SOC increase. A similar result was produced for the state of Lower Saxony, one of Germany's states with the largest percentage of land used for agricultural purposes. Regarding management practices on cropland, it was noted that agriculture is very intensive in Germany and the input of organic fertilizers and crop residues is constantly increasing (NIR figure 70, p.655), catch crops are cultivated, organic fertilizers are applied to 82 per cent of agricultural land and the N surplus in agriculture is 60–80 kg/ha. The assessment based on the data from the German Federal Statistical Office on tillage of cropland and the results of long-term soil monitoring showed an increase in carbon for mineral cropland soils. Germany considers the assumption of equilibrium (based on long-term soil observation sites) to be conservative. Regarding grassland, the Party explained that only the results from Lower Saxony and Bavaria were available. However, since these are the largest federal states in terms of area and, owing to their location, also show large differences in climate, Germany assumed as representative the changes in SOC obtained for permanent observation area sites in those two states, namely unchanged SOC at 10 locations (72 per cent), an increase at 2 locations (14 per cent) and a decrease at 2 locations (14 per cent). The result of the calculations provided by the Party shows a clear increase in organic carbon in the mineral soils under grassland.

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			During the review, Germany also provided information on the calculation of SOC changes in cropland and grassland soils using the tier 1 methodology from the 2006 IPCC Guidelines (vol. 4, chaps. 2, 5 and 6, and equation 2.25). The ERT considers that the recommendation has not been addressed because the Party has not reported the verification of estimates by applying the default methodology in the 2006 IPCC Guidelines (vol. 4, chaps. 2, 5 and 6, and equation 2.25) to estimate SOC changes in cropland remaining cropland and grassland remaining grassland associated with changes in land management in its 2022 submission.
L.11	4.B.2 Land converted to cropland and 4.C.2 Land converted to grassland – CO_2 (L.15, 2020) Accuracy	Report annual net carbon stock accumulation over time for perennial biomass in land converted to a cropland or grassland subcategory that has vegetation with perennial biomass by applying equation 2.7 or 2.15 from the 2006 IPCC Guidelines (vol. 4) or any other method that is consistent with good practice.	Resolved. The Party reported for the first time in its NIR (sections 6.1.2.3.4–6.1.2.3.6, p.558–571) and CRF tables 4.B–4.C CSCs for perennial biomass in land converted to cropland and land converted to grassland at the time at which they occur using a country-specific methodology consistent with good practice.
L.12	4(V) Biomass burning – CH_4 and N_2O (L.16, 2020) Completeness	Use available data on DOM stocks to include them as fuel when calculating CH_4 and N_2O emissions from biomass burning.	Not resolved. The Party reported in its NIR (table 380, p.634) CH_4 and N_2O emissions from biomass burning only, not including DOM. Germany also reported in NIR section 6.4.2.7.5 (pp.632–635) that it has little wildfire damage in terms of burned area, as the average area affected by wildfires for 1990–2020 is 0.845 kha and the total forest area for 2020 is 11,018.307 kha. During the review, the Party clarified that it is continuing to work on this recommendation, while noting that the issue is an insignificant contributor to national total GHG emissions, and will address the issue for its next submission.
Waste			
W.1	5.A.1 Managed waste disposal sites – CH_4 (W.2, 2020) (W.11, 2018) Accuracy	Update the k-values used in the emission estimation as soon as the data from the research projects that will determine national k-values are available, or, if the results are not available in time for the 2019 submission, include the status of these projects in the NIR, including a timeline for the implementation of their results in the inventory.	Addressing. The Party reported in its NIR (section 7.2.1.2.7, p.720) that the use of k-values was assessed by German Environment Agency experts, but the results remain unpublished. The Party therefore continued using the same national k-values as in the previous submission. Germany recognized the difference between national k-values and default values for wet temperate climate given in table 3.3 of the 2006 IPCC Guidelines (vol. 5, chap. 3) and explained in its NIR (section 7.2.1.2.7, p.720) that differences occurred because it used IPCC default half-life values from table 3.4 of the 2006 IPCC Guidelines (vol. 5, chap. 3) for deriving national k-values rather than using the default values suggested in table 3.3. For instance, the national k-value for food waste and sewage sludge was derived from the half-lives of four years (table 3.4), which is equivalent to a k-value of 0.173, but the default k-value given in table 3.3 is 0.185. As a result, the information on half-lives in table 3.4 is inconsistent with the k-value given in table 3.3 in relation to food waste and sewage sludge.

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			The Party also described in its NIR (section 7.2.1.2.7, p.720) that the current calculation using national values would lead to an overestimation of emissions and so a revision of the k-values is required. However, the discrepancies between emissions estimated using the current k-value and the default k-values in table 3.3 are minimal and the ERT of the 2018 review (when the issue was initially raised) concluded that the adjustment of the calculation could be performed when the results of the project become available. However, Germany did not report the status of the research project mentioned in the previous reviews or the timeline for its completion in the NIR. During the review, the Party clarified that the research project has now been completed and the results will be included in the next submission. The ERT notes that the calculation of emissions using the currently applied national k-value, namely 0.173 for food waste and sewage sludge derived from the default half-life value of four years, is in line with 2006 IPCC Guidelines (vol. 5, chap. 3, table 3.4). However, the recommendation has not yet been fully addressed because the Party has not yet used the updated national k-value for the calculation of emissions or reported the results or status of the research project in its NIR.
W.2	5.B.2 Anaerobic digestion at biogas facilities – CH_4 and N_2O (W.10, 2020) Transparency	Report the amount of livestock manure co-digested anaerobically with biowaste at biogas facilities (i.e. the AD) in CRF table 5.B, column B, and report the associated CH_4 and N_2O emissions in CRF table 5.B as "IE" while indicating in the documentation box to that table that they are reported under the agriculture sector in CRF table 3.B(a) to avoid double counting.	Addressing. The Party reported the amount of livestock manure co-digested in column B of CRF table 5.B and reported the associated CH_4 and N_2O emissions as "IE". No information was included in the documentation box. Information on the use of "IE" is reported in CRF table 9, explaining that emissions from livestock manure, including flaring and recovery, are reported under category 3.B (emissions from manure management), as also clarified during the review. The ERT noted that, based on the 2006 IPCC Guidelines (vol. 5, chap. 4.1.1, p.4.5), emissions from flaring should be reported under the waste sector, emissions from biogas used for energy purposes should be reported under the energy sector, and the rest of the emissions from livestock manure should be reported under the agriculture sector. The ERT considers that the reporting does not raise an accuracy issue, but the recommendation has not yet been fully addressed because the Party has not reported the emissions from livestock manure co-digested anaerobically with biowaste at biogas facilities in accordance with the 2006 IPCC Guidelines (vol. 5, chap. 4.1.1, p.4.5) or clearly explained allocation of the emissions (both CH_4 and N_2O), including from flaring and recovery, to the energy, waste and agriculture sectors.
W.3	5.D.1 Domestic wastewater – CH_4 (W.5, 2020) (W.14, 2018) Accuracy	Implement the results of the study that will produce better documented EFs as soon as the data are available, or, if the results are not available in time for the 2019 submission, include the status of this study in the NIR, including a timeline for the implementation of its results in the inventory.	Not resolved. The recalculations for subcategory 5.D.1 (domestic wastewater treatment) were not the result of new country-specific EFs derived from the research project mentioned in previous reviews. Within the subcategory, the Party applied country-specific CH_4 EFs for centralized wastewater treatment plants, following previous recommendations from the in-country review held in 2016, whereas EF values for cesspools and septic tanks derived from Gibbs and Woodbury (1993) were used as the best source of information available for CH_4 EFs, as the report from the research project to derive new country-specific EFs based on CH_4 and N_2O measurements is yet to be

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			published. Germany reported in its NIR (section 7.5.1.1.6, p.743) on the postponement of the research project for deriving EFs for municipal wastewater treatment, but provided no information on the current status or timeline of the project. During the review, the Party clarified that the recalculation of emissions based on the use of new country-specific EFs is expected to be reported in its 2024 submission. The German Environment Agency is currently working on a review paper covering about 40 publications, including the ongoing study, as the basis for representative country-specific EFs. Germany will also consider a new CH_4 EF for septic tanks derived from a literature review and expert opinions.
W.4	5.D.1 Domestic wastewater – CH_4 (W.6, 2020) (W.15, 2018) Accuracy	Investigate whether it is reasonable to assume the same MCF for human sewage (treated in cesspools and septic tanks) as for animal manure, noting that there are significant differences between swine and cattle slurry and that the retention time might be different between a septic tank and a slurry tank and depending on the results of this investigation, either assess whether it would be better to use the appropriate MCF values reported in table 10.17 of the 2006 IPCC Guidelines (vol. 4) than the data that were used in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, or, if animal manure is not found to be representative of human sewage, use the IPCC default MCF.	Resolved. Germany continued to apply the same MCF for human sewage (treated in septic tanks and cesspools) as for animal manure as in its previous submission because country-specific MCFs derived from a research report on emissions from septic tanks and cesspools are not yet available (see ID# W.3 above). The MCF derivation approach was explained in the NIR (section 7.5.1.1.2, p.738). The Party clarified in its NIR (section 7.5.1.1.4, p.741) that the MCF is applicable to human sewage, comparing it with the MCF value of human septic tanks in a study by Leverenz et al. (2010) as a verification procedure. The proposed country-specific MCF value is also comparable with the default MCF values proposed for liquid/slurry animal waste in the 2006 IPCC Guidelines (vol. 4, chap. 10, table 10.17, p.10.44) of 17–25 per cent for cool average annual temperature conditions.
KP-LULUCF			
KL.1	General (KP-LULUCF) – CO_2, CH_4 and N_2O (KL.9, 2020) KP reporting adherence	Update the information reported in the NIR on 'factoring out' in accounting for KP-LULUCF by applying guidance provided in section 2.3.7 of the Kyoto Protocol Supplement.	Resolved. The Party reported in its NIR (section 11.3.1.3, p.825) updated information on whether indirect or natural GHG emissions and removals have been 'factored out', namely that increased CO_2 concentrations above the pre-industrial level, indirect N deposition and dynamic effects of the age structure as a result of activities prior to 1 January 1990 were not excluded from KP-LULUCF GHG calculations. This is in accordance with the guidance provided in section 2.3.7 of the Kyoto Protocol Supplement. Germany also reported that, for FMRL preparation, the existing age-class distribution was used as the starting point for the projection when establishing the benchmark for the accounting using a net-net approach.
KL.2	General (KP-LULUCF) – CO_2, CH_4 and N_2O	Consider the issues listed in ID# L.8 (see document FCCC/ARR/2020/DEU) under the	Not resolved. The Party reported in its NIR (section 6.1.2.1, pp.538–551) that for carbon and N changes in mineral soils, the stock-difference methodology from the 2006 IPCC Guidelines (vol. 4, chap. 2.2.1) was used together with country-specific parameters. Germany also reported in NIR table 336 (p.540) the national mean carbon stock in

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
	(KL.10, 2020) Accuracy	LULUCF sector as also being relevant to KP-LULUCF.	mineral soils obtained for each land-use category and subcategory to be used for the calculation of CSCs in mineral soils without stratification, which allows for the detection of SOC changes associated with changes in the management of land with different soil types and climate condition. During the review, the Party provided additional information (see ID# L.1 above) to demonstrate that its approach to calculating SOC changes associated with changes in the use and management of land with different soil types and climate conditions at a minimum does not result in the understimation of emissions or overestimation of removals. On the basis of information provided during the review to show the conservative nature of the Party's approach, the ERT concluded that this potential problem of a mandatory nature does not influence the Party's ability to fulfil its commitments for the second commitment period of the Kyoto Protocol and therefore the accuracy issue was not included in the list of potential problems and further questions raised.
KL.3	General (KP-LULUCF) – CO_2, CH_4 and N_2O (KL.11, 2020) Accuracy	Consider the issues listed in ID#s L.10 and L.11 (see document FCCC/ARR/2020/DEU) under the LULUCF sector as also being relevant for AR, deforestation and FM.	Resolved. The Party reported in CRF tables 4(KP-I).A.1, 4(KP-I).A.2 and 4(KP-I).B.1 reconciled CSCs for biomass and DOM comparable with the reporting under the Convention when considering that forest land converted to other land uses continues to be reported under deforestation for the whole reporting period under the Kyoto Protocol. The Party also reported reconciled areas under the Kyoto Protocol for forest management and afforestation which match the area of forest land remaining forest land and land converted to forest land (see ID#s L.4–L.7 above).
KL.4	FM – CO_2 (KL.13, 2020) KP reporting adherence	Provide information demonstrating that model-based calculations reproduce the data for FM or forest land remaining forest land for the historical period reported in the inventory.	Not resolved. The Party reported in NIR table 522 (p.849) projected emissions from the biomass carbon pool for 2013–2020, with the biomass carbon pool for 2013 projected as a source of emissions in the amount of 7,456 kt CO_2 eq. In CRF table 4.A, the biomass carbon pool on forest land reported for 2008 is a sink of 44,677.655 kt CO_2 eq. The difference between the two figures, over the five-year period, is 52,133.655 kt CO_2 eq. It was concluded by the ERT that such a difference in the annual net CSC within a short period is not justified by the modelling of future harvests or by the dynamic in the age-class distribution, given that the ageing of forests is minimal within such a short period and that the increased projected harvest rate is expected to rejuvenate the forest estate. The ERT noted that Germany has still not included information to show that its model-based calculations used for constructing a projected FMRL reproduce the data for FM or forest land remaining forest land for the historical period, and further noted that this is not in accordance with the good practice set out in the Kyoto Protocol Supplement (pp.2.97–2.98). During the review, the Party provided the ERT with information that clarifies the main parameters used for the development of emissions and removals and described the reported difference between the projected emissions from the biomass carbon pool for 2013–2020, with the biomass carbon pool for 2013 projected as a source of emissions and the biomass carbon pool on forest land reported for 2008 as a sink, as follows:

ID#	Issue/problem classification[a, b]	Recommendation from previous review report	ERT assessment and rationale
			(1) The new forest development and wood-production model simulates tree growth based on consecutive single tree measurements from the two most recent NFIs, and prolongs tree growth from the past into the future but does not fully include negative (e.g. drought) or positive (CO_2 fertilization, warming) influences. As a result, the FMRL projects an increment of 14.8 Mt CO_2 eq/year less than estimated in the 2017 Carbon Inventory covered in Schwitzgebel and Riedel (2019) using the same methods as the NFI; (2) Different wood densities and ratios between stem and other tree compartments of biomass (the latter also vary with tree age), and thus different carbon masses per m^3 of wood, were considered (on average approximately 1.3 t CO_2 eq m^3 for deciduous and 1.0 t CO_2 eq m^3 for coniferous species). The FMRL projected a higher share of broadleaved tree species in the total harvest. In the calculation based on actual data, only approximately 54 per cent of the projected broadleaves in the FMRL construction was harvested, while for conifers the figure was 98 per cent. Given the different carbon-to-volume ratios and the difference between realized and projected harvests, this deviation accounts for 32.0 Mt CO_2 eq/year of the total difference; (3) The difference between realized and projected harvests amounts to approximately 24 per cent between 2008 and 2013, or approximately 19 million m^3; (4) The level of uncertainty of approximately 10 per cent for living above-ground biomass data in the inventory, which could have an impact on both the 2017 Carbon Inventory covered in Schwitzgebel and Riedel (2019) and input data for the FMRL, could translate into an error of approximately 5 Mt CO_2 eq/year for the difference between the FMRL and the inventory. On the basis of the information provided, the ERT concluded that, despite the lack of transparency in the information in the NIR, this potential problem of a mandatory nature does not influence the Party's ability to fulfil its commitments for the second commitment period of the Kyoto Protocol and therefore this issue was not included in the list of potential problems and further questions raised.
KL.5	FM – CO_2 (KL.14, 2020) Transparency	Provide information on the main factors generating the accounted quantity under FM (i.e. the difference in net emissions between reporting of FM during the second commitment period and the FMRL) and on the difference between the projected harvest rate and the actual harvest rate.	Not resolved. The Party reported in its NIR (table 522, p.849) a projection for biomass CSCs for 2013–2020 to apply to the technical correction to its FMRL. For 2013–2020 the biomass carbon pool was projected to be a source of approximately 7.5–10.3 kt CO_2 eq, while in CRF table 4(KP-I)B.1 a net sink is reported for the same period, including a sink of –55 Mt CO_2 eq for 2020. No evidence is provided in the NIR to show that the lower sink during the second commitment period, compared with what was assumed in the 'business as usual' scenario, is quantitatively consistent with the observed higher harvest rate. This is not in accordance with the good practice set out in the Kyoto Protocol Supplement (p.2.97). During the review, Germany clarified the main factors that generate the accounted quantity under FM (i.e. the difference between the projected harvest rate and the actual

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
			harvest rate, and the difference in net emissions between reporting of FM during the second commitment period and the FMRL) (see ID# KL.4 above). On the basis of the information provided, the ERT concluded that, despite the lack of transparency of the information provided in the NIR, this potential problem of a mandatory nature does not influence the Party's ability to fulfil its commitments for the second commitment period of the Kyoto Protocol. Therefore, the ERT did not include this issue in the list of potential problems and further questions raised by the ERT.
KL.6	FM – CO_2 and N_2O (KL.15, 2020) Completeness	Consider the issues listed in ID# L.11 (see document FCCC/ARR/2020/DEU) under the LULUCF sector (FM) as also being relevant to KP-LULUCF.	Resolved. The Party reported reconciled estimates of CSC in the biomass and DOM carbon pools for forest land remaining forest land and land converted to forest land, and reconsidered forest area reported under the Convention and its Kyoto Protocol to make it consistent for the whole time series (see ID# L.7 above).
KL.7	FM – CO_2 (KL.16, 2020) Transparency	Consider the issue listed in ID# L.9 (see document FCCC/ARR/2020/DEU) under the LULUCF sector (FM) as also being relevant to KP-LULUCF.	Not resolved. The Party reported in its NIR (sections 6.1.2.1.3, p.543, and 6.4.2.5.4, pp.629–630) the methodology used to estimate the net SOC increment in mineral soils in forest land, which was reported as 0.41 t C/ha. The methodology is based on a comparison of the total forest SOC determined from two consecutive national forest soil inventories. The Party did not report any additional information that improved the transparency of the steps and data used in the calculation of the SOC change in order to demonstrate that the calculated SOC change is not biased by changes in forest area over time. During the review, the Party clarified that the calculated SOC change in mineral soils is not affected by changes in forest area because the results are area-based and represent a specific soil volume regardless of the extent to which the forest has changed. The carbon content was calculated using bulk density, fine earth material (< 2 mm), layer thicknesses and SOC concentrations. In order to calculate area-based values, bulk density and soil depth were used. The temporal and spatial variations of the modelled SOC stocks depend on initial conditions, boundary conditions and the mean value of the national forest soil inventory plots covering the specific stratum. The initial conditions include the SOC stocks at the first measurement and their distribution in the respective model pools. The boundary conditions include climate variables and the biomass input. Changes in forest area were not considered in the applied SOC model. The ERT considered the information provided during the review and concludes that, although the transparency issue in the NIR has not been resolved, this issue has no impact on the accounting of KP-LULUCF and therefore does not influence the Party's ability to fulfil its commitments for the second commitment period of the Kyoto Protocol. Therefore, the ERT did not include this issue in the list of potential problems and further questions raised by the ERT.
KL.8	CM – CO_2 (KL.5, 2020) (KL.10,	Stratify the CM estimates, considering the short-rotation coppice, based on the	Resolved. The Party reported in its NIR (table 394, pp.648–649) disaggregated CO_2, N_2O and CH_4 emissions and removals for all carbon pools for seven subcategories of cropland, namely annual crops, hops, vineyards, orchards, tree nurseries, Christmas tree

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
	2018) (KL.12, 2016) (KL.12, 2015) Accuracy	methodology provided in the Kyoto Protocol Supplement.	plantation and short-rotation plantations. The ERT acknowledged that Germany reported for the first time in its NIR (section 6.1.2.3.4, pp.558–560) CSCs at the time at which they occur, taking into account the complete growth cycles of the various woody grassland plants and understory vegetation which is in line with the Kyoto Protocol Supplement (p.2.138). The Party also reported in its NIR (section 11.3.1.1, p.816 and tables 490–491, p.819) the impact of the correction of emissions from land that was cropland during the base year only, and not during the commitment period, which are reported as "0" if the land has been moved into a non-elected or non-accountable category (woody grassland, terrestrial wetlands, waters, peat extraction or settlements), which is in line with the Kyoto Protocol Supplement (p.2.136).
KL.9	CM – CO_2 (KL.7, 2020) (KL.12, 2018) (KL.13, 2016) (KL.13, 2015) Accuracy	Estimate and report the CSCs for woody biomass in accordance with the 2006 IPCC Guidelines and the Kyoto Protocol Supplement, taking into consideration the biomass accumulation from growth and the losses associated with harvest, gathering or disturbance.	Resolved. The Party reported in its NIR (section 6.1.2.3.4, pp.558–559) for the first time CSCs for woody biomass at the time at which they occur across the whole time series, taking into account the complete growth cycle (including the biomass accumulation from growth and the losses associated with harvest, gathering or disturbance), which is in line with the 2006 IPCC Guidelines (vol. 4, chap. 5.2.1.1) (see ID# KL.8 above).
KL.10	CM – CO_2 (KL.17, 2020) Accuracy	Apply good practice, as set out in the 2006 IPCC Guidelines (vol. 4, chaps. 2 and 5), and the Kyoto Protocol Supplement (chap. 1), for estimating changes in forest biomass carbon stocks in order to estimate annual emissions and removals associated with biomass CSCs in short-rotation plantations.	Resolved. The Party reported in its NIR (section 6.1.2.3.4, pp.558–559) for the first time biomass CSCs in short-rotation plantations at the time at which they occur across the whole time series, which is in line with the 2006 IPCC Guidelines (see ID#s L.8 and KL.8 above).
KL.11	CM – CO_2 (KL.18, 2020) Transparency	Consider the issues listed in ID#s L.9, L.10 and L.12 (see document FCCC/ARR/2020/DEU) under the LULUCF sector (CM) as also being relevant to KP-LULUCF.	Addressing. Regarding ID# L.9 (see document FCCC/ARR/2020/DEU) corresponding to ID#s L.3 and KL.7 above, the Party did not report any additional information that improved the transparency of the steps or data used in the calculation of the SOC change in order to demonstrate that the calculated SOC change is not biased by changes in forest area over time. The information provided by the Party during the review is provided in ID# L.3 above. Regarding ID#s L.10 and L.12 (see document FCCC/ARR/2020/DEU) corresponding to ID#s L.4, L.5 and L.8 above, the Party reconciled the CSCs for biomass and DOM for each reported year in a way comparable with its reporting under the Kyoto Protocol. The Party also reported the CSCs of biomass in short-rotation plantations at the time at which they occur for the whole time series, taking into account the complete growth cycle. Noting that accuracy of the estimates is ensured, although the recommendation on transparency was not resolved under Convention reporting (see ID# L.3 above), the ERT concluded that the issue has no impact on the accounting of KP-LULUCF and does not influence the Party's ability to fulfil its commitments for the second commitment period

ID#	*Issue/problem classification*[a, b]	*Recommendation from previous review report*	*ERT assessment and rationale*
			of the Kyoto Protocol. Therefore, this issue was not included in the list of potential problems and further questions raised.
KL.12	CM and GM – CO_2 (KL.19, 2020) KP reporting adherence	Consider the issue listed in ID# L.14 (see document FCCC/ARR/2020/DEU) under the LULUCF sector (CM and GM) as also being relevant to KP-LULUCF.	Not resolved. The Party reported in its NIR (section 6.1.2.1.1, p.539) that for mineral soils with no use or name change, in land-use categories 4.B–4.F, it is assumed that carbon inputs into the soil and carbon extractions from the soil are equal in size, so the systems remain in equilibrium. Germany did not report any information on the verification of reported estimates by applying the default methodology in the 2006 IPCC Guidelines (vol. 4, chaps. 2, 5 and 6, and equation 2.25) to estimate SOC changes in cropland remaining cropland and grassland remaining grassland associated with land management changes. During the review, the Party provided additional information demonstrating its conservative approach to reporting CSC in mineral soils for cropland remaining cropland and grassland remaining grassland (see ID# L.10 above). On the basis of the information provided and proof of the conservative nature of the estimates, the ERT concluded that this potential problem of a mandatory nature does not influence the Party's ability to fulfil its commitments for the second commitment period of the Kyoto Protocol and therefore this issue was not included in the list of potential problems and further questions raised.

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

[b] The report on the review of the 2021 annual submission of Germany was not available at the time of this review. Therefore, the recommendations reflected in this table are taken from the 2020 annual review report. For the same reason, 2021, 2019 and 2017 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

9. 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 2022 annual submission of Germany, 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 Germany

ID#	*Previous recommendation for issue*	*Number of successive reviews issue not addressed*[a]
General		
G.1	Annually review, and if necessary update, the information in the NIR with respect to the calculation of the CPR, ensuring that it is calculated on the basis of the most recent information.	4 (2015/2016–2022)
Energy		
E.2	Include in the NIR the main assumptions used in establishing the provisional energy balance.	3 (2018–2022)
IPPU		
I.4	Report on how time-series consistency was ensured, given the use of different methods in the time series.	4 (2015/2016–2022)
Agriculture	No issues identified.	
LULUCF	No issues identified.	
Waste		
W.1	Update the k-values used in the emission estimation as soon as the data from the research projects that will determine national k-values are available, or, if the results are not available in time for the 2019 submission, include the status of these projects in the NIR, including a timeline for the implementation of their results in the inventory.	3 (2018–2022)
W.3	Implement the results of the study that will produce better documented EFs as soon as the data are available, or, if the results are not available in time for the 2019 submission, include the status of this study in the NIR, including a timeline for the implementation of its results in the inventory.	3 (2018–2022)
KP-LULUCF	No issues identified.	

[a] Reports on the reviews of the 2017, 2019 and 2021 annual submissions of Germany have not yet been published. Therefore, 2017, 2019 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 2022 annual submission

10. Table 5 presents findings made by the ERT during the individual review of the 2022 annual submission of Germany that are additional to those identified in table 3.

Table 5
Additional findings made during the individual review of the 2022 annual submission of Germany

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
General			
G.4	NIR	The Party reported in its NIR for all sectors the extensive use of country-specific EFs. Several of the country-specific EFs are based on expert judgment, but no proper documentation (e.g. a form as included in the 2006 IPCC Guidelines (vol. 1, chap. 2, annex 2A.1)) was included for this expert judgment in the NIR. During the review, the Party provided references for the experts and organizations involved but without providing the necessary documentation to support the expert assessments (i.e. a logical basis for the judgment and the associated empirical evidence) (see ID# E.1 in table 3 and ID#s E.10, E.13, I.11, I.12 and I.14 below). During the review, Germany also explained that, owing to restrictions under legislation on personal data, the documentation relating to expert judgment could not be included in the NIR, but may be provided upon request to the ERT. The ERT recommends that the Party archive all documentation related to expert judgment, ensuring easy accessibility for review on request by the ERT. (For specific recommendations related to the documentation of expert judgment in the NIR refer to ID#s E.10, E.13, I.11, I.12 and I.14 below.)	Yes. Convention reporting adherence
G.5	NIR	The Party's inventory mostly uses country-specific EFs and national research studies and reports for which references are provided in the NIR. However, the ERT noted that, in a number of cases, a short description of the methodology used or explanation as to why the country-specific EF is outside the range of the default values in the 2006 IPCC Guidelines is missing (e.g. see ID#s E.8, E.9, E.10, I.13, I.14 and A.8 below) in the dedicated NIR sections on category-specific QA/QC and verification. During the review, the Party provided additional references in a number of cases but did not always provide sufficient information to explain why certain EFs are much higher or lower than the default values. Germany further stated that an analysis of the individual EFs cannot be carried out as it uses several thousand EFs. The ERT encourages the Party to reduce the number of cross-references to external documents and summarize the key elements of the methodologies and justifications for country-specific EFs for the key categories (in particular where they are lower than the default EFs) within the main body of the NIR.	Not an issue/problem
Energy			
E.5	1. General (energy sector) – all fuels – CO_2, CH_4 and N_2O	The Party continued to rely on a provisional (i.e. not final) energy balance for estimating energy emissions for the most recent inventory year (2020). Germany reported in its NIR (section 18.5.1, p.884) details on the energy balance used for compiling the inventory, and a comparison between the final and provisional energy balances used in the 2021 submission to demonstrate the impacts of replacing provisional with final data. In addition, the	Not an issue/problem

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
		Party reported in its NIR (table 534, p.887) information on its energy data action plan for inventory improvement. Item 2.2 of that plan states that inventory compilers were working with the Working Group on Energy Balances to obtain more timely access to the final energy balance for the most recent year. However, the ERT noted that neither the provisional nor the final energy balance for the latest inventory year was included in the NIR. During the review, the Party confirmed that inventory compilers had been working with the Working Group on Energy Balances and the German Federal Statistical Office to obtain more timely access to the final energy balance for the most recent year. As a consequence, the German Federal Statistical Office started a project in cooperation with the statistical office of the EU to deliver energy data every August for the preceding year. The project was established under an EU grant for the improvement of the timeliness of energy statistics and started in 2020. For 2022 onward, the improved statistical data on energy will be used to compile the preliminary energy balance that is delivered to the inventory compilers for further inventory work in September. This procedure will lead to substantial improvements and reduce the differences between provisional and final energy data in the inventory. The ERT encourages the Party to continue to facilitate collaboration between inventory compilers, the Working Group on Energy Balances and the German Federal Statistical Office to ensure that the final energy balance for the most recent inventory year is made available in time for the preparation of that inventory, and to include the final energy balance in annex 4 to the NIR. The ERT also encourages the Party to include in its NIR an update on the project for improving the timely provision of energy statistics, if the project has not yet been finalized at the time of the next submission.	
E.6	Feedstocks, reductants and other NEU of fuels – liquid fuels – CO_2	The Party reported in CRF table 1.A(d) 103,011 TJ (or 2,114.9 kt C excluded from the reference approach) for the NEU of gasoline for 2018 in the 2020 submission, but used "NO" for the same year in the 2021 and 2022 submissions. The Party also reported "NO" for the NEU of gasoline for 2019 in the 2021 submission, but 145,365 TJ (2,984.55 kt C excluded from the reference approach) in the current submission. No explanation was provided in the NIR for these significant recalculations. In addition, the NEU of gasoline was reported only for 2019 and 2020 in the current submission and "NO" reported for the rest of the time series. In CRF table 1.A(d), the fuel quantity and C/CO_2 excluded are reported, but the carbon EF and CO_2 emissions from NEU were reported as "NA" without further explanation. During the review, Germany explained that the information on the NEU of fuels is taken directly from line 43 of the national energy balance. The Party did not provide a justification for the significant recalculations for the 2018 and 2019 inventory years between the 2020, 2021 and 2022 submissions or for the NEU of gasoline and the alignment of the revised data with the sectoral approach. The ERT recommends that the Party (a) review the time series for the NEU of gasoline and recalculate it, if necessary, (b) explain in which year emissions from this source began in the time series, and (c) clarify whether emissions from the NEU of gasoline are reported elsewhere in the inventory. The ERT also recommends that the Party explain the underlying drivers if further recalculations take place for the NEU of gasoline.	Yes. Accuracy
E.7	Fuel combustion – reference approach – all fuels	The Party reported in CRF table 1.A(b) information on production, imports, exports, stock change and apparent consumption in energy units (TJ). Footnote (1) in CRF table 1.A(b) states that if consumption data are not reported in physical units, the NCVs should be reported at a similar level of disaggregation as fuel types in the NIR and an indication should be provided in the documentation box as to where this information is reported. The	Yes. Transparency

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		ERT noted that no NIR references were provided in the documentation box and that NCVs were not included in CRF table 1.A(b) or in the NIR. During the review, Germany stated that it would investigate this issue and aim to provide the missing data in its next annual submission. The ERT recommends that the Party include the NCVs for all fuels included in the reference approach.	
E.8	1.A.1.a Public electricity and heat production – biomass, CO_2 and CH_4	The Party reported in CRF table 1.A(a)s1 recalculated emissions for biomass consumption under subcategory 1.A.1.a.iv (energy industries – other) for 2003 onward. This led to an increase in emissions of CO_2 of 2.0 per cent (860.8 kt) in 2018 and 2.3 per cent (970.5 kt) in 2019 when compared with the figures in the 2021 submission. It also led to a reduction in CH_4 emissions of 1.2–24.5 per cent/year for 2003–2019 when compared with the 2021 submission. The ERT noted that the trends in the recalculations for CO_2 and CH_4 did not correlate and also noted that the CH_4 IEF for biomass for subcategory 1.A.1.a (public electricity and heat production) of 115.07 kg/TJ was the highest among all reporting Parties (0.05–110.93 kg/TJ excluding Germany), and more than twice as high as that reported by any other Party, except one (0.05–42.22 kg/TJ). During the review, Germany explained that CH_4 emissions depend not only on the combustion technology used but also on the plant size. It therefore distinguished between medium-sized combustion plants, which are regulated by the EU directive on medium combustion plants, and small-sized combustion plants. The disaggregation between the types of plant changed, which led to the recalculation of emissions. The Party did not explain the relevance of technology type or plant size to the calculation of its CH_4 IEF, the differences observed in CO_2 emissions compared with those reported in the 2021 submission, or the reason for having the highest CH_4 IEF of all reporting Parties. The ERT recommends that the Party describe in more detail in the NIR the methodology, data and assumptions used to report emissions from biomass consumed under subcategory 1.A.1.a (public electricity and heat production), including the sources used for the EFs for the combustion plants regulated by the EU directive on medium combustion plants and small-sized combustion plants. The ERT also recommends that the Party adequately explain relevant recalculations made in the NIR to ensure that sufficient information is provided to show whether or not the recalculations were made in accordance with the 2006 IPCC Guidelines.	Yes. Transparency
E.9	1.A.3.b.i Cars – liquid fuels – CO_2	The Party reported in CRF table 1.A(a)s3 CO_2 IEFs for gasoline for 1990–2020 (73.02–75.29 t/TJ) that were outside the range of the default values in the 2006 IPCC Guidelines (67.50–73.00 t/TJ; vol. 2, chap. 3, table 3.2.1). The 2020 value (75.29 t/TJ) was the second-highest reported by Parties (69.30–75.47 t/TJ). During the review, Germany explained that its country-specific values were compared with those provided by Parties such as Denmark, France, the Netherlands and the United Kingdom of Great Britain and Northern Ireland and found to be comparable, as also shown in the NIR (table 57, p.217). The Party also explained that the increase in the CO_2 IEF for 2015–2020 was the result of a recalculation of the NCV by the Working Group on Energy Balances. Furthermore, the Party explained that the country-specific EF will be revised in the next submission on the basis of information from a measurement study compiled in 2021. The ERT noted that information on the NCV revision for 2015 onward and the planned improvements for the NCV for the 2023 submission onward was not included in the NIR.	Yes. Transparency

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		The ERT recommends that the Party provide in the NIR the NCVs used for gasoline for subcategory 1.A.3.b.i (cars) across the time series, providing references for the sources of the NCV values and an explanation of their impact on the CO_2 IEF trend. The ERT encourages the Party to include either the results of the 2021 measurement study for recalculating gasoline NCVs from the 2020 inventory year or a description of progress in implementing the 2021 measurement study in the planned improvement sections of the NIR.	
E.10	1.B.2 Oil, natural gas and other emissions from energy production – liquid fuels, gaseous fuels – CO_2 and CH_4	The Party reported in its NIR numerous instances of expert judgment used to explain EF values and methodological assumptions across the fugitive emissions categories, including for the following subcategories: (a) 1.B.2.a.2 (oil production). The descriptions of the method and EFs in the NIR (section 3.3.2.1.2.1 and table 105, pp.261–262) state that a tier 2 method with country-specific EFs was used, and that the source of this information was expert judgment. The NIR states that the emissions were measured, or calculated, by operators in a report by the German Association for Natural Gas, Petroleum and Geothermal Energy, which led the ERT to believe that a mixture of EFs may be used (default, country- and/or plant-specific). Neither the NIR nor the report by the German Association for Natural Gas, Petroleum and Geothermal Energy include information on the methodology for the estimates. During the review, Germany reiterated that the emissions are measured, or calculated, by operators in the aforementioned report but did not provide any further information; (b) 1.B.2.a.4 (oil refining/storage (anode production)). The Party explained in its NIR (section 3.3.2.1.4.2, pp.267–268) that the source of all GHGs for anode production was EU ETS data. The ERT noted that it was not clear from the NIR whether emissions were measured or if EFs were applied (and, if the latter, the source of the EFs). During the review, Germany explained that AD and the resulting emission data from the EU ETS were used and that EFs were therefore calculated. This information did not adequately explain the methodologies for the calculation of the emissions, which confirmed the use of a tier 2 methodology and country-specific EFs for all years; (c) 1.B.2.a.4 (oil refining/storage (tank storage facilities in refineries)). The Party explained in its NIR (section 3.3.2.1.4.2, p.267) that the CH_4 EF for tank storage facilities in refineries was derived from fugitive volatile organic compound emissions, but did not make it clear why the assumption of 5–10 per cent of the volatile organic compound factor was used. During the review, Germany explained that information on volatile organic compounds was taken from guideline 2440 of the Association of German Engineers (VDI, 2000; chap. 4.5.1) and then divided into NMVOCs and CH_4 in line with the methodology in a study by Bender (2009) based on evaluations of emission declarations. The ERT translated the study into English and noted that it stated that emissions can be conservatively estimated at 5–10 per cent, but it was not clear whether this related to CH_4, what the logical basis for using 5–10 per cent was, or what percentage of volatile organic compounds was used to estimate CH_4 in the inventory given that a range of emissions cannot be reported; (d) 1.B.2.a.4 (oil refining/storage (tank storage facilities outside refineries)). The Party explained in its NIR (section 3.3.2.1.4.2, p.267) that the CH_4 EF for tank storage facilities outside refineries was derived using aggregated EFs, but the source of the emissions and capacities that informed these EFs was unclear (e.g. whether the emissions were measured at each plant or whether the EFs were applied to AD). The Party did not provide additional information during the review; (e) 1.B.2.b.3 (natural gas processing). A split factor of 40 per cent sour gas to 60 per cent sweet gas was applied on the basis of a technical report (WEG, 2008). During the review, the ERT asked the Party if it had verified	Yes. Transparency

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		whether or not there had been changes in the share of sour gas within the total natural gas processed in Germany since the report was published, given that the default EFs for CH_4 and CO_2 vary depending on whether the gas is sweet or sour (see the 2006 IPCC Guidelines, vol. 2, chap. 4, table 4.2.4). The Party explained that there were annual fluctuations, but that national experts consider the 40 per cent split for sour gas to still be applicable. During the review, the Party did not provide additional information on the use of expert judgment.	
		The ERT concluded that the information provided for the subcategories above is not sufficiently detailed regarding the methodologies used and rationale applied, and that the use of expert judgment is not in line with the requirements of the 2006 IPCC Guidelines (vol. 1, chap. 2, annex 2A.1) on the protocol for expert elicitation.	
		During the review, the Party indicated that it could not include some expert judgment in its NIR owing to restrictions under legislation on personal data. The Party stated that information regarding that expert judgment can be provided upon request during the review process. Germany also explained that it uses a large quantity of statistics and studies for estimating its emissions and that all data are checked for their reliability, as described in the NIR sections on category-specific QA/QC and verification.	
		The ERT recommends that, in line with the requirements under the 2006 IPCC Guidelines (vol. 1, chap. 2, annex 2A.1), the Party document the use of expert judgment that underpins the estimates for category 1.B, namely (a) country-specific EFs used to estimate CH_4 emissions for subcategory 1.B.2.a.2 (oil production), (b) CH_4 emissions for subcategory 1.B.2.a.4 (oil refining/storage (anode production, tank storage facilities in refineries, and tank storage facilities outside refineries)), and (c) the split factor of 40 per cent sour gas to 60 per cent sweet gas for estimating CO_2 and CH_4 emissions for subcategory 1.B.2.b.3 (natural gas processing), and hold the relevant documentation at the German Environment Agency (the single national entity of Germany), to be provided for review upon request by the ERT.	
		The ERT encourages the Party to update the information in the NIR and CRF tables to improve clarity on the source of the EFs and methodologies used for each subcategory under category 1.B.2 (oil, natural gas and other emissions from energy production).	
E.11	1.B.2.a Oil – liquid fuels, gaseous fuels – CO_2 and CH_4	The Party reported in its NIR (section 3.3.2.1.1, p.261) that CO_2 and CH_4 emissions for subcategory 1.B.2.a.1 (oil exploration) were estimated using a tier 1 method and the IPCC good practice guidance default EFs (noting that emissions for subcategory 1.B.2.b.1 (gas exploration) are included in this total). This conflicted with the methods and EFs reported as input to CRF summary 3, which listed a tier 2 method and country-specific EFs for CO_2 and CH_4 emissions for this category.	Yes. Convention reporting adherence
		During the review, Germany confirmed that the information in the NIR represented the methodology used, and that it would correct the information describing the methods and EFs meant for CRF summary 3 in its next submission.	
		The ERT recommends that the Party ensure consistency between the information in the NIR and CRF tables by updating the input to CRF summary 3 in terms of methods and EFs used to estimate CO_2 and CH_4 emissions for category 1.B.2.a.1 (oil exploration), namely a tier 1 method and default EF for CO_2 and CH_4 for all years.	
E.12	1.B.2.a Oil – liquid fuels –CH_4	The Party reported in its NIR (section 3.3.2.1.3, p.263) that the CH_4 emissions for subcategory 1.B.2.a.3 (oil transport) were calculated using tier 2 methods, with country-specific EFs. The information provided as input to CRF summary 3 states that the CH_4 EF was country-specific and the method was tier 2 for all years. The ERT	Yes. Convention reporting adherence

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		noted, however, that this information conflicted with the description provided in the NIR (section 3.3.2.1.3.2, p.264), which states that the CH_4 EF for pipelines was taken from the 2006 IPCC Guidelines, whereas the CH_4 EF for inland waterway tankers was estimated using a technical report (Theloke et al., 2013). During the review, the Party confirmed that the information for subcategory 1.B.2.a.3 aggregated in CRF summary 3 should reflect tier 1 and tier 2 for CH_4 methods and default and country-specific for CH_4 EFs for all years. The ERT recommends that the Party correct the description in NIR section 3.3.2.1.3.2 to reflect the CH_4 methods and EFs used, and ensure consistency between the NIR and the CRF regarding the information on methods and EFs used, namely tier 1 and 2 methods and default and country-specific EFs for CH_4 for all years.	
E.13	1.B.2.a Oil – liquid fuels – CO_2	The ERT noted that "NA" was used to report CO_2 emissions for subcategory 1.B.2.a.3 (oil transport) in CRF table 1.B.2. The Party explained in its NIR (section 3.3.2.1.3.4, p.265) that it did not report any emissions for this subcategory based on country-specific information from the Association of the German Petroleum Industry, despite a default EF factor being provided in the 2006 IPCC Guidelines (vol. 2, chap. 4, table 4.2.4). During the review, Germany was asked to provide more information on the technical judgment used to support reporting CO_2 as "NA" for this subcategory. The Party explained that the Association of the German Petroleum Industry reaffirmed via telephone, on 28 September 2022, before the review week, the assumption that there are no emissions for the subcategory. The Party further explained that pipelines are constantly monitored, and the Association has repeatedly confirmed that there are no fugitive CO_2 emissions from oil transport. Written evidence was not available to support this expert judgment during the review. The ERT noted that this was not in accordance with the UNFCCC Annex I inventory reporting guidelines or annex 2A.1 of the 2006 IPCC Guidelines (vol. 1, chap. 2) on the protocol for expert elicitation, which describes how expert judgment should be made, verified and documented. The Party further explained that, given the relevant default EF in the 2006 IPCC Guidelines (vol. 2, chap. 4, table 4.2.4) of 4.9×10^{-7} kt/1,000 m³ and considering the transported amount in Germany was around 83 Mt (assuming a density of 900 kg/m³, this equates to 92,000 x 1,000 m³), the resulting emissions would be 0.04 kt CO_2. The ERT notes that the value is well below the significance threshold for application of an adjustment in accordance with decision 22/CMP.1, annex, paragraph 80(b), in conjunction with decision 4/CMP.11 (364.37 kt CO_2 eq in 2020 for Germany) and therefore this issue was not included in the list of potential problems and further questions raised. The ERT recommends that the Party (a) estimate CO_2 emissions for subcategory 1.B.2.a.3 (oil – transport) and report them in CRF table 1.B.2 in line with the 2006 IPCC Guidelines (vol. 2, chap. 4, table 4.2.4); (b) report CO_2 emissions for this category as "NE" and document the notation key in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines, including the approximate default emissions of 0.04 kt CO_2 provided during the review, in the assessment of completeness in the NIR (annex 5); or (c) continue to report the CO_2 emissions in table 1.B.2 as "NA" and include in the NIR a relevant justification in line with annex 2A.1 of the 2006 IPCC Guidelines (vol. 1, chap. 2).	Yes. Completeness
E.14	1.B.2.a Oil – liquid fuels – CH_4	The Party reported in its NIR (section 3.3.2.1.4.2, p.267) that, for subcategory 1.B.2.a.4 (oil refining/storage – tank storage facilities outside refineries) all gaseous petroleum product emissions were moved from subcategory 1.B.2.a.4 (oil refining/storage) to category 2.B.10 (chemical industry – other – storage of chemical products not considered as fuels), and that a split factor was applied to reallocate liquid petroleum product emissions between	Yes. Transparency

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		subcategories 1.B.2.a.4 and 2.B.10. This led to recalculations of CH_4 emissions for these two subcategories. The ERT noted that no explanation was provided in the NIR as to why all emissions from gaseous petroleum, but only a portion of emissions from liquid petroleum products, were moved to category 2.B.10. The ERT also noted that the source of the split factor used and its derivation were unclear. The ERT further noted that the 2006 IPCC Guidelines (vol. 2, chap. 4.2, p.4.32) state that fugitive emissions are excluded from category 1.B.2 when they occur at industrial facilities other than oil and gas facilities. The ERT therefore considered that the change in allocation was appropriate but noted that it was not adequately explained in the NIR. During the review, Germany explained that the data available only allowed for a split between gaseous and liquid mineral products, but not gaseous fuels, used in non-industrial sectors. It therefore considered it appropriate to report all gaseous products under category 2.B.10. Regarding the split between energy and the NEU of fuels, the Party used the ratio of gasoline to naphtha also applied to NMVOC emissions. Since the production quantities of gasoline and naphtha were similar in size, a split factor of around 50 per cent was applied across the time series, such as 16,217.89 kt gasoline (58 per cent) and 11,804.40 kt naphtha (42 per cent) in 2020. The emissions calculated for all liquid mineral oil products across all years in the time series were multiplied by the ratio factors. The ERT recommends that the Party describe in more detail in the NIR the assumptions, data and references used to disaggregate liquid petroleum products emissions between subcategory 1.B.2.a.4 (oil refining/storage) and category 2.B.10 (chemical industry – other), including the logical basis and split factors used across the time series. The ERT further recommends that the Party explain in the NIR that the data available do not allow for a split between gaseous fuels associated with subcategory 1.B.2.a.4 (oil refining/storage) and category 2.B.10 (chemical industry – other) and that the aggregate of emissions for both categories are reported together under category 2.B.10.	
E.15	1.B.2.b Natural gas – gaseous fuels – CO_2 and CH_4	The Party reported in its NIR (table 135, p.273) the EFs, methods and sources for natural gas production. The sources are listed as expert estimates and the methods used for estimating CO_2 and CH_4 are listed as tier 2. The Party reported the input to CRF summary 3 in terms of methods and EFs used as country-specific for CO_2, which is not consistent with the information in the NIR regarding the method used for CO_2. Germany reported in its NIR (section 3.3.2.2.2.2, p.273) that the emissions for natural gas production are calculated in line with a tier 2 method, but also reported that the default values from the 2006 IPCC Guidelines (vol. 2, chap. 4.2.2.3) were used for 1990–1998, whereas data collected through the annual statistical reports of the German Association for Natural Gas, Petroleum and Geothermal Energy were used for 1999–2020. The methods and assumptions used to derive emissions in the reports of the German Association for Natural Gas, Petroleum and Geothermal Energy are not described in the NIR or the report itself, and it was therefore unclear to the ERT whether the calculations were compliant with the tier 2 methods described in the 2006 IPCC Guidelines. The ERT noted that the description in the NIR suggests use of a tier 1 method and default EF for 1990–1998 and of a tier 2 method and country-specific EFs with data from the German Association for Natural Gas, Petroleum and Geothermal Energy from 1999 onward. The information in CRF Reporter, however, shows that, across the time series, a tier 2 method and country-specific EF were used for CH_4 and that a country-specific method and EF were used for CO_2. The NIR does not explain how time-series consistency is maintained despite the use of different methods between the start and end of the time series.	Yes. Consistency

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		During the review, the Party provided examples of the reports from the German Association for Natural Gas, Petroleum and Geothermal Energy that are used to estimate emissions for this category. Germany also described difficulties it encountered in reporting the correct method tier in CRF Reporter. The Party did not provide evidence that the two different methods used across the time series (tier 1 for 1990–1998 and tier 2 for 1999–2020) were applied in a time-series-consistent way. The ERT recommends that the Party review the methodologies used for estimating CO_2 and CH_4 emissions from natural gas production, ensuring that, where two different methods are used (i.e. tier 1 for 1990–1998 and tier 2 for 1999–2020), there is adherence to the splicing techniques for maintaining time-series consistency described in the 2006 IPCC Guidelines (vol. 1, chap. 5.3.3). The methods and any splicing techniques used should be included in the NIR with adequate information to demonstrate compliance with the 2006 IPCC Guidelines and the UNFCCC Annex I inventory reporting guidelines. The ERT also recommends that the Party update the methodological information on subcategory 1.B.2.b.2 (natural gas production) reported in CRF Reporter as input to CRF summary 3 to reflect the actual methods and EFs used (i.e. a tier 1 method and default EFs for CO_2 and CH_4 for 1990–1998 and a tier 2 method and country-specific EFs for 1999–2020), and to describe in the NIR the country-specific EFs used and how they were developed in line with the 2006 IPCC Guidelines.	
E.16	1.B.2.b Natural gas – gaseous fuels – CO_2 and CH_4	The Party reported in CRF table 1.B.2 the quantity of gas produced as AD under subcategory 1.B.2.b.2 (natural gas production). The quantity of gas produced (and corresponding emissions) declined sharply (75.5 per cent) from 21,059,000,000 m³ in 2003 to 5,155,390,671 m³ in 2020. The ERT could not find an explanation for or description of this trend in the NIR. During the review, the Party explained that the decrease in gas production was predominantly caused by tightened regulations in the light of sociopolitical considerations. No fracking has been carried out in Germany since 2011 and unconventional fracking was completely banned in the country in 2017. Another cause for the decrease is the relative expense of extraction of natural gas in Germany. Around 40 per cent of domestic gas production relates to sour gas, which has a complex processing procedure. Cheap imports from abroad have made it uneconomical to expand production in Germany. The ERT recommends that the Party describe in the NIR the causes for the sharp decline in natural gas produced in Germany since 2003 (75.5 per cent for 2003–2020).	Yes. Transparency
E.17	1.B.2.c Venting and flaring – gaseous fuels – CO_2, N_2O	The Party reported in CRF table 1.B.2 the AD and IEF for gas flaring for CO_2 and N_2O as "IE", despite emission values being reported separately. The methods and EFs used to describe these data in CRF Reporter were tier 2, country-specific for CO_2 and default tier 1 for N_2O. The ERT noted that Germany presented in the NIR (table 160, p.285) the quantity of gas flared as AD but it was not clear why these AD were not included in CRF table 1.B.2. Furthermore, the Party did not explain in its NIR why the AD were reported as "IE" when emission values were reported, or include in the NIR the AD used for the N_2O estimates. During the review, the Party explained that CO_2 emissions are calculated using the amount of gas lost at production sites (tier 2 approach) while N_2O emissions are calculated using the amount of gas produced (default value). Germany did not report AD to avoid misinterpretation of its data, as for CO_2 the formula used is emission [kg] = volume flared natural gas [m³] x EF [kg/m³], whereas for N_2O the formula used is emission [kg] = amount produced [m³] x EF [kg/m³]. If the quantity of gas flared is used in both cases, it would lead to a high IEF for	Yes. Transparency

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		N_2O, whereas if the quantity of gas production is used, it would lead to a low IEF for CO_2. The Party stated that it would add explanatory information in NIR table 160 to improve transparency. The ERT noted that the 2006 IPCC Guidelines provide a range of default EFs for gas flaring (vol. 2, chap. 4, table 4.2.4), with units of measure presented per quantity of production or per quantity of raw gas feed. Either the quantity of gas produced or the quantity of raw gas feed could be relevant AD for natural gas flaring, as they would enable comparability with other Parties to be considered. The ERT also noted that including the AD used to derive emissions of CO_2 and N_2O and a more detailed description of the methods and AD used in the NIR would help avoid potential misinterpretations of the data. The ERT recommends that the Party report AD used for the N_2O estimates (natural gas production) in the NIR in a similar manner to the way that the AD used for the CO_2 estimates is reported in the NIR (table 160). The ERT further recommends that NIR table 160 is updated to indicate that the AD currently reported in the table relate to the CO_2 estimates only. The ERT also recommends that the Party include in the NIR an explanation for reporting the AD on gas flared with a notation key ("IE") in CRF table 1.B.2 when emission values are reported for CO_2 and N_2O for the subcategory.	
E.18	International bunkers and multilateral operations – liquid fuels – CH_4	The Party reported in CRF table 1.D "NA" for CH_4 emissions from aviation gasoline used in international aviation for the whole time series in its 2020 submission. Emission calculations for this category were reported for the whole time series for the first time in the 2021 submission and were subsequently revised down by 33–84 per cent across the time series in the current submission compared with the previous submission. The recalculations, however, have a minor impact on the overall emissions from domestic aviation and for the energy sector. The ERT did not find a clear explanation for the drivers of or verification process for these recalculations of bunker fuels in the NIR. During the review, the Party explained that previously, owing to a lack of information, aviation gasoline was allocated entirely to landing/take-off consumption of domestic flights. As a first step to improving the aviation gasoline split between domestic and international flights, the total consumption was split between domestic and international flights, and between landing/take-off and cruise, leading to four AD time series. The Party further explained that, although total inland deliveries are covered correctly in the national energy balance, information on smaller piston-engine aircraft is still unreliable compared with that on large kerosene aircraft, and so assumptions need to be made within the Transport Emission Model of the Institut für Energie- und Umweltforschung Heidelberg GmbH (see https://www.ifeu.de/en/methods-tools/models/tremod/). Therefore, after the introduction of the split for the first time in the 2021 submission, the disaggregation of aviation gasoline into the four time series remains an issue for revision and refinement within the underlying model. The Party stated that there is currently no schedule for finalizing the refinements. The ERT recommends that the Party explain in the NIR the data and assumptions used to split the aviation gasoline AD between international and domestic flights, and landing/take-off and cruise. The ERT encourages the Party to describe in the NIR the category-specific planned improvements for refinement of the disaggregation of aviation gasoline.	Yes. Transparency

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
IPPU			
I.11	2.B.9 Fluorochemical production – HFC-23	The Party reported in its NIR (section 4.3.9.1.2, p.329) that, since 2011, the relevant production quantities of HCFC-22 (by-product emissions) have been estimated using expert judgment, with those estimates then used to determine HFC-23 emissions. The estimates take into account comparable production facilities in other European countries. The ERT noted that (1) there is no explanation in the NIR as to how the production quantities of HCFC-22 are estimated and who performs these estimates; and (2) details and outcomes of the review of assumptions by industry representatives mentioned in the 2019 submission (p.329) are not included in the NIR. During the review, Germany clarified that (1) the estimates are provided by the only company in Germany responsible for HFC-23 emissions, using a tier 3 method, and (2) as for every review, the parameters of the calculation were assessed by interviewing industry experts and updated where necessary. In this case, the review confirmed the appropriateness of the parameters used, including EFs and AD. For more information, the Party referred the ERT to page 21 of the publication by Warncke and Gschrey (2021). The ERT recommends that the Party include in the NIR a detailed explanation of the estimation of the production quantities of HCFC-22 and HFC-23 emissions under subcategory 2.B.9.a (fluorochemical production – by-product emissions) and hold the relevant background documents (details from the review of assumptions by industry representatives, including its outcomes) at the German Environment Agency to be provided for review upon request by the ERT.	Yes. Transparency
I.12	2.B.9 Fluorochemical production – SF_6, HFC-134a, HFC-227ea	The Party reported in its NIR (section 4.3.9.2.2, p.331) that, in 2019, all EFs for fugitive emissions from fluorochemical production were reviewed during discussions with industry representatives. However, details of this review process and those involved, including any outcomes, were not included. In addition, there was no reference to the report documenting the outcomes in the NIR. During the review, Germany clarified that there are only two manufacturers of F-gases in the country and they were both interviewed and provided feedback on the EFs. As a result, the EFs for the production of SF_6 from 2014 onward were recalculated. As this review solely led to the update of EFs, the outcome was noted and directly implemented in the estimation model. The Party provided a reference to further information on the outcomes of the review on page 21 of the publication by Warncke and Gschrey (2021). The ERT recommends that the Party include in the NIR an explanation of the review of the EFs of the fugitive emissions for category 2.B.9.b (fluorochemical production – fugitive emissions) by industry representatives and hold the relevant documentation at the German Environment Agency to be provided for review upon request by the ERT.	Yes. Transparency
I.13	2.C.2 Ferroalloys production – CO_2	The Party reported for 1995–2020 a CO_2 IEF for category 2.C.2 (ferroalloys production) of 0.11 t/t, which is outside the range of default values in the 2006 IPCC Guidelines (1.3–5 t/t) (vol. 3, chap. 4, table 4.5) and the lowest of all reporting Parties (0.30–4.00 t/t excluding Germany). During the review, the Party clarified that, in category 2.C.2, only CO_2 emissions from electrode burn-off are considered as process-related emissions. CO_2 emissions related to the consumption of the reducing agent are reported under category 1.A.2 (manufacturing industries and construction) because of the structure of the underlying national energy balance, and the use of the default EF from the 2006 IPCC Guidelines would lead to double counting. The ERT considered the explanation, but noted that according to the 2006 IPCC Guidelines (vol.	Yes. Comparability

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		3, chap. 4.3.2.1), emissions from the use of reducing agents should be accounted for under category 2.C.2 (ferroalloys production). On the basis of the information in the NIR (section 4.4.2.1, p.340) that there are five ferroalloy producers in Germany, the ERT considers that a survey of these producers may provide the required AD if the reducing agent amount cannot be determined from the national energy balance. The ERT recommends that the Party collect AD on the quantities of reducing agent consumed in ferroalloys production and reallocate the CO_2 emissions related to the consumption of the reducing agent from category 1.A.2 (manufacturing industries and construction) to category 2.C.2 (ferroalloys production) in line with the 2006 IPCC Guidelines (vol. 3, chap. 4.3.2.1), while ensuring that no double counting of these emissions occurs; alternatively, the ERT recommends that the Party include information explaining the low CO_2 IEF (0.11 t/t in 2020) in category 2.C.2 (ferroalloys production) in the NIR, if the reallocation is not done.	
I.14	2.F.1 Refrigeration and air conditioning – HFC-134a	The Party reported in CRF table 2(II)B-Hs2 the product life factors for HFC-134a for subcategory 2.F.1.d (transport refrigeration) for 1995–2020 within the range of 6.28–14.09 per cent, which is below that in the 2006 IPCC Guidelines (vol. 3, chap. 7, table 7.9) default values (15–50 per cent). The 2020 value (6.28 per cent) is the lowest of that from all reporting Parties (7.00–140.76 per cent excluding Germany). During the review, Germany clarified that refrigerated containers are moved less than refrigerated vehicles, to which the range of default EFs in table 7.9 of the 2006 IPCC Guidelines applies, hence lower emissions occur. In addition, while updating the model for refrigerated containers regarding new refrigerants, the Party also assessed all other parameters of the model. During this assessment the fill for certain refrigerants was altered, as well as the product life EF. The changes are based on interviews with international experts on refrigerated containers from major refrigerated container companies. The experts interviewed stated that a product life EF of 10 per cent is no longer realistic and so the EF was adjusted, as explained in NIR section 4.7.1.2.4 (pp.387–390). The Party stated that more information on the updated calculation model for refrigerated containers can be found on page 41 of the publication by Warncke and Gschrey (2021). The ERT recommends that the Party include in the NIR an explanation of the trend of the product life factors of HFC-134a (range of 6.28–14.09 per cent) for category 2.F.1.d (transport refrigeration), which are lower than the default values of the 2006 IPCC Guidelines (vol. 3, chap. 7, table 7.9), along with relevant documentation of the expert judgment used in line with annex 2A.1 of the 2006 IPCC Guidelines (vol. 1, chap. 2).	Yes. Transparency
I.15	2.F.2 Foam blowing agents – HFCs	The Party reported in CRF table 2(II)B-Hs2 AD for category 2.F.2 (foam blowing agents) closed-cell foam products as “C” (confidential) and emissions as “IE”. An explanation for this could not be found in the relevant section of the NIR (section 4.7.2, pp.405–413), although CRF table 9 explains that “IE” was reported for emissions reported on an aggregated basis together with open-cell foam emissions for confidentiality reasons. During the review, Germany clarified that AD on the production of open-cell foam products (polyurethane integral foam, one-component polyurethane foam and extruded polystyrene hard foam blown with HFC-152a), as well as AD on the production of closed-cell foam products (rigid polyurethane foam and extruded polystyrene hard foam blown with HFC-134a), are confidential because for each product there are fewer than three producers in Germany. As the EFs for the production of open-cell foam products are 100 per cent in all cases, the emissions are also confidential and therefore reported on an aggregated basis with closed-cell foam products.	Not an issue/problem

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
		The ERT encourages the Party to include an explanation for the use of "C" for AD and "IE" for emissions from closed-cell foam products in category 2.F.2 (foam blowing agents) in the NIR.	
Agriculture			
A.7	3.B.1 Cattle – N_2O	The ERT noted that the typical animal mass for dairy cattle differed significantly from the 2020 submission (reduction of 6–10 per cent across the time series). In a similar way, the Nex rate fell by 6–7 per cent across the time series. For non-dairy cattle, the animal mass decreased by 20–30 kg and the Nex rate by about 6–7 kg/head/year. The Party stated that the reasons for the revisions for estimating typical animal mass for cattle and Nex were not stated in the current NIR as the recalculation had taken place in the 2021 submission. The changes in the animal model summarized in the 2021 NIR (section 5.3.4.5, p.506) (e.g. the new division of heifers into two subcategories that differ in terms of productivity, namely dairy heifers and female beef cattle) were explained as adjustments in line with German feeding standards. However, there were no additional clarifications on this point in the 2021 NIR or the current submission. During the review, the Party clarified that, in the 2021 submission, the estimate of typical animal mass for dairy cattle (average for the category) was revised downward owing to revisions in the estimation method for the mass of the youngest animals in this category: calculated as mass immediately after first calving, or "initial mass" in the 2020 submission, but now calculated proportionally to the mass of dairy cows immediately prior to slaughter (or "final mass"; Vos et al., 2022, section 4.3.1.2). This methodological change led to a lower typical animal mass. In turn, this leads to lower energy requirements, lower N uptake and lower Nex (as explained in the 2021 NIR, section 5.1.3.3, pp.455–458). The Party further explained that the final mass of the new subcategory dairy heifers (representing about 90 per cent of the former heifer category) was also revised downward to match the revised (lower) initial weight of dairy cattle. The revisions lowered the typical animal mass of overall non-dairy cattle significantly, with the consequence of lower Nex (described in the 2021 NIR, section 5.1.3.3, p.456). The ERT recommends the Party elaborate in the NIR fully on the basis for the updated estimates for the typical animal mass (also explaining the initial, final and average mass) and Nex rate for dairy and non-dairy cattle and explain how the new methodology is more in line with the German feeding standards, including clear references to those standards.	Yes. Transparency
A.8	3.D.a Direct N2O emissions from managed soils – N_2O	In the NIR (section 5.5.5, p.524) the Party acknowledged that emissions reported using a tier 2 method for category 3.D (direct and indirect N_2O emissions from agricultural soils) are considerably lower, in all years, than the corresponding emissions reported in the 2021 submission. The largest changes were in category 3.D.a (direct N_2O emissions from managed soils), with a downward revision of 27–30 per cent across the time series (e.g. 28.9 per cent in 2018 and 29.2 per cent in 2019). In particular, the IEFs for N_2O emissions from application of inorganic and organic N fertilizers were revised down across the time series in 2019, by 39 per cent and 35 per cent respectively, with values (e.g. 0.006 and 0.007 kg N_2O–N/kg N in 2020 respectively) lower than the default EF of 0.01 kg N_2O–N/kg N in the 2006 IPCC Guidelines (vol. 4, chap. 11, table 11.1). For all the changes, the Party made reference to the new methodology applied (Mathivanan et al., 2021). During the review, the Party clarified that the new country-specific EFs applied for the tier 2 method are based on a literature review and analysis of German field studies of N_2O emissions with known inputs of N (Mathivanan et al., 2021) covering over 30 years and the whole country and region-specific EFs for all German regions. Data are based	Yes. Transparency

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		on the climate and mix of mineral and organic soils using 676 field measurements of N_2O emissions carried out at 43 sites in Germany. The results of the analysis yielded regional EFs in the range of 0.0038–0.0092 kg N_2O–N/kg N applied (as weighted averages for mineral and organic soils). Germany also stated that the mean IEF for inorganic fertilizers reported for 2019 and 2020 of 0.006 kg N_2O–N/kg N (CRF table 3.D and NIR table 316, p.521) is below the default EF in the 2006 IPCC Guidelines, but still within the uncertainty range of 0.003–0.3 kg N_2O–N/kg N (2006 IPCC Guidelines, vol. 4, chap. 11, table 11.1) for EFs using the tier 1 methodology, as well as within the confidence interval of the updated EFs in the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (0.001–0.018 N_2O–N/kg N), which was confirmed by the ERT. The ERT considers that the explanation of the method used to derive the new EFs for the tier 2 methodology provided in the NIR (section 5.5.2.1.1, pp.515–516) and in the supplementary material (Mathivanan et al., 2021) and the justifications provided during the review were sufficient to support the EFs used.	
		The ERT recommends that the Party include in the NIR further information on the development of EFs for N_2O emissions from application of inorganic and organic N fertilizers, along with a detailed comparison with the default values from the 2006 IPCC Guidelines (vol. 4, chap. 11, table 11.1).	
A.9	3.D.a.2.b Sewage sludge applied to soils – N_2O	For the AD (N input from sewage sludge applied to soils) for subcategory 3.D.a.2.b (sewage sludge applied to soils), the following inter-annual changes were identified as significant: 1994/1995 (34.5 per cent) and 2016/2017 (–24.3 per cent).	Yes. Transparency
		During the review, the Party clarified that N quantities of sewage sludge application are based on statistical data, which are available for each individual year, and that the reasons for the high inter-annual changes are not known to the inventory compilers.	
		The ERT recommends that the Party work with data suppliers to establish the underlying reasons for the high inter-annual variations of N input from sewage sludge applied to soils and include explanatory information in its NIR.	
LULUCF		No findings for the LULUCF sector additional to those included in table 3 were made by the ERT during the review for Germany.	
Waste			
W.5	5.B.1 Composting – CH_4, N_2O	Germany reported in its NIR (section 7.3.1.2, p.726) the use of a country-specific CH_4 EF (1.4 g CH_4/kg waste) and N_2O EF (0.074 g N_2O/kg waste) for composting, which are both lower than the default values of 4 g CH_4/kg wet waste and 0.24 g N_2O/kg wet waste in the 2006 IPCC Guidelines (vol. 5, chap. 4, table 4.1). The Party explained in its NIR (section 7.3.1.2, pp.725–727) that the types of composting system and waste are the main factors affecting emissions from composting systems; therefore, Germany derived the EFs from the median value of all measured emission values from the 19 composting facilities reported in Cuhls et al. (2015), instead of using the default average values in the 2006 IPCC Guidelines (vol. 5, chap. 4, table 4.1) as those are considered very high and fluctuated highly among composting facilities.	Yes. Transparency
		In response to a question raised by the ERT, Germany provided information on the types of composting systems used in the country, the share of waste treated in each system, and mean and median values of CH_4 EFs and N_2O EFs for each composting system, obtained from the report of Cuhls et al. (2015). On the basis of this information,	

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
		the ERT agrees that the use of median values to derive country-specific CH_4 EFs would help reduce the uncertainties of EFs compared with the use of their mean values. The weighted average CH_4 EF for composting systems among all types of composting system used was checked, and the ERT concluded that the CH_4 EF value of 1.4 g CH_4/kg biowaste was justified. For N_2O EFs, the reported measured values fluctuated less, so there were smaller differences between the mean values of 87 and 77 g N_2O/t biowaste with the median values reported of 79 and 41 g N_2O/t biowaste for two closed-type systems. The mean values were 79 and 31 g N_2O/t biowaste for two open types of system, with median values of 53 and 24 g N_2O/t biowaste respectively. The weighted average of mean and median values for N_2O EFs was calculated as 66 and 49 g N_2O/t biowaste; therefore, the N_2O EF (0.074 g N_2O/kg biowaste) used in the inventory was considered conservative on the basis of both the mean and the median values of the measurement. The ERT recommends that the Party provide in the NIR detailed information on the types of compost and anaerobic digestion plants with their corresponding CH_4 and N_2O EFs, and respective shares of biowaste treated, used to derive country-specific CH_4 and N_2O EFs.	
W.6	5.D.1 Domestic wastewater – CH_4	The Party reported in its NIR (section 7.5.1.1.2, p.737) the use of a country-specific CH_4 EF for municipal wastewater treatment plants of 0.26 kg/year/inhabitant, based on the study by Becker et al. (2012). The EF was assumed to linearly decrease by half for 1990–2020 on the basis of a study by Grün et al. (2013), and the Party stated in its NIR (section 7.5.1.1.2, p.738) that the reason for this reduction was an improvement in the aeration systems and optimized operational management of the wastewater treatment plants. The ERT noted that a decrease in emissions for those reasons would take place during biological treatment, which represents only a fraction of emissions from the whole treatment process, so the ERT requested the Party to clarify the contribution of emissions in each step of the mechanical and biological process based on the study by Becker et al. (2012). During the review, Germany clarified that 90 per cent of CH_4 emissions originate from sludge treatment and accepted that its statement regarding improved aeration and operation optimization as the reason for this decrease was confusing. The Party also informed the ERT that it plans to keep a constant CH_4 EF value for 2020 onward. The information will be corrected and reported in the next submission. The ERT noted that the country-specific CH_4 EF applied is higher than the default value for centralized aerobic treatment plants (MCF = 0) in the 2006 IPCC Guidelines (vol. 5, chap. 6, table 6.3) so there is no underestimation of emissions for this category. The ERT recommends that the Party update in the NIR the information on the underlying reason for the decrease in the CH_4 EF for wastewater treatment plants and provide an explanation of the trend before and after 2020. The ERT also recommends that the Party provide details on the contribution of various sources in the estimated emissions and the improvement measures performed in the sludge treatment units that led to the decrease in CH_4 emissions in domestic wastewater sector during 1990–2020.	Yes. Transparency
W.7	5.D.1 Domestic wastewater – CH_4	The Party reported in its NIR (section 7.5.1.1.2, p.739) the use of a country-specific MCF of 0.173 for determining emissions from cesspools and septic tanks. The MCF was calculated on the basis of the weighted average of MCF between summer months (MCF = 0.35 for 3.5 months/year) and winter months (MCF = 0.1 for 8.5 months/year). Germany also explained in its NIR (section 7.5.1.1.4, p.741) that this country-specific MCF value was subject to multi-step verification and found to be only slightly different than the MCF value of 0.225 derived from the information available in the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (vol. 5, chap. 6, table 6.3) and the MCF value of 0.22 reported in the study by	Yes. Accuracy

ID#	*Finding classification*	*Description of finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		Leverenz et al. (2010), as well as being comparable with the values used by neighbouring countries. The slightly lower MCF value for Germany is explained by the lower-than-average annual air temperatures in Germany compared with the Parties in the comparison. The ERT accepted the explanation provided by the Party and noted that the country-specific MCF can be further improved if actual temperature data from Germany are used in its determination. During the review, the Party clarified that ongoing research on emissions from septic tanks and cesspools will lead to more accurate EFs for septic tanks and cesspools adjusted on the basis of biological activity using mean soil temperature. The recalculation of emissions using the new EFs is expected for the 2024 submission. The ERT recommends that the Party apply updated MCF values based on actual temperatures in Germany in the estimation of emissions when the ongoing research has been completed (or provide in the NIR information on the status of the research if not yet completed) and provide information on actual temperature conditions in Germany to justify the use of the selected MCF values.	
KP-LULUCF		No findings for KP-LULUCF additional to those included in table 3 were made by the ERT during the review.	

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

VI. Application of adjustments

11. The ERT did not identify the need to apply any adjustments for the 2022 annual submission of Germany.

VII. Accounting quantities for activities under Article 3, paragraph 3, and, if any, activities under Article 3, paragraph 4, of the Kyoto Protocol

12. Table I.5 presents the accounting quantities for KP-LULUCF reported by Germany and the final values agreed by the ERT. The final quantities of units to be issued and are presented in table I.6.

VIII. Questions of implementation

13. No questions of implementation were identified by the ERT during the individual review of the Party's 2022 annual submission.

Annex I

Overview of greenhouse gas emissions and removals and data and information on activities under Article 3, paragraphs 3–4, of the Kyoto Protocol, as submitted by Germany in its 2022 annual submission

1. Tables I.1–I.4 provide an overview of the total GHG emissions and removals as submitted by Germany.

Table I.1
Total greenhouse gas emissions and removals for Germany, base year–2020
(kt CO_2 eq)

	Total GHG emissions excluding indirect CO_2 emissions		*Total GHG emissions and removals including indirect CO_2 emissions*[a]		*Land-use change (Article 3.7 bis as contained in the Doha Amendment)*[b]	*KP-LULUCF (Article 3.3 of the Kyoto Protocol)*[c]	*KP-LULUCF (Article 3.4 of the Kyoto Protocol)*	
	Total including LULUCF	*Total excluding LULUCF*	*Total including LULUCF*	*Total excluding LULUCF*			*CM, GM, RV, WDR*	*FM*
FMRL								–22 418.00
Base year[d]	1 272 617.93	1 245 615.36	NA	NA	NA		41 260.24	
1990	1 268 921.81	1 241 919.23	NA	NA				
1995	1 090 715.50	1 115 305.36	NA	NA				
2000	1 027 336.92	1 036 926.26	NA	NA				
2010	921 074.03	935 768.36	NA	NA				
2011	895 267.37	911 243.77	NA	NA				
2012	890 853.07	916 901.02	NA	NA				
2013	910 652.86	933 987.36	NA	NA		1.53	41 320.90	–65 412.57
2014	871 833.82	894 464.54	NA	NA		–15.65	41 098.78	–65 023.52
2015	877 518.95	897 953.67	NA	NA		–31.73	40 490.49	–62 907.79
2016	878 975.43	901 442.03	NA	NA		792.23	40 016.56	–65 764.11
2017	863 618.16	885 729.47	NA	NA		750.02	39 428.27	–65 519.90
2018	830 492.43	850 541.99	NA	NA		724.47	38 597.77	–63 972.15
2019	784 842.05	799 733.99	NA	NA		639.74	37 864.41	–58 022.80
2020	717 472.61	728 737.65	NA	NA		549.05	37 017.40	–54 098.45

Note: Emissions and removals reported for the sector other (sector 6) are not included in the total GHG emissions.

[a] The Party did not report indirect CO2 emissions in CRF table 6.

[b] The value reported in this column relates to GHG emissions from conversion of forests (deforestation) in 1990 as contained in the report on the review of the Party's report to facilitate the calculation of the assigned amount for the second commitment period of the Kyoto Protocol.

[c] Activities under Article 3, para. 3, of the Kyoto Protocol, namely AR and deforestation.

[d] "Base year" refers to the base year under the Kyoto Protocol, which is 1990 for CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs, SF_6 and NF_3. The base year for CM and GM under Article 3, para. 4, of the Kyoto Protocol is 1990. For activities under Article 3, para. 3, of the Kyoto Protocol and FM under Article 3, para. 4, only the inventory years of the commitment period must be reported.

Table I.2

Greenhouse gas emissions and removals by gas for Germany, excluding land use, land-use change and forestry, 1990–2020

(kt CO_2 eq)

	CO_2[a]	*CH_4*	*N_2O*	*HFCs*	*PFCs*	*Unspecified mix of HFCs and PFCs*	*SF_6*	*NF_3*
1990	1 051 979.10	118 555.32	57 989.38	50.32	3 060.23	5 850.00	4 428.00	6.88
1995	938 613.57	104 349.86	55 250.38	2 614.28	2 085.72	5 919.11	6 467.15	5.29
2000	899 351.82	87 798.42	36 482.69	6 031.99	956.32	2 223.60	4 072.50	8.92
2010	832 540.98	58 139.52	30 841.38	10 338.94	345.37	498.26	3 002.48	61.43
2011	808 911.53	57 051.24	30 854.96	10 785.23	278.51	265.77	3 035.33	61.21
2012	813 693.05	57 597.41	31 001.08	10 966.74	242.20	282.76	3 082.59	35.21
2013	831 207.65	56 966.25	31 171.68	10 958.55	256.94	287.91	3 122.35	16.03
2014	792 255.43	55 847.31	31 704.69	11 112.82	234.33	223.53	3 066.15	20.28
2015	795 556.57	55 626.71	31 654.87	11 367.60	244.18	245.10	3 246.74	11.89
2016	800 339.83	54 366.22	31 521.14	11 311.33	252.13	183.03	3 457.21	11.15
2017	785 616.47	53 797.60	31 027.72	11 046.59	257.16	212.84	3 759.57	11.51
2018	754 408.43	52 006.90	29 715.79	10 050.16	289.59	188.74	3 870.61	11.75
2019	707 149.95	49 944.05	28 948.46	9 324.53	231.88	204.84	3 919.33	10.96
2020	639 381.01	49 015.34	28 182.14	8 792.42	207.25	140.66	3 008.03	10.80
Percentage change 1990–2020	**–39.2**	**–58.7**	**–51.4**	**17 373.0**	**–93.2**	**–97.6**	**–32.1**	**57.0**

Note: Emissions and removals reported for the sector other (sector 6) are not included in this table.

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

Table I.3

Greenhouse gas emissions and removals by sector for Germany, 1990–2020

(kt CO_2 eq)

	Energy	*IPPU*	*Agriculture*	*LULUCF*	*Waste*	*Other*
1990	1 036 443.71	96 891.41	70 581.05	27 002.57	38 003.06	NO
1995	917 378.98	98 600.40	61 251.60	–24 589.86	38 074.38	NO
2000	869 646.70	77 895.33	60 996.60	–9 589.34	28 387.62	NO
2010	800 987.14	62 558.78	57 761.05	–14 694.34	14 461.39	NO

	Energy	*IPPU*	*Agriculture*	*LULUCF*	*Waste*	*Other*
2011	777 237.44	62 484.88	57 844.30	–15 976.41	13 677.16	NO
2012	783 913.88	61 569.03	58 511.25	–26 047.94	12 906.85	NO
2013	801 247.36	61 319.00	59 270.61	–23 334.50	12 150.39	NO
2014	761 165.02	61 193.89	60 547.42	–22 630.72	11 558.21	NO
2015	766 393.39	60 228.95	60 388.04	–20 434.72	10 943.30	NO
2016	768 977.47	62 075.85	59 992.67	–22 466.60	10 396.05	NO
2017	750 502.80	65 933.43	59 310.98	–22 111.31	9 982.26	NO
2018	720 388.57	62 966.87	57 634.29	–20 049.56	9 552.26	NO
2019	673 835.55	59 790.15	56 911.94	–14 891.93	9 196.35	NO
2020	608 399.41	55 472.72	56 095.08	–11 265.04	8 770.45	NO
Percentage change 1990–2020	**–41.3**	**–42.7**	**–20.5**	**–141.7**	**–76.9**	**NA**

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

Table I.4

Greenhouse gas emissions and removals from activities under Article 3, paragraphs 3–4, of the Kyoto Protocol by activity, base year–2020, for Germany

(kt CO_2 eq)

	Article 3.7 bis as contained in the Doha Amendment[a]	*Activities under Article 3.3 of the Kyoto Protocol*		*FM and elected activities under Article 3.4 of the Kyoto Protocol*				
	Land-use change	*AR*	*Deforestation*	*FM*	*CM*	*GM*	*RV*	*WDR*
FMRL				–22 418.00				
Technical correction				6 330.67				
Base year[b]	NA				14 141.85	27 118.39	NA	NA
2013		–621.69	623.22	–65 412.57	18 165.94	23 154.96	NA	NA
2014		–684.72	669.06	–65 023.52	18 168.11	22 930.67	NA	NA
2015		–747.93	716.20	–62 907.79	18 521.90	21 968.59	NA	NA
2016		–379.32	1 171.56	–65 764.11	17 785.30	22 231.26	NA	NA
2017		–467.04	1 217.06	–65 519.90	17 454.87	21 973.40	NA	NA
2018		–531.62	1 256.09	–63 972.15	17 320.19	21 277.58	NA	NA
2019		–622.84	1 262.57	–58 022.80	16 906.17	20 958.23	NA	NA
2020		–725.09	1 274.14	–54 098.45	16 551.80	20 465.60	NA	NA
Percentage change base year–2020					**17.0**	**–24.5**	**NA**	**NA**

Note: Values in this table include emissions from land subject to natural disturbances, if applicable.

[a] The value reported in this column relates to 1990.

[b] The base year for CM and GM under Article 3, para. 4, of the Kyoto Protocol is 1990. For activities under Article 3, para. 3, of the Kyoto Protocol and FM under Article 3, para. 4, only the inventory years of the commitment period must be reported.

2. Table I.5 provides information on the Party's accounting quantities for reporting under Article 3, paragraphs 3–4, of the Kyoto Protocol.

Table I.5

Accounting quantities for activities under Article 3, paragraph 3, and forest management and any elected activities under Article 3, paragraph 4, of the Kyoto Protocol for Germany

(kt CO_2 eq)

GHG source/sink activity	*Net emissions/removals*										*Accounting parameters*	*Accounting quantities*[a]
	Base year[b]	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*Total*[c]		
A.1. AR		–621.690	–684.718	–747.926	–379.324	–467.041	–531.623	–622.836	–725.089	–4 780.247		–4 780.247
Excluded emissions from natural disturbances		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Excluded subsequent removals from land subject to natural disturbances		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
A.2. Deforestation		623.222	669.064	716.197	1 171.557	1 217.062	1 256.091	1 262.575	1 274.136	8 189.904		8 189.905
B.1. FM										–500 721.280		–372 022.610
Net emissions/ removals		–65 412.569	–65 023.515	–62 907.791	–65 764.110	–65 519.896	–63 972.151	–58 022.801	–54 098.446	–500 721.280		
Excluded emissions from natural disturbances[d]		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Excluded subsequent removals from land subject to natural disturbances		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Any debits from newly established forest		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
FMRL[e]											–22 418.000	

GHG source/sink activity	*Net emissions/removals*										*Accounting parameters*	*Accounting quantities*[a]
	Base year[b]	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*Total*[c]		
Technical corrections to FMRL											6 330.666	
FM cap											351 007.813	–351 007.813
B.2. CM (if elected)	14 141.849	18 165.941	18 168.114	18 521.900	17 785.302	17 454.874	17 320.187	16 906.174	16 551.797	140 874.290		27 739.497
B.3. GM (if elected)	27 118.388	23 154.958	22 930.665	21 968.586	22 231.263	21 973.396	21 277.584	20 958.234	20 465.601	174 960.287		–41 986.819
B.4. RV (if elected)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
B.5. WDR (if elected)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a] The accounting quantity is the total quantity of units to be issued or cancelled for a particular activity.
[b] Net emissions and removals from CM, GM, RV and/or WDR, if elected, in the Party's base year as established in decision 9/CP.2.
[c] Cumulative net emissions and removals for all years of the commitment period reported in the annual submission under review.
[d] The Party indicated in its report to facilitate the calculation of the assigned amount for the second commitment period of the Kyoto Protocol that it does not intend to exclude emissions from natural disturbances.
[e] As inscribed in the appendix to the annex to decision 2/CMP.7 in kt CO_2 eq per year.

3. Table I.6 provides an overview of key data from Germany's reporting under Article 3, paragraphs 3–4, of the Kyoto Protocol.

Table I.6
Key data for Germany under Article 3, paragraphs 3–4, of the Kyoto Protocol from its 2022 annual submission

Parameter	*Data values*
Periodicity of accounting	(a) AR: commitment period accounting
	(b) Deforestation: commitment period accounting
	(c) FM: commitment period accounting
	(d) CM: commitment period accounting
	(e) GM: commitment period accounting
	(f) RV: not elected
	(g) WDR: not elected
Elected activities under Article 3, paragraph 4, of the Kyoto Protocol	CM and GM
Election of application of provisions for natural disturbances	No
3.5% of total base-year GHG emissions, excluding LULUCF	43 875.976 kt CO_2 eq (351 007.813 kt CO_2 eq for the duration of the commitment period)
Cancellation of AAUs, CERs and ERUs and/or issuance of RMUs in the national registry for:	
1. AR	Issue 4 780 247 RMUs
2. Deforestation	Cancel 8 189 905 units
3. FM	Issue 351 007 813 RMUs
4. CM	Cancel 27 739 497 units
5. GM	Issue 41 986 819 RMUs

Note: Values in this table reflect the accounting quantities for activities under Article 3, para. 3, and FM and any elected activities under Article 3, para. 4, of the Kyoto Protocol as reported in table I.5.

Annex II

Information to be included in the compilation and accounting database

Tables II.1–II.8 include the information to be included in the compilation and accounting database for Germany. Data shown are from the Party's annual submission, including the latest revised estimates submitted, adjustments (if applicable) and the final data to be included in the compilation and accounting database.

Table II.1
Information to be included in the compilation and accounting database for 2020, including on the commitment period reserve, for Germany
($t CO_2 eq$)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
CPR	3 233 429 900	–	–	3 233 429 900
Annex A emissions				
CO_2	639 381 013	–	–	639 381 013
CH_4	49 015 342	–	–	49 015 342
N_2O	28 182 137	–	–	28 182 137
HFCs	8 792 421	–	–	8 792 421
PFCs	207 252	–	–	207 252
Unspecified mix of HFCs and PFCs	140 657	–	–	140 657
SF_6	3 008 028	–	–	3 008 028
NF_3	10 802	–	–	10 802
Total Annex A sources[a]	728 737 654	–	–	728 737 654
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–725 089	–	–	–725 089
Deforestation	1 274 136	–	–	1 274 136
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–54 098 446	–	–	–54 098 446
CM	16 551 797	–	–	16 551 797
CM for the base year	14 141 849	–	–	14 141 849
GM	20 465 601	–	–	20 465 601
GM for the base year	27 118 388	–	–	27 118 388

[a] The sum of the values for the individual gases and groups of gases may not match the total owing to rounding.

Table II.2
Information to be included in the compilation and accounting database for 2019 for Germany
($t CO_2 eq$)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	707 149 948	–	–	707 149 948
CH_4	49 944 050	–	–	49 944 050
N_2O	28 948 458	–	–	28 948 458
HFCs	9 324 528	–	–	9 324 528
PFCs	231 877	–	–	231 877
Unspecified mix of HFCs and PFCs	204 840	–	–	204 840
SF_6	3 919 330	–	–	3 919 330
NF_3	10 956	–	–	10 956
Total Annex A sources[a]	799 733 988	–	–	799 733 988
Activities under Article 3, paragraph 3, of the Kyoto Protocol				

	Original submission	*Revised submission*	*Adjustment*	*Final value*
AR	–622 836	–	–	–622 836
Deforestation	1 262 575	–	–	1 262 575
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–58 022 801	–	–	–58 022 801
CM	16 906 174	–	–	16 906 174
CM for the base year	14 141 849	–	–	14 141 849
GM	20 958 234	–	–	20 958 234
GM for the base year	27 118 388	–	–	27 118 388

[a] The sum of the values for the individual gases and groups of gases may not match the total owing to rounding.

Table II.3
Information to be included in the compilation and accounting database for 2018 for Germany
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	754 408 432	–	–	754 408 432
CH_4	52 006 900	–	–	52 006 900
N_2O	29 715 792	–	–	29 715 792
HFCs	10 050 164	–	–	10 050 164
PFCs	289 594	–	–	289 594
Unspecified mix of HFCs and PFCs	188 743	–	–	188 743
SF_6	3 870 614	–	–	3 870 614
NF_3	11 748	–	–	11 748
Total Annex A sources[a]	850 541 987	–	–	850 541 987
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–531 623	–	–	–531 623
Deforestation	1 256 091	–	–	1 256 091
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–63 972 151	–	–	–63 972 151
CM	17 320 187	–	–	17 320 187
CM for the base year	14 141 849	–	–	14 141 849
GM	21 277 584	–	–	21 277 584
GM for the base year	27 118 388	–	–	27 118 388

[a] The sum of the values for the individual gases and groups of gases may not match the total owing to rounding.

Table II.4
Information to be included in the compilation and accounting database for 2017 for Germany
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	785 616 471	–	–	785 616 471
CH_4	53 797 604	–	–	53 797 604
N_2O	31 027 724	–	–	31 027 724
HFCs	11 046 594	–	–	11 046 594
PFCs	257 157	–	–	257 157
Unspecified mix of HFCs and PFCs	212 839	–	–	212 839
SF_6	3 759 573	–	–	3 759 573
NF_3	11 507	–	–	11 507
Total Annex A sources[a]	885 729 470	–	–	885 729 470
Activities under Article 3, paragraph 3, of the Kyoto Protocol				

	Original submission	*Revised submission*	*Adjustment*	*Final value*
AR	–467 041	–	–	–467 041
Deforestation	1 217 062	–	–	1 217 062
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–65 519 896	–	–	–65 519 896
CM	17 454 874	–	–	17 454 874
CM for the base year	14 141 849	–	–	14 141 849
GM	21 973 396	–	–	21 973 396
GM for the base year	27 118 388	–	–	27 118 388

[a] The sum of the values for the individual gases and groups of gases may not match the total owing to rounding.

Table II.5
Information to be included in the compilation and accounting database for 2016 for Germany
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	800 339 834	–	–	800 339 834
CH_4	54 366 222	–	–	54 366 222
N_2O	31 521 138	–	–	31 521 138
HFCs	11 311 331	–	–	11 311 331
PFCs	252 127	–	–	252 127
Unspecified mix of HFCs and PFCs	183 027	–	–	183 027
SF_6	3 457 206	–	–	3 457 206
NF_3	11 146	–	–	11 146
Total Annex A sources[a]	901 442 030	–	–	901 442 030
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–379 324	–	–	–379 324
Deforestation	1 171 557	–	–	1 171 557
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–65 764 110	–	–	–65 764 110
CM	17 785 302	–	–	17 785 302
CM for the base year	14 141 849	–	–	14 141 849
GM	22 231 263	–	–	22 231 263
GM for the base year	27 118 388	–	–	27 118 388

[a] The sum of the values for the individual gases and groups of gases may not match the total owing to rounding.

Table II.6
Information to be included in the compilation and accounting database for 2015 for Germany
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	795 556 570	–	–	795 556 570
CH_4	55 626 715	–	–	55 626 715
N_2O	31 654 874	–	–	31 654 874
HFCs	11 367 603	–	–	11 367 603
PFCs	244 183	–	–	244 183
Unspecified mix of HFCs and PFCs	245 099	–	–	245 099
SF_6	3 246 743	–	–	3 246 743
NF_3	11 885	–	–	11 885
Total Annex A sources[a]	897 953 672	–	–	897 953 672
Activities under Article 3, paragraph 3, of the Kyoto Protocol				

	Original submission	*Revised submission*	*Adjustment*	*Final value*
AR	–747 926	–	–	–747 926
Deforestation	716 197	–	–	716 197
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–62 907 791	–	–	–62 907 791
CM	18 521 900	–	–	18 521 900
CM for the base year	14 141 849	–	–	14 141 849
GM	21 968 586	–	–	21 968 586
GM for the base year	27 118 388	–	–	27 118 388

[a] The sum of the values for the individual gases and groups of gases may not match the total owing to rounding.

Table II.7
Information to be included in the compilation and accounting database for 2014 for Germany
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	792 255 427	–	–	792 255 427
CH_4	55 847 307	–	–	55 847 307
N_2O	31 704 689	–	–	31 704 689
HFCs	11 112 824	–	–	11 112 824
PFCs	234 335	–	–	234 335
Unspecified mix of HFCs and PFCs	223 531	–	–	223 531
SF_6	3 066 148	–	–	3 066 148
NF_3	20 279	–	–	20 279
Total Annex A sources[a]	894 464 541	–	–	894 464 541
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–684 718	–	–	–684 718
Deforestation	669 064	–	–	669 064
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–65 023 515	–	–	–65 023 515
CM	18 168 114	–	–	18 168 114
CM for the base year	14 141 849	–	–	14 141 849
GM	22 930 665	–	–	22 930 665
GM for the base year	27 118 388	–	–	27 118 388

[a] The sum of the values for the individual gases and groups of gases may not match the total owing to rounding.

Table II.8
Information to be included in the compilation and accounting database for 2013 for Germany
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	831 207 653	–	–	831 207 653
CH_4	56 966 249	–	–	56 966 249
N_2O	31 171 676	–	–	31 171 676
HFCs	10 958 554	–	–	10 958 554
PFCs	256 944	–	–	256 944
Unspecified mix of HFCs and PFCs	287 909	–	–	287 909
SF_6	3 122 346	–	–	3 122 346
NF_3	16 030	–	–	16 030
Total Annex A sources[a]	933 987 362	–	–	933 987 362
Activities under Article 3, paragraph 3, of the Kyoto Protocol				

	Original submission	*Revised submission*	*Adjustment*	*Final value*
AR	–621 690	–	–	–621 690
Deforestation	623 222	–	–	623 222
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–65 412 569	–	–	–65 412 569
CM	18 165 941	–	–	18 165 941
CM for the base year	14 141 849	–	–	14 141 849
GM	23 154 958	–	–	23 154 958
GM for the base year	27 118 388	–	–	27 118 388

[a] The sum of the values for the individual gases and groups of gases may not match the total owing to rounding.

Annex III

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 the following:

(a) 1.B.2.a.3 Oil transport (CO_2) (see ID# E.13 in table 5);

(b) 4(V) Biomass burning – DOM stocks (CH_4 and N_2O) (see ID# L.12 in table 3).

Annex IV

Reference documents

A. Reports of the Intergovernmental Panel on Climate Change

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B. UNFCCC documents

Annual review reports

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Other

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

Annual status report for Germany for 2022. Available at https://unfccc.int/sites/default/files/resource/asr2022_DEU.pdf.

C. Other documents used during the review

Responses to questions during the review were received from Dirk Günther and Tobias Vosen (German Environment 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:

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