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

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

CONTENTS

I. Overview

A. Introduction

1. This report covers the in-country review of the 2006 greenhouse gas (GHG) inventory submission of Switzerland, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 5 to 10 May 2007 in Bern, Switzerland, and was conducted by the following team of nominated experts from the roster of experts: generalist – Ms. Mirja Kosonen (Finland); energy – Mr. Pavel Fott (Czech Republic); industrial processes – Ms. Marisol Bacong (Philippines); agriculture – Mr. Tomoyuki Aizawa (Japan); land use, land-use change and forestry (LULUCF) – Mr. Xiaoquan Zhang (China); waste – Ms. Maria Paz Cigaran (Peru). Ms. Maria Paz Cigaran and Mr. Tomoyuki Aizawa were the lead reviewers. The review was coordinated by Mr. Matthew Dudley and Mr. Harald Diaz-Bone (UNFCCC secretariat).

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

B. Inventory submission and other sources of information

3. In its 2006 submission, Switzerland submitted a complete set of common reporting format (CRF) tables for the years 1990–2004 and a national inventory report (NIR). Where needed the expert review team (ERT) also used the previous year's submission, additional information provided during the review and other information. The full list of materials used during the review is provided in the annex to this report.

C. Emission profiles and trends

4. In 2004, the most important GHG in Switzerland was carbon dioxide (CO_2), contributing 85.4 per cent to total[1] national GHG emissions expressed in CO_2 equivalent, followed by methane (CH_4), 6.7 per cent, and nitrous oxide (N_2O), 6.3 per cent. Hydrofluorocarbons (HFCs) contributed 1.2 per cent, sulphur hexafluoride (SF_6) 0.3 per cent, and perfluorocarbons (PFCs) 0.1 per cent. The energy sector accounted for 82.5 per cent of total GHG emissions, followed by agriculture (9.9 per cent), industrial processes (5.7 per cent) and waste (1.4 per cent). Total GHG emissions amounted to 53,085 Gg CO_2 equivalent and increased by 0.6 per cent from the base year (1990) to 2004.

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

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

Table 1. Greenhouse gas emissions by gas, 1990–2004 [a]

GHG emissions	Gg CO_2 equivalent								Change
	Base year Convention	1990	1995	2000	2001	2002	2003	2004	BY–2004 (%)
CO_2 (with LULUCF)	42,842.6	42,842.6	40,143.3	45,187.4	44,052.1	43,292.5	46,769.6	44,515.5	3.9
CO_2 (without LULUCF)	44,553.3	44,553.3	43,355.5	43,933.8	44,716.3	43,818.0	44,912.5	45,345.7	1.8
CH_4	4,371.9	4,371.9	3,983.7	3,691.7	3,707.3	3,648.1	3,602.1	3,549.6	–18.8
N_2O	3,628.3	3,628.3	3,504.3	3,432.1	3,411.3	3,410.6	3,326.2	3,329.2	–8.2
HFCs	0.0	0.0	151.8	417.9	492.2	502.5	538.5	617.4	2,740,367.5
PFCs	100.2	100.2	14.7	93.1	52.5	50.5	89.5	76.7	–23.4
SF_6	143.6	143.6	81.3	185.8	233.9	209.3	193.8	175.1	21.9

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

[a] Switzerland submitted revised estimates for all years of the time series in the course of the review on 20 April 2007. These estimates differ from Party's GHG inventory submitted in 2006.

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

Sectors	Gg CO_2 equivalent								Change
	Base year Convention	1990	1995	2000	2001	2002	2003	2004	BY–2004 (%)
Energy	42,133.7	42,133.7	41,686.5	42,463.8	43,222.8	42,345.6	43,459.7	43,795.0	3.9
Industrial processes	3,258.0	3,258.0	2,527.2	2,819.5	2,946.5	2,890.2	2,899.5	3,051.2	–6.3
Solvent and other product use	466.4	466.4	367.4	280.9	270.3	258.5	249.6	236.3	–49.3
Agriculture	5,903.2	5,903.2	5,638.2	5,408.8	5,417.7	5,394.2	5,282.4	5,258.1	–10.9
LULUCF	–1,704.2	–1,704.2	–3,201.2	1,262.9	–655.0	–514.6	1,868.7	–821.0	–51.8
Waste	1,029.5	1,029.5	861.1	772.2	747.0	739.5	759.8	743.9	–27.7
Other	NO	NO	NO	NO	NO	NO	NO	NO	NA
Total (including LULUCF)	51,086.7	51,086.7	47,879.1	53,007.9	51,949.3	51,113.4	54,519.6	52,263.5	2.3
Total (excluding LULUCF)	52,791.0	52,791.0	51,080.4	51,745.1	52,604.2	51,628.0	52,651.0	53,084.5	0.6

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

[a] Switzerland submitted revised estimates for all years of the time series in the course of the review on 20 April 2007. These estimates differ from Party's GHG inventory submitted in 2006.

D. Key categories

6. Switzerland has reported a key category tier 1 analysis, both level and trend assessment, as part of its 2006 submission. The key category analyses performed by the Party and the secretariat[2] produced different results. Switzerland has not included the LULUCF sector in its key category analysis, but presented to the ERT an analysis from the 2007 submission that included LULUCF for 2005. A second reason for the differences is that Switzerland's classification for its key category analysis was more disaggregated than secretariat's. The results of the Party's own analysis reflect the specific conditions of the country. During the in-country review the Party explained that the results of the analysis have had an effect on the inventory planning in the context of allocating resources. In the quality control procedures, priority is given to the key categories.

E. Main findings

7. Switzerland uses mainly country-specific or higher-tier methods to estimate emissions and removals, and has used the latest scientific findings. The inventory is of good quality. The institutional arrangements are well developed, especially for the quality assurance/quality control (QA/QC) archiving system, which is still under construction and will be certified according to the International Organization for Standardization (ISO) standard 9001 in 2007. However, some aspects of Switzerland's inventory could be improved.

F. Cross-cutting topics

1. Completeness

8. The inventory submission of 10 November 2006 is complete. The CRF tables for the years 1990–2004 are provided (except for CRF tables 9a and 9b, which are not reported) and the geographic coverage has been corrected by separating out Liechtenstein from Switzerland's national emissions estimate. The inventory reports all sectors and all source and sink categories, with minor deficiencies, as mentioned below, in the LULUCF sector. The Party assumes carbon stock changes in forest soils for forest land remaining forest land and mineral soil for cropland remaining cropland to be zero, because of lack of data. The ERT recommends Switzerland to make efforts to improve the estimates for carbon stock changes in forest soils, and for mineral soil for cropland remaining cropland.

9. The reporting covers all gases, including actual and potential emissions of all the fluorinated gases (F-gases). Emissions from composting and from digestion of organic waste have been reported for the first time by the Party. The NIR includes information on key categories, methods, data sources, uncertainty estimates, quality assurance/quality control procedures and verification activities. The NIR provides a description of the QA/QC and verification procedures used in the preparation of the GHG inventory.

2. Transparency

10. The documentation in the NIR gives a good basis for the inventory review. There is an ongoing development process in the documentation, where information technology (IT)-based methods are applied for data processing and inventory archiving, supported by QA/QC activities. This improvement follows the recommendations of previous inventory reviews. The level of transparency is improving with

[2] The secretariat identified, for each Party, those source categories that are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC good practice guidance for LULUCF. Key categories according to the tier 1 trend assessment were also identified for those Parties that provided a full set of CRF tables only for 2004. Where the Party performed a key category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key category assessment conducted by the secretariat.

the integration of the national air pollution database (EMIS) system into the inventory compilation process, along with the implementation of the quality management system. The EMIS database stores references to documentation and original data sources used in the inventory compilation. However, the NIR generally cites EMIS as the source of information or data, and Switzerland is encouraged to include references to the original sources of information or data in the NIR. During the in-country visit additional information was made available to the ERT, including confidential material.

11. The ERT found that the reporting of the notation keys "not estimated" ("NE") and "included elsewhere" ("IE") is not always transparent, and corresponding explanations in CRF table 9(a) are not provided. The ERT encourages Switzerland to provide explanations of all cases when the notation keys are used.

12. Methodologies are generally well described in the NIR, but in a number of cases the information reported is not sufficient to explain the assumptions made in choosing methodologies or estimating activity data (AD) and emission factors (EFs) (e.g. in energy, industrial processes, agriculture, waste). The ERT recommends that Switzerland improve the documentation on methodology in the NIR, particularly for the key categories.

3. Recalculations and time-series consistency

13. The ERT noted that recalculations reported by the Party of the time series from the base year (1990) to 2003 had been undertaken, as indicated in the NIR. The recalculations arise mainly from the reallocation of waste incineration emissions to the energy sector; new modelling of domestic aviation and waste-water handling; the recalculation of emissions from industrial processes in the context of development of the EMIS database; improvements to the SF_6 emission estimates; and the recalculation of emissions from burning branches. The net effect of the recalculations (including the separating out of Liechtenstein's emissions from the Swiss inventory) is an increase in emissions of 0.58 per cent for the year 1990 (NIR, page 222) and 0.76 per cent for 2003 (NIR, page 221). The major changes are connected with the reallocation of waste incineration and with increased emissions from LULUCF as well as from solvent and other product use. The rationale for these recalculations is provided in the NIR. The recalculations follow partly from the recommendations of previous reviews and partly from the implementation of a comprehensive improvement plan during the development of the EMIS database.

14. During the in-country visit, Switzerland submitted a revised time series of CO_2 emission estimates from 1.A.4 Other sectors. The ERT accepted and reviewed the revised estimates. The revised estimate for 2004 is 17,895 Gg CO_2, as compared to the previous estimate of 17,876 Gg (a change of +19.3 Gg (+0.1 per cent)).

4. Uncertainties

15. The Party has provided a tier 1 uncertainty analysis and for key categories a tier 2 analysis, as well as an analysis of total inventory uncertainty (without LULUCF). Regarding the tier 2 uncertainty analysis, no documentation of expert evaluations is presented. According to the tier 1 analysis, the total uncertainty of the inventory has increased slightly to 3.34 per cent on the level assessment and to 2.43 per cent on the trend assessment. According to the tier 2 analysis, the total uncertainty is 3.98 per cent. During the in-country visit, the Party explained that tier 2 uncertainty analyses in key categories will have an effect on the setting of priorities in the inventory improvement plan. The Party is encouraged to extend the uncertainty analysis and to integrate it into inventory planning.

5. Verification and quality assurance/quality control approaches

16. Switzerland has developed a QA/QC plan 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). This includes general QC

procedures (tier 1) as well as source/sink category-specific procedures (tier 2) for key categories and for those individual categories in which significant methodological and/or data revisions have occurred.

17. The Party has submitted a description of the QA/QC system, which was implemented for the 2006 inventory compilation process. It includes tier 1 QC activities and standard operating procedures for quality assessment. The energy and industrial processes sectors as well as CH_4 emissions from the agriculture sector were subject to domestic review. An internal study was conducted on discrepancies between the inventory estimates and those published by the International Energy Agency (IEA) regarding CO_2 emissions from the energy sector. The internal review of the NIR was done by the GHG Inventory Core Group.

18. A detailed description of the QA/QC system is included as an annex to the initial report. This annex explains in detail the responsibilities in the quality management system that are allocated to inventory bodies and the partners in the annual inventory compilation process. Switzerland is considering certification of the quality management system according to ISO standard 9001:2000. Quality policy follows the IPCC good practice guidance (chapter 8) and is based the on the PDCA (Plan – Do – Act – Check) cycle. The Supervisory Board for the national inventory carries out the official scrutiny of the inventory.

6. Follow-up to previous reviews

19. The Party has indicated that the ongoing work on the quality management system will continue. In general the progress made in improving the inventory for the 2006 submission has been so comprehensive and resource-intensive that such major improvements are not expected in the near future. The NIR inventory improvement plan indicates that improvements to the archiving system for documentation will continue, and work on the review of the EF of CO_2 from clinker is in progress. Work on estimating above-ground and below-ground carbon budgets is partly completed.

G. Areas for further improvement

1. Identified by the Party

20. The NIR identifies several areas for improvement. These relate in particular to:

(a) Building on the quality management system;

(b) Improving the archiving system for documentation;

(c) Reviewing the CO_2 EF from clinker;

(d) Completing work on the estimation of above-ground and below-ground carbon stocks.

2. Identified by the ERT

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

(a) Improve transparency by

(i) Referring to the original sources of AD, EFs and methodologies in the NIR, and not to EMIS alone;

(ii) Documenting expert judgement uncertainty estimates in accordance with the IPCC good practice guidance for the uncertainty analysis;

(iii) Filling in tables 9a and 9b (completeness), presenting a clear explanation of the categories that are reported as “IE” and “NE”;

(b) Improve its key category analysis by addressing the LULUCF categories as well, as Switzerland indicated during the in-country visit.

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

II. Energy

A. Sector overview

23. In 2004, the energy sector accounted for 82.5 per cent of the total GHG emissions of Switzerland. Within the sector, CO_2 accounted for 98.5 per cent of total emissions. Total emissions from the sector were 3.9 per cent higher in 2004 than in 1990, mainly due to an increase in emissions from transport. Other sectors (mainly residential) and transport (mainly road transport) were the largest source categories, contributing, respectively, 41.2 and 35.6 per cent to the total GHG emissions of the energy sector.

24. AD for the energy sector are taken from the official Swiss energy balance. Additional procedures using energy-economic modelling and bottom-up data are used to allocate AD to the categorization of the CRF tables. Switzerland uses country-specific calorific values and CO_2 EFs that are considered as constant for the whole inventory time series (1990–2004).

25. The oxidation factor is set to 1 for all fuel types, which is justified in the NIR by the following arguments: (a) almost all solid fuels are mainly used in cement kilns where sufficiently long contact time and high temperatures ensure almost complete oxidation; and (b) as for other liquid and gaseous fuels, the very good condition of Swiss boilers supports good oxidation and prevents the formation of soot. For liquid and gaseous fuels, the assumption of an oxidation factor = 1, which might slightly overestimate emissions, is conservative, because consumption of liquid fuels is stagnating and consumption of gaseous fuels increased substantially over the period 1990–2004.

26. For the energy sector, the 2006 submission is complete and in most cases transparent. Only isolated instances of reduced transparency were identified; these are mentioned below in paragraphs 30 (international bunker fuels) and 38 (non-key categories). To improve time-series consistency from 1990 on, Switzerland has undertaken numerous recalculations during the last three years, including: (a) the separating out of energy sector emissions from Liechtenstein from the Swiss inventory; (b) the reallocation of emissions from waste incineration to the energy sector (1.A.1); (c) the implementation of a higher-tier method to estimate emissions from aviation, making it possible to separate domestic aviation from international bunkers in an exact way; and (d) the allocation of emissions that were previously aggregated in manufacturing industries and construction to the relevant subcategories (1.A.2a–f). Sector-specific QA/QC procedures have improved since the last submission. Examples include a comparison of the results of the old system used to calculate emissions with the figures in the national emissions database (EMIS); an annual comparison of AD using relevant outputs of the Federal Office of Energy; and a peer assessment of the energy sector inventory by an independent company.

27. The analysis undertaken by the Party for 2004 is more disaggregated than the secretariat's analysis, with 21 categories in the energy sector identified as key, while the secretariat's analysis identified 10 categories as key. Switzerland has provided sector-specific uncertainty analysis for CO_2 emissions from fuel combustion; however, the uncertainties of the EFs are not considered in this analysis. The Party is encouraged to improve the documentation of the uncertainty analysis to include EFs.

B. Reference and sectoral approaches

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

28. Switzerland reports CO_2 estimates for the reference approach and the sectoral approach for all years of the inventory time series. For CO_2 emissions and apparent fuel consumption for 2004, the differences reported between the two approaches are 1.2 per cent and 1.7 per cent, respectively. The difference in CO_2 emissions for all years of the time series is less than 2 per cent.

29. For several years of the time series a difference in apparent fuel consumption of up to 8 per cent is observed between the reference approach reported by Switzerland and the IEA figures (the IEA figures always being higher). The IEA explains this difference as being due to (a) the higher calorific values used for the IEA analysis, and (b) the fact that it takes into account liquid fuels in 2004 (other kerosene, naphtha, lubricants, refinery feedstocks and other oils) in the reference approach, while these are not reported by Switzerland. The Party is taking measures to supplement its reference approach by incorporating relevant liquid fuels and to harmonize its reporting for the UNFCCC and the IEA.

2. International bunker fuels

30. A new, higher-tier method presented in the latest submission has improved Switzerland's capacity to differentiate international (air) bunkers from domestic aviation fuel consumption data. This method is based on flight movement statistics and has resulted in a revision of the inventory time series. This advanced method, developed in cooperation with the Federal Office of Civil Aviation, was taken from the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines), where it is called tier 3a. However, these have not yet been approved by the relevant UNFCCC bodies (the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP)). As yet, therefore, this can be considered only a national method, and as such it should be more transparently explained in the NIR. In 2004 the estimated share of international bunker fuel is reported to be 96 per cent of combined international and domestic aviation fuel used, compared to the 97.4 per cent reported in the previous submission for 2003 (April 2005), where the split was based on expert judgement.

3. Feedstocks and non-energy use of fuels

31. Switzerland has not reported in CRF table 1.A(a) apparent consumption (imports, exports and stock change) of fuels that are used as feedstocks; only bitumen is reported as a feedstock in this table. However, naphtha, petroleum feedstocks and lubricants appear in the IEA energy balance for the Party. Switzerland has not implemented a recommendation from the previous (2005) review that it should investigate this issue further, but it has indicated that it intends to report more liquid products in its next (2008) inventory submission.

32. CO_2 emissions from the consumption of natural gas in the process of producing hydrogen from the synthesis of ammonia by steam re-forming are reported under 1.A.2. The Party is recommended to report these emissions in the industrial processes sector (2.B.1) in accordance with the IPCC good practice guidance.

4. Country-specific issues

33. Municipal solid waste (MSW) incineration in subsector 1.A.1a (public energy production) can be considered as a country-specific source because of its dominant share among fuels consumed in subsector 1.A.1a (77.4 per cent in 1990 and 85 per cent in 2004, these figures including special wastes). MSW is an important fuel because landfilling of certain waste is forbidden in Switzerland. The CO_2 EF is based on the following parameters: (a) the fraction of carbon (C) content is based on measurements by the environmental offices of the different cantons and the results were statistically

analysed and documented in the EMIS database (370 kg C/t waste in 1990, and 350 kg C/t waste in 2004); (b) the fraction of fossil carbon is 40 per cent, which is the IPCC default value, and this is constant from 1990 to 2004; and (c) the efficiency of combustion is 0.99 (which is within the range given by the IPCC good practice guidance), and this is also constant from 1990 to 2004. The ERT commends Switzerland for its use of CO_2 EFs that are based on measurements of carbon content of MSW and recommends it to evaluate and present in the NIR relevant statistical parameters (such as standard deviation) that are needed for uncertainty evaluation.

C. Key categories

1. Stationary combustion: liquid fuels – CO_2

34. Most combustion of liquid fuels occurs in the sectors other and manufacturing industries and construction. The ERT commends the approach used by Switzerland to disaggregate liquid fuel consumption in stationary sources into the CRF categorization – by energy-economic modelling, also taking into account bottom-up analysis. This approach is applied consistently for all years in the inventory time series. The net calorific values (NCVs) and the CO_2 EFs are kept constant for all years of the time series for the relevant fuel oils (see the NIR, tables 174 and 175). The Party informed the ERT that these values are based on measurements taken in 1998. The ERT considered the use of constant values to be reasonable as there are only small fluctuations in the chemical composition of fuels in Switzerland. The Party is recommended to repeat such measurements at regular intervals in order to improve the accuracy of the inventory, and to obtain more reliable information on the uncertainties of these parameters.

35. The information concerning the NCVs and the CO_2 EFs that is given in annex A2.2 to the NIR should be presented in a more detailed and transparent way, including the number of analyses for each fuel type and the year in which the analysis was undertaken.

2. Road transport: liquid fuels – CO_2

36. Emissions of CO_2 from road transport are evaluated from energy statistics on the amount of gasoline and diesel oil sold in the country. This is consistent with the IPCC methodology. Moreover, these amounts are verified using equivalent values derived from the bottom-up approach that are based on transport statistics (vehicle stocks, vehicle miles travelled, etc.). The verification process reveals a difference (positive for gasoline and negative for diesel oil) which is explained by the Party as being related to “tank tourism”. Switzerland is encouraged to extend the reporting of the data in table 44 of the NIR for the whole time series, and provide further information to support this explanation of the difference, including an assessment of the uncertainty of the transport statistics parameters.

3. Stationary combustion: gaseous fuels – CO_2

37. During the in-country review, Switzerland submitted revised estimates for 1.A.4 Other sectors for all years of the inventory time series, as an error was identified in the existing calculation procedure regarding CO_2 emissions. This error arose from an assumption that fugitive losses during the transmission and distribution of natural gas should be subtracted from the amount of gas that is combusted, generating CO_2 emissions. Switzerland confirmed that the amount of natural gas combusted is based on end-use metered data, which are not affected by fugitive gas losses. The ERT considered these estimates during the review, and recommends that Switzerland provide in its next inventory submission a description of the revised method and the impact of the recalculation on the emissions time series.

D. Non-key categories

Stationary combustion: all types of fuel – CH_4, N_2O

38. In many instances the NIR describes the CH_4 and N_2O EFs as country-specific, even though during the review the ERT identified them as IPCC or CORINAIR default values. Switzerland is recommended to ensure that the correct attribution of the source of an EF (or method) is reported in the NIR, and that it is always consistent with CRF summary table 3, for all gases.

III. Industrial processes and solvent and other product use

A. Sector overview

39. In 2004, total emissions from the industrial processes sector in Switzerland amounted to 3,051 Gg CO_2 equivalent, accounting for 5.7 per cent of total national emissions. The solvent and other product use sector was responsible for emissions of 236 Gg CO_2 equivalent, contributing 0.4 per cent of total national emissions. Between the base year (1990) and 2004, emissions from the industrial processes sector and the solvent and other product use sector decreased by 6.3 per cent and 49.3 per cent, respectively.

40. CO_2 was the dominant gas in both the industrial processes and the solvent and other product use sectors in 2004, accounting for 65.7 per cent and 78.7 per cent, respectively, of their total emissions. With respect to the 1990 levels, CO_2 emissions decreased by 29.2 per cent in industrial processes and by 47.9 per cent in solvent and other product use. HFCs from the consumption of halocarbons and SF_6 are the second most important gas emitted in the industrial processes sector, accounting for 20.2 per cent of the sectoral total in 2004. The changes in HFC, PFC and SF_6 emissions between 1990 and 2004 are +2,740,367 per cent, –23.4 per cent and +21.9 per cent, respectively.

41. The GHG inventory is complete for all years of the time series. The 2006 NIR and CRF tables are complete, covering all source categories under the industrial processes and solvent and other product use sectors. Uncertainty analysis has been performed using both tier 1 methods (for all sources) and tier 2 methods (for key categories).

42. The CRF and the NIR are not fully consistent where the following are concerned: methods and EFs reported in the NIR as compared to CRF summary table 3; the categories under which some emissions are reported (e.g. the NIR indicates that emissions from asphalt roofing are reported in 2.G Other, while the relevant CRF table indicates that they are reported under 2A.6); and the occurrence and non-occurrence of activity and emissions (e.g. production of ethylene and PVC and emissions from plaster). It is recommended that the Party update the CRF tables and make them fully consistent with the 2006 NIR, and vice versa. Specific AD and EFs are not adequately described in the NIR, and the Party is recommended to improve the transparency of its reporting by including descriptions of industrial processes and technology.

43. Some categories are marked as confidential (“C”) but such data were made available to the ERT during the review for carbine production, foam blowing, aerosol/metred dose inhalers, and solvents. Significant AD and EFs have been collected to estimate emissions of the F-gases. Both actual and potential emissions for F-gases have been calculated.

44. The QA/QC procedure is in place and is currently being implemented using the tier 1 method. Improvements are needed in the analysis of the integrity of AD and EFs from the data suppliers. The Party is recommended to cross-check its data between the EMIS database, the Federal Office for the Environment (FOEN) internal GHG inventory files, the NIR and the CRFs. It is also recommended to undertake a thorough review of its internal documentation and organization of the EMIS database in order to ensure that up-to-date AD, EFs and background information are reported in the NIR and the CRF

tables. A quality assurance plan to check/verify source-specific AD and EFs of key sources should be implemented.

45. Recalculations are reported for all categories and applied for the entire time series (base year to 2003). The recalculations arose from the setting up of the new Swiss national air pollution data base (EMIS) and revisions of some AD and EFs. AD have been revised for lime production; road paving with asphalt; plaster production; nitric acid production; organic chemical production; steel production; and production of other chemicals. A revision of the CO_2 EF for lime production was noted. For synthetic gases, improvements to the consistency of the AD and EFs are reported, with the use of data models and import statistics to apply a tier 2 methodology. In solvent and other product use, recalculations have been carried out to account for indirect CO_2 emissions from non-methane volatile organic compounds (NMVOCs) and CO_2 emissions from post-combustion of NMVOCs. The most notable recalculations in 1990 pertain to N_2O (76.2 per cent) and SF_6 (–19.7 per cent); in 2003 they pertain to CH_4 (–24.1 per cent), N_2O (68.8 per cent), PFCs (35.5 per cent) and SF_6 (14.4 per cent).

46. Seven categories in these sectors were identified as key by the Party for 2004: 2.A.1 Mineral products – cement production (CO_2) for level and trend; 2.C.3 Metal production – Al (PFCs) for trend; 2.C.3 Metal production – Al (CO_2) for trend; 2.F Consumption of halocarbons and SF_6 (PFCs) for trend; 2.F_o Consumption of halocarbons and SF_6 (HFCs) for level and trend; 3 Solvent and other product use (CO_2) for level and trend; and 3 Solvent and other product use (N_2O) for trend. The NIR provides information on the split in category 2.F Consumption of halocarbons and SF_6 (HFCs) for the key category assessment with and without refrigeration and air conditioning. The UNFCCC secretariat reported HFC emissions from 2.F Consumption of halocarbons and SF_6 as one key category on both level and trend analysis, and CO_2 emissions from solvent and other product use as a key category on trend analysis only.

B. Key categories

1. Mineral products: cement production – CO_2

47. In 2004, CO_2 emissions from cement production accounted for 56.2 per cent of the total emissions of the sector and 3.2 per cent of total national emissions (excluding LULUCF). These emissions fell between 1990 and 2004 by 32.1 per cent, mainly due to changes in the production capacities of cement plants. It is considered a key category by both level and trend analysis.

48. Emissions from cement production are calculated using the tier 2 method. The CO_2 EF is 525 kg per tonne of clinker and comes from the World Business Council for Sustainable Development. The Party has considered CO_2 emissions from the decomposition of magnesium carbonate ($MgCO_3$), with the EF calculated based on a lime (CaO) content of 64.2 per cent and a magnesium oxide (MgO) content of 2 per cent. The Party reports in the NIR a plan to use country-specific data on the CaO content of clinker and to account for possible non-carbonate feeds. However, it is not clear when this plan will be implemented.

49. The Party is encouraged to report CO_2 emissions from the blasting operation during the extraction of limestone for cement production under category 2.G Others (industrial processes) separately.

2. Metal production: aluminium – CO_2

50. CO_2 from aluminium production is considered a key category on trend analysis by both the Party and the secretariat. CO_2 emissions decreased by 48.4 per cent between 1990 and 2004 due to a reduction in aluminium production, from 87.0 kt in 1990 to 44.9 kt in 2004.

51. The EF used is country-specific at 1.6 tonne CO_2 per tonne of aluminium used. CO_2 is generated from the oxidation of the anode in the electrolysis process and the calculation is based on the amount of

anode used in the material, which is 0.43 tonne of coke per tonne of aluminium. This EF was provided by Swiss foundries in 1990 and is assumed to be constant up to 2004. It is recommended that the Party verify the validity of the EFs supplied by the plant.

3. Metal production: aluminium – PFCs

52. This category was identified as key on trend analysis by both the Party and the secretariat. This is due to an 88.6 per cent decrease in PFC emissions between 1990 (when they amounted to 100.2 Gg CO_2 eq.) and 2004 (11.4 Gg CO_2 eq.). The decline is due to a decrease in aluminium production and to technical efforts by the aluminium plant to reduce emissions.

53. The Party has used the tier 3b approach of the IPCC good practice guidance. Actual measurements made in 1990, 1999 and 2000 reported EFs in kg per tonne of 0.17, 0.06 and 0.04, respectively, for those three years. This is reported to be lower than the European averages, by factors of 3.9, 4.7 and 5.1, respectively. For other years no measurements have been made; thus, European Union (EU) average EFs have been used, multiplied by a factor of 0.25. Emissions of PFCs are reported to consist of 90 per cent tetrafluoromethane (CF_4) and 10 per cent hexafluoroethane (C_2F_6). The NIR does not make it clear whether the EF was derived using the tier 3b approach. The Party is encouraged to determine and report in the NIR the methodology used and the technologies in place in the EU countries considered.

4. Consumption of halocarbons and SF_6 – HFCs

54. In 2004, HFC emissions from consumption of halocarbons amounted to 617 Gg CO_2, accounting for 20.2 per cent of the total emissions of the industrial processes sector and 1.2 per cent of total national emissions. HFC emissions arise from refrigeration and air conditioning (88.1 per cent), foam blowing (9.3 per cent) and aerosols/metered dose inhalers (2.7 per cent). HFC emissions increased significantly, from 0.02 Gg CO_2 equivalent in 1990 to 617.4 Gg CO_2 equivalent in 2004, due to an increase in consumption of HFCs as ozone depleting substance (ODS) substitutes. In 1990, the only source of HFC emissions was refrigeration and air conditioning. Large-scale substitution by non-ODS started in 1995, leading to an increase in emissions of 403 per cent in 1995 compared with 1994. This category is considered as key on both level and trend analysis. HFC emissions from refrigeration and air conditioning are a key category on both level and trend analysis when they are separated out in category 2.F (see paragraph 46), while those from the remaining HFC sources (2.F.2 to 2.F.6) are a key category only on trend analysis.

55. Potential and actual emissions from category 2.F have been estimated using a model. The model uses a tier 1 approach to determine potential emissions and a tier 2 method to determine actual emissions. AD were obtained from the industry and national (including import and export) statistics. Data from foam blowing, solvents and aerosols/metered dose inhalers are reported as confidential.

5. Consumption of halocarbons and SF_6 – PFCs

56. PFC emissions from consumption of halocarbons and SF_6 are considered a key category on trend analysis by both the Party and the secretariat. This is due to the increase in emissions between 1990 (when they amounted to 0.04 Gg CO_2 eq.) and 2004 (when they amounted to 65.34 Gg CO_2 eq.). The main sources of PFC emissions are refrigeration and air conditioning (5.1 per cent), solvents (80.1 per cent) and aerosols/metered dose inhalers (14.7 per cent).

6. Solvent and other product use – CO_2

57. CO_2 emissions due to solvent and other product use are considered a key category by the Party on both level and trend assessment, while the secretariat considered them a key category by trend assessment only. This category showed a significant decrease in CO_2 emissions, from 357.01 Gg in 1990 to 185.98 Gg in 2004, equivalent to a 47.9 per cent reduction. This was primarily due to

restrictions on the use of volatile organic compounds (VOCs) in Switzerland. The Party introduced a VOC tax in 2000.

58. CO_2 emissions from this sector are from the destruction of NMVOCs in exhaust gases from solvents and other compounds for paint application, degreasing and dry cleaning, chemical products, manufacture and processing and other applications, as required by Swiss regulations. The AD and EFs for NMVOCs emissions are country-specific and are based on data on the consumption of solvents, supplied by the industry, and expert estimation, as documented in the EMIS database. This methodology is consistent with the IPCC good practice guidance and the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines). The CO_2 EFs are based on the average carbon content of NMVOC emissions reported in the Netherlands. The Party is encouraged to use a country-specific carbon content of NMVOC emissions and production-based NMVOC emissions data to estimate CO_2 emissions.

59. The uncertainty of total CO_2 emissions from category 3 is estimated to be 50 per cent based on expert estimation. The Party is encouraged to continually improve the quality of its data on the consumption and production of solvents in order to reduce the uncertainty of the AD.

7. Solvent and other product use – N_2O

60. N_2O emissions from solvent and other product use decreased from 109.41 Gg CO_2 equivalent in 1990 to 50.36 Gg CO_2 equivalent in 2004. This category is considered a key category on trend analysis. These emissions mainly arise from category 3.D Other product use, such as anaesthesia and aerosol cans.

61. The NIR reports that the AD and N_2O EFs used are based on data on the consumption of solvents supplied by industry and expert estimation. The uncertainty of total N_2O emissions from category 3 is estimated to be 80 per cent. The Party is encouraged to use production-based and/or consumption-based AD and EFs as recommended in the Revised 1996 IPCC Guidelines.

C. Non-key categories

1. Ammonia production – CO_2

62. In 2004, from a total ammonia production of 40 kilotonnes, CO_2 emissions from ammonia production amounted to 0.32 Gg. A country-specific approach has been used for calculating these CO_2 emissions by multiplying annual ammonia production with a country-specific EF. The EF is not provided in the NIR but the CRF indicates an implied emission factor (IEF) of 0.008 tonne of CO_2 per tonne of ammonia (NH_3) produced. This is much lower than the suggested range in the Revised 1996 IPCC Guidelines of 1.5–1.6 tonne CO_2 per tonne NH_3. The Party is encouraged to include more information on the source(s) of CO_2 emissions and its country-specific EFs in the NIR.

63. The NIR reports that ammonia production is assumed to be constant from 1990 until 2004. The Party is encouraged to review the AD and check its consistency at the industry level.

2. Nitric acid production – N_2O

64. In 2004, N_2O emissions (of 171.06 Gg CO_2 eq.) from nitric acid production represented the only source of N_2O emissions in the industrial processes sector. A country-specific approach has been used in calculating N_2O emissions by multiplying annual nitric acid production with country-specific EFs. The NIR reports an EF for N_2O of 5 kg/t from 1990 to 2004. This was based on ranges of EF values given in the Revised 1996 IPCC Guidelines for the USA and atmospheric pressure plants in Canada. The NIR is not clear on what technology was used or whether abatement technology has been installed.

65. During the in-country review, the EFs from EMIS were confirmed by the Party to be 0.08 kg/t in 1996 and in 2003, as reported by the industry. It is recommended that the Party verify the data from the

industry and recalculate these N_2O emissions from 1996 to 2004 using the verified EF. The Party is also encouraged to describe the abatement technology installed.

3. Iron and steel production – CO_2

66. CO_2 emissions from iron and steel production amounted to 153.15 Gg in 2004. The Party uses a country-specific approach by multiplying the annual production output of steel by an EF of 0.135 tonne CO_2 per tonne of steel. The CO_2 EF is very low compared to the range provided by the Revised 1996 IPCC Guidelines (1.5–1.6 t CO_2/t steel). The method used is not consistent with the IPCC good practice guidance. The type of production facility and its processes are not described in the NIR.

67. During the in-country review, the Party, referring to EMIS, indicated that the 0.135 tonne CO_2 per tonne of iron and steel is the IEF, not the EF, as the NIR indicates. The low EF is due to the use of high organic contaminants of scrap materials used as feed during steel production, which aids in the reduction process. The Party is encouraged to use the tier 1 method as described in the NIR and to describe how the organic contaminants have affected the EF that is reported.

IV. Agriculture

A. Sector overview

68. In 2004, emissions from the agriculture sector in Switzerland amounted to 5,258.09 Gg CO_2 equivalent, or 9.9 per cent of total national emissions (excluding LULUCF), the agriculture sector being the second most important source of emissions after the energy sector. Over the period 1990–2004, emissions from the sector decreased by 10.9 per cent, mainly due to a decrease of CH_4 and N_2O emissions caused by the reduction of the cattle population and reduced input of mineral fertilizers. GHG emissions from the agriculture sector consisted of CH_4 and N_2O, accounting for 52.8 per cent and 47.2 per cent of the total emissions from the sector, respectively. CH_4 emissions from enteric fermentation were the largest category, followed by N_2O from agricultural soils.

69. All GHGs and sources from the agriculture sector indicated in the Revised 1996 IPCC Guidelines and the IPCC good practice guidance are reported, with the notation keys being correctly used; rice cultivation and prescribed burning of savannas do not occur in Switzerland and are correctly reported as “not occurring” (“NO”). A comprehensive assessment in the form of a nitrogen (N) flow analysis, with a diagram indicating N input to soils, N_2O, nitrogen oxide (NO_X) and NH_3 released to the atmosphere, was conducted for this sector. This approach ensured the completeness of the accounting of emissions in this sector. The geographical coverage of the reporting for the sector is complete.

70. The information included in the CRF additional information tables and documentation boxes improves the transparency of the reporting, but some explanations are not provided. The NIR provides detailed information in a concise way, but some explanations should be added to further enhance transparency. Specific instances are described under each source below.

71. Recalculations have been performed for enteric fermentation, manure management and field burning of agricultural residues for the whole time series. Together they result in a 2.9 per cent (178.9 Gg CO_2 eq.) decrease in the emissions estimate for the sector as a whole in 1990, and a 1.7 per cent (90.0 Gg CO_2 eq.) decrease in the estimate for 2003. Regarding enteric fermentation and manure management, dairy cattle and non-dairy cattle have been split into further subcategories according to Switzerland’s improvement plan and the recommendation of the 2004 review report, and the feed intake data for each disaggregated cattle type have been modified accordingly. CH_4 emissions from field burning of agricultural residues have been recalculated with updated EFs, and N_2O from this source has been reported for the first time in accordance with a recommendation of the 2004 review report. For 2003, the recalculations pertain to CH_4 from enteric fermentation and manure management (they result in a 3.2 per cent decrease when compared to the previous (2005) submission of the CRF for 1990), and to

N_2O from manure management and agricultural soils (resulting in a 0.2 per cent increase compared with the 2005 CRF for 1990). During the in-country visit, the ERT was provided with this information. However, CRF table 8(b) does not provide an explanation of the recalculations. The ERT recommends Switzerland to provide an explanation of the recalculations in the relevant CRF tables.

72. Source-specific QA/QC procedures have been conducted for enteric fermentation and manure management with the help of external experts and the organizations relevant to inventory preparation process. However, for agricultural soils, source-specific QA/QC procedures are only partially applied; there are only internal QC checks. The ERT recommends Switzerland to its improve source-specific QA/QC procedures for all key categories of the agriculture sector.

73. Uncertainty assessment has been conducted and background information is provided subcategory by subcategory. However, the results of the uncertainty analysis do not seem to be used for setting the priorities of the inventory development plan. Switzerland is therefore encouraged to use the results of the uncertainty analysis when establishing the inventory development plan.

74. Switzerland informed the ERT that the estimation process related to nitrogen flow using the IULIA model of the Institut für Umweltschutz und Landwirtschaft is to be reviewed in 2007.

B. Key categories

1. Enteric fermentation – CH_4

75. CH_4 emissions from this category amounted to 2,271 Gg CO_2 equivalent in 2004, representing 43.2 per cent of total emissions from the agriculture sector. The largest source was dairy cattle under 4.A.1 Cattle (option A), accounting for 63.1 per cent of CH_4 emissions from enteric fermentation, followed by breeding cattle 2, accounting for 15.3 per cent. The IPCC tier 2 method has been used for the estimation. Switzerland's detailed livestock classification is designed to reflect country-specific conditions; however, neither the NIR nor the CRF gives a clear explanation of each type of livestock. Emissions from non-dairy cattle, suckler cow calves and milk-fed calves are reported as "IE" and "NO" from 1990 to 1998. The ERT recommends that Switzerland provide an explanation of each livestock category in the NIR and ensure completeness by providing the explanations in CRF table 9(a), especially for its use of the notation keys "IE" and "NO" for non-dairy cattle, suckler cow calves and milk-fed calves.

76. The methods used to establish country-specific EFs are well described in the NIR. AD are taken from national statistics, which are provided by the Swiss Farmers' Union. There are notable differences between the data from national statistics and the data of the Food and Agriculture Organization of the United Nations (FAO). Even though data from national statistics should be accurate, the reason for the differences should be assessed as part of a source-specific QA/QC procedure.
The ERT recommends Switzerland to assess its national AD against the FAO data, in line with the source-specific QA/QC of the IPCC good practice guidance (page 4.22, chapter 4.1.3).

77. Under 10 Other (livestock) in CRF tables 4s1, 4.A and 4.B(a)s1, there are many columns for kinds of livestock. This reporting, with this level of disaggregation, may be a cause of misunderstanding. The ERT recommends Switzerland to reconsider how these very detailed disaggregated data are aggregated to be put into the CRF.

2. Manure management – CH_4 and N_2O

78. Emissions from this category amounted to 891 Gg CO_2 equivalent in 2004, representing 16.9 per cent of total sectoral emissions. Emissions from this source consist of CH_4 and N_2O; they amounted to 494.13 and 396.83 Gg CO_2 equivalent, respectively. In 2004, the largest source of CH_4 was dairy cattle under 4.B.1 Cattle (option A), representing 63.3 per cent of CH_4 emissions from manure

management, and N_2O emissions from solid storage and dry lot contributed 91.0 per cent of N_2O emissions from manure management.

79. An IPCC tier 2 method is used for estimating CH_4 emissions and a country-specific method based on the IULIA model is used for N_2O emissions. Both methods are in line with the IPCC good practice guidance. CH_4 emissions have been recalculated due to an improvement in the livestock classification. The establishment of country-specific EFs is well described in the NIR. The AD are consistent with the AD used for enteric fermentation. Source-specific QA/QC has been conducted; however, the Party has not undertaken a comparison of the country-specific EFs and the IPCC default EFs. The ERT recommends Switzerland to conduct a comparison of the country-specific EFs and the IPCC default EFs as part of its QA/QC procedure and to archive the results.

3. Agricultural soils – N_2O

80. Emissions from this category amounted to 2082.24 Gg CO_2 equivalent in 2004, representing 39.6 per cent of the total emissions of the sector. This source consisted of direct soil emissions, indirect soil emissions, pasture, range and paddock manure, and other (use of sewage sludge as fertilizers). Direct soil emissions in 2004 contributed 58.7 per cent of total emissions from agricultural soils, followed by indirect emissions, contributing 32.6 per cent. Country-specific methods are used and seem to be in line with the IPCC good practice guidance. The estimation is based on relationship diagram based on the IULIA model, which is described in figure 28 of the NIR. The EFs and coefficients are clearly described in the NIR. AD are from national statistics and originate from the Swiss Farmers' Union. In this source category, source-specific QA/QC procedures have been conducted only to a limited extent. The ERT recommends the Party to improve source-specific QA/QC procedures and to perform a comparison of the country-specific EFs and the default IPCC EFs.

81. The ERT identified gaps in the CRF tables. However, in the original calculation process (Switzerland's Excel spreadsheet), such gaps are not found (e.g. $Frac_{NCRO}$ is reported as "not available" ("NA") in the CRF, but in the Party's original calculations figures are given). The ERT presumes that an error of conversion unit occurred when the data were exported to EMIS. The ERT recommends the Party to conduct comparisons (e.g. of units) between EMIS and the result of the original calculation processes as a part of routine QA/QC and to archive the result.

82. N_2O emissions reported under 4.D.4 Other amounted 24.0 Gg CO_2 equivalent in 2004. For the period 1990–1994, they are reported as "IE", but this is not properly explained either in the NIR or in the CRF. The ERT recommends Switzerland to give a clear explanation of the use of the notation key "IE" both in the NIR and in the CRF.

C. Non-key categories

Field burning of agricultural residues – CH_4 and N_2O

83. CH_4 and N_2O emissions from this source are reported. Constant values are reported for the whole time series. The ERT encourages the Party not to report same values for all years but to calculate year by year. However, this may seem to be a low priority because the amount of emissions from this source is small.

84. Switzerland has included crop production in the CRF even though it produces no GHG emissions. This information helps to cast light on the conditions of agriculture in Switzerland. The ERT encourages the Party to continue to report this information in its future submissions.

V. Land use, land-use change and forestry

A. Sector overview

85. In 2004, the LULUCF sector in Switzerland represented a net sink of 821 Gg CO_2 equivalent, offsetting 1.57 per cent of total national GHG emissions. Since 1990, GHG emissions by sources and removals by sinks in LULUCF sector have ranged between 1,869 Gg CO_2 equivalent of net sources (in 2003) and 4,973 Gg CO_2 equivalent of net sinks (in 1999).

86. The CRF for 2004 includes estimates of CO_2 emissions/removals for all six land-use categories in the LULUCF sector, and N_2O emissions from disturbance associated with land-use conversion to cropland, as well as N_2O and CH_4 emissions from wildfire in forests. Carbon stock changes in living biomass, dead organic matter and soils as well as CO_2 emissions from agricultural liming are reported under the relevant categories.

87. Land use and land-use change matrices for 18 land-use/cover types have been established for the inventory years reported, 1990–2004, based on the Swiss Land Use Statistics (AREA) and the Swiss National Forest Inventory (NFI), which has a comprehensive QA/QC system, supported by aerial photographs interpreted stereographically into a 100 m x 100 m grid.

88. For the purposes of the inventory, the land-use/cover categories are further disaggregated into five regions, three altitudinal zones and two soil types. Tier 2 methods in the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) and country-specific EFs are largely used.

89. Except for organic soil in cropland and grassland, the carbon stock changes in dead organic matter and soils are assumed to be zero for land remaining [X] land under all six land-use categories. The organic matter above mineral soil is reported for mineral soils, which is not consistent with the IPCC good practice guidance for LULUCF. The Party does not carry out quantitative uncertainty analysis for categories in the LULUCF sector. The ERT therefore recommends the Party to report organic matter above mineral soil for dead organic matter, and to quantify the uncertainties of the key categories in its future submissions.

B. Key categories

1. Forest land remaining forest land – CO_2

90. The annual net CO_2 removals for forest land remaining forest land in 2004 amounted to 2,285 Gg CO_2. Carbon stock changes in living biomass are transparently estimated and reported for two forest types and three altitudinal zones in five regions. The carbon stock changes in living biomass of unproductive forests are (conservatively) assumed to be zero.

91. The attribution of a conversion period of one year for land converted to forest land is not consistent with the IPCC good practice guidance for LULUCF, which defines the land-use conversion period as 20 years or longer. The Party's current attribution of a conversion period of one year tends to overestimate CO_2 removals for forest land remaining forest land. The ERT recommends the Party to explore further whether the available historical data would support the use of a minimum of 20 years as the conversion period to distinguish the subcategories under forest land.

92. The Party uses a biomass expansion factor (BEF) for stocking to estimate the increment of living biomass. This is not consistent with the IPCC good practice guidance for LULUCF, which defines BEF_1 for increment and BEF_2 for stocking separately. Given that the IPCC default value for BEF_1 is lower than BEF_2, the Party's use of BEF_2 for increment tends to overestimate the increase in carbon stock of living biomass. The ERT therefore recommends the Party either to improve its method or to use the appropriate BEF values in its future submissions.

93. Carbon stock changes in soils and dead organic matter for forest land remaining forest land are assumed to be zero based on the tier 1 method in the IPCC good practice guidance for LULUCF. The ERT acknowledges that carbon stock change in dead wood will be estimated and reported in a future submission. At the same time, the ERT recommends the Party to make efforts to improve its estimates of carbon stock changes in forest soils.

2. Cropland remaining cropland – CO_2

94. Cropland remaining cropland in Switzerland was a net source of 553 Gg CO_2 in 2004. The tier 2 method in the IPCC good practice guidance for LULUCF and country-specific factors are used for calculating carbon emissions from organic soil, but they are not transparently documented in the NIR. Carbon stock changes in both living biomass and mineral soils are assumed to be zero. The ERT therefore recommends Switzerland to estimate and report carbon stock changes in mineral soils for this category and to improve the documentation on this in its next NIR.

3. Land converted to cropland, land converted to grassland and land converted to settlements – CO_2

95. Land converted to cropland, land converted to grassland and land converted to settlements were net sources of 29 Gg CO_2, 336 Gg CO_2 and 299 Gg CO_2, respectively, in 2004. Tier 2 methods in the IPCC good practice guidance for LULUCF and country-specific parameters have been used in these categories. Carbon stock changes in all carbon pools for land converted to three land-cover types and two soil types under grassland, and for land converted to four different land-cover types under settlement, are estimated and reported. The ERT recommends the Party to improve its documentation in the NIR concerning the estimation of carbon stock changes in these categories.

C. Non-key categories

1. Land converted to forest land – CO_2

96. Annual increase and decrease in living biomass are estimated and reported. Carbon stock changes due to land being converted to forest land are conservatively assumed to be zero for all carbon pools. Due to the attribution of a conversion period of one year for land converted to forest land, the AD for land converted to forest land are underestimated. As a result, the CO_2 removals for this category tend to be underestimated.

2. Grassland remaining grassland – CO_2

97. Tier 2 methods in the IPCC good practice guidance for LULUCF and country-specific EFs are used for estimating carbon emissions from organic soil, but they are not transparently documented in the NIR. Carbon stock changes in both living biomass and mineral soils are assumed to be zero. The ERT therefore recommends Switzerland to estimate and report carbon stock changes in living biomass and mineral soils for this category and to improve the documentation in its NIR.

3. Biomass burning – CH_4 and N_2O

98. The country-specific EF for CH_4 emissions from forest fire is much lower than the IPCC default value. The ERT therefore recommends the Party to reconsider this EF in its future submissions.

VI. Waste

A. Sector overview

99. In 2004, the waste sector contributed an estimated 1.4 per cent to the total GHG emissions of Switzerland and 13.4 per cent of total CH_4 emissions. From 1990 to 2004 total emissions from the sector decreased by an estimated 27.7 per cent (285.7 Gg), mainly due to (a) a change in the regulatory framework which establishes that all combustible waste that is not recycled must be incinerated in

appropriate plants from 1 January 2000, and (b) a mandatory law on energy recovery (municipal solid waste incinerators are obliged to use the energy from incineration). As a result, most of the emissions from waste incineration (76 per cent in 2004) are reported in the energy sector.

100. The emission estimates for the sector are complete for the whole time series. Emissions from digestion and composting are reported for the first time in category 6.D Others. Some subsources are not included in the estimates of emissions from waste-water handling (more information is provided in the relevant section below). The following categories are reported as "IE" in the set of CRF tables 6, but the explanation is not provided in CRF table 9a: CH_4 from industrial waste water (included in domestic waste water; and explanation is provided in the NIR); N_2O from industrial waste; and N_2O and CH_4 from incineration of biogenic wastes (included in non-biogenic wastes, as explained during the in-country review). For the sake of transparency, the Party should include the explanation for the allocation of these emissions in the CRF and in the NIR.

101. The methodologies Switzerland applies to both key and non-key categories are generally in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. Descriptions of methodologies used, data sources and some parameters are provided in the NIR, but not in enough detail to enable the ERT to replicate and understand the emission estimates. The general reference for data sources is EMIS and not the original source, which reduces the transparency of the inventory for this sector. During the review, however, all the background documentation and original sources were provided and were checked by the ERT. The ERT strongly recommends Switzerland to provide a more detailed description of the methodologies used, including the assumptions made and the rationale for them, especially for the key categories. It is further recommended that a table be included as an annex to the NIR with data for the most important parameters, the original reference source of each, and an explanation of how they are selected or, if applicable, how they are estimated. More details are provided for each category below.

102. Some minor gaps in the CRF and inconsistencies between the NIR and the CRF relating to the reporting of methods and EFs used were identified for the years 1990 and 2004. These include CO_2 emissions from waste incineration – no information is provided in CRF table summary 3; and CH_4 emissions from solid waste disposal sites (SWDS) – the NIR describes the application of the tier 2 IPCC methodology, while in the CRF a country-specific method is reported. These should be corrected for the Party's next inventory submission.

103. Recalculations have been performed in the waste sector for all subcategories. They resulted in a 50 per cent decrease in estimated emissions for 1990 and a 54.9 per cent decrease for 2003. The explanation is provided in the NIR and in CRF tables 8a and 8b, but some important details that Switzerland provided during the in-country review are not included in the NIR or the CRF: the main reason for the changes for CH_4 emissions from SWDS and N_2O from waste-water handling was a change in the methodologies.

104. Some major improvements have been introduced for this sector: (a) a change of methodology for estimating CH_4 emissions from SWDS (from a country-specific to the IPCC tier 2 method, the first order decay method); (b) the estimation of emissions from composting and digestion in category 6.D; and (c) the correct allocation of emissions from waste incineration with energy recovery to the energy sector.

105. QC checks are in place for AD in the waste sector. A review of the entire sector is planned to be carried out during 2007. After this, it is expected that improvements will be made for selected parameters.

B. Key categories

Solid waste disposal sites – CH_4

106. Emissions from this category amounted to 348.73 Gg in 2004, representing 46.9 per cent of the total emissions of the waste sector. Default IPCC values have been used for the following parameters: the methane correction factor (MCF), the degradable organic carbon fraction (DOC_f), fraction of CH_4 in landfill gas (F) and oxidation factor (OX). The degradable organic carbon (DOC) for the three wastes landfilled (MSW, sewage sludge and construction waste) has been provided only for 2004. The composition of waste, the values for the constant *k* used for the time series and the assumption for the figures used are not provided. All this information is, however, available in EMIS at the FOEN in the background paper *Kehrichtdeponien (landfills), from January 13, 2006* (available only in German). The ERT recommends Switzerland to include the following information, with a reference to the original source, in the NIR (or as an annex to it): (a) the assumptions made and methodology used for estimating parameters such as DOC, *k*, waste composition and historical AD; (b) the values used for waste composition, DOC and *k* by types of waste; (c) waste management practices for the periods before 1990, and for selected years of the time series; and (d) the sources of information on CH_4 recovery (including the part flared).

107. In CRF table 6A (additional information), the reported values of DOC and *k* correspond to MSW, and not to those for construction wastes and sewage sludge. The ERT recommends the Party either to explain in the documentation box what kind of waste the values refer to or to provide weighted average values, if applicable.

C. Non-key categories

1. Waste-water handling – CH_4 N_2O

108. Switzerland uses a tier 1 country-specific method based on CORINAIR to estimate CH_4 emissions from waste-water handling, by multiplying the number of inhabitants connected to waste-water treatment plants by an EF that is country-specific, based on measurements and expert estimates (based on studies carried out in 1993). Emissions from industrial waste water are included in domestic and commercial waste water because most industrial waste water is treated in municipal waste-water treatment plants. Waste water from industrial pre-treatment plants is not included because it is considered negligible (this explanation is not, however, provided in the NIR). Emissions per capita are among the lowest of European countries. The ERT recommends Switzerland to revise the EF used and compare its methodology with those used in countries where conditions are similar, since these emissions could be underestimated. It also recommends that the source for the percentage of the population that is connected to waste-water treatment plants and the EFs be provided in the NIR.

109. The IPCC default methodology for estimating N_2O from human sewage is used to estimate emissions from domestic waste water using default EFs, although this is not clearly explained in the NIR or reported in the corresponding CRF table 6.B. Switzerland should include this information in its next inventory submission.

2. Waste incineration – CO_2, CH_4 and N_2O

110. EFs are provided for 2004, but not for the whole time series. References to documentation to explain their use or the estimation process, as applicable, are not included in the NIR. The IEF for CO_2 decreases constantly and sharply (by 71 per cent since 1990), while the AD go up slightly from 1990 to 2004, but the waste incinerated was mostly biogenic in composition in 2004, since it comes basically from sludge (illegal waste remains constant, while hospital waste is no longer incinerated and cable is no longer recycled). It would be helpful to include the sources of AD or the assumptions used in the Party's next NIR.

VII. Conclusions and recommendations

A. Conclusions

111. Switzerland has made significant improvements since last year's submission, most of them in response to recommendations made during the review of the 2005 inventory submission. Some major improvements include: the ongoing implementation of the EMIS database and the QA/QC and archiving IT system; the separation of emissions from Liechtenstein from the national estimates; the allocation of emissions from waste incinerated for energy purposes to the energy sector; recalculations in all sectors due to updating of methodologies, AD or EFs, as explained in chapter 9 of the NIR; a change in the methodology from tier 1 to tier 2 for CH_4 emissions from solid waste disposal sites.

112. Switzerland has submitted a complete set of CRF tables for the years 1990–2004 and a comprehensive NIR. The inventory covers all categories for the whole period 1990–2004 and it is complete in terms of geographical coverage. The main areas for further improvement are indicated in the recommendations below.

B. Recommendations

113. In the course of the review, the ERT formulated a number of recommendations relating to the completeness and transparency of Switzerland's information presented in the NIR and the inventory submission. The key recommendations[3] are that Switzerland:

(a) Finish implementation of its QA/QC system, including the archiving and documentation system, and pursue ISO 9000 certification, as planned by the Party;

(b) Improve the transparency of the NIR, by referring to the original source of data and not only to the EMIS database; reporting explanations of the use of the notation key "IE" in CRF table 9a; describing all assumptions or estimations made for methodologies and parameters used, especially for key categories; and providing information on recalculations on the corresponding tables 8a and 8b;

(c) Document the use of expert judgement for uncertainty analysis following the IPCC good practice guidance;

(d) Provide a key category analysis including the LULUCF categories for its next inventory submission.

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

Annex

Documents and information used during the review

A. Reference documents

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

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

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

UNFCCC. Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories. FCCC/SBSTA/2004/8. Available at <http://unfccc.int/resource/docs/2004/sbsta/08.pdf>.

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

UNFCCC secretariat. Synthesis and assessment report on the greenhouse gas inventories submitted in 2006. FCCC/WEB/SAI/2006. Available at <http://unfccc.int/resource/docs/webdocs/sai/sa_2006.pdf>.

UNFCCC secretariat. Switzerland: Report of the individual review of the greenhouse gas inventory submitted in the year 2005. FCCC/WEB/ARR/2005/CHE. Available at <http://unfccc.int/resource/docs/2006/arr/che.pdf>.

B. Additional information provided by the Party

Switzerland's responses to questions raised by the ERT before, during and after the in country visit, which was completed on 10 March 2007.

Markus Nauser permitted access to legal documents pertaining to institutional arrangements, including agreements and contracts.

Andreas Schellenberger provided documents and checklists pertaining to the quality management system.

Paul Filliger provided a one-page document on recalculations performed, and highlighted a transcription error in the original pages of the NIR.

Paul Filliger sent by email a notification of a revised estimate concerning the energy sector, and a Microsoft Excel spreadsheet was attached to the notification that included a revised time series of the CO_2 revision for natural gas pipelines.

Paul Filliger sent by email a response to the ERT's request for further information about the notification of the revised estimate.

Andreas Schellenberger sent by email responses to questions raised by the ERT energy expert prior to the review. Responses were also provided for questions raised during the energy session concerning the CO_2 and N_2O EFs for solid waste.

Paul Filliger sent responses to questions raised by the ERT industrial processes expert concerning ammonia production; aluminium production technology; and the VOC tax legislation. The request also sought access to confidential f-gas data, which was granted by the Bundesamt für Umwelt (BAFU)/FOEN.

Official text of the VOC tax <http://www.admin.ch/ch/d/sr/c814_018.html>.

Bundesamt für Umwelt (2006), Abfallstatistik 2004. Berne.

Statistische Erhebungen und Schatzungen, Statistiques et évaluations, 2005.

Ammonia Emissions in Switzerland: Present situation, development, technical and economic assessment of abatement measures, recommendations. Swiss Federal Research Station for Agroecology and Agricultute (FAL), Institute of Environmental Protection and Agriculture (IUL) Liebefeld, CH-3003 Berne, Switzerland, and Swiss Federal Research Station for Agricultural Economics and Engineering (FAT), CH-8356 Tanikon, Switzerland.

Menzi, Harald et al. (1997), Ammoniak-Emissionen in der Schweiz: Ausmass und technische Beurteilung des Reduktionspotentials.

Soliva, C.R. et al. (2006), Report to the attention of IPCC about the data set and calculation method used to estimate methane formation from enteric fermentation of agricultural livestock population and manure management in Swiss agriculture.

Soliva, C.R. et al. (2006), Dokumentation der Berechnungsgrundlage von Methan aus der Verdauung und dem Hofdunger landwirtschaftlicher Nutztiere, *im Auftrag des Bundesamtes für Umwelt* (BAFU).

Schmid, Martin et al. (2000), Emissions de protoxyde d'azote de l'agriculture Suisse, Schriftenreihe der FAL 33.

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Leifeld, Jens et al. (2005), Greenhouse gas emissions from Swiss agriculture since 1990: implications for environmental policies to mitigate global warming. *Environmental Science & Policy* 8 (2005), pp. 410–417.

Agriculture calculation worksheets and background information provided by Mr. Daniel Bretscher.

Bundesamt für Umwelt, Wald und Landschaft (BUWAL) (1996), Luftschadstoff-Emissionen aus naturlichen Quellen in der Schweiz. Schriftenreihe Umwelt Nr. 257, p. 19.

Schmid S., B. Zierl and H. Bugmann (2006), Analyzing the carbon dynamics of central European forests: comparison of Biome-BGC simulations with measurements. *Reg. Environ. Change* 6, pp. 167–180.

Herausgeber Eidgenossische Forschungsanstalt fur Wald, Schnee und Landschaft, WSL, Birmensdorf Bundesamt fur Umwelt, Wald und Landschaft, BUWAL. Schweizerisches Landesforstinventar – Ergebnisse der Zweitaufnahme 1993–1995. Verlag Paul Haupt, Berne.

Brassel P. and H. Lischke (2001), Swiss National Forest Inventory: Methods and Models of the Second Assessment. WSL Swiss Federal Research Institute, CH-8903 Birmensdorf.

Leifeld J., S. Bassin and J. Fuhrer (2005), Carbon stock in Swiss agricultural soils predicted by land-use soil characteristics and altitude. *Agriculture, Ecosystems and Environment* 105, pp. 255–266.

Lauber K. and G. Wagner (1996), *Flora Helvetica*. Verlag Paul Haupt, Berne.

Andreas Schellenberger provided responses to the ERT LULUCF expert on Switzerland's LULUCF definitions.

Richard Volz and Esther Thurig provided photocopies of reference documents concerning plant species heights.

Paul Filliger provided responses to questions raised by the ERT waste expert concerning the CO_2 IEFs for waste incineration, waste-water handling, and the allocation of waste emissions to the energy and agriculture sectors.

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