ADVANCE VERSION

United Nations

FCCC/ARR/2013/LIE

Framework Convention on Climate Change

Distr.: General
7 April 2014

English only

Report of the individual review of the annual submission of Liechtenstein submitted in 2013*

* In the symbol for this document, 2013 refers to the year in which the inventory was submitted, and not to the year of publication.

Contents

I. Introduction and summary

1. This report covers the review of the 2013 annual submission of Liechtenstein, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 2 to 6 September 2013 in Vaduz, Liechtenstein, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Mr. Manfred Ritter (Austria); energy – Mr. Julien Vincent (France); industrial processes and solvent and other product use – Ms. Natalya Parasyuk (Ukraine); agriculture – Mr. Roberto Acosta Moreno (Cuba); land use, land-use change and forestry (LULUCF) – Mr. Thiago De Araújo Mendes (Brazil); and waste – Ms. Masako White (Japan). Mr. De Araújo Mendes and Mr. Ritter were the lead reviewers. The review was coordinated by Ms. Sylvie Marchand (UNFCCC secretariat).

2. In accordance with the "Guidelines for review under Article 8 of the Kyoto Protocol" (decision 22/CMP.1) (hereinafter referred to as the Article 8 review guidelines), a draft version of this report was communicated to the Principality of Liechtenstein, which provided comments that were considered and incorporated, as appropriate, into this final version of the report. All encouragements and recommendations in this report are for the next annual submission, unless otherwise specified. The expert review team (ERT) notes that the 2012 review report of Liechtenstein was published before the submission of the 2013 annual submission, except for a corrigendum, which was published after the submission of the 2013 annual submission.

3. In 2011, the main greenhouse gas (GHG) in Liechtenstein was carbon dioxide (CO_2), accounting for 83.2 per cent of total GHG emissions[1] expressed in CO_2 equivalent (CO_2 eq), followed by methane (CH_4) (6.9 per cent) and nitrous oxide (N_2O) (5.9 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 3.9 per cent of the overall GHG emissions in the country. The energy sector accounted for 84.3 per cent of total GHG emissions, followed by the agriculture sector (10.5 per cent), the industrial processes sector (4.0 per cent), the waste sector (0.8 per cent) and solvent and other product use sector (0.4 per cent). Total GHG emissions amounted to 222.04 Gg CO_2 eq and decreased by 3.6 per cent between the base year[2] and 2011. The ERT concludes that the description in the national inventory report (NIR) of the trends for the different gases and sectors is reasonable.

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

5. Additional background data on recalculations by Liechtenstein in the 2013 annual submission, as well as information to be included in the compilation and accounting database, can be found in annex I to this report.

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

[2] "Base year" refers to the base year under the Kyoto Protocol, which is 1990 for all gases. The base-year emissions include emissions from sources included in Annex A to the Kyoto Protocol only.

Table 1
Greenhouse gas emissions from Annex A sources and emissions/removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, by gas, base year[a] to 2011

			Gg CO_2 eq							*Change (%)*
		Greenhouse gas	*Base year[a]*	*1990*	*1995*	*2000*	*2008*	*2009*	*2010*	*2011*	*Base year–2011*
Annex A sources		CO_2	203.10	203.10	209.43	227.56	229.89	214.19	199.56	184.80	–9.0
		CH_4	14.35	14.35	13.36	12.99	15.80	15.52	15.10	15.39	7.2
		N_2O	12.87	12.87	12.52	11.95	12.97	12.78	12.71	13.03	1.2
		HFCs	0.00009	0.00009	0.38	2.32	5.08	5.33	6.65	8.73	9 196 615.0
		PFCs	NA, NO	NA, NO	NA, NO	0.003	0.06	0.05	0.07	0.07	NA
		SF_6	NA, NO	NA, NO	NA, NO	0.09	0.36	0.14	0.02	0.01	NA
KP-LULUCF	Article 3.3[b]	CO_2					0.14	0.22	–0.06	0.21	
		CH_4					NO	NO	NO	NO	
		N_2O					NO	NO	NO	NO	
	Article 3.4[c]	CO_2	NA				NA	NA	NA	NA	NA
		CH_4	NA				NA	NA	NA	NA	NA
		N_2O	NA				NA	NA	NA	NA	NA

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

[a] "Base year" for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for all gases. The "base year" for cropland management, grazing land management and revegetation under Article 3, paragraph 4, of the Kyoto Protocol is 1990. For activities under Article 3, paragraph 3, of the Kyoto Protocol and forest management under Article 3, paragraph 4, only the inventory years of the commitment period must be reported.

[b] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation.

[c] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation.

Table 2
Greenhouse gas emissions by sector and activity, base year[a] to 2011

			Gg CO_2 eq								*Change (%)*
		Sector	*Base year[a]*	*1990*	*1995*	*2000*	*2008*	*2009*	*2010*	*2011*	*Base year–2011*
Annex A		Energy	203.78	203.78	210.56	229.46	232.26	216.51	201.89	187.08	–8.2
		Industrial processes	0.00009	0.00009	0.38	2.41	5.50	5.53	6.75	8.81	9 286 805.6
		Solvent and other product use	2.02	2.02	1.61	1.24	1.00	1.00	0.99	0.99	–50.7
		Agriculture	22.96	22.96	21.62	20.07	23.40	23.19	22.73	23.37	1.8
		Waste	1.58	1.58	1.52	1.72	2.00	1.78	1.77	1.78	13.2
		LULUCF	NA	–9.46	–9.64	–8.59	–7.38	–7.24	–7.14	–7.03	NA
		Total (with LULUCF)	**NA**	**220.87**	**226.06**	**246.31**	**256.78**	**240.77**	**226.98**	**215.02**	**NA**
		Total (without LULUCF)	**230.33**	**230.33**	**235.70**	**254.90**	**264.16**	**248.01**	**234.12**	**222.04**	**–3.6**
		Other[b]	NO	NO	NO	NO	NO	NO	NO	NO	NA
KP-LULUCF	Article 3.3[c]	Afforestation and reforestation					–0.21	–0.22	–0.20	–0.18	
		Deforestation					0.35	0.43	0.14	0.39	
		Total (3.3)					**0.14**	**0.22**	**–0.06**	**0.21**	
	Article 3.4[d]	Forest management					NA	NA	NA	NA	
		Cropland management	NA				NA	NA	NA	NA	NA
		Grazing land management	NA				NA	NA	NA	NA	NA
		Revegetation	NA				NA	NA	NA	NA	NA
		Total (3.4)	**NA**				**NA**	**NA**	**NA**	**NA**	**NA**

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

[a] "Base year" for sources included in Annex A to the Kyoto Protocol refers to the base year under the Kyoto Protocol, which is 1990 for all gases. The "base year" for cropland management, grazing land management and revegetation under Article 3, paragraph 4, of the Kyoto Protocol is 1990. For activities under Article 3, paragraph 3, of the Kyoto Protocol and forest management under Article 3, paragraph 4, only the inventory years of the commitment period must be reported.

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

[c] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation.

[d] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

6. The 2013 annual inventory submission was submitted on 15 April 2013; it contains a complete set of the common reporting format (CRF) tables for the period 1990–2011 and an NIR. Liechtenstein also submitted the information required under Article 7, paragraph 1, of the Kyoto Protocol, including information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, accounting of Kyoto Protocol units, changes in the national system and in the national registry, and the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 15 April 2013.

7. The full list of materials used during the review is provided in annex II to this report.

2. Overall assessment of the inventory

8. Table 3 contains the ERT's overall assessment of the annual submission of Liechtenstein. For recommendations for improvements related to cross-cutting issues for specific categories, please see the paragraphs cross-referenced in the table.

Table 3
The expert review team's overall assessment of the annual submission

		General findings and recommendations
The expert review team's (ERT's) findings on completeness of the 2013 annual submission		
Annex A sources[a]	Complete	Mandatory: none
		Non-mandatory: potential emissions of HFCs, PFCs and SF_6 from consumption for all years. The ERT reiterates the recommendation that Liechtenstein complete CRF table 2(II)s2 for potential emissions data on HFCs and PFCs from consumption of halocarbons and SF_6, together with the estimation methods used (see para. 41)
Land use, land-use change[a] and forestry	Complete	Mandatory: none
		Non-mandatory: none
KP-LULUCF	Complete	Mandatory: None
		Non-mandatory: none
The ERT's findings on recalculations and time-series consistency in the	Generally consistent	Liechtenstein provided information regarding recalculations in CRF table 8(b), but not all

		General findings and recommendations
2013 annual submission		recalculations are explained for all years The ERT recommends that Liechtenstein complete CRF table 8(b) for all years by including explanatory information for all recalculations
The ERT's findings on verification and quality assurance/quality control procedures in the 2013 annual submission	Sufficient	The ERT recommends that Liechtenstein update its improvement development plan to include all the recommendations of previous review reports together with information on the intended implementation date of these recommendations (see para. 11) The ERT recommends that Liechtenstein review and strengthen its QC procedures to eliminate errors and improve the accuracy of its emission estimates (see paras. 21, 81, 87 and 89) The ERT recommends that Liechtenstein implement additional QC procedures to avoid mistakes or discrepancies between the CRF tables and the NIR. (see paras. 16(c), 21, 24 and 35)
The ERT's findings on the transparency of the 2013 annual submission	Sufficient	The rationale for using data from the 2010 Swiss inventory as a proxy for Liechtenstein's 2011 inventory data for each instance is not transparently explained in the NIR. The ERT acknowledges that in general, the use of data from the previous Swiss inventory can be a valid proxy for the current year's inventory of Liechtenstein in the absence of national data. It improves the accuracy of Liechtenstein's inventory overall and allows for a cost-efficient fulfilment of reporting requirements. The ERT recommends that Liechtenstein document why the use of previous year Swiss data is an appropriate proxy for estimating current year emissions in Liechtenstein in a given sector (see paras. 78, 82 and 93) Although the sectoral chapters are generally transparent, the ERT identified several issues related to transparency in multiple sectors, including in the provision of background data used to support the calculation of emissions (see paras. 33, 37, 40, 43, 49, 50, 57, 61, 63, 66, 69, 73, 75, 78, 82, 83, 85, 87–89, 93, 94 and 96) Many documentation boxes in the CRF tables are empty, in particular, in the agriculture sector. The ERT encourages Liechtenstein to

	General findings and recommendations
	fill in more of the available information in the documentation boxes of the CRF tables

Abbreviations: AD = activity data, Annex A sources = sources included in Annex A to the Kyoto Protocol, CRF = common reporting format, ERT = expert review team, KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NE = not estimated, NIR = national inventory report, QA/QC = quality assurance/quality control.

[a] The assessment of completeness by the ERT considers only the completeness of reporting of mandatory categories (i.e. categories for which methods and default emission factors are provided in the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, or the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*).

3. Description of the institutional arrangements for inventory preparation, including the legal and procedural arrangements for inventory planning, preparation and management

Inventory planning

9. The NIR and additional information provided by the Party during the review described the national system for the preparation of the inventory. The Office of Environment (OE) has overall responsibility for the national inventory. The OE was reorganized in 2013 and three other offices previously involved in the preparation of the inventory are now part of OE administrative structure. These are the Office of Agriculture, the Office of Forests, Nature and Land Management, and the Office of Environment. Other national and private institutions are also involved in the preparation of the inventory. Liechtenstein's inventory is also supported by the Swiss Federal Office of the Environment, which provides free use of methods and tools developed by Switzerland.

10. The inventory group consists of a project manager, a person responsible for quality assurance/quality control (QA/QC) activities and a national inventory compiler. A number of external experts, such as the sectoral specialists, also contribute to the inventory through annual contracts.

11. The QA/QC plan is generally in line with the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance), but the improvement development plan provided in NIR chapters 1.3.3 (p. 29) and A8.3 (p. 276) are not fully consistent and are not up to date. For example, the chapter on "Cross-cutting issues/miscellaneous" does not contain those recommendations made in previous review reports that had not been implemented. The ERT recommends that Liechtenstein update its improvement development plan to include all the recommendations made in previous review reports, together with information on the intended implementation date of these recommendations.

12. The NIR does not provide information on the process of final approval of the inventory submission. In response to questions raised by the ERT during the review, Liechtenstein confirmed that the national system has not changed overall, but provided more background information on the effect of the reorganization for the inventory preparation process and the official approval process. The ERT recommends that Liechtenstein update the schematic overview of the national inventory system and the data-collection process (figures 1-1 and 1-2 in the NIR), and further describe the approval process within the new organizational structure.

Inventory preparation

13. Table 4 contains the ERT's assessment of Liechtenstein's inventory preparation process. For improvements related to specific categories, please see the paragraphs cross-referenced in the table.

Table 4
Assessment of inventory preparation by Liechtenstein

		General findings and recommendations
Key category analysis		
Was the key category analysis performed in accordance with the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF)?	Yes	
Approach followed?	Tier 1	
Were additional key categories identified using a qualitative approach?	No	
Has the Party identified key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol following the guidance on establishing the relationship between the activities under the Kyoto Protocol and the associated key categories in the UNFCCC inventory?	Yes	
Does the Party use the key category analysis to prioritize inventory improvements?	Yes	The use of key category analysis to prioritize inventory improvements is not mentioned in the NIR. The ERT recommends that Liechtenstein describe how it uses key categories to prioritize inventory improvements (see para. 16(b))
Are there any changes to the key category analysis in the latest submission?	No	
Assessment of uncertainty analysis		
Approach followed?	Tier 1	
Was the uncertainty analysis carried out in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF?	Yes	

	General findings and recommendations
Quantitative uncertainty (including LULUCF)	Level = 5.3%
	Trend = 5.2%
Quantitative uncertainty (excluding LULUCF)	Level =5.1%
	Trend =5.8%

Abbreviations: ERT = expert review team, LULUCF = land use, land-use change and forestry, NIR = national inventory report.

Inventory management

14. Liechtenstein has a centralized archiving system, which includes the archiving of disaggregated emission factors (EFs) and activity data (AD), and documentation on how these factors and data have been generated and aggregated for the preparation of the inventory. The archived information also includes internal documentation on QA/QC procedures, external and internal reviews, and documentation on annual key categories and key category identification and planned inventory improvements. The backups of the information provided by external contractors are archived centrally in Liechtenstein's National Bank. During the review, the ERT was provided with the requested additional archived information.

4. Follow-up to previous reviews

15. The ERT notes that Liechtenstein has implemented, or is in the process of implementing, some recommendations made in previous review reports and has provided information on such improvements in chapter 10.4 of its NIR. Specifically, the ERT commends Liechtenstein for the external reviews performed in the agriculture and LULUCF sectors. The ERT also welcomes the efforts made by the Party to improve the transparency in all sectors of the NIR.

16. The ERT reiterates the recommendations made in previous review reports that have not yet been implemented by Liechtenstein, including that the Party:

(a) Include information on the process of final approval of the inventory submission (see para. 12 above);

(b) Describe how the key category analysis is used to prioritize inventory development (see table 4);

(c) Provide the key category analysis for 1990 in the CRF tables and enhance the consistency of the information provided in the NIR and the CRF tables on the key category analysis (CRF table 7).

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

17. During the review, the ERT identified a number of areas for improvement, including some related to specific categories. These are listed in the relevant chapters of this report and in table 9.

B. Energy

1. Sector overview

18. The energy sector is the main sector in the GHG inventory of Liechtenstein. In 2011, emissions from the energy sector amounted to 187.08 Gg CO_2 eq, or 84.3 per cent of total GHG emissions. Since 1990, emissions have decreased by 8.2 per cent. The key drivers for the fall in emissions are manufacturing industries and construction and other sectors for which GHG emissions have decreased by 45.2 and 9.8 per cent, respectively, in this period. Several factors explain the emission trend over time: after an increase of 19.6 per cent of total GHG emissions from the energy sector between 1990 and 2006 due to increases in population and employment by 25.7 and 84.3 per cent, respectively, in the past 20 years, as well as an increase in road-vehicle kilometres, emissions decreased in 2007 due to weather conditions and high energy costs and then further decreased between 2008 and 2011. This latter trend between 2008 and 2011 can be attributed to the import of steam from the waste incineration plant situated in Switzerland and the downward trend of tank tourism[3] for road transport. Within the sector, 42.9 per cent of the emissions were from other sectors, followed by 42.5 per cent from transport, 12.5 per cent from manufacturing industries and construction (including stationary and off-road categories) and 1.6 per cent from energy industries. The remaining 0.6 per cent was from fugitive emissions.

19. The ERT commends the Party for its efforts concerning the improvement of the transparency of the NIR for the energy sector. A considerable amount of additional information explaining the emission trends and choices of methods (e.g. oxidation factor, fuel characteristics, consumption split) has been added to the NIR. Most of the recommendations made in the previous review report have been taken into account and further work has been discussed during the review week to improve the quality of the inventory, including: reallocation of emissions from the category other (fuel combustion) to the category manufacturing industries and construction, and reporting on feedstock and non-energy use of fuels. In addition, there are further transparency improvements, such as improvements in the consistency between the CRF tables and the NIR concerning the reference approach (e.g. the paragraph on gasoil consumption estimates (NIR, p. 67), the estimation of diesel oil consumption at gasoline stations (NIR, p. 68) and the consideration of lubricants consumption in road transportation), and improvements to some of the descriptions in the NIR and the modification of notation keys in the CRF tables that are necessary. All category-specific potential problems are treated in the respective paragraphs below.

20. Following discussions between the ERT and the Liechtenstein inventory team during the review week, there remains uncertainty whether Liechtenstein used the correct calorific value for the national natural gas consumption used in the calculation of the inventory. The gas utility company (Liechtensteinische Gasversorgung – LGV) provides natural gas consumptions expressed in GWh as gross calorific value. It is, however, unclear if this value is reported as such in the national energy statistics from Liechtenstein. The inventory team uses the value as net calorific value. This issue has to be clarified by the Liechtenstein inventory team to determine if the appropriate conversion factors are used. The ERT strongly recommends that Liechtenstein clarify and document the correct calorific value for the national natural gas consumption to improve the accuracy of the inventory.

[3] Tank tourism is a phenomenon whereby motorists travel to a neighbouring country where fuel prices are cheaper to refuel their vehicle.

21. Data reported in the CRF tables and in the NIR are not always consistent (see para. 24 below). The ERT recommends that the Party implement additional QC procedures to avoid mistakes or discrepancies between the CRF tables and the NIR.

2. Reference and sectoral approaches

22. Table 5 provides a review of the information reported under the reference approach and the sectoral approach. As Liechtenstein does not report its energy statistics to the International Energy Agency, no comparison with other sources of international data is available.

Table 5
Review of reference and sectoral approaches

		Paragraph cross references
Difference between the reference approach and the sectoral approach	Energy consumption: –0.0000007 PJ, 0.00002%	
	CO_2 emissions: 0.06 Gg CO_2 eq, 0.03%	24
Are differences between the reference approach and the sectoral approach adequately explained in the NIR and the CRF tables?	Yes	24
Are differences with international statistics adequately explained?	Not applicable	23
Is reporting of bunker fuels in accordance with the UNFCCC reporting guidelines?	Yes	25
Is reporting of feedstocks and non-energy use of fuels in accordance with the UNFCCC reporting guidelines?	No	27

Abbreviations: CRF = common reporting format, NIR = national inventory report, UNFCCC reporting guidelines = "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories".

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

23. No comparison with international data is possible for Liechtenstein as the country is not a member of all international organizations. However, there are strong links with the statistics of Switzerland. Due to the Customs Union Treaty of the two States, the import statistics in the Swiss overall energy statistics[4] also include the fossil fuel consumption of Liechtenstein (except for gas consumption). The Liechtenstein OE calculates its national energy consumption and provides data to the Swiss Office of the Environment, which can then correct Swiss fuel consumption data by subtracting Liechtenstein's liquid fuel consumption. Overall liquid fuel consumption is therefore consistent with national Swiss statistics before correction.

[4] Schweizerische Gesamtenergiestatistik 2010. Statistique globale suisse de l'énergie 2010. Swiss Federal Office of Energy, Bern. Available at <http://www.bfe.admin.ch/themen/00526/00541/00542/00631/index.html?lang=de&dossier_id=00763>.

24. The NIR reports that the difference in energy consumption between the reference and the sectoral approaches is 0.09 per cent, while 0.00002 per cent is given in CRF table 1.A(c). Data provided in both documents are therefore not consistent. The ERT recommends that Liechtenstein correct the inconsistency of the data reported on the difference in energy consumption between the reference and the sectoral approaches between the NIR and the CRF tables.

International bunker fuels

25. As a landlocked country, there are no international maritime bunkers in Liechtenstein. Emissions from international aviation occur from two companies that operate helicopters in Liechtenstein. A survey has enabled Liechtenstein to split fuel consumption between national and international bunkers. The ERT commends the Party for the explanation provided in the NIR.

Feedstocks and non-energy use of fuels

26. The ERT noted that AD for feedstocks and non-energy use of fuels are still reported as "NO" (not occurring) in CRF table 1.A(d). Therefore, the ERT reiterates the recommendation made in the previous review report that Liechtenstein report lubricants and bitumen activities in CRF tables 1.A(b) and 1.A(d).

27. The NIR chapter on feedstocks and non-energy use of fuels states that "use of bitumen does not affect fuel consumption data in Liechtenstein, which are only based on imports of secondary fuels". However, secondary fuels also have to be reported in the CRF tables, if they are consumed in the country. The ERT recommends that the Party report secondary fuels consumed in the country and complete the lubricants and bitumen AD in the CRF tables.

3. Key categories

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

28. The significant increase of natural gas consumption in public electricity and heat production (consumption multiplied by 24 between 1990 and 2011) follows the expansion of the natural gas grid and increasing connections in Liechtenstein. District heating steam used in Liechtenstein is imported from a waste incineration plant situated in Buchs, Switzerland. The ERT commends the Party for the transparency of its NIR.

29. For the subcategory manufacturing industries and construction, the ERT acknowledges that the latest version of the NIR has been updated with transparent information on the method applied (AD, trends, EFs) following recommendations made in the previous review report. The ERT commends the Party for the transparency improvements of its latest NIR.

30. Diesel oil consumption and emissions of off-road vehicles in the subcategory manufacturing industry and construction are reported in category other (CRF table 1.A.5(b)) (fuel combustion – mobile; off-road vehicles and other machinery), which is not in line with the IPCC *Revised 1996 Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines). In response to a question raised by the ERT during the review, Liechtenstein explained that it plans to reallocate these emissions in the category manufacturing industries and construction to be in line with the Revised 1996 IPCC Guidelines. The ERT reiterates the recommendation made in

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

previous review reports that the Party reallocate the data on consumption and emissions of construction and industrial off-road machinery from the category other (CRF table 1.A.5(b)) (fuel combustion – mobile; off-road vehicles and other machinery) to the category manufacturing industries and construction (CRF table 1.A.2(f)).

31. CO_2 emissions from the two sites covered by the European Union Emissions Trading System (EU ETS) represented 60 per cent of total CO_2 emissions from the manufacturing industries and construction category in 2008 and only 8 per cent in 2011 as a consequence of the steam import from Switzerland since 2009. The ERT encourages the Party to use the industry reports available from the EU ETS as part of its QA/QC plan to cross-check emissions and AD of the category.

32. As mentioned in the previous review report, all emissions from liquid and gaseous fuels from the food processing, beverages and tobacco subcategory (CRF table 1.A.2(e)) are reported under the subcategory other (manufacturing industries and construction) (CRF table 1.A.2(f)), which is not in line with the Revised 1996 IPPC Guidelines. In its NIR, Liechtenstein explained that the data needed for disaggregation are not available. However, the two companies reporting under the EU ETS are part of the food industry. The ERT recommends that Liechtenstein use the data reported for the purposes of the EU ETS to split the fuel consumption and emissions between the food processing, beverages and tobacco subcategory (CRF table 1.A.2(e)) and the subcategory other industries (CRF table 1.A.2(f)) or explain why these data cannot be used.

Road transportation: liquid fuels – CO_2

33. Lubricants are generally used as an additive to gasoline consumed in two-stroke engines and are therefore to be considered in the energy consumption of road transportation. In response to a question raised by the ERT during the review, the Party has confirmed that consumption of these lubricants is taken into account in the global gasoline sales reported in the national energy statistics. The ERT recommends that Liechtenstein improve the transparency of its NIR by stating that consumption of lubricants is included in the global gasoline sales reported in the national energy statistics.

34. The NIR states that biofuels are not produced in Liechtenstein. Biofuels were imported and then mixed with other road transport fuels from 2007 to 2009 before the only distributor who imported biofuels shut down. Liechtenstein assumes that all gasoline and diesel oil fuels imported from Switzerland do not contain biofuel. Biofuel consumption is therefore only reported from 2007 to 2009 in Liechtenstein. The ERT recommends that Liechtenstein check if biofuel is not already mixed in the imported gasoline and diesel oil fuels and document this in the NIR.

35. Liechtenstein states in its NIR that emissions from this category are calculated based on a tier 1 method (top-down). This category being key, the ERT considers that the Party should use a higher tier. However, in response to questions raised by the ERT during the review, the Party stated that because Swiss country-specific EFs are used, a tier 2 method is actually implemented. The ERT notes that this method is not consistent with that reported in the NIR. The ERT recommends that Liechtenstein correctly report that it uses a tier 2 method for estimating emissions from this category and explain it in its NIR.

Other sectors: liquid fuels – CO_2

36. The NIR states that the distribution of fuel consumptions between the different categories under other sectors had been evaluated by experts for the whole period 1990–2011. The experts of Liechtenstein assumed that the distribution of the gas oil consumption is distributed between the commercial and institutional subcategory (60 per cent), the manufacturing industries subcategory (20 per cent) and the residential subcategory (20 per cent). This split is kept stable between 1990 and 2011. Following a recommendation made

in the previous review report, the Party verified and confirmed the validity for the whole time series. The ERT commends the Party for the transparent description of this assumption in its latest NIR.

4. Non-key categories

Navigation: other liquid fuels – CO_2, CH_4 and N_2O

37. The NIR states that navigation is not occurring in Liechtenstein because there are no lakes, and the Rhine River is not navigable in the territory of Liechtenstein. Therefore, no emissions are occurring for this category. The CRF table for this category reports the notation keys "NA" (not applicable) for other liquid fuels and "NO" for the rest of the fuels. Based on the NIR statement, the ERT recommends that the Party report all notation keys as "NO" for this category.

Oil and natural gas – CO_2 and CH_4

38. Following a recommendation made in the previous review report, CH_4 emissions from natural gas transmission and distribution have been split and reported separately in the 2013 annual submission. In CRF table 1.B.2, CO_2 emissions from natural gas transmission are reported as "NO", which is not in line with the IPCC good practice guidance. However, as stated in the NIR and after discussions with the Party during the review, Liechtenstein estimates that all natural gas fugitive emissions are CH_4 emissions. The ERT encourages the Party to check the split between CH_4 and CO_2 emissions from natural gas fugitive emissions and to modify the notation key if necessary.

C. Industrial processes and solvent and other product use

1. Sector overview

39. In 2011, emissions from the industrial processes sector amounted to 8.81 Gg CO_2 eq, or 4.0 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 0.99 Gg CO_2 eq, or 0.5 per cent of total GHG emissions. Since 1990, emissions have increased by 9,286,805.6 per cent in the industrial processes sector, and decreased by 50.7 per cent in the solvent and other product use sector. The key driver for the rise in emissions in the industrial processes sector is the increasing use of HFCs in refrigeration and air-conditioning equipment. Within the industrial processes sector, all the emissions were from consumption of halocarbons and SF_6: 99.1 per cent of the emissions were from HFCs in refrigeration, air-conditioning equipment and foam blowing, followed by 0.8 per cent from PFCs in the same subcategories and 0.1 per cent from electrical equipment.

2. Key categories

Consumption of halocarbons and SF_6 – HFCs, PFCs and SF_6[6]

40. As indicated in the previous review report, Liechtenstein has not provided any explanation about a slight fluctuation of AD and HFC emissions in the subcategory refrigeration and air-conditioning equipment. In response to questions raised by the ERT during the review, Liechtenstein explained that the fluctuations are a result of changes in consumer behaviour and the economy. The Party indicated that this explanation will be

[6] Not all emissions related to all gases under this category are key categories, particularly SF_6 emissions. However, since the calculation procedures for issues related to this category are discussed as a whole, the individual gases are not assessed in separate sections.

included in the next annual submission. The ERT reiterates the recommendation made in the previous review report that Liechtenstein provide an explanation for the fluctuation in AD and HFC emissions for refrigeration and air-conditioning equipment in its NIR.

41. As indicated in the 2011 and 2012 review reports, Liechtenstein has not provided information in the NIR or CRF tables regarding potential emissions of HFCs and PFCs from consumption of halocarbons and SF_6. In response to questions raised by the ERT during the review, Liechtenstein explained that data on potential emissions are, in principle, available and that work to include these data into the inventory is in progress. The ERT reiterates the recommendations made in previous review reports that the Party complete CRF table 2(II)s2 for potential emissions data on HFCs and PFCs from consumption of halocarbons and SF_6, together with the estimation methods used.

42. The 2011 HFC emissions from the subcategory foam blowing are 27.2 per cent lower than the 2009 value, and the 2009 value is 72.8 per cent lower than the 2008 value. Large inter-annual changes are also identified for the years 1994–1995 (2,477.3 per cent), 2000–2001 (6,760.0 per cent), 2001–2002 (93.7 per cent), 2002–2003 (64.5 per cent) and 2003–2004 (47.4 per cent). The NIR does not provide any explanation for these fluctuations. In response to questions raised by the ERT during the review, Liechtenstein confirmed a further investigation will be conducted. The ERT recommends that Liechtenstein investigate the fluctuations in the emissions from foam blowing and provide a clear explanation in its NIR.

43. SF_6 emissions from the electrical equipment subcategory decreased by 42.7 per cent between 2010 (0.02 Gg) and 2011 (0.01 Gg), and the 2010 value is 82.7 per cent lower than the 2009 value. In addition, the following inter-annual changes in recent years have been identified as large: 2005–2006 (–77.9 per cent), 2006–2007 (102.4 per cent), 2007–2008 (204.0 per cent) and 2008–2009 (–60.8 per cent). In response to questions raised by the ERT during the previous review report, Liechtenstein indicated that the decline was within the range of variability because there are few companies in this category and individual changes in emissions become evident in the total emissions from consumption of halocarbons and SF_6. The ERT reiterates the recommendations made in the previous review report that Liechtenstein provide an explanation for the downward trend in SF_6 emissions from electrical equipment.

D. Agriculture

1. Sector overview

44. In 2011, emissions from the agriculture sector amounted to 23.37 Gg CO_2 eq, or 10.5 per cent of total GHG emissions. Since 1990, emissions have increased by 1.8 per cent. The slight rise in emissions for the sector in 2011 comes from the increase in emissions from enteric fermentation and direct emissions from agricultural soils, resulting mainly from the increasing productivity of dairy cattle and poultry. Within the sector, 45.9 per cent of the emissions were from enteric fermentation, followed by 39.6 per cent from agricultural soils and 14.6 per cent from manure management. Liechtenstein does not have emissions from rice cultivation, burning of savannas or field burning of agricultural residues. For the period 1990–2011, the key driver for emissions has been the increase in animal populations and their influence on enteric fermentation and agricultural soils emissions.

45. The Party has improved its inventory for the agriculture sector since the previous annual submission because it has addressed most of the recommendations made in the previous review report, namely the enhancement of QA/QC practices through an extensive external review and the correction of inconsistencies between the CRF tables and the NIR

and in the time series, as well as other identified issues. The Party has recalculated all categories of the sector. The ERT considers that these recalculations followed the IPCC good practice guidance and were well documented. In all cases, these recalculations lead to increased values for the emission estimates of the reported year.

46. The ERT observed a steady improvement in the inventory of this sector over time. Nonetheless, there are still several issues that could be improved, mainly related to enhancing the transparency in reporting, as specifically mentioned in the assessment on different categories below.

47. The Party has provided detailed information on the use of Swiss methods and relevant Swiss inventory data as a proxy to calculate emission estimates in all categories of the sector due to the similarities of agricultural conditions and management practices between the two countries. These data and methods are commonly used in conjunction with Liechtenstein AD to calculate the emission estimates. The ERT, taking into account the specific conditions of Liechtenstein, considers that this approach is appropriate. The Party also informed the ERT about the periodic contacts between the inventory teams of both countries to ensure the appropriate use and update of the Swiss inventory methods and data Liechtenstein uses when preparing its inventory.

2. Key categories

Enteric fermentation – CH_4

48. Liechtenstein uses a Swiss tier 2 method for this category for all animal subcategories, using the same calculations and, therefore, the same values for the gross energy intake as Switzerland (except for dairy and young cattle, which are Liechtenstein-specific), but using national AD. EFs are country-specific to Switzerland from the 2013 submission. The ERT considers that the methods are appropriate and in line with the Revised 1996 IPCC Guidelines and IPCC good practice guidance (see para. 45 above).

49. The Party implemented the recommendation made in the previous review report to include all breeding cattle under young cattle for the years 1990–2009. However, the ERT found that the recommendation made in the previous review report to include a table with the conversion factors used for calculating the gross energy intake for the different livestock categories in the NIR was not implemented. In response to a question raised by the ERT during the review, Liechtenstein indicated to the ERT that the table will be included in the next annual submission. The ERT reiterates the recommendation made in the previous review report that the Party include a table with the conversion factors used for calculating gross energy intake for livestock categories in its NIR.

50. The ERT also noted that it is not clear from table 6-5 of the NIR how the Party estimated the total population of young cattle. Given that the Party changed the way of reporting young cattle following a recommendation made in the previous review report, the ERT recommends that Liechtenstein explain how the total population of young cattle was estimated for the purposes of reporting in table 6-5 of the NIR.

51. The ERT noted that the reported swine population is about 15 per cent lower than the data reported by the Food and Agriculture Organization of the United Nations (FAO) for the year 2011. In response to questions raised by the ERT during the review week, Liechtenstein explained that these figures must be estimates as the Party is not a member of FAO and, therefore, does not report these figures to FAO. Liechtenstein further stated that it will include a remark to that effect in its next annual submission. The ERT, taking into account this information, considers that comparing the Party's data with FAO data is not an appropriate QA/QC procedure. The ERT therefore encourages the Party to mention that it does not report data to FAO in its NIR.

Manure management – CH_4 and N_2O[7]

52. CH_4 and emission estimates are based on the Swiss country-specific tier 2 method that is in accordance with the IPCC good practice guidance (equation 4.17) using national Liechtenstein AD. The EFs, including manure and methane conversion factors, were calculated on the basis of country-specific values from Switzerland and the IPCC default values. The ERT considers that the methods used are appropriate and in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance.

53. The fractions of animal manure handled using different manure management systems, as well as the grazing time for each livestock category, are based on Swiss data. The ERT noted that, despite recent fraction values being available from farm surveys carried out by Switzerland in 2007 and 2010, Liechtenstein continues to use fraction values from the 2002 survey. As a result, the fraction values for animal manure for the year 2002 are kept constant for the entire time series.

54. In response to questions raised by the ERT during the review, Liechtenstein explained that Switzerland is currently updating data from the 2010 survey and that changes in total emission estimates resulting from the use of the updated data would not be significant. The Party mentioned that it will evaluate whether the new Swiss data can be applied to Liechtenstein for the next annual submission. The ERT recommends that Liechtenstein update the fractions of animal manure handling using different management systems for the most up-to-date Swiss data or explain why this is not necessary.

55. The issue described for CH_4 emissions from manure management in paragraphs 53 and 54 above also applies to the estimation of N_2O emissions from manure management. The ERT recommends that Liechtenstein update the fractions of animal manure handling using different management systems for the most up-to-date Swiss data or explain why this is not necessary.

56. Following recommendations made in previous review reports, the Party corrected the calculations of the total quantity of nitrogen (N) excreted. After this correction, this quantity, calculated as a product of the livestock population number and the N excretion rates, is the same as the sum of N allocated to different types of animal waste management systems, as reflected in CRF table 4.B(b).

57. The Party explained in chapter 6.3.2 of the NIR that it uses a slightly different livestock breakdown for the calculation of CH_4 and N_2O emissions from manure management. The former is based on the numbers of head of livestock, while the calculation of N_2O emissions is based on a different livestock breakdown based on animal "places". However, there is no explanation on how the livestock breakdown by animal "places" is carried out. The ERT recommends that Liechtenstein enhance the transparency of its NIR by explaining how livestock breakdown based on animal "places" is carried out and how these counts differ from those based on animal head numbers.

Direct soil emissions – N_2O

58. The calculations are based on the IPCC good practice guidance tier 1b method, using the updated 2010 Swiss method, IULIA, combined with national Liechtenstein AD. The N excretion factors and ammonia (NH_3) EFs result from the update of the IULIA method with new parameters from the Swiss ammonia model AGRAMMON. Explanations of the model and its applicability to Liechtenstein were provided in the NIR. Because national data is not available in Liechtenstein, data on the use of mineral fertilizers are

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

estimated on the basis of average N input per area, as calculated in Switzerland applied to the area fertilized in Liechtenstein. As already mentioned in paragraph 47 above, the ERT agrees on the approach used by Liechtenstein to estimate emissions in this category and considers that this is in line with the Revised 1996 IPCC Guidelines and IPCC good practice guidance.

59. Following recommendations made in previous review reports, the Party now reports separately the AD for the use of synthetic fertilizers, compost and sewage sludge. During the review week, the Party mentioned that since 2004, it has been forbidden by law to apply sewage sludge as fertilizer to soils, which explains the zero value for the related AD in table 6-17 of the NIR. In addition, following another recommendation made in previous review reports, Liechtenstein will report, in its 2014 submission, information on how these AD are obtained, as proposed in its planned inventory improvements. The ERT recommends that the Party include in its NIR the information regarding the law that forbids the use of sewage sludge as fertilizer to soils and information on how the AD are obtained.

60. During the review week, the Party identified an error in the first bullet point of the provided comparison between the IULIA method with the Revised 1996 IPCC Guidelines specifying that the explanation only refers to young cattle. The Party also pointed to an error in the title of NIR table 6-17, which does not describe properly how the emissions of this category are estimated. The Party indicated that these errors will be corrected in its next annual submission. The ERT recommends that the Party correct the title of table 6-17 to properly describe how N_2O emissions from agricultural soils are calculated.

61. The ERT noted that the area of histosols (cultivated organic soils) reported in NIR table 6-17 does not match the area of organic soils reported as croplands and grasslands in table 7-6 of the NIR. The Party informed the ERT that this might be a consequence of different ways of collecting data and that it will assess and report on the cause of this difference. The ERT recommends that Liechtenstein report on its assessment of the cause of the difference between data reported on histosols (cultivated organic soils) and organic soils reported as croplands and grasslands.

Indirect soil emissions – N_2O

62. The calculation of indirect soil emissions is based on the IPCC good practice guidance tier 1b method, using AD from Liechtenstein. Swiss inventory data are used for some calculations when these data are not available in Liechtenstein, as in the calculation of emissions from leaching and run-off, and NH_3 losses, for which N from fertilizers has to be estimated. The ERT considers that the methods used are appropriate and in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance.

63. In response to recommendations made in previous review reports, in the 2012 and 2013 annual submissions, the Party reported values in the additional information table of CRF table 4.D for $Frac_{GASF}$ and $Frac_{GASM}$. However, during the discussions held in the review week, the Party mentioned that $Frac_{GASF}$ had changed over time. The ERT recommends that Liechtenstein provide updated information on $Frac_{GASF}$ and $Frac_{GASM}$ values in line with the information provided to the ERT.

3. Non-key categories

Pasture, range and paddock manure – N_2O

64. The issue described in paragraphs 53 and 54 above and the corresponding recommendation also apply to this category. The ERT recommends that Liechtenstein update the fractions of animal manure handling using different management systems using the most up-to-date Swiss data or explain why this is not necessary.

E. Land use, land-use change and forestry

1. Sector overview

65. In 2011, net removals from the LULUCF sector amounted to 7.03 Gg CO_2 eq. Since 1990, net removals have decreased by 25.7 per cent. The key drivers for the identified reductions in net removals in the LULUCF sector are mainly the increase in emissions from the land categories grassland, cropland, settlements and other land due to land conversion to grassland and land conversion to settlements, respectively, and the specific reduction of removals on forest land due to a reduction of land conversion to forest land. Within the sector, removals are reported only for forest land (19.96 Gg CO_2 eq in 2011), while emissions are reported from cropland (4.61 Gg CO_2 eq), settlements (3.77 Gg CO_2 eq), grassland (3.18 Gg CO_2 eq), other land (1.15 Gg CO_2 eq) and wetlands (0.22 Gg CO_2 eq).

66. Liechtenstein has provided information on land use and land-use changes. This information includes a national classification and definition of different land uses and their allocation to UNFCCC categories. Liechtenstein has included in its NIR table 7-6 data on the areas maintaining their land use from 1990 to 2011, as well as information about the change between 1990 and 2011 in each category. The ERT noted that NIR table 7-7 representing the land-use change matrix still only includes the change between 2009 and 2010 and that Liechtenstein did not implement the recommendation made in the previous review report to improve the transparency of the reporting of land-use and land-use change areas, and did not act upon the encouragement to report a summary table on the national areas of different land use and land-use change from 1990 to the last year reported, using the approaches for consistent land representation and land-use matrices of the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF). During the review week, Liechtenstein identified technical means to provide this information in a tabular format and mentioned that the summary table will be revised using the approaches for consistent land representation and land-use matrices to further clarify the soil-type classification. The ERT therefore reiterates the recommendation made in the previous review report that the Party improve the transparency of its reporting by implementing the technical means it identified during the review to report a summary table on the national areas of different land uses and land-use changes from 1990 to the last year reported, in line with the IPCC good practice guidance for LULUCF.

67. Following recommendations made in previous review reports, Liechtenstein has corrected the use of notation keys "NE" (not estimated) and "IE" (included elsewhere) for organic soils in several subcategories, such as forest land remaining forest land, cropland remaining cropland and land converted to grassland, and has consistently applied the 20-year interval for land-use conversions as set out in the IPCC good practice guidance for LULUCF. During the review, the ERT was provided with information from an external review undertaken in August 2012 that served as the basis for the improved changes made by Liechtenstein.[8] The ERT commends Liechtenstein for applying these modifications in the 2013 annual submission.

[8] The minutes of the decisions taken to improve the LULUCF sector inventory based on the external review conclusions were provided by Liechtenstein. HG-Inventar Liechtenstein, Review Sektor LULUCF: Besprechung vom 23. August 2012 in Schaan, Ergebnisse und Vorschläge, Fürstentum Liechtenstein, Amt für Umweltschutz (AUS). Jürg Heldstab, INFRAS, Projektleitung; Beat Rihm, METEOTEST, Bearbeitung.

2. Key categories

Forest land remaining forest land – CO_2

68. Liechtenstein uses data for growing stock, gross growth, cut (harvesting) and mortality, derived from the first Swiss national forest inventory (NFI) and the second Swiss NFI, although data for the third NFI and preliminary data for the fourth NFI are already available. Liechtenstein also uses other Swiss parameters (e.g. biomass expansion factors) to estimate carbon stocks and carbon stock changes in this category. The ERT reiterates its previous encouragement to Liechtenstein to consider using data for growing stock, gross growth and mortality derived from the latest Swiss NFI.

69. The ERT noted the division between managed forests, unproductive forests (inaccessible forests and brush forests) and afforestation in the forest land remaining forest land category. Since afforestation is an activity that shall be carried out in an area of land that did not contain forest stocks during the last 50 years, the ERT recommends that Liechtenstein report afforestation under the land converted to forest land rather than in the forest land remaining forest land category.

70. Liechtenstein provided information on growing stock, gross growth and cut and mortality, dead wood and soil carbon for managed forests, and information on carbon stock in living biomass and soil carbon for unproductive forests and afforestation. The ERT noted a recommendation made in the previous report that Liechtenstein provide information on dead wood and litter pools for unproductive forests or afforestation, and for litter in the case of managed forests. However, no additional information was identified in this regard in the 2013 NIR. In response to questions raised by the ERT during the review, the LULUCF experts from Liechtenstein explained that the relevant information update needs to be incorporated into the next annual submission. Hence, the ERT reiterates the recommendation made in the previous review report that Liechtenstein include the information on the comprehensive approach followed for these pools.

Land converted to forest land – CO_2

71. All data between 1990 and 2011 have been recalculated using the 20-year period method for cumulating the areas (instead of 1 year), and as a consequence, the areas are larger in land converted to forest land and smaller in forest land remaining forest land than before, leading to an increase in removals. In the NIR, the Party reports that the amount of losses is smaller because there is no harvesting in the young forests under this land-use category. As for the subcategory forest land remaining forest land, Liechtenstein uses data for growing stock, gross growth, cut (harvesting) and mortality, derived from the first and second Swiss NFIs. The ERT encourages Liechtenstein to consider also using data for growing stock, gross growth and mortality derived from the most up-to-date Swiss NFI.

Cropland remaining cropland –CO_2

72. As with forest land remaining forest land, the methods and parameters used for estimating CO_2 emissions are derived from the Swiss national inventory data (e.g. carbon stocks and carbon stock changes) and, as per the additional information from the external review provided by the Party during the review week, the ERT considers that this approach is compatible with the Liechtenstein environmental conditions and can therefore be applied.

73. The ERT noted a recommendation in the previous review report that Liechtenstein improve the transparency of the information on the soil organic carbon pool in cropland remaining cropland. The Party mentioned that after the external review took place, modifications were undertaken and further data on the areas of organic soils and corresponding emissions were reported in the relevant CRF tables. However, during the review week, the ERT noted that "NS" (no stratification) was reported in table 7-8 of the NIR in the altitude zone and soil classification columns. In response to questions raised by

the ERT during the review, the Party indicated that the soil classification for these "NS" column cells was considered as mineral soils. Although this information was provided in the accompanying text, the ERT recommends that Liechtenstein explain more clearly in table 7-8 of the NIR that the soil classification column cells filled with "NS" are considered as mineral soils.

Land converted to grassland – CO_2

74. The ERT noted a recommendation in the previous review report that Liechtenstein include more information about how parameters on the changes in carbon stocks of land converted to grassland have been obtained and their applicability to Liechtenstein. During the review, Liechtenstein informed the ERT that all data for the period 1990–2011 have been recalculated, taking into account the 20-year period method for cumulating the areas (instead of 1 year), and as a consequence, the areas in land converted to grassland are now cumulated over a 20-year period (instead of 1 year). As a consequence, the areas are larger in land converted to grassland and smaller in grassland remaining grassland than in the previous annual submission. Furthermore, the areas and the emissions from organic soils are now reported separately in the NIR and the CRF tables, which was not the case in previous submissions. The ERT welcomes this new information and agrees that the approach used is in line with the IPCC good practice guidance for LULUCF.

Land converted to settlements – CO_2

75. The ERT noted a recommendation in the previous review report that Liechtenstein provide detailed information on the methods, data and parameters used for these area estimations for each subcategory of the land-use changes to settlements category. In response to a question raised by the ERT during the review, the Party mentioned that due to the external review, all data for 1990–2011 had been recalculated, taking into account the 20-year period method for cumulating the areas (instead of 1 year), and as a consequence, the areas in the land category settlements are larger in the subcategory land converted to settlements and smaller in the subcategory settlements remaining settlements than in the previous annual submission. During the review week, the ERT had access to the report of the external review undertaken by the Party, and the information provided indicates that emissions were not underestimated and removals were not overestimated. The ERT recommends that Liechtenstein include the information provided in the report of the external review to further communicate transparently the methods, data and parameters used for the estimations for each subcategory of the land-use changes to settlements category.

Land converted to other land – CO_2

76. Following recommendations made in previous review reports, the Party improved the transparency of its reporting by including detailed information on how the emissions associated with land conversions to other land were calculated and the rationale for the considerable increase in these emissions in the whole time series. As a result of the external review of the sector, recalculations were carried out and the area in the subcategory land converted to other land has been recalculated, taking into account the 20-year method (instead of 1 year). As a consequence, the areas are larger in subcategory land converted to other land than before.

3. Non-key categories

Land converted to cropland – N_2O

77. During the review, Liechtenstein explained that an error in the formula for calculating the N_2O emissions as a result of the disturbance associated with land-use conversion to cropland had been identified and that emissions reported as "NO" in the

previous annual submission have been replaced by estimates in the 2013 submission. This correction led to higher mineral soil emissions that are no longer reported as "NO".

Grassland remaining grassland – CO_2

78. As stated in the NIR, Liechtenstein uses national AD and data based on experiments, field studies, literature and expert estimates from Switzerland. The approach used is in line with the IPCC good practice guidance for LULUCF. The ERT noted a recommendation in the previous review report that Liechtenstein include more information on the source of the data in the NIR, including how these parameters were obtained and their applicability to Liechtenstein. During the review week, Liechtenstein explained that the use of Swiss data to estimate emissions from Liechtenstein was adequate because of the similarities in their environmental, management and species incidence. The ERT recommends that Liechtenstein provide the explanation presented during the review (e.g. with regard to the incidence of similar species and similar environmental and management conditions compared with Switzerland) that justifies the use of Swiss data to assess emissions and removals from grassland remaining grassland.

Land converted to wetlands – CO_2

79. The ERT noted a recommendation in previous review reports that Liechtenstein provide detailed information on this category with regard to the parameters used for the calculation of emissions. As a result of the external review of the sector, all data for the period 1990–2011 have been recalculated using the 20-year period method for cumulating the areas (instead of 1 year), and as a consequence, the areas are larger in land converted to wetlands and smaller in land converted to settlements than before.

F. Waste

1. Sector overview

80. In 2011, emissions from the waste sector amounted to 1.78 Gg CO_2 eq or 0.8 per cent of total GHG emissions. Since 1990, emissions have increased by 13.2 per cent. The key drivers for the rise in emissions are: an increase in population leading to higher emissions from wastewater treatment and an increase in composting activities, which more than offset the decrease in emissions from the category solid waste disposal on land. Within the sector, 57.9 per cent of the emissions were from wastewater handling, followed by 39.2 per cent from other (waste), 2.2 per cent from waste incineration and 0.7 per cent from solid waste disposal on land.

81. Liechtenstein has made a recalculation for CH_4 emissions from wastewater handling for the entire time series following the identification of an error in the value of CH_4 density. Recalculations were also made for N_2O emissions from wastewater handling for the years 2007–2010 due to an error identified in the value of protein consumption, and for CO_2 emissions from waste incinerated for the entire time series resulting from an error identified in the EFs. The impact of these recalculations on the waste sector is a decrease in total GHG emissions of 0.02 per cent for 2010. The ERT recommends that the Party review and strengthen its QC procedures to eliminate errors and improve the accuracy of emission estimates.

82. Liechtenstein uses country-specific methods and EFs from Switzerland to estimate emissions for all categories in the waste sector. In response to questions raised by the ERT during the review regarding how the Party assesses whether the method and EFs from Switzerland can represent the national conditions in Liechtenstein, the Party explained that regulatory frameworks, technical standard legal principles (e.g. threshold values for regulating waste management) and lifestyle, which affect some of the parameters of EFs of

the waste sector in the country, are nearly the same as those in Switzerland. To improve the transparency of its reporting on emission estimates, the ERT recommends that Liechtenstein explain in its NIR why the methods and EFs from Switzerland can be used for estimating emissions in Liechtenstein.

2. Non-key categories

Solid waste disposal on land – CH_4

83. In response to questions raised by the ERT during the review regarding country-specific conditions on landfills, the Party explained that there are 20 unmanaged dumping sites (registered contaminated sites by dumping of waste since 1998) and 3 managed landfills for inert waste, such as sand and concrete, which is neither chemically or biologically reactive and will not decompose in the country. Due to the enforcement of the Customs Union Treaty with Switzerland and the internal environmental protection law, the transition from landfilling of municipal solid waste (MSW) to exporting of MSW to Switzerland for incineration started during the 1960s and ended in 1974. Therefore, the Party has reported "NO" for emission estimates from managed waste disposal on land for the entire time series, and the annual amount of MSW disposed of has been reported as zero. The ERT recommends that Liechtenstein explain the situation regarding its unmanaged and managed landfill sites in the country, as well as the transition from landfilling of MSW to exporting it to Switzerland for incineration, in order to improve the transparency of its reporting.

Wastewater handling – CH_4 and N_2O

84. Liechtenstein applies a country-specific method adapted from the country-specific method of Switzerland, and aggregated CH_4 and N_2O emissions are reported under domestic and commercial wastewater, while industrial wastewater is reported as "IE".

85. In response to questions raised by the ERT during the review regarding country-specific conditions on the wastewater treatment streams, the Party explained that 99 per cent of the population from all 11 municipalities are connected to one municipal wastewater treatment plant, where mechanical, biological and chemical treatments are applied and the biogas that is produced by anaerobic digestion of sewage sludge and digested sewage sludge (digestate) is transported to Switzerland for incineration. The ERT recommends that the Party provide a more detailed explanation on the country-specific conditions for wastewater treatment streams in its NIR, in order to improve the transparency of its reporting.

Waste incineration – CO_2, CH_4 and N_2O

86. Since 1975, all MSW has been exported to Switzerland for incineration. Therefore, there are no waste incineration plants in the country, and the Party estimates CO_2, CH_4 and N_2O emissions from incineration of illegal waste from gardening, households and construction sites by applying a country-specific tier 2 method in line with Switzerland's method based on the core inventory of air emissions (CORINAIR). The Party calculates AD with the total amount of MSW and the fraction of 0.5 per cent representing waste incinerated illegally based on country-specific conditions and a study conducted by Switzerland.[9,10]

[9] Statistisches Jahrbuch Liechtenstein 2012. Fürstentum Liechtenstein. Office of Statistics, Vaduz 2012. Available at <http://www.llv.li/llv-as-statistisches_jahrbuch>.

[10] E-mail 2 September 2009 from P. Insinna to J. Beckbissinger: Menge Siedlungsabfall im 2008 (data on municipal solid waste 2008).

87. The Party reports in the NIR that 40 per cent of waste incinerated is of fossil fuel origin, mainly plastics; however, the ERT noted that the Party reported the exact same figure of AD for biogenic and non-biogenic waste incineration in the sectoral background information of CRF table 6. During the review week, in response to questions raised by the ERT, Liechtenstein explained that discussions between OE and the outsourced entity had not occurred and that appropriate action had not taken place to resolve this inconsistency in the process of QC procedures. The ERT recommends that Liechtenstein report the correct allocation of AD between biogenic and non-biogenic waste incineration in the CRF tables and review and strengthen its QC procedures, in order to improve the transparency of its reporting.

Other (waste) – CH_4 and N_2O

88. Liechtenstein has reported CH_4 and N_2O emission estimates from open-air composting of organic waste under this category. Emission estimations are based on the country-specific method and EFs of Switzerland. In response to questions raised by the ERT during the review regarding a quantitative breakdown of composted organic waste, the Party explained that organic waste mainly consists of tree pruning and hedge trimming (59.3 per cent) and of garden waste (24.6 per cent), and separately collected organic household waste is exported to and composted in Switzerland. The ERT encourages the Party to document this relevant background information for estimating AD, such as the breakdown of organic waste for composting into its main component sources, in order to improve the transparency of its reporting.

89. The ERT noted that the NIR states that in 2008, there was a significant increase in the amount of composted waste due to the clearing of forest area in the community of Eschen for environmental restoration. However, emission allocations across sectors (waste and LULUCF) relating to the said event are not provided in the NIR and the CRF tables. The ERT recommends that the Party document this relevant information in the NIR and the CRF tables and incorporate a cross-checking process for emission allocations across subcategories within the sector and across sectors in its QC procedures, in order to improve the transparency and accuracy of its reporting.

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

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

Overview

90. Table 6 provides an overview of the information reported and parameters selected by Liechtenstein under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

Table 6
Supplementary information reported under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

		Findings and recommendations
Has the Party reported information in accordance with the requirements in paragraphs 5–9 of the annex to decision 15/CMP.1?	Sufficient	See paragraphs 98 and 99
Identify any elected activities under Article 3, paragraph 4, of the Kyoto Protocol	Activities elected: None Years reported:	

		Findings and recommendations
	None	
Identify the period of accounting	Annual accounting	See paragraph 91
Assessment of the Party's ability to identify areas of land and areas of land-use change	Sufficient	See paragraph 96 Additional information on approach to combine above- and below-ground pools for the estimation of emissions from deforestation provided during review week; "NE" notation keys are still in place in CRF table 5(KP-I)A.2. The ERT recommends that Liechtenstein present in its NIR an additional explanation on the approach used to combine above- and below-ground pools for the estimation of emissions from deforestation together with the scientific references on which the approach is based and to revise its use of the notation key "NE" that is still used in CRF table 5(KP-I)A.2

Abbreviations: CRF = common reporting format, ERT = expert review team, NE = not estimated, NIR = national inventory report.

91. In its 2013 annual submission, Liechtenstein provided the requested supplementary information on KP-LULUCF in the NIR and in the KP-LULUCF CRF tables. Liechtenstein did not elect any activity under Article 3, paragraph 4, of the Kyoto Protocol. The Party elected annual accounting for its activities under Article 3, paragraph 3, of the Kyoto Protocol. The information provided on these activities is generally in line with the reporting requirements included in paragraphs 5–9 of the annex to decision 15/CMP.1.

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

Afforestation and reforestation – CO_2

92. Following a recommendation made in the previous review report to improve the land-use change determination and to provide accurate information on the areas where afforestation has taken place, Liechtenstein was able to identify an error in the calculation of the area of afforestation, and corrections were made. As a result, the carbon sinks under afforestation decreased for all years. Table 10-3 of the NIR presents the information that the correction had conservatively reduced removals by more than 3 Gg CO_2 eq for that activity.

93. The previous review report recommended that Liechtenstein undertake an assessment of the suitability of Swiss methods to Liechtenstein and document the results in its NIR. During the review week, the ERT assessed whether the basic environmental and climate conditions that affect the levels of CO_2 removals and wood production, as well as the forestry management practices, in Liechtenstein are similar to those in Switzerland. Based on responses provided by the Party in response to questions raised by the ERT, the ERT agrees that the Swiss methods are suitable for use in Liechtenstein. Furthermore, Liechtenstein presented the AD used, in particular, data for deforestation resulting from Liechtenstein monitoring the allowances handled by the Government. Hence, the ERT considers that the combined use of Swiss methods with available AD produced by Liechtenstein is adequate and the ERT recommends that this explanation be further detailed in the next annual submission.

94. The previous review report encouraged Liechtenstein to report the estimations for below-ground biomass separately and to include additional information on the approach taken for this pool in its 2013 annual submission. During the review week, the ERT checked the documents produced by the external review conducted on the LULUCF sector.

The documents were the basis for the fundamental changes applied in the 2013 submission and the ERT considers that the updated approach adopted by Liechtenstein does not overestimate removals or underestimate emissions and that the updated approach is comprehensive. However, Liechtenstein did not report estimations for below-ground biomass separately, as it is included in the above-ground biomass, and the ERT noted that the Party still reports "NE" as one of the notation keys for areas of organic soil AD in KP-LULUCF CRF table 5(KP-I)A.1.1. The ERT recommends that Liechtenstein report separate information for below-ground biomass and use the appropriate corresponding notation key in CRF table 5(KP-I)A.1.1.

Deforestation – CO_2

95. The ERT noted a recommendation in the previous review report that Liechtenstein provide more information on the methods, models and assumptions used for the estimation of deforestation and an encouragement to the Party to disaggregate the estimations of emissions from deforestation, taking into account the final use of the area deforested. The ERT noted that new tables for cumulated areas of afforestation and deforestation were included and transparently presented in the 2013 NIR. Further explanation was presented during the review week. The ERT further encourages Liechtenstein to use available national data on the wood used in energy to further cross-check information on the deforestation activities.

96. Following a recommendation made in the previous review report, the Party included in its NIR a more detailed description of the methods and assumptions used to combine the above- and below-ground pools for the estimation of emissions from deforestation. During the review week, Liechtenstein provided additional information regarding the approach used and the justification for using this approach, including the scientific references on which the approach is based. In addition, Liechtenstein corrected the notation key "NE" for below-ground biomass in the summary table and NIR of the 2013 submission. However, "NE" notation keys are still in place in CRF table 5(KP-I)A.2. The ERT recommends that Liechtenstein present in its NIR an additional explanation on the approach used to combine above- and below-ground pools for the estimation of emissions from deforestation, together with the scientific references on which the approach is based, and revise its use of the notation key "NE" in CRF table 5(KP-I)A.2.

97. The ERT noted that wood is used in the energy sector, representing around 10 per cent of the fuel used (in TJ). The ERT encourages Liechtenstein to use energy data on wood consumption to validate KP-LULUCF deforestation data, taking into account also the biomass and wood component of the waste sector (see para. 95 above). The ERT acknowledges that this implies that the origin of wood is known. The ERT further encourages Liechtenstein to use national available data on the wood used in energy to further cross-check information on the deforestation activities.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

98. Liechtenstein has reported information on its accounting of Kyoto Protocol units in the required SEF tables, as required by decisions 15/CMP.1 and 14/CMP.1. The ERT took note of the findings and recommendations included in the standard independent assessment

report (SIAR) on the SEF tables and the SEF comparison report.[11] The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10.

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

Accounting of activities under Article 3, paragraph 3, of the Kyoto Protocol

100. Liechtenstein has reported information on its accounting of KP-LULUCF in the accounting table, as included in the annex to decision 6/CMP.3. Information on the accounting of KP-LULUCF has been prepared and reported in accordance with decisions 16/CMP.1 and 6/CMP.3.

101. Table 7 shows the accounting quantities for KP-LULUCF as reported by the Party and the final values after the review.

Table 7
Accounting quantities for activities under Article 3, paragraph 3, and, if any, activities under Article 3, paragraph 4, of the Kyoto Protocol, in t CO_2 eq

	2013 submission[a]			*2010, 2011 and 2012 submissions*[b]	*Net accounting quantity*[c]
	As reported	*Revised estimates*	*Final*	*Final*	
Afforestation and reforestation	–813		–813	–631	–182
Non-harvested land	–813		–813	–631	–182
Harvested land	NO		NO	NO	NA
Deforestation	1 319		1 319	936	383
Forest management	NA		NA	NA	NA
Article 3.3 offset[d]	NA		NA	NA	NA
Forest management cap[e]	NA		NA	NA	NA
Cropland management	NA		NA	NA	NA
Grazing land management	NA		NA	NA	NA
Revegetation	NA		NA	NA	NA

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

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

[a] The values included under the 2013 submission are the cumulative accounting values for 2008, 2009, 2010 and 2011, as reported in the accounting table of the KP-LULUCF CRF tables for the inventory year 2011.

[b] The values included under the 2010, 2011 and 2012 submissions are the final accounting values as a result of the 2012 review and are included in table 6 of the 2012 annual review report (FCCC/ARR/2012/LIE/Corr.1, page 1) in the column "2012 annual submission", "Final".

[c] The "net accounting quantity" is the quantity of Kyoto Protocol units that the Party shall issue or cancel under each activity under Article 3, paragraph 3, and paragraph 4, if relevant, based on the final accounting quantity in the 2013 submission and where the quantities issued or cancelled based on the 2012 annual review report have been subtracted ("net accounting quantity" = final 2013 – final 2012 annual review report).

[d] "Article 3.3 offset": For the first commitment period, a Party included in Annex I to the Convention that incurs a net source of emissions under the provisions of Article 3, paragraph 3, of the Kyoto Protocol may account for anthropogenic greenhouse gas emissions by sources and removals by sinks in areas under forest management under Article 3, paragraph 4, up to a level that is equal to the net source of emissions under the provisions of Article 3, paragraph 3, but not greater than 9.0 megatonnes of carbon times five, if the total anthropogenic greenhouse gas emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3, paragraph 3.

[e] In accordance with decision 16/CMP.1, annex, paragraph 11, for the first commitment period only, additions to and subtractions from the assigned amount of a Party resulting from forest management under Article 3, paragraph 4, of the Kyoto Protocol after the application of decision 16/CMP.1, annex, paragraph 10, and resulting from forest management project activities undertaken under Article 6, shall not exceed the value inscribed in the appendix of the annex to decision 16/CMP.1, times five.

102. Based on the information provided in table 7 for the activity afforestation/reforestation, Liechtenstein shall issue 182 removal units (RMUs) in its national registry.

103. Based on the information provided in table 7 for the activity deforestation, Liechtenstein shall cancel 383 assigned amount units, emission reduction units, certified emission reduction units and/or RMUs in its national registry.

Calculation of the commitment period reserve

104. Liechtenstein has reported its commitment period reserve in its 2013 annual submission. The Party reported that its commitment period reserve has not changed since the initial review report (950,061 t CO_2 eq), as it is based on the assigned amount and not on the most recently reviewed inventory. The ERT agrees with this figure.

3. Changes to the national system

105. Liechtenstein reported that there are no changes in its national system since the previous annual submission. The ERT concluded that the Party's national system continues to be in accordance with the requirements of national systems outlined in decision 19/CMP.1.

4. Changes to the national registry

106. Liechtenstein reported that there are changes in its national registry since the previous annual submission. The Party described the changes, specifically due to the centralization of the EU ETS operations into a single European Union (EU) registry operated by the European Commission called the Consolidated System of EU registries (CSEUR), in its NIR (see page 223). The CSEUR is a consolidated platform which implements the national registries in a consolidated manner and was developed together with the new EU registry.

107. The ERT noted that there were recommendations in the SIAR that had not been addressed related to the CSEUR, in particular recommendations related to public availability of information on the website, reporting a description of the changes in database structure and reporting of test results. In response to questions raised by the ERT during the review, Liechtenstein provided further information on the changes to the national

registry, including on public availability of information on the national website, and reporting a description of the changes in database structure.

108. The ERT concluded that, taking into account the confirmed changes in the national registry, including additional information provided to the ERT during the review, Liechtenstein's national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP). With respect to the provision of information related to database structure specifically, the ERT encourages the Party to provide additional information in the NIR. The ERT recommends that Liechtenstein include all other additional information in response to the SIAR findings in its NIR in accordance with decision 15/CMP.1, annex, chapter I.G.

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

109. Liechtenstein reported that there is no change in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol since the previous annual submission. The ERT noted that Liechtenstein has not yet provided information on how it gives priority to the actions listed in paragraph 24 of the annex to decision 15/CMP.1 in implementing its commitments under Article 3, paragraph 1, of the Kyoto Protocol. Therefore, the ERT reiterates the recommendation made in the previous review report that the Party report this information.

110. Liechtenstein's reporting of activities to minimize the adverse impacts of response measures includes the following:

(a) Policies and measures developed are compatible and consistent with those of the EU, in order to avoid trade distortion and non-tariff barriers to trade, and to set similar incentives. In accordance with international law, this approach strives to ensure that Liechtenstein is implementing those climate change response measures that are least distortive to trade and do not create unnecessary barriers to trade;

(b) Tax exemption in Switzerland and consequently also in Liechtenstein for biofuels is limited to fuels that meet ecological and social criteria. The conditions are set out in such a way that biofuels do not compete with food production and are not causing degradation of rainforests or other valuable ecosystems;

(c) A project by the Swiss Academies of Arts and Sciences is initiated to assess possible conflicts and synergies between the expansion of renewable energy production and land management. The project takes into account that large-scale use of areas for energy production has to be planned, taking into consideration the maintenance of ecosystem services, the protection of biodiversity and the natural landscapes, which are important for tourism.

III. Conclusions and recommendations

A. Conclusions

111. Table 8 summarizes the ERT's conclusions on the 2013 annual submission of Liechtenstein, in accordance with the Article 8 review guidelines.

Table 8
Expert review team's conclusions on the 2013 annual submission of Liechtenstein

		Cross references
The ERT concludes that the inventory submission of Liechtenstein is complete (categories, gases, years and geographical boundaries and contains both an NIR and CRF tables for 1990–2011)		
Annex A sources[a]	Complete	Table 3
LULUCF[a]	Complete	Table 3
KP-LULUCF	Complete	Table 3
The ERT concludes that the inventory submission of Liechtenstein has been prepared and reported in accordance with the UNFCCC reporting guidelines	Generally yes	Table 5; 25, 27
The submission of information required under Article 7, paragraph 1, of the Kyoto Protocol has been prepared and reported in accordance with decision 15/CMP.1	Yes	90, 91
The Party's inventory is in accordance with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*	Yes	Table 4
Liechtenstein has reported information on Article 3, paragraphs 3 and 4	Yes	6
Liechtenstein has reported information on its accounting of Kyoto Protocol units in accordance with decision 15/CMP.1, annex, chapter I.E, and used the required reporting format tables as specified by decision 14/CMP.1	Yes	98, 99
The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1	Yes	105
The national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1 and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions	Yes	108
Did the Party provide information in the NIR on changes in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol?	Yes	109

Abbreviations: Annex A sources = sources included in Annex A to the Kyoto Protocol, CMP = Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, CRF = common reporting format, ERT = expert review team, IPCC = Intergovernmental Panel on Climate Change, KP-LULUCF = LULUCF emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, LULUCF = land use, land-use change and forestry, NIR = national inventory report, UNFCCC reporting guidelines = "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories".

[a] The assessment of completeness by the ERT considers only the completeness of reporting of mandatory categories (i.e. categories for which methods and default emission factors are provided in the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, the IPCC *Good Practice Guidance and Uncertainty*

Management in National Greenhouse Gas Inventories, or the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*).

B. Recommendations

112. The ERT identified the issues for improvement listed in table 9. All recommendations are for the next annual submission, unless otherwise specified.

Table 9
Recommendations identified by the expert review team

Sector	*Category*	*Recommendation*	*Cross references*
Cross-cutting	Completeness of inventory	Complete CRF table 7 for 1990	16(c)
		Complete CRF table 2(II)s2	41
	Recalculation	Complete CRF table 8(b) for all years by including explanatory information for all recalculations	Table 3
	QA/QC	Update the improvement development plan to include all the recommendations of previous review reports together with information on the intended implementation of these recommendations	Table 3; 11
		Review and strengthen its QC procedures to eliminate errors and improve the accuracy of its emission estimates	Table 3; 21, 81, 87 and 89
		Implement additional QC procedures to avoid mistakes or discrepancies between the CRF tables and the NIR	Table 3; 16(c), 21, 24 and 35
	Transparency	Document why the use of previous year Swiss data is an appropriate proxy for estimating current year emissions in Liechtenstein in a given sector	Table 3; 78, 93
		Improve the transparency in reporting in specific sectors	Table 3
	Inventory planning	Update the schematic overview of the national inventory system and the data-collection process (figures 1-1 and 1-2 in the NIR) and further describe the approval process within the new organizational structure	12
	Inventory preparation	Describe how key categories are used to prioritize inventory improvements	Table 4; 16(b)
Energy	Sector overview	Clarify and document the correct calorific value for the national natural gas consumption to improve the accuracy of the inventory	20
		Implement additional QC procedures to avoid mistakes or discrepancies between the CRF tables and	21

Sector	*Category*	*Recommendation*	*Cross references*
		the NIR	
	Reference and sectoral approaches	Correct the inconsistency of the data reported on the difference in energy consumption between the reference and the sectoral approaches in the NIR and the CRF tables	Table 5; 24
	Feedstocks and non-energy use of fuels	Report lubricants and bitumen activities in CRF tables 1.A(b) and 1.A(d)	Table 5; 26
		Report secondary fuels consumed in the country and complete the lubricants and bitumen AD in the CRF tables	27
	Stationary combustion: liquid and gaseous fuels – CO_2, CH_4 and N_2O	Reallocate the data on consumption and emissions of construction and industrial off-road machinery from the category other (CRF table 1.A.5(b)) (fuel combustion – mobile; off-road vehicles and other machinery) to the category manufacturing industries and construction (CRF table 1.A.2(f))	30
		Use the data reported for the purposes of the EU ETS to split the fuel consumption and emissions between the food processing, beverages and tobacco subcategory (CRF table 1.A.2(e)) and the subcategory other industries (CRF table 1.A.2(f)) or explain why these data cannot be used	32
	Road transportation: liquid fuels – CO_2	Improve the transparency of the NIR by stating that consumption of lubricants is included in the global gasoline sales reported in the national energy statistics	33
		Check if biofuel is not already mixed in the imported gasoline and diesel oil fuels and document this in the NIR	34
		Correctly report that a tier 2 method is used for estimating emissions from this category and explain it in the NIR	35
	Navigation: other liquid fuels – CO_2, CH_4, N_2O	Report all notation keys as “NO” for this category	37
Industrial processes and solvent and other product use	Consumption of halocarbons and SF_6 – HFCs, PFCs and SF_6	Provide an explanation on the fluctuation in AD and HFC emissions for refrigeration and air-conditioning equipment	40
		Complete CRF table 2(II)s2 for potential emissions data on HFCs and PFCs from consumption of halocarbons and SF_6, together with the estimation methods used	41

Sector	*Category*	*Recommendation*	*Cross references*
		Investigate the fluctuations in the emissions from foam blowing and provide a clear explanation	42
		Provide an explanation for the downward trend in SF_6 emissions from electrical equipment	43
Agriculture	Enteric fermentation – CH_4	Include a table with the conversion factors used for calculating gross energy intake for livestock categories	49
		Explain how the total population of young cattle was estimated for the purposes of reporting in table 6-5 of the NIR	50
	Manure Management – CH_4 and N_2O	Update the fractions of animal manure handling using different management systems for the most up-to-date Swiss data or explain why this is not necessary	54
	Manure management – CH_4 and N_2O	Update the fractions of animal manure handling using different management systems for the most up-to-date Swiss data or explain why this is not necessary	55
		Enhance the transparency of the NIR by explaining how livestock breakdown based on animal "places" is carried out and how these counts differ from those based on animal head numbers	57
	Direct soil emissions	Include in the NIR information regarding the law that forbids the use of sewage sludge as fertilizer to soils and information on how the AD are obtained	59
		Correct the title of NIR table 6-17 to properly describe how N_2O emissions from agricultural soils are calculated	60
	Direct soil emissions – N_2O	Report on the assessment of the cause of the difference between data reported on histosols (cultivated organic soils) and organic soils reported as croplands and grasslands	61
	Indirect soil emissions – N_2O	Provide updated information on $Frac_{GASF}$ and $Frac_{GASM}$ values in line with the information provided to the ERT	63
	Pasture, range and paddock manure – N_2O	Update the fractions of animal manure handling using different management systems using the most up-to-date Swiss data or explain why this is not necessary	64
LULUCF	Sector overview	Improve the transparency of reporting by implementing the technical means identified during the review week to report a summary table on the national areas of different land uses and land-use changes from 1990 to the last year reported, in line with the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*	66

Sector	*Category*	*Recommendation*	*Cross references*
	Forest land remaining forest land – CO_2	Report afforestation under the category land converted to forest land rather than in the forest land remaining forest land category	69
		Include the information on the comprehensive approach followed for pools	70
	Cropland remaining cropland – CO_2	Explain more clearly in table 7-8 of the NIR that the soil classification column cells filled with "NS" are considered as mineral soils	73
	Settlements – CO_2	Include the information provided in the report of the external review to further communicate transparently the methods, data and parameters used for the estimations for each subcategory of the land-use changes to settlements category	75
	Grassland remaining grassland – CO_2	Provide in the NIR the explanation presented during the review week (e.g. with regard to the incidence of similar species and similar environmental and management conditions compared with Switzerland) that justify the use of Swiss data to assess emissions and removals from grassland remaining grassland	78
Waste	Sector overview	Review and strengthen QC procedures to eliminate errors and improve the accuracy of emission estimates	81
		Explain in the NIR why the method and EFs from Switzerland can be used for estimating emissions in Liechtenstein	82
	Solid waste disposal on land – CH_4	Explain the situation regarding its unmanaged and managed landfill sites in the country, as well as the transition from landfilling of MSW to exporting it to Switzerland for incineration, in order to improve the transparency of its reporting	83
	Wastewater handling – CH_4 and N_2O	Provide a more detailed explanation of the country-specific conditions for wastewater treatment streams in the NIR, in order to improve the transparency of reporting	85
	Waste incineration – CO_2, CH_4 and N_2O	Report the correct allocation of AD between biogenic and non-biogenic waste incineration in the CRF tables and review and strengthen QC procedures, in order to improve the transparency of reporting	87
	Other (waste) – CH_4 and N_2O	Document the increase in the amount of composted waste due to the clearing of forest area in the community of Eschen for environmental restoration in the NIR and the CRF tables and incorporate a cross-checking process for emission allocations across subcategories within the sector and across sectors in the QC procedures, in order to improve the	89

Sector	*Category*	*Recommendation*	*Cross references*
		transparency and accuracy of reporting	
KP-LULUCF	Afforestation and reforestation – CO_2	Explain why the combined use of Swiss methods with available AD produced by Liechtenstein is appropriate	93
		Report separate information for below-ground biomass and use the appropriate corresponding notation key in CRF table 5(KP-I)A.1.1	94
	Deforestation – CO_2	Present in the NIR the additional explanation on the approach used to combine above- and below-ground pools for the estimation of emissions from deforestation together with the scientific references on which the approach is based and revise the use of the notation key "NE" in CRF table 5(KP-I)A.2	96
National registry	Changes to the national registry	Include all other additional information in response to the SIAR findings in the NIR in accordance with decision 15/CMP.1, annex, chapter I.G	108
Article 3, paragraph 14	Minimization of adverse impacts	Improve reporting on how the Party prioritizes the implementation of the commitments under Article 3, paragraph 14, of the Kyoto Protocol to the actions listed in paragraph 24 of the annex to decision 15/CMP.1	109

Abbreviations: AD = activity data, CRF = common reporting format, EF = emission factor, ERT = expert review team, EU ETS = European Union Emissions Trading System, IPCC = Intergovernmental Panel on Climate Change, KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, LULUCF = land use, land-use change and forestry, MSW = municipal solid waste, NE = not estimated, NIR = national inventory report, NO = not occurring, NS = no stratification, SIAR = standard independent assessment report, QA/QC = quality assurance/quality control.

IV. Questions of implementation

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

Annex I

Background data on recalculations and information to be included in the compilation and accounting database

Table 10
Recalculations in the 2013 annual submission for the base year and the most recent year

Greenhouse gas source and sink categories	*1990*	*2010*	*1990*	*2010*	*Reason for the recalculation*
	Value of recalculation (Gg CO_2 eq)		*Per cent change*		
1. Energy	0.0001	0.26	0.00005	0.1	Changed AD and EFs
A. Fuel combustion (sectoral approach)	0.0001	0.26	0.00005	0.1	
1. Energy industries					
2. Manufacturing industries and construction	0.0001	0.00004	0.0003	0.0002	
3. Transport		0.15		0.2	
4. Other sectors		0.11		0.1	
5. Other					
B. Fugitive emissions from fuels					
1. Solid fuels					
2. Oil and natural gas	–0.001	–0.009	–0.4	–0.83	
2. Industrial processes		0.01		0.1	Changed AD and EFs
A. Mineral products					
B. Chemical industry					
C. Metal production					
D. Other production					
E. Production of halocarbons and SF_6					
F. Consumption of halocarbons and SF_6		0.01		0.1	
G. Other					
3. Solvent and other product use	1.46	0.46	264.1	87.4	Changed AD
4. Agriculture	–1.77	0.18	–7.2	0.8	Changed AD
A. Enteric fermentation	–1.64	0.03	–13.6	0.3	
B. Manure management	–0.14	0.01	–3.9	0.2	
C. Rice cultivation					
D. Agricultural soils		0.14		1.6	
E. Prescribed burning of savannas					
F. Field burning of agricultural residues					
G. Other					

Greenhouse gas source and sink categories	*1990*	*2010*	*1990*	*2010*	*Reason for the recalculation*
	Value of recalculation (Gg CO_2 eq)		*Per cent change*		
5. Land use, land-use change and forestry	–1.25	–1.14	15.2	19.1	Change in calculation period from 1 to 20 years
A. Forest land	–1.25	–1.43	6.7	7.7	
B. Cropland	0.01	0.06	0.2	1.3	
C. Grassland	–0.23	–0.27	–10.9	–8.0	
D. Wetlands		0.09		68.0	
E. Settlements	0.23	0.44	6.8	13.2	
F. Other land		–0.03		–2.6	
G. Other					
6. Waste	–0.003	0.06	–0.2	3.3	Changed AD and EFs
A. Solid waste disposal on land					
B. Wastewater handling	–0.03	0.03	–3.0	3.2	
C. Waste incineration	0.02	0.02	166.0	166.0	
D. Other					
7. Other					
Total CO_2 equivalent without LULUCF	–0.31	0.96	–0.1	0.4	
Total CO_2 equivalent with LULUCF	–1.56	–0.19	–0.7	–0.1	

Abbreviations: AD = activity data, EF = emission factor, LULUCF = land use, land-use change and forestry.

Table 11
Information to be included in the compilation and accounting database in t CO_2 eq for 2011, including the commitment period reserve

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Commitment period reserve	950 061			950 061
Annex A emissions for 2011				
CO_2	184			184
CH_4	15			15
N_2O	13			13
HFCs	8			8
PFCs	0			0
SF_6	0			0
Total Annex A sources	**220**			**220**
Activities under Article 3, paragraph 3, for 2011				
3.3 Afforestation and reforestation on non-harvested land for 2011	–182			–182
3.3 Afforestation and reforestation on harvested land for 2011	NO			NO
3.3 Deforestation for 2011	393			393
Activities under Article 3, paragraph 4, for 2011[c]				
3.4 Forest management for 2011				
3.4 Cropland management for 2011				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2011				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2011				
3.4 Revegetation in the base year				

Abbreviations: Annex A sources = sources included in Annex A to the Kyoto Protocol, NO = not occurring.

[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).

[b] "Final" includes revised estimates, if any, and/or adjustments, if any.

[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 12
Information to be included in the compilation and accounting database in t CO_2 eq for 2010, including the commitment period reserve

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2010				
CO_2	200			200
CH_4	150			150
N_2O	13			13
HFCs	7			7
PFCs	0			0
SF_6	0			0
Total Annex A sources	**370**			**370**
Activities under Article 3, paragraph 3, for 2010				
3.3 Afforestation and reforestation on non-harvested land for 2010	–199			–199
3.3 Afforestation and reforestation on harvested land for 2010	NO			NO
3.3 Deforestation for 2010	143			143
Activities under Article 3, paragraph 4, for 2010[c]				
3.4 Forest management for 2010				
3.4 Cropland management for 2010				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2010				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2010				
3.4 Revegetation in the base year				

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

Table 13
Information to be included in the compilation and accounting database in t CO_2 eq for 2009

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2009				
CO_2	214			214
CH_4	16			16
N_2O	13			13
HFCs	5			5
PFCs	0			0
SF_6	0			0
Total Annex A sources	**248**			**248**
Activities under Article 3, paragraph 3, for 2009				
3.3 Afforestation and reforestation on non-harvested land for 2009	–217			–217
3.3 Afforestation and reforestation on harvested land for 2009	NO			NO
3.3 Deforestation for 2009	433			433
Activities under Article 3, paragraph 4, for 2009[c]				
3.4 Forest management for 2009				
3.4 Cropland management for 2009				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2009				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2009				
3.4 Revegetation in the base year				

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

Table 14
Information to be included in the compilation and accounting database in t CO_2 eq for 2008

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2008				
CO_2	230			230
CH_4	16			16
N_2O	13			13
HFCs	5			5
PFCs	0			0
SF_6	0			0
Total Annex A sources	**264**			**264**
Activities under Article 3, paragraph 3, for 2008				
3.3 Afforestation and reforestation on non-harvested land for 2008	–215			–215
3.3 Afforestation and reforestation on harvested land for 2008	NO			NO
3.3 Deforestation for 2008	350			350
Activities under Article 3, paragraph 4, for 2008[c]				
3.4 Forest management for 2008				
3.4 Cropland management for 2008				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2008				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2008				
3.4 Revegetation in the base year				

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

Annex II

Documents and information used during the review

A. Reference documents

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

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

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

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

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

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

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

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

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

Status report for Liechtenstein 2013. Available at <http://unfccc.int/resource/docs/2013/asr/lie.pdf>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2013. Available at <http://unfccc.int/resource/webdocs/sai/2013.pdf>.

FCCC/ARR/2012/LIE. Report of the individual review of the annual submission of Liechtenstein submitted in 2012. Available at <http://unfccc.int/resource/docs/2013/arr/lie.pdf>.

Standard independent assessment report, parts 1 and 2. Available at <http://unfccc.int/kyoto_protocol/registry_systems/independent_assessment_reports/items/4061.php>.

B. Additional information provided by the Party

Responses to questions during the review were received from Ms. Heike Summer (Environmental Protection Division at the Office of Environment), including additional material on the methods and assumptions used. The following documents[1] were also provided by Liechtenstein:

Switzerland's Greenhouse Gas Inventory. 1990–2011. National Inventory Report 2013, including reporting elements under the Kyoto Protocol. Available at <http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/7383.php>.

HG-Inventar Liechtenstein, Review Sektor LULUCF: Besprechung vom 23. August 2012 in Schaan, Ergebnisse und Vorschläge, Fürstentum Liechtenstein, Amt für Umweltschutz (AUS). Jürg Heldstab, INFRAS, Projektleitung; Beat Rihm, METEOTEST, Bearbeitung.

[1] Reproduced as received from the Party.

Annex III

Acronyms and abbreviations

AD	activity data
CH_4	methane
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CRF	common reporting format
CSEUR	Consolidated System of European Union Registries
EF	emission factor
ERT	expert review team
EU	European Union
EU ETS	European Union Emissions Trading System
FAO	Food and Agriculture Organization of the United Nations
GHG	greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 without GHG emissions and removals from LULUCF
HFCs	hydrofluorocarbons
IE	included elsewhere
IPCC	Intergovernmental Panel on Climate Change
ITL	international transaction log
KP-LULUCF	land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
LULUCF	land use, land-use change and forestry
MSW	municipal solid waste
N	nitrogen
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NFI	national forest inventory
NH_3	ammonia
NIR	national inventory report
NO	not occurring
NS	no stratification
OE	Office of Environment
PFCs	perfluorocarbons
PJ	petajoule (1 PJ = 10^{15} joule)
QA/QC	quality assurance/quality control
RMU	removal unit
SEF	standard electronic format
SF_6	sulphur hexafluoride
SIAR	standard independent assessment report
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change