COMPLIANCE COMMITTEE

CC/ERT/IRR/2007/25
14 December 2007

Report of the review of the initial report of Liechtenstein

Note by the secretariat

The report of the review of the initial report of Liechtenstein was published on 13 December 2007. For purposes of rule 10, paragraph 2, of the rules of procedure of the Compliance Committee (annex to decision 4/CMP.2), the report is considered received by the secretariat on the same date. This report, FCCC/IRR/2007/LIE, contained in the annex to this note, is being forwarded to the Compliance Committee in accordance with section VI, paragraph 3, of the annex to decision 27/CMP.1.

UNITED
NATIONS

UNFCCC Framework Convention on Climate Change

Distr.
GENERAL

FCCC/IRR/2007/LIE
13 December 2007

ENGLISH ONLY

Report of the review of the initial report of Liechtenstein

According to decision 13/CMP.1, each Annex I Party with a commitment inscribed in Annex B to the Kyoto Protocol shall submit to the secretariat, prior to 1 January 2007 or one year after the entry into force of the Kyoto Protocol for that Party, whichever is later, a report (the 'initial report') to facilitate the calculation of the Party's assigned amount pursuant to Article 3, paragraphs 7 and 8, of the Kyoto Protocol, and to demonstrate its capacity to account for emissions and the assigned amount. This report reflects the results of the review of the initial report of Liechtenstein conducted by an expert review team in accordance with Article 8 of the Kyoto Protocol.

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I. Introduction and summary

A. Introduction

1. This report covers the in-country review of the initial report of Liechtenstein, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with Guidelines for review under Article 8 of the Kyoto Protocol (decision 22/CMP.1). The review took place from 11 to 15 June 2007 in Vaduz, Liechtenstein, and was conducted by the following team of nominated experts from the roster of experts: generalist – Ms. Anna Romanovskaya (Russian Federation); energy and industrial processes – Mr. Hristo Vasilev (Bulgaria); agriculture, waste, land use, land-use change and forestry (LULUCF) – Mr. Sabin Guendehou (Benin). Ms. Anna Romanovskaya and Mr. Sabin Guendehou were the lead reviewers. In addition, the expert review team (ERT) reviewed the national system, the national registry, and the calculations of the Party's assigned amount and commitment period reserve (CPR), and took note of the LULUCF parameters. 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 Liechtenstein, which provided comments that were considered and incorporated, as appropriate, in this final version of the report.

B. Summary

1. Timeliness

3. Decision 13/CMP.1 requests Parties to submit the initial report prior to 1 January 2007 or one year after the entry into force of the Kyoto Protocol for that Party, whichever is later. The initial report of Liechtenstein was submitted on 22 December 2006, which is in compliance with decision 13/CMP.1. In its initial report Liechtenstein refers to its submission of the revised greenhouse gas (GHG) inventory dated 29 December 2006. Liechtenstein submitted revised emission estimates on 27 July 2007 in response to questions raised by the ERT in the course of the in-country visit.

2. Completeness

4. Table 1 below provides information on the mandatory elements that have been included in the initial report and reflects revised GHG estimates for 1990 and 2004 as well as revised values of the assigned amount and the CPR provided by Liechtenstein resulting from the review process. These revised estimates are based on the inclusion of missing estimates of methane (CH_4) and nitrous oxide (N_2O) emissions occurring during combustion of biogas from wastewater to produce energy (see paragraphs 77 and 80), estimates of CH_4 emissions from managed waste disposal on land (see paragraph 76) and revisions of direct N_2O emissions from histosols (see paragraph 55), which resulted in a revision of the estimate of the total GHG emissions in the base year from 230,421 tonnes carbon dioxide equivalent (CO_2 eq.) as reported originally by the Party to 229,483 tonnes CO_2 eq. (see paragraphs 85 and 86).

Table 1. Summary of the reporting on mandatory elements in the initial report

Item	Provided	Value/year/comment
Complete GHG inventory from the base year (1990) to the most recent year available (2004)	Yes	1990–2004
Base year for HFCs, PFCs and SF_6	Yes	1990
Agreement under Article 4	No	Not applicable
LULUCF parameters*	Yes	Minimum tree crown cover: 20 per cent Minimum land area: 0.0625 ha Minimum tree height: 3 m
Election of and accounting period for Article 3, paragraphs 3 and 4, activities	Yes	Annual accounting for each activity under Article 3, paragraph 3, elected No activities under Article 3, paragraph 4 elected.
Calculation of the assigned amount in accordance with Article 3, paragraphs 7 and 8	Yes	1 059 940 tonnes CO_2 eq.
Calculation of the assigned amount in accordance with Article 3, paragraphs 7 and 8, revised value	Yes	1 055 623 tonnes CO_2 eq.
Calculation of the commitment period reserve	Yes	953 940 tonnes CO_2 eq.
Calculation of the commitment period reserve, revised value	Yes	950 061 tonnes CO_2 eq.
Description of national system in accordance with the guidelines for national systems under Article 5, paragraph 1	Yes	The elaborated description of archiving of GHG inventory information and the quality assurance/quality control (QA/QC) plan have been provided by the Party following the request of the ERT in the course of the review
Description of national registry in accordance with the requirements contained in the annex to decision 13/CMP.1, the annex to decision 5/CMP.1 and the technical standards for data exchange between registry systems adopted by the CMP	Yes	

* The LULUCF parameters reported in table 1 were provided by the Party to the ERT during the in-country visit.

5. The information in the initial report generally covers the elements required by decision 13/CMP.1, section I of decision 15/CMP.1, and relevant decisions of the Conference of the Parties serving as the Meeting of the Parties (CMP).

3. Transparency

6. The ERT noted that the information reported in the initial report is generally transparent, except for the information on archiving the GHG inventory and quality assurance/quality control (QA/QC) procedures. During the review, the ERT identified the following areas where transparency needs to be further enhanced: (1) information on the legal basis of the national system for GHG inventory preparation; (2) information on the co-operation between sectoral experts and the authors of the national inventory report (NIR) to ensure consistent reporting in the CRF tables and the NIR; (3) explanatory background information on the assumptions, country-specific methods, parameters and emission factors (EFs) and on the uncertainty values used in the compilation of the GHG inventory; and (4) additional explanatory information in the documentation boxes of the CRF (e.g. in the waste sector).

4. Emission profile in the base year, trends and emission reduction target

7. In the base year (1990 for all gases), the most important GHG in Liechtenstein was CO_2 contributing 88.5 per cent to total[1] national GHG emissions expressed in CO_2 eq., followed by CH_4, 5.8 per cent and N_2O, 5.7 per cent (see figure 1). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) taken together contributed negligibly ($5*10^{-7}$ per cent) of the total national GHG emissions in the base year. The energy sector accounted for 88.7 per cent of the total national GHG emissions in the base year followed by agriculture, 9.8 per cent, solvent and other product

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

use, 0.9 per cent, and waste, 0.7 per cent (see figure 2). In the base year, the total national GHG emissions amounted to 229.48 Gg CO_2 eq., an increase of 18.3 per cent from the base year to 2004. The trends for the different gases and sectors are clearly explained in the relevant sections of the NIR and are reasonable.

Figure 1. Shares of gases in total GHG emissions, base year

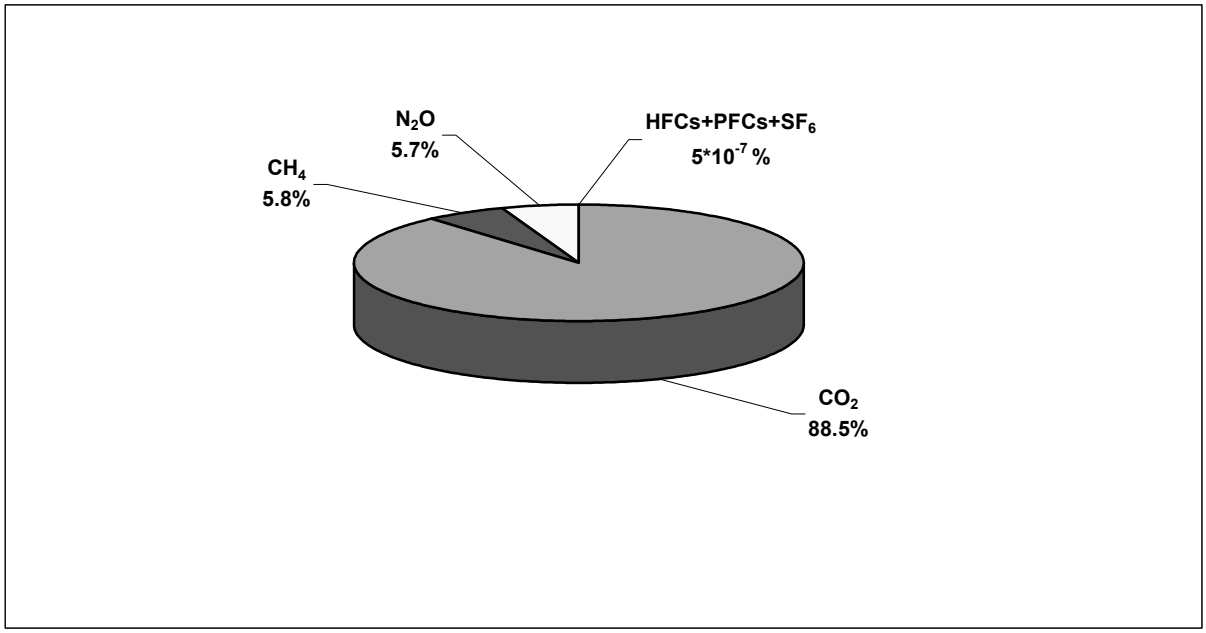
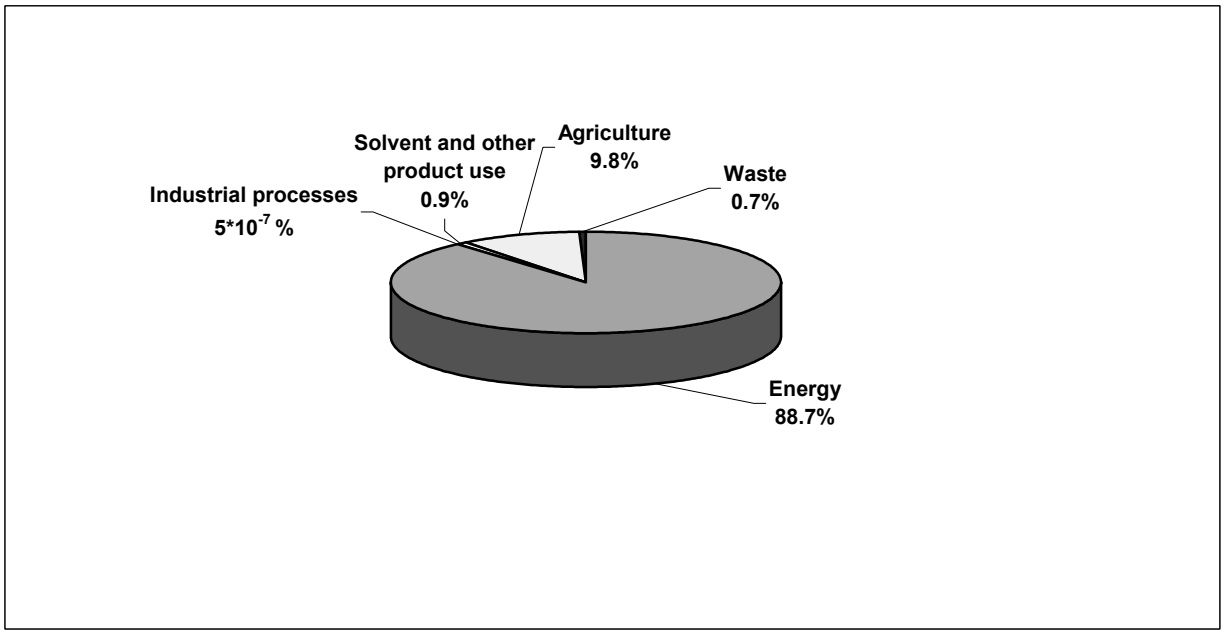


Figure 2. Shares of sectors in total GHG emissions, base year



8. Tables 2 and 3 show the GHG by gas and by sector, respectively.

9. Liechtenstein's quantified emission limitation is 92 per cent as set out in Annex B to the Kyoto Protocol.

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

GHG emissions (without LULUCF)	Gg CO_2 eq.								Change BY–2004 (%)
	Base year [a]	1990	1995	2000	2001	2002	2003	2004[a]	
CO_2	203.06	203.06	209.38	227.52	225.61	230.54	240.01	240.19	18.3
CH_4	13.40	13.40	12.49	12.22	12.94	13.52	13.91	14.34	7.0
N_2O	13.02	13.02	13.93	12.83	12.87	12.82	12.85	12.85	–1.3
HFCs	0.00	0.00	0.39	2.31	2.92	3.16	3.44	3.95	$5*10^{-7}$
PFCs	NA,NO	NA, NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA
SF_6	NA,NO	NA, NO	NA,NO	0.02	0.04	0.05	0.05	0.06	NA

Note: BY = Base year; LULUCF = Land use, land-use change and forestry; NA = Not applicable; NO = Not occurring.

[a] Liechtenstein submitted revised estimates for the base year and 2004 in the course of the review on 27 July 2007. These estimates differ from the Party's GHG inventory submitted in 2006.

Table 3. Greenhouse gas emissions by sector, 1990–2004

Sectors	Gg CO_2 eq.								Change BY–2004 (%)
	Base year [a]	1990	1995	2000	2001	2002	2003	2004[a]	
Energy	203.47	203.47	210.63	229.41	227.34	232.24	241.80	242.09	19.0
Industrial processes	0.00	0.00	0.39	2.32	2.96	3.21	3.49	4.00	$5*10^{-7}$
Solvent and other product use	1.99	1.99	1.61	1.28	1.24	1.19	1.16	1.10	–44.8
Agriculture	22.48	22.48	22.09	20.22	21.32	21.72	22.08	22.44	–0.2
LULUCF	NA	–7.35	–9.33	–5.64	–3.97	–5.45	–5.82	–6.38	NA
Waste	1.55	1.55	1.40	1.66	1.52	1.73	1.73	1.74	12.3
Other	NA	NA	NO	NO	NO	NO	NO	NA	NA
Total (with LULUCF)	NA	222.14	226.79	249.26	250.40	254.63	264.44	264.99	NA
Total (without LULUCF)	229.48	229.48	236.12	254.90	254.37	260.09	270.26	271.37	18.3

Note: BY = Base year; LULUCF = Land use, land-use change and forestry; NA = Not applicable.

[a] Liechtenstein submitted revised estimates for the base year and 2004 in the course of the review on 27 July 2007. These estimates differ from the Party's GHG inventory submitted in 2006.

II. Technical assessment of the elements reviewed

A. National system for the estimation of anthropogenic GHG emissions by sources and sinks

10. Liechtenstein's national system is, in general, prepared in accordance with the guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol (decision 19/CMP.1). The national system has been developed in line with the relevant guidelines and can perform the general and specific functions required. The ERT noted that, in its initial report, the description of archiving of GHG inventory information and the documentation of the QA/QC system was not elaborated in line with decision 22/CMP.1, but that all the required information was provided by the Party in the course of the review. Table 4 shows which of the specific functions of the national system are included and described in the initial report.

Table 4. Summary of reporting on the specific functions of the national system

Reporting element	Provided	Comments
Inventory planning		
Designated single national entity*	Yes	See section II.A.1
Defined/allocated specific responsibilities for inventory development process*	Yes	See section II.A.1
Established process for approving the inventory*	Yes	See section II.A.1
Quality assurance/quality control plan*	Yes	See section II.A.2
Ways to improve inventory quality	Yes	See section II.B.3
Inventory preparation		
Key category analysis*	Yes	See section II.B.1
Estimates prepared in line with IPCC guidelines and IPCC good practice guidance*	Yes	See section II.B.2
Sufficient activity data and emission factor collected to support methodology*	Yes	See section II.B
Quantitative uncertainty analysis*	Yes	See section II.B.2
Recalculations*	Yes	See section II.B.2
General QC (tier 1) procedures implemented*	Yes	See section II.A.2
Source/sink category-specific QC (tier 2) procedures implemented	No	See section II.A.2
Basic review by experts not involved in inventory	Yes	See section II.A.2
Extensive review for key categories	No	See section II.A.2
Periodic internal review of inventory preparation	Yes	See section II.A.2
Inventory management		
Archive inventory information*	Yes	See section II.A.3
Archive at single location	Yes	See section II.A.3
Provide ERT with access to archived information*	Yes	See section II.A.3
Respond to requests for clarifying inventory information during review process*	Yes	See section II.A.1

* Mandatory elements of the national system.

1. Institutional, legal and procedural arrangements

11. During the in-country visit, Liechtenstein explained the institutional arrangements, as part of the national system for the preparation of the GHG inventory. The Office of Environmental Protection (OEP) is the designated single national entity that has a mandate from the Government of Liechtenstein to manage the national system for preparation of the GHG inventory. The tasks of the OEP are described in Government decision RA 2006/1528-8642 dated 13 June 2006. This decision obliges all offices of the Principality of Liechtenstein to support the inventory preparation process and to submit all the information required for the preparation of the GHG inventory to the OEP. Another decision related to the management of the national system for GHG inventory preparation, the Emission Trading Act, was under consideration by the Government of Liechtenstein during the review and is to be adopted by the end of 2007. This act reiterates the functions of the OEP as the single national entity for GHG inventory

preparation and the institution responsible for the preparation of national communications. It sets a framework for the national system for the preparation of the GHG inventory and for the national GHG registry. The OEP is responsible for overall management and coordination of the GHG inventory preparation process, including compilation of the reports, QA and QC activities, archiving of GHG inventory information, administration of the national registry and deciding on the choice of methodologies and the priorities for improvement of the inventory.

12. The specific responsibilities allocated to the inventory development experts and institutions are well defined and are further specified at annual meetings between data suppliers and the inventory preparation group at the OEP. The OEP, other offices of the Principality of Liechtenstein (e.g. the Office of Economic Affairs; the Office of Forest, Nature and Landscape; the Office of Agriculture; and the Office of Land-Use Planning) and some private companies (e.g. Co-operation for the Storage of Gas, Liechtenstein's Gas Utility, Abwasserzweckverband, its Electric Power company and Heliport balzers) are the main providers of activity data (AD) for the GHG inventory preparation. The GHG inventory group at the OEP, 10 sectoral experts from different private companies and seven authors of the NIR are involved in the preparation of the GHG inventory. The sectoral experts who prepare the GHG inventory for Liechtenstein are also involved in the preparation of the Swiss inventory. Although there are no formal agreements between the OEP and the other offices and private companies, these experts and institutions in the national system for GHG inventory preparation cooperate effectively. The ERT concluded that the national system for GHG inventory preparation in Liechtenstein is functional. For the time being, Liechtenstein has allocated the necessary resources to ensure that its GHG inventory complies with the requirements of 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 that the national system for GHG inventory preparation performs its functions.

13. In Liechtenstein there is an established process for the official consideration and approval of the inventory, including recalculations, prior to its submission to the UNFCCC secretariat and for responding to any issues raised by the inventory review. The OEP is responsible for this.

2. Quality assurance/quality control

14. In its initial report, Liechtenstein had not provided a formal QA/QC plan in accordance with the IPCC good practice guidance. However, in the course of the review the ERT learned that Liechtenstein has developed and implemented an informal system of QC procedures (tier 1) which covers: (1) an annual GHG inventory preparation plan; (2) cross-checking of the NIR and the CRF by sectoral experts reviewing the NIR and NIR authors reviewing the GHG emission estimates; (3) consistency checking of all AD against the AD in the inventories from previous years; and (4) internal procedures (periodic surveys and censuses) to check the data collected by the Governmental Offices that provide official statistical data. The ERT recommends that Liechtenstein review the checklists of the AD quality control systems of private companies and describe this procedure in the NIR of its next GHG inventory submission.

15. Liechtenstein has implemented some QA procedures in accordance with the IPCC good practice guidance requirements, including: (1) peer review by a Swiss external expert of all country-specific methodologies and EFs; (2) internal QA by the OEP staff who are not directly involved in the compilation of the GHG inventory; and (3) revision of the applicability of Swiss methodologies and EFs by experts from the other Offices of the Principality of Liechtenstein. The ERT recommends that Liechtenstein describe the QC and QA activities in a transparent manner in the NIR of its next inventory submission.

3. Inventory management

16. Archiving of inventory information is not fully described in the initial report of Liechtenstein. The initial report states that the background information, activity data (AD) and emission factors (EFs) are stored by relevant sectoral experts. The submissions of the GHG inventory are archived by a project manager in the OEP. All public electronic documents are stored by the Information Technology Department of the State administration. During the in-country visit, the ERT learned that Liechtenstein has a single location for storing all annual GHG submissions including the sectoral background data, AD, EFs and descriptions of methodologies on CD-ROMs in a bank safe. In addition, there are procedures for storing, backing-up and taking security measures which are in line with the requirements for the national systems for GHG inventory preparation. The ERT recommends that Liechtenstein provide a description of the archiving procedures for the GHG inventory information following the requirements of the Guidelines of national systems in the next inventory submission under the Kyoto protocol.

B. Greenhouse gas inventory

17. In conjunction with its initial report, Liechtenstein has submitted a complete set of CRF tables for the years 1990–2004 and an NIR.

18. During the review, Liechtenstein provided the ERT with additional information sources. These documents are not part of the initial report 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.

1. Key categories

19. Liechtenstein has reported a tier 1 key category analysis, both level and trend assessment, as part of its initial report submission. Liechtenstein has not included the LULUCF sector in its key category analyses and has only elaborated key category analyses for 2004. However, during the in-country review Liechtenstein explained that the key categories indicated for 2004 are almost fully representative of the entire time series. The key categories in 1990 would only not include consumption of halocarbons and SF_6 which was negligible in the base year. The ERT recommends that Liechtenstein include the LULUCF sector in the key category analyses as is recommended in the *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF), develop the key category analysis for the base year and consider the possibility of using a tier 2 method for key category analysis in the next GHG inventory submission.

20. The key category analyses performed by the Party and the secretariat[2] produced some different results because Liechtenstein has not included the LULUCF sector and has applied different levels of disaggregation for the most significant categories in the energy sector, compared with the levels applied by the secretariat. Key categories identified by the Party and the secretariat for other sectors are generally consistent. Liechtenstein identified 16 key categories and the secretariat 13 key categories in 2004. The results of the key category analyses guide inventory preparation, prioritization of resources and the development of the higher tier methodologies for all the sectors, except LULUCF. Most of the key categories (except agriculture/forestry/fisheries (1.A.4.c)) have been estimated using the tier 2 method and higher tier methods, which is in line with the IPCC good practice guidance.

[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 Land Use, Land-use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) for the base year or base year period as well as the latest inventory year. Key categories according to the tier 1 trend assessment were also identified. 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.

2. Cross-cutting topics

21. The inventory is generally in line with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines), the IPCC good practice guidance and the IPCC good practice guidance for LULUCF.

22. The inventory is in general compiled in accordance with Article 7, paragraph 1, and decision 15/CMP.1.

Completeness

23. In the 2006 submission, Liechtenstein reported a complete set of CRF tables for all years, sectors, sources, sinks, and gases, including actual emissions of HFCs and SF_6 (the fluorinated gases (F-gases)), for the first time. The ERT acknowledges the efforts of the inventory group. The CRF tables are mostly complete. However, several rows in the tables are blank (e.g. the summary overview for key categories (table 7) and CH_4 emissions from manure management (table 4B(a)). The ERT noted reporting gaps in the waste sector. However, in the course of the review, Liechtenstein improved the completeness of its inventory by providing estimates of the categories that were reported as 'NO' (e.g. CH_4 emissions from managed waste disposal on land) and some missing categories (CH_4 and N_2O emissions from the combustion of biogas from wastewater handling to produce energy). The ERT commends this improvement and encourages Liechtenstein to provide these estimates in its future inventory submissions. The ERT also appreciates and encourages Liechtenstein to continue the reporting of subcategories (composting of organic wastes, nitrogen-fixation on pastures), that are additional to those prescribed in the IPCC good practice guidance.

Transparency

24. The NIR provides sufficient information to assess the quality of the GHG inventory. However, some additional information could greatly improve the level of transparency in the NIR and the CRF tables. The assumptions (e.g. interpolation for livestock populations), country-specific methodologies (e.g. estimation of carbon stock changes in the LULUCF sector), parameters, EFs (e.g. for road transport and fugitive emissions in the energy sector) and uncertainty values used in Liechtenstein's inventory are mostly referenced to Swiss data. The ERT noted that explanatory background information for these data was missing in the NIR for all sectors, and for the energy and the LULUCF sectors in particular. If additional information in documentation boxes of the CRF background tables (e.g. wastewater handling (table 6b)) is provided, it will increase the overall transparency of the reporting. The ERT recommends that Liechtenstein describe the background information for all the assumptions and the country-specific data used in a transparent manner in the NIR, and complete the documentation boxes of the CRF tables in its next inventory submission.

Consistency

25. The trends of GHG emissions reported in Liechtenstein's inventory for the period 1990 to 2004 are largely consistent. Most fluctuations in the trends of GHG emissions are clearly described in the NIR. The ERT appreciates the analysis and the description of trends. However, the ERT noted that some rapid fluctuations in AD (e.g. poultry numbers) are not explained in the NIR. The ERT encourages Liechtenstein to add explanatory information on the trends of AD in the NIR of its next inventory submission.

Comparability

26. The inventory is comparable with those of other Parties because the methodologies and formats agreed by the CMP for estimating and reporting inventories are being used. The allocation of the emissions to respective categories follow the Revised 1996 IPCC guidelines and the IPCC good practice guidance with a few minor exceptions in the LULUCF sector (e.g. vineyards and orchards are reported

under grasslands instead of under croplands). The ERT recommends that Liechtenstein fully follow the IPCC recommendations on the allocation of reported emission estimates.

Accuracy

27. The reporting is generally accurate but the ERT noted some minor inconsistencies: (1) inaccurate use of notation keys (e.g. CH_4 emissions from soils should be reported as not estimated 'NE' instead of not occurring 'NO'); (2) inconsistency between tables in the CRF (e.g. reporting of potential HFC emissions in the tables 2(I)s2 and 2(II)s2); (3) inconsistency between the NIR and the CRF tables (e.g. a fraction of fossil carbon is reported in the waste sector in the NIR while in the CRF it is reported under biogenic emissions). The ERT recommends that Liechtenstein correct these inconsistencies in its next inventory submission.

Recalculations

28. The Party's national system for GHG inventory preparation can ensure that recalculations of previously submitted estimates of GHG emissions are prepared in accordance with the IPCC good practice guidance. During the preparation of the GHG inventory, in cases where recalculations are proposed by the data suppliers, permission must be sought from a project manager at the OEP in order to recalculate the time series. All substantial changes in AD or parameters lead to recalculations whereas minor changes that do not lead to any change in estimates of GHG emissions may not be considered as the basis for recalculation.

29. The ERT noted that emissions from the base year to 2003 have been recalculated in order to improve the quality and completeness of the inventory. The major changes include: (1) revision of AD in the energy statistics; (2) revision of EF for direct N_2O emissions from agricultural soils (in the 2006 submission the default EF is used) and (3) estimates for the categories that were not estimated ('NE') in previous submissions. The general rationale for these recalculations is provided in the NIR. These recalculations have significantly improved the quality of the GHG inventory and resulted in an increase of 2.4 per cent in emissions in 2003 and an 8.0 per cent decrease in emissions in the base year.

Uncertainties

30. Liechtenstein has provided a tier 1 uncertainty analysis for the non-LULUCF key categories and for the inventory in total, following the IPCC good practice guidance. The uncertainty analysis for all non-key categories was considered under one residual source and was basis of an expert judgement. The ERT encourages Liechtenstein to add the additional information on the expert judgement applied in uncertainty analysis. Uncertainty values for country-specific parameters are not always clearly described in the NIR. The level of uncertainty associated with the estimates is in some cases based on a qualitative evaluation only (e.g. the NIR reports that the level of uncertainty in the inventory is assessed as low and medium). Correlations in uncertainty analysis are not considered, which may lead to the underestimation of total uncertainties. The ERT recommends that Liechtenstein include the LULUCF categories (in accordance with the disaggregating level proposed in Table 5.4.1. of the IPCC good practice guidance for LULUCF) and separate uncertainties for all non-key categories (in accordance with the disaggregating level proposed in Table 7.1. of the IPCC good practice guidance). The ERT encourages Liechtenstein to consider the possibilities to perform a full Monte Carlo analysis (tier 2) to estimate the correlation of the estimates of emissions.

3. Areas for further improvement identified by the Party

31. The NIR does not identify any planned areas for the improvement of the GHG inventory. The ERT recommends that Liechtenstein consider continuous improvement of the overall quality of emission estimates, AD and EFs. In its response to the issues raised during the review, Liechtenstein indicated its

intention to improve its estimates of N_2O emissions from histosols, CH_4 emissions from managed waste disposal on land and N_2O and CH_4 emissions from wastewater handling.

4. Areas for further improvement identified by the ERT

32. The ERT identified the following cross-cutting issues for improvement. The Party should:

(a) Provide documentation on its QA/QC activities;

(b) Provide a description of the archiving of the GHG information;

(c) Improve transparency in the description of the national group of inventory compilers and of co-operation patterns between the experts involved;

(d) Improve transparency in the GHG inventory reporting by:

(i) providing more precise descriptions of the country-specific methodologies and parameters;

(ii) providing additional information in the documentation boxes of the CRF tables;

(iii) further elaborating its explanation of the AD trends;

(e) Include the LULUCF sector in the key category analysis, provide a key category analysis for 1990 and consider the possibility of using a tier 2 method for the key category analysis;

(f) Provide quantified uncertainty estimates for all categories, including LULUCF, and non-key categories; provide explanatory information on expert judgements used to estimate uncertainty values for country-specific parameters and consider the possibility of implementing a tier 2 uncertainty analysis.

33. Category-specific recommendations for improvements are presented in the relevant sector sections of this report.

5. Energy

Sector overview

34. In the base year, the energy sector accounted for 88.7 per cent (203.47 Gg CO_2 eq.) of the total national emissions of Liechtenstein. The most important energy category is the category of other sectors (1A.4), which contributes 43.7 per cent of the sectoral emissions and 38.7 per cent of the total national emissions. Transport and manufacturing industries and construction contributed 37.5 per cent and 17.4 per cent, respectively, to the sectoral emissions in the base year.

35. During the period 1990–2004, emissions from the energy sector increased by 19.0 per cent, primarily due to increased emissions from the category other sectors, by 25.9 per cent, and transport, by 12.6 per cent.

36. Reporting of the energy sector is generally accurate, with the exception of the reporting of the AD for fugitive emissions, where 'NO' is reported for AD for natural gas distribution. In the course of the review Liechtenstein provided explanations of the CO_2 fugitive emissions from national gas distribution and corrected the notation keys by reporting them as included elsewhere ('IE') instead of 'NO'. The ERT commends this effort by the Party.

37. Liechtenstein has improved its inventory considerably compared with the previous (2005) inventory submission. However, the ERT noted a lack of full documentation on the data sources used

(e.g. the main part of the energy balance or the data files of national statistics) that reduces the transparency of the reporting. The ERT recommends that Liechtenstein provide more detail on the data sources used in the energy sector in its next submission.

38. Recalculations are reported in the CRF for the base year. The recalculations led to increased estimates of CO_2 and CH_4 emissions by 129.6 and 66.8 per cent, respectively, and a decrease in the estimate of N_2O emissions by 73.1 per cent compared to the 2005 submission. The ERT commends the improvements in the AD based on sectoral energy consumption and the elimination of inconsistencies in the data, which were the reasons for the recalculations.

Reference and sectoral approaches

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

39. Liechtenstein forms a customs union with Switzerland and therefore has no specific statistics on the export and import of liquid fuels. Liechtenstein does not have a refinery industry. Liechtenstein therefore states that the reference approach and the sectoral approach are identical and that the reference approach has therefore not been reported explicitly in the 2006 submission. Nevertheless, the ERT encourages Liechtenstein to report the reference approach in its next inventory submission.

International bunker fuels

40. The single category reported under the international bunker fuels is aviation bunkers because there is a helicopter base in the country. Emissions of CO_2 from aviation bunkers decreased by 18.6 per cent from 1990 to 2004. In the base year, GHG emissions from aviation bunkers contributed 85.0 per cent to the total emissions from aviation. This reflects the national circumstances of the country.

Feedstocks and non-energy use of fuels

41. In the base year, Liechtenstein reported feedstock and non-energy use of fuels as 'NO'. Emissions of non-methane volatile organic compound (NMVOC) from road paving with asphalt, however, are estimated and reported in the CRF in the base year, indicating that emissions from lubricants and bitumen do occur. The ERT recommends that Liechtenstein estimate emissions from lubricants and bitumen and report these estimates in its next inventory submission.

Key categories

Stationary combustion: liquid fuels – CO_2

42. Tier 1 and tier 2 methods have been used to calculate CO_2 emissions from stationary combustion. A tier 1 method is applied to estimate emissions from agriculture/forestry/fisheries (1.A.4.c). EFs, AD and methodologies have been satisfactorily described and explained in the NIR and the CRF tables. However, the ERT recommends that Liechtenstein apply a tier 2 method for all subcategories under this key category.

Stationary combustion: gaseous fuels – CH_4

43. The ERT noted that EFs of CH_4 from natural gas combustion in public electricity and heat production and in the manufacturing industry and construction are higher than the IPCC default factors (for gas equipments: 2.5 g/GJ; and for boilers for natural gas: 1.4 g/GJ). In the course of the review, Liechtenstein explained that different parameters were used for the estimates. The specifications for a gas motor formed the basis for the estimation of emissions from co-generation of electricity and heat (a country-specific EF of 25 g/GJ was used) and the specifications for a boiler formed the basis for estimations of emissions from the generation of heat (a country-specific EF of 6 g/GJ was used). The

ERT notes that the estimation is correct and recommends that Liechtenstein enhance transparency in the NIR by including this clarification in its next inventory submission.

Road transportation: liquid fuels – CO_2

44. In the base year, CO_2 emissions from road transportation accounted for 32.8 per cent of total national emissions, an increase of 12.9 per cent from 1990 to 2004. Liechtenstein uses a tier 1 approach to estimate CO_2 emissions from combustion of gasoline and diesel oil. As this is a key category, the ERT recommends that Liechtenstein apply a tier 2 approach in its next inventory submission.

45. Liechtenstein calculates fuel consumption using the approach outlined in the Revised 1996 IPCC Guidelines on the basis of the fuel sold in the country. During the in-country visit, Liechtenstein demonstrated that the emissions are estimated as a second approach based on a mileage approach. This approach is substantiated by a model which as well as other parameters includes transport statistics such as distance travelled by vehicle. The ERT noted that the CO_2 emissions from gasoline and diesel oil estimated using the mileage approach resulted in the estimates that were 45.6 per cent lower in the base year and 31.0 per cent lower in 2004. The ERT considers that the differences between the results using the two different approaches are easily explained (fuelling by Austrian cars due to lower gasoline prices in Liechtenstein) and that the reported level of CO_2 emissions estimated from gasoline and diesel fuel is accurate.

Non-key categories

Fugitive emissions: oil and natural gas – CH_4

46. Fugitive CH_4 emissions from oil and natural gas are estimated using a tier 3 IPCC method, which has been also used to estimate such emissions in Switzerland. The method used is in line with the IPCC good practice guidance. However, the CH_4 implied emission factor (IEF) for distribution of natural gas (391.5 kg/unit) is much higher than the default IPCC EFs (9.5 kg/unit). During the in-country visit, the Party explained that the reason for the difference was a typing error in the CRF tables and that different units (m^3/h/km) for the CH_4 EF were used for the calculations. Liechtenstein has revised the AD and corrected the IEF so that they are within the range of the IPCC default values. The ERT encourages the Party to add information on the length of gas pipelines for 1990–2004 and to explain any country-specific circumstances in its next inventory submission.

6. Industrial processes and solvent and other product use

Sector overview

47. In the base year, only the consumption of halocarbons and SF_6 and mineral products in industrial processes are estimated. The other categories are reported as 'NO'. Liechtenstein reports carbon monoxide (CO) and non-methane volatile organic compounds (NMVOC) emissions from asphalt roofing and NMVOC emissions from road paving with asphalt, and uses Swiss country-specific emissions per inhabitant to estimate these emissions. The ERT encourages Liechtenstein to explain the method in more detail in its next inventory submission.

Non key categories

Consumption of halocarbons and SF_6 – HFCs

48. In the base year, consumption of halocarbons and SF_6 was identified as a non-key category, but in 2004 it was identified as a key category by level and trend. The main source of the AD for this category is actual consumption of HFCs. The ERT noted that Liechtenstein has good statistics on stationary refrigeration and transport-related refrigeration and air-conditioners. Potential emissions of HFC's are reported as 'NO' and the NIR does not provide information on such emissions. The ERT

encourages Liechtenstein to report potential emissions of HFCs in its next inventory submission. The ERT noted that actual emissions of HFCs were negligible in the base year and increased by 7421.2 per cent from 1993 to 2004 and recommends that Liechtenstein explain this trend in the NIR of its next inventory submission.

7. Agriculture

Sector overview

49. In the base year, total emissions from agriculture sector amounted to 22.48 Gg CO_2 eq. and accounted for 9.8 per cent of total national GHG emissions. Over the period 1990–2004, emissions in the sector decreased by 0.2 per cent. In the base year, emissions of CH_4 and N_2O contributed 52.0 per cent and 48.0 per cent of sectoral emissions, respectively. In its tier 1 key category analysis Liechtenstein identified enteric fermentation, direct N_2O emissions from agricultural soils and indirect N_2O emissions from agricultural soils as the key categories. This is in agreement with the secretariat's key category analysis. Enteric fermentation, manure management and agricultural soils contributed 43.6 per cent, 15.2 per cent and 41.2 per cent, respectively, to the sector's emissions. Rice cultivation, prescribed burning of savannas and field burning of agricultural residues are reported as 'NO'.

50. Liechtenstein reports estimates of all gases and categories from the agriculture sector including descriptions, as recommended by the IPCC good practice guidance. However, the uncertainty analysis for the agriculture sector is not clearly described in the NIR. The ERT recommends that Liechtenstein provide more explanatory information on the level of uncertainty in the AD and EFs in its next inventory submission.

51. The EFs for N_2O emissions from agricultural soils were revised and corresponding recalculations of the entire time series were made. In the 2006 submission the default value of the EF for direct N_2O emissions from agricultural soils was used, which resulted in an increase in sectoral emissions of 25.2 per cent in the base year.

52. In addition to the requirements of the IPCC good practice guidance, the composting of organic wastes applied to soils is reported. The ERT appreciates the reporting of this additional category.

Key categories

Enteric fermentation – CH_4

53. The AD for the livestock categories used in the period 1990–2004 has been obtained from different sources: the Office of Agriculture (LWA 2004) and from the Office of Economic Affairs (AVW 1992). It is not clear from the NIR if the methodologies for collecting these data from the two sources are consistent. During the in-country review, Liechtenstein explained that the method of data collection is the same for both data sources and that the data are fully consistent. However, some of the AD (e.g. the numbers of livestock) are not gathered annually and are interpolated. The ERT recommends that Liechtenstein provide explanations of the methodology for collecting and estimating the AD and of their consistency in the NIR of its next inventory submission.

54. Poultry numbers have increased rapidly since 1996. The trend of the poultry population is not explained in the NIR. In the course of the review, Liechtenstein explained that the reasons for this trend are the establishment of two new poultry farms. The ERT encourages the Party to provide explanations of the rapid changing livestock numbers in the NIR of its next inventory submission.

Direct soils emissions – N_2O

55. In the base year, Liechtenstein reports the area of histosols as 471 ha, which is 3.5 times higher than the area of organic soils (132 ha) reported under the LULUCF, cropland, organic soils. The Party

has noted that the area of histosols reported under direct soils emissions (4D1) might be incorrect. This leads to an overestimation of direct N_2O emissions from agricultural soils for the entire time-series. The ERT recommended that Liechtenstein revise the estimates of direct N_2O emissions from histosols. In the course of the review, Liechtenstein provided a revised estimate (9.26 Gg CO_2 eq.) that resulted in a decrease of emissions from agricultural soils by 1.22 Gg CO_2 eq. in the base year.

56. In its NIR, Liechtenstein assumed that 60 per cent of the total nitrogen (N) in N-fixing crops comes from N-fixation. However, it is not clear from the NIR whether the remaining 40 per cent of the N in these types of crops was considered in the estimation of the total N input to soils. In the course of the review, Liechtenstein explained that all N from crop residues is included in the estimation. This is in line with the IPCC good practice guidance. The ERT recommends that Liechtenstein provide the relevant explanation in the NIR of its next inventory submission.

57. For the Party's estimations of the amount of crop residues, the Swiss standard values of crop production have been used for 1990–2004. However, during the in-country visit, the ERT learned that annual national statistics on crop production are available in Liechtenstein. The Party might wish to consider the possibility of using these annual crop production statistics to estimate the amounts of crop residues in its next inventory submission.

8. Land use, land-use change and forestry

Sector overview

58. In the base year, the LULUCF sector represented a net sink of 7.35 Gg CO_2 eq. The inventory in the LULUCF sector is in general complete since it covers all categories and gases, including estimates for wetlands and settlements.

59. The information provided by Liechtenstein is generally transparent. However, data collection techniques and the methodology applied for the base year required additional clarification, which was provided during the in-country review. The ERT recommends that Liechtenstein report these clarifications of methodology and data collection techniques in its next inventory submission.

60. In general, the inventory methods are used consistently throughout the entire time series. In most cases, Liechtenstein applied Swiss methods, country-specific AD and some country-specific EFs. To address the gap in land area data, Liechtenstein used interpolation and extrapolation techniques using existing data from three national land statistics (aerial photographs of the whole country from 1984, 1996 and 2002) and a national forest inventory (Liechtensteinisches Landesforstinventar 1998) and developing a land-use change matrix. The ERT noted that the extrapolation has been applied for the entire 10-years period 2002–2012, which is not in line with the IPCC good practice guidance, as it is too long period. Liechtenstein has also used the NFI of Switzerland to derive some of the country-specific parameters required.

61. The ERT identified some inconsistencies between the NIR and the CRF tables, mainly with regard to the reporting of land use categories (e.g. land converted to forest land, land converted to cropland and land converted to grassland are reported in the CRF tables, but not in the NIR) and recommends that Liechtenstein improve the consistency between the NIR and the CRF tables in its next inventory submission. Furthermore, the ERT found it difficult to identify in the NIR the different land-use categories (e.g. forest land remaining forest, land converted to forest land, cropland remaining cropland, land converted to cropland, grassland remaining grassland, land converted to grassland) and the different carbon pools (living biomass, dead organic matter and soil organic carbon) following the classification presented in the IPCC good practice guidance for LULUCF. The Party is encouraged to clearly distinguish these land-use categories in the NIR of its next inventory submission.

62. None of the formal category-specific QA/QC procedures recommended by the IPCC good practice guidance has been implemented. The ERT recommends that Liechtenstein develop and implement such procedures for the preparation of its next inventory submission.

63. The LULUCF sector has not been included in the Party's key category analysis. The categories presented below were identified as key categories by the UNFCCC secretariat.

Key categories

Forest land remaining forest land – CO_2

64. During the in-country visit, Liechtenstein explained that "inaccessible forest" in the land-use change matrix corresponds to "unmanaged forest". The ERT found that the inclusion of this category in the inventory is not in line with the IPCC good practice guidance for LULUCF and might lead to an overestimation of sinks for the entire time-series. Liechtenstein confirmed the finding and informed the ERT that it will correct the estimations in the future. The ERT recommends that Liechtenstein provide the revised estimates for forest land, including managed forest only, in its next inventory submission.

65. Liechtenstein used the Swiss country-specific method and AD from Liechtenstein to estimate removals from this category. The data on land area were based on interpolation and extrapolation. The NFIs of Switzerland were used to derive the EFs and the parameters required (e.g. biomass expansion factor, biomass density, biomass growth rate) for the estimation of the changes in carbon stocks. None of the three NFIs (NFI , 1983–1985, NFI II, 1993–1995, NFI III, 2000–2006) applied in the estimations of removals from this category does not cover 1990. In response to questions raised by the ERT during the in-country visit, Liechtenstein explained, how the data for the base year were derived. The spreadsheets used were analyzed by the ERT, which concluded that the method is in line with the IPCC good practice guidance for LULUCF. The ERT recommends that Liechtenstein better document the methodology and data used to estimate the emissions and removals in the base year in its next inventory submission.

66. Liechtenstein has not reported any emissions from N fertilization and drainage of soils or from wild fires, and has argued that these practices or events either do not occur or occur only on a very small scale. The ERT encourages Liechtenstein to report these categories, if the data are available or can be obtained.

Cropland remaining cropland – CO_2

67. The estimation of living biomass in annual crops for the estimation of change in carbon stocks is not in line with the IPCC good practice guidance. This leads to overestimation of the carbon stocks. During the in-country visit, Liechtenstein explained that the carbon stocks estimated for living biomass in annual crops, are not included in the inventory and are considered only if land-use changes occur. The ERT confirms the correct reporting of Liechtenstein and recommends that Liechtenstein clarify in its next inventory submission that only perennial cropland is considered for the estimation of the changes in carbon stocks in living biomass in cropland remaining cropland, while carbon stocks in annual crops are considered only in the case of conversion of land to grassland.

Grassland remaining grassland – CO_2

68. In the course of the in-country visit, Liechtenstein confirmed that 'unproductive grassland' identified in the land-use change matrix corresponds to 'unmanaged grassland'. The ERT identified that the inclusion of this category in the inventory is not in line with the IPCC good practice guidance for LULUCF and might overestimate the removals. The ERT recommends that Liechtenstein consider only managed grassland and report it in its next inventory submission.

Settlements – CO_2

69. Liechtenstein used IPCC default parameters and Swiss country-specific data to estimate the carbon stock changes in trees and soils. The ERT acknowledges the efforts made by the Party to report this category.

Non-key categories

Wetlands converted to other land – CO_2

70. The classification by the Party of the 'unproductive wetlands' as 'unmanaged wetlands' is not in line with the IPCC good practice guidance for LULUCF. During the in-country review, Liechtenstein clarified that the carbon stocks are to be considered only if a change in land-use category occurs, and are not included in the inventory. The ERT recommends that Liechtenstein include this clarification and better document the consideration of unproductive wetland in its next inventory submission.

9. Waste

Sector overview

71. In the base year, emissions from the waste sector amounted to 1.55 Gg CO_2 eq. and accounted for 0.7 per cent of the total national GHG emissions. Emissions from the waste sector increased by 12.3 per cent from 1990 to 2004. Liechtenstein explained that the emissions have increased due to the growth of composting activities, thereby reducing the amount of municipal waste sent to Switzerland for incineration. The inventory of the waste sector is in general complete and covers all categories and gases, apart from estimates of CH_4 emissions from landfill and CH_4 and N_2O emissions from biogas from wastewater treatment used to produce energy.

72. The information provided by Liechtenstein is in general transparent. However, Liechtenstein should improve the transparency of its cross-sectoral reporting by better documenting the clarifications provided during the review process in its next inventory submission, for example, clarifications of the reporting of emissions from biogas produced from a wastewater treatment plant and burned to produce energy, which are reported in the energy sector; and reporting of emissions from compost applied to agricultural land, which are included in the agriculture sector. Furthermore, an explanation of the use of some notation keys in the CRF tables (e.g. 'NE' and 'IE' in wastewater handling) was provided only during the in-country visit. The ERT recommends that Liechtenstein provide this explanation on the notation keys mentioned above in its next inventory submission.

73. In general, the inventory methods are used consistently throughout the time series. In most cases Liechtenstein applied Swiss methods together with country-specific AD and some country-specific EFs. Some inconsistencies between the NIR and the CRF tables have been noted (e.g. in the NIR, a fossil ('non-biogenic') fraction of carbon is reported while in the CRF tables this fraction is reported under a 'biogenic' fraction of carbon). The ERT recommends that Liechtenstein improve the consistency between the NIR and the CRF tables in its next inventory submission.

74. Liechtenstein implements some QC checks. However, none of the formal category-specific QA/QC procedures recommended by the IPCC good practice guidance is in place. The ERT recommends that the Party develop and implement category-specific QA/QC procedures.

Key categories

75. No key category has been identified in the waste sector.

Non-key categories

Managed waste disposal on land – CH_4

76. Liechtenstein reported managed waste disposal on land as 'NO', assuming that, because the landfills had ceased operating 16 years before 1990, no emissions had occurred in the base year or during the entire time series. This is the equivalent of the use of the mass balance approach, which underestimates emissions. During the in-country visit and following the suggestion of the ERT, Liechtenstein provided estimates of CH_4 emissions from managed waste disposal on land using the first order decay (FOD) model and provided the AD (e.g. waste generation per capita, amount of waste landfilled) and the parameters (e.g. degradable organic carbon, decay rate constant, oxidation factor) and all the spreadsheets used for the estimates. These revisions resulted in estimates of CH_4 emissions of 0.22 Gg CO_2 eq. in the base year and 0.031 Gg CO_2 eq. in 2004. The ERT commends the provision of the estimates and recommends that Liechtenstein include these emissions in its future inventory submissions.

Wastewater handling – CH_4

77. In order to estimate CH_4 emissions from wastewater treatment plant (including domestic, commercial and industrial wastewater), Liechtenstein used parameters such as the volume of biogas produced and a leakage rate. Liechtenstein used plant-specific data on biogas as well as Swiss data on a leakage rate of 0.2 per cent and for the CH_4 content in biogas of 65 per cent. During the in-country visit, the Party provided documentation on the parameters used and clarification of their use, which the ERT appreciates. During the in-country visit, Liechtenstein confirmed that CH_4 emissions from the use of biogas from wastewater handling to produce energy are not reported in the inventory. The ERT recommends that Liechtenstein estimate and report these emissions under the energy sector. Following this recommendation, Liechtenstein provided estimates of CH_4 emissions from biogas used to produce energy and documented plant-specific data and EFs. These revisions resulted in an estimate of 0.002 Gg CO_2 eq. in the base year being reported under biomass in public electricity and heat production (1.A.1a) in the energy sector. The ERT recommends that Liechtenstein report these emissions in its future inventory submissions.

78. Liechtenstein also informed the ERT that biogenic CO_2 emissions from the biogas used to produce energy are reported under the energy sector as a memo item and not included in the total national GHG emissions. This is in line with the IPCC good practice guidance. The ERT recommends that Liechtenstein better document this information in its next inventory submission in order to enhance the transparency of the reporting.

Wastewater handling – N_2O

79. Liechtenstein used the IPCC default method to calculate N_2O emissions from wastewater handling. However, Liechtenstein used a constant value for protein consumption for the entire time series. The ERT recommends that Liechtenstein investigate the availability of annual statistics on protein consumption (e.g. the data from the United Nations Food and Agriculture Organization or data based on the well-documented judgements of national experts) and estimate N_2O emissions from wastewater handling in its next inventory submission.

80. The ERT identified that Liechtenstein had not reported N_2O emissions from the combustion of biogas from wastewater handling to produce energy and recommended that Liechtenstein estimate and report these emissions under the energy sector. Following these recommendations, in the course of the

review, Liechtenstein provided estimates of 0.53 Gg CO_2 eq. in the base year, reported under biomass of public electricity and heat production (1.A.1a). Well-referenced plant-specific data and EFs have been used. The ERT recommends that Liechtenstein report these emissions in its next inventory submission.

Waste incineration – CO_2, CH_4, N_2O

81. In the NIR Liechtenstein has reported that waste incineration does not occur, but a fraction of household waste is burned by the population and the emissions (CO_2 and non-CO_2) occurring from this practice are calculated and reported by Liechtenstein using country-specific EFs from Switzerland. Liechtenstein confirmed during the in-country visit that the EF used for CO_2 includes only fossil carbon and that the EFs for non-CO_2 emissions are for both fossil and biogenic carbon. This is in line with the IPCC good practice guidance and the ERT recommends that Liechtenstein include this information in its next inventory submission. The ERT has identified that fossil carbon was misallocated in CRF table 6.C. Fossil carbon should be reported under 'non-biogenic' and not under 'biogenic' fraction of carbon. During the review process, Liechtenstein acknowledged the misallocation and added the CO_2 emissions from fossil carbon to the total national GHG emissions. The ERT recommends that Liechtenstein accurately allocate these emissions in its future inventory submissions.

Composting of organic waste – CH_4, N_2O

82. Liechtenstein used Swiss country-specific methods and data to estimate emissions of CH_4 and N_2O from composting of organic waste. The ERT appreciated the clarification provided by Liechtenstein on the distinction between the emissions reported under the waste sector and those reported under the agriculture sector. The ERT encourages Liechtenstein to provide this clarification in its next inventory submission.

C. Calculation of the assigned amount

83. The assigned amount pursuant to Article 3, paragraphs 7 and 8, is calculated in accordance with the annex to decision 13/CMP.1.

84. Liechtenstein's base year is 1990 and the Party has chosen 1990 as its base year for HFCs, PFCs and SF_6. Liechtenstein's quantified emission limitation is 92 per cent as included in Annex B to the Kyoto Protocol.

85. Based on Liechtenstein's original base year emissions, excluding land-use, land-use change and forestry – 230,421 tonnes CO_2 eq. – and its Kyoto Protocol target of 92 per cent, the Party calculated its assigned amount to be 1, 059,940 tonnes CO_2 eq.

86. In response to the inventory issues identified during the review, the Party submitted revised estimates of its base year inventory (229,483 tonnes CO_2 eq.), which resulted in a recalculation of the assigned amount. Based on the revised estimates, the Party calculates its assigned amount to be 1,055,623 tonnes CO_2 eq. The ERT agrees with this figure.

D. Calculation of the commitment period reserve

87. The calculation of the required level of the commitment period reserve is in accordance with paragraph 6 of the annex to decision 11/CMP.1.

88. Based on its original calculated assigned amount – 1,059,940 tonnes CO_2 eq. – Liechtenstein calculates its commitment period reserve to be 953,940 tonnes CO_2 eq.

89. In response to the inventory issues identified during the review, the Party submitted revised estimates of its base year inventory, which resulted in a recalculation of the assigned amount. Based on the revised estimates (229,483 tonnes CO_2 eq.), the Party calculates its commitment period reserve to be 950,061 tonnes CO_2 eq. The ERT agrees with this figure.

E. National registry

90. Liechtenstein has provided most of the information on the national registry system as required by the reporting guidelines under Article 7, paragraphs 1 and 2, of the Kyoto Protocol (decision 15/CMP.1). The information provided is transparent. However, the ERT noted that the information on results of test procedures (paragraph 32 (j) of Decision 15/CMP.1) was not provided in the initial report.

91. In the course of the initial review, the ERT was provided with additional and updated information on the national registry of Liechtenstein (e.g. on on-going work on the development of the national registry and a schedule for the testing and initialization process). Liechtenstein indicated that, according the schedule, the initialization of the national registry should be completed by 25 October 2007.

92. Table 5 summarizes the information on the mandatory reporting elements of the national registry system, as stipulated by decisions 13/CMP.1 and 15/CMP.1.

93. During the in-country visit, the ERT was informed that the internal operational testing of new releases and implementation of patches has started and the results of the initialization process were expected in September 2007. The registry was expected to be fully operational by 25 October 2007.

94. The ERT was also informed of the procedures introduced and security measures taken to minimize discrepancies, terminate transactions and correct problems, and minimize operator error. These procedures and security measures included two-tier architecture. The front-end tier and the data base tier are separated from each other by means of a firewall. The front-end tier is protected from the Internet by means of a firewall and a reverse proxy. Access to the front-end is restricted to port 443 (https). The final system is planned to be hardened with a security template. In case of discrepancies a 24-hour "clean-up" procedure allows identification of errors and clearing of the data base. This procedure will also terminate all pending transactions. Through the reconciliation procedure, the national registry compares its data with those held by the ITL every 24 hours. The software incorporates this reconciliation procedure. Different features can be chosen: conciliation lists, details of last reconciliation and manual intervention audit trail.

95. The ERT acknowledged the efforts made by Liechtenstein to put in place adequate procedures and security measures. The ERT gained the overall impression that Liechtenstein attached adequate importance, and at the time of the in-country review had allocated adequate resources, including human resources, to the development, operation and maintenance of the registry. The ERT encourages the Party to maintain the level of resources available at the moment.

96. The ERT took note of the results of the technical assessment of the national registry, including the results of standardized testing, as reported in the independent assessment report (IAR) that was forwarded to the ERT by the administrator of the international transaction log, pursuant to decision 16/CP.10 on 10 December 2007.

97. The ERT reiterate the main findings of this report, including that the registry has fulfilled all of its obligations regarding conformity with the data exchange standards. These obligations include having adequate transaction procedures; adequate security measures to prevent and resolve unauthorized manipulations; and adequate measures for data storage and registry recovery.

98. Based on the results of the technical assessment, as reported in the IAR, the ERT concluded that Liechtenstein's national registry is fully compliant with the registry requirements as defined by decisions 13/CMP.1 and 5/CMP.1, noting that registries do not have obligations regarding operational performance or public availability of information prior to the operational phase.

Table 5. Summary of information on the national registry system

Reporting element	Provided/ referenced	Comments
Registry administrator		
Name and contact information	Yes	The Office of Environmental Protection
Cooperation with other Parties in a consolidated system		
Names of other Parties with which Liechtenstein cooperates, or clarification that no such cooperation exists.	Yes	Switzerland, Monaco
Database structure and capacity of the national registry		
Description of the database structure	Yes	SeringasTM, version 4.0 implemented
Description of the capacity of the national registry	Yes	Microsoft Structured Query Language Server relational data base management system with a dedicated data model is used
Conformity with data exchange standards (DES)		
Description of how the national registry conforms to the technical DES between registry systems	Yes	The software conforms to the technical standards for data exchange as specified in the UNFCCC data exchange standards, version 1.0, DES #7 of December 18, 2004. Covered in the IAR[a]
Procedures for minimizing and handling of discrepancies		
Description of the procedures employed in the national registry to minimize discrepancies in the transaction of Kyoto Protocol units	Yes	By signing the Licence Agreement, the software developer (CDC) commits to provide a registry software which is fully compliant with the requirements of the UNFCCC and the EU specifications. The transactions will be terminated automatically if the ITL notifies any discrepancy.
Description of the steps taken to terminate transactions where a discrepancy is notified and to correct problems in the event of a failure to terminate the transaction	Yes	
Prevention of unauthorized manipulations and operator error		
An overview of security measures employed in the national registry to prevent unauthorized manipulations and to prevent operator error	Yes	Covered in the IAR
An overview of how these measures are kept up to date	Yes	The servers are subject to a continuous patch process
User interface of the national registry		
A list of the information publicly accessible by means of the user interface to the national registry	Yes	Publicly accessible web-site provides an unsecured access to information related to the registry's activities. Covered in the IAR
The Internet address of the interface to Liechtenstein's national registry	Yes	www.afu.llv.li
Integrity of data storage and recovery		
A description of measures taken to safeguard, maintain and recover data in order to ensure the integrity of data storage and the recovery of registry services in the event of a disaster	Yes	A back-up strategy for the national registry has been developed Covered in the IAR
Test results		
The results of any test procedures that might be available or developed with the aim of testing the performance, procedures and security measures of the national registry undertaken pursuant to the provisions of decision 19/CP.7 relating to the technical standards for data exchange between registry systems.	No	Not available at the time of the in-country review. Test results covered in the IAR.

[a] Pursuant to decision 16/CP.10, the administrator of the international transaction log (ITL), once registry systems become operational, is requested to facilitate an interactive exercise, including with experts from Parties to the Kyoto Protocol not included in Annex I to the Convention, demonstrating the functioning of the ITL with other registry systems. The results of this exercise will be included in the IAR. They will also be included in the annual report to the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol.

F. Land use, land-use change and forestry parameters and election of activities

99. Table 7 shows the Party's choice of parameters for forest definition as well as elections for Article 3, paragraphs 3 and 4, activities in accordance with decision 16/CMP.1.

Table 6. Selection of LULUCF parameters

Parameters for forest definition		
Minimum tree cover	20 %	
Minimum land area	0.0625 ha	
Minimum tree height	3 m	
Elections for Article 3, paragraphs 3 and 4, activities		
Article 3, paragraph 3, activities	**Election**	**Accounting period**
Afforestation and reforestation	Mandatory	Annual
Deforestation	Mandatory	Annual
Article 3, paragraph 4, activities		
Forest land management	Not elected	Not applicable
Cropland management	Not elected	Not applicable
Grazing land management	Not elected	Not applicable
Revegetation	Not elected	Not applicable

100. In the course of the review, the parameters chosen for the definition of forest have been revised and are within the agreed values in decision 16/CMP.1. Liechtenstein has not reported the definitions to the Food and Agriculture Organization of the United Nations.

101. Liechtenstein has decided to account for afforestation, reforestation and deforestation activities annually and has not elected any activities to account under Article 3, paragraph 4.

102. The two definitions of forest used by Liechtenstein in its initial report are not in line with decision 16/CPM.1: the tree crown cover and the tree height specified in these definitions are both higher than the upper limit of the range agreed in decision 16.CMP/1. In response to a recommendation of the ERT, in the course of the review, Liechtenstein provided a single definition of forest and identifies forest parameters in line with decision 16/CMP.1. Liechtenstein should use consistently the definition of forest provided under the Kyoto Protocol and the Convention.

III. Conclusions and recommendations

A. Conclusions

103. The expert review team concluded that the information provided by Liechtenstein is mostly complete and submitted in accordance with the relevant provisions of paragraphs 6, 7 and 8 of the annex to decision 13/CMP.1, section I of the annex to decision 15/CMP.1, and the relevant decisions of the CMP; that the assigned amount pursuant to Article 3, paragraphs 7 and 8, is calculated in accordance with the annex to decision 13/CMP.1, and is consistent with the revised inventory estimates as submitted and reviewed; and that the calculation of the required level of the commitment period reserve is in accordance with paragraph 6 of the annex to decision 11/CMP.1, and the LULUCF definitions are within the agreed range.

104. The national system of Liechtenstein is functional and is broadly consistent with the guidelines for national systems (decision 19/CMP.1) and can fulfil the requirements of the Kyoto Protocol.

Shortcomings relate to the reporting requirements with respect to transparency, in particular the descriptions of the QA/QC and the archiving.

105. Liechtenstein has submitted a complete set of CRF tables for the years 1990–2004 and the NIR, which is complete in terms of geographical coverage, years and sectors and fairly complete in terms of categories and gasses. The ERT considers the inventory submission to be broadly consistent with the UNFCCC reporting guidelines, the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. However, the ERT identified some problems related with transparency and completeness of the reporting. During the in-country review the Party and the ERT agreed on some changes to be made for some categories in the agriculture and in the waste sectors.

106. Based on Liechtenstein's base year emissions – 229,483 tonnes CO_2 eq., including the revised estimates provided in the agriculture and waste sectors – and its Kyoto Protocol target – 92 per cent – the Party calculates its assigned amount to be 1,055,623 CO_2 eq. Liechtenstein calculates its commitment period reserve to be 950,061 t CO_2eq. The ERT agrees with these figures.

107. In response to a recommendation of the ERT, Liechtenstein submitted a single definition of forests. Liechtenstein's choice of parameters to define forest (minimum tree cover: 20 per cent; minimum land area: 0.0625 ha; minimum tree height: 3 metres) are in accordance with decision 16/CMP.1. Liechtenstein has elected not to account for any activities under Article 3, paragraph 4, of the Kyoto Protocol. Liechtenstein has elected annual accounting for Article 3, paragraph 3, activities.

108. Based on the results of the review and the technical assessment, as reported in the independent assessment report, the ERT concluded that Liechtenstein's national registry is fully compliant with the registry requirements as defined by decisions 13/CMP.1 and 5/CMP.1.

B. Recommendations

109. In the course of the review, the ERT formulated a number of recommendations relating to the completeness and transparency of the information presented in Liechtenstein's initial report. The key recommendations[3] are that Liechtenstein should:

- Update and provide information on the national system, including the information on QA/QC and archiving, in the next inventory submission under the Kyoto protocol.
- Include in the NIR of the next inventory submission under the Kyoto protocol a new definition of forest for accounting activities under Article 3, paragraph 3, of the Kyoto Protocol in accordance with decision 16/CMP.1.

110. Enhance the transparency and completeness of its reporting by identifying key categories for the base year and including the LULUCF sector in the key category analysis; reporting emissions for some missing categories in the waste sector; documenting country-specific methodologies and data sources (particularly in the energy and the LULUCF sectors); and calculating uncertainties for all categories consistent with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF.

C. Questions of implementation

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

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

Annex I

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/>.

IPCC. Good practice guidance for land use, land-use change and forestry, 2003. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

IPCC/OECD/IEA. Revised 1996 IPCC Guidelines for national greenhouse gas inventories, volumes 1–3, 1997. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>.

UNFCCC. 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/2004/8. Available at: <http://unfccc.int/resource/docs/2004/sbsta/08.pdf>.

UNFCCC. 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>.

UNFCCC. Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol. FCCC/KP/CMP/2005/8/Add.3. Available at: <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf#page=14>.

UNFCCC. Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol. FCCC/KP/CMP/2005/8/Add.2. Available at: <http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf#page=54>.

UNFCCC. Guidelines for review under Article 8 of the Kyoto Protocol. FCCC/KP/CMP/2005/8/Add.3. Available at: <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf#page=51>.

UNFCCC secretariat. Status report for Liechtenstein. 2006. Available at: <http://unfccc.int/resource/docs/2006/asr/lie.pdf>.

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>.

UNFCCC secretariat. Liechtenstein: Independent assessment report of the national registry of Liechtenstein. Reg_IAR_LI_2007_1. Will be available at: <www.unfccc.int>.

B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Helmut Kindle, Mr. Patrick Insinna, Mr. Sven Braden (the Office of Environmental Protection), Mr. Jurg Heldstab, Ms. Myriam Steinemann (INFRAS Consulting), Mr. Jurg Fussler (EBP Ernst Basler and Partner), Mr. Jurgen Beckbissinger

(Acontec AG Air Controlling, Consulting and Technics) including additional material on the methodology and assumptions used.

Emissionshandelsgesetz (EHG)Vaduz, 12. Juni 2007 / BrSv, Aktenplan-Nr. 864, Courtesy Translation of Articles related to the Preparation of Greenhouse Gas Inventories within the Emission Trading Act.

Fuerstentum Liechtenstein, Amt fur Volkswirtschaft, Statistisches Jahrbuch 2006, 2006, (in German).

Fuerstentum Liechtenstein, Betriebszahlung 1995, Landwirtschaft, Provisorische Ergebnisse, Amt fur Volkswirschaft, Vaduz, 1995, (in German).

Klimainventar und Inventory Report 2006 – Vorbereitung Initial Report. Vaduz, 12 Juni 2006. RA 2006/1528-8642 (in German).

Regierung des Fuerstentum Liechtenstein, Klimainventar und Inventory Report 2006 – Vorbereitung Initial Report, RA 2006/1528-8642, 13 Juni, 2006, (in German).

References used in the energy sector

Arbeitsblatt Emissionsfaktoren Feuerungen (Stand Oktober 05), SAEFL 2005. Country specific NCV and EF for combustion emissions of GHG and GHG precursors, (in German).

INFRAS, Strassenverkehrsemissionen im Fuerstenturm Liechtenstein 1990, 2000, 2010, Schlussbericht 18.01.2002. Emissions from road transport in Liechtenstein 1990, 2000, 2010. Final report (in German).

References used in the land use, land-use change and forestry sector

Amt fuer Wald, Natur und Landschaft, Rechenschaftsbericht des Amtes fuer Wald, Natur und Landschaft fuer das Jahr 2003 (in German).

Amt fuer Wald, Natur und Landschaft, Rechenschaftsbericht des Amtes fur Wald, Natur und Landschaft fuer das Jahr 2004, (in German).

Amt fuer Wald, Natur und Landschaft, Rechenschaftsbericht des Amtes fur Wald, Natur und Landschaft fuer das Jahr 2005, (in German).

Land-use change matrix 1984–2002, data matrix.

Liechtensteinisches Landesgesetzblatt, Waldgesetz vom 25. Marz 1991, (in German).

Relation between land-use categories, land-cover categories and the combined categories, data matrix.

Waldordnungen in Liechtenstein – Ablauf Bewilligungsverfahren, Juni 2007, (in German).

References used in the waste sector

Bundesamt fuer Umwelt, Wald und Landschaft, Handbuch, Emissionfaktoren fur stationaere Quellen, Ausgabe 2000. Data for illegal waste burning by households, (in German).

Annex II

Acronyms and abbreviations

AD	activity data
CH_4	methane
CO_2	carbon dioxide
CO_2 eq.	carbon dioxide equivalent
CRF	common reporting format
EC	European Community
EF	emission factor
ERT	expert review team
EU	European Union
F-gas	fluorinated gas
GHG	greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 without GHG emissions and removals from LULUCF
GJ	gigajoule (1 GJ = 10^9 joule)
GWP	global warming potential
HFCs	hydrofluorocarbons
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
kg	kilogram (1 kg = 1 thousand grams)
LULUCF	land use, land-use change and forestry
m^3	cubic metre
Mt	million tonnes
Mtoe	millions of tonnes of oil equivalent
N	nitrogen
NA	not applicable
NMVOC	non-methane volatile organic compound
N_2O	nitrous oxide
NFI	national forest inventory
NIR	national inventory report
OEP	Office for environmental protection
PFCs	perfluorocarbons
PJ	petajoule (1 PJ = 10^{15} joule)
QA/QC	quality assurance/quality control
SF_6	sulphur hexafluoride
SO_2	sulphur dioxide
Tg	teragram (1 Tg = 1 million tonnes)
TJ	terajoule (1 TJ = 10^{12} joule
UNFCCC	United Nations Framework Convention on Climate Change

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