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Report of the individual review of the greenhouse gas inventory of Luxembourg submitted in 2006*

* In the symbol for this document, 2006 refers to the year in which the inventory was submitted, and not to the year of publication.

CONTENTS

I. Overview

A. Introduction

1. This report covers the in-country review of the 2006 greenhouse gas (GHG) inventory submission of Luxembourg, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 11 to 16 June 2006 in Luxembourg city, Luxembourg, and was conducted by the following team of nominated experts from the roster of experts: generalist – Mr. Michael McGettigan (Ireland); energy – Ms. Kristien Aernouts (Belgium); industrial processes – Ms. Karin Kindbom (Sweden); agriculture – Mr. Jorge Alvarez (Peru); land use, land-use change and forestry (LULUCF) – Mr. Richard Volz (Switzerland); waste – Mr. Faouzi Senhaji (Morocco). Mr. Michael McGettigan and Mr. Faouzi Senhaji were the lead reviewers. The review was coordinated by Mr. Sergey Kononov (UNFCCC secretariat).

2. In accordance with the Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention, a draft version of this report was communicated to the Government of Luxembourg, which provided comments that were considered and incorporated, as appropriate, in this final version of the report.

B. Inventory submission and other sources of information

3. In its 2006 submission, Luxembourg submitted a complete set of common reporting format (CRF) tables for the years 1990–2004 and a national inventory report (NIR). Luxembourg submitted revised emission estimates on 28 July 2007 in response to questions raised by the ERT during the in-country visit; this report is based on these revised estimates. Where needed the expert review team (ERT) also used the previous year's submission, additional information provided during the in-country visit and other information. The full list of materials used during the review is provided in the annex to this report.

C. Emission profiles and trends

4. In 2004, the most important GHG in Luxembourg was carbon dioxide (CO_2), contributing 91.1 per cent to total[1] national GHG emissions expressed in CO_2 eq., followed by methane (CH_4), 3.5 per cent, and nitrous oxide (N_2O), 4.8 per cent. Hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6) taken together contributed 0.6 per cent of the overall GHG emissions and emissions of perfluorocarbons (PFCs) are reported as not occurring ("NO"). The energy sector accounted for 88.9 per cent of total national emissions in 2004, followed by industrial processes (5.5 per cent), agriculture (5.2 per cent) and waste (0.3 per cent). Total GHG emissions (excluding LULUCF) amounted to 13,348.79 Gg CO_2 eq. in 2004 and increased by 1.4 per cent between 1990 and 2004.

5. Tables 1 and 2 show the GHG emissions by gas and by sector, respectively.

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

Table 1. Greenhouse gas emissions by gas, 1990–2004

GHG emissions	Gg CO_2 equivalent								Change
	Base year (Convention)	1990	1995	2000	2001	2002	2003	2004	BY–2004 (%)
CO_2 (with LULUCF)	11 924.27	11 924.27	9 017.53	8 745.53	9 054.72	9 872.07	10 246.60	11 861.94	–0.5
CO_2 (without LULUCF)	12 219.20	12 219.20	9 312.46	9 040.46	9 349.65	10 167.00	10 541.53	12 156.87	–0.5
CH_4	460.04	460.04	469.75	486.46	483.47	479.99	473.40	469.29	2.0
N_2O	471.14	471.14	506.59	565.82	551.14	568.14	569.81	644.27	36.7
HFCs	14.21	14.21	14.21	43.01	50.92	58.82	66.73	74.63	425.3
PFCs	–	–	–	–	–	–	–	–	–
SF_6	2.91	2.91	2.91	3.52	3.57	3.62	3.68	3.73	28.2

BY = Base year; LULUCF = Land use, land-use change and forestry.

Note: Luxembourg submitted revised estimates for the base year and 2004 in the course of the 2006 inventory review. These estimates differ from the GHG inventory submitted in 2006.

Table 2. Greenhouse gas emissions by sector, 1990–2004

Sectors	Gg CO_2 equivalent								Change
	Base year (Convention)	BY–2004 (%)	1995	2000	2001	2002	2003	2004	BY–2004 (%)
Energy	10 730.04	10 730.04	8 510.75	8 579.38	8 958.99	9 783.41	10 238.73	11 862.42	10.6
Industrial processes	1 612.68	1 612.68	992.16	761.99	713.53	737.19	686.27	735.85	–54.4
Solvent and other product use	18.31	18.31	16.86	15.17	14.59	14.68	14.72	14.78	–19.3
Agriculture	756.93	756.93	749.87	736.72	709.65	702.53	671.46	691.57	–8.6
LULUCF	–294.93	–294.93	–294.93	–294.93	–294.93	–294.93	–294.93	–294.93	0.0
Waste	49.53	49.53	36.28	46.02	42.00	39.76	43.97	44.17	–10.8
Total (with LULUCF)	12 872.57	12 872.57	10 010.99	9 844.35	10 143.82	10 982.65	11 360.22	13 053.86	1.4
Total (without LULUCF)	13 167.50	13 167.50	10 305.92	10 139.28	10 438.75	11 277.58	11 655.15	13 348.79	1.4

BY = Base year; LULUCF = Land use, land-use change and forestry.

Note: Luxembourg submitted revised estimates for the base year and 2004 in the course of the 2006 inventory review. These estimates differ from the GHG inventory submitted in 2006.

D. Key categories

6. Luxembourg has reported a key category tier 1 analysis, both level and trend assessment, as part of its 2006 submission. The key category analyses performed by the Party and the secretariat[2] produced similar results except that Luxembourg has used a more detailed level of disaggregation of key categories and has not included the LULUCF sector in its key category analysis. The ERT recommends that Luxembourg include the LULUCF sector in its future key category analyses.

E. Main findings

7. The inventory of Luxembourg is partially in line with the *Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines), the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF). There are deficiencies of varying degrees with respect to all the inventory reporting principles, the majority of which are evidently due to the lack of proper institutional and organizational arrangements for preparing and reporting the emission inventories. Luxembourg acknowledged this finding at the time of the in-country visit and undertook urgent measures during the review to establish the legal framework necessary for the implementation of formal institutional and procedural arrangements for inventory preparation and management. Furthermore, Luxembourg carried out major improvements to its GHG inventory during the review by performing a substantial amount of recalculations that improve the transparency, completeness, consistency and accuracy of the inventory. By submitting the revised inventories and by supplying the additional information requested by the ERT, Luxembourg has demonstrated sufficient capacity to comply with the UNFCCC reporting guidelines.

F. Cross-cutting topics

1. Completeness

8. The 2006 inventory submission shows full coverage for all years 1990–2004 but in the reporting of some source categories in all years, for example, in the agriculture and waste sectors, is very incomplete. The ERT believes that only a modest effort is needed to address this deficiency in reporting. During the in-country visit, Luxembourg made a number of presentations to show how estimates can be provided for the categories not included. The results were submitted to the ERT during the review process and they showed a satisfactory level of completeness for all years.

2. Transparency

9. The 2006 NIR provides only a basic description of how the Luxembourg inventory is compiled and lacks much of the detail needed to support a complete technical assessment of the emission estimates reported. In many cases it is difficult to reconcile the activity data reported with the statistical information in the sources referenced. For important emission sources, such as CH_4 from solid waste, the method (tier 1 or tier 2) is described but there is no further elaboration of the various inputs and parameters underlying the estimation, which makes full technical review impossible.

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

10. While Luxembourg's use of the CORINAIR approach is in accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines), its SNAP nomenclature of emitting activities differs from the IPCC reporting categories for GHGs and the relevant EFs are often applied in a different way. The extensive use of CORINAIR leads to some difficulties with regard to review if the NIR does not describe its application in sufficient detail. This is a major reason for the lack of transparency in many parts of the GHG inventory of Luxembourg. In addition, the ERT discovered that the NIR of the 2006 submission was largely the work of external experts who had no part in compiling the inventory. The ERT recommends that this practice be discontinued and that sufficient support be provided to ensure that all experts who are engaged in inventory compilation are individually responsible for documenting their work in accordance with the guidance provided for preparing the NIR.

3. Recalculations and time-series consistency

11. The 2006 submission is the first from Luxembourg to contain a full time-series of CRF tables. No recalculations are reported in this submission and the NIR does not describe any recalculations. The existing inventory preparation system currently cannot ensure that recalculations of previously submitted estimates of GHG emissions by sources and removals by sinks are prepared in accordance with the IPCC good practice guidance. The ERT acknowledges the efforts made by Luxembourg to recalculate its inventories during the review and welcomes the organizational and administrative provisions related to future recalculations, which are part of the proposed quality assurance/quality control (QA/QC) plan (see paragraph 18).

12. While the estimates produced by Luxembourg are in general internally consistent, a full assessment of consistency in the context of the UNFCCC reporting guidelines is hampered by the use of the same estimate of emissions for many categories for all years reported. The work Luxembourg has undertaken to revise its estimates for some categories and to improve completeness significantly improves the consistency of the inventory.

4. Uncertainties

13. The Party has not provided an uncertainty analysis for each source category or for the inventory in total, although such analysis is required by the IPCC good practice guidance.

14. Luxembourg is aware of the need to report on uncertainty and is addressing this issue. However, this is another aspect of the inventory where the provisions under CORINAIR have taken precedence over the UNFCCC reporting requirements. An evaluation of uncertainty based on CORINAIR qualitative indicators was provided during the in-country visit. The ERT recommends that the Party redirect its efforts in this area towards quantitative uncertainty assessment according to the IPCC good practice guidance. The ERT pointed out that a modest amount of work on this basis would produce an adequate estimate of uncertainty and that the estimate would be low for Luxembourg's GHG inventory, given the very large contribution of CO_2 from combustion to the total GHG emissions in the country. This outcome would put a positive perspective on the published annual estimates.

5. Verification and quality assurance/quality control approaches

15. Luxembourg has not elaborated a QA/QC plan in accordance with the IPCC good practice guidance. The current procedures do not incorporate systematic checking in the context of QC or any other form of official review, either internally or externally, before inventory submission. Checking is limited to that provided by the CRF Reporter software at the end of the process and to ad hoc correspondence between the individuals in the Environment Agency and the Ministry of Environment who compile and report the inventory, respectively. In recognition of the importance of QA/QC

procedures to the inventory process and in response to the ERT's comment that a QA/QC plan is a crucial element of the inventory preparation process, Luxembourg made available its proposed draft plan during the course of the review.

6. Follow-up to previous reviews

16. The ERT recognizes that Luxembourg has not previously been subject to an in-country review and consequently has not had the opportunity to benefit from the review process to the same extent as most other Annex I Parties. There is no established process for official consideration and approval of the inventory, including recalculations, prior to its submission, or for responding to any issues raised by the inventory review process.

G. Areas for further improvement

1. Identified by the Party

17. The current inventory practice does not include any systematic identification of shortcomings in inventory compilation and reporting, or a plan to address them. There are various statements about planned improvements to most aspects of the inventory in the 2006 NIR, but there is no indication of the order of priority or particular targets for the next or subsequent reporting cycles. Improvements to-date have been made largely on an ad hoc basis. A more systematic approach to recalculations is provided for under the proposed QA/QC system.

2. Identified by the ERT

18. Based on the findings of the in-country review, the ERT identified the following cross-cutting issues as the priority items for improvement. The Party should:

(a) Implement the institutional and organizational arrangements for inventory preparation and management as soon as possible under the Regulation[3] that entered into force on 7 August 2007 with the Environment Agency as the lead agency;

(b) Ensure that the formal institutional arrangements for inventory preparation, facilitate the inclusion of additional inventory experts, such as those who presented additional information and proposals for revised estimates during the in-country visit;

(c) Implement the QA/QC management system that has been drawn up;

(d) Assign formal roles and responsibilities to secure timely data supply and to plan, prepare and manage the annual inventory;

(e) Implement the new inventory management procedures as soon as possible in order to streamline inventory preparation and reporting so that institutional efficiencies are increased and potential reporting errors are minimized;

(f) Prepare quantified estimates of uncertainty for inclusion in future submissions;

(g) Ensure that the individual inventory compilers and experts describe the methods and data they have used for their respective components of the inventory as the primary means to improve the NIR;

[3] Reglèment grand-ducal du 1 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. <http://www.leglilux.public.lu/leg/a/archives/2007/1300708/1300708.pdf>.

(h) Further develop and consolidate the methods for the estimation of emissions in the agriculture and waste sectors that were adopted during the review as better alternatives to the CORINAIR approach, and document their application fully in its future NIRs;

(i) Reorganize and extend the management of the data archiving system to incorporate all essential data related to the GHG time-series in a secure manner that facilitates efficient identification and access to all electronic and hard-copy data elements. Prepare a user manual to describe the content, structure, management and maintenance of the archiving system.

19. Recommended improvements relating to specific source/sink categories are presented in the relevant sector sections of this report.

II. Energy

A. Sector overview

20. The energy sector in Luxembourg is the most important sector in the GHG inventory. In the base year, it was responsible for 81.5 per cent of total GHG emissions and in 2004 this share had increased to 88.9 per cent. Emissions from the sector increased by 10.6 per cent between 1990 and 2004. This overall trend conceals differences between the major contributing sectors. The key driver for the rise in emissions is the transport sector, where CO_2 emissions increased by more than 150 per cent over this period, mainly due to so-called fuel tourism (the purchase of automotive fuels by vehicles in transit through Luxembourg). CO_2 emissions in the iron and steel sector declined over the same period due to a change from the production of basic oxygen furnace steel to electric arc furnace steel. Electricity production increased and changed from using excess blast furnace gas to a new natural gas-fired power plant and several new combined heat and power (CHP) installations.

21. The reporting in the energy sector is complete for CO_2, but for CH_4 and N_2O the emissions for some categories and years are reported as not estimated ("NE"). During the in-country visit it became clear that in some cases (when "NE" appears only in a few years) this was probably the result of the truncation of data to two decimal digits during internal data transfers from one format to another. The ERT recommends that Luxembourg check whether and where in the data processing steps these data were lost and ensure that this problem is solved for future inventory submissions. In some other cases, CH_4 and N_2O emissions are NE for all years and the ERT recommends that Luxembourg complete its inventory for these categories/gases. These issues were taken into account in revised estimates which Luxembourg submitted during the review process. Specific examples are provided for the respective categories in the sector sections of this report below.

22. Luxembourg uses appropriate tiers in estimating the emissions in the energy sector. A tier 2 approach for CH_4 and N_2O is used, taking different technologies into account in the choice of emission factors (EFs). Most EFs are taken from CORINAIR but country-specific EFs for CO_2 are used for some fuels, such as blast furnace gas. The ERT recommends that the selection of EFs be described better in the NIR, that comparisons with IPCC default values be made and that the possibility of using more country-specific EFs should be investigated further. In response to this recommendation, Luxembourg revised its EFs using IPCC default values (not taking into account the oxidation factors for CO_2) instead of CORINAIR EFs and submitted revised estimates during the review process. As part of the improvements planned for Luxembourg's future submissions, the use of country-specific EFs will be considered where possible.

23. Luxembourg should increase the transparency of the data and methods used in the energy sector by giving more explanation in the NIR, and by making the CRF tables and the NIR fully consistent.

More transparency is required in relation to the allocation of fuel use in category 1.A.2 (manufacturing industries and construction) and any other treatment of data from the Service Central de la Statistique et des Etudes Economiques du Luxembourg (STATEC) to make them more suitable for using with the technology-dependent EFs for CH_4 and N_2O. To make the NIR more transparent, explanations should be included as to what data are used and how they were used in all categories. Because of the importance of energy data as basic activity data (AD) in the energy sector, more cooperation between the energy administration and the inventory agency may be helpful in making the energy consumption data more suitable for inventory purposes.

24. No actual QA/QC procedures are in place for this sector. However, some ad hoc checks of total activity data against STATEC data were re-run and demonstrated during the in-country visit. However, the possible problem of truncation (see paragraph 21 above) showed that the current checks are not able to prevent problems. The ERT suggests that interim steps in handling/transforming data from one format to another be limited as far as possible and that intermediate checks be introduced to prevent errors in the final inventory results.

B. Reference and sectoral approaches

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

25. The CO_2 emissions from fuel combustion were calculated using the reference approach and the sectoral approach. There are differences of –0.79 per cent and –6.31 per cent in the CO_2 emission estimates between the reference approach and the sectoral approach in 1990 and 2004, respectively. The difference varies from year to year and often exceeds 2 per cent (e.g. –9.50 per cent in 1999). The difference between the reference approach and the sectoral approach becomes much larger for the individual fuel types. For example, in 1990 apparent consumption of liquid fuels was 15.3 per cent higher than the sectoral use of liquid fuels. For solid fuels, apparent consumption was 56.7 per cent higher than the consumption in the sectoral approach, while the CO_2 emissions were 10.3 per cent higher. No explanations of these differences are provided in the documentation box of CRF table 1.A(c) or in the NIR. During the in-country visit, however, the reasons were explained. The main reason for solid fuels is the fact that coke for the blast furnaces from 1990 to 1997 is not included in the sectoral approach (only blast furnace gas is included). For liquid fuels, the input of the residual fuel as a reducing agent in the blast furnace is also not included but emissions are accounted for under industrial processes. In the later years, there is also a small difference for gaseous fuels, because the emissions from natural gas use in the electric arc furnaces are allocated under industrial processes and not the energy sector in the current approach. Luxembourg should include these explanations in the appropriate documentation boxes and the NIR.

2. International bunker fuels

26. CO_2 emissions from bunker fuels are reported under memo items as required, but no estimates are reported for CH_4 and N_2O for either aviation kerosene or aviation gasoline. Luxembourg has no marine bunkers. For aviation bunkers, all aviation kerosene is assumed to be used for international air traffic, which is a reasonable approach. In the present CRF tables, no aviation gasoline is reported. During the in-country visit, a methodology was presented whereby a small part of aviation gasoline is allocated to international aviation based on expert judgement (namely, 10 per cent of the aviation gasoline allocated under bunker fuels). Luxembourg should apply this methodology to calculate CH_4 and N_2O emissions as well, and include these estimates in the inventory. Luxembourg added CH_4 and N_2O from kerosene use in its revised estimates submitted during the review process but emissions from aviation gasoline were not included.

3. Feedstocks and non-energy use of fuels

27. Luxembourg has no feedstocks and only a small non-energy use of fuels. In CRF table 1A(d), lubricants and bitumen are reported for all years and white spirit for some years. However, the associated emissions (only from lubricants and white spirit, as all carbon in bitumen is considered to be stored) are not allocated anywhere. Luxembourg should quantify and allocate the related emissions, and explain the procedure and data used in the NIR.

C. Key categories

1. Electricity and heat production: gaseous fuels – CO_2

28. For the estimation of activity data for CHP plants, the NIR indicates that an internal study was used. The method used in the study is not explained in the NIR. During the in-country visit, however, the study was made available. The method is an estimate based on production and consumption data for a few "example" plants, resulting in an average value for the amount of fuel used per megawatt (MW) installed for three types of plant (natural gas and diesel motors, and gas turbines). These averages are used to calculate the annual consumption of fuel, based in the power generation capacity (in MW installed) from annual statistics provided by STATEC. The data in the CRF tables for 2002 and 2003 should be updated with the data from this study. The ERT believes that Luxembourg could improve these estimates by using actual data on energy use and production, which may be available from the energy administration. Overall, however, the method used for this estimate does not influence the total use of gaseous fuels and can only affect the allocation of fuels (and emissions) as between sectors.

29. A new gas turbine CHP plant started operation in 2002. The resulting emissions are allocated under category manufacturing industries and construction (1.A.2), and not together with the other (smaller) CHPs which are allocated under category public electricity and heat production (1.A.1(a)). The ERT suggests that transparency might be improved by allocating the new plant also under 1.A.1(a). In response, Luxembourg reallocated the data for this plant from manufacturing industries and construction – other (1.A.2(f)) to 1.A.1(a) as part of the revised estimates submitted during the review process. Luxembourg should confirm in its next submission that all CHP allocated to 1.A.1(a) produce heat and power for public use only.

2. Manufacturing industries and construction: liquid/solid/gaseous fuels – CO_2

30. The NIR and the CRF tables are not clear as to whether all industries are included in the category manufacturing industries and construction (1.A.2). For chemicals, pulp, paper and print, food processing, beverages and tobacco, the notation key "NE" is used. However, in reality these emissions are included in sub-category manufacturing industries and construction – other (1.A.2(f)) and they should therefore be reported as included elsewhere ("IE"). During the in-country visit, it became clear that when the energy data from STATEC are rearranged to correspond better to the 1.A.2 sub-categories, the final difference in fuel consumption (between the totals from the bottom-up approach used for the sub-categories for which the energy use is known, and the overall national totals from STATEC) is allocated under 1.A.2(f). This also explains the large fluctuations in fuel use and emissions in this sub-category. Luxembourg should provide a more detailed explanation of this approach and its consequences in its NIR or CRF tables. In the revised submission presented during the review process, Luxembourg added the notation key "NO" for sub-categories chemicals (1.A.2(c)); pulp, paper and print (1.A.2(d)); and food processing, beverages and tobacco (1.A.2(e)). However, it should check whether it would be better to use the notation key "IE". Luxembourg has also reallocated natural gas consumption by electric arc furnaces from industrial processes to 1.A.2(f). It would be better to include these under iron and steel (1.A.2(a)).

31. Luxembourg has and uses good activity data for the iron and steel industry. The methodology, however, should be improved by using tier 2 methods. During the in-country visit, the use of tier 2 methods was discussed and the methodology was improved by Luxembourg in the revised estimates submitted following the in-country visit.

3. Road transport: liquid fuels – general

32. The use of liquefied petroleum gas (LPG) is indicated as "NE" in the CRF tables. However, what is reported under residual fuel oil is in fact LPG. This mistake was made when the data were transferred from the Environment Agency to the Ministry of Environment, which shows how multiple transfers can affect the quality of data. The ERT recommends that this error be corrected and unnecessary data transfers eliminated from the process of inventory preparation. Luxembourg made the corrections to the data for LPG in its revised estimates submitted during the review process.

4. Road transport: liquid – N_2O and CH_4

33. For road transport, the N_2O and CH_4 emissions are reported in the CRF but not by fuel type. Luxembourg indicated that this is probably due to a problem with CRF Reporter. To enhance transparency, this problem should be solved and estimates should be reported for the individual fuels. In response to this remark, Luxembourg included the emissions per fuel type in its CRF tables in its revised estimates submitted during the review process.

34. The COPERT III model was used to estimate fuel consumption and GHG emissions for the national vehicle fleet of Luxembourg. This estimate shows that in 2004 only about one-quarter of fuels sold was actually used by the national vehicle fleet. The CO_2 emissions are upscaled by extrapolation using the national statistics on fuels sold, which means that the structure of the whole vehicle fleet purchasing fuel in Luxembourg was assumed to be the same of that of the national vehicle fleet. During the in-country visit, it was made clear that N_2O emissions have also been upscaled for gasoline and diesel oil, and CH_4 only for gasoline, also using a simple linear extrapolation. As the N_2O and CH_4 EFs are technology-dependent, this method assumes that the vehicle fleet of Luxembourg is representative of the total vehicle fleet that purchases fuel in Luxembourg. Given the large amount of fuel tourism and the fact that N_2O emissions from road transport is a key category, Luxembourg was encouraged to analyse whether this is a plausible assumption and to investigate whether other options are possible. Luxembourg should also upscale CH_4 emissions for diesel oil using the same method as for N_2O and include them in the inventory. In response to this remark, Luxembourg included CH_4 emissions from diesel oil as part of the revised estimates submitted following the in-country visit.

5. Other sectors: general

35. The population of Luxembourg grew by about 20 per cent between 1990 and 2004. There has also been an increase in the number of commuters coming to work in Luxembourg. These changes are apparently not reflected in total energy use and emissions in Luxembourg because CO_2 emissions increased by only 5.4 per cent and fuel use by about 8 per cent over this period. During the in-country visit, the ERT did not receive a clear explanation of the much lower increase in fuel use and emissions, although references were made to an increase in energy efficiency, better insulation, and more efficient heating devices. The ERT recommends that Luxembourg analyse the CO_2 trends in more detail and explain them in its next NIR. Luxembourg proposes to improve the estimates for category 1.A.4 (other sectors) and to provide a split between the commercial/institutional sector and the residential sector in its future submissions. The ERT welcomes the proposal as a means to facilitate trend analysis for these sub-categories.

D. Non-key categories

1. Electricity and heat production: liquid/solid/gaseous – CH_4 and N_2O

36. These CH_4 and N_2O emissions are reported as "NE" in the CRF tables for all years for liquid and gaseous fuels, and as "NE" for solid fuels from 1990 to 1997 ("NO" is reported for the period 1998–2004), although relevant EFs are reported in the NIR. Luxembourg was encouraged to include these emissions in its CRF tables. In response, Luxembourg added estimates for CH_4 and N_2O for the appropriate years in the revised estimates submitted during the review process.

2. Electricity and heat production: other– CO_2 and N_2O

37. The waste incinerator in Luxembourg produces electricity and should therefore be allocated under category 1.A.1(a) and not under the waste sector. The ERT noted that the same value for CO_2 emissions is reported for all years; it is based on expert judgement. During the in-country visit, Luxembourg made available exact data on the amount of waste incinerated and on waste composition for several years. With these data, it would be possible to produce better estimates of CO_2 emissions from waste incineration. The ERT therefore recommends that Luxembourg calculate the emissions of the non-biogenic part for CO_2 and N_2O based on these data and include them in the inventory under other fuels (1.A.1(a)), and that it describe the methodology in its next NIR. Luxembourg recalculated the emissions from waste incineration and included these under other fuels (1.A.1(a)) instead of category 6.C in the revised estimates submitted during the review process (see paragraphs 90 and 91).

3. Manufacturing industries and construction – CH_4 and N_2O

38. Emissions of CH_4 and N_2O are reported as "NE" in 2002 and 2003 for liquid, solid and gaseous fuels, although activity data are reported. The N_2O emissions from solid and gaseous fuels are indicated to be "NE" for the years 1995–1998 and 2000 –2004. This creates inconsistencies in the time-series. In the revised estimates submitted during the review process, Luxembourg included estimates for these (minor) emissions.

4. Civil aviation: liquid – CO_2, CH_4 and N_2O

39. Activity data are reported as "NE" for all years. During the in-country visit, Luxembourg presented a methodology whereby aviation gasoline may be reported and divided between international flights and domestic flights based on expert judgement. For its next inventory submission, Luxembourg was encouraged to include emissions of CO_2, CH_4 and N_2O and to explain the method used in the NIR. In response, Luxembourg added the AD and emission estimates in the revised inventories submitted during the review process.

5. Railways: liquid – N_2O and CH_4

40. These N_2O emissions are reported as "NE" for the years 1995–2001 and CH_4 emissions are reported as "NE" for all years. Since activity data are available for all years, these emissions should be estimated and included in the inventory. Luxembourg provided estimates of N_2O and CH_4 for this category in the revised inventories submitted following the in-country visit.

6. Navigation: liquid – N_2O

41. These N_2O emissions are reported as "NO" or "NE". Activity data are the same for all years and are based on expert judgement. Luxembourg was encouraged to investigate whether a different method might be used to estimate these AD and emissions. Luxembourg provided improved estimates of N_2O for this category in the revised inventories submitted following the in-country visit.

7. Other sectors: all fuels – N_2O

42. These N_2O estimates are reported as "NE" for all years for gaseous and solid fuels. For liquid fuels, N_2O is reported as "NE" in 2000, 2003 and 2004. This may be due to the "truncation" problem (the loss of data during data transfers). These emissions should be estimated and included in the inventory. Luxembourg provided estimates of N_2O for this category in the revised inventories submitted following the in-country visit.

8. Memo items: biomass

43. Biomass use is reported only for the category other sectors (1.A.4). The activity data come from STATEC and are more or less stable for all years. Other sources, however, indicate that the use of wood stoves and biogas from composting increased during the last few years. If additional data reflecting this trend become available from other sources in Luxembourg, estimates for future years may be improved and used in the inventory. For example, the Administration of Water and Forests has data on the wood harvested in public forests and makes estimates of harvesting in private forests. The forestry information system could be analysed to help improve the data used for biomass combustion.

III. Industrial processes and solvent and other product use

A. Sector overview

44. In 1990, the industrial processes sector accounted for 12.2 per cent and the solvent and other product use sector 0.1 per cent of total GHG emissions in Luxembourg. Emissions from industrial processes decreased by 54.4 per cent between 1990 and 2004, mainly due to a complete transition from basic oxygen furnaces (BOFs) to electric arc furnaces (EAFs) in steel production. As a result, in 2004 the share of industrial processes in total GHG emissions was only 5.5 per cent. GHG emissions from solvent and other product use decreased by 19.3 per cent between 1990 and 2004; their share in total national GHG emissions remained in 2004 as it was in 1990 (0.1 per cent).

45. The inventory is complete for CO_2 but no estimates for N_2O or CH_4 are provided for the industrial processes sector. For the fluorinated gases (F-gases), actual emissions of HFCs and SF_6 are reported, but no estimates for PFCs or of potential emissions are provided and no relevant background data are reported. The ERT recommends that Luxembourg improve the completeness of the inventory by providing estimates for N_2O and CH_4 emissions where appropriate. A complete time-series of data on the use of N_2O for anaesthesia was provided and included in the revised estimates submitted after the in-country visit.

46. To increase transparency, the ERT recommends that Luxembourg provide in the NIR more explanations on data sources, EFs, methodologies, activity data and the emission trends observed. Transparency in the CRFs could be improved by providing completed background tables for the F-gases. The information in the NIR is not always consistent with that provided in the CRF, and Luxembourg should address this issue in its next inventory submission.

47. No recalculations have been made in the 2006 submission. Several recalculations were, however, made as a result of the discussions during the in-country visit, and were submitted as revised estimates to the ERT for consideration. The recalculations are further discussed for the individual categories below. New information on emissions or EFs had originally not been treated according to good practice for recalculations and time-series consistency. For example, when new information on the EF for glass production was obtained (see paragraph 56), no assessment was made of whether data for earlier years should be recalculated to ensure time-series consistency. Furthermore, based on the point estimates for the years 1995–2000 for emissions of F-gases, a constant value equal to that for 1995 is reported until 1999, with a sudden change to the point estimate for the year 2000. Good practice would

have been to interpolate emission values for the intermediate years. In the revised estimates provided by Luxembourg in response to the recommendations made during the in-country visit, these deviations from good practice had been attended to (see paragraphs 57, 58 and 61).

48. No formal QA/QC procedures exist for the sector and no uncertainty estimates are reported in the 2006 submission. In Luxembourg's response to the discussions during the in-country visit, some quantitative uncertainty estimates were provided with the revised estimates. Planned improvements are mentioned in the NIR in general terms, such as revising the AD and EFs, but are generally not further specified.

B. Key categories

1. Cement production – CO_2

49. Emissions have been estimated using the CORINAIR "simple" methodology, which corresponds to the IPCC tier 1 method. As this is a key category, a tier 2 methodology should be used according to the IPCC good practice guidance. A constant plant-specific emission factor, which is somewhat higher than the IPCC default, has been used but is not transparently explained in the NIR. During the in-country visit new calculations for 1990 and 2004 using a tier 2 method were presented to the ERT.

50. The ERT welcomed the effort made by Luxembourg to apply the appropriate tier for this key category and recommends that the entire time-series be recalculated according to the tier 2 method, since all the required plant-specific information is available. In the revised estimates which Luxembourg subequently submitted the tier 2 method is used to estimate CO_2 emissions for the full time-series, based on five-yearly plant-specific data on lime (CaO) content and annual clinker production. The revised estimation method should be transparently described in Luxembourg's next NIR.

2. Iron and steel production – CO_2

51. In the period 1990–2004 a complete transition took place in the production of steel, from BOF to EAFs. Emissions from all processes covered in iron and steel production have been estimated using the CORINAIR "simple" methodology (a tier 1 method). Since this is a key category, a tier 2 methodology should be used according to the IPCC good practice guidance. During the in-country visit new calculations based on a tier 2 method were presented to the ERT; the method was applied for 1990 for blast furnaces and BOF steel production, and for 2004 for EAF steel production.

52. According to information provided during the in-country visit, detailed data concerning blast furnaces and BOF steel production are available for 1990, taking into account all carbon-containing materials in a carbon balance, as required for the tier 2 methodology. Emission factors can be derived from the 1990 data and used for subsequent years. Blast furnace gas is allocated to the energy sector.

53. The ERT recommends that Luxembourg revise the relevant time-series (1990–1997) for BOF steel production in line with the new calculations. In the revised estimates provided to the ERT during the in-country visit, the tier 2 method has been applied. The EFs were derived from the detailed calculations for 1990 and used for subsequent years. Emissions are calculated and reported separately for sinter production, blast furnaces and basic oxygen furnaces. The new method improves transparency and is according to good practice.

54. In the emission estimates for EAF steel production, plant-specific data on the use of anthracite, carbon and electrodes as well as natural gas acting as a reducing agent are included. New calculations for 2004, which were presented during the in-country visit, exclude the use of natural gas which is allocated instead to the energy sector. This is in line with the IPCC good practice guidance.

55. The ERT recommends that Luxembourg recalculate, for the next submission, the relevant time-series (1993–2004) for EAFs according to that tier 2 method, and investigate whether additional detailed information on carbon contents in input materials taken from the European Union (EU) emissions trading scheme (ETS) permits, or from a detailed mass balance approach, can be applied retrospectively to ensure consistency in the time-series. In the revised estimates provided to the ERT a tier 2 method based on a detailed carbon balance available for 2004 has already been applied. Information on the carbon content in input material (scrap, electrodes, anthracite and carbon) and carbon remaining in the steel product was used in the calculation. Based on the 2004 calculations, an EF for EAF steel production has been derived and used for earlier years. The revised methodologies for estimating emissions from BOF and EAF steel production should be transparently reported in Luxembourg's next NIR.

C. Non-key categories

1. Other mineral products – glass production – CO_2

56. The activity data used for calculating CO_2 emissions from float glass production are reported to be the same in all years, corresponding to the plant capacity according to the operating permit rather than to actual production data. Furthermore, the EF is given as constant for the period 1990–1999, with a subsequent considerable change upwards in 2000. The new, higher EF (0.142 t CO_2/t glass) has been used for subsequent years. The information provided to the ERT during the in-country visit showed that there is no justification for this sudden change in the EF.

57. New calculations for 1990 and 2004 were presented during the in-country visit, based on the actual production data and a constant plant-specific emission factor identical to the one used for the years 2000–2004 (0.142 t CO_2/t glass). These preliminary calculations are in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance and their results are consistent with other available estimates based on information on raw material input from the EU ETS, with a resulting EF of 0.14 t CO_2/t glass, which confirms that the use of the higher EF is appropriate.

58. The ERT recommends that the Party recalculate the whole time-series according to the calculations presented for 1990 and 2004. In the revised estimates provided to the ERT the full time-series was recalculated according to the recommendations, including the use of actual annual production data and a constant EF of 0.142 t CO_2/t glass. The revised estimates have improved the accuracy of the inventory and time-series consistency by using actual production data and revising the EF for earlier years.

2. Food and drink – CO_2

59. Estimates of CO_2 from this category are reported in the 2006 submission. According to the Revised 1996 IPCC Guidelines, CO_2 emissions from this source should not be accounted for if they are of biogenic origin. During the in-country visit it was confirmed by means of other documentation that the CO_2 is indeed of biogenic origin. In accordance with the ERT's recommendation at the time, Luxembourg has removed these estimated CO_2 emissions for the entire time-series from the inventory.

3. Consumption of halocarbons and SF_6 – HFCs and SF_6

60. The emissions of HFCs and SF_6 reported in the 2006 submission are based on estimated data for 1995 and 2000. Emissions for the years 1990–1999 are assumed to be the same as in 1995 and emissions in the period 2000–2004 are taken to be the same as in 2000. Since HFCs in many applications were a substitute for chlorofluorocarbons (CFCs), and generally entered into widespread use a few years after 1990, the HFC emissions for 1990 are probably overestimated by this assumption. Preliminary data from a new draft study on fluorinated gases in Luxembourg confirm that the level of emissions reported for 1995 is reasonable.

61. In response to recommendations made by the ERT during the in-country visit, Luxembourg applied interpolation of HFC and SF_6 emissions in the revised estimates so that the same value does not apply for several consecutive years. In addition, the previously aggregated emission estimates reported as an unspecified mix of HFCs have been disaggregated and emissions are reported for individual HFC species in the revised estimates.

62. The ERT recommends that Luxembourg use information from the new draft F-gas study and recalculate the emissions for the whole time-series for its next submission. The ERT further recommends that AD and EFs be reported in the relevant background tables of the CRF.

IV. Agriculture

A. Sector overview

63. The GHG inventory reported in 2006 contains emission estimates for three categories: enteric fermentation, manure management and agricultural soils. The inventory is therefore very incomplete as several categories have not been reported (e.g. N_2O emissions from manure management, direct N_2O from animal manures, direct N_2O from crops and pastures, and indirect N_2O from nitrogen deposition and leaching), and not all the CRF tables have been completed (e.g. table 4.F). Following the recommendation of the ERT and its recognition of this serious problem of completeness, during the in-country visit Luxembourg initiated a comprehensive revision of the emission estimates for the agriculture sector, intended to cover all sources.

64. The revision by Luxembourg produced recalculated estimates for the whole time-series, which were included as part of the revised inventories submitted to the ERT during the review process. They were prepared in a manner that makes full use of the available national statistics for agriculture and country-specific EFs, where such factors could be developed. In all other cases the IPCC default data on the EFs and other parameters needed for the calculations have been strictly applied.
The ERT welcomed this major revision of the inventory and believes that it improves the quality of the estimates considerably. It brings a satisfactory level of transparency, consistency and comparability to the emissions time-series. The ERT now recommends that the new approach be consolidated and further developed to deliver consistent results in future submissions. Given the extent of the changes for the agriculture sector, the following assessment refers mainly to the revised estimates.

65. In 2004, emissions from the agriculture sector amounted to 691.6 Gg CO_2 eq., or 5.2 per cent of Luxembourg's total national emissions. The principal categories are CH_4 emissions from enteric fermentation (4.A) and N_2O emissions from agricultural soils (4.D), contributing 34.8 and 47.2 per cent of the sectoral total, respectively. Emissions from the agriculture sector decreased by 65.4 Gg CO_2 equivalent, or 8.6 per cent, from 756.9 Gg CO_2 eq. in 1990 to 691.6 Gg CO_2 eq. in 2004, due to a reduction in the cattle population and in the use of synthetic fertilizers.

66. Luxembourg had identified two key categories in the agriculture sector in the incomplete inventory of the 2006 submission. These are CH_4 emissions from enteric fermentation and direct N_2O emissions from agricultural soils. In the revised submission received during the review direct N_2O emissions from agricultural soils is the only key category in 2004, accounting for 2.44 per cent of total national emissions.

67. The NIR of the 2006 submission does not include any uncertainty analysis or QA/QC procedures for the agriculture sector.

B. Key categories

Direct emissions from agricultural soils – N_2O

68. In its 2006 submission, Luxembourg had calculated direct N_2O emissions from agricultural soils only for synthetic fertilizers (4.D.1.1) using the CORINAIR method, leaving the reporting for this category substantially incomplete. The ERT suggested that sufficient AD are available to estimate all relevant emissions from agricultural soils in Luxembourg and that the 1996 Revised IPCC Guidelines and the IPCC good practice guidance provide a simple approach, together with extensive default data on EFs and other parameters, to calculating these emissions. The ERT recommends that Luxembourg prepare the estimates on this basis and that it submit the revised estimates for the full time-series from 1990 to 2004. The submission of revised data received during the review reflects full implementation of this recommendation with strict application of the IPCC methodologies and default data.

69. All relevant categories within 4.D are covered by the new estimates and CRF table 4.D is fully completed to show emissions and the corresponding nitrogen (N) inputs. Luxembourg includes sewage sludge spreading as a specific item under other direct emissions (4.D.1.6). Category 4.D contributed 93.7 per cent of N_2O emissions in the agriculture sector and 50.6 per cent of total national N_2O emissions in 2004. The principal sub-categories are synthetic fertilizers (4.D.1.1) and nitrogen leaching and run-off (4.D.3.2), which accounted for 27.5 and 32.4 per cent, respectively, of the emissions in category 4.D in 2004.

C. Non-key categories

1. Enteric fermentation – CH_4

70. Enteric fermentation is the main source of CH_4 emissions in Luxembourg, contributing 51.3 per cent of total national CH_4 emissions in 2004. Cattle accounted for 97.5 per cent of CH_4 emissions from enteric fermentation in 2004 and Luxembourg uses the option B characterization for cattle to report these emissions and other background data in the CRF tables. The main sub-categories are mature dairy cattle, with 43.6 per cent of emissions from enteric fermentation in 2004, and young cattle with 37.4 per cent.

71. Luxembourg uses the tier 2 method to estimate emissions of CH_4 from enteric fermentation in the three basic animal classes (mature dairy, mature non-dairy and young cattle) adopted to characterize the cattle population using STATEC population data. The estimation of gross energy intake to derive the EF follows the IPCC good practice guidance closely and the national data for relevant parameters are taken from official publications of STATEC and the Service d'Economie Rurale (SER).

72. The implied emission factor (IEF) for mature dairy cattle reported by Luxembourg in its 2006 submission is 121.8 kg/head for all years in the period 1990–2004, and the ERT questioned this as being too high for the base year. The new analysis for dairy cattle produces CH_4 EFs ranging from 105.4 kg/head/yr in 1990 to 125.4 kg/head/yr in 2004, which are among the highest reported by Annex I Parties. These values are valid and are driven by high milk yield, which increased from 4,787 kg/head/yr in 1990 to 6,734 kg/head/yr in 2004. The high milk yields are confirmed by the SER and reflect the move towards high yield and lower population resulting from reform of the EU common agricultural policy (CAP). The dairy cattle population decreased by one-third in Luxembourg between 1990 and 2004.

73. The EF for mature female non-dairy cattle is 54.73 kg/head for all years (1990–2004) while that for mature male non-dairy cattle is 53.22 kg/head over the same period. Luxembourg uses the sub-categories of calves and growing heifers to represent the young cattle class. The EF for calves increases slightly from 31.3 kg/head in 1990 to 31.45 kg/head in 2004, and that for growing heifers varies from

43.85 kg/head to 43.91 kg/head over the period. The ERT is satisfied that Luxembourg's EFs for non-dairy cattle are appropriate for use in estimating CH_4 from enteric fermentation and they are broadly in line with those of other Annex I Parties.

2. Manure management – CH_4

74. Luxembourg uses detailed national information on animal waste management systems (AWMS) together with default data in table B-1 of the Revised 1996 IPCC Guidelines to develop EFs to calculate CH_4 emissions from manure management. The animal characterization is the same as that used under enteric fermentation (4.A). The estimates are in accordance with good practice. This is a very minor source of emissions in Luxembourg, accounting for only 0.77 per cent of total national emissions in 2004.

3. Manure management – N_2O

75. Luxembourg uses national information on nitrogen excretion and AWMS along with IPCC default EFs to calculate CH_4 emissions from manure management. The values adopted for nitrogen excretion are appropriate and the estimates are in accordance with the IPCC good practice guidance. This category accounted for only 0.16 per cent of total national emissions in 2004.

V. Land use, land-use change and forestry

A. Sector overview

76. Luxembourg provides data in the CRF tables only under other (5.G). A "carbon intake by temperate forests" of 294.93 Gg CO_2 and an "N_2O emission of broadleaf and coniferous forests" of 0.07 Gg are reported. The amount of the sink equals 2.2 per cent of total national GHG emissions in CO_2 eq. in 2004. Luxembourg has stated that the values reported are only a rough estimate calculated in 1996. The value is applied as a constant for all years from 1990 to 2004. According to Luxembourg, this estimate was put under category other (5.G) to reflect the rough character of the estimate. The ERT recommends that Luxembourg put the data, even when they are only a rough estimate, in the appropriate category (such as forest land), fill in the relevant background tables and to use the documentation boxes to provide complementary explanations. In all the sectoral background tables from 5.A to 5.F and 5(I) to 5(V), the notation keys are used. No data on land use, land-use change and stock change in the different land-use categories and activities are reported. The LULUCF sector is not included in the key category analysis of the inventory. The ERT encourages Luxembourg to include the sector in the key category analysis according to the IPCC good practice guidance for LULUCF. The key category analysis by the secretariat identifies other (5.G) as a key category.

77. The ERT noted that Luxembourg has comprehensive information to report on land use and land-use change. Detailed land-use maps from 1989 and 1999 were presented to the ERT during the in-country visit. The ERT was also informed that Luxembourg has started a project in cooperation with the European Space Agency within the framework of the Global Monitoring for Environment and Security (GMES) using satellite techniques for land-use information. The ERT believes that the available data allow Luxembourg to improve its reporting on the LULUCF sector considerably, and recommends that Luxembourg apply approach 2 or 3 of chapter 2 of the IPCC good practice guidance for LULUCF to provide a land-use change matrix for all land-use categories. The ERT encourages Luxembourg also to make agreements with different institutions which can provide information for carbon stock changes or for emissions from certain activities for the reporting in the LULUCF sector.

B. Key categories

Forest land remaining forest land – CO_2

78. The ERT is of the opinion that the value reported under other (5.G) should be reclassified and reported under forest land remaining forest land (5.A.1). Forest land remaining forest land is therefore treated as a key category in this review and not category other (5.G), which would be key category according to the CRF tables of Luxembourg and the key category analysis of the secretariat. A short document on the calculation of the rough estimate of the stock change was provided during the review. From this documentation an IEF of 2.41 Mg C/ha for gains in the carbon (C) stock in living biomass could be derived. This value is similar to the IEFs of neighbouring countries.

79. The Administration of Waters and Forests is responsible by law for collecting data on forests and forest management. The ERT was informed that the information system used by the Administration of Waters and Forests records, among other parameters, detailed data on stock and harvesting in public forests, which cover 47 per cent of the forested area. The information on private forests is estimated by state officials. The harvesting data are reported in the *Statistical Yearbook* of Luxembourg. Detailed statistics on forest fires are also available in Luxembourg. From 1999 to 2000 the first National Forest Inventory was carried out. It will be repeated in the years 2009 and 2010 and will improve data availability and data quality. Deforestation has been under legal control since 1905. The law has been tightened in several steps, and since 1982 any afforestation or deforestation has required a ministerial permit. Information on these activities therefore can be found in the respective legal proceedings.

80. The ERT concludes that Luxembourg has a good information basis to report on carbon stock change of forests and on conversions from and to forest. It encourages Luxembourg to use the available data and to calculate consistent emission/removal estimates for this category for the whole time-series. The ERT recommends that Luxembourg use the relevant methodological guidance provided in chapter 5 of the IPCC good practice guidance for LULUCF.

VI. Waste

A. Sector overview

81. Luxembourg's 2006 inventory submission reports estimates of CH_4 emissions for solid waste disposal on land and CO_2 emissions from waste incineration. During the review, Luxembourg submitted recalculated inventories for all years, which included emissions of CH_4 and N_2O from wastewater handling. The notation key "IE" has been used for all emissions from waste incineration, the relevant emissions being reallocated to the energy sector because they are associated with energy recovery. In the revised estimates, the waste sector contributed 6.4 per cent to total national CH_4 emissions and 0.3 per cent (44.2 Gg CO_2 eq.) of total national GHG emissions in 2004. Solid waste disposal on land accounted for 54.2 per cent of all emissions in the waste sector in 2004. There are no key categories in the sector.

82. Sectoral GHG emissions decreased by 10.8 per cent between 1990 and 2004. This change is due to an increase in the amount of waste recycled and waste incinerated, with a simultaneous decline in the amount of waste landfilled at solid waste disposal sites – by 22.6 per cent between 1990 and 2004.

83. All the sectoral CRF tables have been provided. However, in some cases the notation keys have been used incorrectly. The ERT recommends that Luxembourg revise the use of the notation keys and provide in the NIR more detailed information on the methodologies, AD and EFs used in the waste sector. Luxembourg should also make use of the documentation boxes in the CRF tables and comment more extensively in the NIR on the results of emission estimates.

84. No QA/QC procedures are reported and no assessment of uncertainties has been attempted. The ERT recommends that Luxembourg assess the uncertainties, elaborate on them in the NIR and use them in data processing (e.g. in interpolation).

B. Non-key categories

1. Solid waste disposal on land – CH_4

85. In 2004, CH_4 emissions from solid waste disposal on land accounted for 6.4 per cent of total national CH_4 emissions and for 79 per cent of the CH_4 emissions reported by Luxembourg for the waste sector. The IPCC tier 2 method has been used to estimate these emissions. The composition of municipal solid waste and the parameters used in the first order decay (FOD) model are not provided. The ERT recommends that in its future submissions Luxembourg fill this gap, and provide a flow diagram with a mass balance and the solid waste composition.

86. The CH_4 emission estimates from solid waste disposal on land (6.A) for the whole time-series 1990–2004 are based on activity data for the period 1975–2004. In the emission estimates made, Luxembourg assumes that all national landfill sites have been fully managed since 1975. Accordingly, Luxembourg uses the value of 1.0 for the methane correction factor (MCF) in the FOD model. However, for the period 1975–1990 no information on actual waste management practices is provided in the NIR and the ERT did not receive such information during the in-country visit. If any of the sites for waste disposal were unmanaged at any time during the period 1975–1990, a lower value of the MCF, reflecting the applicable proportions of managed/unmanaged waste, should be used in the FOD model to be in line with the IPCC good practice guidance.

87. During the in-country visit, the ERT requested Luxembourg to provide evidence of the landfill management practices during the indicated period (1975–1990) and to recalculate the CH_4 emissions using an appropriate value of the MCF if not all landfilled waste was fully managed during that period. In its response, Luxembourg provided some justification for its approach by stating that solid waste disposal practice after 1975 at the landfills concerned would come within the definition of managed sites as given by the IPCC good practice guidance, with waste incineration taking over from the poorly managed sites. The ERT accepts this explanation.

88. The SIDA[4] waste disposal site was closed in January 1994. Its CH_4 emissions are not taken into account in the 2006 inventory submission, although such emissions do occur at sites that have been closed. The ERT recommends that Luxembourg include this source category in the inventory and calculate the corresponding emissions for the whole time-series. This was done in the revised estimates submitted during the review process.

2. Wastewater handling – CH_4 and N_2O

89. Emissions from wastewater treatment plants are NE in the 2006 submission. During the in-country visit, the Party presented an overview of this source category and new estimates of CH_4 and N_2O emissions. The estimates for N_2O are based on 70 per cent denitrification rates for biological wastewater treatment plants with denitrification and 35 per cent in plants without denitrification, and assume that 1 per cent of the N denitrified is emitted as N_2O. The ERT recommends that Luxembourg include these estimates in the inventory and they were provided in the revised estimates submitted during the review process. This is a very minor source of emissions (6.9 Gg CO_2 eq. in 1990 and 7.3 Gg CO_2 eq. in 2004) but their inclusion improves the completeness of the inventory.

[4] SIDA: Syndicat de communes pour la collecte, l'évacuation et l'élimination des ordures provenant des communes de la région de Wiltz et du nord du pays.

3. Waste incineration – CO_2 and N_2O

90. These CO_2 emissions are reported as a constant value (10.0 Gg) in the 2006 submission based on expert judgement of the non-biogenic fraction of waste incinerated, and N_2O emissions are not reported. The information provided to the ERT during the in-country visit showed that Luxembourg has sufficient data to derive improved estimates for CO_2 emissions from waste incineration that take account of the actual amount of non-biogenic waste incinerated and to include estimates of N_2O emissions. The ERT recommends that Luxembourg use the Revised 1996 IPCC Guidelines and the IPCC good practice guidance to estimate accurately these emissions and include them in the whole time-series from 1990 to 2004. The ERT also noted that CO_2 emissions from waste incineration should be reported under the energy sector because waste incineration is used for energy production.

91. In response to the ERT's recommendations, a new time-series of emission estimates was developed for CO_2, CH_4 and N_2O from waste incineration and they were reported in CRF category other fuels (1.A.1(a)). The total emissions from the category increased from 36.2 Gg CO_2 eq. in 1990 to 69.5 Gg CO_2 eq. in 2004. The IPCC tier 2 method is used for CO_2 taking full account of waste composition and the fossil carbon fractions in waste components.

VII. Conclusions and recommendations

92. The ERT identified deficiencies in Luxembourg's 2006 submission with respect to all the inventory reporting principles, the majority of which are due to the lack of proper institutional and organizational arrangements for preparing and reporting the annual inventories. The ERT is aware that Luxembourg has not previously been subject to an in-country review and consequently has not had the opportunity to benefit from the review process to the same extent as most other Annex I Parties. This also partly explains the status of inventory development.

93. During the review Luxembourg made major improvements to its GHG inventory by performing a substantial amount of recalculations using methods that the ERT finds to be in accordance with the revised 1996 IPPC guidelines and the IPCC good practice guidance. This work has improved the transparency, completeness, consistency and accuracy of the inventory considerably. By submitting the revised inventories and by supplying the additional information requested by the ERT, Luxembourg has demonstrated sufficient capacity to comply with the UNFCCC reporting guidelines.

94. In performing the recalculations, Luxembourg has adopted more direct use of the methodologies given by the revised 1996 IPCC guidelines and the IPCC good practice guidance in favour of CORINAIR methods, which had been in use for many years. This increases the transparency and comparability of the estimates and facilitates the work of the ERT considerably.

95. Following the extensive recalculations exercise, a consistent time-series of annual inventories has been achieved for the period 1990–2004. More rigorous application of the revised 1996 IPPC guidelines and the IPCC good practice guidance has allowed Luxembourg to make better use of available annual statistics as AD for sectors such as agriculture and waste. This development allows for improved trend analysis and for more efficient review.

96. Luxembourg acknowledged its lack of formal institutional and procedural arrangements for inventory preparation and management and undertook urgent measures to establish the legal framework necessary for implementing such provisions for future submissions. A regulation adopted by the government on 20 July 2007 which entered into force on 7 August 2007 designates the Environment Agency as the body with overall responsibility for the inventory and sets out the roles of the administrations and services that will support the agency in its task as the compiler and data coordinator of the national inventory. The ERT is satisfied that the institutional, legal and procedural arrangements

provided for under the regulation, together with the proposed QA/QC management system, should ensure that future submissions by Luxembourg are in line with the UNFCCC reporting guidelines.

97. In the course of the review, the ERT formulated a number of recommendations relating to the completeness and transparency of Luxembourg's information presented in the initial report. The key recommendations[5] are that Luxembourg should:

(a) Implement the proposed institutional and procedural arrangements related to inventory preparation and management and the associated QA/QC plan as soon as possible;

(b) Further develop and consolidate the improved methods for estimating emissions in the agriculture, industrial processes and waste sectors that were adopted during the review and fully document their application in future NIRs;

(c) Complete any outstanding work on recalculations for several parts of the inventory, and submit the results and supporting documentation with a view to achieving complete, transparent and comparable inventories for all years;

(d) Develop an improvement programme to address all the important inventory issues identified in this review and implement the programme on a systematic phased basis;

(e) Use the next NIR to describe the recalculations and improvements that have been carried out and to present a description of trends based on the much improved inventory time-series;

(f) Include quantified estimates of uncertainty in line with the IPCC good practice guidance as a component of future annual inventory submissions;

(g) Build on the benefits gained from the in-country review and respond to the various stages of the review process in the coming years.

[5] For a complete list of recommendations, the relevant sections of this report should be consulted.

Annex

Documents and information used during the review

A. Reference documents

IPCC. Good practice guidance and uncertainty management in national greenhouse gas inventories, 2000. Available at <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

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UNFCCC secretariat. Synthesis and assessment report on the greenhouse gas inventories submitted in 2006. FCCC/WEB/SAI/2006. Available at <http://unfccc.int/resource/docs/webdocs/sai/sa_2006.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) including additional material on the methodologies and assumptions used. The following additional information was provided by Luxembourg during the review:[1]

Loi du 5 juillet 1989 modifiant et complétant la loi modifiée du 4 juillet 1973 portant réorganisation de l'administration des eaux et forêts. Mémorial – *Journal Officiel du Grand-Duché de Luxembourg*, no. 52, 28 juillet 1989.

Loi du 11 août 1982 concernant la protection de la nature et des ressources naturelles. *Code de l'Environnement – 1998*. Vol. 2.

Loi du 4 juillet 1973 portant réorganisation de l'administration des eaux et forêts. Mémorial – *Journal Officiel du Grand-Duché de Luxembourg*, no. 40, 9 juillet 1973.

Loi du 30 janvier 1951 ayant pour objet la protection des bois. *Code de l'Environnement – 1998* Vol. 2.

[1] This list does not include the presentations made by Luxembourg's experts during the in-country visit.

Loi du 12 mai 1905 concernant le défrichement des propriétés boisées. *Code de l'Environnement – 1998*. Vol. 2.

Ministère de l'agriculture, de la viticulture et du développement rural (MAVDR). 2005. *The Agriculture of Luxembourg in Figures – 2005*. MAVDR, Service de l'économie rurale.

Ministerium für Landwirtschaft, Weinbau und Entwicklung des ländlichen Raumes (MLWER). 2006. *Der Luxemburger Wald in Zahlen: Ergebnisse der Luxemburger Landeswaldinventur 1998–2000*. MLWER.

Ministry of Environment of Luxembourg (MEV). 2005. *Landschaftsmonitoring Luxembourg 2005: Abschlußbericht1962–1999*.

Ministry of Environment of Luxembourg (MEV) and Austrian Federal Environment Agency (UBA). 2006. Administrative partnership agreement" between the Ministry of Environment of Luxembourg (MEV) and the Austrian Federal Environment Agency (UBA). Luxembourg/Vienna.

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Thewes F and Weidenhaupt A. 1999. *Hydrofluocarbures (HFC), perfluorocarbures (PFC), hexafluorure de soufre (SF_6): estimation des rejets annuels au Luxembourg entre 1995 et 2010*. Centre de ressources des technologies pour l'environnement (CRTE).

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