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Report on the individual review of the annual submission of Luxembourg 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 Luxembourg, 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 9 to 14 November 2020.

* 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"
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"
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CPR	commitment period reserve
CRF	common reporting format
EF	emission factor
ERT	expert review team
ERU	emission reduction unit
EU	European Union
FAOSTAT	statistical database of the Food and Agriculture Organization of the United Nations
F-gas	fluorinated gas
FM	forest management
FMRL	forest management reference level
$Frac_{LEACH-(H)}$	fraction of nitrogen input to managed soils that is lost through leaching and run-off
GEORG	emission model for off-road vehicles and machinery
GHG	greenhouse gas
GM	grazing land management
HBEFA	Handbook of Emission Factors for Road Transport
HFC	hydrofluorocarbon
HWP	harvested wood products
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
LPIS	Land Parcel Identification System
LULUCF	land use, land-use change and forestry
N	nitrogen
NA	not applicable
NE	not estimated
$N_{EFFLUENT}$	nitrogen in the effluent discharged to aquatic environments
NEMO	Network Emission Model

Nex	nitrogen excretion
NF_3	nitrogen trifluoride
NIR	national inventory report
NMVOC	non-methane volatile organic compound
Nm^3	normal cubic metre
NO	not occurring
N_{WWT}	nitrogen associated with direct emissions from wastewater treatment plants
N_2O	nitrous oxide
PFC	perfluorocarbon
QA/QC	quality assurance/quality control
RMU	removal unit
RV	revegetation
SEF	standard electronic format
SF_6	sulfur hexafluoride
SIAR	standard independent assessment report
UNFCCC Annex I inventory reporting guidelines	"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories"
UNFCCC review guidelines	"Guidelines for the technical review of information reported under the Convention related to greenhouse gas inventories, biennial reports and national communications by Parties included in Annex I to the Convention"
WDR	wetland drainage and rewetting
Wetlands Supplement	*2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*
WWTP	wastewater treatment plant
Y_m	methane conversion factor
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 Luxembourg, 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 9 to 14 November 2020 and was coordinated by Suvi Monni (secretariat). Table 1 provides information on the composition of the ERT that conducted the review for Luxembourg.

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

Area of expertise	*Name*	*Party*
Generalist	Agita Gancone	Latvia
	Mauro Meirelles de Oliveira Santos	Brazil
Energy	Pierre Boileau	Canada
	Vincent Camobreco	United States of America
IPPU	Pia Forsell	Finland
Agriculture	Marta Alfaro	Chile
LULUCF and KP-LULUCF	Yasna Rojas Ponce	Chile
Waste	Excellent Hachileka	Zambia
Lead reviewers	Pierre Boileau	
	Mauro Meirelles de Oliveira Santos	

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 Luxembourg resolve identified findings, including issues[1] designated as problems.[2] Other findings, and, if applicable, the encouragements of the ERT to Luxembourg to resolve related issues, are also included.

4. A draft version of this report was communicated to the Government of Luxembourg, 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 Luxembourg, 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.

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

II. Summary and general assessment of the Party's 2020 annual submission

7. In accordance with paragraph 76 of the UNFCCC review guidelines and paragraphs 47 and 65 of the Article 8 review guidelines, the ERT has prioritized the review of issues and problems identified in previous review reports or in the initial assessment, recalculations that have changed the emission or removal estimate for a category by more than 2 per cent or national total emissions by more than 0.5 per cent for any of the recalculated years and supplementary information reported under the Kyoto Protocol. Table 2 provides the assessment by the ERT of the Party's 2020 annual submission with respect to the tasks undertaken during the desk review. Further information on the issues identified, as well as additional findings, may be found in tables 3, 5 and 6.

Table 2
Summary of review results and general assessment of the 2020 annual submission of Luxembourg

Assessment			*Issue/problem ID#(s) in table 3, 5 or 6*[a]
Dates of submissions	Original submission: NIR, 15 April 2020; CRF tables (version 1), 15 April 2020; SEF tables (SEF-CP1-2019 and SEF-CP2-2019), 15 April 2020		
	Revised submission: NIR, 27 May 2020		
	Unless otherwise specified, values from the most recent submission are included in this report		
Review format	Desk review		
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?	Yes	G.2
	(b) Selection and use of methodologies and assumptions?	Yes	W.5, W.6, W.7, W.9, W.13
	(c) Development and selection of EFs?	Yes	L.5
	(d) Collection and selection of AD?	Yes	I.19, I.20, I.26, L.6, L.7, L.8, L.11, KL.2, KL.9
	(e) Reporting of recalculations?	Yes	I.1
	(f) Reporting of a consistent time series?	No	
	(g) Reporting of uncertainties, including methodologies?	Yes	G.7, G.13, I.9, I.16, A.17, L.2, L.3, L.4
	(h) QA/QC?	QA/QC procedures were assessed in the context of the national system (see supplementary information under the Kyoto Protocol below)	
	(i) Missing categories, or completeness?[b]	Yes	E.15, L.15, KL.8
	(j) Application of corrections to the inventory?	No	
Significance threshold	For categories reported as insignificant, has the Party provided sufficient information showing that the likely level of emissions meets the criteria in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines?	No	A.14
Description of trends	Did the ERT conclude that the description in the NIR of the trends for the different gases and sectors is reasonable?	No	I.25, A.16
Supplementary information	Have any issues been identified related to the following aspects of the national system:		

Assessment			*Issue/problem ID#(s) in table 3, 5 or 6*[a]
under the Kyoto Protocol	(a) Overall organization of the national system, including the effectiveness and reliability of the institutional, procedural and legal arrangements?	No	
	(b) Performance of the national system functions?	No	
	Have any issues been identified related to the national registry:		
	(a) Overall functioning of the national registry?	No	
	(b) Performance of the functions of the national registry and the adherence to technical standards for data exchange?	No	
	Have any issues been identified related to the reporting of information on AAUs, CERs, ERUs and RMUs and on discrepancies in accordance with decision 15/CMP.1, annex, chapter I.E, in conjunction with decision 3/CMP.11, taking into consideration any findings or recommendations contained in the SIAR?	No	
	Have any issues been identified in matters related to Article 3, paragraph 14, of the Kyoto Protocol, specifically problems related to the transparency, completeness or timeliness of the reporting on the Party's activities related to the priority actions listed in decision 15/CMP.1, annex, paragraph 24, in conjunction with decision 3/CMP.11, including any changes since the previous annual submission?	No	
	Have any issues been identified related to the following reporting requirements for KP-LULUCF:		
	(a) Reporting requirements of decision 2/CMP.8, annex II, paragraphs 1–5?	No	
	(b) Demonstration of methodological consistency between the reference level and reporting on FM in accordance with decision 2/CMP.7, annex, paragraph 14?	No	
	(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?	No	
CPR	Was the CPR reported in accordance with decision 18/CP.7, annex; decision 11/CMP.1, annex; and decision 1/CMP.8, paragraph 18?	No	G.1
Adjustments	Has the ERT applied any adjustments under Article 5, paragraph 2, of the Kyoto Protocol?	No	
	Has the Party submitted a revised estimate to replace a previously applied adjustment?	NA	Luxembourg does not have a previously applied adjustment
Response from the Party during the review	Has the Party provided the ERT with responses to the questions raised, including the data and information necessary for assessing conformity with the UNFCCC Annex I inventory reporting guidelines and any further guidance adopted by the Conference of the Parties?	Yes	
Recommendation for an exceptional in-country review	On the basis of the issues identified, does the ERT recommend that the next review be conducted as an in-country review?	No	
Questions of implementation	Did the ERT list any questions of implementation?	No	

[a] Further information on the issues identified, as well as additional findings, may be found in tables 3, 5 and 6.

[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 15 April 2019,[3] 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 Luxembourg'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 Luxembourg

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
General			
G.1	CPR (G.5, 2018) KP reporting adherence	Select the CPR as the lower value between 90 per cent of the assigned amount and the value of eight times the latest inventory year reported in the annual submission.	Addressing. The Party correctly reported the CPR in its NIR (p.728) as 65,209,026 t CO_2 eq. The Party selected the CPR as the lower value between 90 per cent of the assigned amount and the value of eight times the most recently reviewed inventory. To calculate 100 per cent of eight times the most recently reviewed inventory, Luxembourg used total GHG emissions including LULUCF (10,333,875 t CO_2 eq). However, for this calculation total emissions without LULUCF should be used (10,547,155 t CO_2 eq). During the review, the Party provided updated calculations using the correct total GHG emissions without LULUCF. The correction does not have an impact on the CPR of the Party. The ERT considers that the recommendation has not yet been fully addressed because the calculation of eight times the most recently reviewed inventory has not been carried out correctly.
G.2	Key category analysis (G.2, 2018) (G.8, 2016) (G.8, 2015) Convention reporting adherence	Improve QA/QC in reporting on the key category analysis to ensure consistency with the UNFCCC Annex I inventory reporting guidelines.	Addressing. The Party reported on the key category analysis in its NIR (chap. 1.5). During the review, the Party clarified that it has improved the QA/QC for reporting on key categories since the 2019 submission by cross checking the total emissions used for the key category analysis against the reported national total emissions. Differences between key categories reported in the NIR and CRF table 7 were identified in the report on the review of the 2018 annual submission, including that category 4.C.2 CO_2 was listed as a key category by trend in CRF table 7 but not in table 12 of the 2018 NIR; the same inconsistency occurs in the 2020 submission between CRF table 7 and NIR table 1-10. Other examples of inconsistencies include the following: for 2018, CRF table 7 lists category 1.A.3.b N_2O as a key category by level assessment, but this category is not listed in NIR table 1-6 and

[3] FCCC/ARR/2018/LUX. The ERT notes that the report on the individual inventory review of Luxembourg'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
			category 2.F.1 aggregate F-gases is a key category by level assessment according to CRF table 7, but this category is not listed in NIR table 1-8. In NIR tables 1-8 (p.72) and 1-10 (p.75), category 4.E.2 CO_2 and N_2O is included as a key category, but it is not indicated as such in CRF table 7 for 2018. During the review, the Party clarified that differences identified in Luxembourg's key category analysis presented in the NIR and CRF table 7 are probably due to the use of different aggregation levels. It provided the spreadsheet used for the identification of key categories. The Party informed the ERT that information about the differences between the key categories identified in the NIR and those in CRF table 7 will be included in its next NIR.
G.3	National system (G.8, 2018) KP reporting adherence	Detail the key changes introduced by the grand-ducal regulation of 24 April 2017 in the NIR, chapter 13 (information on changes in the national system).	Resolved. The Party reported information regarding the new regulation in its 2019 NIR (chaps. 1.2, pp.53–60; and 14, p.663). In the 2020 NIR, the Party refers to the regulation for example in its description of the national system (chap. 1.2.1.2).
G.4	QA/QC and verification (G.14, 2018) Convention reporting adherence	Ensure that data validation checklists are completed prior to submission for every sector for each annual submission, and stored in the Party's central archiving system in electronic format.	Resolved. The Party reported information on data validation checklists in its NIR (chap. 1.6, pp.83–85). During the review, the Party clarified that the data validation checklists completed prior to the 2020 submission are stored in its central archiving system in electronic format. The Party additionally provided screenshots of checklists by sector stored in the same system.
G.5	Time series (G.4, 2018) (G.5, 2016) (G.5, 2015) Transparency	Provide a detailed explanation of the main drivers of the increase in F-gases in the NIR.	Resolved. The Party reported information on F-gas emission trends between 1990, 1995 (base year for f-gases under the Kyoto Protocol) and 2018 in its NIR (chaps. 2.3, pp.149–159, and 4.1.1, pp.317–322). Main drivers, such as increased use of mobile and stationary cooling equipment, aerosols and high-voltage electrical devices, are described in the NIR (p.159). The ERT considers that the explanation was sufficiently transparent. During the review, the Party further clarified that the main driver of the increase in F-gases over the past three decades is the rapidly increasing population and workforce of Luxembourg. The number of residents increased from approximately 370,000 in 1991 to approximately 600,000 in 2018 (NIR figure 2-14, p.117). The cross-border commuting workforce increased from approximately 35,300 in 1990 to approximately 192,100 in 2018 (NIR figure 2-16, p.120). Inhabitants and transborder commuters occupy more and more residential, institutional and commercial buildings, which leads to a greater need for air conditioning (HFCs) as well as high-voltage electrical devices (SF_6). The Party stated that to increase transparency this explanation will be included in the relevant sections in its next NIR.
G.6	Uncertainty analysis (G.11, 2018) Convention reporting adherence	Correct the inconsistencies in the uncertainty analysis regarding: (a) Emissions of N_2O from liquid fuels consumed in navigation to exclude biomass;	Resolved. (a) In NIR table 1-12 (p.89), emission estimates of N_2O from liquid fuels consumed in navigation have been corrected to exclude biomass;

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
		(b) The combined uncertainty values for CH_4 and N_2O for agriculture; (c) The outdated uncertainty values for CH_4 and N_2O for categories 1.A.3.c and 1.A.3.d liquid fuels.	(b) The 2020 NIR no longer includes a sector-specific uncertainty table for agriculture, which would correspond to table 202 in the 2018 NIR. NIR table 1-12 also does not present combined uncertainty values for CH_4 and N_2O for the whole agriculture sector, but provides total subcategory combined uncertainty values. Therefore, the inconsistencies identified in the previous review are no longer present. During the review, the Party explained that the combined uncertainty values for the agriculture subcategories have been determined by the sector expert and are based on Monte Carlo simulation. The combined uncertainties for the agriculture sector are calculated for each annual submission. The Party also informed the ERT that it plans to include in the NIR information on the combined uncertainty values for the agriculture subcategories used for tier 1 uncertainty estimates, including reasons for any changes, in comparison with the previous submission. The ERT welcomed the plan; (c) The Party corrected the outdated uncertainty values for CH_4 and N_2O for categories 1.A.3.c and 1.A.3.d liquid fuels in NIR table 1-12.
G.7	Uncertainty analysis (G.11, 2018) Convention reporting adherence	Improve the QC processes for reporting on uncertainty by including a check of total emissions from the uncertainty table against the total emissions in the CRF tables to identify any differences and to ensure input uncertainties are updated each year.	Not resolved. The Party reported an uncertainty assessment in its NIR (chap. 1.7, pp.87–92). The ERT identified differences in the sum of the emissions in the uncertainty table 1-12 (pp.89–92) when compared with the total emissions in CRF table summary 2 (e.g. for the base year (1990), for category 1.A.3.a, incorrect CO_2 emissions were included). During the review, the Party acknowledged the errors and clarified that, for its 2021 submission, a sum check has been integrated into the uncertainty calculation file in order to identify any differences with the CRF tables and to ensure that input uncertainties are updated each year. The Party noted that this activity should help to avoid such errors in future submissions. The ERT noted that the Party did not incorporate category-specific uncertainties appropriately into the main uncertainty calculation table (e.g. for category 2.A.3, the EF uncertainty value provided in NIR table 1-12 (p.91) is 10 per cent, as in the 2018 NIR (table 14), while the value provided in chap. 4.2.3.3 (p.333) is 5 per cent). This indicates that a QC process to ensure input uncertainties are updated each year was not implemented. During the review, the Party indicated that the EF uncertainty in NIR table 1-12 should be 5 per cent.
Energy			
E.1	Fuel combustion – reference approach – liquid fuels – CO_2 (E.5, 2018) (E.14, 2016) (E.14, 2015) Convention reporting adherence	Include data on petroleum coke, other kerosene and other oil (white spirit) in the reference approach as it is possible to enter fuels in CRF table 1.A(b) that are used for non-energy purposes in CRF table 1.A(d).	Resolved. The Party reported in its 2019 NIR (p.180 and table 259) that it had addressed the recommendation by including data on petroleum coke, other kerosene and other oil (white spirit) in CRF tables 1.A(b) and 1.A(d). Amendments to the reference approach were made for the whole time series since the 2019 submission. According to CRF table 1.A(d), emissions from petroleum coke are included under iron and steel production, and those from other kerosene under solvent use. Use of white spirit was reported as “NO”.

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
E.2	Fuel combustion – reference approach – liquid fuels – CO_2 (E.16, 2018) Convention reporting adherence	Correct the reference approach to include the 190.05 TJ jet kerosene exported in 2016 to ensure comparability with the sectoral approach.	Resolved. The Party corrected the reference approach and reported in CRF table 1.A(b) the figures for exports of jet kerosene in 2016 (4.41 kt) and 2017 (22.29 kt). For all other years, "NO" is reported.
E.3	Fuel combustion – reference approach – liquid fuels – CO_2 (E.17, 2018) Convention reporting adherence	Identify the sources of error and correct all discrepancies in jet kerosene for international aviation between CRF table 1.D and CRF table 1.A(b) for all years.	Addressing. The Party corrected the discrepancies for 2010. However, differences still occur for some years. The largest difference occurred for 1998: the value in CRF table 1.A(b) is 11,853.88 TJ and in CRF table 1.D it is 12,492.22 TJ. During the review, the Party clarified that data in CRF table 1.A(b) are taken from the International Energy Agency and not from the national energy balance. This leads to discrepancies because of different protocols for rounding the data and there may be differences in updating the data between the two agencies. The Party indicated in its response that it will be replacing all International Energy Agency data with national energy balance data in its next submission.
E.4	Feedstocks, reductants and other non-energy use of fuels – all fuels – CO_2 (E.6, 2018) (E.15, 2016) (E.15, 2015) Transparency	Replace the notation key "NE" with the notation key "IE" in reporting emissions for use of fuels/solid fuels/anthracite and other bituminous coal in CRF table 1.A(d).	Resolved. The Party reported CO_2 emissions from the NEU reported in the inventory for anthracite and other bituminous coal as "IE" in CRF table 1.A(d).
E.5	1.A Fuel combustion – sectoral approach – liquid fuels – CO_2 (E.18, 2018) Transparency	Provide in the NIR information on the biofuel import certificates and the online registry system on biofuel supply chains.	Not resolved. Information on the biofuel import certificates and the online registry system on biofuel supply chains has not been included in the NIR. During the review, the Party clarified that the online registry system for tracking biofuel supply chains derives from the legal obligations under EU directive 2009/30/EC, transposed into Luxembourg law by the modified grand-ducal regulation of 27 February 2011 defining the sustainability criteria of biofuels and bioliquids, but that import certificates have still not been obtained from this registry.
E.6	1.A Fuel combustion – sectoral approach – liquid fuels – CO_2, CH_4 and N_2O (E.19, 2018) Transparency	Include in the NIR details of the method and data used to estimate CO_2, CH_4 and N_2O emissions from the fossil fraction of biodiesel.	Resolved. The Party reported in its NIR (p.260) information on the method and data used for estimating emissions from the fossil fraction of biodiesel, reported as other fossil fuels (fossil part of biodiesel), for all categories where blended diesel is used (1.A.3.b, 1.A.3.c, 1.A.3.d, 1.D.1.b, 1.A.2.g.vii, 1.A.4.c.ii, and 1.A.5.b). AD, IEFs and emissions for the fossil part of biodiesel used in road transportation are provided in NIR table 3-64.
E.7	1.A.3.b Road transportation – liquid fuels – CH_4	Provide justification of the applicability of domestic fleet CH_4 EFs to the transborder fleet, or adopt an alternative approach, such as using default CH_4 EFs for the transborder fleet.	Not resolved. Information on the assumptions for EFs used for estimation of emissions from road transportation is provided in chapter 3.2.8.3.2.2 (pp. 256–265) of the NIR (description of NEMO). However, no justification is provided for the applicability of domestic fleet CH_4 EFs to the transborder fleet. During the review, the Party explained that the justification for assuming a similar age and technology

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
	(E.20, 2018) Transparency		composition for passenger cars in the transborder commuter fleets is that the owners of these vehicles work in Luxembourg, have significantly higher salaries than if they were working in their home country and thus have higher living standards than their non-commuting fellow citizens. As a consequence, the commuter fleets are considered to be more similar to Luxembourg's domestic fleet than to the average fleet of the commuters' countries of residence. For heavy-duty vehicles, the composition of the transborder fleet is considered to be identical to that of the domestic fleet, which has a high percentage of new vehicles. This is justified through expert judgment in the form of a personal communication from Luxembourg's customs office. Indeed, the national and transborder heavy-duty vehicle fleets are very similar and roughly consist of 80 per cent models aged 1–5 years, 15 per cent models aged 5–10 years, and 5 per cent models aged more than 10 years. The ERT agreed with the justifications provided by the Party but notes that the information should be included in the NIR.
E.8	1.A.3.b Road transportation – liquid fuels – CO_2, CH_4 and N_2O (E.13, 2018) (E.20, 2016) (E.20, 2015) Transparency	Include detailed information about biofuels in the NIR.	Resolved. The Party reported in annex 4 to its 2019 NIR (p.739) information on biofuel use based on the national energy balance. This information is also presented in annex 4 to the 2020 NIR and is similar to the information in the 2018 NIR. However, the ERT considers that the information is sufficiently transparent. See also ID# E.5 above.
E.9	1.A.3.b Road transportation – gasoline – CO_2 (E.11, 2018) (E.19, 2016) (E.19, 2015) Transparency	Explain how the CO_2 EF for gasoline used in road transportation is estimated in the NIR.	Resolved. The Party reported in its NIR (pp.197–199) the methodology for calculating the CO_2 EF for gasoline used in road transportation. A country-specific CO_2 EF for gasoline was determined according to the quantities of gasoline imported from the different countries and the respective EFs used by these countries, as shown in NIR table 3-20.
E.10	1.A.3.b Road transportation – diesel – CH_4 and N_2O (E.21, 2018) Transparency	Justify the assumptions underlying the estimation of the diesel used by transborder cars and heavy-duty vehicles, including the assumptions on the shares of the gasoline- and diesel-fuelled cars in the transborder fleet, or use an alternative approach to avoid a possible underestimation of CH_4 and N_2O emissions.	Not resolved. Information on estimation of emissions from road transportation is provided in chapter 3.2.8.3.2.2 (pp.256–265) of the NIR (description of NEMO). However, no justification is provided for the assumptions underlying the estimation of the diesel used by trans-border cars and heavy-duty vehicles, including the assumptions on the shares of the gasoline- and diesel-fuelled cars in the transborder fleet. During the review, the Party explained that the share of diesel- and gasoline-fuelled cars in the transborder commuter fleets is not based on the share of Luxembourg's domestic fleet, but on the shares of the fleets of the neighbouring regions (Belgium, Grand Est (France) and Rhineland-Palatinate and Saarland (Germany)). However, the detailed composition of each of these fleets (age, technology) is supposed to be identical to the structures of Luxembourg's domestic fleet (e.g. the CH_4 IEF of the domestic gasoline-fuelled passenger car

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
			fleet is applied to the gasoline-fuelled commuting passenger car fleet), owing to a lack of region-specific fleet data from the neighbouring countries (see also ID# E.7 above). In order to increase transparency, Luxembourg plans to include this information in the next NIR. As noted by the previous ERT, the assumption on the shares of the gasoline- and diesel-fuelled cars in the transborder fleet also has an impact on the estimated shares of diesel used by transborder cars and heavy-duty vehicles. The ERT agreed with the justification provided by the Party but notes that the information should be included in the NIR.
E.11	1.A.3.d Domestic navigation – liquid fuels – CO_2, CH_4 and N_2O (E.14, 2018) (E.10, 2016) (E.10, 2015) (26, 2014) Transparency	Review the possible double counting of emissions from leisure boats reported under navigation.	Resolved. The Party reported in its NIR (chap. 3.2.8.5.2.1) that the amounts of fuel sold at its only marina are reported in its national energy balance and that it is assumed that the amounts are being combusted in Luxembourg. The Party clarified that this type of reporting in the national energy balance ensures that double counting is avoided.
E.12	1.A.4.a Commercial/institutional – biomass – CO_2, CH_4 and N_2O (E.23, 2018) Transparency	Update the NIR text with the description of biomass fuel types and choice of EFs, and correct the entries in NIR table 107.	Addressing. The Party updated the text in its NIR (p.296), listing biogas, wood and wood waste as biomass fuels used in Luxembourg. The Party reported in NIR table 3-93 (corresponding to table 107 in the 2018 NIR) the EFs for wood and wood waste, in addition to biogas. However, there was a typographical error indicating that the CH_4 EF for wood and wood waste was only 30 kg/TJ, when in fact it should be the default value of 300 kg/TJ included in the 2006 IPCC Guidelines (vol. 2, chap. 2, table 2.4). The Party indicated that it will correct this error in its next NIR.
E.13	1.A.4.b Residential – liquid fuels – CH_4 and N_2O (E.24, 2018) Transparency	Gather more information on potential off-road fuel use by commuters (e.g. export in jerrycans for household and gardening use) to estimate the quantity of fuel sold to transborder commuters and likely used for non-transport purposes such as motorized gardening equipment and off-road vehicles, estimating the associated emissions, revising the emissions for road transportation accordingly and describing the estimations in the NIR.	Addressing. During the review, the Party explained that it had attempted to gather more information on potential off-road fuel use by transborder commuters. It explained that publicly available statistics and literature on socioeconomic behaviours of commuters (e.g. publications of the Luxembourg Institute of Socio-Economic Research) have been reviewed but no information has been found on potential off-road fuel export by commuters working in Luxembourg. Hence, estimating the amount of fuel exported for household and gardening applications would be a challenging task and the uncertainty of the resulting emissions would be extremely high. Luxembourg calculated a conservative estimate, according to which transborder commuters use as much fuel for gardening tools and leisure boats per capita as residents and fuel them exclusively with fuel purchased in Luxembourg. This allows the maximum amount of fuel that could possibly be reallocated from passenger cars to off-road applications and the resulting change in CH_4 and N_2O emissions due to different EFs to be determined. Using AD and IEFs from Luxembourg's 2018 submission, the resulting change in estimated total emissions for the different inventory years would range between 0.0028 and 0.0168 Gg CO_2

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			eq, and between 0.00002 and 0.00015 per cent of Luxembourg's national total emissions for the respective years. Even an extremely conservative assumption would thus lead to an emission difference that is several orders of magnitude below the threshold of significance. For these reasons, Luxembourg does not plan to reallocate any fuel to off-road use by commuters. The ERT agreed with this approach but noted that the rationale should be included in the NIR.
E.14	1.A.4.b Residential – liquid fuels – CH_4 (E.25, 2018) Transparency	Revise the CH_4 EF for residential use of gasoline and, if choosing a non-IPCC default EF, include in the NIR a justification of its applicability to Luxembourg.	Addressing. Luxembourg explained in NIR table 3-101 that CH_4 emissions from off-road machinery use reported under category 1.A.4.b were recalculated: the GEORG model used for calculating off-road emissions was based on EFs from HBEFA 4.1 (HBEFA 3.3 in the 2019 submission). According to the 2020 NIR table 3-96, the CH_4 EF for gasoline used under category 1.A.4.b for 2018 is 82.76 kg/TJ, while the EF used in the 2018 submission for 2016 was 26.90 kg/TJ (table 110 of the 2018 NIR). During the review, the Party further clarified that the EFs for gasoline use in small engines were updated according to the revised version of its model for calculating mobile emissions. Emissions reported under this category are exclusively from gardening equipment with two- or four-stroke gasoline engines. This update resulted in a significant increase in the CH_4 EFs for category 1.A.4.b.ii: in the 2018 submission, the EFs for 1990 and 2016 were 55.66 and 26.90 kg/TJ, respectively, while in the 2020 submission the EFs for 1990 and 2016 are 265.80 and 82.87 kg/TJ, respectively. The range of IPCC default CH_4 EFs for household gasoline engines is 72–450 kg/TJ for two-stroke engines and 48–300 kg/TJ for four-stroke engines (2006 IPCC Guidelines, vol. 2, chap. 3, table 3.3.1). Luxembourg's EFs in the 2020 submission are thus within these ranges. The ERT considers that the recommendation has not yet been fully addressed since justification for the applicability of the CH_4 EF for residential use of gasoline to Luxembourg is not provided in the NIR.
E.15	1.B.2.b Natural gas – CO_2 and CH_4 (E.26, 2018) Completeness	Include emissions and AD estimates for venting from natural gas transmission, and include in the NIR a description of the estimation methodology.	Addressing. The Party did not include the emission estimates in its 2020 submission, but has proceeded with the development of the methodology for reporting in 2021. During the review, the Party clarified that, according to the national natural gas provider Creos Luxembourg, 2016 was a typical year with regard to venting (no major works in the gas network) with a vented volume of approximately 2,000 Nm^3. In 2017, 40,000 Nm^3 were vented due to major works (in that specific year). Given the vented volume, the molecular composition and the CO_2 and CH_4 content of the natural gas (tier 3 approach according to the 2006 IPCC Guidelines, vol. 2, chap. 4, p.4.66), the total GHG emissions from venting in 2016 and 2017 were approximately 0.03 and 0.66 Gg CO_2 eq. This means that, even in a year where major network interventions took place, emissions from venting are well below the threshold of significance. The Party explained that

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			Creos Luxembourg is not able to provide AD for venting for the entire time series, and extrapolation of vented volumes would be challenging in view of the high variability that is apparent for 2016 and 2017. In order to obtain an entire time series, the Party is planning to take the ratio of the average vented quantity between 2016 and 2017 and total annual consumption and to extrapolate this ratio over the entire time series. Hence, by multiplying this ratio with the annual natural gas consumption, an estimate of the annual quantity of vented natural gas for the entire time series would be obtained. Even though Luxembourg estimates that the impact of the underestimation is well under the threshold of significance, it plans to report emissions from venting under category 1.B.2.c in its next submission.
IPPU			
I.1	2. General (IPPU) (I.1, 2018) (I.1, 2016) (I.1, 2015) (38, 2014) Transparency	Explain every recalculation, such as the update of AD and EFs for solvent and other product use.	Addressing. The NIR includes information on recalculations but does not provide quantitative information, for example for solvent use in chapter 4.5.3.1.7, which includes descriptions of recalculations but no numerical data for AD or EFs, or the impact on the total emissions or at a category level. During the review, the Party clarified that it plans to include detailed explanations of the recalculations performed at the category level in the next NIR.
I.2	2. General (IPPU) (I.1, 2018) (I.1, 2016) (I.1, 2015) (38, 2014) Transparency	State correctly that recalculations have not been implemented for the solvent and other product use sector.	Resolved. Recalculations were carried out for solvent use and explained in the NIR (chap. 4.5.3.1.7). See also ID# I.1 above.
I.3	2.A.3 Glass production – CO_2 (I.4, 2018) (I.8, 2016) (I.8, 2015) Convention reporting adherence	Explain the sources of information used to inform the uncertainty of key parameters such as AD and EFs for this category.	Resolved. The Party reported in its NIR (p.333) the sources of information used to inform the uncertainty for AD and EFs, referring to a study from 2008 and consultation with the only glass-producing company in the country.
I.4	2.D.2 Paraffin wax use – CO_2 (I.11, 2018) Transparency	Explain the trend of AD and CO_2 emissions and the significant inter-annual changes between 2009 and 2010 and between 2012 and 2013 in the NIR.	Addressing. The Party explained in its NIR (p.355) that the significant inter-annual change between 2009 and 2010 was caused by a new company starting to use paraffin wax. The explanation for the other significant inter-annual change from 0.67 kt CO_2 in 2012 to 2.67 kt CO_2 in 2013 was not made clear in the NIR, but during the review the Party clarified that it is due to increased activity at the new company. The ERT considers that the recommendation has not yet been fully addressed because the explanation of the trend and all significant inter-annual changes has not been reported in the NIR.

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I.5	2.D.2 Paraffin wax use – CO_2 (I.12, 2018) Transparency	Include in the NIR the source of the values of the uncertainty reported for AD and EFs for paraffin wax use.	Resolved. The Party reported in its NIR (p.356) the source of the values of the uncertainty of AD and EFs for paraffin wax use as the 2006 IPCC Guidelines (vol. 3, chap. 5.3.3).
I.6	2.D.3 Other (non-energy products from fuels and solvent use) – NMVOCs (I.13, 2018) Transparency	Revise the information on road paving with asphalt in the NIR to clarify that these emissions are occurring and reported in Luxembourg.	Resolved. The Party reported in its NIR (pp.375 and 388) NMVOC emissions for road paving with asphalt for the whole time series.
I.7	2.D.3 Other (non-energy products from fuels and solvent use) – NMVOCs (I.13, 2018) Transparency	Include the AD and IEFs for road paving with asphalt in the NIR tables 151 and 152.	Resolved. The Party included the AD and IEFs for road paving with asphalt in the NIR (table in chap. 4.5.3.2 (p.388) and table 4-28).
I.8	2.D.3 Other (non-energy products from fuels and solvent use) – NMVOCs (I.13, 2018) Convention reporting adherence	Revise the notation key used for asphalt roofing so that the information is consistent with the CRF tables.	Resolved. The Party reported NMVOC emissions from asphalt roofing as "NO" in NIR table 4-28 (p.375) and corrected the relevant information in the NIR (p.389).
I.9	2.F Product uses as substitutes for ozone-depleting substances – HFCs, PFCs and SF_6 (I.14, 2018) Convention reporting adherence	Estimate and report the uncertainty for each subcategory under 2.F and explain in the NIR how those uncertainties are estimated.	Not resolved. The uncertainty for each subcategory under 2.F and how they are estimated has not been reported in the NIR (only an overall uncertainty estimate for AD and EFs under 2.F is provided in chap. 4.7.1.2). During the review, the Party clarified that it plans to implement this recommendation for the next submission.
I.10	2.F Product uses as substitutes for ozone-depleting substances – HFCs (I.15, 2018) Convention reporting adherence	Revise NIR table 158 so that the HFC emissions for categories 2.F and 2.F.1 reported for all years in the time series are consistent with the emissions reported in CRF table 2(I)s2.	Not resolved. The Party reported in NIR table 4-33 (p.396), which corresponds to table 158 of the 2018 NIR, emissions for the whole time series from products used as substitutes for ozone-depleting substances. The ERT noted that emissions reported for categories 2.F and 2.F.1 in the NIR are not consistent with the values reported in CRF table 2(I)s2. For example, 2018 emissions for categories 2.F and 2.F.1 were reported in the NIR as 63.03 and 56.82 Gg CO_2 eq, respectively, but in CRF table 2(I)s2 as 63.08 and 56.88 Gg CO_2 eq, respectively. Similar inconsistencies occur for other years in the time series. During the review, the Party clarified that there was an erroneous formula in the Excel file used to generate the NIR tables, which will be corrected for the next submission.

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I.11	2.F.1 Refrigeration and air conditioning – HFCs (I.8, 2018) (I.11, 2016) (I.11, 2015) Transparency	Describe in the NIR the expert consultation process applied to inform the choice of EF used for estimating emissions from disposal of stationary air-conditioning equipment.	Not resolved. The Party continued to use the EF for disposal of stationary air-conditioning equipment of 20 per cent (NIR p.400) and did not report the expert consultation process used to inform the choice of EF. The Party indicated in the NIR (p.400) that the decommissioned equipment is exported to neighbouring countries and therefore a part of the decommissioning process does not take place in Luxembourg.
I.12	2.F.1 Refrigeration and air conditioning – HFCs (I.16, 2018) Transparency	Correct the description in the NIR of the estimation of HFC emissions from manufacture of refrigeration equipment.	Addressing. The Party reported in its NIR (p.398) that the emissions from manufacture of refrigeration equipment were reassessed with the producer in 2018, after which values were determined to be equal to those for 2006 (i.e. 2 kg HFC-134a per year) on the basis of the AD. However, the ERT noted that the manufacturing emissions for category 2.F.1.b vary across the time series. They are reported as "NO" for 1990–1998 and vary between 0.81 and 2.98 kg HFC-134a for 1999–2018 in CRF table 2(II)B-Hs2. This indicates that the description in the NIR, stating that emissions were assumed to be equal to those in 2006, is not correct.
I.13	2.F.1 Refrigeration and air conditioning – HFCs (I.9, 2018) (I.12, 2016) (I.12, 2015) Transparency	Provide in the NIR the methods (IPCC tier or country-specific), AD and EFs applied to estimate HFC emissions during manufacture, operation, disposal and recovery (occurring during disposal phase) for the reporting of refrigeration and air-conditioning categories, especially commercial refrigeration and stationary air-conditioning categories.	Addressing. The Party included in its NIR (pp.398–400) some new information on the selection of EFs and on the AD used to estimate emissions during disposal for reporting these subcategories as well as further information on emissions from manufacture of refrigeration equipment. The NIR does not mention IPCC tiers or whether the method used is country-specific with respect to subcategory descriptions. Descriptions of the method, EFs and AD used to estimate recovery during disposal were also not included in the NIR.
I.14	2.F.1 Refrigeration and air conditioning – HFCs (I.17, 2018) Accuracy	Reassess with the sole company producing refrigerators in Luxembourg the AD, EFs and emissions for manufacture of refrigerators, including the emissions from accidental releases, and, if necessary, revise the time series of HFC emission estimates to include emissions from these accidental releases.	Resolved. The Party reported in its NIR (p.398) that emissions from accidental releases are accounted for in the total emissions from manufacture of refrigerators. The manufacturing emissions of Luxembourg's single refrigerator production plant were reassessed in 2018 (see ID# I.12 above). Based on the reassessment, the Party did not identify any need for a recalculation.
I.15	2.F.1 Refrigeration and air conditioning – HFCs (I.17, 2018) Transparency	Explain in the NIR the methodology used to estimate all emissions, planned and unplanned (e.g. from accidental and other unplanned releases), from manufacture of refrigeration equipment, including a description of any recovery system.	Addressing. The Party reported in its NIR (p.398) updated information about emissions from refrigerator production (see ID# I.12 above) and noted that emissions from accidental and other unplanned releases were included in the total emissions of refrigerator production; however, the Party did not provide information in the NIR or during the review on the methodology used to estimate those emissions or a description of any recovery system. The ERT considers that the recommendation has not yet been fully addressed because the Party has not explained the methodology used or provided a description of any recovery system.

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I.16	2.F.1 Refrigeration and air conditioning – HFCs (I.17, 2018) Convention reporting adherence	Make efforts to estimate the uncertainty of the AD and EFs used to estimate emissions from manufacture of refrigerators.	Not resolved. The Party did not report information on the estimation of the uncertainty of the AD and EFs used to estimate emissions from manufacture of refrigerators in its NIR (see also ID# I.9 above). During the review, the Party clarified that it plans to report uncertainties for emissions from manufacture of refrigerators in its next submission.
I.17	2.F.1 Refrigeration and air conditioning – HFCs (I.18, 2018) Transparency	Explain in the NIR the decrease in HFC emissions from 2.F.1.a (commercial refrigeration) between 2014 and 2015 (14.7 per cent) and 2015 and 2016 (35.3 per cent).	Resolved. The Party explained in its NIR (p.395) that the decrease in HFC emissions is related to EU regulations that ban and restrict the usage of various F-gases commonly used in refrigeration and air conditioning, which became visible in 2015 and even more pronounced in 2016.
I.18	2.F.1 Refrigeration and air conditioning – HFCs (I.19, 2018) Transparency	Explain in the NIR the decrease in HFC emissions from 2.F.1.f (stationary air conditioning) between 2012 and 2013 and between 2015 and 2016, including the impact of the EU regulation on phasing out various HFCs.	Addressing. The Party explained in its NIR (p.395) that the decrease between 2015 and 2016 is due to EU regulation 517/2014. The decrease occurred in 2016 instead of 2015, as in 2015 suppliers were in possession of ample stocks and prices did not increase at that point in time. The Party did not provide an explanation for the decrease between 2012 and 2013 in the NIR or during the review.
I.19	2.F.2 Foam blowing agents – HFCs (I.20, 2018) Accuracy	Estimate the emissions from foam blowing using country-specific data or, if this is not possible, estimate these emissions using a proxy (e.g. using per capita emissions from neighbouring Parties) and justify the applicability of the value used to the circumstances of Luxembourg.	Addressing. The Party reported in the NIR (p.406) that although efforts were made to collect country-specific data for the estimation of emissions from foam blowing, no suitable data had been obtained. The Party recalculated emissions from foam blowing using, as a proxy, an average of per capita emissions from neighbouring Parties instead of using data from a single Party (Belgium). The recalculations increased the emissions for 2000–2016 when compared with the 2018 submission. The increase was largest in relative terms for 2016 at 68.8 per cent. However, no justification for the applicability of the values used to the circumstances of Luxembourg was provided in the NIR or during the review. In NIR table 4-34 on planned improvements, the Party explained that it plans to continue its efforts to obtain country-specific data.
I.20	2.G.2 SF_6 and PFCs from other product use – SF_6 (I.21, 2018) Accuracy	Estimate and report SF_6 emissions from medical use and from particle accelerators and explain in the NIR how the estimations were made, including information on the number of medical devices and particle accelerators using SF_6 and the SF_6 amount used to fill and refill equipment.	Addressing. The Party reported in its NIR (p.413) that particle accelerators are currently used only in radiation therapy, but, owing to lack of data concerning the total amount of SF_6 present in the devices as well as the corresponding refill rates and amounts, emissions could not be calculated using country-specific data. Instead, the Party estimated the emissions using a proxy method and applied data reported for Germany to Luxembourg on per capita basis. The emissions from particle accelerators reported in CRF table 2(II)B-Hs2 are about 0.02 t SF_6 for 1990–2018. The ERT considers that the recommendation has not yet been fully addressed because the Party has not yet collected data from the radiation therapy companies and consequently has not reported all information requested in the recommendation.

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I.21	2.G.3 N_2O from product uses – N_2O (I.22, 2018) Transparency	Either confirm that N_2O is not used in veterinary applications and include this information in the NIR or, if N_2O is used, estimate and report N_2O emissions and describe the methodology in the NIR.	Resolved. The Party reported in its NIR (p.414) that, according to data provided by the association representing all the veterinarians active in Luxembourg, use of N_2O as anaesthesia in veterinary hospitals or clinics in Luxembourg does not occur.
I.22	2.G.4 Other (other product manufacture and use) (I.23, 2018) Transparency	Explain in the NIR how the uncertainties reported for the AD and EFs are estimated.	Resolved. The Party reported that the uncertainties reported in its NIR (p.418) for category 2.G.4 are received from the country's only solvent manufacturer.
I.23	2.H Other (IPPU) – N_2O (I.24, 2018) Transparency	Describe the beverage and food industry in the country and confirm that N_2O is not used in these processes.	Resolved. The Party reported in its NIR (p.419) that there is no N_2O use in the beverage and food industry in the country.
Agriculture			
A.1	3. General (agriculture) (A.1, 2018) (A.5, 2016) (A.5, 2015) Transparency	Include in the NIR information related to the complete revision that was undertaken in the agriculture sector, preferably in the sector overview section as well as elaborating as appropriate in the other sections, in order to enhance the transparency and understanding of issues that are affected by the revision.	Resolved. The Party provided in its NIR a short overview of recalculations by section (chaps. 5.2.7, p.452; 5.3.4, p.469; 5.4.4, p.487; 5.6.4, p.507; and 5.9.3, p.512). Full details of recalculations for the agriculture sector between the 2019 and 2020 submissions were summarized in annex 3A to the NIR (pp.748–776). The ERT noted that the description of the changes made for the 2015 submission and referred to in the report on the review of the 2015 submission were not described in the 2020 NIR; however, the ERT considers that the current reporting on the agriculture sector methodologies and on the most recent recalculations is sufficiently transparent.
A.2	3. General (agriculture) – CH_4 and N_2O (A.9, 2018) Transparency	Provide in the NIR information supporting the assumptions on the values for digestible energy for cattle, goats and horses, and pigs, including information on the consideration of pasture grazing during summer and the three main forage sources and feed concentrates used in the country for cattle and other ruminants.	Resolved. The Party reported in its NIR (pp.465–466) information on digestible energy for cattle, goats and horses, as well as assumptions and explanations regarding the respective values chosen, including information on how pasture digestibility and diets change over the year. Luxembourg explains that the main forage sources used in Luxembourg for cattle and other ruminants are fresh grass, grass silage and corn silage (whole plant) with average digestibility values of 68.6 per cent (62.4–73.1 per cent); 71.1 per cent (68.2–73.2 per cent) and 74.7 per cent (73.9–76.5 per cent), respectively. Digestible energy values for fattening pigs, breeding pigs and weaners were reported in CRF table 3.As2. The ERT considers the explanations provided to be adequate.
A.3	3. General (agriculture) – CH_4 and N_2O (A.10, 2018) Convention reporting adherence	Estimate the country-specific uncertainty of the digestible energy values used in the estimates.	Resolved. The Party reported uncertainty calculations for the agriculture sector in annex 3B to its NIR (pp.777–790). The uncertainty for digestible energy for the animal categories for which the parameter was used in the calculation (cattle and sheep) was estimated to be approximately 5 per cent (NIR p.783). This value is

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			based on feed characterization as reported in the NIR (pp.465–466) (see ID# A.2 above).
A.4	3.A Enteric fermentation – CH_4 (A.8, 2018) Transparency	Revise NIR table 164 and report consistent total and CH_4 emissions for all years.	Resolved. The Party reported CH_4 emissions for all years in NIR table 5-1 (p.423), which corresponds to table 164 in the 2018 NIR. The CH_4 emissions for category 3.A are the same as the total emissions for that category, and thus the identified error has been corrected.
A.5	3.A.2 Sheep – CH_4 (A.11, 2018) Accuracy	Improve the accuracy of the estimate by collecting data on age structure for sheep, and revise the estimate by using the appropriate Y_m values for each age in accordance with the 2006 IPCC Guidelines.	Resolved. The Party collected data on age structure for sheep and recalculated the emissions across the time series. The Party reported in its NIR (chap. 5.2.1, p.428) information on sheep categories (mature sheep over 1 year and lambs under 1 year). AD for both categories were also provided in the NIR (table 5-5, pp.431–432) and live weight and daily weight gain were reported in NIR table 5-17 (p.462). The Party used the default values of 6.5 per cent for Y_m for mature sheep and 4.5 per cent for Y_m for lambs under 1 year in accordance with the 2006 IPCC Guidelines (vol. 4, chap. 10, table 10.13). See also ID# A.15 in table 5.
A.6	3.B Manure management – CH_4 (A.3, 2018) (A.6, 2016) (A.6, 2015) Transparency	Report on the values used for the methane conversion factor from the anaerobic digester, particularly in relation to or in comparison with the recommendation in the report on the review of the 2014 submission (para. 49).	Not resolved. The Party did not report in the NIR the values used for the methane conversion factor for the anaerobic digester. During the review, the Party indicated that this recommendation will be implemented in the next submission.
A.7	3.B Manure management – N_2O (A.12, 2018) Transparency	Provide in the NIR detailed information on the methodology used or the reference document on Nex estimates for animals other than dairy cattle.	Resolved. The Party reported the methodology and the references used to document Nex estimates for animals other than dairy cattle in its NIR (chap. 5.2.5.2, pp.442–444), including specific values as shown in NIR table 5-11. Additional information on recalculations was provided in annex 3A (pp.749 (summary) and 762). In these sections, the Party explained the assumptions used and rationale for the selection of Nex values on the basis of information generated for similar animal production systems in neighbouring countries.
A.8	3.B.1 Cattle – N_2O (A.4, 2018) (A.8, 2016) (A.8, 2015) Transparency	Include all the necessary explanations, information and references on the Nex from dairy cows in the NIR.	Resolved. The Party reported the methodology or the references used to document Nex estimates for dairy cows in its NIR (chap. 5.2.5.1, including table 5-10, pp.440–441). Additional information on recalculations was provided in annex 3A (pp.749 (summary) and 762).
A.9	3.B.1 Cattle – N_2O (A.13, 2018) Convention reporting adherence	Report the correct values of Nex for dairy cows in CRF table 3.B(b) for all years of the time series and ensure that those values are consistent with the values reported in the NIR.	Resolved. The Party reported correct Nex values in CRF table 3.B(b). These values were consistent with the values reported in NIR table 5-10. During the review, Luxembourg also provided examples of cross-check verifications between information in CRF table 3.B(b) and the NIR tables.
A.10	3.D Direct and indirect N_2O emissions from agricultural soils – N_2O	Include in the NIR information on the methodology, AD and EFs used for estimating the N_2O emissions from compost applied to soils.	Resolved. The Party reported AD for compost applied to soils (in kg N) in NIR table 5-32 (p.493). Additionally, it explained the data source for AD on compost (p.495). The Party used the IPCC default EF (from the 2006 IPCC Guidelines, vol.

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	(A.15, 2018) Transparency		4, chap. 11, table 11.1) to estimate N_2O emissions from compost applied to soils (0.01 kg N_2O-N/kg N) (NIR p.504).
A.11	3.D.a.5 Mineralization/ immobilization associated with loss/gain of soil organic matter – N_2O (A.14, 2018) Transparency	Include a reference, in the agriculture chapter of the NIR, to the section in the LULUCF chapter where the methodology to estimate N_2O emissions from the conversion of land to cropland is described.	Resolved. The Party included in its NIR (chap. 5.6.3.1.5, p.502) a reference to the section (6.3.4.2.3) of the LULUCF chapter that provides information on estimation of N_2O emissions from the conversion of land to cropland.
A.12	3.D.a.5 Mineralization/ immobilization associated with loss/gain of soil organic matter – N_2O (A.14, 2018) Convention reporting adherence	Correct the values for N inputs and EFs reported in CRF table 3.D.	Resolved. The Party reported in CRF table 3.D the correct values for N inputs and EFs.
A.13	3.G Liming – CO_2 (A.6, 2018) (A.10, 2016) (A.10, 2015) Accuracy	Include in the NIR refined documentation on the level of use of both dolomite and limestone and indicate this reporting of emissions from agricultural applications of these carbonates in IPPU under other process uses of carbonates.	Resolved. Luxembourg reported detailed information on dolomite and limestone use in agricultural soils in its NIR (chap. 5.9, pp.508–512), including the AD and underlying assumptions, method and EF used for estimating emissions for this category. The Party reported that according to a personal communication with the director of Versis S.A., more than 95 per cent of the lime used in Luxembourg used to be dolomite. The information was also confirmed by the data collected by the Agricultural Test Farm Network of Luxembourg, which operates under the Service for Rural Economy, part of the Ministry of Agriculture, Viticulture and Rural Development. For simplification reasons it was therefore assumed that until 2017 dolomite accounted for all lime used. The ERT noted that this is a conservative assumption, because the EF for dolomite is higher than that for limestone (2006 IPCC Guidelines, vol. 4, chap. 11, p.11.27). In 2018, a larger quantity of limestone was sold, which is why since 2018 both dolomite and limestone are considered separately in the inventory (NIR p.508). Information on recalculations was summarized in chapter 5.9.3 (p.512) and additional information can be found in annex 3A (see p.749 for a summary and p.776 for further details). Luxembourg additionally confirmed that lime is only used in agricultural soils and that there is no lime production in Luxembourg. Limestone is used for cement (clinker) and flat glass production. Quarrying and mining of raw materials for clinker production occurs in France. The mine used by the clinker production facility (located in Rumelange, Luxembourg) is situated in Ottange, just across the border in France. Raw materials are transported via covered conveyor belts (approximately 1 km long) to the clinker production facility. The Party clarified that national statistics

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			do not include data on quarrying of raw materials such as limestone and dolomite. Only import and export data are reported and annual checks are done to make sure that import and export data for limestone match the AD reported for glass and clinker production, and to a minor extent for use in agriculture. The ERT noted that in the NIR (chap. 4.2.5) the Party explained that other process use of carbonates is not occurring. Therefore, the ERT considers that it is not necessary to include the explanation of dolomite and limestone use in agriculture in that section.
A.14	3.H Urea application – CO_2 (A.16, 2018) Transparency	Include in the NIR information to demonstrate that the total national aggregate of estimated emissions for all gases and categories considered insignificant remains below 0.1 per cent of the national total GHG emissions, as requested in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Not resolved. The Party reported emissions for category 3.H in its NIR (chap. 5.10, p.513, including table 5.39). It indicated that emissions for this category varied between 0.00005 and 0.00028 Gg CO_2 in 2016–2018 and are therefore below the threshold of significance established in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. However, the estimations were presented as carbon and not as CO_2 and there was also an error in the units used. During the review, the Party acknowledged the error and stated that it will be corrected in the next submission. The ERT agreed that, once corrected, emissions for this category vary between 1.04 (2016) and 0.18 (2018) Gg CO_2, remaining below the significance threshold. The ERT considers that the recommendation has not yet been addressed because the Party has not yet provided the required information to demonstrate that the total national aggregate of estimated emissions for all gases and categories considered insignificant remains below 0.1 per cent of the national total GHG emissions.
LULUCF			
L.1	4. General (LULUCF) (L.6, 2018) (L.14, 2016) (L.14, 2015) Convention reporting adherence	Ensure accuracy in the NIR text, tables and figures and consistency between the NIR and CRF tables, and improve the QC procedures.	Addressing. The Party has consistently reported information on the trend for the LULUCF sector in its NIR (table 6-1, p.515) and in CRF table 10. However, some inconsistencies were identified in the NIR, including the following: table 6-15 has a range of annual net CO_2 removals from land-use change to forest between –305.46 and –56.76 Gg CO_2, but in the text (p.534) the range is between –306 and –72 Gg CO_2; and in table 6-1 emissions under settlements were reported as 60.06 Gg CO_2 eq for 2018 and in the text (p.515) as 60.6 Gg. Additionally, the ERT noted inconsistencies in the matrices of CRF table 4.1 for 1999–2012, where the final areas for the year (X-1) do not equal the initial areas for the following year (X) (see ID# L.9 below). During the review, the Party clarified that the inconsistencies in the NIR are typographical errors. It indicated that it plans to address these by having a second person cross-checking the numbers in the text, NIR tables and CRF tables for the next submission. The ERT considers that the recommendation has not yet been fully addressed because the Party's reporting still includes some inconsistencies.

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
L.2	4. General (LULUCF) – CO_2 (L.9, 2018) Transparency	Elaborate in the NIR the methods and underlying assumptions used for the expert judgment on: (a) Fertilizer use (NIR section 11.3.1.2); (b) Practices of fuelwood collection (NIR p.469); (c) C/N ratio for mineral soils (NIR p.473); (d) Mineral soils in grassland (NIR p.477); (e) Uncertainty for the biomass expansion factor (NIR p.496); (f) Uncertainties for carbon stock in settlements (NIR p.499).	Not resolved. The Party has continued using expert judgment without details of the assumptions used in its NIR (fertilizer use, p.695; practices of fuelwood collection, p.545; C/N ratio for mineral soils, p.560; mineral soils in grassland, p.564; uncertainty for the biomass expansion factor, p.581; and uncertainties for carbon stock in settlements, p.584). During the review, the Party clarified that the expert judgments are generally based on personal communications (telephone calls and meeting exchanges) with the individual experts. It explained that it is currently refining its QC system, which will include a methodology for collecting and documenting expert judgments. The Party indicated that in the next submission those references will be properly documented, following the QC system, and referenced in the NIR. The refinement of the QC system will be continued throughout 2021 and is planned to be fully implemented for Luxembourg's 2022 submission.
L.3	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.10, 2018) Convention reporting adherence	Include an uncertainty assessment of the land-use and land-use change maps.	Not resolved. The Party did not include an uncertainty assessment of the land-use and land-use change maps in its NIR. During the review, the Party clarified that it is currently carrying out a new assessment of land-use changes, which will include an uncertainty assessment of land-use changes. This will be included in the 2022 submission.
L.4	4. General (LULUCF) – CO_2 (L.11, 2018) Transparency	Include in the NIR information clarifying the random and eventual systematic uncertainties associated with growth rate and carbon stock factors.	Not resolved. The Party did not include in its NIR information to clarify the random and eventual systematic uncertainties associated with growth rates and carbon stock factors. During the review, the Party provided the background studies (Stevens et al., 2014a and 2014b; Universite de Liege, 2015a) that contain details on the standard deviations and confidence boundaries for all parameters (growth rate, carbon stock, deadwood stock). The Party indicated that it plans to include this information in its next NIR.
L.5	4. General (LULUCF) – CO_2 (L.12, 2018) Accuracy	Demonstrate the accuracy of the soil carbon stock factors, by land use, which are used in the estimates of CO_2 emissions and removals from mineral soils, in particular so that the long-term carbon stock changes due to land-use changes are accounted or corrected for in the assessment to avoid under- or overestimation of emissions and removals, or, alternatively, improve the accuracy of the soil carbon stock factors.	Not resolved. The Party did not include in its NIR information to demonstrate the accuracy of the soil carbon stock factors by land use. During the review, the Party clarified that it is currently assessing whether it is possible to use a spatially explicit methodology for carbon stock changes in mineral soils. This should improve the accuracy of soil carbon stock factors and, if implemented, this change would be incorporated in the 2022 submission.
L.6	Land representation – CO_2 (L.13, 2018) Accuracy	Update the extrapolation for areas of land use and land-use change for 2013–2016 to take into account both land use and land-use change on the basis of information on management data.	Addressing. The Party reported in its NIR (p.532) that the estimates of land use and land-use change for 2013–2018 were carried out by linear extrapolation as for the 2018 submission. During the review, the Party clarified that the whole land-use change matrix is currently being reviewed and updated with the latest land-use map (for 2015–2018). The Party plans to implement classification based on land cover

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			and land use. The new land-use matrix is expected to be available for the 2022 submission.
L.7	Land representation – CO_2 (L.13, 2018) Accuracy	Use a stratification in accordance with the 2006 IPCC Guidelines (vol. 4, chap. 3, p.16).	Addressing. The ERT notes that the compilation of new information about land representation (see ID# L.6 above) is an opportunity for the Party to implement a stratification in accordance with the 2006 IPCC Guidelines (vol. 4, chap. 3, p.16). During the review, the Party explained the challenges related to stratification due to the small size of its forests and provided the ERT with a feasibility study regarding the application of geographically explicit land-use data (Korzeniowska et al., 2020).
L.8	Land representation – CO_2 (L.14, 2018) Accuracy	Estimate the portion of grassland and cropland that falls outside the scope tracked by LPIS in order to correct for the bias; and explain in the NIR how any potential overestimation of removals is avoided.	Addressing. The Party reported in its NIR (pp.530–531) and CRF table 4.1 the conversions between cropland and grassland areas for 2010–2018 using information from LPIS. The Party did not report an estimation for the portion of grassland and cropland that falls outside the scope tracked by LPIS in order to correct for the bias. Moreover, the Party did not explain in the NIR how any potential overestimation of removals is avoided. During the review, the Party clarified that the land-use change matrix is currently being reviewed and updated with data from the new 2015–2018 land-use maps for Luxembourg. LPIS maps will be included and georeferenced in this analysis. This will allow a direct analysis of the grassland areas that fall outside the scope of LPIS. These updated land-use data are planned to be integrated in the 2022 submission.
L.9	Land representation – CO_2 (L.15, 2018) Transparency	Include (in addition to NIR table 215) a description that land representation takes into account the 20-year period for an area to be transferred from a converted category into a remaining category.	Not resolved. The Party included NIR table 6-13 (p.532), which is similar to NIR table 215 in the 2018 submission, in its 2020 NIR. The Party did not include a description of the land representation taking into account the 20-year period for an area to be transferred from a converted category into a remaining category. During the review, the ERT asked for information on land uses and conversion between 1971 and 1990. The Party clarified that information on land uses and conversions between 1971 and 1990 is available in tabular format. It also provided the ERT with the National Forestry Accounting Plan. The ERT reviewed the plan and noted that information is available only for conversions of land to forest land and that there is no information about forest land remaining forest land between 1971 and 1990 or the other categories of land uses. The Party plans to include tabular information for conversions to forest land in the next NIR.
L.10	4.A.1 Forest land remaining forest land – CO_2 (L.17, 2018) Transparency	Explicitly provide in the NIR the steps of the calculation of the above-ground biomass factors for forest land.	Not resolved. The Party did not report in its NIR additional information to explain the steps of the calculation of the above-ground biomass factors for forest land. During the review, the Party referred to a study (Gembloux Agro-Bio Tech, 2015) that provides a step-by step description of the calculation method for above-ground biomass factors, indicating that it plans to include details of this study in its next submission.

ID#	*Issue/problem classification*[a, b]	*Recommendation made in previous review report*	*ERT assessment and rationale*
L.11	4.A.1 Forest land remaining forest land – CO_2 (L.18, 2018) Accuracy	Collect more information on harvests in private forests directly from private landowners and compare them with the harvest rates from the national forest inventory and report the results of this comparison in the NIR.	Addressing. The Party reported in its NIR (figure 6-10, p.544) volumes of wood harvested in public and private forests. The volumes of wood harvested in private forests are estimated using the same approach as for the 2018 submission, on the basis of the national forest inventory and taking into account information on harvests in public forests. During the review, the Party clarified that it is in contact with the association of private forest owners and is waiting for a meeting. The Party considers that it could be difficult to obtain information; however, the ERT considers it important to obtain information to validate the estimation of harvest in private forests. The ERT considers that the recommendation has not yet been fully addressed because the Party has not yet collected more information on harvests in private forests directly from private landowners and compared them with the harvest rates estimated from the national forest inventory.
L.12	4.B Cropland – CO_2 (L.19, 2018) Transparency	Report a value for above- and below-ground biomass separately in table 223 of the NIR.	Not resolved. The Party did not report a value for above- and below-ground biomass separately in NIR table 6-25 (p.549), which corresponds to table 223 in the 2018 NIR. During the review, the Party referred to page 549 of the NIR, which explains that the values in table 6-25 include both above- and below-ground biomass values.
L.13	4.B Cropland – CO_2 (L.19, 2018) Transparency	Explain how the average carbon stock value of vineyards was obtained (e.g. on the basis of values reported by Germany and Switzerland).	Resolved. The Party has included in its NIR (p.549) an explanation of how the average carbon stock value of vineyards was obtained on the basis of values reported by Germany (2014 NIR) and Switzerland (2015 NIR).
L.14	4.G HWP – CO_2 (L.20, 2018) Accuracy	Collect the data necessary to complement current data sets on HWP (production, import and export of industrial round wood, sawnwood and paperboard) to the extent possible and use extrapolation techniques to complete the time series.	Resolved. The Party has collected the data necessary to complement data sets on HWP and reported net CO_2 emissions and removals from HWP for the whole time series with the use of extrapolation techniques. It explains in the NIR (pp.589–592) that for import and export of industrial roundwood it used information from FAOSTAT (data combined for Belgium and Luxembourg between 1961 and 2000) and amended this data with national information taking into account imports and exports between Luxembourg and Belgium. For the production of sawnwood and wood-based panels before 2000, the information was completed considering the production ratio of both countries for 2000–2005. See ID# L.17 in table 6.
L.15	4(V) Biomass burning – CH_4 and N_2O (L.21, 2018) Completeness	Estimate and report CH_4 and N_2O emissions from biomass burning (including wildfires and controlled burning after infestations) on all land-use categories and describe in the NIR how the estimations were made.	Not resolved. The Party has not reported estimations of emissions from biomass burning (including wildfires and controlled burning after infestations) in its submission. During the review, the Party clarified that it is not mandatory to burn the damaged wood from insect infestations; rather, it is common practice to remove the damaged wood from the forest and use it in biomass plants with energy recovery. The Party indicated that there are no official data on forest fires; however, minor fires have occurred in recent years. It indicated that one fire occurred on an area of 10 ha and that it considered the emissions from this fire insignificant and for this reason did not report them in the inventory.

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			The ERT considers that for the completeness of the inventory, the Party should estimate the emissions from biomass burning or, if the emissions are considered insignificant, report them as "NE" and provide a justification in the NIR that the likely level of emissions is below the threshold established in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. Given that there is some evidence of fires occurring, the ERT also considers it important that the Party improve its efforts to register official data for these fires.
Waste			
W.1	5. General (waste) – CO_2, CH_4 and N_2O (W.15, 2018) Convention reporting adherence	Correct the errors identified in table 239 of the NIR so that total emissions reported for the waste sector and subcategories 5.A solid waste disposal and 5.D wastewater treatment are consistent with the sum of the CO_2, CH_4 and N_2O emissions reported for the same categories.	Resolved. The ERT considers that the recommendation has been fully addressed because the Party has corrected the errors identified in table 239 of the 2018 NIR (table 7-1 of the 2020 NIR) and the total emissions reported for the waste sector and subcategories 5.A solid waste disposal and 5.D wastewater treatment are consistent with the sum of the CO_2, CH_4 and N_2O emissions reported.
W.2	5.A Solid waste disposal on land – CH_4 (W.16, 2018) Transparency	Provide in the NIR information justifying the use of an oxidation factor of 0.1 by explaining that solid waste disposal sites in Luxembourg are covered with oxidizing material as indicated in the 2006 IPCC Guidelines, because they are operated by gradually covering different parts of the solid waste disposal sites with a layer of soil.	Not resolved. The Party provided in its NIR (pp.622 and 627) the same reference for the oxidation factor of 0.1 as in the 2018 NIR. It explained that the pre-treated waste from mechanical-biological treatment (similar to compost or soil) is in many cases placed on top of waste and thus used as a CH_4 oxidizing material. However, the Party has not clearly indicated whether all solid waste disposal sites have been covered by oxidizing material to justify the use of an oxidation factor of 0.1 from the 2006 IPCC Guidelines (vol. 5, chap. 3, table 3.2).
W.3	5.A Solid waste disposal on land – CH_4 (W.17, 2018) Transparency	Provide in the NIR information justifying the use of the methane generation rate of 0.08 for estimating CH_4 emissions from indirectly deposited waste by including the information that the pre-treatment before disposal to solid waste disposal sites leads to substantial decay (aerobic) of organic components, including rapidly degradable waste components.	Resolved. The Party reported in its NIR (p.622) that after the pre-treatment (rotting) process the remaining waste is predominantly constituted of materials that have a longer half-time value and hence the lower value of the range in the 2006 IPCC Guidelines (vol. 5, chap. 3, table 3.3) for the methane generation rate for bulk waste in wet boreal and temperate climate zone was chosen.
W.4	5.B.2 Anaerobic digestion at biogas facilities – CH_4 (W.18, 2018) Convention reporting adherence	Ensure the consistency of the data on CH_4 emissions reported in NIR table 255 and CRF table 5.B.	Resolved. The Party reported in NIR table 7-17 (p.643) (corresponding to table 255 in the 2018 NIR) on CH_4 emissions consistent with the data in CRF table 5.B for 2016 (0.51 kt).
W.5	5.D Wastewater treatment and discharge – N_2O (W.10, 2018) (W.2,	Review the N_2O EF for plants with significant denitrification and use a consistent methodology to estimate these emissions.	Not resolved. The emissions reported for WWTPs with significant denitrification (advanced WWTPs) are the same in the 2018 NIR (table 260) and the 2020 NIR (table 7-22, column "N_2O wwtp-de"), indicating that they were not recalculated. The Party explained in the NIR (p.651) that it used the tier 1 method in accordance

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	2016) (W.2, 2015) (77, 2014) Accuracy		with the 2006 IPCC Guidelines (vol. 6, chap. 6.3.1.1) to estimate emissions from wastewater treatment. However, the ERT noted that actually the Party did not follow the method in the 2006 IPCC Guidelines (vol. 6, chap. 6.3.1.1) in its calculation of emissions from advanced WWTPs and that the method used for advanced WWTPs was therefore not consistent with that used for other types of WWTPs. In its NIR (p.651), the Party explained that it used the methodology from the 2006 IPCC Guidelines (vol. 5, chap. 6, box 6.1 (on estimating direct N_2O emissions from WWTPs)) to estimate emissions from advanced WWTPs. The ERT noted that the Party interpreted the methodology, in particular the term N_{WWT}, in a manner that excludes the indirect N_2O emissions from effluent, which, according to the 2006 IPCC Guidelines (vol. 5, section 6.3.1.1), are expected to be significantly higher than the direct emissions. The Party explained that according to its understanding, N_{WWT}, which is to be subtracted from N in effluent, refers to all N that is fed to the WWTP and that as a result, $N_{EFFLUENT}$-N_{WWT} is zero and no indirect emissions are calculated owing to discharge of effluent from advanced WWTPs (with denitrification). The ERT is of the view that N_{WWT} refers to N in direct N_2O emissions, and it thus represents only a small share of N entering the plant. During the review, the Party provided its calculation sheet for N_2O from WWTPs with significant denitrification. The ERT noted that it was based on the assumption that the N removal efficiency is 100 per cent. The ERT considers that even modern WWTPs usually cannot achieve a 100 per cent reduction in N in the effluent. However, the Party also explained in the NIR (p.652) that even if the N removal efficiency was 85 per cent, the difference would be below the significance threshold established in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. The ERT agreed that this would also be the case with even lower removal efficiency and therefore concluded that a revision of the assumption on N removal efficiency is unlikely to lead to a difference above the threshold for application of an adjustment in accordance with decision 22/CMP.1, annex, paragraph 80(b), in conjunction with decision 4/CMP.11. The ERT considers that the recommendation has not yet been fully addressed because the Party has not sufficiently justified its methodology and assumptions in the NIR or fully demonstrated the use of a consistent methodology to estimate these emissions.
W.6	5.D Wastewater treatment and discharge – N_2O (W.11, 2018) (W.3. 2016) (W.3, 2015) (79,	Take into account the N removed in the sludge spread on agricultural fields when estimating the N_2O emissions from wastewater in order to avoid double counting; revise the method used to estimate N_2O emissions from wastewater handling.	Addressing. The Party recalculated the emissions from wastewater treatment for WWTPs without denitrification in the 2019 submission for the entire time series as can be seen by comparing 2018 NIR table 260 and 2019 NIR table 256 (column "N_2O wwtp"). The 2019 NIR (chap. 8.5.6) refers to recalculations made in response to the review process, but does not specifically mention any improvements regarding N removed in the sludge spread on agricultural fields. In its NIR (p.651), Luxembourg stated that for older WWTPs it is assumed that 35 per

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	2014) Accuracy		cent of $N_{EFFLUENT}$ is removed in sludge. It further explained that the estimate is based on measurements of N in the influent and effluent at several older WWTPs. However, the equation on page 654 of the NIR indicates that the value of 35 per cent is not related to sludge removal, but is the assumed denitrification rate for plants without denitrification. This indicates no improvement in the methodology since the 2018 submission, since the same parameter with a value of 35 per cent is included in the 2018 NIR (p.567). During the review, the Party explained that the 35 per cent does indeed refer to sludge removal in all WWTPs without denitrification. The ERT considers that the recommendation has not yet been fully addressed because even though the Party has recalculated the emissions, it has not provided adequate information in the NIR on whether or how the method used to account for N removed in sludge has been revised. It also has not elaborated how the N removed in the sludge spread on agricultural fields is taken into account when estimating the N_2O emissions from wastewater to avoid double counting. In particular, the Party has not provided in the NIR sufficient justification for the value of 35 per cent used, or compared it with the amounts of sludge applied to soils, composted or incinerated. However, based on the calculation file provided by the Party during the review, the ERT notes that the magnitude of the emissions from WWTPs without denitrification is small and therefore any changes in the assumptions regarding the amount of N removed as sludge is unlikely to lead to a difference above the threshold for application of an adjustment in accordance with decision 22/CMP.1, annex, paragraph 80(b), in conjunction with decision 4/CMP.11. For related recommendations to improve transparency, see ID# W.14 in table 6.
W.7	5.D.1 Domestic wastewater – N_2O (W.13, 2018) (W.14, 2016) (W.14, 2015) Accuracy	Implement the results of the study on revising the calculation of emissions from wastewater treatment, taking into account the recommendations of earlier reviews.	Addressing. During the review, the Party stated that the recommendation was addressed in the 2019 submission (see ID#s W.5 and W.6 above). Table 7-25 of the NIR on planned improvements refers to an ongoing study regarding reassessment of the country-specific EF for WWTPs with and without denitrification following review recommendations. In the same table and during the review, the Party also mentioned that rather than developing a country-specific methodology, it plans to use the methodology provided in the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*, when it has been approved.
W.8	5.D.1 Domestic wastewater – N_2O (W.19, 2018) Accuracy	Use country-specific protein consumption data for the estimation of N_2O emissions from domestic wastewater treatment and explain any change in the estimations in the NIR.	Resolved. The Party carried out a recalculation in the 2019 submission as explained in table 257 of the 2019 NIR. For example, for 2016, the emissions for the population not connected to wastewater treatment plants increased from 1.21 (2018 NIR, table 260) to 1.42 t N_2O (2019 NIR, table 256). The Party reported in its NIR (p.653) that the protein consumption data were taken from the latest data for Luxembourg of the Food and Agriculture Organization of the United Nations.

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			The Party also reported that the missing years were extrapolated to ensure a complete time series for AD.
W.9	5.D.1 Domestic wastewater – N_2O (W.20, 2018) Accuracy	Ensure that N in sludge removed is considered in the estimation of the N_2O emissions from domestic wastewater treatment to avoid double counting of the N_2O emissions.	Addressing. See ID# W.6 above.
W.10	5.D.1 Domestic wastewater – N_2O (W.21, 2018) Accuracy	Ensure that N_2O emissions from non-consumed protein are included in N_2O emissions from domestic wastewater treatment.	Resolved. N_2O emissions from non-consumed protein are included in N_2O emissions from domestic wastewater treatment as reported in the NIR (pp.653–654).
W.11	5.D.2 Industrial wastewater – CH_4 (W.22, 2018) Transparency	Provide information in the NIR to justify the use of the notation key "NO" for reporting CH_4 emissions from industrial wastewater treatment by explaining that Luxembourg's two WWTPs are well managed and treat wastewater below their designed maximum loads.	Not resolved. The Party reported in its NIR (chap. 7.5.2, p.650) that all industrial WWTPs are aerobic and consequently no CH_4 emissions occur, hence the use of notation key "NO". However, the Party has not provided a clear description of the two WWTPs or a justification to confirm that they are well managed and that they treat wastewater below their designed maximum loads. During the review, the Party explained that it plans to restructure the NIR to improve transparency as the current NIR is not clear on industrial WWTPs.
W.12	5.D.2 Industrial wastewater – N_2O (W.23, 2018) Transparency	Improve the transparency of the documentation in the NIR on the country-specific values for the denitrification rate (70 per cent) by providing a clear explanation of how the values are derived, the assumptions used and the appropriateness of the values used.	Not resolved. The information in the 2020 NIR is the same as that in the 2018 NIR. During the review, the Party clarified that the denitrification rate of 70 per cent presented in its NIR (p.657) is calculated using the average of the analytical results over the past 15 years of the effluents of the industrial WWTPs. It considered 70 per cent the average conservative value (the calculated value for the main industrial WWTPs is 73 per cent). The ERT noted that according to the NIR (p.656) there are only two industrial wastewater treatment plants in Luxembourg. Therefore, there is a lack of clarity regarding what the "main industrial WWTPs" included in the calculation of the country-specific denitrification rate are.
W.13	5.D.3 Other (wastewater treatment and discharge) – N_2O (W.14, 2018) (W.4, 2016) (W.4, 2015) (78, 2014) Accuracy	Review the estimates for all discharges of wastewater, including those from wastewater plants, to confirm there are no underestimates, and that all N_2O emissions are estimated and N removal at these plants should be considered in the estimates.	Addressing. The Party indicated in its NIR that it used the first equation on page 654 of the NIR to calculate emissions from the population not connected to WWTPs (i.e. using septic tanks). The ERT considers that it may not be relevant to apply the "fraction of industrial and commercial co-discharged protein" to this population, noting that the use of that factor may lead to an overestimation of emissions. See also ID#s W.5 and W.6 above on wastewater treated in WWTPs.
KP-LULUCF			
KL.1	General (KP-LULUCF) – CO_2 (KL.5, 2018)	Correct NIR table 274 so that it is consistent with the values reported in CRF tables 4(KP-I)A.1 and NIR-2.	Not resolved. Inconsistencies were identified between NIR table 11-1 (p.681) (corresponding to table 274 in 2018 NIR) and CRF tables 4(KP-I)A.1, 4(KP-I)A.2 and NIR-2. For example, for 1990, NIR table 11-1 indicates 0 kha for deforestation, while in CRF table 4(KP-1)A.2 and NIR-2 the area is reported as

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	Convention reporting adherence		0.44 kha. During the review, the Party clarified that NIR table 11.1 is deferred by one year, meaning that the land areas reported for 1991 show the values for 1990 and so forth. The CRF tables show the correct values and hence emission estimates are not affected. The Party plans to correct NIR table 11-1 in its next submission.
KL.2	General (KP-LULUCF) – CO_2 (KL.6, 2018) Accuracy	Use a stratification for KP-LULUCF activities in accordance with the 2006 IPCC Guidelines (vol. 4, chap. 3, p.16).	Addressing. See ID#s L.6 and L.7 above.
KL.3	General (KP-LULUCF) – CO_2 (KL.6, 2018) Convention reporting adherence	Correct the minimum land area reported in CRF table NIR-1 to show 0.5 ha and not 0.05 ha.	Resolved. The Party reported that the minimum land area for forest land is 0.5 ha in the NIR (p.538 and p.679) and CRF table NIR-1. See ID# KL.9 in table 6.
KL.4	AR – CO_2 (KL.2, 2018) (KL.7, 2016) (KL.7, 2015) Convention reporting adherence	Ensure consistency of the information on carbon stock change for above-ground biomass between the CRF tables and NIR data.	Resolved. The Party reported corrected information on carbon stock change for above-ground biomass in NIR table 11-7 (p.692). This information is consistent with the information reported in CRF table 4(KP-I)A.1.
KL.5	AR – CO_2 (KL.3, 2018) (KL.7, 2016) (KL.7, 2015) Transparency	Provide information and references for biomass growth rates used for AR areas.	Addressing. The Party reported information for biomass growth rates used for AR areas in NIR table 11-7 (p.692). However, references for biomass growth rates used were not included. During the review, the Party clarified that references will be included in the next submission.
KL.6	AR – CO_2 (KL.7, 2018) KP reporting adherence	Correct the information reported in CRF table NIR-2 on CM and GM, and report the conversion of cropland and grazing land to forest land (afforestation) under "other" converted to forest land (afforestation).	Resolved. The Party corrected the information reported in CRF table NIR-2 on CM and GM for the entire time series and reported the conversion of cropland and grazing land to forest land (afforestation) under "other" converted to forest land (afforestation).
KL.7	FM (KL.9, 2018) KP reporting adherence	Report the FM cap as 3,604.402 kt CO_2 eq in the CRF accounting table.	Not resolved. The Party reported the FM cap as 3,571.87 kt CO_2 eq in its NIR (p.729) and CRF accounting table. During the review, the Party clarified that in its next submission it will report the FM cap as 3,604.402 kt CO_2 eq in the CRF accounting table in line with 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 Luxembourg (FCCC/IRR/2016/LUX).
KL.8	Biomass burning – CH_4 and N_2O (KL.8, 2018) Completeness	Estimate and report CH_4 and N_2O emissions from biomass burning (including wildfires and controlled burning after infestations) for all appropriate KP-LULUCF activities; and describe in the NIR how the estimations were made.	Not resolved. Emissions from biomass burning were not reported. See ID# L.15 above.

[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 Luxembourg 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, 2019 and 2017 are excluded from the list of review years in which issues could have been identified.

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

9. In accordance with paragraph 83 of the UNFCCC review guidelines, the ERT noted that the issues and/or problems included in table 4 have been identified in three or more successive reviews, including the review of the 2020 annual submission of Luxembourg, 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 Luxembourg

ID#	*Previous recommendation for the issue*	*Number of successive reviews issue not addressed*[a]
General		
G.2	Improve QA/QC in reporting on the key category analysis to ensure consistency with the UNFCCC Annex I inventory reporting guidelines.	3 (2015/2016–2020)
Energy	No issues identified.	
IPPU		
I.1	Explain every recalculation, such as the update of AD and EFs for solvent and other product use.	4 (2014–2020)
I.11	Describe in the NIR the expert consultation process applied to inform the choice of EF used for estimating emissions from disposal of stationary air-conditioning equipment.	3 (2015/2016–2020)
I.13	Provide in the NIR the methods (IPCC tier or country-specific), AD and EFs applied to estimate HFC emissions during manufacture, operation, disposal and recovery (occurring during disposal phase) for the reporting of refrigeration and air-conditioning categories, especially commercial refrigeration and stationary air-conditioning categories.	3 (2015/2016–2020)
Agriculture		
A.6	Report on the values used for the methane conversion factor from the anaerobic digester, particularly in relation to or in comparison with the recommendation in the report on the review of the 2014 submission (para. 49).	3 (2015/2016–2020)
LULUCF		
L.1	Ensure accuracy in the NIR text, tables and figures and consistency between the NIR and CRF tables, and improve the QC procedures.	3 (2015/2016–2020)

ID#	*Previous recommendation for the issue*	*Number of successive reviews issue not addressed*[a]
Waste		
W.5	Review the N_2O EF for plants with significant denitrification and use a consistent methodology to estimate these emissions.	4 (2014–2020)
W.6	Take into account the N removed in the sludge spread on agricultural fields when estimating the N_2O emissions from wastewater in order to avoid double counting; revise the method used to estimate N_2O emissions from wastewater handling.	4 (2014–2020)
W.7	Implement the results of the study on revising the calculation of emissions from wastewater treatment, taking into account the recommendations of earlier reviews.	3 (2015/2016–2020)
W.13	Review the estimates for all discharges of wastewater, including those from wastewater plants, to confirm there are no underestimates, and that all N_2O emissions are estimated and N removal at these plants should be considered in the estimates.	4 (2014–2020)
KP-LULUCF		
KL.5	Provide information and references for biomass growth rates used for AR areas.	3 (2015/2016–2020)

[a] Reports on the reviews of the 2017 and 2019 annual submissions of Luxembourg 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. Tables 5–6 present findings made by the ERT during the individual review of the 2020 annual submission of Luxembourg that are additional to those identified in table 3. In accordance with paragraph 76(b) of the UNFCCC review guidelines, the ERT has prioritized in table 5 recalculations that changed the total emissions or removals for a category by more than 2 per cent and/or national total emissions by more than 0.5 per cent for any of the recalculated years.

Table 5
Additional findings made during the individual review of the 2020 annual submission of Luxembourg related to recalculations

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
Energy			
		Recalculations were made for the energy sector that changed the emission or removal estimate for some categories by more than 2 per cent and/or national total emissions by more than 0.5 per cent; however, the ERT did not identify any issues or problems with these recalculations.	

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
IPPU			
		Recalculations were made for the IPPU sector that changed the emission or removal estimate for some categories by more than 2 per cent and/or national total emissions by more than 0.5 per cent; however, the ERT did not identify any issues or problems with these recalculations.	
Agriculture			
A.15	3.A.2 Sheep – CH_4	Luxembourg recalculated emissions from enteric fermentation from sheep (see ID# A.5 in table 3). According to the NIR (p.460), the default values of 6.5 per cent for Y_m for mature sheep and 3.5 per cent for Y_m for lambs under 1 year were used to estimate emissions from enteric fermentation from sheep (category 3.A.2). However, CRF table 3.As1 indicates that a Y_m of 4.5 per cent was used for lambs under 1 year for all years. During the review, the Party clarified that it used a Y_m value for lambs under 1 year of 4.5 per cent and that the uncertainty range 3.5–5.5 per cent was used in the Monte Carlo simulation, in accordance with table 10.13 of the 2006 IPCC Guidelines (vol. 4, chap. 10). Thus, the information provided in the CRF tables was correct. Luxembourg also indicated that this error will be corrected in its next NIR. The ERT recommends that the Party consistently report Y_m values in the NIR and CRF table 3.As1 for emissions from enteric fermentation for lambs.	Yes. Convention reporting adherence
LULUCF			
		Recalculations were made for the LULUCF sector that changed the emission or removal estimate for some categories by more than 2 per cent and/or national total emissions by more than 0.5 per cent; however, the ERT did not identify any issues or problems with these recalculations.	
Waste			
		Recalculations were made for the waste sector that changed the emission or removal estimate for some categories by more than 2 per cent and/or national total emissions by more than 0.5 per cent; however, the ERT did not identify any issues or problems with these recalculations.	
KP-LULUCF			
		Recalculations made for KP-LULUCF activities changed the emission or removal estimate for a category by more than 2 per cent and/or national total emissions by more than 0.5 per cent; however, the ERT did not identify any issues or problems with these recalculations.	

[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.

11. Table 6 contains additional findings made by the ERT during the individual review of the 2020 annual submission that are not covered in tables 3 or 5, but are within the scope of the desk review as specified in paragraph 76 of the UNFCCC review guidelines or paragraph 65 of the Article 8 review guidelines and are findings that the ERT wishes to convey to the Party.

Table 6
Additional findings made during the individual review of the 2020 annual submission of Luxembourg

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
General			
G.8	Follow-up to previous reviews	The Party reported planned improvements, including those in response to the review process, in NIR table 10-10 (chap. 10.4, p.677), and has provided a list of these planned improvements without a tentative time frame (except for category 4.A). During the review, the Party provided a new version of table 10-10 containing an additional column that gives the tentative time frame for each planned improvement, which it plans to include in the table in its next NIR. The Party also reported in its NIR (chap. 1.6.6.4, p.86) planned improvements regarding QA/QC; however, no tentative time frame was provided and the improvements were not included in table 10-10. During the review, the Party indicated that implementation of the QA/QC activities is planned for the next submission (see ID# G.12 below). The ERT encourages the Party to update the list of planned improvements presented in the NIR (including those in response to the review process) to cover the improvements related to implementation of QA/QC procedures and to include in the list a tentative time frame for these improvements.	Not an issue/problem
G.9	National registry	In its NIR (chap. 14, p.730), the Party stated that no changes have been made to the database and application backup plan or to the disaster recovery plan, and that the database model is provided in annex A. However, according to part 1 of the SIAR (dated 26 July 2020, p.7), annex A was not submitted. During the review, the Party indicated that annex A was published on 10 August 2020 through the UNFCCC submission portal. The ERT encourages the Party to include the database model annex A in a timely manner.	Not an issue/problem
G.10	National registry	In its NIR (chap. 14, p.730), the Party stated that no changes have been made to the national registry's conformance to technical standards and referred to annex B. However, according to part 1 of the SIAR (dated 26 July 2020, p.8) annex B was not submitted. During the review, Luxembourg indicated that annex B was published on 10 August 2020 through the submission portal. The ERT encourages the Party to include annex B in a timely manner.	Not an issue/problem
G.11	National registry	The Party provided in its NIR (chap. 12.4 on publicly accessible information, p.727) a reference to annex XVI to EU regulation 2216/2004, which is no longer in force according to part 1 of the SIAR (dated 26 July 2020, p.10). During the review, Luxembourg indicated that the correct legal reference is EU regulation 389/2013 and that this will be corrected in its next NIR. The ERT recommends that the Party update the legal reference regarding publicly available information in its next NIR.	Yes. Transparency
G.12	QA/QC and verification	The ERT identified issues related to a potential lack of sufficient quality control in the Party's submission. Examples include inconsistencies in the NIR and the CRF tables (see ID#s E.3, L.1 and KL.1 in table 3 and ID#s I.24, I.26 and I.27 below) and errors in the reporting of uncertainties (see ID# G.7 in table 3). The Party reported in its NIR (chap. 1.6.6, pp.83–86) that steps to implement QA/QC procedures have been taken but further improvements are needed, one of which is to strengthen the implementation of the quality management system. During the review, in response to a question of the ERT regarding what kind of activities are planned to strengthen the implementation of the quality management system for the next submission, the Party clarified that during 2020 three additional members joined	Yes. Convention reporting adherence

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		Luxembourg's inventory team, one of whom will be mainly in charge of QA/QC activities, whereas at the time of the review (November 2020) the inventory team was receiving QA/QC training from an external partner. The training covers, for example, general reporting guidelines, uncertainty assessment and documentation of expert judgment. In addition, an update to Luxembourg's quality manual (ongoing until the 2022 submission) is being carried out within the framework of the above-mentioned training sessions. The Party noted that the main emphasis will be on the improvement of data validation checklists (sector-specific and general) and the creation of relevant QA/QC procedures. The ERT welcomed the Party's plan. The ERT recommends that the Party strengthen the implementation of the QA/QC procedures, as planned, to avoid incorrect assessment of uncertainties and inconsistencies in the NIR and the CRF tables, and that the Party report on the improvements in the NIR.	
G.13	Uncertainty analysis	The Party performed quantitative uncertainty assessments following approach 1 of the 2006 IPCC Guidelines (vol. 1, chap. 3). The uncertainty assessment provided in NIR table 1-12 (pp.89–92) was performed for the latest inventory year (2018) and the trend between the base year and the latest inventory year. However, in accordance with paragraph 15 of the UNFCCC Annex I inventory reporting guidelines, the quantitative uncertainty assessment is to be performed for at least the base year and the latest inventory year and for the trend between these two years. During the review, the Party confirmed that it has not performed an uncertainty assessment for the base year of the inventory. It also explained that it is unlikely to be able to include an uncertainty assessment for the base year before the 2022 submission, as the assessment of uncertainties for AD and EFs for the base year requires a significant effort from all sector experts. The Party stated that the table for the tier 1 uncertainty analysis presented in the 2006 IPCC Guidelines (vol. 1, chap. 3) includes only the uncertainties for the latest inventory year and the trend, and does not include the necessary columns and formulae for determining the base-year uncertainty. The ERT noted that a separate calculation table could be used for the base-year uncertainties by including the base-year emissions and uncertainties in the columns that are indicated to be used for the latest inventory year. The ERT recommends that the Party include the quantitative uncertainty assessment for the base year for all source and sink categories, as well as for the total inventory, in its 2022 submission.	Yes. Convention reporting adherence
Energy			
		No findings for the energy sector additional to those included in table 3 were made by the ERT during the review.	
IPPU			
I.24	2. General (IPPU) – all gases	The Party reported in NIR table 4-1 (pp.319–320) emissions for the whole time series for the IPPU sector. The ERT noted inconsistencies between the information in that table and CRF tables 2(I)s1 and 2(I)s2 for categories 2.C, 2.F and 2.G. For example, CO_2 emissions for 2.C in 2009 are reported as 128.66 kt CO_2 in CRF table 2(I)s1 but 112.66 kt CO_2 in the NIR. During the review, the Party informed the ERT that the CO_2 emissions from the Primus process (2.C.1) for 2003–2009 were omitted in error from NIR table 4-1 (and tables 4-9 and 4-10) and the other inconsistencies are related to an erroneous formula in the Excel file used to generate the NIR tables. The ERT also noted that the notes to NIR table 4-1 indicating the global warming potential values used were incorrect. The Party acknowledged the error during the review.	Yes. Convention reporting adherence

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		The ERT recommends that the Party revise NIR tables 4-1, 4-9 and 4-10 so that the whole time series of emissions is consistent with data in CRF tables 2(I)s1 and 2(I)s2. The ERT also recommends that the Party update the notes to NIR table 4-1 regarding the global warming potential values used.	
I.25	2.A.1 Cement production – CO_2	The Party reported in its NIR (p.326) that the emissions from cement production have decreased by 34.8 per cent since 1990. The AD decreased by 28.7 per cent from 1990 to 2018 while the IEF decreased by 10.3 per cent from 543.78 kg CO_2/t clinker in 1990 to 487.60 kg CO_2/t clinker in 2018 (NIR table 4-5 and CRF table 2(I).A-Hs1). Reasons for the IEF reduction were not sufficiently described. During the review, the Party clarified that in 2012 the operating company started to measure and determine the actual content of carbon, organic carbon, calcium oxide and magnesium oxide in the different raw materials. These materials include some decarbonated materials such as blast furnace slag. The increased use of such decarbonated compounds (but containing calcium oxide and magnesium oxide) explains the decreasing trend in the IEF.	Yes. Transparency
		The ERT recommends that the Party provide an explanation of the emission trends in the NIR, in particular regarding significant variations in the IEF across the time series, by providing more information on the drivers influencing CO_2 emissions from cement production, such as that provided during the review regarding increased use of decarbonated compounds containing calcium oxide and magnesium oxide.	
I.26	2.D.1 Lubricant use – CO_2	The Party reported in NIR table 4-18 (p.353) AD and emissions from lubricant use (category 2.D.1) for the whole time series. The ERT noted that part of the AD and emissions reported for category 2.D.1 in the NIR are not consistent with the values in CRF table 2(I).A-Hs2. For example, for 2008, AD of 10,218.00 t and emissions of 6.02 kt CO_2 were reported in the NIR, but AD of 4,103.00 t and emissions of 2.42 kt CO_2 were reported in CRF table 2(I).A-Hs2. For 2014, the emissions reported in CRF table 2(I).A-Hs2 are 4.37 kt CO_2 and in NIR table 4-18 they are reported as 4.39 kt CO_2. Similar inconsistencies occur for 2009–2012. During the review, the Party explained that the data reported in the NIR are correct but the AD and CO_2 emissions reported in the corresponding CRF table were not correctly updated. The ERT noted that the magnitude of the error for 2014 (0.02 kt CO_2) is below the threshold of significance for application of an adjustment in accordance with decision 22/CMP.1, annex, paragraph 80(b), in conjunction with decision 4/CMP.11.	Yes. Accuracy
		The ERT recommends that the Party correct the AD and emissions reported in CRF table 2(I).A-Hs2 for 2008–2014 so that they are consistent with the data in NIR table 4-18.	
I.27	2.G Other product manufacture and use – N_2O and SF_6	The Party reported in NIR table 4-35 (p.410) emissions from other product manufacture and use for the entire time series. The ERT noted that for some years the emissions reported in the NIR for categories 2.G, 2.G.1 (electrical equipment) and 2.G.2.c (soundproof windows) are not consistent with the values reported in CRF tables 2(I)s2 and 2(II)B-H. For example, for 1990, emissions for categories 2.G and 2.G.2.c were reported as 9.92 and 0.00 kt CO_2 eq, respectively, in the NIR but as 10.47 and 0.55 kt CO_2 eq, respectively, in the CRF tables. For 2014, emissions for categories 2.G and 2.G.1 were reported as 14.18 and 1.07 kt CO_2 eq, respectively, in the NIR, but as 14.20 and 1.09 kt CO_2 eq, respectively, in the CRF tables. During the review the Party explained that errors were made while copying the figures to the NIR table. The ERT also noted that the title of NIR table 4-35 was incorrect as it referred to category 2.F instead of 2.G.	Yes. Convention reporting adherence

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		The ERT recommends that the Party revise NIR table 4-35 so that all emissions reported are consistent with the emissions reported in CRF tables 2(I)s2 and 2(II)B-H. It also recommends that the Party correct the title of NIR table 4-35.	
Agriculture			
A.16	3.D.a.4 Crop residues – N_2O	The Party reported in its NIR (chap. 5.6) and CRF table 3.D direct N_2O emissions from agricultural soils, including information on methods and assumptions for N in crop and forage residues (chap. 5.6.3.1.3, pp.496–501). Several inter-annual changes in N in crop residues returned to soils are significant, including those for 2011–2012 (43.6 per cent) and 2014–2015 (−27.8 per cent), which are not transparently explained in the NIR. During the review, the Party clarified that the differences were mainly attributable to variations in harvests between years and could be partially explained by temperature differences and variations in annual precipitation, as reported in the NIR (figures 2.6–2.7, pp.109−110; and figure 2.9, p.111), indicating that climate conditions in 2011 were less favourable and hampered growth, whereas in 2012 the climate afforded better growing conditions. The opposite situation was observed in the 2014–2015 season. The ERT agrees with the Party that, although yield variability occurred during these seasons, it seems to be significant only for certain crops such as fodder beet and grasses (2011), and potato, beet and grasses (2015) (NIR table 5.34, p.500). Furthermore, information on climate conditions reported in the NIR suggests that these two seasons were hotter and drier than average years. Luxembourg indicated that N from crop residues from grass corresponds – according to the median for 1990–2018 – to more than 60 per cent of the total N from crop residues, and that maize and wheat were also relevant crops owing to the area cultivated each year. Therefore, if climate conditions affected the development of grasslands and crops, the yield was in turn affected and therefore also the quantities of total residues and direct N_2O emissions for category 3.D. In addition, the Party explained the effect of rainfall patterns on grassland production. The ERT recommends that, to increase transparency, the Party include in the NIR information to explain the significant inter-annual changes observed in N inputs in crop residues returned to soils. The explanation could include information on the contribution of grasses, maize and wheat residues to the total N from crop residues and an explanation of the effects of rainfall pattern distribution and temperature on grasses, maize and wheat yields.	Yes. Transparency
A.17	3.G Liming – CO_2	The Party indicated in its NIR (annex 3, section on CO_2 emissions from managed soils, p.790) that the uncertainty range for the quantities of limestone and dolomite was assumed to be uniformly distributed over a range of 20 per cent. The emissions from liming have increased significantly over recent years (NIR table 5-37, p.509) in relation to a significant increase in lime sales in the country in 2011−2018 (NIR table 5-38, p.511) but no detailed information on the rationale for assuming a uniform distribution and the range of uncertainty was provided. During the review, Luxembourg indicated that AD collection is in the form of an interview or survey, and the uncertainty was considered to be approximately 20 per cent. Additionally, in response to a question posed by the ERT, Luxembourg clarified that AD are also confirmed through consultation with farmers, and that for the 2020 submission a cross check was done for 2018 with the data collected within the Farm Accountancy Data Network public database, which were in agreement. To increase the transparency of the next submission, the ERT recommends that the Party include in the NIR the source of the uncertainty value for AD for this category as well as the rationale for estimating the uncertainty value.	Yes. Transparency

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
LULUCF			
L.16	Land representation – CO_2	Inconsistencies similar to those identified in the report on the review of the 2018 submission (ID# L.15) in the matrices of CRF table 4.1 exist for 1999–2012, where the final areas for the year (X-1) do not equal the initial areas for the following year (X). For example, for 1999 the final area of cropland is reported as 66.32 kha and the initial area of cropland for 2000 as 65.95 kha. The Party included in its NIR (pp.525 and 527) the same explanation as that provided in the 2018 submission, namely that the areas derived from the geographical information system data sets have been placed in relation to the official area of Luxembourg and that there are some inconsistencies for grassland and cropland between 1999 and 2007. During the review, the Party explained that it plans to evaluate how to avoid the inconsistencies in the matrices. The ERT recommends that Luxembourg ensure the consistency of the areas in CRF table 4.1 for 1999–2012 so that the final areas for the year (X-1) equal the initial areas for the following year (X).	Yes. Comparability
L.17	4.G HWP – CO_2	The Party reported a complete HWP time series in its NIR (pp.588–593) and CRF tables 4.Gs1 and 4.Gs2. The Party did not include information about the national data source or reference used to complete the time series in the NIR or the factors used to convert from product units to carbon in its NIR or CRF table 4.Gs2. In addition, the ERT noted some inconsistencies between the information included in the NIR (p.588) about the half-life (35 years) for sawnwood and the information included in CRF table 4.Gs1 for 2014–2018 (half-life of 36–40 years). Furthermore, the Party did not include information about imports and exports in CRF table 4.Gs2. During the review, the Party explained that the value for the half-life of sawnwood products presented in the NIR is correct (35 years) and in the CRF tables an error occurred during copying and pasting but the carbon emission and removal calculations were not affected. The Party also stated that it plans to report imports and exports as well as the factors used to convert from product units to carbon in the next submission in order to improve transparency. The ERT recommends that the Party include information about both the national data source or reference used to complete the HWP time series in the NIR and the factors to convert from product units to carbon in its NIR and CRF table 4.Gs2, correct the information about the half-life of sawnwood in CRF table 4.Gs1 and include information about imports and exports in CRF table 4.Gs2.	Yes. Transparency
L.18	4(IV).2 N leaching and run-off – N_2O	The Party reported a value of 2,250 kg N_2O-N/kg N for the IEF for N leaching and run-off in CRF table 4(IV), which is the second highest value of all reporting Parties for the entire time series and the highest for the EU countries. The value reported in the CRF table is not consistent with the information in the NIR (p.561), according to which the Party used equation 11.10 from the 2006 IPCC Guidelines (vol. 4, chap. 11), with EF_5 equal to 0.0075 kg N_2O-N/kg N and $Frac_{LEACH-(H)}$ with a default value of 0.30 kg N/kg N addition or deposition by grazing animals (2006 IPCC Guidelines, vol. 4, chap. 11, table 11.3). During the review, the Party clarified that there was a mistake in the conversion of the AD unit of kt to kg, and, as a consequence, the IEF reported in CRF table 4(IV) was incorrect; however, this did not affect the estimated emissions. The ERT confirmed that the value reported for the emissions is correct. The Party also stated that it plans to correct the value of the IEF in CRF table 4(IV). The ERT recommends that the Party correct the values of the AD and IEF for N leaching and run-off in CRF table 4(IV).	Yes. Convention reporting adherence

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
Waste			
W.14	5.D.1 Domestic wastewater – N_2O	The ERT noted that the Party's description of the method used to estimate emissions for WWTPs without denitrification lacked transparency (see also ID# W.6 in table 3): (a) In its NIR (p.654) the Party used the parameter $N_{EFFLUENT}$ to denote N generated by the population connected to WWTPs without denitrification, while in the 2006 IPCC Guidelines (vol. 5, chap. 6, p.6.25) the parameter $N_{EFFLUENT}$ refers to N in the effluent discharged to aquatic environments; (b) Regarding sludge from WWTPs, the Party reported in its NIR (pp.646, 634 and 492) that emissions from sludge are taken into account under CRF categories 1.A.2.g (sludge incineration), 5.B.1 (sludge composting) and 3.D (sludge application to agriculture soils) and hence to avoid double counting are not taken into account in CRF category 5.D. The Party also reported sludge removed in CRF table 5.D as "NE". However, in the NIR (p.651) Luxembourg stated that for older WWTPs it is assumed that 35 per cent of $N_{EFFLUENT}$ is removed in sludge; (c) The equation on page 654 indicates that the value of 35 per cent is the assumed denitrification rate for plants without denitrification. During the review, the Party confirmed that the value of 35 per cent refers to sludge removal and that the assumed 35 per cent removal applies not only to older WWTPs without denitrification but to all biological WWTPs without denitrification; (d) The equation on page 654 of the NIR indicates that only 35 per cent of N is taken into consideration in the calculation of emissions from WWTPs without denitrification (instead of 65 per cent, which would be remaining if 35 per cent were removed). During the review, the Party indicated that actually the remaining 65 per cent of N is considered in the estimation of emissions, which was confirmed by the review of the calculation file that the Party provided to the ERT during the review. The ERT recommends that the Party: (a) When using the methods from the 2006 IPCC Guidelines (vol. 5, chap. 6), use the parameters such as $N_{EFFLUENT}$ in the same meaning as in the 2006 IPCC Guidelines; (b) Report consistently in the NIR and CRF table 5.D whether sludge removal has been taken into consideration in the estimates for category 5.D.1, and whether the amount of sludge removed has been estimated; (c) Report consistently in the NIR that the value of 35 per cent represents the sludge removal instead of the denitrification rate and clarify that it is applied to all biological WWTPs without denitrification; (d) Correct the equation on page 654 of the NIR so that it is clear that 65 per cent, instead of 35 per cent, of N is considered in the estimation of emissions.	Yes. Transparency
KP-LULUCF			
KL.9	General (KP-LULUCF) – CO_2	As explained under ID# KL.3 in table 3, the Party reported in the NIR (pp.538 and 679) and CRF table NIR-1 that the minimum land area for forest land is 0.5 ha. The ERT noted that according to 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 Luxembourg, the Party has selected 0.5 ha as the minimum land area to apply in the definition of forest, and that the selected area is fixed for the commitment period (decision 16/CMP.11, annex, para. 16). During the review, the Party explained that the definition of forest took the minimum area of 0.5 ha for forest land as reported to the Food and	Yes. Accuracy

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*	*Is finding an issue/problem?*[a]
		Agriculture Organization of the United Nations. However, the national forest inventory also covers groves with a minimum land area of 0.05 ha (NIR table 6-16, p.536). The Party explained that 0.05 ha is predominately used as the minimum land area for forest land and therefore it plans to use it in the reporting tables. The ERT recommends that the Party use the minimum land area of 0.5 ha in its definition of forest for KP-LULUCF, as included 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 Luxembourg. The ERT also recommends that the Party use the same minimum land area in the definition of forest for the LULUCF sector.	

[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

12. The ERT did not identify the need to apply any adjustments for the 2020 annual submission of Luxembourg.

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

13. Luxembourg 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

14. 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 Luxembourg in its 2020 annual submission

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

Table I.1
Total greenhouse gas emissions for Luxembourg, 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								–418.00
Base year	12 857.93	12 756.68	NA	NA	268.38		NA	
1990	12 842.31	12 741.06	NA	NA				
1995	9 522.87	10 091.81	NA	NA				
2000	8 951.57	9 669.11	NA	NA				
2010	12 049.58	12 169.06	NA	NA				
2011	11 755.30	12 046.25	NA	NA				
2012	11 391.50	11 773.25	NA	NA				
2013	10 675.20	11 234.48	NA	NA		–132.77	NA	–433.83
2014	10 304.55	10 776.85	NA	NA		–131.95	NA	–352.82
2015	9 868.52	10 290.10	NA	NA		–131.10	NA	–296.86
2016	9 541.33	10 050.69	NA	NA		–130.22	NA	–386.94
2017	9 833.28	10 235.70	NA	NA		–129.33	NA	–277.37
2018	10 333.88	10 547.15	NA	NA		–128.41	NA	–94.94

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. Luxembourg has not elected any activities under Article 3, para. 4, of the Kyoto Protocol. 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 Luxembourg, 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	11 847.64	581.65	310.50	0.00	NO	NO	1.28	NO
1995	9 170.30	586.38	318.23	15.15	NO	NO	1.75	NO
2000	8 731.57	585.41	318.68	31.08	NO	NO	2.36	NO
2010	11 219.29	591.66	297.15	53.67	NO	NO	7.29	NO
2011	11 114.55	567.31	300.09	56.55	NO	NO	7.75	NO
2012	10 851.40	559.25	295.55	58.91	NO	NO	8.14	NO
2013	10 303.87	563.56	296.08	62.45	NO	NO	8.51	NO
2014	9 825.22	576.50	299.36	66.86	NO	NO	8.91	NO
2015	9 333.17	582.38	297.59	67.60	NO	NO	9.37	NO
2016	9 080.25	586.33	308.34	66.04	NO	NO	9.72	NO
2017	9 250.40	593.66	312.14	69.58	NO	NO	9.90	NO
2018	9 568.52	587.66	313.13	67.64	NO	NO	10.20	NO
Percentage change 1990–2018	**–19.2**	**1.0**	**0.8**	**94 601 051.4**	**NA**	**NA**	**694.9**	**NA**

Note: Emissions and removals reported in the sector other (sector 6) are not included in this table.
[a] Luxembourg did not report indirect CO_2 emissions in CRF table 6.

Table I.3
Greenhouse gas emissions by sector for Luxembourg, 1990–2018
(kt CO_2 eq)

	Energy	*IPPU*	*Agriculture*	*LULUCF*	*Waste*	*Other*
1990	10 300.98	1 639.38	695.57	101.25	105.14	NO
1995	8 259.92	1 028.74	702.11	–568.93	101.03	NO
2000	8 088.16	781.18	694.56	–717.53	105.21	NO
2010	10 738.32	675.77	659.90	–119.48	95.07	NO
2011	10 615.41	692.07	647.80	–290.95	90.97	NO
2012	10 416.93	632.81	634.42	–381.75	89.10	NO
2013	9 884.09	616.00	644.89	–559.28	89.50	NO
2014	9 394.03	632.61	659.58	–472.30	90.64	NO
2015	8 906.86	625.11	672.75	–421.57	85.38	NO
2016	8 628.29	650.69	688.16	–509.36	83.55	NO

	Energy	*IPPU*	*Agriculture*	*LULUCF*	*Waste*	*Other*
2017	8 794.37	659.63	697.69	–402.41	84.00	NO
2018	9 112.19	662.58	690.44	–213.28	81.93	NO
Percentage change 1990–2018	**–11.5**	**–59.6**	**–0.7**	**–310.7**	**–22.1**	**NA**

Note: Luxembourg 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 Luxembourg

(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				–418.00				
Technical correction				181.68				
Base year	268.38				NA	NA	NA	NA
2013		–179.71	46.94	–433.83	NA	NA	NA	NA
2014		–176.68	44.74	–352.82	NA	NA	NA	NA
2015		–173.63	42.53	–296.86	NA	NA	NA	NA
2016		–170.55	40.33	–386.94	NA	NA	NA	NA
2017		–167.45	38.13	–277.37	NA	NA	NA	NA
2018		–164.33	35.92	–94.94	NA	NA	NA	NA
Percentage change base year–2018					**NA**	**NA**	**NA**	**NA**

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

[a] Luxembourg has not elected to report on any activities under Article 3, para. 4, of the Kyoto Protocol. 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.

1.

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

Table I.5
Key relevant data for Luxembourg 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: not elected (e) GM: not elected (f) RV: not elected (g) WDR: not elected
Elected activities under Article 3, paragraph 4, of the Kyoto Protocol	None
Election of application of provisions for natural disturbances	Yes, for AR and FM
3.5% of total base-year GHG emissions, excluding LULUCF	450.550 kt CO_2 eq (3 604.402 kt CO_2 eq for the duration of the commitment period)
Cancellation of AAUs, CERs and ERUs and/or issuance of RMUs in the national registry for:	
1. AR	NA
2. Deforestation	NA
3. FM	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 Luxembourg. 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 Luxembourg
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
CPR	**65 209 026**	**–**	**–**	**65 209 026**
Annex A emissions				
CO_2	9 568 520	–	–	9 568 520
CH_4	587 658	–	–	587 658
N_2O	313 135	–	–	313 135
HFCs	67 640	–	–	67 640
PFCs	NO	–	–	NO
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF_6	10 202	–	–	10 202
NF_3	NO	–	–	NO
Total Annex A sources	**10 547 155**	–	–	**10 547 155**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–164 328	–	–	–164 328
Deforestation	35 922	–	–	35 922
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–94 942	–	–	–94 942

Table II.2
Information to be included in the compilation and accounting database for 2017 for Luxembourg
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	9 250 402	–	–	9 250 402
CH_4	593 665	–	–	593 665
N_2O	312 144	–	–	312 144
HFCs	69 582	–	–	69 582
PFCs	NO	–	–	NO
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF_6	9 904	–	–	9 904
NF_3	NO	–	–	NO
Total Annex A sources	**10 235 697**	–	–	**10 235 697**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–167 454	–	–	–167 454
Deforestation	38 126	–	–	38 126
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				

	Original submission	*Revised submission*	*Adjustment*	*Final value*
FM	–277 369	–	–	–277 369

Table II.3
Information to be included in the compilation and accounting database for 2016 for Luxembourg
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	9 080 253	–	–	9 080 253
CH_4	586 334	–	–	586 334
N_2O	308 337	–	–	308 337
HFCs	66 045	–	–	66 045
PFCs	NO	–	–	NO
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF_6	9 721	–	–	9 721
NF_3	NO	–	–	NO
Total Annex A sources	**10 050 690**	–	–	**10 050 690**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–170 555	–	–	–170 555
Deforestation	40 330	–	–	40 330
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–386 945	–	–	–386 945

Table II.4
Information to be included in the compilation and accounting database for 2015 for Luxembourg
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	9 333 169	–	–	9 333 169
CH_4	582 379	–	–	582 379
N_2O	297 587	–	–	297 587
HFCs	67 596	–	–	67 596
PFCs	NO	–	–	NO
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF_6	9 367	–	–	9 367
NF_3	NO	–	–	NO
Total Annex A sources	**10 290 097**	–	–	**10 290 097**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–173 631	–	–	–173 631
Deforestation	42 534	–	–	42 534
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–296 861	–	–	–296 861

Table II.5
Information to be included in the compilation and accounting database for 2014 for Luxembourg
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	9 825 216	–	–	9 825 216
CH_4	576 502	–	–	576 502

	Original submission	*Revised submission*	*Adjustment*	*Final value*
N_2O	299 365	–	–	299 365
HFCs	66 857	–	–	66 857
PFCs	NO	–	–	NO
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF_6	8 914	–	–	8 914
NF_3	NO	–	–	NO
Total Annex A sources	**10 776 853**	–	–	**10 776 853**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–176 684	–	–	–176 684
Deforestation	44 738	–	–	44 738
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–352 821	–	–	–352 821

Table II.6
Information to be included in the compilation and accounting database for 2013 for Luxembourg
(t CO_2 eq)

	Original submission	*Revised submission*	*Adjustment*	*Final value*
Annex A emissions				
CO_2	10 303 872	–	–	10 303 872
CH_4	563 563	–	–	563 563
N_2O	296 080	–	–	296 080
HFCs	62 453	–	–	62 453
PFCs	NO	–	–	NO
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF_6	8 514	–	–	8 514
NF_3	NO	–	–	NO
Total Annex A sources	**11 234 483**	–	–	**11 234 483**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–179 712	–	–	–179 712
Deforestation	46 943	–	–	46 943
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–433 830	–	–	–433 830

Annex III

Additional information to support findings in table 2

Missing categories that may affect completeness

The categories for which estimation methods are included in the 2006 IPCC Guidelines that were reported as "NE" or for which the ERT otherwise determined that there may be an issue with the completeness of the reporting in the Party's inventory are the following:

(a) 1.B.2.b Natural gas – CO_2 and CH_4 (see ID# E.15 in table 3);

(b) 4(V) Biomass burning – CH_4 and N_2O (see ID# L.15 in table 3);

(c) Biomass burning (KP-LULUCF) – CH_4 and N_2O (see ID# KL.8 in table 3).

A.

Annex IV

Reference documents

A. Reports of the Intergovernmental Panel on Climate Change

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

IPCC. 2014. *2013 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/.

IPCC. 2019. *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*. E Calvo Buendia, K Tanabe, A Kranjc, et al. (eds.). Geneva: IPCC. Available at https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/.

B. UNFCCC documents

Annual review reports

Reports on the individual reviews of the 2014, 2015, 2016 and 2018 annual submissions of Luxembourg, contained in documents FCCC/ARR/2014/LUX, FCCC/ARR/2015/LUX, FCCC/ARR/2016/LUX and FCCC/ARR/2018/LUX, 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 Luxembourg for 2020. Available at https://unfccc.int/sites/default/files/resource/asr2020_LUX.pdf.

C. Other documents used during the review

Responses to questions during the review were received from Nora Becker (Environment Agency, Ministry of Sustainable Development and Infrastructure of Luxembourg), including additional material on the methodology and assumptions used. The following references have been reproduced as received:

Gembloux Agro-Bio Tech, 2015. Exploitation des données de l'inventaire forestier national permanent du Grand-Duché de Luxembourg pour quantifier la biomasse ligneuse en forêt.

Korzeniowska, K., Kleeschulte, S. Carrão, H. 2020. Support to LULUCF reporting in Luxembourg: Feasibility study on the application of geographically explicit land-use data to estimate changes in the Grand Duchy of Luxembourg between 1989 and 2018. Niederanven.

Ministry of the Environment, Climate and Sustainable Development of Luxembourg. 2019. National Forestry Accounting Plan – Luxembourg. National Forestry Accounting Plan and Reference Levels for 2021–2025 in accordance with Regulation (EU) 2018/841.

Stevens, A., van Wesemael, Bas, Marx, S., Leydet. L. 2014a. Mapping Topsoil Organic Carbon Stocks in Grand-Duchy of Luxembourg. Universite catholique de Louvain.

Stevens, A., van Wesemael, Bas, Marx, S., Leydet. L. 2014b. Mapping Topsoil Organic Carbon Content in Grand-Duchy of Luxembourg. Universite catholique de Louvain.

Universite de Liege. 2015a. Biomass and carbon stocks of the Luxembourg forest: Estimates and uncertainties based on NFI data.

Universite de Liege. 2015b. Exploitation des données de l'inventaire forestier national permanent du Grand-Duché de Luxembourg pour quantifier la biomasse ligneuse en forêt.