Advance Version

COMPLIANCE COMMITTEE **CC/ERT/ARR/2012/9**
17 April 2012

Report of the individual review of the annual submission of Luxembourg submitted in 2011

Note by the secretariat

The report of the individual review of the annual submission of Luxembourg submitted in 2011 was published on 17 April 2012. 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/2011/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.

United Nations FCCC/ARR/2011/LUX

Framework Convention on Climate Change

Distr.: General
17 April 2012

English only

Report of the individual review of the annual submission of Luxembourg submitted in 2011*

* In the symbol for this document, 2011 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 in-country review of the 2011 annual submission of Luxembourg, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 19 to 24 September 2011 in Luxembourg city, Luxembourg, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Ms. Maria Lidén (Sweden); energy – Mr. Julien Vincent (France); industrial processes – Ms. Detelina Petrova (Bulgaria); agriculture – Mr. Donald Reuben Kamdonyo (Malawi); land use, land-use change and forestry (LULUCF) – Mr. Nalin Srivastava (India); and waste – Ms. Violeta Hristova (Bulgaria). Ms. Lidén and Mr. Srivastava were the lead reviewers. The review was coordinated by Mr. Tomoyuki Aizawa (UNFCCC secretariat).

2. In accordance with the "Guidelines for review under Article 8 of the Kyoto Protocol" (decision 22/CMP.1), a draft version of this report was communicated to the Government of Luxembourg, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

3. In 2009, 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 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 88.0 per cent of total GHG emissions, followed by the agriculture sector (5.8 per cent), the industrial processes sector (5.5 per cent), the waste sector (0.6 per cent) and the solvent and other product use sector (0.1 per cent). Total GHG emissions amounted to 11,684.38 Gg CO_2 eq and decreased by 8.9 per cent between the base year[2] and 2009.

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. Table 3 provides 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 2009[a]

			Gg CO_2 eq							*Change*
		Greenhouse gas	*Base year*[a]	*1990*	*1995*	*2000*	*2005*	*2007*	*2008*	*2009*	*Base year–2009 (%)*
Annex A sources		CO_2	11 870.82	11 870.82	9 132.40	8 771.36	12 154.36	11 425.30	11 277.25	10 710.06	–9.8
		CH_4	467.13	467.13	474.75	471.58	455.29	445.94	448.54	448.26	–4.0
		N_2O	474.84	474.84	479.38	492.49	484.32	458.94	463.48	452.67	–4.7
		HFCs	15.62	13.54	15.62	28.79	53.23	61.33	63.68	65.78	321.0
		PFCs	0.00	0.00	0.00	0.01	0.15	0.21	0.24	0.22	NA
		SF_6	1.55	1.13	1.55	2.15	5.04	6.15	6.57	7.40	376.2
KP-LULUCF	Article 3.3[b]	CO_2							64.16	63.00	
		CH_4							NO	NO	
		N_2O							0.00	0.00	
	Article 3.4[c]	CO_2	NA						NA	NA	NA
		CH_4	NA						NA	NA	NA
		N_2O	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 2009

			Gg CO_2 eq								*Change*
		Sector	*Base year[a]*	*1990*	*1995*	*2000*	*2005*	*2007*	*2008*	*2009*	*Base year–2009 (%)*
Annex A		Energy	10 344.59	10 344.59	8 257.42	8 186.68	11 684.01	10 884.07	10 796.40	10 284.96	–0.6
		Industrial processes	1 625.54	1 623.03	1 001.67	756.73	716.34	767.44	706.21	642.21	–60.5
		Solvent and other product use	23.90	23.90	19.74	15.81	16.65	17.48	16.90	16.02	–33.0
		Agriculture	745.87	745.87	737.15	724.11	660.63	656.42	669.63	674.09	–9.6
		Waste	90.06	90.06	87.73	83.05	74.78	72.47	70.63	67.10	–25.5
		LULUCF	NA	347.75	–238.10	–385.41	–385.65	–273.18	–272.34	–296.43	NA
		Total (with LULUCF)	**NA**	**13 175.21**	**9 865.60**	**9 380.97**	**12 766.74**	**12 124.71**	**11 987.43**	**11 387.95**	NA
		Total (without LULUCF)	**12 829.97**	**12 827.46**	**10 103.70**	**9 766.38**	**13 152.40**	**12 397.88**	**12 259.77**	**11 684.38**	**–8.9**
		Other[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA
KP-LULUCF	Article 3.3[c]	Afforestation & reforestation							–76.51	–78.00	
		Deforestation							141.03	141.36	
		Total (3.3)							**64.52**	**63.36**	
	Article 3.4[d]	Forest management							NA	NA	
		Cropland management	NA						NA	NA	NA
		Grazing land management	NA						NA	NA	NA
		Revegetation	NA						NA	NA	NA
		Total (3.4)	**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

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]	*Accounting quantity*[c]
Commitment period reserve	42 662 696				
Annex A emissions for current inventory year					
CO_2	67 535 829			67 535 829	
CH_4	5 666 118			5 666 118	
N_2O	5 417 106			5 417 106	
HFCs	1 055 623			1 055 623	
PFCs	35 046			35 046	
SF_6	349 142			349 142	
Total Annex A sources	**80 058 865**			**80 058 865**	
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	–2 648 318			–2 648 318	
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	1 263 842			1 263 842	
Activities under Article 3, paragraph 4, for current inventory year[d]					
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					

Abbreviation: 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] "Accounting quantity" is included in this table only for Parties that chose annual accounting for activities under Article 3, paragraph 3, and elected activities under Article 3, paragraph 4, if any.

[d] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one of these activities.

6. The Party's 2011 GHG inventory is generally in line with the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines), the 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). However, the expert review team (ERT) identified some instances where the inventory is not fully in line with the IPCC good practice guidance, as explained in paragraph 29 below.

7. The 2011 inventory submission is generally of a high quality, but the ERT identified a need for further improvements in the following areas: transparency (energy, LULUCF and waste sectors); completeness (potential emissions of fluorinated gases (F-gases) in the industrial processes sector); time-series consistency (energy, LULUCF and industrial processes sectors); accuracy (industrial processes, LULUCF and waste sectors); and the uncertainty assessment (LULUCF and waste sectors).

8. Luxembourg acknowledged these findings at the time of the review and undertook measures to address some of the areas requiring improvement by providing: suitable references and information on the expert judgement used for the energy sector; calculation spreadsheets that presented information on the methodologies, parameters and activity data (AD) used in the preparation of the agriculture and LULUCF sectors of the inventory; and information on the incorrect entries in the LULUCF sector of the national inventory report (NIR). The ERT commends Luxembourg for the efforts made to provide this additional information during the review week.

9. The Party has submitted supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol in accordance with chapter I of the annex to decision 15/CMP.1.

10. Luxembourg has chosen to account for activities under Article 3, paragraph 3, of the Kyoto Protocol at the end of the commitment period. The Party has not elected any activities under Article 3, paragraph 4, of the Kyoto Protocol. Luxembourg has reported information on activities under Article 3, paragraph 3, of the Kyoto Protocol in accordance with decisions 15/CMP.1, 16/CMP.1 and 6/CMP.3.

11. Luxembourg has reported information on its accounting of Kyoto Protocol units in accordance with chapter I.E of the annex to decision 15/CMP.1, and has used the standard electronic format (SEF) tables as required by decision 14/CMP.1.

12. The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1.

13. 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 decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP).

14. Luxembourg has reported 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, in its NIR.

15. In the course of the review, the ERT formulated a number of recommendations relating to the transparency (see paras. 44, 48, 66, 99, 101, 102, 111, 113, 127, 129, 131 and 132 below), accuracy (see paras. 46, 47, 57, 90, 92, 103, 105, 107 and 112 below), consistency (see paras. 54, 74, 76, 81, 100 and 127 below) and completeness (see paras. 52 and 66 below) of the annual submission.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

16. The 2011 annual inventory submission was submitted on 15 April 2011; it contains a complete set of common reporting format (CRF) tables for the period 1990–2009 (except for CRF table 2(II).F) and an NIR. 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 under Article 3, paragraph 14, of the Kyoto Protocol. The SEF tables were also submitted on 15 April 2011. Luxembourg resubmitted its NIR on 27 May 2011. The annual submission was submitted in accordance with decision 15/CMP.1.

17. 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]

18. 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.

Completeness of inventory

19. The inventory is complete in terms of years, geographical coverage, and gases. The CRF tables submitted cover the period 1990–2009. However, the Party did not provide the sectoral background table 2(II).F or estimates of potential emissions of HFCs, PFCs and SF_6. The ERT reiterates the encouragement of the previous review report that Luxembourg explore the possibility of estimating potential emissions of HFCs, PFCs and SF_6 in its next annual submission.

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

Overview

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

Inventory planning

21. During the review week, Luxembourg described the national system for the preparation of the inventory. The Environment Agency of Luxembourg (Administration de

[3] The SIAR, parts I and II, is prepared by an independent assessor in line with decision 16/CP.10 (paras. 5(a), 6(c) and 6(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.

l'Environnement (AEV)) has overall responsibility for the national inventory. Overall management of the inventory is assigned to one staff member of AEV, who is nominated as the inventory focal point. AEV also acts as the national inventory compiler, checking and putting together emission estimates and other information coming from sector experts working in other administrations or services. These other organizations are described in detail in the NIR. Also, the NIR explains each organization's responsibilities with respect to the determination of AD, EFs and methods. Whereas AEV has the technical knowledge and responsibility for the inventory, the Department of the Environment of the Ministry of Sustainable Development and Infrastructures (MDDI) acts as the national focal point and is responsible for the official annual submission. AEV has the ultimate responsibility for QA/QC, which is well planned and clearly documented in the NIR. During the review week, Luxembourg provided additional information on the implementation of the national system, and from this the ERT concludes that there is a shortage of human resources within the national system and that there is a need to strengthen the national system to improve future annual submissions. Many of the issues detected during the review with regard to the inventory are related to the shortage of human resources for future inventory development. The key recommendations of the ERT are that Luxembourg:

(a) Increase the number of staff within the national system for the preparation of the inventory, including a backup for the national inventory compiler for future inventory development;

(b) Designate one person to be solely responsible for the preparation of the LULUCF sector;

(c) Ensure that the QA/QC management system is further strengthened throughout all parts of the inventory.

22. To facilitate the work within the inventory system and also for security reasons, the ERT encourages Luxembourg to:

(a) Strengthen the use of the web-based inventory archive system CIRCALUX (see para. 30 below) for all staff working on the inventory;

(b) Continue with its plans to implement the software system MESAP for inventory preparation, which includes the estimation of emissions and the archiving of EFs and AD.

Inventory preparation

Key categories

23. Luxembourg has reported a key category tier 1 analysis, both level and trend assessment, as part of its 2011 annual submission. The key category analysis performed by Luxembourg and that performed by the secretariat[4] produced somewhat different results caused by the different level of disaggregation of the subcategories used for the analysis. Moreover, the key category analysis performed by Luxembourg, as presented in the NIR, is not fully consistent between the different sections of the NIR or with the CRF tables, owing to transcription errors. The ERT recommends that Luxembourg enhance its QC procedures

[4] 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.

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. Luxembourg has included the LULUCF sector in its key category analysis, which was performed in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The key category analysis is used by Luxembourg as a criterion for the prioritization of the inventory improvement plan which is part of the QA/QC plan.

24. With regard to KP-LULUCF activities, 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. However, the method used for the selection of LULUCF key categories, and hence KP-LULUCF key categories, is not clearly described in the NIR. The ERT recommends that Luxembourg revise the information in the NIR to transparently reflect the methodology used for the identification of key categories for the reporting under the Convention and the Kyoto Protocol in its next annual submission.

Uncertainties

25. Luxembourg has reported a tier 1 uncertainty analysis as part of its 2011 annual submission. The results are reported using table 6.1 of the IPCC good practice guidance, both including and excluding LULUCF. The uncertainty analysis has been prepared in accordance with the IPCC good practice guidance, but only for the key categories and their sum. The ERT noted that, according to paragraph 14 of the annex to decision 19/CMP.1, it is mandatory for Parties included in Annex I to the Convention to quantify the inventory uncertainty for each category, as well as for the inventory as a whole. During the review week, Luxembourg informed the ERT that it was planning to undertake a study in 2011 that will include a general revision of the uncertainties. The ERT reiterates the recommendation from the previous review report that Luxembourg implement its planned improvements, and prepare uncertainty estimates for all categories in the inventory and report thereon in its next annual submission. The uncertainties in the Party's submission are generally low, owing to the fact that most emissions in Luxembourg are CO_2 emissions from combustion within the energy sector. The uncertainty analysis is used by Luxembourg as a criterion for the prioritization of the inventory QA/QC plan.

Recalculations and time-series consistency

26. Recalculations have been performed and reported in accordance with the IPCC good practice guidance. The ERT noted that the recalculations reported by the Party of the time series 1990–2008 have been undertaken to take into account changes in AD (in all sectors); improved EFs (in the energy and agriculture sectors); and improved methods (in the energy sector). The major changes, and the magnitude of the impact, include: a decrease in estimated total GHG emissions in 1990 of 290.94 Gg CO_2 eq (2.2 per cent) and a decrease in GHG emissions in 2008 of 234.16 Gg CO_2 eq (1.9 per cent). Changes in total emissions mostly relate to the recalculations performed within the energy sector. The rationale for these recalculations is provided in the NIR and in CRF table 8(b). The ERT finds that the information in the NIR is not fully transparent regarding the recalculations within the industrial process sector (see para. 67 below) , the agriculture sector (see para. 87 below) and the LULUCF sector (see para. 98 below). The ERT recommends that Luxembourg include complete and transparent information in the NIR as well as in the CRF tables on the rationale for all recalculations and their impact on emission levels in its next annual submission.

27. The ERT noted that the NIR only discusses time-series consistency in the category-specific section for the energy sector. As also noted by the previous ERT, there is no

discussion on time-series consistency for the other sectors or for the inventory as a whole, which is required by the annotated outline of the NIR. The ERT recommends that Luxembourg improve transparency by reporting on time-series consistency for each sector as well as for the inventory as a whole in its next NIR.

Verification and quality assurance/quality control approaches

28. Luxembourg has a quality management system that is transparently described in the NIR. During the review, Luxembourg also provided additional information on details of the system. There is a quality manual that has been compiled according to the 'Plan-Do-Check-Act' cycle. There are documented routines for addressing recommendations from internal and external reviews. An external audit is conducted for each annual submission. All recommendations received are recorded in the QA/QC plan (for cross-cutting issues at a general level of the inventory), the priority list (for issues that require additional funding or decisions from different authorities) or the inventory improvement plan (for sector-specific issues). Luxembourg has established criteria for the prioritization of the QA/QC plan, taking into account uncertainties, key categories, recommendations from the ERT, internal audit findings and the time and effort necessary to implement the improvements. There are QC checklists for each sector. The ERT finds that the Party's quality management system is in line with the IPCC good practice guidance. For security reasons and also to increase transparency within the inventory and reduce the risk of errors, the ERT recommends that Luxembourg:

(a) Improve the documentation on how each step in the inventory preparation process has been performed;

(b) 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;

(c) Continue with its efforts to strengthen the implementation of the quality management system, for example, through the training of sectoral experts and by further improving the use of sector-specific QC checklists.

Transparency

29. The information provided in the CRF tables is transparent. The Party's 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. In the 2011 submission, which is an improvement on the previous annual submission, the NIR also includes annexes in accordance with the annotated outline; however, some of the information in the annexes (e.g. on the energy balance) is not included. During the review, Luxembourg informed the ERT that the annexes will be improved, subject to the availability of resources. The ERT recommends that Luxembourg implement these improvements in its next annual submission. The ERT also recommends that Luxembourg include information on: the EFs used in the energy sector (see para. 44 below); the AD, EFs and underlying parameters used for the calculation of emissions from the industrial processes sector (see paras. 66 and 72 below); and the data sources, methods and assumptions used in the LULUCF sector (see para. 99 below).

Inventory management

30. 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.

3. Follow-up to previous reviews

31. In the 2011 submission, Luxembourg has demonstrated its responsiveness to the recommendations from 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.

32. The ERT identified a number of recommendations from previous review reports that have not yet been addressed, including:

(a) Uncertainty analysis (see para. 25 above);

(b) The completion of the annexes to the NIR (see para. 29 above);

(c) The improvement of the quality management system (see para. 28 above);

(d) The energy sector (see para. 27 above and paras. 44, 47 and 48 below);

(e) The industrial process sector (see paras.72, 77 and 79 below);

(f) The LULUCF sector (see paras. 99 and 107 below);

(g) The waste sector (see paras. 112, 115 and 119 below);

(h) The KP LULUCF reporting (see para. 127 below).

4. Areas for further improvement

Identified by the Party

33. The 2011 NIR identifies the following areas for improvement relating to the quality management system: the strengthening of the implementation of the quality management system in general; the implementation of QC procedures in the LULUCF sector; the strengthening of the implementation of QA/QC procedures for KP-LULUCF reporting; the development of the 'four-eyes' principle in inventory work; and the establishment of criteria for the prioritization of the QA/QC plan. With respect to improving other aspects of the inventory, the Party identified 34 issues across all sectors of the NIR.

Identified by the expert review team

34. During the review, the ERT identified cross-cutting issues for improvement. These are listed in paragraph 156 below.

35. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report.

B. Energy

1. Sector overview

36. The energy sector is the main sector in the GHG inventory of Luxembourg. In 2009, emissions from the energy sector amounted to 10,284.96 Gg CO_2 eq, or 88.0 per cent of total GHG emissions. Since 1990, emissions have decreased by 0.6 per cent. The switch from blast furnaces to electric arc furnaces resulted in a significant reduction in emissions between 1994 and 1997. This drop was then compensated by an increase in the domestic production of electricity (a combined heat and power (CHP) gas turbine has been in

operation since 2002) and in emissions from road transportation. Within the sector, 59.1 per cent of the emissions were from transport, followed by 18.0 per cent from other sectors, 11.3 per cent from energy industries and 11.2 per cent from manufacturing industries and construction. The remaining 0.4 per cent were from fugitive emissions from fuels. The observed trends between 1990 and 2009 are emission increases of 3,159.0 per cent for energy industries, 130.0 per cent for transport (mainly from road transportation), 39.8 per cent for other sectors and 158.7 per cent for fugitive emissions from fuels, whose growth is closely linked to natural gas use in Luxembourg; and decreases in emissions from manufacturing industries and construction (by 81.6 per cent) and other (fuel combustion) (by 100 per cent, as fuel consumption has been reallocated to other sectors since 2003). During the period 1990–2009, CO_2 emissions from the energy sector decreased by 1.2 per cent, while CH_4 and N_2O emissions increased by 31.1 and 85.9 per cent, respectively.

37. Luxembourg has updated its energy balance, which is now prepared and provided by the national statistical institute STATEC. The new energy balance allows Luxembourg to better describe fuel consumption at a subcategory level for the period 2000–2009. For the period 1990–1999, the data are not sufficiently detailed to allow for the recalculation of the fuel consumption per category for the entire time series. The updated energy balance was used to estimate emissions from the energy sector in the 2011 submission.

38. Luxembourg has also greatly improved the data streamlining process between the inventory and the energy balance. The net calorific values (NCV) and densities used are now consistent between the inventory and the data developed and provided to the International Energy Agency (IEA) by STATEC. The ERT noted the constructive bilateral cooperation between the inventory team and STATEC, which ensures that the fuel consumption data used in the calculations are mostly the same. Differences relate to the allocation of solid fuels between energy and non-energy use in the steel industry, and the fuel consumption figures for some subcategories, which might also be different as the bottom-up approach is preferred to the top-down approach. The fuel consumption figures used in the inventory might thus be overestimated.

39. A number of recalculations have been performed for the energy sector between the 2010 and 2011 submissions. The impact of these recalculations on the energy sector is a reduction in emissions of 2.7 per cent for 1990 and of 1.9 per cent for 2008.

40. Total natural gas consumption has been corrected downwards by about 10 per cent for the entire time series. This correction is due to the fact that the data for natural gas consumption were provided to the inventory team not in terms of gross calorific values but in terms of NCVs.

41. Following the recommendation from the previous review report, Luxembourg has reallocated the emissions from the autoproduction of electricity in the iron and steel industry from energy industries to manufacturing industries and construction. These emissions occurred from 1990 to 1997. In addition, recalculations were performed due to the correction of the data as outlined in paragraph 40 above. Although this reallocation has no influence on total GHG emissions, it explains the drop of 97.3 per cent in emissions from energy industries for 1990. The recalculation explains the drop of 12.2 per cent in emissions from energy industries for 2008. Consequently, emissions from manufacturing industries and construction have increased by 21.6 per cent for 1990 between the 2010 and 2011 submissions.

42. Another major recalculation concerns the use of the new STATEC energy balance (including revised fuel consumption data, densities and NCVs). According to the information provided by Luxembourg during the review week, the revision of the energy balance explains the reallocation of energy consumption for fuel combustion (especially

natural gas) between manufacturing industries and construction and the other categories (fuel combustion).

43. The ERT commends Luxembourg for these improvements and for all the recalculations performed for the 2011 submission.

44. The NIR mentions, on several occasions, the European Monitoring and Evaluation Programme/European Energy Agency (EMEP/EEA) *Air Pollutant Emission Inventory Guidebook – 2009*, which is not included in the list of references of the NIR. The EFs from the *2006 IPCC Guidelines for National Greenhouse Gas Inventorie*s (hereinafter referred to as the 2006 IPCC Guidelines) are used to estimate CH_4 and N_2O emissions from almost all categories and subcategories of the energy sector. Luxembourg justified this choice during the review week by explaining that these EFs are more representative of the situation in Luxembourg than the older EFs contained in the Revised 1996 IPCC Guidelines and the IPCC good practice guidance because they better reflect Luxembourg's situation, which includes modern plants and processes (very few EFs are different between the Revised 1996 IPCC Guidelines and the 2006 IPCC Guidelines). In order to justify the use of the EFs from the 2006 IPCC Guidelines, the Party suggested including this explanation under the "national circumstances" section of the energy chapter in the NIR of the next annual submission. The ERT supports this suggestion and reiterates the recommendation made in the previous review report that the Party include all the references and detailed justification for the EFs used in the next annual submission.

2. Reference and sectoral approaches

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

45. Luxembourg greatly increased the consistency between the data used for its inventory (the sectoral approach) and the data used for the reference approach (which are also provided to the IEA). The ERT commends Luxembourg for the work carried out in this area.

46. However, the ERT noticed that there are still discrepancies in terms of the reported fuel consumption data and emissions between the reference and the sectoral approaches. Some of these discrepancies are explained in the NIR and were also discussed during the review. Luxembourg already plans to separate the biogenic matter from fossil fuels under liquid fuels in the reference approach as part of its improvement plan. With regard to solid fuels, the ERT advised Luxembourg during the review to include the quantities of fuels used as reductant in the steel industry in CRF table 1.A(d), so that these consumptions and emissions are not taken into account in the apparent energy consumption of that table. Finally, the consumption of municipal solid waste (MSW) could be separated and directly added to CRF table 1.A(c) in order to avoid discrepancies. The ERT recommends that Luxembourg implement these improvements in the next annual submission so that the results from the reference and the sectoral approaches are comparable.

47. The ERT observed a difference of about 7 per cent between the two approaches (higher consumption in the sectoral approach than in the reference approach) in natural gas consumption. This issue was also identified in the previous review report. Luxembourg was not able to explain the difference, which could be due to the conditions in which natural gas characteristics are measured (e.g. the temperature of reference, density). During the review, Luxembourg stated that it would check this issue with STATEC. As this difference could represent an overestimation of about 2 per cent in total sectoral emissions, the ERT recommends that the Party conduct an analysis to provide an explanation for the difference observed between the two approaches in the NIR of its next annual submission.

International bunker fuels

48. In Luxembourg, all jet kerosene is used for international flights. The share of consumed aviation gasoline between domestic and international flights is based on expert judgement (90 per cent for domestic flights and 10 per cent for international ones). During the review week, the Party provided the basis for the expert judgement (an internal document from an expert from Luxfuel, which is the only company selling aviation fuels at the airport). The ERT considered this share as reasonable, taking into account the size of the country. However, the ERT reiterates the recommendation from the previous review report that the Party provide a precise reference for the expert judgement used in the NIR.

Feedstocks and non-energy use of fuels

49. The NIR provides an explanation for the reported non-energy use of fuels together with information on where CO_2 emissions from the manufacture, use and disposal of carbon-containing products are considered. The IPCC default values are applied to calculate the fraction of carbon stored. CO_2 emissions from coke and electrodes (made out of anthracite) used in iron and steel industry are reported under iron and steel production in the industrial processes sector. Emissions from the use of solvents are reported in the solvent and other product use sector. The ERT agreed with this.

50. Luxembourg's estimates of emissions from the use of motor oil (by default, 50 per cent of the total quantity of lubricants sold) are not included under CO_2 emissions from transport, but should be included under that category. This task has already been defined in the Party's inventory improvement plan. The ERT recommends that Luxembourg allocate emissions from the use of motor oil under the transport sector.

3. Key categories

Stationary combustion: solid, liquid, gaseous and other fuels – CO_2, CH_4 and N_2O[5]

51. The Twinerg installation is covered by the European Union emissions trading scheme (EU ETS) and reports its CO_2 emissions from natural gas consumption to the EU ETS by using the default value of 56.1 t/TJ from the Revised 1996 IPCC Guidelines. However, in the GHG inventory reported to the UNFCCC, these emissions are reported using a country-specific EF calculated according to the origin of the natural gas. The EF therefore varies from year to year (e.g. from 57.76 t/TJ in 1990 to 57.09 t/TJ in 2009). The time-series consistency of this EF is checked by the Party on a yearly basis. As the Twinerg site represents more than 90 per cent of the Party's emissions from public electricity and heat production, the use of a country-specific EF is appropriate. The ERT commends Luxembourg for its efforts in that regard.

52. MSW is used in waste incineration. The CO_2 EFs for the fossil fraction of MSW are based on regular studies carried out by the waste division of AEV. For the years where no data are available, EFs from available years are reported. The ERT noticed that this practice has led to time-series inconsistencies. The ERT recommends that Luxembourg improve the time-series consistency of the EF for MSW in its next annual submission. This could be done by extrapolating the EF between two years for which data are available.

53. The ERT noted a sharp increase in liquid fuel consumption in the category agriculture, forestry and fisheries between 2008 and 2009 (by 53 per cent). Luxembourg explained during the review week that this increase could be confirmed using the energy

[5] CH_4 and N_2O emissions under this category are not always key categories. However, since the calculation procedures for and issues related to this category are discussed as a whole, the individual gases are not assessed in separate sections.

balance. The ERT recommends that Luxembourg check for any updates to this category in the next version of the national energy balance and provide justified explanations for any large inter-annual changes.

54. The ERT noticed some time-series inconsistencies in the CH_4 and N_2O EFs for other sectors. According to the Party, the IEF varies across the time series according to the share of diesel and gas oil consumed in this category, as gas oil is attributed to stationary sources and diesel oil is attributed to mobile sources (i.e. the EFs for stationary and mobile sources are different). The ERT recommends that the Party check the variation of the IEF across the time series to ensure that time-series consistency is maintained.

55. Luxembourg has reported the emissions for the category other (fuel combustion) from 1990 to 2003. The update of the national energy balance since 2003 has allowed Luxembourg to greatly improve the transparency of its reporting by splitting energy consumption into the relevant subcategories. However, some emissions have been reported under other (fuel combustion) for the period 1990–2003 due to a lack of sufficiently detailed data. However, this does not influence the national total GHG emissions, as total energy consumption is considered in the national energy balance. The ERT commends the Party for the improvement in the transparency of its reporting by splitting energy consumption previously included under the category other (fuel combustion) into the relevant subcategories.

Road transportation: liquid fuels: CH_4 and N_2O[6]

56. CH_4 and N_2O emissions from road transportation are calculated using the COPERT IV model with data on the Luxembourg fleet applied to the total quantity of fuel sold in the country. As the fleet refuelling in Luxembourg might be significantly different from the fleet from Luxembourg, the Party has launched a study to enable the more accurate estimation of emissions from both the domestic and the international fleets refuelling in Luxembourg by improving the input data used in the COPERT IV model. A draft report on the study is expected soon. The ERT commends the Party for this study.

4. Non-key categories

Stationary combustion: biomass fuels – CO_2, CH_4 and N_2O

57. The ERT noticed that there is a time-series inconsistency in the data used to determine the share of biomass in the tyres consumed for clinker production. These data have been reported under the EU ETS since 2007. In total, 27 per cent of the weight of the used tyres is considered to be derived from biomass in the calculation. In response to a question raised by the ERT during the review week, Luxembourg provided the reference for this assumption. The share of biomass was checked and agreed to by the ERT. However, as no data on the biomass content of the tyres consumed for clinker production were available for the previous years (1998–2006), the Party assumes that the share is 0 per cent. The ERT recommends that the Party check this assumption and, if needed, maintain time-series consistency by modifying this value for each year of the period 1998–2006 according to the IPCC good practice guidance for future annual submissions.

Railways: liquid fuels – CO_2, CH_4 and N_2O

58. The ERT observed a sharp increase in the fuel consumption of railways for the most recent years of the time series (2006–2009). This was also observed by the previous ERT.

[6] CH_4 emissions under this category are not a key category. However, since the calculation procedures for and issues related to this category are discussed as a whole, the individual gases are not assessed in separate sections.

According to the information provided by the Party during the review, this was due to errors detected in the file provided by the operator of Luxembourg's railway company (CFL). The ERT recommends that Luxembourg recalculate these emissions using correct data in the next annual submission, as suggested by the ERT during the review.

Navigation: liquid fuels – CO_2, CH_4 and N_2O

59. The emissions from leisure boats were included in the 2011 submission. The fuel consumption used as AD for this estimation is obtained from the fuel seller which is the sole marina in Luxembourg. The ERT noted that the Party has not checked whether the reported fuel consumption is already included in the national statistics which is used for the AD for other subcategories. The ERT recommends that Luxembourg check if the fuel consumption considered for these boats has already been taken into account in other subcategories of the energy balance, in order to avoid any double counting.

Oil and natural gas – CH_4

60. Luxembourg has used the tier 1 method defined in the 2006 IPCC Guidelines to estimate CH_4 emissions from natural gas distribution. This methodology leads to higher emissions compared to those obtained using the EF from the IPCC good practice guidance. The Party explained during the review week that this methodology was justified because the installations in Luxembourg are relatively new compared to those of other countries. Although oil and natural gas is not a key category (as there is only one operator in Luxembourg), the ERT encourages the Party to collect country-specific data in order to improve the accuracy of the inventory.

5. Areas for further improvement

Identified by the Party

61. The Party identified the following improvements in its NIR:

(a) The separation of biogenic matter from fossil fuels in the reference approach;

(b) The provision of a separate quantitative estimate for each discrepancy between the reference approach and the sectoral approach;

(c) The investigation and explanation of any differences between the data reported to international organizations and the data reported in the annual submission;

(d) The reallocation of emissions from off-road vehicles and other machinery from the respective subcategories of manufacturing industries and construction, including other non-ferrous activities if relevant (e.g. copper processing and production from copper scrap), which are now included under the category other (manufacturing industries and constructions);

(e) The improvement of the accuracy of the emissions from the use of lubricants;

(f) The collection of information to help refine the fuel consumption split between the commercial/institutional category and the residential category for the years 1990–1999.

Identified by the expert review team

62. The ERT recommends that Luxembourg make the following improvements to future annual submissions:

(a) The correction of the total natural gas consumption as an unexplained difference of 7 per cent is observed between the consumption reported for the reference and the sectoral approaches;

(b) The checking of fuel consumption data to eliminate the possibility of the double counting of emissions;

(c) The correction of time-series inconsistencies;

(d) The improvement of the transparency of the NIR by justifying the use of the EFs contained in the 2006 IPCC Guidelines, and providing appropriate references and a clear rationale for the main recalculations.

63. The ERT also encourages Luxembourg to collect country-specific data on CH_4 emissions from oil and natural gas.

C. Industrial processes and solvent and other product use

1. Sector overview

64. In 2009, emissions from the industrial processes sector amounted to 642.21 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 16.02 Gg CO_2 eq, or 0.1 per cent of total GHG emissions. Since the base year, emissions have decreased by 60.5 per cent in the industrial processes sector, and decreased by 33.0 per cent in the solvent and other product use sector. The key driver for the fall in emissions in the industrial processes sector is the change in the production process of steel from blast furnaces to electric arc furnaces between 1994 and 1998. Luxembourg reports that the financial and economic crisis that started in the second half of 2008 is mainly responsible for the 9.0 per cent decrease in emissions between 2008 and 2009. Within the industrial processes sector, 68.5 per cent of the emissions were from mineral products, followed by 20.0 per cent from metal production and 11.4 per cent from consumption of halocarbons and SF_6.

65. Potential emissions of F-gases for all years of the time series have not been reported. During the review week, the ERT was informed that Luxembourg plans to include the estimates of potential F-gas emissions in the next annual submission. The ERT welcomes this planned improvement and encourages Luxembourg to proceed with its implementation in order to improve completeness.

66. The ERT recommends that Luxembourg provide a more detailed explanation in the NIR on the AD, EFs, methodologies and assumptions applied to the category consumption of halocarbons and SF_6, in order to increase the transparency of its reporting. Luxembourg did not fill in any notation keys or numeric values in the background tables for F-gases (e.g. CRF sectoral background table 2(II).F) for all reporting years. The transparency and completeness of the CRF tables could be improved by providing completed background tables for emissions of F-gases.

67. The ERT noted that the Party has made a recalculation in the category consumption of halocarbons and SF_6, based on a new study on the estimation of HFCs, PFCs and SF_6 (Econotec, 2010[7]). The recalculation has been performed in order to use more country-specific data for all years of the time series. As a result of the recalculation, total sectoral emissions have decreased by 4.0 per cent in 2008.

[7] Econotec. 2010. *Estimates and Projections of Fluorinated Greenhouse Gases (HFCs, PFCs and SF_6) in Luxembourg* (in French). Brussels: Econotec Consultants.

68. The ERT noted that category-specific QC procedures have been conducted for several categories, such as a comparison of the AD provided by the plants for the GHG inventory, the data for the EU ETS and national statistics. However, there are some categories to which these QC procedures have not been applied. The ERT further noted that comparisons were conducted between the IPCC default EF and the EF provided by the plants for cement production, and between the EU ETS data from the plants and the country-specific EF for glass production. The ERT encourages Luxembourg to apply, to the extent possible, QC procedures to all categories for which the data used to calculate the emission estimates are provided by the plants.

69. Uncertainty values for AD and EFs have been provided in the NIR for most categories, except for F-gases. The Party has used the default uncertainty values provided in the IPCC good practice guidance.

2. Key categories

Cement production – CO_2

70. Luxembourg applies a tier 2 methodology based on the calcium oxide (CaO) and magnesium oxide (MgO) contained in clinker to estimate CO_2 emissions from cement production. This is in line with the IPCC good practice guidance. Data on the CaO and MgO content in clinker are provided once every five years by the only cement production plant in the country and are interpolated for the other years by AEV. Following the recommendations from previous review reports, Luxembourg has collected and used the annual data on the CaO and MgO content in clinker to estimate CO_2 emissions from cement production for 2008 and 2009. The ERT encourages Luxembourg to continue this practice.

Other (mineral products) – CO_2

71. Luxembourg has one glass production company, which owns two plants. The AD used to calculate CO_2 emissions from glass production are the annual production data and a constant EF of 0.142 t CO_2/t glass based on the loss of ignition of the batch composition, provided by the plant operator. The calculated plant-specific EF is in the range of the reporting Parties (0.03–0.44 t CO_2/t glass).

72. In response to a question raised by the ERT during the review, Luxembourg provided information on how the EF for glass production, which includes recycled glass, was estimated. The ERT recommends that Luxembourg include the information provided during the review in the NIR of its next annual submission.

Iron and steel production – CO_2

73. Luxembourg applies a tier 2 methodology for iron and steel production, taking into account all carbon-containing materials such as anthracite, carbon, steel scrap and electrodes. Emissions from blast furnace gas consumption are reported in the energy sector, whereas emissions from anthracite, carbon, other fuels and electrodes used as reductant are reported in the industrial processes sector under the category iron and steel production.

74. In response to a question raised by the ERT during the review, Luxembourg explained that the EFs used for sinter production (79.19 kg CO_2/t), blast furnace gas (75.61 kg CO_2/t) and basic oxygen furnace gas (115.36 kg CO_2/t) were calculated on the basis of detailed information on the carbon consumption available for the year 1990 and documented in the study "TÜV Studie". A country-specific methodology has been applied for the years 1991–1997 based on the EF determined for the year 1990. For electric arc furnaces, the EF (56.80 kg CO_2/t) for 2004 was calculated on the basis of the externally verified carbon consumption for the three iron and steel producing plants. The EF for 2004

was also applied to the years 1993–2003 based on the country-specific methodology. For the years 2005–2009, the carbon consumption from three electric arc furnaces and the PRIMUS process is based on the verified EU ETS data, which is compared with the national solid carbon consumption. The ERT recommends that Luxembourg include a carbon mass balance for the entire time series and more information on the country-specific methodology in order to increase transparency in the NIR of its next annual submission.

Consumption of halocarbons and SF_6 – HFCs and SF_6

75. Luxembourg has reported actual HFC and SF_6 emissions based on the new study on the estimation of HFCs, PFCs and SF_6 (Econotec, 2010). The results of the study cover the following categories: refrigeration and air-conditioning equipment, foam blowing, aerosols/metered dose inhalers, electrical equipment and noise-reduction windows. The ERT compared the F-gas emissions per capita among the reporting Parties and noted that the EF for Luxembourg (131.00 kg CO_2 eq/capita) was a little higher than the average EF (126.72 kg CO_2 eq/capita). The ERT concluded that Luxembourg's estimation level was appropriate. The ERT commends the Party for conducting the new study and applying the results of the study to the estimation of HFC and SF_6 emissions.

76. The ERT noted that the emissions of HFCs and SF_6 are assumed to be constant for the period 1990–1995 (HFC emissions from foam blowing and aerosols/metered dose inhalers, and SF_6 emissions from electrical equipment). The ERT recommends that Luxembourg provide a description of the trend in the NIR and maintain the time-series consistency of these categories in accordance with the IPCC good practice guidance.

77. The ERT further noted that HFC emissions from transport refrigeration, foam blowing and aerosols/metered dose inhalers are estimated on the basis of the data from neighbouring countries (i.e. Belgium, Germany). The ERT reiterates the recommendation from the previous review report that Luxembourg make efforts to collect and use country-specific data in the calculation of HFC emissions for the entire time series.

78. During the review week, the ERT noted that Luxembourg has information that tracks the flow and amount of HFC, PFC and SF_6 emissions (in bulk and equipment). The ERT recommends that Luxembourg provide this information in the NIR and in the relevant CRF tables in its next annual submission.

3. Non-key categories

Soda ash production and use – CO_2

79. Luxembourg reports CO_2 emissions from soda ash use as included elsewhere ("IE"), including it in the emissions from glass production. During the in-country review, the Party provided information on the total amount of soda ash used in the two plants of the national glass company. The ERT recommends that Luxembourg include more information on soda ash use in the NIR of its next annual submission.

Solvent and other product use – CO_2 and N_2O

80. The ERT noted that CO_2 emissions from solvent and other product use are estimated partly on the basis of national data (import–export statistics and production statistics) and partly on the basis of data from Austria applied to the national conditions. The ERT encourages Luxembourg to obtain more country-specific data to estimate these emissions.

81. 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 2003–2009, emissions are estimated from country-specific data collected from hospitals in Luxembourg. The ERT recommends that Luxembourg ensure time-series

consistency by recalculating emissions for the period 1990–2002, either by obtaining and using country-specific data or by using data-splicing techniques to recalculate the AD for the period 1990–2002.

4. Areas for further improvement

Identified by the Party

82. Luxembourg has identified improvements to increase transparency, in particular through the provision of an improved description of the methodologies and assumptions used for the category consumption of halocarbons and SF_6.

Identified by the expert review team

83. HFC emissions from transport refrigeration, foam blowing and aerosols/metered dose inhalers are estimated on the basis of data from neighbouring countries (Belgium, Germany). The ERT recommends that Luxembourg make efforts to collect and use country-specific data in the calculation of HFC emissions for the entire time series.

84. The ERT recommends that Luxembourg cross-check the plant-specific information on the amount of soda ash used with the national statistics in order to ensure the completeness of CO_2 emissions from soda ash use in the next annual submission.

D. Agriculture

1. Sector overview

85. In 2009, emissions from the agriculture sector amounted to 674.09 Gg CO_2 eq, or 5.8 per cent of total GHG emissions. Since the base year, emissions have decreased by 9.6 per cent. The key drivers for the fall in emissions are the reduction in the number of cattle and a decline in synthetic fertilizer application. Within the sector, 45.7 per cent of the emissions were from agricultural soils, followed by 36.5 per cent from enteric fermentation and 17.7 per cent from manure management. CH_4 accounted for 50.5 per cent of the sectoral emissions, while N_2O accounted for the remaining 49.5 per cent. Rice cultivation, field burning of agricultural residues and prescribed burning of savannas do not occur in Luxembourg.

86. During the review week, Luxembourg provided calculation spreadsheets that presented information on the methodologies, parameters and AD used in the preparation of the agriculture sector of the inventory. In response to a recommendation in the previous review report, the Party has included in the NIR tables with information on the AD and parameters used for the estimation of emissions and their units. Luxembourg has also used 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. While the descriptions provided in the footnotes have enhanced the transparency of the inventory, such detailed information in the footnotes does not always facilitate the readers' understanding of the estimation methodology. The ERT, therefore, encourages the Party to include such information in the actual text of the NIR in order to increase the readability of the NIR.

87. Luxembourg has performed recalculations for the agriculture sector between the 2010 and 2011 submissions due to revised parameters and updated AD. Provisional fertilizer data were replaced with actual data and new estimates of sewage sludge were used. The recalculations were performed for the following categories: enteric fermentation (an increase of 0.001 per cent for 2008), manure management (an increase of 0.2 per cent for 2008) and agricultural soils (an increase of 0.1 per cent for 2008). However, the Party did not specify in the NIR the impact of these recalculations on the agriculture sector. The

ERT recommends that the Party include information on the impact of the recalculations on the agriculture sector in the NIR.

88. Luxembourg has planned several improvements in the inventory preparation process for the agriculture sector, most of which are in response to recommendations from previous review reports. These include: the breakdown of sheep between lambs and mature animals to allow for the calculation of more precise live weights for the animal category; the breakdown of swine into various subcategories to allow for the application of more precise parameter values for the estimation of emissions; and the inclusion of ostriches in the inventory. The ERT commends Luxembourg for addressing previous recommendations in its planned improvements. However, the ERT notes that some of these plans may not be implemented due to the conditions attached to their implementation, such as whether their implementation will be time- and resource-consuming, or the consideration of whether the share of emissions from the relevant categories is insignificant. The ERT, therefore, recommends that the Party consider the implementation of these plans taking into account the priority and feasibility of their implementation.

2. Key categories

Enteric fermentation – CH_4

89. 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 in line with the IPCC good practice guidance. The ERT notes that the Party has revised the average gross energy intake and average CH_4 conversion rates for poultry. The Revised 1996 IPCC Guidelines and the IPCC good practice guidance do not provide specific methodologies for the estimation of emissions from poultry and the Party has used Austrian parameters for the gross energy intake. The ERT commends the Party for reporting these emissions.

90. The ERT notes that the IEFs for mature non-dairy cattle have remained constant (55.2 kg CH_4/head/day) from 1990 to 2009 although these factors are affected by weight changes. The ERT recommends that the Party revise the EFs to take into account weight changes in accordance with the IPCC good practice guidance for the next annual submission.

91. The NIR indicates that in Luxembourg there is a small number of ostriches, but emissions from these have not been included because of a lack of estimation methodology in the Revised 1996 IPCC Guidelines. The ERT encourages Luxembourg to adopt methodologies from other countries where the national circumstances are similar to those of Luxembourg and to report those emissions as “other poultry” under other (enteric fermentation).

Manure management – CH_4

92. A tier 2 method has been applied to estimate CH_4 emissions from cattle, while a tier 1 method has been applied for the estimation of CH_4 emissions from all other livestock in line with the IPCC good practice guidance. The ERT recommends that Luxembourg develop and apply higher-tier methods for the estimation of CH_4 emissions from swine, which are significant animals for the category.

Direct soil emissions – N_2O

93. Tier 1a and tier 1b methods and IPCC default EFs have been used to estimate emissions from this category. As this category is identified as a key category, the ERT encourages Luxembourg to develop and apply country-specific EFs to this category in its next annual submission. Luxembourg has used the 2008 fertilizer value (13,334 t N) for the

estimation of N_2O direct soil emissions in 2009, because at the time of the calculations the 2009 data were not available. During the review week, Luxembourg revealed that this is an annual problem that occurs because of delays in data transmission between institutions. The ERT recommends that the Party recalculate the emissions once the 2009 value is available and enhance the coordination between data collection and handling institutions as the continued use of proxy data affects the accuracy of the inventory estimates.

3. Areas for further improvement

Identified by the Party

94. Luxembourg identified many category-specific planned improvements in its NIR, including: exploring the application of country-specific EFs and parameters and the estimation of emissions by further disaggregating swine and chickens, if national data are available to allow for that disaggregation; and the provision of more information on the parameters, EFs and AD used in its NIR in order to improve transparency.

Identified by the expert review team

95. The ERT recommends that the Party revise the EF for enteric fermentation of mature non-dairy cattle to take into account weight changes in accordance with the IPCC good practice guidance for the next annual submission. The ERT also recommends that Luxembourg develop and apply higher-tier methods for swine, which are significant animals for the category manure management.

E. Land use, land-use change and forestry

1. Sector overview

96. In 2009, net removals from the LULUCF sector amounted to 296.43 Gg CO_2 eq. In the base year, net emissions from the LULUCF sector amounted to 347.75 Gg CO_2 eq. The key driver for the rise in removals is the increase in removals from changes in the living biomass pool in forest land remaining forest land. In 2009, within the sector, removals of 393.14 Gg CO_2 eq were from forest land remaining forest land, followed by emissions of 109.23 Gg CO_2 eq from land converted to settlements, removals of 78.00 Gg CO_2 eq from land converted to forest land and emissions of 26.92 Gg CO_2 eq from land converted to grassland. Land converted to cropland accounted for emissions of 20.45 Gg CO_2 eq and land converted to wetlands accounted for emissions of 9.83 Gg CO_2 eq. The remaining emissions of 7.80 Gg CO_2 eq and 0.46 Gg CO_2 eq were from cropland remaining cropland and land converted to other land, respectively.

97. The LULUCF sector of Luxembourg's inventory is generally complete. The Party has reported the following emissions as not estimated ("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. The reporting of these categories is not mandatory and thus the inventory is complete.

98. The Party's NIR states that Luxembourg has not performed any recalculations for the LULUCF sector between the 2010 and 2011 submissions.

99. The information reported on the LULUCF sector is generally transparent. However, Luxembourg has not provided transparent information in the NIR on: the data source for the losses in the living biomass pool in forest land remaining forest land; the data source for the dead organic matter carbon stock changes in forest land converted to cropland, grassland, wetlands, settlements and other land; the method and assumptions used to obtain

the “20-year areas” and annually converted areas for various land-use categories; and 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.

100. Luxembourg uses three different land-use/land cover maps from the Occupation Biophysiques du Sol (OBS) surveys conducted in 1989, 1999 and 2007 (OBS89, OBS99 and OBS07) to obtain its land use and land-use change information using the IPCC approach 3 methodology for land area representation. However, these surveys differ from each other in terms of the methodology followed, the minimum mapping units and the accuracy of the classifications. The first OBS data set (OBS89) was based on a field survey. The second data set (OBS99) was collected based on aerial colour infrared orthophotos and some field surveying. The third data set (OBS07) is an update of the OBS99 survey using very high resolution satellite images (1 m pixel size) from the IKONOS commercial earth observation satellite of the United States of America. The land-use change in the intervening years has been derived using linear interpolation. Since the survey techniques vary in terms of the methodology used, the minimum mapping units and the accuracy of the classifications, they are not time-series consistent and, therefore, should not be used to estimate land-use change without applying an appropriate correction. The NIR mentions that Luxembourg plans to use the results of the OBS survey conducted in 2010 or alternatively a new survey based on remote sensing conducted in 2012 to improve the accuracy of the land area estimates. The ERT recommends that Luxembourg use the methods described in the IPCC good practice guidance for LULUCF, including data-splicing techniques, to ensure the time-series consistency of the land area information used in the inventory.

101. Luxembourg has not performed an uncertainty assessment for the LULUCF sector. The ERT recommends that Luxembourg perform and report the results of an uncertainty analysis for the LULUCF sector in the next annual submission.

102. 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 QA/QC elements for the LULUCF sector in the next annual submission.

2. Key categories

Forest land remaining forest land – CO_2

103. Forest land remaining forest land is the most significant category in the LULUCF sector. Fluctuations in emissions/removals from forest land are driven to a large extent by the significant inter-annual variability in biomass changes in forest land remaining forest land due to variations in the influencing factors on growth and harvest, such as weather conditions, timber demand and prices. While the NIR provides information on the estimation of biomass increment, it does not contain any information on the biomass losses in forest land remaining forest land. During the review, Luxembourg informed the ERT that there are both public and private forests in Luxembourg. While the data on public forests is obtained from official statistics, the information on private forests is based on expert judgement. Considering that this is a key category, it is extremely important that reliable and well-substantiated AD are used for the estimation methods. The Party informed the ERT that the results of the National Forest Inventory of 2010 will be available next year and there are plans to recalculate the emission/removal estimates based on those results. The ERT recommends that Luxembourg use the more accurate results from the National

Forest Inventory to recalculate the emission/removal estimates from forest land remaining forest land.

104. Luxembourg uses biomass increment rates from yield tables for various species together with some IPCC default and country-specific parameters. In the course of the review week, Luxembourg showed the ERT the spreadsheets used for the calculation of the mean annual increment value for various species. The Party explained that mean annual increment values were not available from the yield tables for age classes above 150 years and, therefore, for those age classes, the mean annual increment values were based on expert judgement. However, the ERT believes that some of those values are higher than expected and may result in an overestimation of removals. Luxembourg also informed the ERT that the results of the National Forest Inventory of 2010 will be available next year and there are plans to recalculate the emission/removal estimates based on those results. The ERT recommends that Luxembourg use the more accurate results from the National Forest Inventory to recalculate the emission/removal estimates from forest land remaining forest land.

105. Luxembourg uses a mix of tier 1 and tier 2 methods to estimate emissions and removals from forest land remaining forest land using some country-specific parameters together with IPCC defaults and tier 1 default assumptions. In accordance with the default tier 1 assumptions from the IPCC good practice guidance for LULUCF for forest land remaining forest land, the carbon stock changes in the dead organic matter and soil carbon pools have been assumed to be zero. However, as CO_2 emissions from forest land remaining forest land is a key category, according to the IPCC good practice guidance for LULUCF it is necessary to use higher-tier methods to estimate the emissions from it. The ERT recommends 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.

3. Non-key categories

Land converted to forest land – CO_2

106. Luxembourg has reported the carbon stock changes in dead wood for land converted to forest land as "NO". The NIR does not provide any information on the reason for this assumption. However, the Party has reported in the KP-LULUCF section of the NIR and also explained during the review week 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. While the ERT believes that this is a reasonable assumption, the ERT recommends 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.

Emissions from disturbance associated with land-use conversion to cropland – N_2O

107. The value of the C/N ratio used for the estimation of N_2O emissions from forest land converted to cropland is given in the NIR as 10:12 or 0.84. However, this value is extremely low compared to the default value provided in the IPCC good practice guidance for LULUCF, which is 15. This issue was also raised in the previous review report. In the course of review, the Party informed the ERT that the value provided in the NIR is different from that used in the CRF tables, which is 12. The ERT recommends that Luxembourg provide the correct value, as used in the CRF tables, in the NIR of the next annual submission.

4. Areas for further improvement

Identified by the Party

108. Luxembourg has identified the following areas for improvement in the NIR:

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

(b) The performance of a tier 1 and tier 2 uncertainty analysis for the LULUCF sector.

Identified by the expert review team

109. The ERT recommends that Luxembourg make the following improvements in future annual submissions:

(a) The improvement of transparency by providing transparent information on: the estimation of areas and area changes for the land-use categories; biomass removals in forest land; the dead wood carbon stock changes in forest land converted to cropland and grassland; and consistent values for the C/N ratio used in the estimation of N_2O emissions from forest land converted to cropland;

(b) The improvement of completeness by including estimates of changes in the dead wood and soil carbon pools for forest land converted to cropland and grassland;

(c) The performance of a tier 1 and tier 2 uncertainty analysis for the LULUCF sector;

(d) The provision of transparent information on sector-specific QC checks for the LULUCF sector.

F. Waste

1. Sector overview

110. In 2009, emissions from the waste sector amounted to 67.10 Gg CO_2 eq, or 0.6 per cent of total GHG emissions. Since the base year, emissions have decreased by 25.5 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 pre-treatment before landfilling; and the installation of CH_4 recovery systems at waste disposal sites. Within the sector, 55.9 per cent of the emissions were from solid waste disposal on land, followed by 22.6 per cent from the category other (composting) and 21.5 per cent from wastewater handling.

111. The CRF tables include estimates of all gases and categories of emissions from the waste sector in accordance with the Revised 1996 IPCC Guidelines. The information provided on the waste sector is generally transparent; however, some additional information, such as the waste generation rate and the fraction of MSW disposed in solid waste disposal sites (SWDS), has not been provided in the CRF tables. The ERT noted that the incorrect notation key was used to report the AD for industrial wastewater handling. In the CRF tables, the AD are reported as "NO" even when the N_2O emissions are reported in the NIR. In the NIR, Luxembourg described the methodology used, which is based on the measured concentration of N in wastewater. Therefore, the notation key "NA" (not

applicable) should be used to report the AD instead of "NO". The ERT recommends that Luxembourg correct the use of the notation key in the next annual submission.

112. Recalculations were performed for CH_4 emissions from solid waste disposal on land for the period 2005–2008 owing to an update of the analysis for the generated volume of MSW and CH_4 recovery. The impact of these recalculations is an increase of 2.0 per cent in total sectoral emissions for 2008. The rationale for these recalculations is provided in the NIR. In 2000, a recalculation was performed for CH_4 recovery from SWDS following a recommendation from the previous review report. For the year 2000, data from 2001 were used due to the unavailability of data. The ERT is of the view that, if CH_4 recovery data are not available, Luxembourg should use either the default value from the IPCC good practice guidance (zero) or should clearly document the reason for using the 2001 measured data for the 2000 estimates. The ERT believes that the use of undocumented estimates of landfill gas recovery is not appropriate because such estimates tend to overestimate the amount of CH_4 recovered. The ERT reiterates the recommendations from previous review reports that Luxembourg either use monitored data to report CH_4 recovery or apply the default CH_4 recovery ratio from the IPCC good practice guidance and provide a detailed explanation for the recalculation in the next annual submission.

113. Recalculations were also performed for N_2O emissions from domestic and commercial wastewater for the period 2003–2008 owing to an update of the population data. The impact of these recalculations is an increase of 1.4 per cent in total sectoral emissions for 2008. The rationale for these recalculations is provided in CRF table 8(b) but is not provided in the NIR. The ERT recommends that Luxembourg provide complete and transparent information on the recalculations for this category in the next annual submission.

114. The ERT noted that Luxembourg calculated the GHG emissions from solid waste disposal on land and from domestic and commercial wastewater using different population data. The ERT recommends that the Party use consistent population data for all inventory categories.

115. Luxembourg 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 typing mistakes and discrepancies between the data in the CRF tables and in the NIR. The ERT recommends that Luxembourg more strictly apply verification and QA/QC procedures and conduct category-specific QA/QC procedures for all waste categories in its next annual submission.

116. 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 Luxembourg include a discussion on the uncertainty for each category in the waste sector in the next annual submission.

2. Non-key categories

Solid waste disposal on land – CH_4

117. The IPCC first order decay method was used to estimate CH_4 emissions from solid waste disposal on land. Luxembourg uses different CH_4 generation rate constants (k) and degradable organic carbon (DOC) values for different waste types. All parameters are default values from the 2006 IPCC Guidelines, which better reflect the Party's circumstances and its use of more disaggregated AD than the values from the Revised 1996 IPCC Guidelines. The ERT noted that some additional information for the period 2006–2009, such as the waste generation rate and the fraction of MSW disposed to SWDS, has not

been presented in the NIR or in the CRF tables. The ERT recommends that Luxembourg improve the transparency of its reporting by providing the missing information in the NIR and in the CRF tables in the next annual submission.

Wastewater handling – CH_4 and N_2O

118. Luxembourg reports N_2O emissions from industrial wastewater (sludge) as "NE". In response to questions raised by the ERT during the review week, Luxembourg explained that the sludge from industrial wastewater (generated in only one plant) is exported to neighbouring countries for incineration. The ERT recommends that Luxembourg report N_2O emissions from this category as "NO" and provide an explanation in the NIR of its next annual submission.

119. The ERT noted that the AD and emissions for CH_4 and N_2O emissions from commercial wastewater (sludge) are reported as "NE". During the review, Luxembourg explained that part of the sludge applied to agricultural soils and the following N_2O emissions are reported under the category agricultural soils. Other parts of sludge are incinerated in the energy sector and the emissions therefrom are reported under the category other (manufacturing industries and construction). The remainder of the sludge is composted and the CH_4 and N_2O emissions therefrom are reported under the category other (waste). Therefore, the AD, CH_4 and N_2O emissions should be reported as "IE" instead of as "NE". The ERT recommends that Luxembourg report these emissions using the appropriate notation keys in the next annual submission.

Waste incineration – CO_2, CH_4 and N_2O

120. Luxembourg has estimated emissions of CO_2, CH_4 and N_2O from waste incineration and reported them under the energy sector. The NIR includes detailed explanations of the AD, EFs and methods used in the energy sector, under the public electricity and heat production category. This is in line with the IPCC good practice guidance. Luxembourg provided detailed information on country-specific NCVs for the different types of waste incinerated. The ERT commends Luxembourg for its efforts in that regard.

Other (waste) – CH_4 and N_2O

121. Luxembourg reports CH_4 and N_2O emissions from composting under this category. Emissions from composting have been calculated using the method provided in the 2006 IPCC Guidelines. The ERT commends Luxembourg for reporting the GHG emissions from this category.

3. Areas for further improvement

Identified by the Party

122. Luxembourg has identified the following areas for improvement: the improvement of the AD for domestic and commercial wastewater handling through the implementation of the results from the new census on waste that was conducted at the beginning of 2011; the use of the updated list of wastewater treatment plants which produce methane gas for energy reuse in CHP; and the inclusion of the aerobic pre-treatment of MSW before landfilling at the SIDEC landfill in the subcategory compost production.

Identified by the expert review team

123. The ERT recommends that Luxembourg improve the transparency of its reporting by providing the missing information (see para. 0 above) in the NIR and in the CRF tables in 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

124. 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, both afforestation and reforestation, and deforestation were identified as non-key categories.

125. The ERT commends Luxembourg for this improvement. The previous ERT recommended that Luxembourg include complete information in the KP-LULUCF CRF tables in the next annual submission. Luxembourg has provided a complete set of CRF tables including all the relevant information with the 2011 submission.

126. In its original submission of 2010, Luxembourg reported the required information set out in paragraphs 5–7 of the annex to decision 15/CMP.1 However, it failed to report the required information set out in paragraph 8 of the annex to decision 15/CMP.1. In the course of the 2010 review, Luxembourg provided this information to the ERT. The ERT recommended that Luxembourg include all the reporting elements set out in paragraphs 5–8 in its next annual submission. The Party has included this information in its 2011 submission. The ERT commends Luxembourg for this improvement. As Luxembourg did not elect any activities under Article 3, paragraph 4, of the Kyoto Protocol, it does not have to report the required information set out in paragraph 9 of the annex to decision 15/CMP.1.

127. As explained in paragraph 100 above, Luxembourg has used land-use data from three OBS land-use surveys (OBS89, OBS99 and OBS07). This land-use information has been used to estimate the areas of land subject to afforestation, reforestation and deforestation activities. Apart from the issue of time-series consistency identified in paragraph 100 above, the ERT believes that the areas of land subject to these activities are identifiable in each survey, and that the minimum spatial units used to determine the areas of land subject to these activities is taken into account under the land-use survey techniques used by Luxembourg. However, Luxembourg has not provided transparent information on the exact methodology and assumptions used to obtain the areas of land subject to afforestation, reforestation and deforestation activities, as recommended in the previous review report. In the course of the review, Luxembourg provided material showing the detailed steps involved in the calculation of the estimates of the areas of land subject to these activities, which greatly helped the ERT to understand the methodology used by the Party. The ERT recommends that Luxembourg transparently include this information in its NIR in the next annual submission.

128. The data and methods used by Luxembourg to estimate emissions and removals from afforestation and reforestation, and deforestation activities are the same as those used for the reporting under the Convention. This information has been included in chapters 7 (LULUCF) and 11 (KP-LULUCF) of the NIR.

129. Luxembourg has provided information demonstrating that the activities under Article 3, paragraph 3, of the Kyoto Protocol began on or after 1 January 1990 and are directly human-induced under section 11.4.1 of the NIR. The NIR cites the Luxembourg National Nature Conservation Act as the basis for the directly human-induced nature of the afforestation and reforestation, and deforestation activities. However, the ERT felt that the

NIR did not provide sufficient detail to prove the directly human-induced nature of the afforestation and reforestation activity, especially with regard to the possibility of regrowth on abandoned lands. During the review week, Luxembourg provided the ERT with information on the National Nature Conservation Act, which is supported by European Council legislation establishing the common rules for direct support schemes under the European Union Common Agricultural Policy. The ERT found this information to be very helpful in understanding the basis of the assumption used by the Party. The ERT recommends that Luxembourg include, in the NIR of its next annual submission, a complete description of the relevant provisions in the relevant legislation, as mentioned above, demonstrating that the activities under Article 3, paragraph 3, are directly human-induced.

130. Luxembourg has not performed an uncertainty analysis of the emissions and removals from afforestation, reforestation and deforestation activities. The ERT recommends that Luxembourg perform an uncertainty analysis of the emissions and removals from afforestation, reforestation and deforestation activities in the next annual submission.

131. Luxembourg has not transparently described the QA/QC procedures for KP-LULUCF reporting as recommended in the previous review report. During the review week, the Party provided some additional material, including detailed calculation spreadsheets, which helped the ERT to understand some of the QA/QC procedures followed by Luxembourg for KP-LULUCF reporting, especially for ensuring consistency between the reporting under the Convention and under the Kyoto Protocol. The ERT recommends that Luxembourg include detailed information on the QA/QC procedures followed for KP-LULUCF reporting in the NIR of its next annual submission.

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

Afforestation and reforestation – CO_2

132. For afforestation and reforestation activities, changes in the stock of dead wood are assumed not to occur due to the lack of dead wood in young forests and all other land uses. While the ERT believes that this is a reasonable assumption, the ERT recommends that Luxembourg substantiate this assumption with appropriate evidence (e.g. studies or survey results) in order to improve the transparency of the annual submission.

133. Luxembourg has reported the carbon stock changes in the below-ground biomass pool as "IE", including them in the carbon stock changes in the above-ground biomass pool. It is clear from the information provided in the NIR that it is possible to separate the carbon stock changes in the living biomass pool into those in the above- and below-ground biomass pools. The ERT recommends that Luxembourg report the carbon stock changes in the above- and below-ground biomass pools separately in the KP-LULUCF CRF tables in the next annual submission, in order to improve the transparency of its reporting.

Deforestation – CO_2 and N_2O

134. Luxembourg has reported the carbon stock changes in the below-ground biomass pool as "IE", including them in the carbon stock changes in the above-ground biomass pool. It is clear from the information provided in the NIR that it is possible to separate the carbon stock changes in the living biomass pool into those in the above- and below-ground biomass pools. The ERT recommends that Luxembourg report the carbon stock changes in the above- and below-ground biomass pools separately in the KP-LULUCF CRF tables in the next annual submission, in order to improve the transparency of its reporting.

135. Luxembourg has reported the N_2O emissions associated with land-use conversion to cropland in mineral soils in areas subject to deforestation activity in addition to those reported for forest land converted to cropland in the reporting under the Convention (0.0 Gg and 0.01 Gg, respectively), even though all the emissions from deforestation activity occur in forest land converted to cropland and the land area basis is the same for both (0.93 kha). However, the values of the IEFs used differ (0.80 kg N_2O-N/ha and 0.68 kg N_2O-N/ha, respectively). The ERT recommends that Luxembourg correct this discrepancy and provide the same values for the EFs and for the estimation of emissions in the reporting under the Convention and under the Kyoto Protocol.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

136. 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, except the calculation of its commitment period reserve (see para. 139 below). The ERT took note of the findings included in the SIAR on the SEF tables and the SEF comparison report.[8] The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10.

137. Information on the accounting of Kyoto Protocol units has been prepared and reported in accordance with chapter I.E of the annex to decision 15/CMP.1, except the calculation of the commitment period reserve (see para. 139 below), 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 (CDM) registry and meets the requirements set out in paragraph 88(a–j) of the annex to decision 22/CMP.1. 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

138. 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.

Calculation of the commitment period reserve

139. Luxembourg has reported its commitment period reserve in its 2011 annual submission. However, the ERT noted that Luxembourg reported in its NIR the remaining amounts for each Kyoto Protocol unit in the national registry as of 31 December 2011, instead of the calculation of its commitment period reserve in accordance with paragraph 6 of the annex to decision 11/CMP.1 and as required by paragraph 18 of the annex to decision 15/CMP.1. In response to questions raised by the ERT during the review week,

[8] The SEF comparison report is prepared by the 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.

Luxembourg correctly reported the calculation of its commitment period reserve, which has not been 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 and recommends that Luxembourg include information on the calculation of its commitment period reserve in its next annual submission.

3. Changes to the national system

140. Luxembourg reported that there have been no changes to 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.

4. Changes to the national registry

141. Luxembourg reported that there has been a change to its national registry since the previous annual submission. Luxembourg reported in the NIR that security measures have been employed in its national registry since November 2010 and that all users need a password (provided via text message) in order to gain authorized access to the national registry. 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

142. 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. Luxembourg has reported 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, in its 2011 annual submission. The reported information is considered complete and transparent.

143. Luxembourg reported that it is working to minimize not only the adverse impacts of climate change but also any adverse impacts due to the reduction of GHG emissions, by striving to implement all its commitments under the Kyoto Protocol. In the Party's development of a long-term sustainable development policy, adverse impacts are avoided through two main actions:

(a) As set out in the EU ETS, emission allowances are granted for free to companies with certain characteristics. This is done in order to avoid the risk of carbon leakage and to reduce the risk of an increase in GHG emissions in other countries that do not have comparable environmental standards;

(b) Joint implementation and CDM projects can only be eligible in Luxembourg if they respect specific social and environmental criteria, and priority is given to technology transfer projects.

144. In implementing its commitments under Article 3, paragraph 14, of the Kyoto Protocol, Luxembourg gave priority to:

(a) Substantially reforming its energy markets to reduce market imperfections and in order to comply with European Union legislation;

(b) Putting in place several fiscal incentives with the aim of reducing the use of fossil fuels in the transport sector;

(c) Putting in place several subsidies in the residential, commercial and institutional sectors, with the aim of reducing the use of fossil fuels and improving the use of renewable energy sources and promoting energy efficiency.

III. Conclusions and recommendations

145. Luxembourg made its annual submission on 15 April 2011, and resubmitted its NIR on 27 May 2011 due to detected errors. 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 the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol). This is in line with decision 15/CMP.1.

146. The ERT concludes that the inventory submission of Luxembourg has been prepared and reported in accordance with the UNFCCC reporting guidelines. The inventory submission is complete and the Party has submitted a complete set of CRF tables for the years 1990–2009 and an NIR; these are complete in terms of geographical coverage, years and sectors, as well as complete in terms of categories and gases. CRF sectoral background table 2(II).F was not provided. Estimates of potential emissions of HFCs, PFCs and SF_6 were also not provided.

147. 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.

148. Luxembourg'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 identified some instances where the inventory is not fully in line with the IPCC good practice guidance as explained in paragraph 29 above. The 2011 inventory submission is generally of a high quality, but the ERT identified a need for further improvements in the following areas: transparency (energy, LULUCF and waste sectors); completeness (potential emissions of F-gases in the industrial processes sector); time-series consistency (energy, LULUCF and industrial processes sectors); accuracy (industrial processes, LULUCF and waste sectors); and the uncertainty assessment (LULUCF and waste sectors).

149. The Party has made recalculations for the inventory between the 2010 and 2011 submissions, some of which have been made in response to the 2010 annual review report, while others have been conducted 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 estimated total GHG emissions in 1990 of 290.94 Gg CO_2 eq (2.2 per cent) and a decrease in estimated total GHG emissions in 2008 of 234.16 Gg CO_2 eq (1.9 per cent).

150. 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.

151. Luxembourg has not made any recalculations for the KP-LULUCF activities between the 2010 and 2011 submissions.

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

153. The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1. However, the ERT noted that there is a shortage of human resources within the national inventory system and that there is a need to further strengthen the national system in order to improve quality of future annual submissions. Many of the issues detected during the review with regard to the inventory are related to the shortage of human resources for future inventory development.

154. 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.

155. Luxembourg has reported the information requested under chapter I.H of the annex to decision 15/CMP.1, "Minimization of adverse impacts in accordance with Article 3, paragraph 14" as part of its 2011 annual submission. The information was provided on 15 April 2011. The information provided was complete and transparent (see paras. 143 and 144 above).

156. The ERT identifies the following cross-cutting issues for improvement:

(a) Increasing the number of staff within the national inventory system, including a backup for the national inventory compiler for future inventory development (see para. 21 above);

(b) The designation of a person with overall responsibility for the preparation of the LULUCF sector (see para. 21 above);

(c) The strengthening of the QA/QC management system (see paras. 21 and 28 above);

(d) The enhancement of the coordination between data collection and handling institutions (see para. 93 above).

157. In the course of the review, the ERT formulated a number of recommendations relating to the transparency (energy, LULUCF and waste sectors); completeness (potential emissions of F-gases in the industrial processes sector); time-series consistency (energy, LULUCF and industrial processes sectors); and accuracy (industrial processes, LULUCF and waste sectors) of the annual submission; and the uncertainty assessment (LULUCF and waste sectors) in Luxembourg's annual submission. The key recommendations are that Luxembourg:

(a) In the energy sector: eliminate discrepancies between the reference and the sectoral approaches; provide transparent information on the use of expert judgement and on the use of the EFs provided in the 2006 IPCC Guidelines; resolve time-series consistency issues arising from the variations in the values of the IEFs used in the calculation of N_2O and CH_4 emissions from stationary combustion (liquid fuels) in the energy sector; provide data for earlier years of the time series on the share of biomass in the tyres used for clinker production; and use available data to ensure that there is no missing data on MSW;

(b) In the industrial processes sector: improve completeness in the reporting of potential emissions of F-gases; provide transparent information regarding the EFs, AD and methods used for the estimation of emissions from consumption of halocarbons and SF_6; improve the time-series consistency of HFC and SF_6 emissions from refrigeration and foam blowing and N_2O emissions from solvent and product use; and prepare and include a carbon mass balance for the entire time series for iron and steel production;

(c) In the agriculture sector: use higher-tier methods for swine and direct N_2O emissions from soils; and use EFs that better reflect the variation in livestock performance parameters across the time series for non-dairy cattle;

(d) In the LULUCF sector: provide transparent information on the AD used for forest land remaining forest land, and forest land converted to cropland, grassland and settlements; resolve time-series consistency issues arising from the use of the three OBS land use/land cover survey techniques across the time series; use expert judgement for living biomass; use IPCC tier 1 assumptions for dead organic matter in forest land remaining forest land, and for the dead organic matter pool in land converted to forest land; use a correct C/N ratio for the estimation of N_2O emissions from disturbance associated with conversion to cropland; and conduct an uncertainty assessment and provide a description of the QA/QC procedures in the LULUCF sector;

(e) In the waste sector: resolve transparency issues relating to the use of inappropriate notation keys for CH_4 emissions from sewage sludge; provide information on the recalculation of N_2O emissions from wastewater disposal and the parameter values used for the first order decay model for CH_4 emissions from solid waste disposal; and use the correct CH_4 recovery factor or the IPCC default value for CH_4 emissions from solid waste disposal;

(f) For KP-LULUCF reporting; provide transparent information on the AD used and on the separation of above- and below-ground biomass for afforestation, deforestation and reforestation activities and QA/QC procedures; resolve time-series consistency issues caused by the use of three different land use/land cover survey techniques for obtaining AD for afforestation, deforestation and reforestation activities; and eliminate the discrepancy in the IEFs used for the reporting under the Convention and under the Kyoto Protocol for the N_2O emissions from disturbance associated with conversion to cropland in the supplementary information on activities relating to Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

IV. Questions of implementation

158. 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 2011. Available at <http://unfccc.int/resource/docs/2011/asr/ lux.pdf>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2011. Available at <http://unfccc.int/resource/webdocs/sai/2011.pdf>.

FCCC/ARR/2010/LUX. Report of the individual review of the annual submission of Luxembourg submitted in 2010. Available at <http://unfccc.int/resource/docs/2011/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, Mr. Pierre Dornseiffer and Mr. Serge Less (AEV), Ms. Kirsten Franz (SEG), Mr. Eric De Brabanter (MDDI), Mr. Jean-Paul Hoffmann (SER), Mr. Georges Kugener (ANF), Mr. Marc Weyland (ASTA), Mr. Dominique Manetta and Mr. Tom Bechet (AGE), Dr. Olivier Thunus (STATEC) and Mr. Willibald Croi (Luxspace), including additional material on the methodology and assumptions used. The following documents[1] were also provided by Luxembourg:

Circalux website (demonstration). Available at https://circalux.etat.lu/Members/irc/public/invges/home (only for members).

Umweltbundesamt Wien. 2011. *Checkliste für inspektionsstellen öve/önorm en ISO/IEC 17020 Nationales System* (Final report audit of National System).

AEV. 2011. QA/QC-plan for national system 2011

AEV. 2011. Improvement plan 2011

AEV. 2011. Priority list 2011

AEV. 2011. Criteria for the prioritization of the QA/QC plan

AEV. 2011. QC checklists

VDZ-Tätigkeitsbericht. 2008. *Umweltschutz bei der Zementherstellung 2005 – 2007*

Protocole de conversation téléphonique.doc

AEV_Recalculation Effects_2010v2.1_2011v13_110401.xls

EnergyCompEBsub2011sub2010.xls

Question_1A4c.xls

Thewes F. and Weidenhaupt A., 1999. *Annual emission estimates of HFC, PFC and SF_6 in Luxembourg between 1990 and 2010* (in French). Hydrofluorocarbones (HFC), perfluorocarbones (PFC), hexafluorure de soufre (SF_6). Estimation des rejets annuels au Luxembourg entre 1995 et 2000. Administration de Environment et CRTE, Luxembourg

ECONOTEC, 2010, *Estimates and projection of fluorinated greenhouse gases (HFC, PFC and SF_6) in Luxembourg* (in French). Estimation et projection des rejets atmosphériques de gaz a effet de serre fluores (HFC, PFC and SF_6)au Luxembourg. ECONOTEC Consultants, Bruxelles

EC regulation 1782/2003;

Règlement grand-ducal du 8 avril 2005 portant certaines mesures d'application, au Grand-Duché de Luxembourg, du régime de paiement unique et de la conditionnalité dans le cadre de la politique agricole commune;

Calculation spreadsheets for mean annual increment and CRF tables

[1] Reproduced as received from the Party.

Annex II

Acronyms and abbreviations

AD	activity data
CaO	calcium oxide
CH_4	methane
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CRF	common reporting format
DOC	degradable organic carbon
EF	emission factor
ERT	expert review team
EU	European Union
F-gas	fluorinated gas
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
GJ	gigajoule (1 GJ = 10^9 joule)
HFCs	hydrofluorocarbons
IE	included elsewhere
IEA	International Energy Agency
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
MgO	magnesium oxide
MSW	municipal solid waste
NA	not applicable
N_2O	nitrous oxide
NCV	net calorific value
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 site
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change