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Report on the individual review of the annual submission of Germany submitted in 2020*

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 2020 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 2 to 7 November 2020 remotely.

* In the symbol for this document, 2020 refers to the year in which the inventory was submitted, not to the year of publication.

Contents

Abbreviations and acronyms

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"
B_o	maximum methane-producing capacity
C	carbon
CER	certified emission reduction
CH_4	methane
CM	cropland management
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"
CORINE	Coordination of Information on the Environment (programme)
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CPR	commitment period reserve
CRF	common reporting format
DOC	degradable organic carbon
DOM	dead organic matter
EF	emission factor
ERT	expert review team
ERU	emission reduction unit
FM	forest management
FMRL	forest management reference level
GHG	greenhouse gas
GM	grazing land management
HFC	hydrofluorocarbon
IE	included elsewhere
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
KP-LULUCF	activities under Article 3, paragraphs 3–4, of the Kyoto Protocol
KP reporting adherence	adherence to the reporting guidelines under Article 7, paragraph 1, 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 conversion factor
N	nitrogen
NA	not applicable
NE	not estimated
NFI	national forest inventory
NF_3	nitrogen trifluoride
NH_3	ammonia
NIR	national inventory report
NMVOC	non-methane volatile organic compound
NO	not occurring

NO_X	nitrogen oxides
N_2O	nitrous oxide
PFC	perfluorocarbon
QA/QC	quality assurance/quality control
RMU	removal unit
RV	revegetation
SF_6	sulfur hexafluoride
SOC	soil organic carbon
SOC_{REF}	reference soil organic carbon stocks
SRC	short-rotation coppice
TOW	total organics in wastewater
UNFCCC Annex I inventory reporting guidelines	"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories"
UNFCCC review guidelines	"Guidelines for the technical review of information reported under the Convention related to greenhouse gas inventories, biennial reports and national communications by Parties included in Annex I to the Convention"
VS	volatile solid(s)
WDR	wetland drainage and rewetting
Wetlands Supplement	*2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*
2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*

I. Introduction

1. This report covers the review of the 2020 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 2 to 7 November 2020 remotely[1] and was coordinated by Simon Wear, Veronica Colerio, Roman Payo and Nalin Srivastava (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	Elena Gavrilova	North Macedonia
	Harry Vreuls	Netherlands
Energy	Renata Patricia Soares Grisoli	Brazil
	Anand Sookun	Mauritius
	Julien Vincent	France
IPPU	Stanford Mwakasonda	United Republic of Tanzania
	Ingrid Person Rocha e Pinho	Brazil
	Emma Salisbury	United Kingdom
Agriculture	Kent Buchanan	South Africa
	Laura Cardenas	United Kingdom
	Marcelo Theoto Rocha	Brazil
LULUCF and KP-LULUCF	Sandro Federici	San Marino
	Esther Mertens	Belgium
	Sekai Ngarize	Zimbabwe
Waste	Philip Acquah	Ghana
	Jose Manuel Ramírez García	Spain
	Sergii Shmarin	Ukraine
Lead reviewers	Philip Acquah	
	Harry Vreuls	

2. The basis of the findings in this report is the assessment by the ERT of the Party's 2020 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[2] designated as problems.[3] Other findings, and, if applicable, the encouragements of the ERT to Germany to resolve related issues, are also included.

[1] Owing to the circumstances related to the coronavirus disease 2019, the review had to be conducted remotely.
[2] Issues are defined in decision 13/CP.20, annex, para. 81.
[3] Problems are defined in decision 22/CMP.1, annex, paras. 68–69, as revised by decision 4/CMP.11.

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 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 2020 annual submission

7. Table 2 provides the assessment by the ERT of the Party's 2020 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 2020 annual submission of Germany

Assessment			*Issue/problem ID#(s) in table 3 or 5*[a]
Date of submission	Original submission: NIR, 15 April 2020; CRF tables (version 1), 18 March 2020; standard electronic format tables (SEF-CP1-2019 and SEF-CP2-2019), 15 April 2020		
Review format	Centralized review conducted remotely		
Application of the requirements of the UNFCCC Annex I inventory reporting guidelines and the Wetlands Supplement (if applicable)	Have any issues been identified in the following areas:		
	(a) Identification of key categories?	No	
	(b) Selection and use of methodologies and assumptions?	Yes	L.8, L.12, L.15, L.16, W.6, KL.3, KL.5, KL.7
	(c) Development and selection of EFs?	Yes	I.8, W.2, W.5
	(d) Collection and selection of AD?	Yes	I.6, I.7
	(e) Reporting of recalculations?	Yes	I.18
	(f) Reporting of a consistent time series?	Yes	I.8, I.16, I.17
	(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	L.13, L.16, KL.15, KL.18
	(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?	Yes	
Supplementary information under the Kyoto Protocol	Have any issues been identified related to the following aspects of the national system:		
	(a) Overall organization of the national system, including the effectiveness and reliability of the institutional, procedural and legal arrangements?	No	

Assessment			*Issue/problem ID#(s) in table 3 or 5[a]*
	(b) Performance of the national system functions?	No	
	Have any issues been identified related to the national registry:		
	(a) Overall functioning of the national registry?	No	
	(b) Performance of the functions of the national registry and the adherence to technical standards for data exchange?	No	
	Have any issues been identified related to the reporting of information on 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 standard independent assessment report?	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.13, KL.14
	(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.3
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	
Question 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 5 April 2019,[4] and had not been resolved by the time of publication of the review report of the Party's 2018 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. The ERT noted that the individual review of Germany's 2019 annual submission did not take place in 2019 owing to insufficient funding for the review process.

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

ID#	*Issue/problem classification[a, b]*	*Recommendation made in previous review report*	*ERT assessment and rationale*
General			
G.1	Uncertainty analysis (G.2, 2018) (G.2, 2016) (G.2, 2015) Convention reporting adherence	If continuing to include uncertainty estimates for AD and EFs in the combined uncertainty of the emissions, provide clear documentation of this in the NIR.	Resolved. The Party reported separate uncertainty estimates for the AD and the EFs for all categories in annex 7 to its NIR (p.971, table 625, column E).
G.2	Uncertainty analysis (G.12, 2018) Convention reporting adherence	Estimate and report uncertainties for the base year in accordance with the UNFCCC Annex I inventory reporting guidelines. (The 2006 IPCC Guidelines (vol. 1, chap. 3.2.1.3) indicate that well-informed expert judgments are an appropriate data source in the absence of other information, and the uncertainty estimates available for the earlier years of Germany's inventory could serve as a starting point for expert judgment.)	Resolved. The Party reported base-year uncertainty in its NIR (section 1.7.1.2, p.132).
G.3	CPR (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. As in the 2018 NIR, Germany continues to provide a value for the CPR of 3,233,429,899 t CO_2 eq (NIR, section 12.5). As noted in the previous review reports, the value used for the CPR should be consistent with the value agreed in the report to facilitate the calculation of the assigned amount (FCCC/IRR/2016/DEU), based on the assigned amount for the second commitment period of the Kyoto Protocol, which equals 3,233,429,900 t CO_2 eq. This value should be consistently reported in the national registry and in the NIR.

[4] FCCC/ARR/2018/DEU. The ERT notes that the report on the individual inventory review of Germany's 2019 annual submission has not been published yet. As a result, the latest previously published annual review report reflects the findings of the review of the Party's 2018 annual submission.

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
G.4	QA/QC and verification (G.7, 2018) Transparency	Correct the presentation of information in section 4.4 with respect to category 2.C.7 as well as the title of chapter 9 of the NIR.	Resolved. The Party presented the information on category 2.C.7 (other production (metal industry)) correctly in NIR section 4.4.7 (p.351), and corrected the title of NIR chapter 9 to refer to N_2O and not NO_X (p.746).
G.5	Methods (G.9, 2018) KP reporting adherence	Include in the NIR the key assumptions underlying the assessment of the insignificance of the categories for which emissions are not estimated.	Resolved. The Party reported the key assumptions underlying its assessment of insignificance in the relevant sections of the sectoral chapters of the NIR: 3.3.2.3.1.1 (p.287), 4.2.4.1.2 (p.306), 4.4.1.2 (p.339), 4.4.1.3 (p.341), 4.8.1.3 (p.420), 4.9.1 (p.438), 5.1.3.1 (p.450), 5.1.3.6.4 (p.463), 6.5.2.3.2 (p.636), 7.2.1.5 (p.707), 7.3.1.5 (p.710), 7.3.2.5 (p.714), 7.6.1.5 (p.745), 18.8.3 (p.864) and 19.3.1 (p.895), as well as in table 599 of annex 5 (p.923).
G.6	CRF tables (G.10, 2018) Comparability	Include an explanation for each category reported as "IE" in CRF table 9 or provide a reference to the section in the NIR where the explanation is included.	Resolved. The Party included a reference to the explanation in the relevant section of the NIR for each category reported as "IE" in CRF table 9. In addition, table 600 of annex 5 (p.923) contains an overview of sources and sinks that are included elsewhere.
G.7	CRF tables (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.	Addressing. The Party reported 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, as "NE" in CRF table 6. For the energy and IPPU sectors, "IE" was also used to report indirect CO_2 emissions. The ERT considers that the recommendation has not yet been fully addressed because the Party still uses "IE" to report indirect CO_2 emissions from the energy and IPPU sectors, which is not in line with paragraph 29 of the UNFCCC Annex I inventory reporting guidelines.
G.8	CRF tables (G.11, 2018) Comparability	Noting that the Party reports indirect N_2O emissions from leaching and run-off under the LULUCF sector in CRF table 4(IV), use the notation keys "NE" and "IE" to report indirect N_2O emissions from leaching and run-off under the LULUCF sector in CRF table 6.	Resolved. The Party reported indirect N_2O emissions from the LULUCF sector as "NE" and "IE" in CRF table 6.
Energy			
E.1	Feedstocks, reductants and other non-energy use of fuels – bitumen (E.6, 2018) Comparability	Use the correct notation key (i.e. "NO" instead of "NE") in CRF table 1.A(d) to report CO_2 emissions from the non-energy use of bitumen.	Resolved. The Party corrected its notation key use in CRF table 1.A(d) for CO_2 emissions from the non-energy use of bitumen, reporting "NO" instead of "NE".
E.2	1.A Fuel combustion – sectoral approach – all fuels – CO_2, CH_4 and N_2O	Include in the NIR the main assumptions used in establishing the provisional energy balance.	Not resolved. The Party reported in its NIR (section 18.5.1) that the provisional energy balance used for the 2018 estimates is based on various data sources. However, the methodology used to derive the energy balance is based on particular national circumstances, which were not reported transparently, and little information was

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
	(E.7, 2018) Transparency		included in the NIR on the 2018 energy balance (section 18.4.1.1.3). Items 3.1–3.3 in NIR table 560 indicate inventory improvement related to the provisional energy balance is an ongoing action plan. During the review, the Party explained that statistics were used for the provisional energy balance wherever possible; extrapolation was used only in exceptional cases. The following data were used in developing the energy balance: (a) Energy consumption of the conversion sector is available from the Federal Statistical Office surveys on a monthly basis and the total final energy consumption can, therefore, be calculated; (b) Energy consumption of the subsectors of the energy sector is calculated using the share of the previous year and the total final energy consumption of the current reporting year; (c) Original energy data are used when additional information is available (e.g. for iron and steel production); (d) Data on heating degree days and oil sales are available for the residential sector and can be used for the emission estimates; (e) The waste quantity of the previous year is used for waste fuels. The Party indicated during the review that data compilation for the 2021 submission was already well advanced; therefore, Germany would not be able to provide further explanation of the provisional energy balance or the assumptions used in developing it in the NIR 2021. However, Germany plans to include this information in the NIR of the 2022 submission. The ERT considers that the recommendation has not yet been resolved because the Party did not provide an adequate explanation in its NIR of its use of a provisional energy balance.
E.3	1.C CO_2 transport and storage – gaseous fuels – CO_2 (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.	Addressing. The Party reported "NA" in the blank cell in CRF table 1s2 (i.e. for CO_2 captured for domestic storage) as well as for CO_2 captured for storage in other countries. During the review, the Party clarified that although CO_2 is only stored in a facility for test purposes, Germany has never deducted any storage emissions from the inventory. The Party indicated that it would report "NO" in future submissions. The ERT considers that the recommendation has not yet been fully addressed because the Party, given the national circumstances described in the NIR, did not report "NO" for CO_2 captured for domestic storage and for storage in other countries in CRF table 1s2.

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
IPPU			
I.1	2.A.1 Cement production – CO_2 (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.	Addressing. The Party reported in its NIR (section 4.2.1.2, p.294) the source of information and the basis for the assumptions related to bypass dust estimation. During the review, the Party clarified that according to the German Cement Works Association, the amount of bypass dust changed from 1 to 2 per cent in 2009 because the amount of bypass dust has increased since 2009 when it was 1 per cent. In recent years, this reached a share of 1.6–1.8 per cent so a conservative estimate was applied assuming the amount of bypass dust changed from 1 to 2 per cent in 2009. The ERT considers that the recommendation has not yet been fully addressed because the Party did not include this information in the NIR.
I.2	2.A.2 Lime production – CO_2 (I.13, 2018) Transparency	Improve the transparency of reporting in the NIR by explaining what the two channels of data sources for lime production are and including a description of the data-collection system.	Resolved. The Party explained in its NIR (section 4.2.2.4, p.298) the two channels of data sources for lime production and included a description of the data-collection system.
I.3	2.A.3 Glass production – CO_2 (I.14, 2018) Transparency	Include in the NIR an explanation for the increasing CO_2 IEF trend since 2011, namely that the production share of more GHG-intensive products, such as stone wool and glass fibres, has increased.	Resolved. The Party explained in its NIR (section 4.2.3.1, p.300) the CO_2 IEF trend since 2011 as follows: "The IEF has been increasing overall, for all types of glass. This is due to absolute and relative increases in production causing higher emissions – especially mineral fibres".
I.4	2.A.4 Other process uses of carbonates – CO_2 (I.11, 2018) Transparency	Provide in the NIR the explanation that certain product groups do not emit process-related CO_2 emissions, referring to the research project from 2017 and to the consultation with the European Union Emissions Trading System authority, and indicate the CO_2 emissions from such product groups as "NO" instead of "negligible" in NIR table 188.	Resolved. The Party explained in the NIR (section 4.2.4.1) the product groups included under this category (2.A.4), with reference to the research project completed in 2017. The relevant NIR table 196 ("CO_2 emission factors for various ceramics product groups") was updated to include the products that are considered in the inventory.
I.5	2.B.2 Nitric acid production – N_2O (I.16, 2018) Transparency	Include in the NIR the type of technology used to control emissions at nitric acid plants.	Addressing. The Party reported in its NIR (section 4.3.2.2, p.316) that "some plants have been retrofitted with second, secondary waste-gas-treatment systems that make their N_2O-emissions reductions even greater." During the review, the Party clarified that selective catalytic reduction technology is used to reduce N_2O and NH_3 emissions, and that one plant has two selective catalytic reductions in a row. The ERT considers that the recommendation has not yet been fully addressed because the Party has not yet provided this detail in the NIR.
I.6	2.B.2 Nitric acid production – N_2O	Use the newly available plant-specific data to estimate N_2O emissions for the plant for which estimates are currently used.	Resolved. The Party confirmed in NIR table 509 that "plant-specific data are in use", and explained in the NIR (section 4.3.2.2) the method of data collection.

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
	(I.17, 2018) Accuracy		
I.7	2.B.3 Adipic acid production – N_2O (I.3, 2018) (I.8, 2016) (I.8, 2015) Transparency	For the third plant, which started operations in 2002 but began conducting measurements only in 2013, report on how N_2O emissions were estimated for 2002–2012.	Resolved. The Party explained in its NIR (section 4.3.3.2, p.318) how the N_2O emissions from the third adipic acid production plant were estimated for 2002–2012, namely on the basis of the quantities of adipic acid produced and a suitable N_2O EF for two possible plant statuses (unimpeded and reduced operation). The explanation is consistent with the information provided to the ERT during the previous review.
I.8	2.B.3 Adipic acid production – N_2O (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 Party reported in its NIR (section 4.3.3.1, p.318) that "since 2013, (a third producer) also has had the option of using a redundant emissions-reduction system if his primary system should fail". During the review, the Party clarified that the switch to a tier 3 method in 2013 coincides with the third producer bringing into service a redundant emissions-reduction system. This caused a change in the IEF for that plant and the overall IEF. As such, time-series consistency cannot be verified. The ERT considers that the recommendation has not yet been fully addressed because the Party did not include this information in the correct NIR section on time-series consistency (section 4.3.3.3).
I.9	2.B.4 Caprolactam, glyoxal and glyoxylic acid production – N_2O (I.18, 2018) Transparency	Clarify in the NIR that when assessing significance, approximated data from both caprolactam plants were used and it was determined that both plants together fall below the threshold of significance.	Resolved. The Party reported in its NIR (section 4.3.4.2, p.320) that emissions from both caprolactam plants in the country were estimated (a total of 17.9 kt CO_2 eq) and together are still below the threshold of significance in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.
I.10	2.B.9 Fluorochemical production – HFCs (I.19, 2018) Transparency	Clarify in the NIR the unit for the EF of 0.15 for fluorochemical production and provide further justification for the choice of the EF.	Resolved. The Party provided in its NIR (section 4.3.9.1.2) further justification for the choice of the HFC-23 EF for hydrochlorofluorocarbon production, the unit for the EF (0.15 kg/kg HCFC-22) and a comparison of the EF with the EFs in table 3.28 of the 2006 IPCC Guidelines (vol. 3).
I.11	2.C.3 Aluminium production – SF_6 (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.	Addressing. The Party reported in its NIR (section 4.4.3.2) the change in the SF_6 EF and that the use of this EF had been justified by confidential measurement records certified by the pertinent permit authority. During the review, the Party clarified that the change in EF to 1.5 per cent from 2009 onward was validated by confidential reports recognized by regulatory authorities. The ERT considers that the recommendation has not yet been fully addressed because the Party did not include the information on the validation of the EF used from 2009 in the NIR.
I.12	2.C.7 Other (metal industry) –	Clarify whether process emissions from nickel production are included in the inventory for	Resolved. The Party explained in the NIR (section 4.4.7, p.351) that GHG emissions are not relevant for this category (2.C.7). The ERT notes that although nickel

ID#	*Issue/problem classification[a, b]*	*Recommendation made in previous review report*	*ERT assessment and rationale*
	CO_2 (I.21, 2018) Transparency	1990 and 1991, and if so, report the emissions in CRF table 2(I).A-Hs2 or, if emissions are included elsewhere, use an appropriate notation key in accordance with paragraph 37 of the UNFCCC Annex I inventory reporting guidelines.	production occurred up until 1991, there are no process EFs in the 2006 IPCC Guidelines. CRF table 2(I).A-Hs2 reported AD for 1990 and 1991, and the emissions and IEFs were reported as "NO" for these years.
I.13	2.C.7 Other (metal industry) – CO_2 (I.22, 2018) Transparency	Include in the NIR a clarification of whether process emissions from copper production other than those included in the energy sector occur and are reported and align the text in sections 4.4 and 4.4.7.1 accordingly.	Resolved. The Party clarified in the NIR (section 4.4.7.1, p.351) that process emissions from fire refining in anode furnaces during copper production are included under the energy sector because the manufacturing industry statistics do not separately report the reducing agent.
I.14	2.C.7 Other (metal industry) – CO_2 (I.22, 2018) Comparability	Use the notation key "IE" in CRF table 2(I).A-Hs2 for process emissions from copper production if emissions are estimated but included elsewhere.	Resolved. CRF table 2(I).A-Hs2 has been updated to report "IE" for emissions from copper production.
I.15	2.E Electronics industry – HFCs, PFCs, SF_6 and NF_3 (I.23, 2018) Convention reporting adherence	Include in the NIR the uncertainty values for the categories 2.E.1 (integrated circuit or semiconductor), 2.E.3 (photovoltaics) and 2.E.4 (heat transfer fluid).	Resolved. The Party added the uncertainty values for the categories 2.E.1 (integrated circuit or semiconductor), 2.E.3 (photovoltaics) and 2.E.4 (heat transfer fluid) to the NIR in sections 4.6.1.3, 4.6.3.3 and 4.6.4.3, respectively.
Agriculture			
A.1	3. General (agriculture) – CH_4 and N_2O (A.9, 2018) Transparency	Investigate and provide supplementary information in the NIR, or in a supplementary publication referenced in the NIR (such as Haenel et al. (2018)), on performance parameters of buffaloes (e.g. weight, milk yield, husbandry practices) to support and justify the appropriateness of the use of the EF, VS value and N excretion rate developed for suckling cows in the estimation of emissions from enteric fermentation and manure management of buffaloes in 1990–2012.	Resolved. The Party reported in table 4.3 in section 4.1.1.2 of Haenel et al. (2020) the performance parameters of Italian buffaloes for 2019 from Italy's CRF tables and compared these with country-specific data on suckling cows for 2018. The EF value and N excretion rate are comparable, while the VS excretion value is higher and the B_o value is lower in Italian buffaloes. In Haenel et al. (2020, p.117), the Party explained that the high Italian buffalo VS value is a direct computational consequence of the low B_o value. The product of VS excretion and B_o is comparable to the corresponding value for German suckling cows. Section 4.1.1.2 of Haenel et al. (2020) is referenced in NIR table 236. The performance parameters of German buffaloes were not investigated by the Party, but the ERT considers their comparison with those of Italian buffaloes to adequately justify the use of the EF, VS value and N excretion rate.
A.2	3. General (agriculture) – CH_4 and N_2O (A.9, 2018) Transparency	Improve the transparency of reporting by providing information on buffalo numbers available for 2012 to justify the view that, in accordance with paragraph 73 of the UNFCCC Annex I inventory reporting guidelines, the	Resolved. The Party reported in the NIR that the buffalo population in 2000–2012 was interpolated with data provided by the German buffalo association (p.452), and that the buffalo population from 1990 to 2000 was estimated by linear back extrapolation (p.116). The Party explained that buffalo husbandry is practised in Germany only to a

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
		amount of effort and the resources required for improving this subcategory are disproportional to the impact on the level or trend of GHG emissions.	very limited extent. As a result, buffalo/cattle ratios (ratios of the number of animals) range from 0 to about 0.03 per cent across the time series.
A.3	3.A.1 Cattle – CH_4 (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.	Not resolved. The Party reported in section 4.7.2 of Haenel et al. (2020, p.181) that the estimated metabolizable energy value of suckling cows is from KTBL (2006). The Party also reported that activity at pasture is considered in the estimated metabolizable energy value of suckling cows (Haenel et. al (2020)). The ERT considers that the recommendation has not yet been addressed because the Party did not include in the NIR the performance indicators (e.g. weight, weight gain, milk yield) used by KTBL (2006) to estimate the metabolizable energy value (dry matter intake) or the reason this information was not reported. The Party also did not explain in the NIR how the changes in energy required for activity at pasture contribute to the values of metabolizable energy and dry matter intake of suckling cows.
A.4	3.A.1 Cattle – CH_4 (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.	Not resolved. The Party did not report energy requirements by grazing for heifers. During the review, the Party clarified that the model used for estimating energy requirements would be updated for the 2021 submission to include all individual energy contributions, including grazing. Germany also stated that a detailed description of the improved model would be provided in the 2021 update of Haenel et al. (2020).
A.5	3.D.a.6 Cultivation of organic soils (i.e. histosols) – N_2O (A.4, 2018) (A.7, 2016) (A.7, 2015) Transparency	Provide a clear explanation of the derivation and application of the country-specific EF used for drained grassland in the NIR to justify the appropriateness of the EF used.	Resolved. The Party reported in the NIR (section 5.5.2.1.1, p.510) that the source of the country-specific EF was a study conducted by Tiemeyer et al. (2016). Information was included on the method used to derive the EF based on data sets of 122 whole-year measurements for 12 different peatland areas in Germany.
LULUCF			
L.1	4.A.1 Forest land remaining forest land – CO_2 (L.10, 2018) Transparency	Include in the NIR a comparison of the times series of total harvest of public forests derived from German logging statistics, total harvest derived from NFIs and the corrected logging statistics calibrated with forest inventory data.	Resolved. The Party reported the required information in NIR figure 74 (p.689).
L.2	4.A.1 Forest land remaining forest land –	Explain in the NIR that the logging statistics include only public forests and that a	Resolved. The Party explained in the NIR (section 6.4.2.2.1, p.597) that wood harvest statistics published by the Federal Statistical Office are 30 per cent short of the real

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
	CO_2 (L.10, 2018) Transparency	description of the estimation process is provided in the NIR (i.e. the official harvest statistics are corrected on the basis of information on the loss of merchantable wood derived from NFIs).	figures because of harvest losses, and that some cut wood and fuelwood comes from private households and is not considered in the statistics.
L.3	4.A.1 Forest land remaining forest land – CO_2 (L.10, 2018) Transparency	Provide an explanation for the difference if the values of "calibrated harvest" are not equal to the NFI data for the years in which the NFI was carried out.	Resolved. The Party reported in NIR figure 74 a comparison of the wood harvest statistics published by the Federal Statistical Office, the NFI data and the derived calibrated time series of wood harvesting applied to calculate carbon stock changes in the biomass and harvested wood product pools (see ID# L.2 above). The differences in the years in which the NFI was completed, as well as in any other years, arise because some cut wood and fuelwood comes from private households and is not considered in the statistics (NIR, section 6.4.2.2.1).
L.4	4.B.1 Cropland remaining cropland – CO_2 (L.11, 2018) Transparency	Improve the transparency of reporting by including in the NIR an explanation of the estimation process for cropland biomass carbon stock, including how the EFs for different crops are derived from the official statistics and how the Party ensures that no overestimation or underestimation of EFs occurs, given that no information on crops is currently available in the land classification system used.	Resolved. The Party reported information on how the biomass carbon pool is estimated, as well as how unbiased average values of biomass for the five subdivisions of cropland were derived in the NIR (section 6.1.2.3, pp.546–562).
L.5	4.B.1 Cropland remaining cropland – CO_2 (L.4, 2018) (L.8, 2016) (L.8, 2015) Comparability	Use the notation key "NE" to report carbon stock changes for mineral soils when a tier 1 zero stock change method is used.	Resolved. The Party estimated the SOC changes in mineral soils for the entire time series and did not report "NE" for this pool in CRF table 4.B.
L.6	4.E.2 Land converted to settlements – CO_2 (L.5, 2018) (L.9, 2016) (L.9, 2015) Accuracy	Reassess the SOC value used to estimate SOC stock changes for land converted to settlements, taking into consideration the 2006 IPCC Guidelines, or provide transparent and verifiable evidence, based on national studies and research, to support the use of the country-specific SOC value.	Resolved. The ERT notes that this issue is focused on how SOC is calculated for settlements considering their mix of different land-cover elements (e.g. buildings, infrastructure, gardens). The Party reported in its NIR (section 6.1.2.1.6) information on how country-specific SOC values are calculated considering these diverse elements. However, the ERT identified a general accuracy issue regarding the approach to calculating land use specific SOC values and associated carbon stock changes that are relevant for all land uses and land-use changes (see ID# L.8 in table 5).

Waste

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
W.1	5.A.1 Managed waste disposal sites – CH_4 (W.3, 2018) (W.9, 2016) (W.9, 2015) Transparency	Include all references supporting the use of country-specific DOC values as a footnote to NIR table 397.	Resolved. The Party provided information in NIR table 478 (corresponding to table 397 of the 2016 NIR, p.661) on the sources of the data, as well as the DOC values for the various waste fractions, including country-specific DOC values for the fraction of organic waste (18 per cent) and waste from mechanical–biological treatment facilities (2.3 per cent). The other DOC values, that is of garden and packaging waste (20 per cent), paper and paperboard (40 per cent), wood and wood straw (43 per cent), textiles (24 per cent) and diapers (24 per cent), are default values from table 2.4 in the 2006 IPCC Guidelines (vol. 5).
W.2	5.A.1 Managed waste disposal sites – CH_4 (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 NIR table 480 that the k-values calculated from default values of half-lives ($t_{1/2}$) contained in table 3.4 of the 2006 IPCC Guidelines based on equation ($k = \ln 2 / t_{1/2}$) for all the waste fractions were the same as the default k-values contained in table 3.3 of the 2006 IPCC Guidelines (vol. 5). However, Germany identified and documented a discrepancy between the k-value for organic waste (0.173) calculated using the default half-life from table 3.3 and the default value from table 3.4 (0.185) (NIR, section 7.2.1.2.7, p.704); in this case, the Party maintained the default k-value for organic waste (k = 0.173) used in the 2018 submission. The ERT notes that the country-specific k-value equivalent to a half-life ($t_{1/2}$) of 3.747 (NIR, p.704) is lower than the default half-life value ($t_{1/2} = 4$) in table 3.4 of the 2006 IPCC Guidelines. The value used by the Party implies a faster rate of degradation, which could result in an overestimation of emissions. This apparent overestimation has been observed and is being investigated by two ongoing research projects conducted by the Party (NIR, section 7.2.1.6 and table 510, p.779). However, the NIR did not specify the status of the projects. Germany indicated during the review that the results of the ongoing research projects to determine country-specific k-values were not available in time to implement them in the 2020 annual submission (NIR, section 7.2.1.6, p.707). While the latest results of the research have been published, they can only be incorporated into the emission inventory report after clarification of review questions with the contractors, QA through peer review and public validation by national experts. These processes are planned for completion in 2020. The Party expects the results from the research projects to be applied in the 2021 submission.
W.3	5.B Biological treatment of solid waste – CH_4 and N_2O (W.12, 2018) Transparency	Include in the NIR more information on the derivation of the CH_4 and N_2O EFs for composting and anaerobic digestion, in particular the identification of outliers, the criteria for excluding a given measurement and the fact that the EFs are based on seasonal measurements.	Resolved. The Party included in the NIR (section 7.3.1.2, p.709) additional information on the derivation of the country-specific CH_4 and N_2O EFs for the composting of biowaste based on the research of Cuhls et al. (2015), which it referenced in the NIR. The Party explained during the review why the EFs for German treatment plants are at the lower end of the default range in the 2006 IPCC Guidelines, attributing this to high operating efficiency standards with respect to active ventilation, temperature monitoring and control, and regular turning of compost heaps in the German plants. The NIR (section 7.3.1.4, p.710) includes a comparison of Germany's EFs (NIR table 484) with those of countries with similar national circumstances (e.g.

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
			Austria, Belgium and Denmark) to help justify the statistical values Germany has adopted. The Party included additional information (NIR, p.712) on the basis for identifying and the criteria for excluding specific results of the plant-specific measurements as outliers by expert peer review.
W.4	5.B.2 Anaerobic digestion at biogas facilities – N_2O (W.13, 2018) Transparency	Include in the section of the NIR on anaerobic digestion at biogas facilities a reference to the section(s) in the agriculture sector chapter where the methodology is described (in NIR 2018, these were sections 5.1.3.6.5 and 5.1.4).	Resolved. The Party included in NIR section 7.3.2.1 (p.711), on category 5.B.2 (anaerobic digestion at biogas facilities (which includes co-digestion of livestock manure)), a reference to section 5.1.3.6.5 (p.465), on category 3.B (manure management) to reflect the country-specific practice of manure co-digestion and storage of digestates) under the agriculture sector, where the methodology for calculating emissions from the anaerobic digestion of livestock manure (cattle, swine and poultry) and storage of the resulting digestates is described.
W.5	5.D.1 Domestic wastewater – CH_4 (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.	Addressing. The Party has not implemented the results of the study to determine more precise CH_4 EFs for domestic wastewater (NIR, section 7.5.1.1.2, p.716) or provided information on its status. During the review, the Party clarified that the study is yet to be published. Clarification with the contractor of review questions regarding the latest draft as well as an assessment of the applicability of the results of the study to determine a country-specific EF were delayed, and were subsequently planned for the first half of 2020 for reporting in the 2021 submission. However, given the circumstances of the coronavirus disease 2019, the Party expects adoption of the study results and the realization of the objective of this national inventory improvement plan could be delayed until the 2022 submission.
W.6	5.D.1 Domestic wastewater – CH_4 (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.	Addressing. In its NIR (section 7.5.1.1.2, pp.717–719), Germany continued to use the assumed MCF values of animal manure of 35 per cent for the summer period (about 3.5 months) and 0.1 (10 per cent) for the winter period (about 8.5 months), which is based on the Gibbs and Woodbury (1993) studies. This is because the planned research project to improve the MCF, which was completed in 2018 (the project is still unpublished), did not obtain any data (national or international) more appropriate for deriving a country-specific MCF. The derived weighted average MCF of 0.173 (17.3 per cent) was therefore used for the 2020 submission. However, the Party indicated during the review that the issue had been resolved, and provided additional information with detailed justification of the continued use of the derived MCF in response to the request of the ERT. The Party confirmed that the information will be reported in the 2021 submission.
W.7	5.D.1 Domestic wastewater –	Describe in more detail in the NIR the basis for the assumption that the study by Grün et al.	Resolved. The Party revised paragraph 2 on page 685 of the NIR 2018 in section 7.5.1.1.2 (p.716) of the NIR 2020, including the common characteristics of German

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
	CH_4 (W.16, 2018) Transparency	(2013), which covers only about five wastewater treatment plants, is representative of the whole country.	wastewater treatment plants as the basis for justifying the five plants covered by the research of Grün et al. (2013) as being representative of the whole country. The common characteristics of the treatment technology are "emissions-relevant mechanical and biological process steps in wastewater treatment (grit chamber, nitrification, denitrification, and P-elimination), as well as sludge treatment (primary and excess sludge, sludge digestion, sludge heaping)".
W.8	5.D.2 Industrial wastewater – CH_4 (W.9, 2018) (W.14, 2016) (W.14, 2015) Transparency	Provide the actual AD underpinning the CH_4 emission estimates from industrial wastewater in CRF table 5.D, as referenced in Austermann-Haun and Witte (2014).	Resolved. The Party reported in NIR table 493 the AD (annual chemical oxygen demand loads) expressed as TOW referenced in Austermann-Haun and Witte (2014) (NIR, p.733) for the relevant industrial wastewater sources used for calculating the aggregate AD for chemical industry, food industry, and paper and pulp industry summarized in NIR table 494. The total AD in table 494 are consistent with the AD expressed as total organic product (degradable organic component) reported in CRF table 5.D. The Party also provided the information used to estimate the country-specific derived IEF of 1.86 kg CH_4/t chemical oxygen demand for the determination of emissions of dissolved CH_4 from anaerobic industrial wastewater treatment plants (NIR, section 7.5.2.1.2, p.733).
W.9	5.D.2 Industrial wastewater – CH_4 (W.17, 2018) Transparency	Include in the NIR a table showing TOW and CH_4 EFs for wastewater in different industries.	Resolved. The Party reported in NIR table 493 calculated TOW and CH_4 EFs for wastewater in different industries based on Austermann-Haun and Witte (2014), which was referenced in the NIR (see also ID# W.8 above).
KP-LULUCF			
KL.1	Deforestation – CO_2 (KL.2, 2018) (KL.5, 2016) (KL.5, 2015) Transparency	Include in the NIR an explanation for the gain in carbon stock in above-ground and below-ground biomass on areas subject to deforestation.	Resolved. The Party reported methods applied to estimate carbon stock changes in above-ground and below-ground biomass in deforested lands that are relevant for the land category under which the deforested land is reclassified (NIR section 11.3.1.1.2). However, the information items of CRF table 4(KP-I)A.2 have not been compiled with data on carbon stock changes (see ID# L.13 in table 5).
KL.2	Deforestation – CO_2 (KL.4, 2018) (KL.6, 2016) (KL.6, 2015) Transparency	Include in CRF table 4(KP-I)A.2 the land areas under deforestation by land-use category in the reporting year and include in the NIR a table with the complete time series of land areas under deforestation for the reporting period.	Resolved. The Party reported in the information items of CRF table 4(KP-I)A.2 areas of deforested land disaggregated by final land use, and included in NIR tables 518 and 519 a complete time series of land areas under deforestation for the reporting period.
KL.3	Deforestation – CO_2 (KL.5, 2018) (KL.7, 2016) (KL.7, 2015) Accuracy	Revise the estimates of soil carbon stock changes for deforestation since reassessment of the SOC value, or provide transparent and verifiable evidence, based on national studies and research, to support the use of the country-specific SOC value.	Resolved. The ERT notes that this issue is limited to deforestation where settlements result (see ID# L.6 above). However, the ERT identified a general accuracy issue regarding the approach to calculating land use specific SOC values and associated carbon stock changes that is relevant for all land uses and land-use changes (see ID# L.8 in table 5).

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
KL.4	FM – CO_2 (KL.7, 2018) (KL.9, 2016) (KL.9, 2015) Accuracy	Apply a technical correction well before the end of the commitment period.	Resolved. The Party reported an FMRL technical correction in its NIR (section 11.5.3.4, pp.819–822) and Kyoto Protocol accounting CRF tables.
KL.5	CM – CO_2 (KL.10, 2018) (KL.12, 2016) (KL.12, 2015) Accuracy	Stratify the CM estimates, considering the SRCs, based on the methodology provided in the Kyoto Protocol Supplement.	Not resolved. The Party reported disaggregated estimates for five categories of cropland remaining cropland: annual crops, hops, vineyards, orchards, and other perennial crops (see NIR table 426). However, the ERT considers that the recommendation has not yet been fully addressed because the Party did not stratify estimates by soil types or management practices recognized to be a significant determinant of SOC stocks in cropland (i.e. tillage, carbon inputs) (see step 5 (p.2.136) of the Kyoto Protocol Supplement). Further, Germany did not report any carbon stock changes in land subject to CM that is no longer classified as cropland. The ERT notes that it is good practice to report carbon stock changes from any land subject to CM in any year of the commitment period, even when that land is no longer assigned to cropland use. If the land has been subject to CM in the base year only, then emissions and removals in the reporting year can be excluded, although it is good practice to describe the consequences of this exclusion on reported emissions and removals in order to achieve transparency in reporting. During the review, the Party did not provide any additional information.
KL.6	CM – CO_2 (KL.11, 2018) (KL.12, 2016) (KL.12, 2015) Transparency	Include in the NIR detailed information on SRCs, including information on the fertilization occurring in the SRCs and harvested wood products originating from the SRCs.	Resolved. The Party reported in the NIR (section 6.1.2.3.4.3, pp.558–560) information on how carbon stock changes are estimated for short-rotation plantations.
KL.7	CM – CO_2 (KL.12, 2018) (KL.13, 2016) (KL.13, 2015) Accuracy	Estimate and report the carbon stock changes 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.	Not resolved. The Party reported that "for the remaining categories of cropland, grassland, woody grassland, wetlands and settlements, no carbon stock changes are listed in cases in which crops (annual or perennial) do not change" in its NIR (p.546). During the review, the Party clarified that the rotation times of permanent crops are highly variable and depend on their species (between approximately 3 and 30 years, but usually fewer than 20). The Party therefore does not know the age structure of the permanent crops in the 'remaining' category or the stage of growth at which permanent crops change from the transitional to the remaining category. Germany assumes a long-term equilibrium of carbon stock and that the age groups of the different species in the remaining category are uniformly distributed over the long term.

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
			The ERT considers that the recommendation has not yet been addressed because the Party's reporting is not in accordance with the 2006 IPCC Guidelines. The ERT considers that national GHG inventories shall report emissions when those occur. The methodology applied by Germany, which is based on reporting net zero emissions (the consequence of assuming a constant carbon stock at its long-term equilibrium level), involves counting in any year an amount of future emissions or removals up to an amount that counterbalances, to zero, the actual emissions and removals occurring in that year. The ERT is of the view that the information available, including the time series of national crop statistics, as well as the use of expert judgment when no information is available, would allow Germany to implement the following method from the 2006 IPCC Guidelines (vol. 4, chap. 5.2.1.1): "The default method is to multiply the area of perennial woody cropland by a net estimate of biomass accumulation from growth and subtract losses associated with harvest or gathering or disturbance (according to equation 2.7 in chap. 2). Losses are estimated by multiplying a carbon stock value by the area of cropland on which perennial woody crops are harvested".
KL.8	CM – CO_2 (KL.13, 2018) (KL.13, 2016) (KL.13,2015) Transparency	Include in the NIR transparent and verifiable information to demonstrate that the CM soil pool is not a net source.	Resolved. The Party reported in the NIR (section 6.5.2.3.23, pp.635–638) information demonstrating that soil organic matter in mineral soil is not a net source of GHG emissions.

[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 2019 annual submission of Germany was not available at the time of this review. Therefore, the recommendations reflected in this table are taken from the 2018 annual review report. For the same reason, 2017 is 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 2020 annual submission of Germany, and had not been addressed by the Party at 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 the issue*	*Number of successive reviews issue not addressed*[a]
General		
G.3	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.	3 (2015/2016–2020)
Energy		
E.3	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.	3 (2015/2016–2020)
IPPU		
I.8	Report on how time-series consistency was ensured, given the use of different methods in the time series.	3 (2015/2016–2020)
Agriculture	No issues identified.	
LULUCF	No issues identified.	
Waste	No issues identified.	
KP-LULUCF		
KL.5	Stratify the CM estimates, considering the SRCs, based on the methodology provided in the Kyoto Protocol Supplement.	3 (2015/2016–2020)
KL.7	Estimate and report the carbon stock changes 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 harvesting, gathering or disturbance.	3 (2015/2016–2020)

[a] The reports on the reviews of the 2017 and 2019 annual submissions of Germany have not yet been published. Therefore, 2017 and 2019 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 2020 annual submission

10. Table 5 presents findings made by the ERT during the individual review of the 2020 annual submission of Germany that are additional to those identified in table 3.

Table 5
Additional findings made during the individual review of the 2020 annual submission of Germany

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
General			
G.9	Key category analysis	While the Party reported key categories pursuant to the tier 1 approach in NIR table 6, the table does not clearly segregate categories identified as key by level from those identified as key by trend, because the headings of the columns of the table refer to the level assessment only. The ERT noted that this is not in accordance with the 2006 IPCC Guidelines (vol. 1, tables 4.2–4.3) because the relationship between the level and the trend of each category's emissions and removals is not systematically and transparently presented. During the review, the Party clarified that an error had been made in the headings for columns 10–12 of NIR table 6, but the data in the table are correct. The ERT encourages Germany to follow tables 4.2–4.3 of the 2006 IPCC Guidelines (vol. 1) for reporting the key category analysis in the NIR.	Not an issue/problem
G.10	Further improvements (identified by the Party)	The Party reported potential further improvements to individual categories in the sectoral chapters of its NIR (e.g. in section 3.2.12.3, p.158), but not all these potential further improvements were included in NIR table 510 on planned improvements, although sometimes the table is cross-referenced. The ERT noted that this is not in accordance with the UNFCCC Annex I inventory reporting guidelines because information obtained from implementing the QA/QC programme, the inventory review process and other verification activities should be considered in the development and/or revision of the QA/QC plan and the quality objectives. During the review, the Party clarified that data loss had occurred when entering the planned improvements into NIR table 510, but this was not noticed until after the NIR had been finalized. The ERT recommends that Germany improve its 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 planned improvements of the inventory (NIR table 510 in the 2020 submission).	Yes. Convention reporting adherence
Energy			
E.4	Feedstocks, reductants and other non-energy use of fuels – solid fuels – CO_2	The Party reported the IEF and CO_2 emissions from coal tar, other bituminous coal, coke oven/gas coke and lignite for non-energy uses as "NE" in CRF table 1.A(d) with AD reported for these fuels. There was no explanation provided in the table or in the NIR. The ERT noted that where no CO_2 emissions from non-energy uses are expected, instead of reporting "NE", it would be better to report "NA", in line with paragraph 37 of the UNFCCC Annex I inventory reporting guidelines, for an activity that exists but for which relevant emissions and removals are considered not to occur. During the review, the Party explained that in some cases where no emissions are expected and where the types of fuels are not included in any other fuel category, it reported "NE". The Party indicated that in future submissions it	Yes. Comparability

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		would report "NA" in CRF table 1.A(d) in cases where no emissions are expected and would provide estimates where emissions are expected.	
		The ERT recommends that Germany, when completing CRF table 1.A(d) in future submissions, report estimates of emissions from non-energy uses 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 the non-energy use of a fuel).	
E.5	1.A.3.b Road transportation – gasoline – CO_2	The Party reported in NIR table 59 the CO_2 EF for fossil-based gasoline as being up to 75.29 tg/TJ (e.g. for 2017 and 2018), which is higher than the upper value of the default range in the 2006 IPCC Guidelines (vol. 2, chap. 2) (73.00 t/TJ). In the NIR (p.216), Germany indicated that the comparatively high CO_2 EF for gasoline is the result of an adjustment.	Yes. Transparency
		During the review, the Party clarified that the adjustment was related to the average annual country-specific net calorific value (in kJ/kg fuel), which was lowered significantly after 2014 by the responsible mineral oil authority (until 2014 it was 43.542 kJ/kg; as of 2015 it is 42.281 kJ/kg) resulting in a significantly higher energy-related CO_2 EF for gasoline (in t CO_2/TJ).	
		The ERT encourages that Germany improve the transparency of future NIRs by including 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.	
IPPU			
I.16	2.A.4 Other process uses of carbonates – CO_2	The Party reported large inter-annual variation in CO_2 emissions for subcategory 2.A.4.b (other uses of soda ash) between 2016 and 2017 (–39.6 per cent) and 2017 and 2018 (–65.6 per cent) in CRF table 2(I).A-Hs1, and also reported that emissions decreased from 205.7 kt CO_2 in 2016 to 42.7 kt CO_2 in 2018. Germany stated in the NIR (section 4.2.4.2.2, p.309) that "at the time the inventory was being prepared, clarification of those figures was still underway…the low values for the years 2017 and 2018 lead to a decreasing trend, one that cannot yet be explained from a technical industry standpoint and that would seem to arise calculatory from the balance-sheet method used".	Yes. Accuracy
		During the review, the Party explained that verification of these figures is still in progress and that it is aiming to make relevant improvements for the next submission. During the review, the ERT determined there were no underestimates of emissions.	
		The ERT recommends that Germany 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.	
I.17	2.C.2 Ferroalloys production – CO_2	The Party reported the source of the AD used to estimate CO_2 emissions for category 2.C.2 (ferroalloys production) from 1995 onward in its NIR (section 4.4.2.1, p.342), but did not provide information on the AD used for 1990–1994.	Yes. Transparency
		During the review, the Party clarified that production figures from the Federal Statistical Office were used for 1990–1994, but since 1995, these production figures have not been included in national production statistics. As a result of this situation, data from the British Geological Survey were used for 1995 onward.	

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		The ERT recommends that Germany include in future NIRs information on the source of AD for 1990–1994 used to estimate CO_2 emissions from ferroalloys production.	
I.18	2.D.1 Lubricant use – CO_2	The Party reported emissions of 138.84 kt CO_2 and 2.33 kt NMVOC for 2011 in CRF table 2(I)s2. NIR table 213 shows the recalculation made for 2011 resulted in a much higher change to the emissions (33.70 per cent) than the recalculations made for other years, which ranged from –0.37 to +0.48 per cent.	Yes. Accuracy
		During the review, the Party provided the calculation spreadsheet for NMVOC and CO_2 emissions from stationary lubricant use. The ERT noted that the NMVOC emissions for 2011 were calculated as 23.33 kt, not 2.33 kt as reported in CRF table 2(I)s2. Germany explained after examining the point raised by the ERT that a transcription error must have occurred with the decimal place in the database and that it would be corrected in the next submission. The ERT noted that this error in NMVOC emissions resulted in an error in CO_2 emissions.	
		The ERT recommends that Germany correct in the next submission the error in CO_2 and NMVOC emissions from stationary lubricant use for 2011 in CRF table 2(I)s2.	
I.19	2.D.2 Paraffin wax use – CO_2	The Party reported a CO_2 IEF of 2.50 t CO_2/t product in CRF table 2(I).A-Hs2 for category 2.D.2 (paraffin wax use), while the NIR (section 4.5.2.1, p.358) provides a value of 2.9467 t CO_2/t product. The EF in the NIR is consistent with the default EFs in the 2006 IPCC Guidelines (vol. 2, chap. 1), that is, 40.2 TJ/kt in table 1.2 (default net calorific values) and 73.3 kg/TJ in table 1.4 (default CO_2 EFs for combustion), while the EF in CRF table 2(I).A-Hs2 is not consistent with these default values.	Yes. Comparability
		During the review, the Party clarified that the AD in CRF table 2(I).A-Hs2 for category 2.D.2 include the biogenic fraction (15 per cent) of wax, thus resulting in an artificial IEF for CO_2 emissions.	
		The ERT recommends that Germany 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.	
I.20	2.E.3 Photovoltaics – SF_6	The Party reported in its NIR (section 4.6.3.1, p.374) that "in Germany, use of SF_6 in solar technology began in 2003…from 2014 onward, no wafer production with SF_6 has taken place in Germany". For category 2.E.3 (photovoltaics), CRF table 2(II).B-Hs1 reports consumption and emissions of SF_6 for 2018 as 0.05 t and 0.002 t, respectively. For 1990–2002 and 2014–2017, consumption and emissions have blank cells.	Yes. Comparability
		During the review, the Party confirmed the 2018 data from the Federal Statistical Office are incorrect and would be corrected for the next submission, and indicated that the appropriate notation key, "NO", would be reported for 2018.	
		The ERT recommends that Germany update CRF table 2(II).B-Hs1 such that the appropriate notation key is reported for all years where SF_6 emissions from photovoltaics are not occurring (i.e. 1990–2002 and 2014 onward).	
I.21	2.G.3 N_2O from product uses – N_2O	The Party reported that it made recalculations of N_2O emissions for subcategory 2.G.3.a (medical applications) for 1990–2002). CRF table 2(I).A-Hs2 in the 2019 submission reports N_2O emissions for 1990–2002 (ranging between 6.81 kt N_2O in 1990 to 3.42 kt N_2O in 2002), while CRF table 2(I).A-Hs2 in the 2020 submission reports emissions as "C" (confidential) for 1990–2002. There are no recalculations for 2003 onward.	Yes. Accuracy
		During the review, the Party clarified that the export from the database to CRF Reporter did not work, so a lot of IPPU data had to be added to CRF Reporter manually. This led to what is assumed to be human error, and N_2O	

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		emissions from anaesthetic use, explosives, semiconductor production, and propellant for pressure and aerosol products being reported as confidential. The ERT recommends that Germany correct in future submissions 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.	
Agriculture			
A.6	3. General (agriculture)	The Party reported the dairy cattle population in its NIR (p.454) and in Haenal et al. (2020, section 3.4.2.2). The population decreased significantly from 1990 to 1991 – by 11.4 per cent – but the reason for this change is not described in the NIR or in Haenal et al. (2020). The Party also reported the IEF for enteric fermentation of swine in CRF table 3.As1. The IEF decreased significantly from 1990 to 1991 – by 16.3 per cent – but the reason for this change is not described in the NIR or in Haenal et al. (2020). During the review, the Party clarified that after German reunification in 1990, the animal populations of dairy cattle and swine decreased due to structural changes resulting from the reunification. The ERT recommends that Germany 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.	Not an issue/problem
A.7	3.B.3 Swine – N_2O	The Party reported that there are no other manure management systems (free range pigs) in the country in CRF table 3.B(b) and in the NIR (p.464) that "free-range management of swine plays an insignificant role in Germany and it is thus not occurring in Germany". During the review, the Party clarified that, according to the 2010 agriculture census conducted by the Federal Statistical Office, there were approximately 48,800 free range pigs in 2010, equating to 0.2 per cent of all swine housing types. The Party explained that according to expert opinion, this population has not changed because of the strict national requirements for swine housing systems, and further, that free range pigs are not excluded from the inventory but are included in other management systems because total pig numbers are used in the inventory. The ERT recommends that Germany 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 its NIR that free range pigs are not excluded from the inventory but that their numbers are captured under other management systems.	Yes. Transparency
A.8	3.D.a.2.c Other organic fertilizers applied to soils and 3.D.b Indirect N_2O emissions from managed soils – N_2O	The Party reported in its NIR (p.509) that the emissions associated with the application of biowaste residues to crops as fertilizer are included under the waste sector. In the waste chapter (on p.709 regarding composting facilities and p.712 regarding digestion plants) the Party reported that EFs for the composting of biowaste include both emissions from the composting itself and emissions from the storage and application of the compost. Furthermore, the Party stated in the NIR (p.709) that "the nitrous oxide emissions following fertilization with compost are very low. They can be neglected, since the nitrogen they include is organically bound and mineralizes very slowly". The ERT noted that the 2006 IPCC Guidelines (vol. 3, chap. 11) recommend that direct and indirect N_2O emissions from organic fertilizers applied to managed soils be estimated. The Guidelines provide a default EF of 0.01 kg N_2O-	Yes. Transparency

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		N per kg N applied to estimate direct N_2O emissions, 0.01 kg N_2O-N per kg NH_3-N and NO_X-N volatilized to estimate indirect N_2O emissions, and 0.0075 kg N_2O per kg N to estimate leaching and run-off. During the review, the Party confirmed that the EF for the composting of biowaste is based on a country study (Cuhls et al., 2015) and it includes composting as well as the storage of compost and its application onto soils. Germany reported that the emissions from the storage and application of biowaste are 25g N_2O per Mg biowaste. The ERT recommends that Germany increase the transparency of its reporting by providing detailed information in the next 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. 3, chap. 11). The ERT also recommends that the Party remove the statement "they can be neglected, since the nitrogen they include is organically bound and mineralizes very slowly" from the NIR (p.709).	
LULUCF			
L.7	4. General (LULUCF) – CO_2	The ERT encourages Germany to use the Wetlands Supplement in preparing its annual inventory for CO_2 off-site emissions in drained organic soils for future annual submissions.	Not an issue/problem
L.8	4. General (LULUCF) – CO_2 and N_2O	The Party applied a country-specific methodology for estimating SOC changes in mineral soils associated with changes in the use of land, as reported in its NIR (section 6.1.2.1, pp.532–541); that is, it calculated a single national average SOC content for each land-use category and subcategory, as shown in NIR table 534. The ERT noted that this is not in accordance with the good practice established in the 2006 IPCC Guidelines (vol. 4, chaps. 2, 4, 5 and 6, and equation 2.25), which requires stratification of the entire population (SOC in mineral soils across the entire national territory) by climate zone, soil type, use of land and management practice of land with the aim of minimizing, so far as practicable, the variability of the average factors to avoid any biases, so far as can be judged, and minimizing uncertainties, so far as practicable. The methodology applied by Germany does not stratify SOC values by climate zone, soil type or management practice. The ERT noted that the Party's limited stratification of SOC compared with the IPCC default stratification means that uncertainty is not reduced as far as practicable. A method that uses the average SOC values of national conditions for each reported category or subcategory can only be valid if land-use conversions are assumed to occur for each land category in equal proportion to the spatial distribution of the SOC content within that category. The NIR does not provide evidence for the assumption that the distribution of SOC values, and associated mean, in each land category corresponds to the distribution, and associated mean, of the areas within the relevant land-use change category. It is therefore not possible to state that the SOC change estimates are accurate, as for instance when land-use changes occur preferentially in a subset of the land category population; for example, the conversion of grassland to forest land is very likely to occur on the less productive land, which very likely has a lower SOC content than the average calculated across the entire area of the grassland. During the review, the Party clarified that the problem is known and the solution is progressing under the stepwise implementation of a new German soil reporting system, as follows: step 1, implementation of new nationwide EFs derived from the results of nationwide soil inventories; step 2, implementation of a new reporting method; step 3, full automation of the German LULUCF reporting system; and step 4, regionalization of the soil inventory results.	Yes. Accuracy

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		While the implementation of steps 1 to 3 will inform the next inventory submission, step 4 is expected to be implemented later. The new soil reporting system, once completed, will stratify SOC according to use and natural and site-specific conditions (e.g. geomorphology, parent material, regional climate zone). The ERT recommends that Germany ensure that the new reporting system is capable of detecting and reporting SOC changes associated with changes in the use and management of land with different soil types and climate conditions at a minimum. Until the new reporting system is fully implemented, the ERT recommends that the Party apply a method consistent with good practice, as defined by the 2006 IPCC Guidelines (vol. 4, section 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 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.	
L.9	4.A Forest land – CO_2	The Party described in the NIR (sections 6.1.2.1.3 and 6.4.2.5.4) the methodology used to estimate the net SOC increment in mineral soils on 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. During the review, the Party explained the detailed methodology for estimating the net soil carbon in mineral soils down to 30 cm of forest land, which is described in Grüneberg et al. (2014). Briefly, to calculate the carbon stock change rate, forest land and soil information was attributed to available nationwide geodata sets. All plots were grouped by soil class (further stratified by federal states, as the sampling density deviated across states) because the magnitude and sequestration rate of soil carbon is strongly related to soil properties (Six et al., 2002). The distribution of dominant soil group formations (n = 16) was derived from the 72 units of the national soil map (1:1,000,000). The forest land area was derived from a geographical information system based intersection of the national soil map with a CORINE land-cover raster map. Specific carbon stocks of each soil group (Mg/ha, down to a depth of 30 cm) were attributed to the corresponding forest land for each inventory. Subsequently, area-weighted averages (determined by considering covered forest land of each soil group) were calculated to obtain carbon stocks from the first and second national forest soil inventory for each soil group. The carbon stock change rate of the mineral soil (down to a depth of 30 cm) was estimated by determining the difference of averaged carbon stocks. These carbon stocks were related to the years elapsed between the two soil inventories. The difference in carbon stocks estimated is related to a specific volume (Mg/ha/year per 30 cm), which means that this estimated change rate can be attributed to any possible forest area. In this derivation, the forest areas (which the ERT was concerned about) exclusively served as a weighting factor. The ERT recommends that Germany 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 order to demonstrate that the calculated SOC change is not biased by changes in forest area over time.	Yes. Transparency
L.10	4.A Forest land – CO_2	The Party reported in its NIR (section 6.4.2.2.8, p.606) that to calculate carbon stock changes between two time points (1987–2002, 2002–2008, 2008–2012 and 2012–2017), the "continuous forest inventory" method was used; that is, for scaling up a national total estimate, only cluster points that were included at both time points were used.	Yes. Accuracy

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		The same method has been applied to biomass and DOM carbon pools, although for DOM, the carbon stock data are limited to three points in time (2002, 2008 and 2017). The ERT noted that the total biomass carbon stock change reported for the forest domain under the Convention in CRF table 4.A (forest land remaining forest land and land converted to forest land, with the latter limited to stock gains) and CRF tables 4.B–4.E (forest land converted to other land uses, limited to stock losses) does not match the total biomass carbon stock change reported under the Kyoto Protocol in CRF tables 4(KP-I)A.1 (afforestation and reforestation, limited to stock gains), 4(KP-I)A.2 (deforestation, limited to stock losses) and 4(KP-I)B.1 (FM). The same inconsistency was found for the DOM carbon pool. For instance, for 2017, the total forest-related biomass annual net carbon stock change reported under the Convention is 13,986.504 kt C (forest land remaining forest land, 12,551.962 kt C; land converted to forest land, 1,697.615 kt C; forest land converted to other land uses, –263.073 kt C), while under the Kyoto Protocol the total is 14,591.672 kt C (FM, 12,391.471 kt C; AR, 2,515.870 kt C, deforestation, –315.668). Similarly, for DOM, the total annual net carbon stock change reported for 2017 under the Convention is 845.838 kt C (forest land remaining forest land, 884.969 kt C; land converted to forest land, 105.690 kt C; forest land converted to other land uses, –144.822 kt C) and under the Kyoto Protocol is 925.831 kt C (FM, 873.172 kt C; AR, 197.628 kt C; deforestation, –144.969 kt C). The ERT also noted that the forest definition applied under the Convention does not significantly differ from that applied under the Kyoto Protocol (NIR, p.781) and that carbon stock change estimates under both reporting requirements are based on data from the same database and on the same methodologies for determining land representation (NIR, sections 6.2–6.3) and calculating carbon stock changes (NIR, pp.790–791). Thus, for each carbon pool in each inventory year the total carbon stock change of the forest domain reported under the Convention should match the one reported under the Kyoto Protocol; further, both should match the total carbon stock change calculated by subtracting the total carbon stock determined from an NFI from the total carbon stock of the previous NFI. During the review, the Party did not provide any additional information. The ERT recommends that Germany reconcile in each year the total carbon stock change reported under the Convention and under the Kyoto Protocol for each of the biomass and DOM carbon pools. The ERT further recommends that the Party reconcile the total carbon stock change reported for biomass and DOM in any period between two subsequent NFIs with the total carbon stock change calculated across the period as the difference between the total carbon stock of the two subsequent NFIs.	
L.11	4.A Forest land – CO_2 and N_2O	The Party reported in its NIR (sections 6.2–6.3) that the same data sources and methods were applied to land representation for LULUCF under the Convention as to KP-LULUCF activities under the Kyoto Protocol. The Party also reported that the forest definition applied under the Convention does not significantly differ from that applied under the Kyoto Protocol (NIR, p.781) so lands classified as forest or non-forest under the Convention have the same classification under the Kyoto Protocol. Accordingly, the total area reported as forest land under the Convention should be identical to that reported under the Kyoto Protocol (and vice versa). However, the ERT noted that in every inventory year the total area reported as forest land under the Convention does not match that reported under the Kyoto Protocol. For instance, for 2017, the total forest area reported under the Convention is 10,986.159 kha (forest land remaining forest land, 10,792.496 kha;	Yes. Accuracy

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		land converted to forest land, 193.663 kha), while under the Kyoto Protocol the total is 10,965.449 kha (FM, 10,699.156 kha; AR, 266.293 kha). During the review, the Party did not provide any additional information. The ERT recommends that Germany reconcile in each year the total carbon stock change reported under the Convention and under the Kyoto Protocol for each of the biomass and DOM carbon pools. The ERT further recommends that the Party reconcile the total carbon stock change reported for biomass and DOM in any period between two subsequent NFIs with the total carbon stock change calculated across the period as the difference between the total carbon stock of the two subsequent NFIs.	
L.12	4.B Cropland – CO_2	The Party reported short-rotation plantations for wood production under cropland instead of forest land in CRF table 4.B and section 6.1.2.3.4.3 (pp.558–561) of the NIR. In that section, the Party also reported that biomass carbon stock changes in short-rotation plantations for wood production are only reported in the year of conversion of a land to a short-rotation plantation, and the biomass carbon stock net gain is estimated once, as an instantaneous accumulation in the year of conversion only. The ERT noted that this is not in accordance with the 2006 IPCC Guidelines (vol. 4, chap. 1, on land-use categories; chap. 2, on generic methodologies for estimating stock changes in carbon pools; chap. 4, on additional guidance to estimate carbon stock changes in forest land; and chap. 5, on additional guidance to estimate carbon stock changes in cropland) because short-rotation plantations produce wood rather than crops and meet the forest land definition of the 2006 IPCC Guidelines, as well as the thresholds of the German forest definition, so IPCC good practice for estimating forest biomass carbon stock changes applies even if this management system is reported by the Party under cropland. During the review, the Party clarified that lands with short-rotation plantations are considered to be agricultural areas (cropland) and that managing forest land as short-rotation plantations is prohibited by German forest codes and laws. Accordingly, short-rotation plantations are not included in the NFI. The ERT recommends that Germany 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 carbon stock changes in short-rotation plantations.	Yes. Accuracy
L.13	4.B.1 Cropland remaining cropland – CO_2	The Party reported a ‘net zero’ biomass carbon stock change in cropland remaining cropland with perennial vegetation under the assumption of long-term equilibrium of such carbon stocks in its NIR (section 6.1.2.3, pp.546–563). The ERT noted that this is not in accordance with the 2006 IPCC Guidelines (vol. 4, chap. 5.2.1.1) because the default method is to multiply the area of perennial woody cropland by a net estimate of biomass accumulation from growth and subtract losses associated with harvesting, gathering or disturbance (according to equation 2.7). Losses are estimated by multiplying a carbon stock value by the area of cropland on which perennial woody crops are harvested. This implies that the IPCC tier 1 methodology assumes continuous accumulation of biomass in perennial crops until the final harvest occurs. During the review, the Party clarified that the rotation times of permanent crops are highly variable and depend on their species (between approximately 3 and 30 years, but usually fewer than 20). Therefore, the age structure of the permanent crops in the ‘remaining’ category is unknown, as is the stage of growth at which permanent crops change	Yes. Completeness

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		from the transitional to the remaining category. Consequently, the carbon stock is assumed to be in long-term equilibrium, and the age groups of the different cultures in the remaining category are assumed to be uniformly distributed over the long term. However, the ERT notes that national GHG inventories shall report emissions when those actually occur. The methodology applied by Germany, which is based on reporting net zero emissions (the consequence of assuming a constant carbon stock at its long-term equilibrium level), involves counting in any year an amount of future emissions or removals up to an amount that counterbalances the actual emissions and removals occurring in that year. The ERT recommends that Germany report annual estimates of net carbon stock changes 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 European Union member States (the ERT notes that the limited availability of relevant data experienced by Germany is also experienced by other European countries).	
L.14	4.B.1 Cropland remaining cropland and 4.C.1 Grassland remaining grassland – CO_2	The Party reported in its NIR (p.532) that "for mineral soils with no use or name change, in land-use categories 4.B, 4.C, it is assumed that the pertinent carbon inputs into the soil and carbon extractions from the soil are equal in size, so that the systems are in equilibrium". The increased use of organic fertilizers shown in NIR figure 62 is expected to have caused, across time, a permanent average increase in the soil organic carbon stock of German agricultural land. The ERT noted that assuming equilibrium in SOC in cropland remaining cropland and grassland remaining grassland without consideration of changes in cultural practices and their intensity is not in accordance with the 2006 IPCC Guidelines (vol. 4, chaps. 2, 5 and 6, and equation 2.25) because the IPCC default method differentiates SOC in mineral soils of cropland according to tillage intensity and amount of carbon input, including organic fertilizers, as well as by use type including set-aside, and of grassland according to carbon input and intensity of management. Thus, IPCC good practice requires the estimation of SOC changes associated with changes in those variables. During the review, the Party clarified that no official or representative data regarding the management of agricultural land were available to the inventory compilation team and, therefore, that no quantified comprehensive spatially explicit assessments of the effects of different management measures on SOC content in the cropland remaining cropland and grassland remaining grassland categories can be made yet. Further, the Party stated that the findings (as summarized in the NIR, section 6.5.2.3) of the permanent soil observation system, which examines agricultural areas that are cultivated according to the well-established methods of good agricultural practice, indicate that on average there have been no changes in the SOC of agricultural mineral soils over the last 25 years. Finally, the Party informed the ERT that it is working on a medium-term solution that will provide the capability to implement a new inventory methodology after 2025 by conducting a second nationwide inventory of agriculturally used soils (start: 2021); developing model ensembles, which will be validated by results from the first and second agricultural soil inventory; attempting to gain access to georeferenced agricultural management data for the inventory, in particular from the German Integrated Administration and Control System (which is a difficult process because of German privacy legislation and necessary negotiations with all 16 German federal states); and exploring options of deriving management information from remote sensing data (which would only cover the future and recent past).	Yes. Convention reporting adherence

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		Acknowledging the future work on the subject as planned by the Party, the ERT notes that the country-specific methodology currently applied requires verification as per paragraph 41 of the UNFCCC Annex I inventory reporting guidelines.	
		The ERT recommends that Germany 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.	
L.15	4.B.2 Land converted to cropland and 4.C.2 Land converted to grassland – CO_2	The Party reported in its NIR (p.530) that biomass carbon stock changes for land-use changes are calculated under the assumption that the entire carbon stock change occurs in the year of the conversion.	Yes. Accuracy
		The ERT noted that this approach is not consistent with conversion to land with perennial biomass, as per good practice set out in the 2006 IPCC Guidelines (vol. 4, chaps. 2, 5 and 6, and equations 2.7 and 2.15), because perennial biomass accumulates over time, not just in the year of conversion.	
		During the review, the Party confirmed that perennial biomass in non-forest land is assumed to accumulate once, in the year of conversion, and to be in long-term equilibrium thereafter.	
		The ERT recommends that Germany 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.	
L.16	4(V) Biomass burning – CH_4 and N_2O	The Party reported above-ground biomass stocks as fuel for estimating GHG emissions from biomass burning in NIR table 411.	Yes. Completeness
		The ERT noted that this is not in accordance with the 2006 IPCC Guidelines (vol. 4, equation 2.27) because fuel also includes litter and deadwood.	
		During the review, the Party acknowledged the missing stocks while noting that biomass burning is an insignificant contributor to national total GHG emissions. The ERT acknowledged this insignificance.	
		The ERT recommends that Germany use available data on DOM stocks to include them as fuel when calculating CH_4 and N_2O emissions from biomass burning.	
Waste			
W.10	5.B.2 Anaerobic digestion at biogas facilities – CH_4 and N_2O	Germany reported AD as "NO" in the CRF table for this category (5.B). The ERT noted, however, that 677.0 t of livestock manure in 2018 and an estimated 2,373.0 t in 2020 were co-digested with biowaste at digestion plants (NIR, section 7.3.2.1, p.711). The emissions from the livestock component of the plant feedstock were appropriately reported under the agriculture sector in CRF table 3.B(a), column K (NIR 2018, sections 5.1.3.6.5 and 5.1.4) in order to avoid double counting.	Yes. Transparency
		During the review, the ERT and the Party discussed the appropriate reporting of this category (5.B) with respect to footnote 4 to CRF table 3.B(a), and agreed that the AD should be reported in CRF table 5.B, column B, while the emissions should be reported as "IE" in order to improve the consistency of the NIR and the CRF tables and also to ensure the reporting is in accordance with footnote 4 to CRF table 3.B(a) (i.e. "This category should include all organic waste from sources not covered by municipal solid waste").	

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		The ERT recommends that Germany report in future submissions 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.	
KP-LULUCF			
KL.9	General (KP-LULUCF) – CO_2, CH_4 and N_2O	The Party reported that no indirect or natural GHG emissions sources or sinks were included in the reported estimates of carbon stock changes (NIR, section 11.3.1.3, p.799), although carbon stock changes measured by a comparison of consecutive NFIs do account for any direct and indirect human-induced as well as natural effects.	Yes. KP reporting adherence
		The ERT noted that the reporting is not in accordance with the Kyoto Protocol Supplement because section 11.3.1.3 of the NIR does not provide information on whether indirect and natural GHG emissions and removals have been factored out. The Kyoto Protocol Supplement (section 2.3.7) states that for the purpose of accounting under the Kyoto Protocol, 'factoring out' in the accounting of KP-LULUCF has been addressed through a 'net-net' approach, where the net change in GHG emissions and removals is accounted for by comparing GHG emissions and removals during the commitment period with a benchmark under either a base year or a 'business as usual' scenario, which could also be a scenario in which emissions and removals are assumed to sum to zero.	
		During the review, the Party did not provide any additional information.	
		The ERT recommends that Germany 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.	
KL.10	General (KP-LULUCF) – CO_2, CH_4 and N_2O	The ERT recommends that Germany consider the issue listed in ID# L.8 under the LULUCF sector above as also being relevant to KP-LULUCF activities.	Yes. Accuracy
KL.11	General (KP-LULUCF) – CO_2, CH_4 and N_2O	The ERT recommends that Germany consider the issues listed in ID#s L.10 and L.11 under the LULUCF sector above as also being relevant for AR, deforestation and FM.	Yes. Accuracy
KL.12	Deforestation – CO_2	The Party reported in the information item of CRF table 4(KP-I)A.2 the area of deforested lands disaggregated by final land use, although it did not report the annual carbon stock changes in each carbon pool.	Not a problem
		The ERT, taking into consideration the inconsistencies in carbon stock change estimates reported under the Convention and under the Kyoto Protocol, as noted in ID#s L.10 and L.11 above, encourages Germany to report annual carbon stock change estimates for each carbon pool in the information item of CRF table 4(KP-I)A.2.	
KL.13	FM – CO_2	The Party reported in NIR table 553 a projection of the biomass carbon stock changes for 2013–2020, as applied in the technical correction to its FMRL. For 2013, the biomass carbon pool is projected to be a net source of 7,396 kt CO_2, while in CRF table 4.A, a net sink is reported of 45,044 kt CO_2 for 2008, which is the latest year of the historical period to be used to project the FMRL. The difference between the two figures is 52,440 kt CO_2.	Yes. KP reporting adherence
		The ERT noted that Germany, in its FMRL submission, projected an increase in the harvest rate of approximately 24 per cent between 2008 and 2013, or approximately 19 million m^3, which can explain no more than half of the projected decrease in the biomass sink (see document FCCC/TAR/2011/DEU). The ERT therefore concludes that	

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		the large difference of 52,440 kt CO_2 in the annual net carbon stock change within such a short period (four years) is not justified by the modelling of future harvests or by the dynamic in the age–class distribution, given that ageing of forests is minimal within such a short period and, in any case, the increased projected harvest rate is expected to rejuvenate the forest estate. The Party did not provide information – neither in the NIR nor in the FMRL submission – to show that model-based calculations used for constructing a projected FMRL reproduce the data for FM or forest land remaining forest land for the historical period. The ERT 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 did not provide any additional information. The ERT recommends that Germany provide in future submissions 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.	
KL.14	FM – CO_2	The Party reported in NIR table 553 a projection of the biomass carbon stock changes for 2013–2020, as applied in the technical correction to its FMRL. For 2013–2018, the biomass carbon pool is projected to be a net source of 7,861 Gg CO_2, while in CRF table 4(KP-I)B.1 for the same period, a net sink of –45,470 kt CO_2 is reported. The ERT noted that the increase in the harvesting rate between the historical period (2000–2008) and the projected period (2013–2020) is approximately 30 per cent or 23 million m^3 (see tables 8–9 of the FMRL submission (available at https://unfccc.int/topics/land-use/workstreams/land-use--land-use-change-and-forestry-lulucf/forest-management-reference-levels), so the projected harvest increase cannot alone justify the projected decrease of 53 Mt CO_2 in the forest sink. The ERT also noted that the NIR does not provide information on the main factors generating the accounted quantity (i.e. the difference in net emissions between reporting of FM during the second commitment period and the FMRL); in particular, the NIR does not provide evidence that the lower sink during the second commitment period, as compared with what was assumed in the 'business as usual' scenario, is quantitatively consistent with the observed higher harvest rate, and/or evidence that other major factors are contributing to the difference. This is not in accordance with the good practice set out in the Kyoto Protocol Supplement (p.2.97). During the review, the Party did not provide any additional information. The ERT recommends that Germany provide in its next submission 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.	Yes. Transparency
KL.15	FM – CO_2 and N_2O	The ERT recommends that Germany consider the issue listed in ID# L.11 under the LULUCF sector (FM) above as also being relevant to KP-LULUCF activities.	Yes. Completeness
KL.16	FM – CO_2	The ERT recommends that Germany consider the issue listed in ID# L.9 under the LULUCF sector (FM) above as also being relevant to KP-LULUCF activities.	Yes. Transparency

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
KL.17	CM – CO_2	The Party reported short-rotation plantations for wood production under cropland instead of forest land in CRF table 4.B and section 6.1.2.3.4.3 (pp.558–561) of the NIR. In that section, the Party also reported that biomass carbon stock changes in short-rotation plantations for wood production are only reported in the year of conversion of a land to a short-rotation plantation, and the biomass carbon stock net gain is estimated once, as an instantaneous accumulation in the year of conversion only. The ERT noted that this is not in accordance with the Kyoto Protocol Supplement (chap. 1), which requires reporting, and accounting, of annual emissions and removals associated with carbon stock changes in woody biomass, including emissions associated with the removal of tree cover below the forest threshold in land that – although it meets the forest definition – is reported under a non-forest Kyoto Protocol activity. However, the ERT also noted that such an exclusion will not impact the accounting if appropriate methods for estimating annual changes in woody biomass are applied. The ERT recommends that Germany apply good practice, as set out in the 2006 IPCC Guidelines (vol. 4, chaps. 2 and 5), and the Kyoto Protocol Supplement (as quoted above in chap. 1), for estimating changes in forest biomass carbon stocks in order to estimate annual emissions and removals associated with biomass carbon stock changes in short-rotation plantations.	Yes. Accuracy
KL.18	CM – CO_2	The ERT recommends that Germany consider the issues listed in ID#s L.9, L.10 and L.12 under the LULUCF sector (CM) above as also being relevant to KP-LULUCF activities.	Yes. Completeness
KL.19	CM – GM – CO_2	The ERT recommends that Germany consider the issue listed in ID# L.14 under the LULUCF sector (CM and GM) above as also being relevant to KP-LULUCF activities.	Yes. KP reporting adherence

[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 2020 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. Germany elected commitment period accounting and therefore the issuance and cancellation of units for KP-LULUCF is not applicable to the 2020 review.

VIII. Questions of implementation

13. No questions of implementation were identified by the ERT during the individual review of the Party's 2020 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 2020 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 for Germany, base year[a]–2018

(kt CO_2 eq)

	Total GHG emissions excluding indirect CO_2 emissions		*Total GHG emissions including indirect CO_2 emissions[b]*		*Land-use change (Article 3.7 bis as contained in the Doha Amendment)[c]*	*KP-LULUCF (Article 3.3 of the Kyoto Protocol)[d]*	*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								–385 382.65
Base year	1 224 330.90	1 253 143.42	NA	NA	NA		36 936.27	
1990	1 220 646.04	1 249 458.56	NA	NA				
1995	1 090 862.61	1 121 370.24	NA	NA				
2000	1 008 120.10	1 043 426.39	NA	NA				
2010	922 674.52	942 338.00	NA	NA				
2011	900 566.23	919 434.65	NA	NA				
2012	895 339.80	924 147.41	NA	NA				
2013	914 157.78	941 570.26	NA	NA		–5 541.34	34 218.73	–63 454.87
2014	874 325.02	902 388.74	NA	NA		–5 836.55	34 126.52	–64 268.88
2015	878 734.01	906 320.05	NA	NA		–6 130.94	33 950.64	–63 906.76
2016	881 479.57	909 052.47	NA	NA		–6 423.04	33 809.18	–64 004.89
2017	867 667.61	894 296.28	NA	NA		–5 660.02	34 966.76	–64 507.68
2018	831 436.95	858 368.68	NA	NA		–6 244.51	34 777.11	–65 239.57

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

[a] "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.

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

[c] 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 report to facilitate the calculation of the assigned amount for the second commitment period of the Kyoto Protocol of the Party.

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

Table I.2
Greenhouse gas emissions by gas for Germany, excluding land use, land-use change and forestry, 1990–2018
(kt CO_2 eq)

	CO_2[a]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3
1990	1 052 348.54	121 192.51	62 522.84	50.32	3 068.79	5 840.68	4 428.00	6.88
1995	939 176.70	105 613.35	59 500.66	2 614.41	2 098.93	5 893.75	6 467.15	5.29
2000	899 780.20	88 605.55	41 763.06	6 030.21	975.00	2 190.96	4072.50	8.92
2010	832 669.74	59 181.20	36 235.58	10 343.93	355.79	487.84	3 002.48	61.43
2011	809 426.95	58 067.17	37 539.21	10 760.51	285.02	259.26	3 035.33	61.21
2012	813 893.12	58 804.79	36 863.34	10 943.41	247.78	277.18	3 082.59	35.21
2013	831 316.28	58 219.39	37 406.74	10 944.63	261.59	283.26	3 122.35	16.03
2014	792 684.87	56 991.08	38 050.34	11 118.15	238.05	219.81	3 066.15	20.28
2015	795 816.36	56 767.56	38 667.07	11 321.15	246.97	242.31	3 246.74	11.89
2016	800 510.29	55 506.92	37 834.30	11 297.46	252.13	183.03	3 457.21	11.15
2017	786 654.55	54 738.29	37 540.91	11 121.45	257.16	212.84	3 759.57	11.51
2018	755 362.34	52 641.89	35 518.29	10 487.12	289.76	186.88	3 870.66	11.75
Percentage change 1990–2018	**–28.2**	**–56.6**	**–43.2**	**20 740.8**	**–90.6**	**–96.8**	**–12.6**	**70.8**

Note: Emissions and removals reported in 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 by sector for Germany, 1990–2018
(kt CO_2 eq)

	Energy	IPPU	Agriculture	LULUCF	Waste	Other
1990	1 037 047.95	94 803.49	79 305.20	–28 812.52	38 301.93	NO
1995	918 029.11	96 895.78	68 157.61	–30 507.62	38 287.73	NO
2000	870 053.32	76 581.09	68 264.19	–35 306.29	28 527.79	NO
2010	801 507.80	62 606.32	63 626.16	–19 663.48	14 597.71	NO
2011	777 889.63	62 462.22	65 264.77	–18 868.42	13 818.03	NO
2012	784 620.31	61 594.72	64 886.41	–28 807.61	13 045.98	NO
2013	801 818.98	61 358.28	66 106.19	–27 412.48	12 286.80	NO
2014	761 972.68	61 255.84	67 472.48	–28 063.72	11 687.73	NO
2015	766 928.74	60 242.19	67 965.90	–27 586.04	11 183.22	NO
2016	769 721.18	62 104.81	66 491.11	–27 572.90	10 735.36	NO

	Energy	*IPPU*	*Agriculture*	*LULUCF*	*Waste*	*Other*
2017	752 375.67	65 628.06	66 070.32	–26 628.67	102 22.23	NO
2018	720 283.83	64 791.53	63 564.89	–26 931.73	9 728.43	NO
Percentage change 1990–2018	**–30.5**	**–31.7**	**–19.8**	**–6.5**	**–74.6**	**NA**

Notes: (1) Germany did not report emissions or removals in 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[a]–2018, for Germany

(kt CO_2 eq)

	Article 3.7 bis as contained in the Doha Amendment[b]	*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				5 268.00				
Base year	NA				12 966.42	23 969.85	NA	NA
2013		–6 671.93	1 130.59	–63 454.87	15 732.09	18 486.63	NA	NA
2014		–6 974.63	1 138.08	–64 268.88	15 615.27	18 511.25	NA	NA
2015		–7 277.73	1 146.78	–63 906.76	15 852.65	18 097.99	NA	NA
2016		–7 581.69	1 158.66	–64 004.89	15 964.95	17 844.22	NA	NA
2017		–7 280.83	1 620.81	–64 507.68	16 197.42	18 769.34	NA	NA
2018		–7 878.75	1 634.24	–65 239.57	16 590.18	18 186.93	NA	NA
Percentage change base year–2018					**27.9**	**–24.1**	**NA**	**NA**

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

[a] 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.

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

2. Table I.5 provides an overview of key relevant data from Germany's reporting under Article 3, paragraphs 3–4, of the Kyoto Protocol.

Table I.5
Key relevant data for Germany under Article 3, paragraphs 3–4, of the Kyoto Protocol from its 2020 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 t CO_2 eq (351 007 813 t 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	NA
2. Deforestation	NA
3. FM	NA
4. CM	NA
5. GM	NA

Annex II

Information to be included in the compilation and accounting database

Tables II.1–II.6 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 2018, 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	755 362 342	–	–	755 362 342
CH_4	52 641 892	–	–	52 641 892
N_2O	35 518 286	–	–	35 518 286
HFCs	10 487 116	–	–	10 487 116
PFCs	289 757	–	–	289 757
Unspecified mix of HFCs and PFCs	186 879	–	–	186 879
SF_6	3 870 660	–	–	3 870 660
NF_3	11 748	–	–	11 748
Total Annex A sources	**858 368 679**			**858 368 679**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–7 878 750	–	–	–7 878 750
Deforestation	1 634 240	–	–	1 634 240
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–65 239 567	–	–	–65 239 567
CM	16 590 177	–	–	16 590 177
CM for the base year	12 966 416	–	–	12 966 416
GM	18 186 930	–	–	18 186 930
GM for the base year	23 969 852	–	–	23 969 852

Table II.2
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	786 654 551	–	–	786 654 551
CH_4	54 738 293	–	–	54 738 293
N_2O	37 540 906	–	–	37 540 906
HFCs	11 121 452	–	–	11 121 452
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	**894 296 279**	**–**	**–**	**894 296 279**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–7 280 835	–	–	–7 280 835
Deforestation	1 620 813	–	–	1 620 813

	Original submission	*Revised submission*	*Adjustment*	*Final value*
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–64 507 685	–	–	–64 507 685
CM	16 197 423	–	–	16 197 423
CM for the base year	12 966 416	–	–	12 966 416
GM	18 769 337	–	–	18 769 337
GM for the base year	23 969 852	–	–	23 969 852

Table II.3
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	800 510 288	–	–	800 510 288
CH_4	55 506 917	–	–	55 506 917
N_2O	37 834 299	–	–	37 834 299
HFCs	11 297 458	–	–	11 297 458
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	**909 052 468**	**–**	**–**	**909 052 468**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–7 581 695	–	–	–7 581 695
Deforestation	1 158 659	–	–	1 158 659
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–64 004 888	–	–	–64 004 888
CM	15 964 954	–	–	15 964 954
CM for the base year	12 966 416	–	–	12 966 416
GM	17 844 222	–	–	17 844 222
GM for the base year	23 969 852	–	–	23 969 852

Table II.4
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	795 816 359	–	–	795 816 359
CH_4	56 767 559	–	–	56 767 559
N_2O	38 667 069	–	–	38 667 069
HFCs	11 321 153	–	–	11 321 153
PFCs	246 973	–	–	246 973
Unspecified mix of HFCs and PFCs	242 309	–	–	242 309
SF_6	3 246 743	–	–	3 246 743
NF_3	11 885	–	–	11 885
Total Annex A sources	**906 320 050**	**–**	**–**	**906 320 050**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–7 277 726	–	–	–7 277 726
Deforestation	1 146 781	–	–	1 146 781
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–63 906 758	–	–	–63 906 758
CM	15 852 653	–	–	15 852 653

	Original submission	*Revised submission*	*Adjustment*	*Final value*
CM for the base year	12 966 416	–	–	12 966 416
GM	18 097 989	–	–	18 097 989
GM for the base year	23 969 852	–	–	23 969 852

Table II.5
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	792 684 874	–	–	792 684 874
CH_4	56 991 084	–	–	56 991 084
N_2O	38 050 342	–	–	38 050 342
HFCs	11 118 147	–	–	11 118 147
PFCs	238 055	–	–	238 055
Unspecified mix of HFCs and PFCs	219 812	–	–	219 812
SF_6	3 066 148	–	–	3 066 148
NF_3	20 279	–	–	20 279
Total Annex A sources	**902 388 741**	**–**	**–**	**902 388 741**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–6 974 626	–	–	–6 974 626
Deforestation	1 138 078	–	–	1 138 078
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–64 268 880	–	–	–64 268 880
CM	15 615 269	–	–	15 615 269
CM for the base year	12 966 416	–	–	12 966 416
GM	18 511 253	–	–	18 511 253
GM for the base year	23 969 852	–	–	23 969 852

Table II.6
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	831 316 279	–	–	831 316 279
CH_4	58 219 386	–	–	58 219 386
N_2O	37 406 737	–	–	37 406 737
HFCs	10 944 629	–	–	10 944 629
PFCs	261 594	–	–	261 594
Unspecified mix of HFCs and PFCs	283 258	–	–	283 258
SF_6	3 122 346	–	–	3 122 346
NF_3	16 030	–	–	16 030
Total Annex A sources	**941 570 260**	**–**	**–**	**941 570 260**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–6 671 932	–	–	–6 671 932
Deforestation	1 130 594	–	–	1 130 594
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–63 454 873	–	–	–63 454 873
CM	15 732 095	–	–	15 732 095
CM for the base year	12 966 416	–	–	12 966 416
GM	18 486 633	–	–	18 486 633
GM for the base year	23 969 852	–	–	23 969 852

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) 4.B.1 cropland remaining cropland – perennial biomass (CO_2) (see ID# L.13 in table 5);

(b) 4(V) biomass burning – DOM stocks (CH_4 and N_2O) (see ID# L.16 in table 5);

(c) FM (CO_2 and N_2O) (see ID# KL.15 in table 5);

(d) CM (CO_2) (see ID# KL.18 in table 5).

Annex IV

Reference documents

A. Reports of the Intergovernmental Panel on Climate Change

IPCC. 1997. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. JL Houghton, LG Meira Filho, B Lim, et al. (eds.). Paris: IPCC/Organisation for Economic Co-operation and Development/International Energy Agency. Available at https://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html.

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

IPCC. 2014. *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol*. T Hiraishi, T Krug, K Tanabe, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at https://www.ipcc.ch/publication/2013-revised-supplementary-methods-and-good-practice-guidance-arising-from-the-kyoto-protocol/.

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

B. UNFCCC documents

Annual review reports

Reports on the individual reviews of the 2013, 2014, 2015, 2016 and 2018 annual submissions of Germany, contained in documents FCCC/ARR/2013/DEU, FCCC/ARR/2014/DEU, FCCC/ARR/2015/DEU, FCCC/ARR/2016/DEU and FCCC/ARR/2018/DEU, respectively.

Other

Aggregate information on greenhouse gas emissions by sources and removals by sinks for Parties included in Annex I to the Convention. Note by the secretariat. Available at https://unfccc.int/sites/default/files/resource/AGI%202020_final.pdf.

Annual status report for Germany for 2020. Available at https://unfccc.int/sites/default/files/resource/asr2020_DEU.pdf.

C. Other documents used during the review

Responses to questions during the review were received from Dirk Günther (German Environment Agency), including additional material on the methodology and assumptions used. The following references have been reproduced as received:

Austermann-Haun, U., & Carozzi, A. (2011): Bereitstellung einer qualitätsgesicherten Datengrundlage für die Emissionsberichterstattung zur Umsetzung von internationalen Luftreinhalte- und Klimaschutzvereinbarungen für ausgewählte Industriebranchen – hier: N_2O Emissionsfaktoren aus der Abwasserreinigung der vier relevantesten Industriebereiche. Detmold.

Retrieved from Austermann-Haun, U., & Witte, H. (2014): Liste der großtechnischen Anaerobanlagen zur Industrieabwasserreinigung in Deutschland, Stand April 2014. Hochschule Ostwestfalen-Lippe. Detmold.

Cuhls, C., Mähl, B., Clemens, J., & Herrmann, T. (2015): Ermittlung der Emissionssituation bei der Verwertung von Bioabfällen. Dessau-Roßlau.

Gibbs, M. J., & Woodbury, J. W. (1993): Methane and Nitrous Oxide: Methods in National Emissions Inventories and Options for Control: Proceedings, ed. A.R. van Amstel, 81-90. Amersfoort, The Netherlands, 3-5 February 1993.

Grün, E., Schmelz, K.-G., & Schild, L. (2013): Klimarelevante Emissionen des Emschersystems. KA Korespondenz Abwasser, Abfall, 60(3), 200. Available at https://docplayer.org/116385867-Korrespondenz-abwasser-abfall.html.

Grüneberg E, Ziche D, Wellbrock N (2014): Organic carbon stocks and sequestration rates of forest soils in Germany. Global Change Biol 20(8): 2644-2662, DOI:10.1111/gcb.12558.

Haenel H-D, Rösemann C, Dämmgen U, et al. 2018. Calculations of Gaseous and Particulate Emissions from German Agriculture 1990–2016: Report on Methods and Data (RMD). Submission 2018. Available at https://www.thuenen.de/media/publikationen/thuenen-report/Thuenen_Report_57.pdf.

Haenel, H.-D., Rösemann, C., Dämmgen, U., Döring, U., Wulf, S., Eurich-Menden, B., Freibauer, A., Döhler, H., Schreiner, C., & Osterburg, B. (2020): Calculations of gaseous and particulate emissions from German agriculture 1990 - 2018. Report on methods and data (RMD). Submission 2020. Thünen Report 77 (pp. 448). Retrieved from https://www.thuenen.de/de/infothek/publikationen/thuenen-report/doi:10.3220/REP1584363708000.

J. Six, R.T. Conant, E.A. Paul, K. Paustian Stabilization mechanisms of soil organic matter: Implications for C-saturation of soils Plant Soil, 241 (2002), pp.155-176.

KTBL – Kuratorium für Technik und Bauwesen in der Landwirtschaft (ed.) (2006b) Betriebsplanung Landwirtschaft 2006/07. KTBLDatensammlung.

20th ed., Darmstadt: KTBL, 672 pTiemeyer, B., Borraz, E. A., Augustin, J., Bechtold, M., Beetz, S., Beyer, C., Drösler, M., Ebli M,Eickenscheidt, T., Fiedler, S., Förster, C., Freibauer, A., Giebels, M., Glatzel, S., Heinichen, J., Hoffmann, M., Höper, H., Jurasinski, G., Leiber-Sauheitl, K., Peichl-Brak, M., Roßkopf, N., Sommer, M., & Zeitz, J. (2016): High emissions of greenhouse gases from grasslands on peat and other organic soils. Global Change Biology, 22, 4134-4149.