Advance Version

COMPLIANCE COMMITTEE **CC/ERT/ARR/2013/10**
9 April 2013

Report of the individual review of the annual submission of Luxembourg submitted in 2012

Note by the secretariat

The report of the individual review of the annual submission of Luxembourg submitted in 2012 was published on 8 April 2013. For purposes of rule 10, paragraph 2, of the rules of procedure of the Compliance Committee (annex to decision 4/CMP.2, as amended by decision 4/CMP.4), the report is considered received by the secretariat on the same date. This report, FCCC/ARR/2012/LUX, contained in the annex to this note, is being forwarded to the Compliance Committee in accordance with section VI, paragraph 3, of the annex to decision 27/CMP.1.

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Report of the individual review of the annual submission of Luxembourg submitted in 2012*

* In the symbol for this document, 2012 refers to the year in which the inventory was submitted, and not to the year of publication.

Contents

I. Introduction and summary

1. This report covers the centralized review of the 2012 annual submission of Luxembourg, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 24 to 29 September 2012 in Bonn, Germany, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Mr. Takeshi Enoki (Japan) and Mr. Dennis Rudov (Belarus); energy – Mr. Christo Christov (Bulgaria), Mr. Sangay Dorji (Bhutan), Mr. Lawrence Kotoe (Ghana) and Mr. Constantin Harjeu (Romania); industrial processes – Ms. Marisol Bacong (Philippines) and Ms. Yongsook Lyu (Republic of Korea); agriculture – Ms. Agita Gancone (Latvia) and Mr. Jacques Kouazounde (Benin); land use, land-use change and forestry (LULUCF) – Ms. Andrea Brandon (New Zealand) and Ms. Naoko Tsukada (Japan); and waste – Mr. Pavel Gavrilita (Republic of Moldova) and Mr. Kai Skoglund (Finland). Ms. Bacong and Mr. Enoki were the lead reviewers. The review was coordinated by Ms. Sevdalina Todorova-Brankova and Ms. Astrid Olsson (UNFCCC secretariat).

2. In accordance with the "Guidelines for review under Article 8 of the Kyoto Protocol" (decision 22/CMP.1) (hereinafter referred to as the Article 8 review guidelines), a draft version of this report was communicated to the Government of Luxembourg, which made no comment on it.

3. In 2010, the main greenhouse gas (GHG) in Luxembourg was carbon dioxide (CO_2), accounting for 91.7 per cent of total GHG emissions[1] expressed in carbon dioxide equivalent (CO_2 eq), followed by nitrous oxide (N_2O) (3.9 per cent) and methane (CH_4) (3.8 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 0.6 per cent of the overall GHG emissions in the country. The energy sector accounted for 88.2 per cent of total GHG emissions, followed by the agriculture sector (5.7 per cent), the industrial processes sector (5.5 per cent), the waste sector (0.5 per cent) and the solvent and other product use sector (0.1 per cent). Total GHG emissions amounted to 12,080.99 Gg CO_2 eq and decreased by 6.0 per cent between the base year[2] and 2010.

4. Tables 1 and 2 show GHG emissions from Annex A sources, emissions and removals from the LULUCF sector under the Convention and emissions and removals from activities under Article 3, paragraph 3, and, if any, Article 3, paragraph 4, of the Kyoto Protocol (KP-LULUCF), by gas and by sector and activity, respectively. In table 1, CO_2, CH_4 and N_2O emissions included in the rows under Annex A sources do not include emissions and removals from the LULUCF sector.

5. Tables 3–5 provide information on the most important emissions and removals and accounting parameters that will be included in the compilation and accounting database.

[1] In this report, the term "total GHG emissions" refers to the aggregated national GHG emissions expressed in terms of CO_2 eq excluding LULUCF, unless otherwise specified.

[2] "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 and SF_6. The base year emissions include emissions from Annex A sources only.

Table 1

Greenhouse gas emissions from Annex A sources and emissions/removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, by gas, base year to 2010[a]

			Gg CO_2 eq								
		Greenhouse gas	*Base year*[a]	*1990*	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*Change Base year–2010(%)*
Annex A sources		CO_2	11 894.27	11 894.27	9 147.56	8 624.86	11 968.92	11 064.47	10 525.56	11 077.44	–6.8
		CH_4	468.78	468.78	476.05	471.95	455.36	448.50	448.13	457.09	–2.2
		N_2O	474.73	474.73	479.23	479.59	477.26	470.32	473.84	472.40	–0.5
		HFCs	15.59	12.01	15.59	28.62	53.01	63.46	65.54	66.47	326.4
		PFCs	0.00	0.00	0.00	0.01	0.15	0.24	0.22	0.20	NA
		SF_6	1.55	1.13	1.55	2.15	5.04	6.57	7.00	7.39	375.4
KP-LULUCF	Article 3.3[b]	CO_2						64.16	63.00	46.75	
		CH_4						NO	NO	NO	
		N_2O						0.35	0.36	0.35	
	Article 3.4[c]	CO_2	NA					NA	NA	NA	NA
		CH_4	NA					NA	NA	NA	NA
		N_2O	NA					NA	NA	NA	NA

Abbreviations: KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol; NA = not applicable; NO = not occurring.

[a] "Base year" for Annex A sources 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 and SF_6. The "base year" for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

[b] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation. Only the inventory years of the commitment period must be reported.

[c] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation. For cropland management, grazing land management and revegetation, the base year and the inventory years of the commitment period must be reported.

Table 2
Greenhouse gas emissions by sector and activity, base year[a] to 2010

			Gg CO_2 eq								
		Sector	*Base year[a]*	*1990*	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*Change Base year–2010 (%)*
Annex A		Energy	10 369.70	10 369.70	8 273.87	8 027.79	11 491.70	10 590.50	10 113.69	10 652.19	2.7
		Industrial processes	1 625.50	1 621.50	1 001.64	756.56	716.11	705.99	641.57	660.24	–59.3
		Solvent and other product use	23.90	23.90	19.74	15.81	16.65	16.90	16.11	14.34	–40.0
		Agriculture	745.87	745.87	737.15	724.11	660.72	669.81	682.04	690.25	–7.5
		Waste	89.94	89.94	87.58	82.91	74.56	70.36	66.87	63.97	–28.9
		LULUCF	NA	347.75	–238.10	–385.41	–385.65	–272.34	–296.43	–295.37	NA
		Total (with LULUCF)	**NA**	**13 198.67**	**9 881.88**	**9 221.78**	**12 574.08**	**11 781.22**	**11 223.86**	**11 785.62**	**NA**
		Total (without LULUCF)	**12 850.92**	**12 850.92**	**10 119.98**	**9 607.19**	**12 959.74**	**12 053.56**	**11 520.29**	**12 080.99**	**–6.0**
		Other[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA
KP-LULUCF	Article 3.3[c]	Afforestation and reforestation						–76.51	–78.00	–93.80	
		Deforestation						141.03	141.36	140.90	
		Total (3.3)						**64.52**	**63.36**	**47.09**	
	Article 3.4[d]	Forest management						NA	NA	NA	
		Cropland management	NA					NA	NA	NA	NA
		Grazing land management	NA					NA	NA	NA	NA
		Revegetation	NA					NA	NA	NA	NA
		Total (3.4)	**NA**					**NA**	**NA**	**NA**	**NA**

Abbreviations: LULUCF = land use, land-use change and forestry, KP-LULUCF = LULUCF emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol; NA = not applicable.

[a] "Base year" for Annex A sources 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 and SF_6. The "base year" for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

[b] Emissions/removals reported in the sector other (sector 7) are not included in Annex A to the Kyoto Protocol and are therefore not included in national totals.

[c] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation. Only the inventory years of the commitment period must be reported.

[d] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation. For cropland management, grazing land management and revegetation, the base year and the inventory years of the commitment period must be reported.

Table 3
Information to be included in the compilation and accounting database in t CO_2 eq for the year 2010, including the commitment period reserve

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Commitment period reserve	42 662 696			42 662 696
Annex A emissions for current inventory year				
CO_2	11 071 946	11 077 443		11 077 443
CH_4	456 938	457 092		457 092
N_2O	472 397			472 397
HFCs	66 471			66 471
PFCs	198			198
SF_6	7 390			7 390
Total Annex A sources	12 075 340	12 080 991		12 080 991
Activities under Article 3, paragraph 3, for current inventory year				
3.3 Afforestation and reforestation on non-harvested land for current year of commitment period as reported	–93 805			–93 805
3.3 Afforestation and reforestation on harvested land for current year of commitment period as reported	NO			NO
3.3 Deforestation for current year of commitment period as reported	140 897			140 897
Activities under Article 3, paragraph 4, for current inventory year[c]				
3.4 Forest management for current year of commitment period				
3.4 Cropland management for current year of commitment period				
3.4 Cropland management for base year				
3.4 Grazing land management for current year of commitment period				
3.4 Grazing land management for base year				
3.4 Revegetation for current year of commitment period				
3.4 Revegetation in base year				

Abbreviations: NO = not occurring.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 4
Information to be included in the compilation and accounting database in t CO_2 eq for the year 2009

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2009				
CO_2	10 520 523	10 525 558		10 525 558
CH_4	447 999	448 131		448 131
N_2O	473 842			473 842
HFCs	65 540			65 540
PFCs	218			218
SF_6	6 999			6 999
Total Annex A sources	**11 515 121**	**11 520 289**		**11 520 289**
Activities under Article 3, paragraph 3, for 2009				
3.3 Afforestation and reforestation on non-harvested land for 2009 as reported	–77 996			–77 996
3.3 Afforestation and reforestation on harvested land for 2009 as reported	NO			NO
3.3 Deforestation for 2009 as reported	141 360			141 360
Activities under Article 3, paragraph 4, for 2009[c]				
3.4 Forest management for 2009				
3.4 Cropland management for 2009				
3.4 Cropland management for base year				
3.4 Grazing land management for 2009				
3.4 Grazing land management for base year				
3.4 Revegetation for 2009				
3.4 Revegetation in base year				

Abbreviations: NO = not occurring.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 5
Information to be included in the compilation and accounting database in t CO_2 eq for the year 2008

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2008				
CO_2	11 058 419	11 064 467		11 064 467
CH_4	448 382	448 503		448 503
N_2O	470 321			470 321
HFCs	63 460			63 460
PFCs	242			242
SF_6	6 571			6 571
Total Annex A sources	**12 047 394**	**12 053 563**		**12 053 563**
Activities under Article 3, paragraph 3, for 2008				
3.3 Afforestation and reforestation on non-harvested land for 2008 as reported	–76 513			–76 513
3.3 Afforestation and reforestation on harvested land for 2008 as reported	NO			NO
3.3 Deforestation for 2008 as reported	141 030			141 030
Activities under Article 3, paragraph 4, for 2008[c]				
3.4 Forest management for 2008				
3.4 Cropland management for 2008				
3.4 Cropland management for base year				
3.4 Grazing land management for 2008				
3.4 Grazing land management for base year				
3.4 Revegetation for 2008				
3.4 Revegetation in base year				

Abbreviations: NO = not occurring.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

6. The 2012 annual inventory submission was submitted on 5 April 2012; it contains the common reporting format (CRF) tables for the period 1990 to 2010. The national inventory report (NIR) was submitted on 11 May 2012. Luxembourg also submitted information required under Article 7, paragraph 1, of the Kyoto Protocol, including information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, accounting of Kyoto Protocol units, changes in the national system and in the national registry, and the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 5 April 2012. The annual submission was not fully submitted in accordance with decision 15/CMP.11.

7. During the review, Luxembourg informed the expert review team (ERT) that between the previous submission and this submission, additional efforts had been made, and this submission was the first in which the CRF tables were finalized on 15 March, the deadline for the submission of the inventory to the European Union (EU). The Party also informed the ERT that the Party's goal is to finalize the next NIR on 15 March, so that it can be submitted in time to meet the EU and the UNFCCC (15 April) deadline. The expert review team (ERT) recommends that Luxembourg meet this goal and submit its next annual submission, both the CRF tables and NIR, by 15 April 2013 as required by decision 22/CMP.8.

8. Luxembourg officially submitted revised emission estimates on 12 November 2012 in response to questions raised by the ERT during the review. The values used in this report are based on the values contained in the submission of 12 November 2012.

9. The ERT also used the previous year's submission during the review. In addition, the ERT used the standard independent assessment report (SIAR), parts I and II, to review information on the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and on the national registry.[3]

10. During the review, Luxembourg provided the ERT with additional information. The documents concerned are not part of the annual submission but are in many cases referenced in the NIR. The full list of materials used during the review is provided in annex I to this report.

[3] The SIAR, parts I and II, is prepared by an independent assessor in line with decision 16/CP.10 (paras. 5(a), and 6(c) and (k)), under the auspices of the international transaction log administrator using procedures agreed in the Registry System Administrators Forum. Part I is a completeness check of the submitted information relating to the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and to national registries. Part II contains a substantive assessment of the submitted information and identifies any potential problem regarding information on the accounting of Kyoto Protocol units and the national registry.

Completeness of inventory

11. The inventory is complete in terms of years, geographical coverage and gases. The inventory covers most mandatory[4] source and sink categories for the period 1990–2010. However, the ERT noted that combustion of lubricants and fugitive emissions from oil were not included in the inventory (see para. 34 below) and the Party did not provide estimates of potential emissions of HFCs, PFCs and SF_6 in its submission (see para. 50 below). In addition, Luxembourg is not reporting several non-mandatory categories under the LULUCF sector (see para. 80 below). The ERT encourages Luxembourg to explore the possibility of estimating potential emissions of HFCs, PFCs and SF_6 and non-mandatory categories under LULUCF sector in its next annual submission. The ERT recommends that Luxembourg include the estimates for the fugitive emissions from oil in its next annual submission.

12. Luxembourg has reported inventory data in a complete set of CRF tables, including the sectoral background table 2(II).F which had not been filled out in previous annual submissions. The ERT welcomes this improvement. The ERT noted that Luxembourg generally follows the annotated NIR outline; however, in some places insufficient information is provided (see para. 26 below).

2. A description of the institutional arrangements for inventory preparation, including the legal and procedural arrangements for inventory planning, preparation and management

Overview

13. The ERT concluded that the national system continued to perform its required functions. The Party reported no changes to the national system since the previous annual submission.

Inventory planning

14. The NIR and additional information submitted by the Party described the national system for the preparation of the inventory. The Environment Agency of Luxembourg (AEV) has overall responsibility for the national inventory and compiles the national inventory and implements the quality assurance/quality control (QA/QC) procedures. The Ministry of Sustainable Development and Infrastructures (MDDI) (Department of the Environment (MDDI-DEV)) acts as the national focal point and is responsible for the official annual submission. Other organizations are also involved in the preparation of the inventory as data providers, such as the National Statistical Institute (STATEC under the Ministry of Economic Affairs and External Trade), the Ministry of Finance (Customs and Excise Agency), the National Society of Technical Control (SNCT, under MDDI), the Ministry of Internal Affairs and Spatial Planning (Water Management Agency), the Ministry of Agriculture (Agency for Technical Services for Agriculture, Rural Economics Service) and the Nature and Forestry Agency (under MDDI).

14. There is no change in the national system and one member of AEV staff, which is nominated as the inventory focal point, is in charge of the overall management of the inventory. In response to a question raised during the review, the Party explained that, until now, the number of staff could not be increased, as recommended in the previous review

[4] Mandatory source and sink categories under the Kyoto Protocol are all source and sink categories for which the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* provide methodologies and/or emission factors to estimate GHG emissions.

report. However, MDDI-DEV was notified of the results of the outcome of the previous review by a written note, in which additional staff was requested. The Party also explained that a discussion is well under way to find an interim solution to the staff shortage. However, engaging additional staff is a long process which has to go through different governmental bodies. MDDI-DEV is well aware of the situation and has found an interim solution as follows: an additional person will support the inventory of the industrial processes sector, mainly the F-gases inventory. The selection of this person is currently under way, and the person will start work in November/December 2012. A second person will be seconded from the Registry department, to support the national inventory compiler alongside with other tasks. The recruitment of this staff member is scheduled for 2013. The ERT welcomes the increase in staff and encourages Luxembourg to include an update on the achieved progress in the NIR of its next annual submission. The ERT further reiterates the recommendation of the previous review report that Luxembourg designate one person to be responsible for the LULUCF sector.

15. In response to a question raised by the ERT during the review regarding the encouragement in the previous review report on the implementation of the software system, MESAP, for inventory preparation, which includes the estimation of emissions and the archiving of emission factors (EFs) and activity data (AD), Luxembourg informed the ERT that import templates from Excel are in preparation and implementation is well under way, although a bit slower than expected. The ERT encourages Luxembourg to continue its efforts in ensuring good software support for inventory preparation and management and to report the progress thereon in its next annual submission.

Inventory preparation

Key categories

16. Luxembourg has reported a key category tier 1 analysis, both level and trend assessment, as part of its 2012 submission. The key category analysis performed by the Party and that performed by the secretariat[5] produced similar results. Luxembourg has included the LULUCF sector in its key category analysis, which was performed in accordance with the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF). The ERT noted that NIR tables 1-6 to 1-9 on the key category analysis do not seem to match the information in CRF table 7. The ERT recommends that Luxembourg enhance its QC procedures for the key category analysis to ensure that accurate information is provided in the CRF tables and in all relevant sections of the NIR in its next annual submission.

17. Luxembourg has not identified key categories for activities under Article 3, paragraph 3, of the Kyoto Protocol for 2010 in table NIR-3 and the NIR explains that afforestation and reforestation, and deforestation are non-key categories because the corresponding categories (land converted to forest land and land converted to settlements, respectively) are non-key categories in the reporting under the Convention in accordance with the IPCC good practice guidance for LULUCF.

[5] The secretariat identified, for each Party, the categories that are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC good practice guidance for LULUCF. Key categories according to the tier 1 trend assessment were also identified for Parties that provided a full set of CRF tables for the base year or period. Where the Party performed a key category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key category assessment conducted by the secretariat.

18. In the NIR, Luxembourg explained that the results of the key category analysis are used to prioritize the development and improvement of the inventory.

Uncertainties

19. The NIR states that IPCC tier 1 and tier 2 uncertainty analyses have been performed, and the results of the tier 1 analysis are presented, both at a summary level and at the individual category level. However, the referenced annex 7 with the tier 2 analysis results was not included in the NIR. In response to a question raised by the ERT during the review, Luxembourg provided the ERT with a study on the uncertainty of the inventory. This study contains information on the tier 2 uncertainty based on the 2011 annual submission. Thus, in the current submission the tier 1 uncertainty analysis was conducted for the 2012 annual submission data for key categories only, and the tier 2 analysis has not been updated and covers the 2011 annual submission data for all categories. The ERT commends the Party for its improvements to the uncertainty assessment. However, the ERT recommends that Luxembourg improve its uncertainty analysis by covering all inventory categories and reporting on all performed analyses with the latest inventory data in the next NIR.

20. Uncertainties for the KP-LULUCF sector have not been assessed in the 2012 annual submission; this is planned for the annual submission in 2013 or 2014. The ERT reiterates the recommendation of the previous review report that Luxembourg perform an uncertainty analysis of the emissions and removals from afforestation, reforestation and deforestation activities in the next annual submission.

21. According to the NIR, the results of the tier 1 analysis show overall uncertainty (excluding LULUCF) of 2.5 per cent and a trend uncertainty of 0.9 per cent. The results including LULUCF indicate an overall uncertainty of 3.5 per cent and an uncertainty of 3.1 per cent for the trend. The uncertainty analysis is used by Luxembourg as a criterion for the prioritization of inventory improvements.

Recalculations and time-series consistency

22. Recalculations have been performed and reported in accordance with the IPCC good practice guidance. The ERT noted that recalculations reported by the Party of the years 1990–2009 have been undertaken mainly to take into account revised AD (e.g. revised energy balance in the energy sector and revised population data for the solvent and other product use and the waste sectors, revised crop production data and new estimates of sewage sludge use, and the inclusion of ostriches in the agriculture sector) and to correct identified errors (e.g. double counting of one type of installation for estimating SF_6 emissions). The recalculations do not affect the industrial processes sector (except for fluorinated gases (F-gases)) and the LULUCF sector. The magnitude of the impact of the recalculations for 1990 was an increase by 0.2 per cent in CO_2 eq emissions excluding LULUCF and a decrease by 1.4 per cent in 2009. The rationale for these recalculations are generally provided in the NIR (at category-specific and summary level) and in CRF table 8(b). However, the ERT recommends that the Party expand the recalculation section to include values recalculated and the impact of the change on the emissions of the sector in the next annual submission. Sector-specific information on recalculations is provided in the sectoral sections of this report.

Verification and quality assurance/quality control approaches

23. Luxembourg has a quality management system that is in line with the IPCC good practice guidance. The system and its components are transparently described in the NIR. However, the ERT noted that in the NIR (section 1.6.6.1) the QC procedures seem to be the same as reported in the previous NIR, despite the recommendation of the previous review report that Luxembourg develop QC checklists for cross-cutting issues such as: the

compilation of the CRF tables and the NIR; the key category analysis and the uncertainty analysis. In response to a question raised by the ERT, Luxembourg stated that after the implementation of the MESAP database system (see para. 15 above) the consistent compilation of the CRF and NIR will be ensured and the key category analysis will be automated. The Party also stated that the cooperation between sector experts has been optimized through QA/QC training. The ERT welcomes the planned and implemented improvements and encourages the Party to further improve the QC procedures of its annual submission and describe them in the next annual submission.

24. During the review, the Party provided the QA/QC and improvement plan for 2012. The ERT noted that the deadlines for the improvements planned (especially those as a result of the 2011 review report) had been left blank and there is no indication of which issues are prioritized, based on what criteria or a remark on the level of difficulty for implementation of the recommendation. The ERT recommends that Luxembourg include clear priorities in the improvement plan list, elaborate on the level of difficulty for implementing the planned improvements and include a timeline for their implementation.

25. The ERT noted that the NIR submitted on 11 May includes many comments and highlights implying that the report was not final, which was confirmed by the Party in response to a question raised by the ERT. In addition, the ERT detected various inconsistencies in the NIR information (e.g. references to nonexistent tables (e.g. table 3-28)). The ERT recommends that Luxembourg carry out the necessary QA/QC procedures in addition to submitting the annual submission in a timely manner.

Transparency

26. The information provided by Luxembourg in its NIR follows the structure contained in the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines) and the annotated outline of the NIR. However, the ERT noted that some of the information at the category level is not detailed enough (e.g. on uncertainty, QA/QC), not updated (numerous tables) or missing (e.g. information on the energy balance). The ERT recommends that Luxembourg continue to improve the transparency of its inventory, including the elements as suggested in the sector-specific sections of this report.

Inventory management

27. Luxembourg has a centralized archiving system, which includes the archiving of disaggregated EFs and AD, and documentation on how these factors and data have been generated and aggregated for the preparation of the inventory. The archived information also includes internal documentation on QA/QC procedures, external and internal reviews, and documentation on annual key categories and key category identification and planned inventory improvements. Luxembourg archives all inventory information in a single web-based system called CIRCALUX, which is regularly backed up. All staff members have access to the CIRCALUX system and staff awareness about this communication and archiving tool is periodically refreshed, mostly during QA/QC audits.

3. Follow-up to previous reviews

28. The ERT notes that, despite the limited resources of the inventory team, Luxembourg has demonstrated its responsiveness to the recommendations of the previous review report and has been able to make a number of changes over the past year, which have improved the transparency, accuracy, completeness and timeliness of its reporting. The ERT commends Luxembourg for these improvements. However, there is a list of recommendations from previous review report that are reiterated above or in the sector-

specific sections below. The ERT recommends that Luxembourg address pending recommendations from previous review reports, taking into account the priority and feasibility of their implementation. The ERT considers that the Party's reporting on the improvements made since the previous annual submission is not sufficiently transparent, as it is not always clear which recommendations have been implemented and which have not. The ERT encourages Luxembourg to provide a table in the NIR demonstrating how the recommendations from the previous review reports have been addressed in the annual submission and information on how Luxembourg intends to address the recommendations that have not yet been implemented (including prioritization of planned improvements with a clear time line for their implementation).

4. Areas for further improvement identified by the expert review team

29. During the review, the ERT identified several issues for improvement. These are listed in table 6 below.

30. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report and in table 6 below.

B. Energy

1. Sector overview

31. The energy sector is the main sector in the GHG inventory of Luxembourg. In 2010, emissions from the energy sector amounted to 10,652.19 Gg CO_2 eq, or 88.2 per cent of total GHG emissions. Since 1990, emissions have increased by 2.7 per cent. The fastest growing categories were energy industries (due to the operational start of the Twinerg gas turbine in 2001) and transportation, which grew by 3,473.6 and 137.8 per cent respectively between 1990 and 2010 (1.9 and 6.4 per cent increase from 2009 to 2010). As a result, the corresponding share of energy industries in the total energy-related GHG emissions has risen from 0.3 to 11.9 per cent and of transport from 25.6 per cent to 59.1 per cent. For the other categories, the shares of their emissions are 13.1 per cent for manufacturing industries and construction (with a 77.8 per cent decrease between 1990 and 2010), 15.4 per cent for other sectors and 0.4 per cent for fugitive emissions.

32. The Party has made recalculations for the energy sector between the 2011 and 2012 submissions in response to the 2011 annual review report, following changes in AD and in order to rectify identified errors. The impact of these recalculations on the energy sector is an increase in emissions of 0.2 per cent in the base year and a decrease in emissions of 1.7 per cent for 2009. The main recalculations in 2009 took place in the following categories:

(a) Other sectors – a decrease of 11.6 per cent (213.97 Gg) due to revised AD;

(b) Transport – a decrease of 2.7 per cent (166.97 Gg CO_2 eq) due to updated AD;

(c) Manufacturing industries and construction – an increase of 10.5 per cent (121.16 Gg CO_2 eq) due to revised AD, correction of errors and the use of a category-specific EF for diesel oil.

33. The recalculations are performed for the entire time series and these are well documented in the NIR and CRF table 8(b). However, the ERT recommends that the Party expand the recalculation section to include values recalculated and the impact of the change on the emissions in the next annual submission.

34. The sector is complete in terms of gases, years and geographical coverage. Luxembourg has reported all categories and all fuels. A minor omission linked to the

portion of lubricants combusted was detected (see para. 44 below). In addition, the ERT noted that there are no fugitive emissions from oil reported by the Party. Given that liquid fuels are the main fuels in the fuel mix reported by the Party, the ERT encourages the Party to investigate the occurrence of fugitive emissions from the distribution of oil products in its next annual submission using, for example, data from neighbouring Parties, as planned by the Party.

35. Methodologies, uncertainty analysis, recalculations and planned improvements are reported transparently for this sector. However, the ERT noted that many of the sections of the NIR had not been updated since the previous annual submission, which hinders the transparency of the reporting for the last inventory year. In addition, the ERT noted that NIR table 3-28 – "Emission factors for IPCC Sub-category 1A2a – Iron and Steel" is missing from the NIR. The ERT recommends that Luxembourg increase the QC before submitting the annual submission and include and update all relevant tables in the next NIR. The previous review report had reiterated the recommendation that the Party include all the references and detailed justification for the EFs used. In response to a question raised by the ERT, Luxembourg explained that it was not in a position to implement this recommendation in its 2012 annual submission due to staff and time limitations. The ERT reiterates the recommendation that the Party include all the references and detailed justification for the EFs, to be implemented for the next annual submission as planned by the Party.

36. The ERT noted that Luxembourg has implemented most of the recommendations in the previous review reports regarding the correction of detected errors. However, the ERT noted that there are other issues still pending, such as the possible double counting of emissions from leisure boats reported under navigation and the collection of country-specific data for estimating CH_4 emissions from natural gas distribution. The ERT reiterates these recommendations. Other major pending recommendations are reiterated in the category-specific paragraphs, below.

2. Reference and sectoral approaches

Comparison of the reference approach with the sectoral approach and international statistics

37. Estimates of CO_2 emissions from fuel combustion have been calculated using the reference approach and the sectoral approach. For 2010, the CO_2 emissions estimated using the reference approach were 2.95 per cent higher than the emissions estimated using the sectoral approach. The ERT noted that the emissions estimated with the sectoral approach are continuously lower than those estimated with the reference approach, with the difference reaching 3.8 per cent (in 1998). Some explanations are provided in the documentation box of CRF table 1.A(c), which are insufficient to explain the difference. In addition, the ERT noted that not all explanations in the documentation box have been updated since the 2011 annual submission and recommends that the Party update these explanations for the next annual submission.

38. The ERT noticed that the discrepancies in terms of the reported fuel consumption data and emissions between the reference and the sectoral approaches are the highest for other fuels and solid fuels. Thus, for example, although there is a close match in the fuel consumption between the approaches, the emissions from the solid fuels in the reference approach are 22.9 per cent higher. The ERT noted that in CRF table 1.A(d) there is information for non-energy use of solid fuels, but the carbon stored from that table is not subtracted from the reference approach, which would have changed the difference between the approaches. The ERT recommends that Luxembourg consistently report the information between CRF table 1.A(b) and 1.A(d) in the next annual submission. The ERT further encourages the Party to proceed with its plan for improvements and the inclusion of a quantitative estimate of each separate discrepancy between the approaches. The ERT

recommends Luxembourg to include thorough explanations for the difference between the approaches in its next annual submission.

39. The ERT noted that the per cent difference between the two approaches for 2010 had not been included in the NIR and the explanations and tables provided in the NIR had not changed from the previous annual submission. During the review week, Luxembourg provided updated tables 3.7 and 3.8 with corrected data for the comparison between the approaches. The ERT recommends that the Party improve the QA/QC checks before the submission of the next NIR and make sure that all year-specific information is updated.

International bunker fuels

40. The NIR explained that, based on a communication with an expert from the sole aviation fuel reseller (Luxfuel) and communications with the aviation authorities, 10 per cent of aviation gasoline is assumed to be used in international flights. Consequently, all kerosene sales and 10 per cent of the aviation gasoline sales and their related emissions were allocated to international bunkers. The ERT noted that the data reported by the national statistics supplied to the International Energy Agency (IEA) on jet kerosene are different from the data obtained from the fuel supplier. The ERT recommends that the Party recheck the assumption for the aviation fuel used for international bunkers and address the inconsistency with IEA figures for jet kerosene in its next annual submission.

41. A small discrepancy is detected for the marine bunkers, for which fuel consumption was reported as nil to the IEA, while gas/diesel oil is reported in the CRF table 1.C (omitted in table 1.A(b)). In response to the previous review stages, the Party proved the national data to be more accurate. The Party explained that, in the IEA/Eurostat joint questionnaire data precision is limited (no digit), hence some variables reported as not occurring ("NO") (since they correspond to 0 kt according to the database) are perhaps not 'real' 0 but rather are values smaller than 0.5. The ERT encourages Luxembourg to continue to use valid national data in the national inventory and to ensure that data are also used in table 1.A(b) to improve consistency between the reference and the sectoral approaches.

Feedstocks and non-energy use of fuels

42. The ERT noted that in the 2011 annual submission Luxembourg reported the fraction of carbon stored from lubricants as 50 per cent and indicated that the emissions from motor oil are reported under road transportation. However, in the 2012 annual submission, Luxembourg reports the fraction of carbon stored as having a value of 1, and under planned improvements reports that CO_2 emissions from lubricant oils are used in road transportation and 50 per cent of carbon should be considered as being emitted under this category. In response to the list of potential problems and further questions raised by the ERT during the review week, Luxembourg provided revised estimates using the default fraction of carbon stored for lubricants from the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) for the entire time series and reported associated emissions under road transportation (see para. 45 below). The ERT welcomes this improvement and recommends that Luxembourg reflect these changes in the NIR of its next annual submission.

3. Key categories

Stationary combustion: solid fuels – CO_2

43. The CO_2 implied emission factor (IEF) for solid fuels for manufacturing industries and construction shows large fluctuations across the time series. It had high values at the beginning of the period (158.13–190.87 t/TJ) followed by a decrease of 40.1 per cent between 1997 and1998 and comparatively stable values thereafter (around 94.80 t/TJ). The

NIR makes reference to table 3.28 with regard to the evolution of IEFs across the time series but the referenced table 3.28 is not provided in the NIR. The ERT recommends that the Party check the variation of the IEF across the time series to ensure that time-series consistency is maintained and provide relevant trend information to improve transparency in the next annual submission.

4. Non-key categories

Stationary combustion: biomass – CO_2, CH_4 and N_2O

44. The CO_2 IEF for biomass for manufacturing industries and construction was constant (88 t/TJ) between 1998 between 2001 and, after a minor increase between 2001 and 2004 (from 88 t/TJ to 91.86 t/TJ), increased by 17.0 per cent between 2004 and 2005 (107.48 t/TJ). The IEF for CH_4 and N_2O remained constant over the 1998–2010 period. In response to the previous review stage, the Party clarified this with the use of different types of biomass over the time series. The ERT recommends that the Party include further clarification of biomass use and the actual EFs used, in order to clarify the time-series consistency in its next annual submission. In addition, the ERT noted that the discussion in the previous review report on the biomass in the tyres consumed for clinker production and the relevant assumption substantiated during the in-country review, were not reflected in the NIR. The ERT recommends that the Party provide the assumption used and its justification in the next NIR.

Road transportation: liquid fuels – CO_2 and N_2O

45. In response to the list of potential problems and further questions raised by the ERT during the review week (see para. 42 above), the Party provided revised CO_2 emission for road transportation including the emissions from lubricants for the whole time series. The recalculations resulted in an increase in CO_2 emissions from road transportation by 0.1 per cent for 2010 (5.50 Gg). The ERT concluded that the potential problem had been resolved by the Party.

46. There are still large inter-annual fluctuations for the N_2O IEF for gasoline (ranging from –22.8 to +32.2 per cent) without clear trend information being provided in the NIR. In response to a question raised by the ERT during the review, Luxembourg clarified that a study on road transportation emissions has been conducted and that the Party is considering how best to implement the findings of this study in the next annual submission. The ERT commends the Party for carrying out this study and reiterates the recommendation from the previous review report that Luxembourg incorporate relevant findings from the study in the next annual submission.

Railways: liquid fuels – CO_2, CH_4 and N_2O

47. The previous review reports noted a sharp increase in both energy consumption and emissions between 2007 and 2008 and onwards. In response to a question raised by the previous ERT, the Party mentioned in the NIR that the data for 2007/08 need to be treated as provisional until the Party completes an assessment of the reasons for this trend with the national railways company. The ERT noted that the trend has been revised in the current annual submission due to revised AD from the operator. The ERT welcomes this improvement and recommends that Luxembourg update the NIR and include further explanation on the emission trend in the next annual submission.

Stationary combustion: solid fuel – CH_4

48. Luxembourg uses a constant IEF for CH_4 (10 kg/TJ) for solid fuel consumption in the subcategory residential. The IEF is one of the lowest used by the Parties (range: 0.44–443.28 kg/TJ) and below the IPCC default (300 kg/TJ). The ERT considers that the use of an unjustified low CH_4 EF could lead to an underestimation of the emissions from the

subcategory residential in the 2012 annual submission and therefore recommended that the Party reconsider the CH_4 EF with a view to justifying it or revising the CH_4 emissions from solid fuel combustion in the subcategory residential for the whole time series. In response to the list of potential problems and further questions raised by the ERT during the review week, Luxembourg explained that it erroneously applied the CH_4 EF for fossil solid fuels from industrial combustion installations to the subcategory residential. This mistake was corrected in the revised information submitted on 12 November 2012 by applying the default EF (300 kg CH_4/TJ) from the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines) (Vol. 2, Chap. 2, table 2.5, p. 2.22), which is identical to the default EF in the Revised 1996 IPCC Guidelines. The correction has been applied over the entire time series, which had a minor impact on the national total (less than 0.01 per cent).

C. Industrial processes and solvent and other product use

1. Sector overview

49. In 2010, emissions from the industrial processes sector amounted to 660.24 Gg CO_2 eq, or 5.5 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 14.34 Gg CO_2 eq, or 0.1 per cent of total GHG emissions. Since 1990, emissions have decreased by 59.3 per cent in the industrial processes sector, and decreased by 40.0 per cent in the solvent and other product use sector. The key drivers for the fall in emissions in the industrial processes sector are the change in the production process of steel from blast furnaces to electric arc furnaces between 1994 and 1998 and the economic crisis in recent years. Nevertheless, Luxembourg reports that emissions from the industrial processes sector increased by 2.9 per cent in 2010 compared with 2009, which is mainly the result of the recovery from the economic crisis. Within the industrial processes sector, 68.5 per cent of the emissions were from mineral products, followed by 20.2 per cent from metal production and 11.2 per cent from consumption of halocarbons and SF_6.

50. The Party has made recalculations for the industrial processes sector between the 2011 and 2012 submissions affecting emissions of HFCs and SF_6 from consumption of halocarbons and SF_6. The rational for the recalculations is reported as the correction of an error (double counting of one installation) under the subcategory electrical equipment for SF_6 and the provision of detailed data for HFCs. The impact of these recalculations on the sector is a decrease in emissions of 0.1 per cent for 2009. The recalculations are mentioned in CRF table 8(b) and in the NIR. However, the ERT noted that while NIR table 10-1 indicates 100 per cent recalculation difference for PFC emissions between the annual submissions in 2011 and 2012 for 2009, there is no difference reported in CRF table 8(a). The ERT recommends that Luxembourg ensure consistency of reported information on the recalculations between the NIR and the CRF tables and recommends that Luxembourg expand the recalculation information at the category level in its next annual submission.

51. The Party has made recalculations for the solvent and other product use sector between the 2011 and 2012 submissions following changes in AD. The impact of these recalculations on the solvent and other product use sector is an increase in emissions of 0.6 per cent for 2009. The main recalculations took place in the category use of N_2O for anaesthesia.

52. The reporting of the industrial processes sector is generally complete, except for the potential emissions from consumption of halocarbons and SF_6. According to the previous review report, Luxembourg was planning to report potential F-gas emissions in this year's annual submission. However, the ERT noted that the plan has not been implemented in the 2012 annual submission. The ERT encourages Luxembourg to proceed with the implementation of this plan in order to enhance the completeness of its inventory.

53. The ERT noted some improvements in the transparency of the reporting of F-gas emissions, particularly including some information in CRF table 2(II).F. However, the table is still not complete and provides no details on all the emissions reported under the category consumption of halocarbons and SF_6 in CRF table 2(II). Thus CRF tables 2(I) and 2(II) report emissions from refrigeration and air-conditioning equipment and noise-reduction windows, while table 2(II).F provides no background data on the estimation of these emissions. The ERT recommends that Luxembourg improve the consistency of its reporting in the next annual submission. The ERT further noted that the previous review report recommended that Luxembourg provide relevant explanations on the emissions of HFCs and SF_6 that are assumed to be constant for the period 1990–1995 (HFC emissions from foam blowing, and SF_6 emissions from electrical equipment). The ERT reiterates the recommendation of the previous review report that Luxembourg provide a description of the trend in the NIR and maintain time-series consistency of these categories in accordance with the IPCC good practice guidance.

54. Luxembourg has used AD from neighbouring countries for the categories consumption of halocarbon and SF_6 (transport refrigeration, foam blowing and aerosol/metered dose inhalers – from Belgium and Germany) and solvent and other product use. The ERT reiterates the recommendation of the previous review reports that the Party make more efforts to collect and use country-specific data in the calculation of emissions to improve the accuracy of its annual submissions.

55. Uncertainty values for AD and EFs have been provided in the NIR for most categories. The Party has used the default uncertainty values provided in the IPCC good practice guidance. Since there is no detailed discussion and no uncertainty values provided for the F-gases, the ERT recommends that Luxembourg include uncertainly estimates and documentation for F-gases in the NIR of its next annual submission.

56. The ERT noted that category-specific QC procedures have been reported for several categories, such as a comparison of the AD provided by the plants for the GHG inventory, the data for the EU Emissions Trading System (EU ETS) and national statistics. The ERT recommends that Luxembourg include further information and evidence on the conducted QA/QC procedures in the next NIR.

57. Luxembourg has addressed some of the recommendations of the previous review report, such as improving the transparency of how the EF for glass production was estimated, improved information for iron and steel production, and for F-gases. However, there are some pending recommendations such as the need to provide further information on the use of soda ash in the country. The ERT reiterates this recommendation, as well as some of the other recommendations for the sector discussed in the category-specific sections below.

2. Key categories

Iron and steel production – CO_2

58. During the review week, the ERT noted that Luxembourg applied different methodologies for different time spans for this category. For electric arc furnace steel production the 2007 EU ETS guidelines[6] are used to estimate emissions for 2004–2010 and a simplified country-specific methodology is used for the years 1990 to 2003. For the

[6] 2007/589/EC: Commission Decision of 18 July 2007 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

PRIMUS process, the 2004 EU ETS guidelines[7] are used for 2005–2009 (the process was shut down in 2009), whereas the emissions for 2003 to 2004 are estimated based on the relative carbon consumption and the average ratio of the CO_2 emission per carbon consumption for the years 2005–2008. The CO_2 IEF for the category has decreased from 280.90 kg CO_2/t steel in 1990 to 50.73 kg CO_2/t steel in 2010. The 2010 value is well below the 2009 value (60.69 kg CO_2/t steel in CRF table 2(I).A-G and 53.56 kg CO_2/t steel in table 4.11 of the NIR). The ERT reiterates the recommendation of the previous review report that Luxembourg make a plan to improve time-series consistency and include a carbon mass balance for the entire time series. In addition, the ERT recommends that Luxembourg include an explanation of the variations of the IEF over the time series, include more information on the country-specific methodologies and how the time-series consistency is maintained in order to increase transparency in the NIR of its next annual submission. The ERT further recommends that Luxembourg ensure consistent reporting of the information on the IEF between the CRF tables and the NIR in the next annual submission.

Consumption of halocarbons and SF_6 – HFCs, PFCs and SF_6

59. The ERT noted the efforts made by Luxembourg to increase the transparency of the reporting within the category, namely the disaggregated reporting of the emissions in the CRF tables and the inclusion of more information on the methodology and the main assumptions used in the estimates in the NIR. However, the ERT concluded that the transparency could be further improved and recommends that some of the background information used in the calculations is actually included in the NIR (e.g. annual population data and per capita emissions of Germany for transport refrigeration or of Belgium for foam blowing).

60. Although Luxembourg reports actual emissions of PFCs from refrigeration and air-conditioning equipment in the CRF tables, the potential emissions from this sub-category and the total potential emissions of PFCs are reported as "NO". The ERT recommends that Luxembourg reconsider the notation key and replace it with a relevant estimate or use the notation key "not estimated' ("NE") in its next annual submission.

3. Non-key categories

Solvent and other product use – CO_2, and N_2O

61. Luxembourg estimates CO_2 emissions from this category based on national data (import-export statistics and production statistics) and EFs and estimation model from Austria. The ERT reiterates the encouragement of the previous review report that Luxembourg make efforts to collect country-specific data to estimate these emissions.

62. N_2O emissions from anaesthesia are estimated for the period 1990–2002 by combining emissions data from Germany with the relative population in Luxembourg. For the period 2003–2010, emissions are estimated from country-specific data collected from hospitals in Luxembourg. The ERT reiterates the recommendation of the previous review report that Luxembourg ensure time-series consistency by recalculating the emissions for the period 1990–2002, either by obtaining and using country-specific data or by using data-splicing techniques in the IPCC good practice guidance to recalculate the AD for the period 1990–2002.

[7] 2004/156/EC: Commission Decision of 29 January 2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

D. Agriculture

1. Sector overview

63. In 2010, emissions from the agriculture sector amounted to 690.25 Gg CO_2 eq, or 5.7 per cent of total GHG emissions. Since 1990, emissions have decreased by 7.5 per cent. The key drivers for the fall in emissions are the decrease in dairy cattle numbers due to the Common Agriculture Policy of the EU, a decline in the application of synthetic fertilizer and the reduction of emissions from nitrogen leaching and run-off. Within the sector, 45.8 per cent of the emissions were from agricultural soils, followed by 36.4 per cent from enteric fermentation and 17.8 per cent from manure management. CH_4 accounted for 50.5 per cent of the GHG emissions from the sector and the remaining 49.5 per cent were from N_2O.

64. The Party has made recalculations for the agriculture sector between the 2011 and 2012 submissions in response to the 2011 annual review report, due to the inclusion of ostriches and following changes in AD. The impact of these recalculations on the agriculture sector is an increase in emissions of 1.2 per cent for 2009. The main recalculations took place in the category agricultural soils (increase of 2.6 per cent) due to revised crop production data and revised AD for sewage sludge use. The recalculations cover the period from 2003 to 2009 and only in 2009 are above 1 Gg CO_2 eq. They are well documented in CRF tables 8(a) and 8(b) but insufficiently documented in the NIR. The ERT commends the Party for having reported in the NIR, in response to the recommendation in the previous review report, the rationale of the recalculations and their impacts by category. However, the impact of the recalculations on the agriculture sector is not reported in the NIR. The ERT therefore reiterates the recommendation from the previous review report that, in the next annual submission, Luxembourg report the impact of the recalculations on the whole agriculture sector, however minor that impact might be.

65. The inventory is complete in terms of categories and gases; emission estimates have been provided for all years of the time series. Emissions from the categories prescribed burning of savannas, rice cultivation and field burning of agricultural residues do not occur in the country. The ERT commends the Party for including emissions from ostriches by using the CH_4 IEF from Norway in response to the encouragement in the previous review report.

66. In general, Luxembourg's NIR is transparent in terms of reporting of methods, data and emissions. Some minor transparency issues are noted (e.g. the use of ample footnotes in the NIR to explain the assumptions used and to provide a definition of each classification, as well as references for the information sources that do not always facilitate the readers' understanding of the estimation methodology), as indicated in the previous review report. The ERT recommends that the Party continue to improve the transparency of its reporting of the sector by including the relevant information from the footnotes in the actual text of the NIR of the next annual submission.

67. Uncertainties are estimated by Luxembourg but the underlying background information used to estimate them is not sufficiently detailed. The ERT recommends that, in the next annual submission, Luxembourg improve the transparency of the reporting of the uncertainties estimation by providing sufficient background information.

68. Luxembourg implemented some QA/QC activities that are described in the NIR. However, some minor consistency issues within the NIR and CRF tables were detected by the ERT, for example: on page 317 (table 6.20) of the NIR it is written 4B1 – Cattle – Mature Dairy Cattle instead of 4B1 – Cattle – Young Cattle; Luxembourg reported that CH_4 emissions increased by 24.1 per cent in section 6.1.1 of the NIR, but figure 6.1 presents an increase of 22.1 per cent; and the value reported for nitrogen excretion for

pasture range and paddock differs between CRF table 4.B(b) and table 4.D. The ERT recommends that, in the next annual submission, Luxembourg improve its QC activities to ensure the consistency of the reporting within and between the NIR and the CRF tables.

69. Most of the recommendations from the 2011 review report were not implemented, but Luxembourg included them as planned improvements, together with any pending issues from previous review reports. In response to a question raised by the ERT during the review, the Party stated that the implementation of the previous review reports' recommendations depends on data and time availability, given the lower priority of the sector due to its relative significance in the overall national emissions. The ERT recommends that Luxembourg address the pending recommendations from previous review reports, and include information in the next NIR on the previous recommendations that have been implemented and the prioritization of planned improvements (based on previous recommendations) with a clear time line for their implementation.

2. Key categories

Enteric fermentation – CH_4

70. Luxembourg used the IPCC tier 1 method to estimate CH_4 emissions from enteric fermentation for all livestock except cattle, for which a tier 2 method is used. This is in line with the IPCC good practice guidance.

71. The ERT noted that the IEF of mature non-dairy cattle continues to be constant for the entire time series (55.2 kg CH_4/head/day) although it depends on weight changes. The ERT therefore reiterates the recommendation in the previous review report that, in the next annual submission, the Party revise the EFs to take into account weight changes in accordance with the IPCC good practice guidance.

72. The ERT noted that Luxembourg used equation 7 from the Revised 1996 IPCC Guidelines to estimate cattle live body weight for mature dairy and non-dairy cattle (tables 6.9 and 6.10 of the NIR) although in the Revised 1996 IPCC Guidelines this equation refers only to calves. In response to a question raised by the ERT during the review, the Party acknowledge the fact and was not able to justify that this equation can be used to estimate other cattle weight. The ERT recommends that, in the next annual submission, Luxembourg improve the accuracy of reported cattle live body weight.

73. The ERT noted an inconsistency between the livestock category labelled 4A1 – Cattle – Young Cattle – Growing Heifers (table 6.4 of the NIR) and the types of animal included in the same category. Luxembourg included male and female young cattle from 1-2 years in the category, while "heifers" refers only to female cattle. The ERT recommends that, in the next annual submission, Luxembourg change the label of the category to ensure consistency between the label and animal types included.

Manure management – CH_4

74. Luxembourg used a tier 2 method to estimate CH_4 emissions from cattle and a tier 1 method to estimate CH_4 emissions from all other livestock. The ERT noted that previous review reports have recommended that Luxembourg develop and apply higher-tier methods for the estimation of CH_4 emissions from swine, which are significant animals for this category. In response to a question raised by the ERT, Luxembourg stated that it plans to implement this recommendation in the next annual submission because most of the background data and parameters needed for implementing tier 2 method have now been collected. The ERT commends the Party for this planned improvement and reiterates the recommendation in the previous review report that the Party implement the higher-tier method for the next annual submission.

75. The ERT noted a lack of the transparency regarding the reporting of the method used to estimate the nitrogen excretion from cervidae species. Luxembourg reported in the NIR (table 6.25) that the method used is based on the IPCC good practice guidance (pp. 4.20 and 4.21). The ERT recommends that, in the next annual submission, Luxembourg improve the transparency of its reporting of the method used to estimate nitrogen excretion from these species by better clarifying the way the IPCC good practice guidance is applied.

Agricultural soils – N_2O

76. Luxembourg combined the tier 1, tier 1a and tier 1b methods with the IPCC default EF to estimate N_2O emissions from agricultural soils. As this category is identified as a key category, the ERT reiterates the encouragement of the previous review report that, in the next annual submission, Luxembourg develop and apply country-specific EFs to this category.

77. In CRF table 4.D, the Party reports that the value of fraction of livestock N excreted and deposited onto soil during grazing ($Frac_{GRAZ}$) is 0.45, but the ERT noted that the background information underlying this parameter value is not available in the NIR. The ERT recommends that, in the next annual submission, Luxembourg improve the transparency of its reporting in the NIR by providing the background information used to estimate $Frac_{GRAZ.}$

78. The fertilizer values for the estimation of N_2O direct soil emissions are not available for 2009 and 2010 and the Party used provisional data. The ERT reiterates the recommendation in the previous review report that, in the next annual submission, the Party recalculate the emissions once the 2009 and 2010 values are available. The ERT encourages Luxembourg to make efforts to ensure the timely provision of the AD needed for the sectoral emission estimates and enhance the coordination between data collection and handling institutions as the continued use of proxy data affects the accuracy of the inventory estimates.

E. Land use, land-use change and forestry

1. Sector overview

79. In 2010, net removals from the LULUCF sector amounted to 295.37 Gg CO_2 eq. Since 1990, the sector has changed from a net source (net emissions of 347.75 Gg CO_2 eq in 1990) to a net sink. The key driver for the rise in removals is the net carbon stock change occurring in living biomass in forest land. In 2010, removals of 397.51 Gg were from forest land remaining forest land and 72.66 Gg from land converted to forest land. All other categories resulted in net CO_2 emissions: 108.22 Gg from land converted to settlements; 29.05 Gg from land converted to grassland; 6.61 Gg from cropland remaining cropland; and 18.17 Gg from land converted to cropland. Land converted to wetlands accounted for 9.73 Gg and land converted to other land accounted for 0.44 Gg of emissions. There were 2.57 Gg CO_2 eq of N_2O emissions reported for the sector.

80. The Party has made no recalculations for the LULUCF sector between the 2011 and 2012 submissions.

81. Luxembourg's LULUCF sector reporting is complete for the mandatory categories. The following non-mandatory emissions are reported as "NE": CO_2 emissions from wetlands remaining wetlands; CO_2, CH_4 and N_2O emissions from settlements remaining settlements; CH_4 and N_2O emissions from land converted to settlements; and CO_2 emissions from harvested wood products.

82. The information provided for the LULUCF sector is generally transparent. In the 2012 annual submission, Luxembourg has provided additional information on the data

source for the losses in the living biomass pool in forest land remaining forest land in 2010. The ERT commends the Party for this inclusion. In response to questions raised by the ERT during the review, Luxembourg provided additional information on the data source for the dead organic matter carbon stock changes in forest land converted to cropland, grassland, wetlands, settlements and other land and the method and assumptions used to obtain the "20-year areas" and annually converted areas for various land-use categories. The ERT recommends that the Party include this additional information supplied to the ERT in the next NIR. In addition, the ERT notes that there are still areas where the NIR lacks transparency and more information is required, including: the method for calculating living biomass carbon stock changes in settlements converted to forest land; the source of the soil carbon stock EFs used for land-use changes; the sector-specific QC checks employed for the LULUCF sector. The ERT recommends that Luxembourg improve the transparency of its inventory by including transparent information on all the above elements in the next annual submission.

83. Luxembourg uses the IPCC approach 3 for land area representation. In response to a recommendation in the 2011 review report, and in response to questions raised by the ERT during the current review, Luxembourg demonstrated that methods to ensure time-series consistency of land area information have been applied. The ERT commends Luxembourg for ensuring time-series consistency of land area information and recommends that Luxembourg include additional information on this issue in its next NIR to improve the transparency of the report.

84. During the review week Luxembourg advised the ERT that it has performed an uncertainty assessment for the LULUCF sector but the results had not been received in time to be included in chapter 7 (LULUCF) of the NIR, although they are reported in chapter 1.7. The ERT commends Luxembourg for performing the assessment and recommends that Luxembourg report the results of the uncertainty analysis for the LULUCF sector in the next annual submission.

85. Luxembourg has provided information on a few general QA/QC procedures performed as part of the overall QA/QC system of the GHG inventory. However, the sector-specific QC elements for the LULUCF sector are not clearly described in the NIR. The ERT therefore recommends that Luxembourg transparently describe the various sector-specific QC procedures for the LULUCF sector. In addition, the ERT detected small differences in the land use net emissions/removals reported in NIR tables 7-1 and 7-12 compared with those reported in the CRF tables. The ERT recommends that the Party improve its QC to ensure consistency of the data reported.

86. Luxembourg has provided a list of planned improvements in the 2012 NIR. In response to questions raised by the ERT during the review regarding progress, the Party explained that one of the planned improvements, the tier 1 and 2 uncertainty analysis, has been completed. The pending improvements are:

(a) To investigate whether the level of sealing of settlement areas, which is currently based on expert judgement, could be updated using data from the European Urban Atlas project;

(b) A study to analyse the carbon in dead organic matter and soil carbon pools, based on soil samples from the first national forest inventory. This study could be made in 2014 at the earliest;

(c) To report in the 2013 annual submission the carbon stock change in dead wood for land converted to forest land.

87. The ERT encourages Luxembourg to continue to work on these improvements. The ERT commends Luxembourg for progress in the implementation of recommendations from

previous review reports, namely: the implementation of the uncertainty analysis; the correction of the value reported of the carbon/nitrogen ratio used in the estimating N_2O emissions from disturbance associated with land-use conversion to cropland; and the milestone achievement of the completion of the second national forest inventory (NFI). The ERT looks forward to the progress in relation to previous recommendations which will be possible once the data are validated and analyses carried out. Recommendations from previous review reports that have not been addressed are reiterated in this report.

2. Key categories

Forest land remaining forest land – CO_2

88. Forest land remaining forest land is the most significant category in the LULUCF sector. During the previous review, Luxembourg informed the ERT that the results of the second NFI would be available in 2012 and that there were plans to recalculate the emission/removal estimates based on those results. In response to a question raised by the ERT during the review requesting a progress update, Luxembourg informed the ERT that some delays have been observed. The results of the second NFI have been compiled, but have not yet been officially validated. Officially validated results will become available in the summer/autumn of 2013. At that stage, they will be integrated in the inventory and recalculations done for the 2014 annual submission. The ERT therefore reiterates the recommendations of the previous review reports that Luxembourg use the results from the NFI as soon as possible to recalculate the emission/removal estimates and AD from forest land remaining forest land.

89. Luxembourg uses a combination of tier 1 and tier 2 methods to estimate emissions and removals from forest land remaining forest land by using some country-specific parameters together with IPCC defaults and tier 1 default assumptions. The previous review report recommended that Luxembourg collect data on the changes in the dead organic matter and soil carbon pools and report thereon in the next annual submission in order to improve the accuracy of the estimates for which currently Luxembourg reports zero values ("NO"). The 2012 NIR itemises this as a planned improvement. In response to a question raised by the ERT on progress in this regard, Luxembourg stated that a study to analyse the carbon in dead organic matter and soil carbon pools will be conducted in 2014 at the earliest. The ERT recommends that the Party prioritize this work (see also para. 111 below).

Land converted to forest land – CO_2

90. Land converted to forest land in Luxembourg became a key category in 2010. In 2010, the area of land converted to forest land in Luxembourg was around 8.7 per cent of the total forest land area. The largest contribution to the conversion is from grassland (50 per cent).

91. Luxembourg uses a combination of tier 1 and tier 2 methods to estimate emissions and removals from land converted to forest land using some country-specific parameters together with IPCC defaults and tier 1 default assumptions. The NIR explains how the change of carbon stock in the biomass of cropland and grassland conversions is carried out. The CRF tables report gains and losses for settlement conversions but the NIR does not explain how this is calculated. The change of soil carbon stocks for lands converted to forest land are reported, and EFs are provided but the source of these EFs is not provided. The ERT recommends that Luxembourg provide the method for calculating living biomass carbon stock changes in settlements converted to forest land and the source of the soil organic carbon stock EFs (e.g. the scientific paper or report from which the values are taken) in the next annual submission.

92. Luxembourg reports the carbon stock changes in dead wood for land converted to forest land as "NO". There is no information in chapter 7 of the NIR to explain why this is reported as "NO". However, the Party has reported in the KP-LULUCF section of the NIR that for afforestation and reforestation areas (based on areas of land converted to forest land) changes in the stock of dead wood are assumed not to occur due to the lack of dead wood in young forests and other land uses. The previous review report found this assumption reasonable and recommended that Luxembourg substantiate this assumption with appropriate evidence (e.g. studies or survey results) and provide a transparent description in the LULUCF section of the NIR. The ERT reiterates this recommendation.

F. Waste

1. Sector overview

93. In 2010, emissions from the waste sector amounted to 63.97 Gg CO_2 eq, or 0.5 per cent of total GHG emissions. Since the base year, emissions have decreased by 28.9 per cent. The key driver for the fall in emissions is the decrease in CH_4 emissions from solid waste disposal on land, due to: a decrease in the quantity of waste being landfilled, notably as a result of the development of recycling schemes and the expansion of the number and variety of waste categories collected by recycling centres; aerobic pretreatment before landfilling; and the installation of CH_4 recovery systems at waste disposal sites. Within the sector, 54.3 per cent of the emissions were from solid waste disposal on land, followed by 23.9 per cent from the category other (waste) and 21.8 per cent from wastewater treatment. CH_4 emissions from solid waste disposal on land decreased by 53.4 per cent between 1990 and 2010. CH_4 emissions from wastewater treatment decreased by 49.5 per cent between 1990 and 2010, but at the same time N_2O emissions from wastewater treatment increased by 17.4 per cent. Emissions from compost production, reported under other (waste), have been increasing since the start of large-scale composting in 1993.

94. The Party has made recalculations for the waste sector between the 2011 and 2012 submissions by revising AD in response to the 2011 annual review report. The impact of these recalculations on the waste sector is a decrease in emissions of 1.29 per cent for 2009. The recalculations took place in the category domestic and commercial wastewater treatment due to changes in AD (population data) after harmonization between Statistics Luxemburg and Eurostat data. This resulted in a slight decrease in CH_4 and N_2O emissions from wastewater treatment. Due to the recalculations, N_2O emissions decreased by 2.2 per cent and CH_4 emissions by 0.5 per cent in the year 2009. Recalculations were performed to the whole time series, 1990–2009, ensuring the time-series consistency and the rationale for the recalculations are provided in the NIR.

95. The waste sector is complete. The CRF tables include estimates of all gases and categories of emissions from the waste sector in accordance with the Revised 1996 IPCC Guidelines.

96. The information provided in the CRF tables on the waste sector is generally transparent; however some additional information, such as the share of aerobic and anaerobic treatment of sludge from domestic and commercial wastewater has not been provided in the CRF tables. The ERT recommends that Luxembourg provide this information in the next annual submission.

97. The estimates within the sector are generally well documented in the NIR. However, in the NIR (page 399) it is stated that "only uncategorized waste disposal on land is relevant for Luxemburg". This information conflicts with the information provided in the NIR (page 402) and in the CRF tables where the Party reports CH_4 emissions from managed solid

waste disposal sites. The ERT recommends that the Party check the consistency of the reporting in the next annual submission.

98. The ERT noted that uncertainty estimates have been reported for wastewater handling only. For other categories, uncertainty estimates are referred to in the general uncertainty chapter of the NIR. The ERT reiterates the recommendation of the previous review report that Luxemburg include a discussion on the uncertainty for each category in the waste sector in the next annual submission.

99. Luxemburg has conducted basic tier 1 QA/QC procedures for the waste sector. Category-specific QA/QC procedures have been implemented for wastewater handling only. Nevertheless, there are some discrepancies between data in the CRF tables and in the NIR. The ERT encourages Luxemburg to more strictly apply verification and QA/QC procedures and conduct category-specific QA/QC procedures for all waste categories in its next annual submission.

100. Luxemburg is planning category-specific improvement for domestic and commercial wastewater handling based on the new census of the AD for municipal wastewater treatment plants in the next annual submission. For other categories no category-specific planned improvements are reported.

101. The ERT commends the Party for its efforts to address the recommendations of the previous review report, namely: the updating of the notation keys use in the tables; the revision of the AD for population used in the sectoral estimates; and the inclusion of information on waste generation rate and the fraction of municipal solid waste disposed to solid waste disposal sites (SWDS).

2. Non-key categories

Solid waste disposal on land – CH_4[8]

102. The IPCC tier 2 first-order decay (FOD) model was used to estimate CH_4 emissions from solid waste disposal on land. Luxemburg uses different values for CH_4 generation rate constant (k) and degradable organic carbon for different waste types. All parameters except the methane correction factor (MCF) (0.1) for uncategorized waste disposal sites are default values from the 2006 IPCC Guidelines, which better reflect the Party's circumstances and uses more disaggregated AD than the Revised 1996 IPCC Guidelines.

103. For uncategorized waste disposal sites the Party used the MCF of 0.1. This low MCF value reflects the situation where all waste is pretreated before it is disposed on the SWDS. The NIR does not include information on how this MCF is calculated. During the review, the Party explained that the 0.1 value is also endorsed in the 2006 IPCC Guidelines, which specified under the mechanical-biological (MB) treatment of waste that "Due to the reduced amount in material, organic content and biological activity, the MB-treated waste will produce up to 95 per cent less CH_4 than untreated waste when disposed in SWDS" (Vol. 5, ch. 4, p. 4.4). The Party explained to the ERT that, the Party estimated that about 90 per cent less CH_4 is emitted, hence the MCF of 0.1 was used. The ERT recommends that the Party include this information provided to the ERT in the NIR of its next annual submission.

104. The ERT noted that, for CH_4 recovery from solid waste disposal on land, data for the year 2001 was used for the year 2000 due to the unavailability of data for the year 2000. The ERT reiterates the recommendation from the previous review reports that Luxemburg either use monitored data to report CH_4 recovery or apply the default CH_4 recovery ratio

[8] For Luxemburg no key categories were identified for the waste sector for the year 2010. Solid waste disposal on land was identified as a key category for the years 1990–2003.

from the IPCC good practice guidance for the year 2000. During the review, the Party explained that the recovery value for the year 2000 will be revised in the next annual submission.

Wastewater handling – CH_4 and N_2O

105. The Party uses the IPCC tier 1 method with country-specific and default EFs to estimate CH_4 and N_2O emissions from wastewater handling. The ERT noted that the Party has improved the transparency of the reporting by revising the notation keys in table 6.B. Particularly, the notation key for the CH_4 and N_2O emissions from domestic and commercial human sewage sludge was revised from "NE" to included elsewhere ("IE"), as suggested in the previous review report. The Party explained in the NIR that part of the sludge is applied to agricultural soils and the following N_2O emissions are reported under the category agricultural soils. Other parts of the sludge are incinerated with energy recovery and the emissions are therefore reported in the energy sector under other (manufacturing industries and construction). The remainder of the sludge is composted and the CH_4 and N_2O emissions are therefore reported under the category other (waste). The ERT encourages the Party to expand the explanation on the sludge use by including the amount of sludge and the distribution of the above-mentioned treating methods in the NIR of the next annual submission.

106. For industrial wastewater treatment (sludge) the notation key for CH_4 emission was changed from "NE" to "NO". In response to a question raised by the ERT during the review, Luxemburg explained that the sludge from industrial wastewater (generated in only one plant) is exported to neighbouring countries for incineration. To further improve the transparency of the reporting, the ERT encourages the Party to provide the time series of the sludge exported from the country in the NIR of the next annual submission.

G. Supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

1. Information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

Overview

107. Luxembourg has reported emissions and removals from activities under Article 3, paragraph 3, of the Kyoto Protocol. This is in accordance with the "Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol" as Luxembourg did not elect any activity under Article 3, paragraph 4, of the Kyoto Protocol. Luxembourg has chosen to account for KP-LULUCF activities at the end of the commitment period. According to the analysis undertaken by Luxembourg, afforestation, reforestation and deforestation were not considered key categories.

108. Luxembourg has provided in the NIR complete information on the mandatory requirements outlined in paragraphs 5 to 9 of the annex to decision 15/CMP.1.

109. The previous review report[9] recommended that Luxembourg follow the IPCC good practice guidance methods to ensure time-series consistency of the land information used in the inventory. The 2012 ERT followed up on this recommendation, and was provided with additional information that satisfied this requirement. The ERT recommends that Luxembourg report in its next annual submission the information that describes the process followed to ensure time-series consistency in the production of the land use and land-use change information.

[9] FCCC/ARR/2010/LUX, paragraph 100.

110. The Party has made no recalculations for the KP-LULUCF activities between the 2011 and 2012 submissions.

111. The reporting of KP-LULUCF activities is generally complete. However, carbon stock changes in organic soils and dead wood are reported as "NO", as are non-CO_2 emissions, except for N_2O from disturbance associated with land-use conversion to cropland for which estimates are provided. The ERT considers that Luxembourg has no organic soils and that justifies the notation key "NO" used for this pool. The NIR reports that no biomass burning occurs on afforested, reforested or deforested land, and that forests are not fertilised nor lime applied. The ERT recommends that Luxembourg provide verification that the practice of biomass burning, and forest fertilisation does not occur in its next annual submission. The NIR indicates that the reporting of "NO" for dead wood is due to the young age of the forests and that this will be verified in the analysis of data collected during the second NFI. The ERT recommends that Luxembourg report the results of the analysis which verifies that the dead wood pool does not occur and thereby justify the use of the notation key "NO" in its next annual submission.

112. Luxembourg reports carbon stock changes in the below-ground biomass and litter pools as "IE", including them in the carbon stock changes in the above-ground biomass and soil pools respectively. However, the recommendation of the previous review report that the Party separate the carbon stock changes in these pools into their respective subcategories (in the above- and below-ground biomass pools and litter and soil pools)[10] has not been acted on. In response to a question raised by the ERT during the review, Luxembourg stated that there are no plans to do so. The ERT reiterates the recommendations of the previous review report that Luxembourg report these pools separately in its next annual submission.

113. The previous review report identified an issue for Luxembourg in providing transparent information on the exact methodology and assumptions used to obtain the areas of land subject to afforestation, reforestation and deforestation and recommended that Luxembourg transparently include this information in the next annual submission. The ERT reiterates the recommendation of the previous review report that Luxembourg transparently include this information in the next NIR.

114. The previous review report identified an issue for Luxembourg in not reporting sufficient detail in its NIR to prove the assumption that all afforestation, reforestation and deforestation activities are directly human-induced. Luxembourg improved the information provided in the 2012 NIR and sufficient detail has been provided. The ERT commends the Party for the inclusion of additional information in the 2012 NIR to support this assumption.

115. Following the recommendation of the previous review report regarding the transparent reporting of the QA/QC procedures for the KP–LULUCF reporting in the NIR, Luxembourg has included a list of the QC checks applied by the Party to its report. Those are of generic character and include simple accuracy, consistency and completeness checks. The ERT commends the Party for the improvement made to the NIR and encourages Luxembourg to implement activity-specific checks in future annual submissions.

Activities under Article 3, paragraph 3, of the Kyoto Protocol

116. Luxembourg reports soil carbon stock estimates for afforestation, reforestation and deforestation activities using country-specific data. The source of the country-specific data for soil carbon stock changes has not been provided, despite the ERT requesting the source during the review week. The ERT recommends that the Party report the source of the

[10] FCCC/ARR/2010/LUX, paragraphs 133 and 134.

country-specific data for soil carbon stock change estimations in its next annual submission.

Afforestation and reforestation – CO_2

117. For afforestation and reforestation activities, changes in the stock of dead wood are assumed to be "NO". The ERT reiterates the recommendation of the previous review report that the Party provide verifiable proof that the dead wood pool is not a net source in its next annual submission.

Deforestation – CO_2

118. The previous review report identified an inconsistency in the IEF for N_2O emissions associated with land-use conversion to cropland in mineral soils in the reporting under the Convention and under the Kyoto Protocol. The ERT observed that a discrepancy remains, although the reported ratio being applied in the NIR text is now correct. The Party explained that an incorrect carbon:nitrogen ratio value has been used in the calculations for the KP-LULUCF activities and that this will be corrected for the next annual submission. The ERT recommends that Luxembourg apply the correct carbon:nitrogen ratio in the calculations and perform the necessary recalculations in its next annual submission.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

119. Luxembourg has reported information on its accounting of Kyoto Protocol units in the required SEF tables, as required by decisions 15/CMP.1 and 14/CMP.1. The ERT took note of the findings included in the SIAR on the SEF tables and the SEF comparison report.[11] The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10. The ERT reiterated the main findings contained in the SIAR.

120. Information on the accounting of Kyoto Protocol units has been prepared and reported in accordance with decision 15/CMP.1, annex, chapter I.E, and reported in accordance with decision 14/CMP.1 using the SEF tables. This information is consistent with that contained in the national registry and with the records of the international transaction log (ITL) and the clean development mechanism registry and meets the requirements referred to in decision 22/CMP.1, annex, paragraph 88(a–j). The transactions of Kyoto Protocol units initiated by the national registry are in accordance with the requirements of the annex to decision 5/CMP.1 and the annex to decision 13/CMP.1. No discrepancy has been identified by the ITL and no non-replacement has occurred. The national registry has adequate procedures in place to minimize discrepancies.

National registry

121. The ERT took note of the SIAR and its finding that the reported information on the national registry is complete and has been submitted in accordance with the annex to decision 15/CMP.1. The ERT further noted from the SIAR and its finding that the national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with decisions 16/CP.10 and 12/CMP.1. The national registry also has adequate security, data safeguard and disaster recovery measures in place and its operational performance is adequate.

[11] The SEF comparison report is prepared by the international transaction log (ITL) administrator and provides information on the outcome of the comparison of data contained in the Party's SEF tables with corresponding records contained in the ITL.

Calculation of the commitment period reserve

122. Luxembourg has reported its commitment period reserve in its 2012 annual submission. Luxembourg reported that its commitment period reserve has not changed since the initial report review (42,662,696 t CO_2 eq), as it is based on the assigned amount and not on the most recently reviewed inventory. The ERT agrees with this figure.

3. Changes to the national system

123. Luxembourg reported that there are no changes in its national system since the previous annual submission. The ERT concluded that the Party's national system continues to be in accordance with the requirements of national systems outlined in decision 19/CMP.1. The ERT welcomes the steps undertaken to increase the number of staff involved in inventory compilation (see para. 14 above) and recommends that the Party include an update on the progress in this direction in the NIR of its next annual submission.

4. Changes to the national registry

124. Luxembourg reported that there are no changes in its national registry since the previous annual submission, besides minor security measure improvements. The ERT concluded that the Party's national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions.

5. Minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol

125. Luxembourg did not provide information on changes in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol in its annual submission. The description is the same as was reported in the previous year. Luxembourg has included information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, as requested in chapter I.H of the annex to decision 15/CMP.1. The ERT noted that the 2012 NIR also includes information on the actions in implementing its commitments under Article 3, paragraph 14 in line with para 24(a)-(f) of the annex to decision 15/CMP.1 and particularly on the progressive reduction or phasing out of market imperfections, fiscal incentives and subsidies. The ERT concluded, therefore, that the information provided is transparent and generally incomplete. The ERT recommends that the Party, in its next annual submission, report any changes in its information provided under Article 3, paragraph 14, in accordance with decision 15/CMP.1, annex, chapter I.H.

III. Conclusions and recommendations

A. Conclusions

126. Luxembourg made its annual submission of the CRF tables on 5 April 2012 and the NIR was submitted on 11 May 2012. The annual submission contains the GHG inventory (comprising CRF tables and an NIR) and supplementary information under Article 7, paragraph 1, of the Kyoto Protocol (information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, Kyoto Protocol units, changes to the national system and the national registry, and minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol). This is in line with decision 15/CMP.1, except for the delay in the submission of the NIR.

127. The ERT concludes that the inventory submission of Luxembourg has been prepared and reported in accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories". The inventory submission is complete and the Party has submitted a complete set of CRF tables for the years 1990–2010 and an NIR; these are complete in terms of geographical coverage, years and sectors, as well as generally complete in terms of categories and gases. Estimates of fugitive emissions from oil, potential emissions of HFCs, PFCs and SF_6 and non-mandatory LULUCF categories were not provided.

128. The submission of information required under Article 7, paragraph 1, of the Kyoto Protocol has been prepared and reported in accordance with decision 15/CMP.1.

129. The Party's inventory is generally in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. However, the ERT noted lack of reporting of the emissions from combustion of lubricants and erroneous use of the N_2O EF for solid fuels under the residential sub-category. These methodological issues were corrected in the revised estimates included in the submission of 12 November 2012.

130. The Party has made recalculations for the inventory between the 2011 and 2012 submissions in response to the 2011 annual review report, following changes in AD and EFs, and in order to rectify identified errors. The impact of these recalculations on the national totals is a decrease in emissions of 1.4 per cent for 2009. The main recalculations took place in the following sectors/categories:

(a) Other sectors, transport, manufacturing industries and construction (energy);

(b) Agricultural soils (agriculture).

131. Luxembourg has reported emissions and removals from activities under Article 3, paragraph 3, of the Kyoto Protocol, and did not elect any activity under Article 3, paragraph 4, of the Kyoto Protocol. Luxembourg has chosen to account for KP-LULUCF activities at the end of the commitment period. The ERT concludes that Luxembourg's submission on KP-LULUCF is generally in accordance with the requirements of paragraphs 5-9 of the annex to decision 15/CMP.1. However, the Party did not provide enough verifiable information in the NIR to justify that some of the pools reported as not occurring are not a net source of emissions such as the dead wood pool in afforestation and reforestation and the non-carbon greenhouse gases in both afforestation/reforestation and deforestation.

132. The Party has made no recalculations for the KP-LULUCF activities between the 2011 and 2012 submissions.

133. Luxembourg has reported information on its accounting of Kyoto Protocol units in accordance with decision 15/CMP.1, annex, chapter I.E, and used the required reporting format tables as specified by decision 14/CMP.1.

134. The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1. The ERT welcomes the steps undertaken to increase the number of staff involved in inventory compilation.

135. The national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions.

136. Luxembourg has reported information under decision 15/CMP.1, annex, chapter I.H, "Minimization of adverse impacts in accordance with Article 3, paragraph 14" as part of its 2012 annual submission. The information is transparent and generally complete.

B. Recommendations

137. The ERT identifies issues for improvement as listed in table 6 below.

Table 6
Recommendations identified by the expert review team

Sector	*Category*	*Recommendation*	*Paragraph reference*
Cross-cutting	National system	Provide the national inventory report (NIR) of its next annual submission on time	7
	Completeness	Includes estimates of fugitive emissions from oil	11
	National system	Report on the progress in ensuring additional staff; designate responsible person for the LULUCF sector	14 and 123
	Key category analysis	Enhance QC procedures and accurate reporting of the key category analysis	17
	Uncertainties	Improve the uncertainty analysis by covering all inventory categories and report on all performed analyses (including for LULUCF and KP-LULUCF) in the next NIR	19, 20 and 84
	Recalculations	Expand the recalculation section to include values recalculated and the impact of the change on the sector	22, 33 and 64
	QA/QC	Include priorities, level of difficulty and timeline for implementation in the improvement plan list	24
		Carry out the necessary QA/QC procedures prior to inventory submission and ensure updated and consistent data are reported in the NIR	25, 35, 39, 43, 58, 68 and 85
	Transparency	Continue to improve the transparency of the inventory (see below)	26
	Follow-up of previous reviews	Address pending recommendations from previous review reports	28, 36, 57, 69 and 87
Energy	General	Improve transparency by including all the references and detailed justification for the EFs used, trend information	36 and 47
	Reference approach	Include thorough explanation for the difference between the approaches; update the explanation in the documentation box of table 1.A(c) and in the NIR; consistently report the information between CRF table 1.A(b) and 1.A(d)	37, 38 and 39
	Bunker fuels	Recheck the assumption for the aviation fuel used for international bunkers and address the inconsistency with IEA figures for jet kerosene	40
	Feedstocks and non-energy use of fuels	Report the revision to the fraction of carbon stored value for lubricants in the next NIR.	42 and 45

Sector	*Category*	*Recommendation*	*Paragraph reference*
	Stationary combustion: solid fuels, biomass	Check the variation of the IEF across the time series to ensure that time-series consistency is maintained and provide relevant explanations on the trend	43
	Stationary combustion: biomass	Include further clarification of the biomass types used and the actual EF used in order to clarify the time-series consistency issue.	44
	Stationary combustion: biomass	Include the information on biomass in the tyres consumed for clinker production.	44
	Road transport: liquid fuels	Incorporate relevant findings of the study on road transportation emissions in the next annual submission.	46
Industrial processes	General	Ensure consistency of reported information on the recalculations between the NIR and the CRF tables, and expand the recalculation information at the category level	50
		Include further information and evidence on the conducted QA/QC procedures.	56
	Iron and steel production	Make a plan to improve time-series consistency and include a carbon mass balance for the entire time series; include more information on the country-specific methodologies, how the time-series consistency is maintained, and on the IEFs trend	58
	Consumption of halocarbons and SF_6	Improve transparency by including background information used in the calculations	59
		Correct the notation key used for potential emissions	60
		Improve the consistency of reporting between CRF tables 2(I), 2(II) and 2(II)F.	53
		Provide a description of the trend of HFC emissions from foam blowing and SF_6 emissions from electrical equipment in the NIR and ensure time-series consistency	53
		Make more efforts to collect and use country-specific data for estimating emissions from consumption of halocarbons and SF_6	54
		Include uncertainly estimates for F-gases.	55
Solvent and other product use		Ensure time-series consistency by recalculating the emissions for the period 1990–2002.	62
Agriculture	General	Improve the transparency of the reporting by including more background methodological and uncertainty related information in the text of the NIR, correcting table title for table 6.4 of the NIR	66, 67 and 73
	Enteric fermentation	Revise the CH_4 EF for mature non-dairy cattle	71
		Improve the accuracy of the cattle life body weight estimates	72

Sector	*Category*	*Recommendation*	*Paragraph reference*
	Manure management	Apply the higher-tier method for the estimation of CH_4 emissions from swine.	74
		Improve the transparency of the reporting of the method used to estimate nitrogen excretion from cervidae species.	75
	Agricultural soils	Provide the background information used to estimate $Frac_{Graz}$	77
		Use up-to-date AD for fertilizers and ensure timely availability of the AD.	78
LULUCF	Cross-cutting	Improve the transparency of the reporting on the method for calculating living biomass carbon stock changes in settlements converted to forest land; the source of the soil carbon stock EFs used for land-use changes; the sector-specific QC checks employed for the LULUCF sector and provide additional information on the data source for the dead organic matter carbon stock changes, on the method and assumptions used to obtain the "20-year areas" and annually converted areas for various land-use categories; on ensuring time series consistency of land area information	82 and 83
		Transparently describe the various sector-specific QC procedures for the LULUCF sector	85
	Forest land remaining forest land	Use the results from the NFI as soon as possible to recalculate the emission/removal estimates and AD from forest land remaining forest land	88
		Prioritize reporting on the changes in the dead organic matter and soil carbon pools	89
	Land converted to forest land	Provide the method for calculating living biomass carbon stock changes in settlements converted to forest land and the source of the carbon stock EFs	91
		Justify the assumption that carbon stock changes in dead wood for land converted to forest land is not occurring.	92
Waste	General	Improve the transparency of reporting by providing additional information such as the share of aerobic and anaerobic treatment of sludge from domestic and commercial wastewater.	96
		Ensure consistent reporting on the types of waste disposal sites in the NIR and CRF	97
		Include a discussion on the uncertainty for each category in the waste sector.	98
	Solid waste disposal on land	Justify the values used for MCF.	103
		Use monitored data to report CH_4 recovery or apply the default CH_4 recovery ratio from the IPCC good practice guidance for the year 2000	104
KP-LULUCF	General	Report in its next annual submission the	109

Sector	*Category*	*Recommendation*	*Paragraph reference*
		information that describes the process followed to ensure time-series consistency in the production of the land use and land-use change information	
		Provide verification that the practice of biomass burning, and forest fertilisation does not occur	111
		Report separately below-ground biomass and litter pools	112
		Provide transparent information on the exact methodology and assumptions used to obtain the areas of land subject to afforestation, reforestation and deforestation.	113
		Report the source of the country-specific data for soil carbon stock changes	116
Afforestation and reforestation		Provide verifiable proof that the dead wood pool is not a net source	117
Deforestation		Apply the correct carbon: nitrogen ratio and recalculate the N_2O emissions associated with land-use conversion to cropland in mineral soils	118
Article 3, paragraph 14		Provide information on any changes in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14	132

IV. Questions of implementation

138. No questions of implementation were identified by the ERT during the review.

Annex I

Documents and information used during the review

A. Reference documents

Intergovernmental Panel on Climate Change. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>.

Intergovernmental Panel on Climate Change. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>.

Intergovernmental Panel on Climate Change. *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

Intergovernmental Panel on Climate Change. *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. Available at <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories". FCCC/SBSTA/2006/9. Available at <http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf>.

"Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention". FCCC/CP/2002/8. Available at <http://unfccc.int/resource/docs/cop8/08.pdf>.

"Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol". Decision 19/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf#page=14>.

"Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol". Decision 15/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf#page=54>.

"Guidelines for review under Article 8 of the Kyoto Protocol". Decision 22/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf#page=51>.

Status report for Luxembourg 2012. Available at <http://unfccc.int/resource/docs/2012/asr/lux.pdf>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2012. Available at <http://unfccc.int/resource/webdocs/sai/2012.pdf>.

FCCC/ARR/2011/LUX. Report of the individual review of the greenhouse gas inventory of Luxembourg submitted in 2011. Available at <http://unfccc.int/resource/docs/2012/arr/lux.pdf >.

UNFCCC. *Standard Independent Assessment Report*, parts I and II. Available at <http://unfccc.int/kyoto_protocol/registry_systems/independent_assessment_reports/items/4061.php>.

B. Additional information provided by the Party

Responses to questions during the review were received from Dr. Marc Schuman (AEV), including additional material on the methodologies and assumptions used. The following document[1] was also provided by Luxembourg:

Wilfried Winiwarter, Traute Köther and Marc Schuman. 2011. *Uncertainty of Luxembourg's GrenhouseGas Inventory - Update 2011*. AIT-F&PD-Report – limited distribution

[1] Reproduced as received from the Party.

Annex II

Acronyms and abbreviations

AD	activity data
CH_4	methane
CaO	calcium oxide
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CRF	common reporting format
EF	emission factor
ERT	expert review team
EU	European Union
EU ETS	EU Emissions Trading System
F-gas	fluorinated gas
FOD	first-order decay
GHG	greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 without GHG emissions and removals from LULUCF
HFCs	hydrofluorocarbons
IE	included elsewhere
IEA	International Energy Agency
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
ITL	international transaction log
kg	kilogram (1 kg = 1,000 grams)
KP-LULUCF	land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
LULUCF	land use, land-use change and forestry
MCF	methane conversion factor
MgO	magnesium oxide
Mt	million tonnes
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
QA/QC	quality assurance/quality control
SEF	standard electronic format
SF_6	sulphur hexafluoride
SIAR	standard independent assessment report
SWDS	solid waste disposal sites
Tg	teragram (1 Tg = 1 million tonnes)
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change