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**Report of the individual review of the greenhouse gas inventories  
of Luxembourg submitted in 2007 and 2008<sup>\*</sup>**

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<sup>\*</sup> In the symbol for this document, 2008 refers to the year in which the inventory was submitted, and not to the year of publication.

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## I. Executive summary

1. This report covers the in-country review of the 2007 and 2008 greenhouse gas (GHG) annual inventory submissions of Luxembourg, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. In accordance with the conclusions of the Subsidiary Body for Implementation at its twenty-seventh session, the focus of the review is on the most recent (2008) submission.<sup>1</sup> The review took place from 13 to 17 October 2008 in Luxembourg City, Luxembourg, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Mr. Michael Strogies (Germany); energy – Mr. Amit Garg (India); industrial processes – Mr. Newton Paciornik (Brazil); agriculture – Ms. Janka Szemesová (Slovakia); land use, land-use change and forestry (LULUCF) – Mr. Walter Oyhantçabal (Uruguay); and waste – Ms. Melissa Weitz (United States of America). Mr. Strogies and Mr. Paciornik were the lead reviewers. The review was coordinated by Ms. Ruta Bubniene (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 2006, (as contained in the 2008 annual submission), the main GHG in Luxembourg was carbon dioxide (CO<sub>2</sub>), accounting for 90.9 per cent of total GHG emissions<sup>2</sup> expressed in CO<sub>2</sub> eq, followed by nitrous oxide (N<sub>2</sub>O) (4.9 per cent) and methane (CH<sub>4</sub>) (3.5 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>) collectively accounted for 0.7 per cent of the overall GHG emissions in the country. The energy sector accounted for 88.7 per cent of total GHG emissions, followed by industrial processes (5.7 per cent), agriculture (5.2 per cent), waste (0.3 per cent), and solvent and other product use (0.1 per cent). Total GHG emissions amounted to 13,321.90 Gg CO<sub>2</sub> eq and increased by 1.0 per cent between the base year<sup>3</sup> and 2006.

4. In 2005, (as contained in the 2007 annual submission), total GHG emissions amounted to 13,256.59 Gg CO<sub>2</sub> eq. The shares of gases and sectors in 2006 (2008 annual submission) were similar to those of 2005 (2007 annual submission). The trends for the different gases and sectors are clearly explained in the relevant sections of the national inventory report (NIR) and are reasonable.

5. Tables 1 and 2 show GHG emissions by gas and by sector, respectively, as they are reported in the 2008 submission.

6. Luxembourg has made significant improvements since the previous inventory submission. The improvements include the preparation of an initial quality assurance/quality control (QA/QC) plan, based on the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the establishment of a centralized archiving system. In addition, methodological improvements, especially in the agriculture sector, have been implemented. Luxembourg has improved the transparency of its NIR by including tables of activity data (AD), and descriptions of the methodologies used to calculate emissions (for example in wastewater treatment practices). The expert review team (ERT) commends Luxembourg for its efforts to improve the estimates in the inventory.

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<sup>1</sup> FCCC/SBI/2007/34, paragraph 104.

<sup>2</sup> In this report, the term “total GHG emissions” refers to the aggregated national GHG emissions expressed in terms of CO<sub>2</sub> eq excluding LULUCF, unless otherwise specified.

<sup>3</sup> Base year refers to the base year under the Kyoto Protocol, which is 1990 for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, and 1995 for HFCs, PFCs and SF<sub>6</sub>. The base year emissions do not include any possible emissions from deforestation; however, if applicable, these are taken into account when the assigned amount is calculated.

**Table 1. Greenhouse gas emissions by gas, 1990–2006**

Greenhouse gas emissions	Gg CO <sub>2</sub> eq								Change base year–2006 (%)
	Base year <sup>a</sup>	1990	1995	2000	2003	2004	2005	2006	
CO <sub>2</sub>	12 219.20	12 219.20	9 312.46	9 040.46	10 534.19	12 167.49	12 064.29	12 108.29	–0.9
CH <sub>4</sub>	460.04	460.04	469.75	486.64	475.25	471.17	469.18	463.56	0.8
N <sub>2</sub> O	490.15	490.15	535.48	611.33	585.27	685.53	670.83	659.15	34.5
HFCs	14.21	14.21	14.21	43.01	66.73	74.63	82.54	87.04	512.7
PFCs	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF <sub>6</sub>	2.91	2.91	2.91	3.52	3.68	3.73	3.78	3.86	32.7

*Abbreviation:* NA= not applicable.

<sup>a</sup> Base year refers to the base year under the Kyoto Protocol, which is 1990 for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, and 1995 for HFCs, PFCs and SF<sub>6</sub>. The base year emissions do not include any possible emissions from deforestation; however, if applicable, these are taken into account when the assigned amount is calculated.

**Table 2. Greenhouse gas emissions by sector, 1990–2006**

Sector	Gg CO <sub>2</sub> eq								Change base year–2006 (%)
	Base year <sup>a</sup>	1990	1995	2000	2003	2004	2005	2006	
Energy	10 730.04	10 730.04	8 510.75	8 579.38	10 233.46	11 875.14	11 828.22	11 812.00	10.1
Industrial processes	1 612.68	1 612.68	992.16	761.99	686.27	735.85	702.42	754.48	–53.2
Solvent and other product use	18.31	18.31	16.86	15.17	14.72	14.78	14.90	15.08	–17.7
Agriculture	775.94	775.94	778.76	782.40	686.70	732.61	699.92	694.86	–10.5
LULUCF	NA	–294.93	–294.93	–294.93	–294.93	–294.93	–294.93	–294.93	NA
Waste	49.53	49.53	36.28	46.02	43.97	44.17	45.16	45.49	–8.2
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Total (with LULUCF)</b>	NA	12 891.58	10 039.88	9 890.04	11 370.19	13 107.62	12 995.68	13 026.97	NA
<b>Total (without LULUCF)</b>	13 186.51	13 186.51	10 334.81	10 184.97	11 665.12	13 402.55	13 290.61	13 321.90	1.0

*Abbreviations:* LULUCF = land use, land-use change and forestry, NA = not applicable.

<sup>a</sup> Base year refers to the base year under the Kyoto Protocol, which is 1990 for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, and 1995 for HFCs, PFCs and SF<sub>6</sub>. The base year emissions do not include any possible emissions from deforestation; however, if applicable, these are taken into account when the assigned amount is calculated.

7. The inventory is largely complete, except for the non-inclusion of detailed estimates for LULUCF, and is mostly compiled in accordance with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) and the IPCC good practice guidance. The inventory submission is generally in line with the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories” (hereinafter referred to as the UNFCCC reporting guidelines). A full set of common reporting format (CRF) tables for the years 1990–2006 is provided.

8. Most elements of the national system have been established in accordance with the requirements of national systems as defined in decision 19/CMP.1. The Party has designated a single national entity that has overall responsibility for the national inventory, provided the associated institutional arrangements, prepared a QA/QC plan; established a functioning archive system, described processes for collecting data and developing estimates, and identified key categories and processes to make recalculations to improve the inventory. Luxembourg improved the inventory by carrying out a tier 2 uncertainty analysis. The ERT noted that three relevant studies have been outsourced to external experts and that the improvements are mainly the result of research activities and intensive cooperation with the Austrian Federal Environment Agency. The ERT appreciates the high level of professionalism shown by the sectoral experts, and the effective cooperation between the national inventory compiler (NIC), sectoral experts and external independent consultants.

9. The ERT recommends that Luxembourg further elaborate its QA/QC system, implement a centralized data handling and estimation tool, and establish a procedure for official approval of the inventories before they are submitted to the UNFCCC secretariat.

10. The ERT identified areas for further improvement for all sectors. Luxembourg acknowledged this finding at the time of the in-country review visit and undertook initial measures for further improvements, specifically in the LULUCF sector.

## II. Overview

### A. Inventory submission and other sources of information

11. Luxembourg submitted a complete set of CRF tables for the period 1990–2006 on 23 April 2008, an NIR on 2 June 2008 and a revised version of the NIR on 19 July 2008. Since the submission of the NIR was delayed, the inventory is not entirely in line with decision 15/CMP.1. The Party indicated that the 2008 submission is also its voluntary submission under the Kyoto Protocol.<sup>4</sup> In its 2007 submission, Luxembourg included a complete set of CRF tables for the period 1990–2005 and an NIR. The ERT encourages Luxembourg to submit its next inventory by 15 April 2009 or within six weeks from that date as required by decision 15/CMP.1.

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

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<sup>4</sup> Parties may start reporting information under Article 7, paragraph 1, of the Kyoto Protocol, from the year following the submission of the initial report, on a voluntary basis (decision 15/CMP.1).

## B. Key categories

13. Luxembourg has reported a key category tier 1 analysis, both level and trend assessment, as part of its 2008 submission. The key category analysis performed by the Party and performed by the secretariat<sup>5</sup> produced similar results, however there were some differences owing to differences in the level of disaggregation used by the Party and the secretariat. Luxembourg has not included the LULUCF sector in its key category analysis, which was not performed in accordance with the *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF). The same key categories were identified in the 2007 submission and the 2008 submission. During the in-country review visit, Luxembourg informed the ERT of its intention to include LULUCF in its key category analysis and to use a tier 2 approach for the key category analysis in its next annual submission. The ERT encourages Luxembourg to implement these planned improvements and to reduce, as appropriate, the level of category disaggregation in the key category assessment.

## C. Cross-cutting issues

### 1. Completeness

14. The inventory is complete in terms of years and geographic coverage and is almost complete in terms of sectors, categories and gases, with the exception of the LULUCF sector. The LULUCF sector is only partially covered, with an aggregated constant value used for the entire time series. During the review, Luxembourg provided information on how it intends to acquire the data and estimate the missing emissions/removals in the LULUCF sector. The ERT strongly recommends that Luxembourg provide revised and complete estimations of the emissions by sources and the removals by sinks in the LULUCF sector in its next annual submission.

15. The ERT identified minor potential sources of emissions that are reported as not estimated ("NE") in the inventory. In particular, the following categories were reported as "NE": fugitive emissions from the distribution of mineral oil products; potential HFC, PFC and SF<sub>6</sub> emissions; emissions from fire extinguishers (consumption of halocarbons and HFCs); solvents (consumption of halocarbons and HFCs); other applications using ozone-depleting substance substitutes (consumption of halocarbons and HFCs); semiconductor manufacture (consumption of halocarbons and HFCs); and N<sub>2</sub>O from industrial wastewater. The ERT noted that Luxembourg has not included in its inventory emissions from international marine bunkers, changes in carbon stocks in soils, CO<sub>2</sub> emissions from agricultural lime application, N<sub>2</sub>O emissions from soil disturbances and GHG emissions/removals from land-use conversion. The ERT recommends that Luxembourg include these emissions/removals in future annual submissions if it assesses that these categories are relevant.

16. The ERT found only minor discrepancies (in the waste sector) between the CRF and the NIR. The time series are complete, except for a few source categories where the estimates do not cover the entire time series.

### 2. Transparency

17. The NIR is largely transparent. The ERT was able to assess the data used and methodologies applied. Luxembourg provides justifications for the assumptions made and its choice of data and

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<sup>5</sup> 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 Land Use, Land-Use Change and Forestry*. 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. 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.

methods. The ERT noted the need to improve the transparency in certain chapters of the NIR, especially descriptions of the reference approach and key category analysis. The NIR follows the structure provided in the UNFCCC reporting guidelines. All of the sources used are referenced and most of the references are accessible on the Internet.

### 3. Recalculations and time-series consistency

18. The ERT noted that recalculations reported by the Party of the time series 1990–2005 have been undertaken to take into account improvements in the inventory following the inclusion of new AD in the agriculture sector and the reallocation of emissions in the energy sector. The effect of the recalculations in 2005 is an increase in total GHG emissions by 0.26 per cent. The rationale for these recalculations is provided in the NIR.

19. The ERT noted that the time series are not entirely consistent, as constant AD are used for either the entire time series or part of the time series for a number of categories. The constant parameters are used in the following cases: net calorific value (NCV) for natural gas (fuel consumption – liquid fuel); background data for the COPERT model (in road transportation); the share of residential and commercial fuel combustion (other sectors); AD for paint application, degreasing and dry cleaning, and other (in the solvent and other product use sector); animal weight for dairy and non-dairy cattle (enteric fermentation and manure management in the agriculture sector); carbon intake by temperate forests (other in the LULUCF sector); solid waste composition and the amount of solid waste disposal on land (in the waste sector); and population using septic tanks /small-scale mechanical wastewater treatment systems (in the waste sector).

20. The ERT further noted that in many cases (for example outdated assumptions for the COPERT model to estimate emissions from road transportation) the use of annual actual values would significantly improve consistency and reduce uncertainty. The ERT recommends that Luxembourg assess and revise the parameters listed in paragraph 19 above and that the Party include the revised parameters in its next annual submission. The ERT acknowledges the efforts made by Luxembourg to recalculate parts of its inventory (for example in the LULUCF sector) during the in-country review.

### 4. Uncertainties

21. The ERT noted that in its 2007 submission, Luxembourg did not provide uncertainty estimates. In its 2008 submission, Luxembourg has reported the results of a tier 1 and a tier 2 uncertainty analysis for each category (excluding the LULUCF sector) and for the inventory as a whole. Since the LULUCF sector was not included, the analysis is not entirely in line with the IPCC good practice guidance. The ERT recommends that Luxembourg improve its uncertainty analysis by including the LULUCF sector. The uncertainty parameters used by Luxembourg are, in most cases, based on expert judgement (country-specific values or Austrian parameters, where appropriate). The ERT noted that for 2006 the overall uncertainty of the inventory is lower for the tier 1 approach (2.86 per cent) than the uncertainty estimated using the tier 2 approach (4.04 per cent). The ERT recommends that Luxembourg continue to include periodically a tier 2 uncertainty analysis in its future annual submissions.

### 5. Verification and quality assurance/quality control approaches

22. The ERT noted that Luxembourg has undertaken activities to implement a QA/QC system for the compilation of the inventory. The QA/QC system is currently organized by an external consultant. The QA/QC system partially covers elements of the QA/QC prescribed in the IPCC good practice guidance. The ERT noted that a description of the QA/QC system is included in the NIR and that it reflects the national circumstances of Luxembourg. The ERT strongly recommends that Luxembourg improve its QA/QC system by:



- (a) Revising the existing timeline used in the inventory compilation process according to the time needed to complete the inventory, as established in the UNFCCC reporting guidelines, instead of basing the timeline on the availability of data. The current timeline does not allow enough time for QA/QC procedures;
- (b) Establishing a decision-making body for relevant decisions, such as adopting the QA/QC plan. This body should prioritize possible inventory improvements, set timelines and meet more than once a year;
- (c) Defining the roles of experts involved in the QA/QC system (data providers, sectoral experts, NIC, decision-making body);
- (d) Defining and implementing quality objectives;
- (e) Preparing checklist procedures and adapting them to the content required for the different roles and process steps;
- (f) Including specific QC procedures for steps in the QC process and for defined roles and implementing source-specific procedures, where possible;
- (g) Taking into account the findings of audits and reviews when elaborating the QA/QC plan;
- (h) Implementing the four-eyes principle throughout the QA/QC process as a minimum standard for QA/QC;
- (i) Implementing a centralized data handling system for the inventory;
- (j) Securing centralized procedures for the consistent conversion of GHG emissions to CO<sub>2</sub> eq emissions in order to ensure the consistent and correct use of global warming potentials;
- (k) Establishing an official approval procedure for the national GHG inventory submission before it is submitted;
- (l) Internalizing the QA/QC system in the Environment Agency of Luxembourg coordinated by an expert who is not involved in the inventory process itself.

23. The ERT further recommends that Luxembourg perform detailed cross-cutting checks of input data (multiple sources) in accordance with its QA/QC plan in its next annual submission. The ERT suggests that Luxembourg use peer review procedures for the validation and verification of country-specific values in line with the IPCC good practice guidance in its next annual submission.

24. The ERT also recommends that Luxembourg establish criteria for the prioritization of the QA/QC plan. The ERT suggests that Luxembourg consider the following points when setting priorities for improvements in the inventory: completeness and results of the key category analysis, consistency (stop using constant values), and the results of the uncertainty assessment.

## 6. Institutional arrangements

25. During the in-country review visit, Luxembourg explained the national system and the institutional arrangements for the preparation of the inventory. The Environment Agency of Luxembourg has overall responsibility for the national inventory. Other agencies that belong to the Ministry of Agriculture, Ministry of Economic Affairs and External Trade, Ministry of the Environment, Ministry of Finance, Ministry of the Interior and Spatial Planning, and Ministry of Transport are also involved in the preparation of the inventory. These agencies provide the input data (AD and emission

factors (EFs)) on the basis of inter-institutional legal arrangements. The Environment Agency of Luxembourg coordinates the inventory compilation process and organizes QA/QC procedures. Experts from various institutions are involved following a nomination procedure. The national system currently provides the resources required for the compilation of the inventory. The ERT noted the high level of professionalism by sectoral experts, and the good cooperation between those working within the national inventory system, the NIC, and the external independent consultants. The ERT encourages Luxembourg to internalize procedures that are currently outsourced (uncertainty assessment and the QA/QC system) and to take this into account in future resource planning.

#### 7. Inventory management

26. Luxembourg has an electronic centralized archiving system, which includes the archiving of disaggregated EFs and AD, and documentation on how these EFs and AD have been generated and aggregated for the preparation of the inventory. The archived information includes internal documentation on QA/QC procedures, external and internal reviews, and documentation on the annual key categories identification and planned inventory improvements. The archive is hosted on the central server of the Government of Luxembourg and therefore adequate security procedures are in place.

27. The Party's archiving system (CIRCALUX) is based on the data exchange and storage system of the European Commission (EC). Responsibility for the archive lies with the single national entity and access is password protected. All of the detailed information for the inventory estimation and related documents is archived. During the in-country review visit, the ERT was provided with the additional archived information, as requested. The archiving system was first used during the compilation of the 2008 annual submission. The ERT recommends that Luxembourg include earlier submissions in the electronic archiving system and that Luxembourg use a centralized data storage and processing system for the preparation of its next annual submission.

#### 8. Follow-up to previous reviews

28. The ERT noted that since its 2006 inventory submission, Luxembourg has significantly improved its reporting. The improvements are visible in all sectors (for example the inclusion of estimates that were previously not included), but particular progress has been made in cross-cutting issues, such as establishing a legal basis for the national system, identifying all of the institutions involved in the preparation of the inventory and defining the responsibilities of these institutions. The ERT commends Luxembourg for these improvements.

29. The ERT also noted that a number of recommendations made in previous reviews have not been addressed in the 2008 submission. Examples include: the reporting of carbon stock changes in the LULUCF sector and the reporting of emissions from asphalt roofing and road paving in the industrial processes sector.

### **D. Areas for further improvement**

#### 1. Identified by the Party

30. The 2008 NIR identifies several areas for further improvement. These planned improvements cover all sectors and several cross-cutting issues. The quality manual for the compilation of the inventory, which was presented during the in-country review visit, lists further improvements. The ERT acknowledges this work and recommends that Luxembourg prioritize these improvements by taking into account the points listed in paragraph 24 above when setting priorities.

## 2. Identified by the expert review team

31. The ERT identifies the following cross-cutting issues for improvement:
- (a) The expansion of the national system by securing resources for further needs, such as including the LULUCF data in the inventory and internalizing the QA/QC system in the single national entity;
  - (b) The establishment of an official approval process that takes place before the GHG inventory is submitted to the UNFCCC secretariat;
  - (c) The reorganization of the QA/QC system;
  - (d) The reassessment of the methodologies used in inventory estimation, based on the obligations derived from the key category analysis;
  - (e) The improvement of the key category analysis (a detailed description in the NIR, the inclusion of the LULUCF sector, and the use of a tier 2 approach, if possible);
  - (f) The prioritization of inventory improvements;
  - (g) The improvement of the completeness and consistency of the inventory.
32. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report.

## III. Energy

### A. Sector overview

33. The energy sector is the main sector in the GHG inventory of Luxembourg. In 1990, the energy sector accounted for 10,730.04 Gg CO<sub>2</sub> eq, or 81.4 per cent of total GHG emissions. In 2005, as reported in the 2007 submission, the energy sector accounted for 11,821.21 Gg CO<sub>2</sub> eq, or 89.2 per cent of total GHG emissions. Emissions from the sector, as reported in 2008 submission, decreased to 11,812.00 Gg CO<sub>2</sub> eq, or 88.7 per cent of total GHG emissions in 2006. Sectoral emissions increased by 10.1 per cent between 1990 and 2006.
34. Within the energy sector, for the year 2006, 61.7 per cent of the emissions were from transport, followed by 14.1 per cent from manufacturing industries and construction, 12.5 per cent from energy industries, and 11.2 per cent from other sectors. The remaining 0.5 per cent was from fugitive emissions from fuels – oil and natural gas. In the 2007 and the 2008 annual submissions, the shares of emissions from sub-categories of the energy sector for the latest reported year were similar.
35. The main contributor to emissions from the energy sector has changed in the period 1990–2006 from iron and steel industries at the beginning of the time series to road transportation at the end of the time series. The key driver for the rise in emissions in the energy sector is road transportation. CO<sub>2</sub> emissions from road transportation increased by more than 150 per cent over the time series. The key driver for the rise in emissions was ‘fuel export’ (the purchase of automotive fuels by commuters and drivers of vehicles in transit through Luxembourg). CO<sub>2</sub> emissions from iron and steel industries declined over the time series, as electric arc furnace (EAF) steel was produced instead of basic oxygen furnace (BOF) steel. National electricity production increased after several new combined heat and power installations started operations in the mid 1990s and after the installation of a new natural gas-fired power plant in 2002.
36. Reporting of the energy sector is generally complete, except for CO<sub>2</sub> emissions from biogas; CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from international marine bunker fuels; and CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions

from oil (distribution of oil products), which are reported as “NE”. Luxembourg included emissions from international marine bunker fuels (small leisure vessels that use gasoline) under navigation and road transportation. The ERT encourages Luxembourg to report these emissions under international marine bunker fuels.

37. The ERT noted that GHG emissions from other transportation are reported as not applicable (“NA”). However, off-road vehicles are used in the country (for example in the agriculture sector). The ERT recommends that Luxembourg estimate and report these emissions in its next annual submission.

38. During the review week, the ERT was informed that Luxembourg is revising its energy balance, in particular for energy industries, and manufacturing industries and construction, although reporting using a top-down method is complete and it seems that no AD are missing except for the categories mentioned in paragraph 36 above. The ERT noted that the revisions would improve the quality of the energy balance and the ERT encourages Luxembourg to include a summary of the energy balance in its next annual submission.

39. AD (in energy units) for natural gas, the main fuel in Luxembourg, is provided by the National Statistical Institute (STATEC). During the in-country review, the ERT noted that Luxembourg applies a constant NCV, taken from the STATEC data, throughout the time series. However, the data provided by one of the country’s fuel suppliers for recent years differ from the data provided by STATEC. The ERT recommends that Luxembourg assess the country-specific NCV for natural gas and recommends that Luxembourg apply annual NCV values across the time series in its next annual submission.

40. The ERT noted that coal consumption has declined significantly since the base year and its total share was less than 2 per cent of the national energy consumption in 2006. However, energy consumption data for different types of coal (such as brown coal, coking coal, lignite) is reported as “NA”. Lignite use in the asphalt industry is not mentioned in the NIR. The ERT encourages Luxembourg to report CO<sub>2</sub> emissions from lignite use in the asphalt industry in its next annual submission.

41. The Energy Directorate of the Ministry of Economic Affairs conducts surveys on an annual basis to collect energy data, which is aggregated and given to the Environment Agency of Luxembourg so that the inventory can be compiled. The ERT recommends that the data suppliers provide the single national entity with disaggregated energy data to enable the entity to better allocate emissions to inventory sub-categories.

42. The ERT noted that in general Luxembourg applies default EF values from recognized international scientific literature that has been recently published for its main fossil fuels: natural gas, diesel oil and gasoline. Since CO<sub>2</sub> emissions from stationary combustion (liquid fuels) is a key category, country-specific EFs should be used. The ERT noted that the NCV, chemical composition and amount of fuel imported is generally available for each fuel import and could be used to derive country-specific EFs. During the in-country review, Luxembourg agreed to look into this issue and agreed to try to include country-specific EFs for these fossil fuels in its next annual submission. The ERT recommends that Luxembourg estimate and report these country-specific EFs in its next annual submission.

43. The ERT noted that Luxembourg does not report biofuel imports separately (they are included with gasoline and diesel) and classifies biofuel as a fossil fuel. According to the IPCC good practice guidance, CO<sub>2</sub> emissions from biofuel should be reported as a memo item and should not be added to total GHG emissions. Luxembourg informed the ERT that two to five per cent of annual GHG emissions from road transportation might be attributed to emissions from biofuel. During the in-country review visit, the ERT noted that good data on the percentage of biofuel included in the batches of imported liquid fuels are available. The ERT recommends that Luxembourg estimate GHG emissions from biofuel and reallocate CO<sub>2</sub> emissions from biofuel accordingly in its next annual submission.

### 1. Completeness

44. The CRF includes estimates of most gases and categories of emissions from the energy sector, as recommended by the Revised 1996 IPCC Guidelines. Not included are: CO<sub>2</sub> emissions from biogas; CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from international marine bunker fuels; and CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from oil (distribution of oil products).

45. The ERT noted that Luxembourg has a limited number of facilities that produce emissions that fall under a key category. The ERT noted that emissions from these facilities should be estimated using the tier 2 approach and should be based on fuel-specific consumption at a plant level. However, this information is not currently available, which makes it difficult to verify whether or not some installations and the fuel consumed therein have been missed when estimating sectoral emissions using a bottom-up approach. Biogas consumption is one such example. Although Luxembourg uses a top-down approach to ensure the completeness of all fuel-based emissions, the ERT encourages Luxembourg to prepare a list of all energy-consuming facilities under the energy industries, and manufacturing industries and construction categories along with the fuel consumption of each category to ensure that completeness is checked on a systematic basis. This would also enhance and institutionalize QA/QC procedures for AD.

### 2. Transparency

46. The information provided in the NIR is generally transparent and sufficiently detailed. However, AD collection and the reasons for choosing default EFs could be explained in greater depth.

### 3. Verification and quality assurance/quality control approaches

47. Luxembourg cross-checks AD from three sources for large facilities that are under the European Union Emissions Trading Scheme (EU ETS): the Operations Permit, the Registry Operator and STATEC. The Operations Permit and the Registry Operator are both run by the Environment Agency of Luxembourg. The ERT noted that there are minor discrepancies between the data in the Operations Permit and the data in the Registry Operator. Energy consumption data at the facility level are not provided by STATEC but could be provided to the Environment Agency of Luxembourg. The ERT recommends that Luxembourg reconcile these differences on a systematic basis and report on this in its next annual submission.

## **B. Reference and sectoral approaches**

### 1. Comparison of the reference approach with the sectoral approach and international statistics

48. In 2006, the energy consumption and CO<sub>2</sub> emissions calculated using the reference approach were 1.52 per cent and 1.47 per cent lower, respectively, than the values calculated using the sectoral approach. The main reasons for this difference were the different data sources that were used (data provided by the International Energy Agency and Eurostat joint questionnaire were used for the reference approach; data provided by STATEC and data published in annual activity reports by the Ministry of Economic Affairs and External Trade were used for the sectoral approach), the EFs used, and the inclusion of municipal solid waste under the category other solid fuel in the sectoral approach. The ERT recommends that Luxembourg provide a comparative analysis in tabular format in its next annual submission.

### 2. International bunker fuels

49. Luxembourg has only one international airport and almost all of the aviation activity in the country is international traffic. Domestic aviation is limited mainly to small aeroplanes that use gasoline or helicopters. Based on expert judgement, Luxembourg considers that 10 per cent of these aviation activities are for international purposes. However, these activities are not accounted for under emissions

from aviation bunker fuels. The ERT encourages Luxembourg to account for these emissions in its next annual submission.

50. The total CO<sub>2</sub> emissions from aviation bunker fuels was 1,241.14 Gg CO<sub>2</sub>, which was 10.5 per cent of the total energy sector GHG emissions in Luxembourg in 2006. Luxembourg currently uses tier 1 methodology and default EFs, but it is planning to use EF estimation based on landing and take-off (LTO) and aircraft types to improve the accuracy of its emission estimates. The ERT noted that water-borne navigation on Luxembourg's only river (the Moselle) is used for international navigation to/from Germany for both passenger and freight traffic. During the in-country review, the ERT was informed that there is a gasoline filling station for water-borne leisure traffic on this river, but sales from this filling station are currently counted under road transportation. The ERT suggests that Luxembourg report these sales separately under transport, and suggests that emissions from fuel purchased for international water-borne navigation be reported under international marine bunkers.

### 3. Feedstocks and non-energy use of fuels

51. Luxembourg has five iron and steel plants that use coking coal as a reducing agent. Emissions from these plants are reported under industrial processes. The ERT commends Luxembourg for the clarity of reporting of emissions from iron and steel production.

52. Luxembourg reports lubricants and bitumen as feedstocks and estimates that 100 per cent of carbon is stored in bitumen and 50 per cent of carbon is stored in lubricants (7.76 Gg of non-emitted CO<sub>2</sub> in 2006). This percentage for the carbon stored follows the 1996 Revised IPCC Guidelines. The ERT noted that the CO<sub>2</sub> emissions from the remaining 50 per cent of carbon, which is not stored in lubricants, are not reported under other liquid fuels (road transportation), for which the notation key "NA" is used. The ERT recommends that Luxembourg report the remaining CO<sub>2</sub> emissions from lubricants under the relevant categories where they are combusted (for example, road transportation or waste incineration) in its next annual submission.

## C. Key categories

### 1. Stationary combustion: gaseous fuels – CO<sub>2</sub>

53. The reallocation of emissions is the main issue under the manufacturing industries and construction category. The ERT noted that there are at least two chemical plants that should be reported under the manufacturing industries and construction – chemicals category, but these are currently reported under the manufacturing industries and construction – other category. The ERT further noted that there are at least two tobacco and milk production plants that should be reported under the manufacturing industries and construction – food processing, beverages and tobacco category that have been included under the manufacturing industries and construction – other category. The ERT also noted that fuel combustion for power generation and heat production is reported under the manufacturing industries and construction – other category, but they should be reported under the energy industries – public electricity and heat production category. The ERT recommends that Luxembourg reallocate these emissions in its next annual submission.

### 2. Road transportation: liquid fuels – CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O

54. In 2006, CO<sub>2</sub> emissions from road transportation was the largest key category in Luxembourg. The Party currently uses IPCC default EFs for these fuels, which is not in line with the IPCC good practice guidance. The ERT recommends that Luxembourg use country-specific EFs for diesel oil and gasoline used in road transportation in its next annual submission. Biofuel emissions are to be accounted for separately as a memo item, as explained in paragraph 43 above, in its next annual submission.

55. The ERT noted that Luxembourg is using the COPERT III model to estimate CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from fuel consumed by vehicles registered in Luxembourg. The Party indicated that the same

implied emission factors (IEFs) are used for domestic and exported fuels to estimate CH<sub>4</sub> and N<sub>2</sub>O emissions from fuel consumed by vehicles registered in Luxembourg, which could not be verified by the ERT. The ERT recommends that Luxembourg elaborate on the IEFs applied for all fuels used for road transportation in its next annual submission.

56. The ERT noted that some of the parameters in the COPERT III model are more than 20 years old and therefore the ERT encourages Luxembourg to update them. The ERT noted that the methodology and reporting tables do not differentiate between domestic and ‘fuel export’ emissions from road transportation, as both are considered to be domestic emissions. However, the ERT recognizes that Luxembourg distinguishes between domestic fuel consumption and ‘fuel export’ and that the Party reports these emissions separately in the NIR to highlight specific national circumstances.

### 3. Stationary combustion: gaseous and liquid fuels – CO<sub>2</sub>

57. The ERT noted that fuel consumption under the commercial/institutional and residential sectors is presently split equally based on expert judgement. During the in-country review week, it was indicated that better fuel accounting could be achieved by using disaggregated data from STATEC and other sources. The ERT recommends that Luxembourg apply the actual data available for fuel consumption in these sub-categories and report CO<sub>2</sub> emissions from these sub-categories accordingly in its next annual submission.

## **D. Non-key categories**

### Fugitive emissions from oil, natural gas and other sources: gaseous and liquid fuels – CH<sub>4</sub> and N<sub>2</sub>O

58. The ERT noted that Luxembourg reports fugitive CH<sub>4</sub> emissions from natural gas transmission and includes emissions from natural gas distribution and leakages in the same category. This is not in line with the IPCC good practice guidance. The ERT recommends that Luxembourg report these emissions separately in its next annual submission.

59. The ERT further noted that Luxembourg reports fugitive CH<sub>4</sub> and N<sub>2</sub>O emissions from the transportation and distribution of oil products as “NE”. The ERT recommends that Luxembourg estimate and report these emissions in its next annual submission.

## **E. Areas for further improvement**

### 1. Identified by the Party

60. In the NIR and during the in-country review visit, Luxembourg informed the ERT of the following planned improvements in various sub-categories:

- (a) The revision of AD, taking into account data from the EU ETS and Operating Permits;
- (b) The revision of EFs for coking coal, fuel used in railways, and fuel combustion – other sectors (commercial/institutional, residential, and agriculture/forestry/fisheries);
- (c) The reallocation of emissions from biofuels, and manufacturing industries and construction;
- (d) The investigation into the possible use of data obtained from COPERT IV instead of data obtained from COPERT III;
- (e) The validation of the biogenic and non-biogenic shares of waste in waste incineration with energy recovery;
- (f) The use of LTO and aircraft types to estimate emissions from aviation;

- (g) The investigation into whether or not emissions should be reported for international marine bunkers and multilateral operations.

## 2. Identified by the expert review team

61. The ERT recommends and encourages Luxembourg to undertake the following further improvements:

- (a) The use of country-specific EFs for all key sources, especially the combustion of natural gas, diesel oil and gasoline;
- (b) The updating of the national energy balance, especially for the energy industries, and the manufacturing industries and construction categories;
- (c) The use of disaggregated AD from STATEC, preferably background information from energy surveys;
- (d) The elaboration in the NIR on the NCV and EFs used.

## **IV. Industrial processes and solvent and other product use**

### **A. Sector overview**

62. In 2006, the industrial processes sector accounted for 754.48 Gg CO<sub>2</sub> eq, or 5.7 per cent of total GHG emissions, and the solvent and other product use sector accounted for 15.08 Gg CO<sub>2</sub> eq, or 0.1 per cent of total GHG emissions. Emissions from the industrial processes sector decreased by 53.2 per cent between 1990 and 2006. The key driver for the fall in emissions is the use of EAFs in iron and steel production instead of BOFs. As a result, emissions from the iron and steel production category accounted for 22.6 per cent of emissions from the industrial processes sector in 2006, whereas in 1990 they accounted for 61.1 per cent of total sectoral emissions.

63. Within the industrial processes sector, 57.2 per cent of emissions were from cement production, followed by 12.0 per cent from the consumption of halocarbons and SF<sub>6</sub>, and 8.2 per cent from glass production. In 2006, CO<sub>2</sub> accounted for 88.0 per cent of emissions from the industrial processes sector, whereas emissions of fluorinated gases (F-gases) accounted for the remaining 12.0 per cent.

64. In the 2007 and 2008 submissions, the trends and the share of categories and gases for the industrial processes and solvent and other product use sector in the latest reported years were very similar.

### 1. Completeness

65. The CRF includes estimates of most gases and categories of emissions from the industrial processes sector, as recommended by the Revised 1996 IPCC Guidelines. Not included are: asphalt roofing, road paving, and the use of halocarbons in fire extinguishers and solvents, even though this was highlighted in previous reviews. Potential emissions of HFCs are very important for QC and verification, but these are not reported. In general, notation keys are used correctly, but there are still some errors regarding the use of the notation keys not occurring (“NO”) and “NE” (e.g. asphalt roofing, semiconductor manufacturing). The ERT recommends that Luxembourg improve the completeness of the inventory and that the Party find out if categories identified as “NO” actually do not occur in the country.



## 2. Transparency

66. Transparency in the inventory of the industrial processes sector has improved considerably since the last submission. However, this is not the case for the solvent and other product use sector. The ERT encourages Luxembourg to provide a more detailed description of the assumptions and methodology used in the solvent and other product use sector in its next annual submission.

## 3. Recalculations and time-series consistency

67. No recalculations have been undertaken since the extensive recalculations undertaken during the last review. The time series are generally consistent, except for the solvent and other product use sector, in which estimates for many sub-categories are based on data for just a single year.

## 4. Verification and quality assurance/quality control approaches

68. The ERT noted that some sector-specific QC procedures have been described in the NIR, but these should be developed further as part of the improvement of the QA/QC plan. The ERT further noted that the results from some alternative methodologies currently being developed and from studies currently taking place have been used as a verification procedure for EFs.

## **B. Key categories**

### 1. Cement production – CO<sub>2</sub>

69. Luxembourg applies a tier 2 methodology based on the calcium oxide (CaO) content of clinker, in line with the IPCC good practice guidance. Data on CaO content are provided once every five years by the only cement production plant in the country and are interpolated for the other years by the Environmental Agency of Luxembourg. The ERT recommends that Luxembourg collect and use annual data for the CaO content in clinker, given that the cement company acquires this information on a daily basis.

70. The ERT recommends that Luxembourg find out if dolomite is used as a raw material as well as limestone and recommends that the Party modify the methodology used if necessary. The ERT noted that Luxembourg has already planned this improvement.

### 2. Iron and steel production – CO<sub>2</sub>

71. Luxembourg has made significant progress in improving estimations for this category since the previous inventory submission. A tier 2 methodology is applied in line with the IPCC good practice guidance, taking into account all carbon-containing materials and correctly tracking structural changes that have taken place in this sector (using EAFs instead of BOFs) in the period 1990–1997.

72. The ERT noted that Luxembourg had taken care not to double count emissions from iron and steel production with emissions reported in the energy sector. Blast furnace gas consumption is allocated to the energy sector, whereas anthracite, carbon, other fuels, and electrodes are reported under iron and steel production as reducing agents.

## **C. Non-key categories**

### 1. Glass production – CO<sub>2</sub>

73. Luxembourg only has one glass production company, which has two plants. A tier 2 methodology is applied, with a constant EF provided by the company for the year 2003.

74. Luxembourg is planning to apply a tier 3 methodology based on the composition of the raw material used in glass production and has already used tier 3 methodology as a QA/QC tool. The results are consistent with the tier 2 methodology that is currently applied, but they show that EFs may change

from year to year. The ERT recommends that Luxembourg apply a tier 3 methodology, as the necessary data is available.

## 2. Soda ash use – CO<sub>2</sub>

75. Luxembourg reports soda ash use as included elsewhere (“IE”), as soda ash is only used in glass production. The ERT recommends that Luxembourg find out if soda ash has other uses in the country as part of its implementation of tier 3 methodology for glass production (when the total amount of soda ash used for glass production should become known).

## 3. Consumption of halocarbons and SF<sub>6</sub> – HFCs and SF<sub>6</sub>

76. Luxembourg reports F-gases based on a report produced in 1999. This report provided emission estimates of F-gases for the year 1995, and projections for the years 2000, 2005 and 2010. The ERT noted that assumptions for these projections are not transparent (some are based on circumstances in Germany). For example, one assumption was that the increase in emissions from refrigeration was correlated with the population increase. The actual population and not the population projections estimated in 1999 should be used to improve accuracy. The ERT recommends that Luxembourg identify the assumptions for these projections and recommends that Luxembourg re-estimate emissions for the time series based on real values and not projections in its next annual submission.

77. At the time of the review, the ERT noted that a consultant was carrying out a study on the estimation of HFC, PHF and SF<sub>6</sub> emissions (Econotec, 2008). The ERT recommends that Luxembourg ensure that the study is in line with the IPCC good practice guidance, that assumptions are transparent and correspond to circumstances in Luxembourg, and that the Party allow for further improvements based on country-specific data.

78. The ERT recommends that estimates should be based primarily on data collected in the country rather than data or studies carried out in neighbouring countries (these should be used mainly as QA/QC tools). The ERT recommends that Luxembourg continue to implement procedures that make it possible to track the flow and amount of HFCs, PFCs and SF<sub>6</sub> (in bulk and equipment) in the country, leading to more accurate emission estimates.

## 4. Solvent and other product use – CO<sub>2</sub> and N<sub>2</sub>O

79. Emission estimates for solvent use are based on a study conducted in 1990 (Brieda Fr., 1990). The AD are constant for the entire time series for many subsectors. Information in the NIR is not transparent and does not make it possible to assess how emission estimates have been calculated.

80. Austrian consultants conducted a study entitled “Luxembourg’s emission inventory from solvent use 2008” (Institute of Industrial Ecology, 2008), which should improve emission estimates for this sector. The ERT recommends that Luxembourg ensure that the study is completed and is in line with the IPCC good practice guidance, and that the assumptions are transparent, correspond to circumstances in Luxembourg and allow for further improvements based on country-specific data.

81. The AD and information contained in the NIR for this category includes data on HFCs used as solvents. The ERT recommends that Luxembourg report these emissions under consumption of halocarbons and SF<sub>6</sub> (2.F.5).

82. N<sub>2</sub>O emissions from anaesthesia are estimated using estimates from Germany. The ERT recommends that Luxembourg investigate the assumptions in the German methodology and decide if they can be applied to national circumstances in Luxembourg. The ERT also recommends that Luxembourg examine the possibility of acquiring data on the consumption of anaesthesia products in Luxembourg.

## **D. Areas for further improvement**

### **1. Identified by the Party**

83. The NIR identifies several areas for improvement. The most relevant are studies on F-gases and solvents, which would improve the accuracy, completeness and time-series consistency of the inventory.

### **2. Identified by the expert review team**

84. The ERT recommends that Luxembourg increase its efforts to collect country-specific data rather than rely on data or studies carried out in neighbouring countries. The ERT also recommends that Luxembourg continue to implement procedures that make it possible to track the flow and stocks (in bulk or equipment) of HFCs, PFCs and SF<sub>6</sub>, leading to more accurate emissions estimates.

## **V. Agriculture**

### **A. Sector overview**

85. In 2006, the agriculture sector accounted for 694.86 Gg CO<sub>2</sub> eq, or 5.2 per cent of total GHG emissions. Emissions from the sector decreased by 10.5 per cent between 1990 and 2006. The key drivers for the fall in emissions are reductions in cattle populations and reductions in emissions from agricultural soils. Within the sector, 47.7 per cent of the emissions were from agricultural soils, followed by 34.3 per cent from enteric fermentation and 18.0 per cent from manure management.

86. In 2006, CH<sub>4</sub> emissions from the agriculture sector accounted for 73.9 per cent of the total CH<sub>4</sub> emissions in the country and have decreased by 3.9 per cent over the period 1990–2006. N<sub>2</sub>O emissions accounted for 53.4 per cent of the total N<sub>2</sub>O emissions in the country and have decreased by 16.0 per cent over the period 1990–2006.

### **1. Completeness**

87. The CRF for 2006 includes estimates of all gases and sources of emissions from the agriculture sector, as recommended by the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. The NIR of the 2006 submission states that the application of sewage sludge to agricultural soils is reported under the agriculture sector.

88. The following categories are reported as “NE”: CH<sub>4</sub> emissions from enteric fermentation for goats, rabbits and other animals (1990–1996), and other poultry (all years); and N<sub>2</sub>O emissions from manure management from goats, other poultry, rabbits and other animals (1990–1996). Parameters such as the nitrogen/carbon ratio (N/C ratio) in biomass (crop residue) and residue/crop ratio for several crop categories are also reported as “NE”. AD and emissions from mules and asses were reported as “IE” for the period 1990–2004 because mules and asses were reported under the sub-category horses.

89. In some cases, a complete time series for several animal species (such as goats, mules and asses, other poultry, rabbits, and other animals) is not provided. The ERT encourages Luxembourg to make further efforts to provide a complete time series for the years 1990–1996 (for the years 1990–2004 in the case of mules and asses) following the IPCC good practice guidance.

### **2. Transparency**

90. The NIR and CRF tables are transparent, but the agriculture sector could be further improved by including input parameters for estimation using a higher-tier method, especially for key categories. Further information in the NIR to explain fluctuations in trends and to justify the country-specific parameters used would further enhance the overall transparency of reporting within the sector.

91. The ERT noted that in some cases (incorporation of crop residues in soils and N-fixing crops), transparency in the allocation of sources and other parameters used for estimation is insufficient. The ERT encourages Luxembourg to make further efforts to increase the transparency of its reporting in its next annual submission.

### 3. Recalculations and time-series consistency

92. Luxembourg carried out recalculations for 2005 for its estimates of CH<sub>4</sub> emissions from enteric fermentation (0.02 per cent increase), CH<sub>4</sub> and N<sub>2</sub>O emissions from manure management (0.01 and 2.38 per cent increase, respectively), and N<sub>2</sub>O emissions from agricultural soils (7.96 per cent increase). The reasons for the recalculations are provided in the NIR and were discussed during the in-country review. The ERT encourages Luxembourg to improve the documentation on methodological changes and to justify these recalculations in the NIR and CRF table 8(b) in its next annual submission.

### 4. Uncertainties

93. The ERT welcomes the efforts made by Luxembourg to improve estimates for the agriculture sector, in particular the application of a tier 2 methodology for uncertainty estimation. The ERT encourages Luxembourg to further implement QA/QC activities in the sector and encourages the Party to take further steps to improve uncertainty analyses for the agriculture sector and to improve the documentation of the verification process used during the peer review. The ERT welcomes the improvement in electronic and paper archives of AD references for the agriculture sector.

## **B. Key categories**

### 1. Enteric fermentation – CH<sub>4</sub>

94. Luxembourg applied a tier 2 methodology for non-dairy cattle in the enteric fermentation category. The IEF for mature male non-dairy cattle is based on default parameters (gross energy intake) and is applied to the entire time series. The ERT noted that several of the input parameters used to estimate emission factors are from Germany. Given the relatively small size of Luxembourg and the similar agricultural practices in Luxembourg and Germany, the use of the parameters from Germany could be classed as a tier 2 methodology. The ERT recommends that Luxembourg make efforts to improve the accuracy of the data and provide information for the entire time series.

95. The ERT welcomes improvements made in the recalculation of CH<sub>4</sub> emissions for dairy cattle using the tier 2 approach and using animal numbers for different sub-categories (milk productivity and fat content in milk). However, the ERT encourages Luxembourg to improve the transparency of trend fluctuations and the rationalization for choosing criteria when using EFs.

96. Luxembourg uses AD that are reported in the statistical publications of the Rural Economy Department of Luxembourg and STATEC. AD are not available for all years for goats, mules and asses, other poultry, rabbits, and other animals. The ERT recommends that Luxembourg complete the time series, clearly specify the data sources and the method used to fill data gaps, explain the criteria for its choice of methods, explain the way the AD are collected, and explain the influence of the AD trend on emissions in its next annual submission. The ERT recommends that Luxembourg focus on developing the quality of the input parameters that have the greatest effect on country-specific EFs for key livestock species.

### 2. Direct soil emissions – N<sub>2</sub>O

97. The IPCC default tier 1a methodology and default EFs have been used to estimate direct N<sub>2</sub>O emissions from agricultural soils. Luxembourg has compiled estimates of emissions from synthetic fertilizers, animal manure applied to soils, N-fixing crops, crop residues and sewage sludge spreading. The emissions from histosols are reported as “NO”. The ERT encourages Luxembourg to develop

country-specific EFs according to the country-specific data available on N sources. The ERT noted a misallocation of N-fixing crops under this category and recommends that Luxembourg reallocate crops, by excluding pasture, range and paddock, and beet from the N-fixing crops category, and recommends that the Party only include fodder crops. The ERT further recommends that Luxembourg provide an explanation on the allocation of crop and fodder species in its next annual submission.

98. In its previous submission, Luxembourg included emissions from sewage sludge spreading and presented the methodology used. The ERT welcomes this and encourages Luxembourg to maintain consistency in its reporting and documentation in the NIR and encourages the Party to use the same approach in the agriculture and waste sectors to avoid double counting from this source.

### 3. Pasture, range and paddock manure – N<sub>2</sub>O

99. Luxembourg uses a country-specific  $\text{Frac}_{\text{GRAZ}}$  value of 44 per cent. N excreted in pasture, range and paddock as a percentage of total N excretion, calculated using the data in table 4.B(b), equals 44 per cent, which is in accordance with the  $\text{Frac}_{\text{GRAZ}}$  value. This methodological approach to ensure consistency between reporting categories is in line with the IPCC good practice guidance. The share of N excreted during grazing varies from 45 per cent for dairy cattle to 60 per cent for sheep, goats and horses. The ERT acknowledges the consistency of Luxembourg's approach to reporting and encourages the Party to swap the tier methodology used in the NIR for a tier 1b methodology for pasture, range and paddock manure.

### 4. Indirect soil emissions – N<sub>2</sub>O

100. Luxembourg estimates N<sub>2</sub>O emissions from atmospheric deposition and from leaching and run-off using the tier 1 default methodology and default EFs for indirect soil emissions, which is not in line with the IPCC good practice guidance. The ERT welcomes Luxembourg's intention to make further improvements in its estimates with a view to revising the ammonia balance. The ERT encourages Luxembourg to collect and harmonize the necessary input data in order to increase accuracy in its next annual submission.

## C. Non-key categories

### 1. Manure management – CH<sub>4</sub>

101. The ERT noted that Luxembourg uses a tier 1 methodology for all animal categories and default EFs to estimate CH<sub>4</sub> emissions from manure management, which is in line with the IPCC good practice guidance. The ERT recommends that Luxembourg apply a tier 2 approach in its key category analysis in order to identify significant animal species. The ERT welcomes the inclusion of new animal species in the 2008 annual submission and the country-specific approach for the allocation of animal categories across animal waste management systems (AWMSs). The ERT welcomes the improved transparency in the NIR and the increasing accuracy in allocating a fraction of manure for specific AWMSs.

102. The ERT noted that a new type of AWMS (biogas installations) that combusts biogas from manure for energy purposes was introduced in the 2008 annual submission. No leakages were reported in the agriculture or energy sectors. The ERT recommends that Luxembourg provide information on biogas combustion under the energy sector in its next annual submission to ensure consistency across sectors and to avoid under- or overestimation and double counting of emissions.

### 2. Manure management – N<sub>2</sub>O

103. Luxembourg estimated N<sub>2</sub>O emissions from manure management using equation 4.18 of the IPCC good practice guidance, and has applied default N excretion rates for each livestock category and country-specific fractions of wastes to each manure management system. N<sub>2</sub>O emissions are estimated using the default EFs for each AWMS. The ERT considers the information provided to be appropriate,

but recommends that Luxembourg improve the transparency of its reporting by providing the necessary background information and data for the entire time series in its next annual submission.

#### **D. Areas for further improvement**

##### **1. Identified by the Party**

104. The ERT welcomes initiatives taken by Luxembourg to make further improvements in the agriculture sector by reducing the use of default EFs, parameters and coefficients and replacing them with country-specific values. The ERT also welcomes the improvements Luxembourg has made in its QA/QC activities.

##### **2. Identified by the expert review team**

105. The ERT recommends that Luxembourg analyse further the impact of sewage sludge and compost spreading on fields and that the Party increase the transparency of its reporting of this category in its next annual submission. The ERT also recommends that Luxembourg reconsider the use of notation keys in CRF table 4.F for parameters such as residue/crop ratio, dry matter fraction of residue, carbon fraction of residue and N/C ratio of biomass residue. The notation key “NE” should be replaced with “NA”.

### **VI. Land use, land-use change and forestry**

#### **A. Sector overview**

106. In 2006, the LULUCF sector accounted for 294.93 Gg CO<sub>2</sub> eq removals, or 2.3 per cent of total GHG emissions including LULUCF.

107. The ERT noted that the CRF tables report the same constant value for the entire time series (1990–2006). This single value is reported under other (5 G). The NIR states that the value reported is a rough estimate calculated in 1996 and states that it was reported under the category other to show that it was an estimate. The ERT noted that in all of the sectoral background tables from 5.A to 5.F and 5 (I) to 5 (V) the notation key “NE” is used. The ERT reiterates the recommendation from the review of the 2006 inventory submission and strongly recommends that Luxembourg allocate the estimates of carbon stock changes under the appropriate category (forest land) and that the Party complete all of the relevant background tables, using the documentation boxes to provide additional explanations, in its next annual submission.

108. No estimates of carbon stock changes in biomass, dead organic matter or soils have been provided for the different land-use categories and sub-categories (tables 5A to 5E). These tables should have contained AD on areas for the different categories and sub-categories of land use, and the associated carbon stock changes for the different carbon pools. No estimations have been provided for potential emissions from fertilization, liming, drainage, conversions to cropland and biomass burning (tables 5 (I) to 5 (V)). The ERT noted that the Party has the information required to be able to estimate several of these categories (e.g. no fertilizer is used in forest land and biomass burning is forbidden, so the notation key “NO” could have been used instead of “NE”). The ERT further noted that the flow of information on non-forest land use could be improved. The ERT strongly recommends that Luxembourg increase its capacity to handle information on land use in the LULUCF sector.

109. The ERT noted with concern that not reporting on the remaining carbon pools may create major problems with regard to reporting in 2010 of mandatory activities under Article 3, paragraph 3, of the Kyoto Protocol. During the review, the ERT highlighted a number of issues in the national system to ensure that areas of land subject to LULUCF activities under Article 3, paragraph 3, of the Kyoto Protocol are identifiable.

110. During the review, Luxembourg provided annual estimates of emissions and removals from the forest land remaining forest land category for the entire time series. Luxembourg informed the ERT that two experts from governmental institutions have been nominated to contribute to the LULUCF inventory and that possible data sources have been identified. Luxembourg also informed the ERT that the Austrian Federal Environment Agency intends to train these experts to enable them to provide the NIC with the necessary data for the 2009 annual submission. The ERT commends Luxembourg for its efforts and recommends that the Party report missing estimates in the LULUCF sector in its next annual submission.

111. During the review, the ERT learned that Luxembourg commissioned a forest monitoring project (Global Monitoring for Environment and Security (GMES) Service Element on Forest Monitoring Luxembourg) in cooperation with the European Space Agency, which aims to estimate land use and land-use change using satellite techniques. The project is due to be completed in April 2009 and from then on the Party should be able to map the six land-use categories defined under the UNFCCC, track land-use changes, and monitor afforestation, reforestation and deforestation areas. The ERT acknowledges the effort made by Luxembourg to improve the representation of land use and land-use change in its inventory submission and recommends that Luxembourg provide a complete inventory for the LULUCF sector, effectively address the issues in the national system in order to cover activities under Article 3, paragraph 3, of the Kyoto Protocol, and that it report thereon in its next annual submission.

112. There are some differences between the 2007 submission and the 2008 submission. Estimates of N<sub>2</sub>O emissions have been removed, following a recommendation made by the previous ERT. The ERT noted that some useful information reported in the 2007 submission was not reported in the 2008 submission (e.g. the time series for forest areas by forest subtypes, general references to the methodology used in calculations, and some important data on the annual increment and amount of wood harvested annually). The ERT encourages Luxembourg to revise this type of data and incorporate it into its next annual submission.

#### 1. Transparency

113. The NIR does not provide any clear explanations on how the single value reported under the category other was estimated; methodologies, AD and EFs are not reported. The lack of transparency meant that the ERT was not able to review the inventory in detail for this sector. The ERT strongly recommends that Luxembourg provide a thorough description of the methodologies, AD, EFs and other parameters used to estimate values, including the necessary references to data sources, in its next annual submission.

#### 2. Recalculations and time-series consistency

114. The ERT noted that Luxembourg has sufficient information (forest maps, remote images, and statistics) to report a time series of removals that reflect inter-annual variations in forest area and wood extraction. The Party also has country-specific data on the annual increment of different forest types and species needed to improve the accuracy and completeness of its reporting of the LULUCF sector. The ERT recommends that Luxembourg report a complete time series to reflect more effectively the reality of what is taking place in the LULUCF sector by using the best possible combination of national information, data from countries with similar biomass conditions and IPCC default values.

## **B. Key categories**

### Forest land remaining forest land – CO<sub>2</sub>

115. The ERT was not able to assess whether or not the methodologies used were appropriate and in line with the IPCC good practice guidance for LULUCF, as the parameters (country-specific, IPCC default, combination parameters) and the AD (country-specific AD, and AD from national statistics and other sources) used were not provided in the NIR.

116. During the in-country review visit, the ERT noted that the single value reported was provided in the past by an external expert and could not be substantiated by reliable background data. In response to the ERT request made during the in-country review visit, Luxembourg provided a new estimate of removals in forest land remaining forest land for 2006, which increases the original value submitted in 2006 from -294.93 Gg CO<sub>2</sub> to -355.3 Gg CO<sub>2</sub>. A recalculated time series was presented, using data collected from national statistics. According to this data, the sector was a net source of emissions in 1990 (+296.92 Gg CO<sub>2</sub>). The ERT concluded that the data required to estimate forest land remaining forest land is available and that Luxembourg has proven that it has the capacity to estimate this following the IPCC good practice guidance for LULUCF. The ERT recommends that Luxembourg make a significant effort to document these estimates extensively and report them for the entire time series in its next annual submission.

117. The Forest and Water Agency of Luxembourg is responsible by law for collecting data on forests and forest management. Following a request made by the ERT, Luxembourg provided, inter alia, data on forest areas by forest type, wood stocks, wood harvesting and the annual increment in above-ground biomass for different forest types during the in-country review visit. The ERT noted that the first National Forest Inventory was carried out in 2000 and a second is due to be completed in 2011.

118. The ERT noted that deforestation has been regulated since 1905. The law has been tightened in on several occasions and all afforestation and deforestation has been recorded since 1982, as these activities require a permit. Therefore, information on changes in forest land areas, which has to be reported under Article 3, paragraph 3, of the Kyoto Protocol, is available.

## **C. Areas for further improvement**

### 1. Identified by the Party

119. The NIR describes the activities undertaken to improve reporting on LULUCF activities. Luxembourg plans to report LULUCF activities based on the results of a study commissioned by the Water and Forest Administration of Luxembourg. The study aims to collect and update all of the necessary data for the calculation and reporting of LULUCF activities. The ERT noted that the final results of the study were not available during the review and the latest available interim report was provided in an annex to the NIR. More specific activities for further improvements were not identified in the NIR.

### 2. Identified by the expert review team

120. The ERT identified the urgent need to enhance capacities to manage information and methodologies in order to produce an inventory that is in line with the reporting requirements of the UNFCCC and its Kyoto Protocol. In this regard, the ERT recommends that Luxembourg continue to build capacities in the single national entity in order to make efforts to estimate emissions and removals from the LULUCF sector and provide the remaining estimates in its next annual submission.



## VII. Waste

### A. Sector overview

121. In 2006, the waste sector accounted for 45.49 Gg CO<sub>2</sub> eq, or 0.3 per cent of total GHG emissions. Emissions from the sector decreased by 8.2 per cent between 1990 and 2006. Within the sector, 49.3 per cent of the emissions were from solid waste disposal on land, followed by 33.9 per cent from composting, and 16.8 per cent from wastewater treatment. Luxembourg reports emissions from waste incineration under the energy sector. The ERT noted that industrial wastewater handling is reported as “NE”.

#### 1. Completeness

122. The CRF includes estimates of most gases and categories of emissions from the waste sector, as recommended by the Revised 1996 IPCC Guidelines. Industrial wastewater handling is not included. During the in-country review visit, Luxembourg provided the ERT with preliminary estimates for N<sub>2</sub>O emissions from industrial wastewater handling and indicated that these estimates would be included in its 2009 annual submission. The ERT recommends that Luxembourg include these estimates in its next annual submission.

#### 2. Transparency

123. Within the waste sector, information generally is well presented. The NIR includes AD, EFs and the methods used. However, the ERT noted that the description of estimates in all sub-categories in the waste sector lacks transparency and the ERT recommends that Luxembourg improve the transparency of reporting in the waste sector by placing specific focus on describing country-specific methods in more detail, including data sources for AD and describing solid waste and wastewater management practices.

124. The ERT noted that the incorrect notation key was used for CH<sub>4</sub> emissions from industrial wastewater handling. During the in-country review visit, Luxembourg explained that all industrial wastewater is treated in large centralized treatment systems that do not emit CH<sub>4</sub> (with the exception of the chemical plant that releases a significant amount of N (see paragraph 133 below). Therefore, the notation key “NA” should be used and not “NE”. The ERT recommends that Luxembourg correct this error in its next annual submission.

#### 3. Recalculations and time-series consistency

125. The inventory includes estimates of CH<sub>4</sub> emissions from three solid waste disposal sites: two solid waste disposal sites for the period 1990–2006, and one landfill operated by the Association for the management of household and similar to household waste for the municipalities of the region Wiltz and other regions of the north of the country (SIDA) for the period 1990–1993. The NIR explains that the SIDA landfill closed in 1993. However, the ERT noted that the landfill continues to emit CH<sub>4</sub> and these emissions should be quantified. During the in-country review visit, the Party provided the ERT with these emissions estimates. The ERT recommends that Luxembourg include these emissions estimates in its next annual submission.

126. The ERT noted that Luxembourg used constant values for AD on waste composition in solid waste disposal on land for the time periods 1975–1989, 1990–1997, 1998–2002 and 2003–2006. The ERT noted that annual AD on waste composition were available for the years 1992–1994 and 2004 and recommends that Luxembourg interpolate and extrapolate these data in order to improve time-series consistency in its next annual submission.

#### 4. Verification and quality assurance/quality control approaches

127. The ERT noted that Luxembourg has several calculation spreadsheets for the waste sector that contain specific instructions for QA/QC and have space to note whether or not QA/QC checks have been completed. The ERT encourages Luxembourg to use these tools extensively for QA/QC checks during the preparation of the annual inventory submission.

#### **B. Non-key categories**

##### 1. Solid waste disposal on land – CH<sub>4</sub>

128. The ERT noted that the SIDA landfill, which closed in 1993, continues to emit CH<sub>4</sub> and these emissions are not reported. During the in-country review visit, it was revealed that Luxembourg estimated CH<sub>4</sub> emissions from this landfill for the years 1993–2006 using the IPCC first order decay (FOD) method. The ERT recommends that Luxembourg add these emissions to the entire time series, including emissions after the closure of the landfill, in its next annual submission.

129. The ERT noted that estimates of CH<sub>4</sub> recovery from landfills for the entire time series are based on an average rate taken from a study (Strauss, 2006). During the in-country review week, Luxembourg explained that it plans to use CH<sub>4</sub> recovery data reported in environmental permits that were submitted to the Environment Agency of Luxembourg for each landfill in order to calculate actual annual recovery over the time series with data from each year, starting in 1990. Luxembourg provided the ERT with example permits that were submitted to the Environment Agency of Luxembourg for two of the landfills. The ERT concluded that the data are appropriate for the emissions calculations and recommends that Luxembourg use these data to improve consistency over the time series in its next annual submission.

130. The ERT noted a discrepancy between the NIR and the CRF tables; a closed landfill for industrial waste (Ronnebierg) was included in the NIR, but was not included in the emissions estimates. During the in-country review, the ERT learned that the amount and composition of the waste in the landfill are unknown and only limited data are available on vented CH<sub>4</sub>. The ERT recommends that Luxembourg continue to look for data on the composition/amount of waste in this landfill or that Luxembourg utilize the available data on CH<sub>4</sub> to estimate emissions from this source in its next annual submission.

131. The ERT noted that to estimate its CH<sub>4</sub> emissions from landfills, Luxembourg uses a model that includes data for annual waste disposal and waste composition for the period 1975–2006 when data were unavailable. According to the IPCC good practice guidance, this historical data used for disposal estimates is insufficient for the FOD model. Luxembourg selected the k value of 0.5, or a half life of 14 years, but it is good practice to use half lives of 3–5. The ERT noted that it is good practice to estimate historical data on waste disposal, starting with the year 1948 and to include these historical data in the FOD calculations. The ERT recommends that Luxembourg calculate emissions using this historical data on waste disposal and waste composition or that the Party use estimated values starting with the year 1948.

##### 2. Wastewater treatment and handling – CH<sub>4</sub> and N<sub>2</sub>O

132. The ERT noted that CH<sub>4</sub> emissions were estimated using an incorrect global warming potential of 23 from the Third Assessment Report of the IPCC instead of 21 from the Second Assessment Report of the IPCC, as required by the UNFCCC reporting guidelines. The ERT recommends that Luxembourg report emissions using the correct global warming potential in its next annual submission.

133. The ERT further noted that Luxembourg has a chemical plant that produces plastics, which releases N into aquatic environments. This is not accounted for in the 2008 submission. During the in-country review visit, Luxembourg stated that it intended to estimate emissions from this source in its next annual submission.

### 3. Waste incineration – CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O

134. The ERT noted that the NIR does not include updated information on the method used to estimate emissions from this source. In the 2007 submission, waste incineration emissions were only estimated for CO<sub>2</sub> using a constant annual value of 10 Gg CO<sub>2</sub> based on expert judgement. These emissions estimates were reported under the waste sector. The 2008 submission reports these emissions estimates under the energy sector, and contains improved emissions estimates for CO<sub>2</sub> and emissions estimates for CH<sub>4</sub> and N<sub>2</sub>O, all of which were calculated using annual AD, IPCC methods and EFs. The ERT encourages Luxembourg to update this information in its next annual submission.

135. Luxembourg has improved its reporting of this source category in recent years. The Party has improved transparency in the NIR by including tables of AD, descriptions of waste incineration, and the practices and methodology used to calculate emissions. In addition, Luxembourg has improved the accuracy of its emissions estimates by using plant-specific values (from environmental permits) to estimate the amount and composition of waste combusted. The inventory is more complete than previous submissions, as estimates of CH<sub>4</sub> and N<sub>2</sub>O emissions from this practice are included in the 2008 submission.

### 4. Other – CH<sub>4</sub> and N<sub>2</sub>O

136. Luxembourg reports CH<sub>4</sub> and N<sub>2</sub>O emissions from composting under this category. The ERT noted that Luxembourg has made improvements in this source category in recent years. In its 2008 submission, Luxembourg used recognized international scientific literature to estimate CH<sub>4</sub> and N<sub>2</sub>O emissions from this source. Luxembourg has improved the transparency of the NIR by including tables of AD, descriptions of composting practices and the methodology used to calculate emissions.

## **C. Areas for further improvement**

### 1. Identified by the Party

137. The ERT noted that waste is pretreated before it is disposed of in landfills. Luxembourg identified the analysis of the effects of pretreatment on landfilled waste composition as a potential area for further improvement in the solid waste disposal on land category.

138. In wastewater treatment, the Party has identified an area for further improvement in AD. The Party intends to use improved protein consumption data from the Food and Agriculture Organization of the United Nations to estimate N<sub>2</sub>O emissions from this source in its next annual submission.

139. The Party identified the category other (6.D) as an area for further improvement in order to find out whether or not there is sewage sludge that needs to be accounted for under this category instead of under agricultural soils and in order to find out whether or not there are emissions from the pretreatment of waste before it is landfilled that should be accounted for under the category other (6.D).

### 2. Identified by the expert review team

140. The ERT recommends that Luxembourg continue to investigate other industrial sources that may result in CH<sub>4</sub> or N<sub>2</sub>O emissions from wastewater handling. Another area for improvement is CO<sub>2</sub> emissions from waste incineration. The Party is encouraged to find out if the Association for the management of household and similar to household waste for the municipalities of the districts Luxembourg, Esch-sur-Alzette and Capellen (SIDOR) plant reports CO<sub>2</sub> data in its environmental permits. If this is the case, this information could be used to verify emissions estimates.

141. The ERT noted that within the framework of the Soil Concept project (sponsored by the Directorate General XIII of the EC), emissions from spreading compost composed of, inter alia, sewage sludge for the years 2000–2006 have been estimated. The ERT recommends that the Party clarify in its

next annual submission whether or not emissions occurring as a result of the Soil Concept project are included under other waste – compost production or agricultural soils.

## **VIII. Other issues**

### **1. Changes to the national system**

142. Luxembourg reported on changes to its national system in the 2008 submission. The changes include a detailed assessment of the implementation of recommendations provided during and after the review of the initial report under the Kyoto Protocol. Luxembourg provided information on the basic regulations<sup>6</sup> governing the national system, the roles and functions of the system, and the data and work flow through the system. In accordance with the regulations governing the system, the Environment Agency of Luxembourg was made the single national entity with overall responsibility for the process of data collection, inventory estimation and cross-cutting issues as defined in decision 19/CMP.1.

143. In its 2008 submission, Luxembourg provided an overview of the institutions included in the national system and their responsibilities. The Environment Agency of Luxembourg is responsible for the compilation of inventories (the CRF tables and the NIR), but responsibility for reporting lies with the Ministry of the Environment. The ERT considers this information and the changes made to be broadly in accordance with the requirements of national systems as defined in decision 19/CMP.1. The necessary financial support for the future functioning of the national system is generally secured through national regulation. The internal and external experts seem to be appropriate for needs in the short term. The ERT recommends that Luxembourg expand the national system to include the elaborated data in the LULUCF sector and recommends that the Party internalize quality management in the Environment Agency of Luxembourg in the future.

### **2. Changes to the national registry**

144. The Party has not reported on any changes to its national registry in the 2008 submission. In response to questions raised by the ERT during the review, the Party confirmed that, with the exception of the change in the software used (from SERINGAS to the European Community Registry software), no other changes to the national registry have taken place. The ERT considers this change to be in accordance with the requirements of national registries as defined in decision 13/CMP.1. The ERT recommends that Luxembourg provide a more detailed description of roles, functions and procedures in the national registry in its next annual submission.

### **3. Commitment period reserve**

145. Luxembourg has not reported its commitment period reserve in the 2008 submission. In response to questions raised by the ERT during the review, Luxembourg reported that its commitment period reserve has not changed since the initial report review (42,662,696 t CO<sub>2</sub> eq). The ERT agrees with this figure. The ERT recommends that Luxembourg include information on its commitment period reserve in its next annual submission.

## **IX. Conclusions and recommendations**

146. The ERT concludes that Luxembourg has made significant improvements since the 2006 inventory submission by following recommendations made during the previous review and implementing other improvements identified by the Party. These improvements include, among other things, the establishment of a legal framework for the national system, the elaboration of an initial QA/QC plan, and

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<sup>6</sup> Règlement grand-ducal du 1er août 2007 relatif à la mise en place d'un Système d'Inventaire National des émissions de gaz à effet de serre dans le cadre de la Convention-cadre des Nations Unies sur le Changement Climatique (in French).

the establishment of a centralized archiving system. The ERT commends Luxembourg for its efforts to improve emissions estimates in the inventory.

147. The ERT concludes that the inventory has generally been prepared in accordance with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance and has been partially prepared in accordance with the IPCC good practice guidance for LULUCF. The inventory generally covers all sectors and most source and sink categories, and is generally complete in terms of years, gases and geographic coverage. The ERT identified some gaps in the reporting, in particular in the LULUCF sector, instances of potential under- and overestimations of emissions, and issues of time-series consistency (for example in the energy and industrial processes sectors).

148. The ERT recommends that Luxembourg assess and report emissions/removals from the LULUCF sector in accordance with the IPCC good practice guidance for LULUCF, as a priority improvement in its next annual submission. The ERT further recommends that Luxembourg establish a centralized data management system to handle the inventory data, as centralized data management is fundamental for the implementation of the QA/QC system throughout the inventory compilation process.

149. The ERT also recommends that Luxembourg:

- (a) Improve the exchange of data between the different governmental and non-governmental institutions involved in the preparation of the inventory;
- (b) Develop further the mandatory facility-based reporting programme in order to improve and expand the use of emissions data from industry;
- (c) Develop a tier 2 key category analysis;
- (d) Update the uncertainty analyses more regularly, develop in-house expertise on uncertainty, and replace default background data and the use of data from the inventories of other countries with estimated uncertainties for Luxembourg;
- (e) Include the LULUCF sector in key category analysis and uncertainty analysis;
- (f) Develop further the plan for improvements based on the outcomes of the uncertainty and key category analyses, and QA/QC procedures;
- (g) Improve transparency in the NIR by elaborating the description of the methodologies used for the inventory compilation, in particular in the energy, and industrial processes and solvent and other product use sectors;
- (h) Improve consistency between the NIR and the CRF, in particular in the waste sector;
- (i) Improve the completeness of the inventory by including estimates for all identified categories of emissions in the country in its next annual submission.

## **X. Questions of implementation**

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

Annex

**Documents and information used during the review**

**A. Reference documents**

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>>.

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>>.

“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 2007. Available at <<http://unfccc.int/resource/docs/2007/asr/lux.pdf>>.

Status report for Luxembourg 2008. Available at <<http://unfccc.int/resource/docs/2008/asr/lux.pdf>>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2007. Available at <<http://unfccc.int/resource/webdocs/sai/2007.pdf>>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2008. Available at <<http://unfccc.int/resource/webdocs/sai/2008.pdf>>.

FCCC/ARR/2006/LUX. Report of the individual review of the greenhouse gas inventory of Luxembourg submitted in 2006. Available at <<http://unfccc.int/resource/docs/2007/arr/lux.pdf>>.

FCCC/IRR/2007/LUX. Report of the review of the initial report of Luxembourg. Available at <<http://unfccc.int/resource/docs/2007/irr/lux.pdf>>.

## **B. Additional information provided by the Party**

Responses to questions during the review were received from Mr. Eric De Brabanter (Ministry of the Environment), Mr. Jean Biver, Mr. Robert Schmit, Mr. Marc Schuman, Mr. Georges Blasen, Mr. Pierre Dornseiffer, Mr. Serge Less (Environment Agency of Luxembourg), Mr. Dominique Manetta and Mr. Jean-Marie Ries (Ministry of Interior and Spatial Planning, Water Management Administration of Luxembourg), Mr. Jean-Paul Hoffmann, (Rural Economy Department of Luxembourg), Ms. Kirsten Becker (SEG Umwelt-Service GmbH, Germany), Mr. Hermann Schmit-Stejskal, Mr. Andreas Windsperger (Institute for Industrial Ecology, Austria) and Mr. Wilfried Winiwarter (Austrian Research Centers GmbH, Austria), including additional material on the methodology and assumptions used. The following documents were also provided by Luxembourg:

Becker K., 2008. *Quality Assurance & Quality Control in Luxembourg GHG Inventory*, SEG Umwelt Service GMBH.

Brieda Fr. 1990. *Emissions inventory of the Grand Duchy of Luxembourg* (in German). Emissionskataster für das Grossherzogtum Luxemburg. Report 934/659001, TÜV Rheinland.

Econotec, 2008. *Emissions estimates of HFC, PFC and SF<sub>6</sub> in Luxembourg*, draft report.

Environment Agency, 2008. Annual report 2007. *Waste Management at SIEC Landfill* (in French). Installation de traitement et d'élimination pour déchets ménagers et assimilés au SIEC-Fridhaff.

Environment Agency, 2008. Annual report 2007. *Waste Management at SIGRE Landfill* (in French). Installation de traitement et d'élimination pour déchets ménagers et assimilés au SIGRE.

Environment Agency, 2008. Various handouts and outreach materials on composting.

Environment Agency, 2008. *Recalculations of time series of net removals of CO<sub>2</sub> in forest land remaining forest land in Luxembourg (1990–2006)*.

Forest Administration, 2008. Recalculations of time series of net removals of CO<sub>2</sub> in forest land remaining forest land in Luxembourg (1990–2006).

Forest Administration, 1996. *The Contribution of the Forest of Luxembourg to the global carbon cycle*.

GHG\_AGRICULTURE\_Workfile\_080625.xls. (Worksheet use for estimation of CH<sub>4</sub> and N<sub>2</sub>O emissions from enteric fermentation, manure management, agricultural soils and field burning of agricultural residues).

Institute of Industrial Ecology, 2008. *Luxembourg's emission inventory from solvent use 2008*. Draft report. St. Pölten, Austria.

Ministry of Agriculture, Wine Production and Rural Development, Rural Economy Department, 2008. *The agriculture of Luxembourg in 2008*.

STATEC Luxembourg, 2008: *Annual 2007 statistics of Luxembourg* (in French). Annuaire Statistique du Luxembourg 2007.

STATEC Luxembourg, 2008. *Luxembourg in figures*.

Steinlechner, E., et al. 1994. *Opportunities of Prevention and Use of Anthropogenic Methane Emissions* (in German). Möglichkeiten der Vermeidung und Nutzung Anthropogener Methanemissionen. Graz, Austria.

Strauss, D. 2006. *Identification of Atmospheric Methane Emissions for the Waste and the Agriculture Sectors and distribution of natural gas in the Grand Duchy of Luxembourg: analysis of calculation methods and uncertainties* (in French). Détermination des émissions atmosphériques de méthane du secteur des déchets, du secteur agricole et de la distribution de gaz naturel au Grand-Duché de Luxembourg : analyse des méthodes de calcul - calcul d'incertitudes, Rapport de Stage pour l'Administration de l'Environnement, Luxembourg.

Thewes F. and Weidenhaupt A., 1999. *Annual emission estimates of HFC, PFC and SF<sub>6</sub> in Luxembourg between 1990 and 2010* (in French). Hydrofluorocarbures (HFC), perfluorocarbones (PFC), hexafluorure de soufre (SF<sub>6</sub>). Estimations des rejets annuels au Luxembourg entre 1995 et 2010. Administration de l'Environnement et CRTE, Luxembourg.

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