UNITED NATIONS
NATIONS UNIES

FRAMEWORK CONVENTION ON CLIMATE CHANGE - Secretariat
CONVENTION - CADRE SUR LES CHANGEMENTS CLIMATIQUES - Secrétariat

FCCC/WEB/IRI/2004/CHE 15 December 2004

SWITZERLAND

REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY SUBMITTED IN THE YEAR 2004[1]

EXECUTIVE SUMMARY

1. This report covers the in-country review of the 2004 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 of the Conference of the Parties. The review took place from 13 to 17 September 2004 in Bern, Switzerland, and was conducted by the following team of nominated experts from the roster of experts: Generalist – Mr. Jan Pretel (Czech Republic), Energy – Mr. Leif Hockstad (United States), Industrial Processes – Mr. Mauro Meirelles de O. Santos (Brazil), Agriculture – Ms. Britta Hoem (Norway), Land-use Change and Forestry – Mr. Sergio González (Chile), Waste – Ms. Angelina Madete (Tanzania). Mr. Pretel and Mr. González were the lead reviewers. The review was coordinated by Ms. Rocío Lichte (UNFCCC secretariat).

2. In accordance with the "UNFCCC guidelines for the technical review of greenhouse gas inventories from Annex I Parties" (hereinafter referred to as 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.

3. In the year 2002, the most important greenhouse gas in Switzerland was carbon dioxide (CO_2), contributing 84 per cent to total[2] national greenhouse gas emissions expressed in CO_2 equivalent, followed by methane (CH_4) – 8 per cent, and nitrous oxide (N_2O) – 7 per cent. Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6) taken together contributed 1 per cent of the overall greenhouse gas emissions in the country. HFCs contributed 0.9 per cent, PFCs 0.07 per cent and SF_6 0.35 per cent. By Intergovernmental Panel on Climate Change (IPCC) sector, Energy accounted for 78 per cent of total GHG emissions, followed by Agriculture (10 per cent), Waste (7 per cent) and Industrial Processes (5 per cent).

4. Total greenhouse gas emissions in 2002 amounted to 52,254 Gg CO_2 equivalent and decreased by 1.7 per cent from 1990 to 2002. Tables 1 and 2 provide data on emissions by gas and by sector from 1990 to 2002. Over the period 1990–2002, total CO_2 emissions (without LUCF) decreased by 1.3 per cent, whereas total net CO_2 emissions/removals increased by 2.4 per cent, mainly as a result of reduced removals due to a storm event. CH_4 emissions decreased during the same period by 14.7 per cent, mainly because of a reduction in emissions from enteric fermentation; N_2O emissions decreased by 0.1 per cent over the same period; the increase in the transport sector was compensated by a reduction in emissions from agricultural soils. Emissions of PFCs decreased by 64 per cent, SF_6 emissions increased by almost 4 per cent and emissions of HFCs increased from 0.02 Gg CO_2 equivalent in 1990 to 473 Gg CO_2 equivalent in 2002.

[1] In the symbol for this document, 2004 refers to the year in which the inventory was submitted, and not to the year of publication.
[2] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO_2 equivalent excluding Land-use Change and Forestry, unless otherwise specified.

Table 1. Greenhouse gas emissions by gas, 1990–2002

GHG emissions	Gg CO_2 equivalent													Change from 1990–2002 %
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	
CO_2 (with LUCF)[a]	43,012	44,672	44,406	40,952	40,231	41,026	41,492	40,517	41,886	42,341	43,808	45,182	44,027	2.4
CO_2 (without LUCF)	44,305	46,031	45,849	43,360	42,643	43,401	44,019	43,211	44,508	44,617	43,678	44,752	43,741	-1.3
CH_4	4,988	4,974	4,843	4,826	4,682	4,696	4,638	4,484	4,449	4,433	4,369	4,361	4,258	-14.7
N_2O	3,565	3,635	3,682	3,655	3,653	3,633	3,682	3,622	3,642	3,649	3,668	3,567	3,561	-0.1
HFCs	0.0	0.4	2.9	61.3	80.2	115.3	165.8	206.2	275.6	334.5	376.0	434.7	472.9	2,099,212
PFCs	100.2	84.7	69.3	29.7	17.7	14.7	17.2	23.9	28.5	30.8	68.2	29.6	36.3	-63.8
SF_6	178.3	180.2	182.1	147.8	125.2	102.8	97.5	168.4	155.2	142.5	185.9	213.4	184.7	3.6
Total (with CO_2 from LUCF)	51,844	53,546	53,185	49,671	48,789	49,588	50,093	49,022	50,436	50,931	52,475	53,788	52,539	1.3
Total (without CO_2 from LUCF)	53,137	54,905	54,629	52,079	51,201	51,963	52,620	51,715	53,058	53,207	52,345	53,358	52,254	-1.7

[a] LUCF = Land-use Change and Forestry

Table 2. Greenhouse gas emissions by sector, 1990–2002

GHG source and sink categories	Gg CO_2 equivalent													Change from 1990–2002 %
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	
Energy	40,571	42,764	42,797	40,544	39,717	40,552	41,346	40,698	41,906	41,962	40,758	41,630	40,545	-0.1
Industrial Processes	3,228	2,872	2,704	2,422	2,563	2,440	2,304	2,243	2,314	2,364	2,606	2,688	2,646	-18.0
Solvent Use	108	110	112	114	117	119	119	120	120	121	121	121	123	14.1
Agriculture	6,091	6,099	5,980	5,965	5,809	5,795	5,753	5,530	5,516	5,509	5,500	5,456	5,425	-10.9
LUCF[a]	-1,293	-1,359	-1,443	-2,408	-2,411	-2,375	-2,527	-2,694	-2,622	-2,276	130	430	285	-122.1
Waste	3,140	3,060	3,035	3,033	2,995	3,058	3,097	3,125	3,203	3,250	3,360	3,463	3,515	11.9
Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	na

[a] LUCF = Land-use Change and Forestry

5. Switzerland's national GHG inventory also includes the energy-related emissions produced by its neighbouring country, the Principality of Liechtenstein (32,000 inhabitants, corresponding to 0.44 per cent of the Swiss population). Switzerland and Liechtenstein form a customs and monetary union leading to unrestricted exchange of goods including, for example, fossil fuels. Liechtenstein's emissions will continue to be included in the Swiss GHG inventory for the 2005 submission, but it is expected that as of the 2006 submission they will be excluded from the Swiss inventory for all inventory years.

6. Switzerland has provided a national inventory report covering the years 1990–2002, as well as a nearly complete set of common reporting format tables for the same period, which include data for all required GHGs (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) as well as indirect GHGs – nitrogen oxide (NOx), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs), and sulphur dioxide (SO_2).

7. The overall responsibility for preparing the national inventory report lies with the Swiss Agency for the Environment, Forests and Landscape (SAEFL) as the GHG inventory coordinator. The national inventory report contains information on methodologies, activity data, emission factors and a key source analysis (both level and trend analysis) for the year 2002 and brief explanations of quality assurance/quality control approaches for most sectors. In some cases, however, this information is not sufficient to enable a full understanding of the underlying assumptions and methodological choices, in particular for country-specific approaches, which sometimes made it difficult for the expert review team to reproduce some of the estimates reported in the inventory. Switzerland presented comprehensive and useful information to the expert review team during the review. The inclusion of these explanations and information in the next submission would greatly increase the transparency of the Swiss inventory. Specific examples are provided in the discussion on individual sectors below. Switzerland frequently applies country-specific methodologies and emission factors, mainly because of specific national circumstances, and this effort is welcomed by the expert review team. Further research, better

documentation and verification of the decisions to use such approaches, focusing on how country-specific approaches to reducing uncertainties in the emissions estimates have been developed, are strongly encouraged.

8. Switzerland is building a more complete and transparent inventory, showing progress every year. The Swiss inventory team identified a number of areas for further improvement for each sector of the inventory. A step-by-step implementation plan, as planned by Switzerland, would provide Switzerland with a clear path for improving the inventory. The ongoing Climate Reporting Project (from 2003 up to and including 2006), part of which focuses on the national inventory system, could be a suitable framework for developing and implementing such a plan.

9. The main issues identified in the Swiss inventory are the following:

a) The documentation in the national inventory report, and partly also in the common reporting format tables, of methodologies, emission factors, activity data and underlying assumptions, is not entirely sufficient or transparent. To some extent this limits the transparency of the submission, in particular with regard to country-specific methodologies and emission factors. More information is needed in order to assess their contribution to the accuracy and completeness of the inventory;

b) Except for the fluorinated gases, no quantitative uncertainty estimates have been provided;

c) More detailed explanation of the reasons for recalculations, including quality assurance/quality control procedures before recalculations are started, would be welcomed; and

d) Formal quality assurance/quality control procedures (including a paper copy of the quality assurance/quality control plan) are lacking, and the archiving system is not entirely adequate. This latter is to some extent related to limited human resources.

10. Details on these cross-cutting issues are explained in the sections for each sector below, as are the recommendations for further improvements.

11. Switzerland has made significant improvements since the last inventory submission and submitted a national inventory report for the first time. The structure of the report is very clear and in principle it follows the requirements of the UNFCCC reporting guidelines (some inconsistencies and missing explanations are discussed in the main part of the report). A full set of common reporting format tables for 1990–2002, including recalculations for some years of the time series (1990, 2000 and 2001), also forms part of the submission. A major pending issue is the completion of quantitative uncertainty estimates.

I. OVERVIEW

A. Inventory submission and other sources of information

12. Switzerland submitted a national inventory report (NIR) and an almost complete set of common reporting format (CRF) tables for the years 1990–2002 on 14 April 2004. The CRF data set for 2002 contains data for the entire period in the trend and summary tables.

13. Where needed the expert review team (ERT) also used previous years' submissions, including the recalculated CRF tables for the years 1990, 2000 and 2001, which were reported as part of the 2004 submission.

14. During the review Switzerland provided the ERT with additional information sources. These documents are not part of the inventory submission, but are in many cases referenced in the NIR. The full list of materials used during the review is provided in annex 1 to this report.

B. Key sources

15. Switzerland has reported a key source tier 1 analysis, both level and trend assessment, as part of its 2004 submission. The key source analyses performed by the Party and the secretariat[3] produced similar results. Switzerland has identified 19 key sources, 16 of them on the level assessment, 18 of them on the trend assessment, while the secretariat identified 17 key sources, all of them on the trend assessment and 12 of them on the level assessment.

16. The differences encountered were the following:

a) Switzerland has identified more key sources because it has used a higher level of category disaggregation in the Energy sector; however, in the Industrial Processes and Agriculture sectors Switzerland has used a lower level of disaggregation;

b) Switzerland has identified all key sources that were also identified by secretariat; the only exception is category 2.F.8 Other Sources of SF_6, which was identified as a key source by the secretariat's analysis. This difference could be explained by the generally higher level of aggregation used by Switzerland.

17. The key source analysis is considered by Switzerland to be a critical factor for the preparation of its future submissions. It is used to prioritize the methodological development of the inventory.

C. Cross-cutting topics

Completeness

18. Switzerland has submitted GHG inventories for all required years (1990–2002) using the CRF and the NIR, and provided data for all required greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) as well as indirect GHGs (NOx, CO and NMVOCs) and SO_2, and all major sources and sinks relevant for Switzerland. A few, probably minor, sources are currently not covered, as discussed in the respective sector sections. The geographic coverage is also complete.

19. The Swiss inventory includes most of the required CRF tables; however, some (e.g., 4.C, 4.E, 5.B, 5.C, 5.D) have not been completed. Notation keys are not used entirely consistently across the CRF tables. The ERT encourages the national experts to use the notation keys and documentation boxes appropriately in the next CRF, in a broader manner, which could help to improve the level of transparency and completeness. The specific cases and the correct or incorrect use of notation keys are described in the sector-by-sector analysis below.

Transparency

20. The Swiss NIR adheres to the structure required in the UNFCCC reporting guidelines and includes information on methodologies, activity data (AD), emission factors (EFs) and emission trends, quality assurance/quality control (QA/QC) procedures, uncertainties, and a key source analysis. Nevertheless, in many cases this information is limited in detail and incomplete, which reduces the transparency of the inventory. More information about the methodologies used is needed, in particular in the Agriculture and Land-use Change and Forestry (LUCF) sectors; this would greatly improve the transparency of the inventory.

21. External sources used for estimating country-specific EFs should be better explained and referenced, as the current version of the NIR in some cases does not make it possible for the ERT fully to

[3] The secretariat had identified, for each individual Party, those source categories which are key sources in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC good practice guidance. Key sources according to the tier 1 trend assessment were also identified for those Parties providing a full CRF for the year 1990. Where the Party has performed a key source analysis, the key sources presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key source assessment conducted by the secretariat.

assess the underlying assumptions and the rationale for choices of data, methods and other inventory parameters. There is a lack of explanation regarding the assumptions used in determining country-specific EFs and models. The specific cases are described in the sector-by-sector analysis below.

22. In general, the ERT found that the CRF and the NIR were transparent and consistent. However, in some cases the CRF refers to different values from those referred to in the NIR. In most cases this has been explained as omissions when previous sheets and/or data were copied into explicit CRF tables; this is a good argument for improving the QA/QC procedures which Switzerland intends to include in its National Inventory System, which is in preparation.

Recalculations and time-series consistency

23. Since the 2003 submission, recalculations have been undertaken for the years 1990, 2000 and 2001, and corresponding recalculation tables been completed in the CRF. The major changes include the following source categories: 1A.3a, 1.A.5, 1.A.3a, 2.C, 2.E, 2.F, 4.A, 4.B, 4.D, 4.F, 5.A, 5.D and 6.A. The rationales for these recalculations, which in the opinion of the ERT have contributed to the overall improvement of the inventory, are briefly described in the NIR.

24. The recalculations for 2001 decreased the figures for total emissions by 0.2 per cent. The major changes as compared to the 2003 submission include: an increase in the figures for CO_2 emissions in the LUCF sector by 1,959 Gg CO_2 equivalent (corresponding to a 22 per cent increase); and increases in the figures for CH_4 emissions by 0.2 per cent and for N_2O emissions by 0.1 per cent in the Agriculture sector. Total CO_2 emissions were revised downwards in the Energy sector by 0.1 per cent and in the Waste sector by 0.5 per cent. Similar changes also influenced the emission trends. The ERT encourages the Swiss experts to undertake QA/QC procedures for the basic input data before starting recalculations.

Uncertainties

25. Switzerland has provided qualitative uncertainty estimates in table 7 of the CRF, which are mainly based on expert judgment. The majority of the emissions estimates are assessed as being of high quality (uncertainty ± 5 per cent) – this is the case for CO_2 from energy and industrial processes and CH_4 from enteric fermentation – or of medium quality (uncertainty ± 20 per cent) – for all other sectors and source categories except N_2O from agricultural soils. The estimates for this later source category are assessed as being of low quality (uncertainty ± 50 per cent). The ERT expressed the view that this expert judgment may have overestimated the quality of the estimates for enteric fermentation. No documentation was available to support the figures presented.

26. Quantitative uncertainty estimates have not yet been provided, except for the fluorinated gases (F-gases), for which a Monte Carlo analysis has been performed and quantitative uncertainty estimates been provided. For mobile air conditioning a high quality level (uncertainty 7 per cent) is indicated; the estimates for other source categories are of medium quality (uncertainty between 17 and 35 per cent). Switzerland intends to make substantial improvements for the 2005 submission.

Verification and quality assurance/quality control approaches

27. Switzerland has provided information about QA/QC procedures for almost every sector of the inventory in the NIR. These procedures are not well documented, and are applied as regular internal checks but not necessarily in a systematic way. They are not entirely in line with the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance). A lack of QA/QC procedures for the establishment of national country-specific EFs, based on expert judgement or specific studies, has been identified. This may to some extent also be the reason for some inconsistencies between the NIR and the CRF.

28. Switzerland does not have a written QA/QC plan in place yet. It expressed its intention to implement QA/QC procedures in accordance with the IPCC good practice guidance as a part of the Climate Reporting Project (terminating in 2006), which will focus on the National Inventory System.

Institutional arrangements

29. During the in-country visit, Switzerland explained the institutional arrangements for preparation of the inventory. The SAEFL has overall responsibility for the national inventory. It maintains internal GHG inventory files which contain all the basic data needed to set up the GHG inventory; some of the data are also stored in Switzerland's national air pollution database (EMIS 1995) operated by the SAEFL. In addition, the Swiss Federal Office of Energy (SFOE), the Swiss Federal Office for Agriculture (FOAG) through its Swiss Federal Research Station for Agroecology and Agriculture (FAL), the Federal Office for Civil Aviation (FOCA) and the private companies INFRAS (responsible for drafting NIR text on trends, Transport, LUCF, Agriculture and bunkers issues), Ernst Basler & Partner (responsible for drafting NIR text on stationary combustion, Industrial Processes and Waste) and Carbotech (responsible for data on F-gases) have specific responsibilities in the preparation of the inventory. The external consultancy firms INFRAS and Ernst Basler & Partner under the overall responsibility of the SAEFL compile the various chapters of the NIR.

30. Although the current arrangements allow Switzerland to compile an inventory on time, some improvements of the QA/QC procedures on institutional levels are still needed. The National Inventory System currently under development should include an improved level of institutional communication between the SAEFL and all the other contributors involved.

Record keeping and archiving

31. Switzerland has a centralized but not yet fully systematic archiving system for all documents and information needed for replication of the inventory. Documents and most of the data are archived in the SAEFL on two different servers and at two different places as part of the EMIS database, which has been developed as a central emissions database for all pollutants. EMIS is currently undergoing a complete redesign taking into account the IPCC/UNFCCC coding formats. Some of the background documents and reports are available only in German or French. Some background data and information are available only from cooperating agencies and companies; the ERT recommends a centralized database as part of Switzerland's new National Inventory System.

Follow-up to previous reviews

32. The major improvements in the 2004 submission are recalculations for the years 1990–2001 in the relevant CRF tables. As this is the first time the NIR has been part of the Swiss submission it has been rather difficult for the ERT to evaluate follow-up progress since the previous review (a desk review of the 2001 submission). Nevertheless, Switzerland has undertaken a key source analysis for the first time, improved the transparency of its GHG inventory, implemented the IPCC good practice guidance on uncertainty analysis for part of its inventory (F-gases), and provided basic explanations of some assumptions used for uncertainty analysis. Some qualitative QA/QC procedures are also briefly described in the NIR for some sectors of the inventory. The major pending issues are the consistency and full transparency of the NIR and the provision of quantitative uncertainty estimates.

D. Areas for further improvement

Identified by the Party

33. In its NIR, Switzerland mentions several areas for improvement, including:

a) full redesign of the 1995 EMIS database, which is currently under way; it is being extended to incorporate more data sources, updated and migrated to a new software platform, and will allow automated completion of the GHG inventory in the CRF; and

b) checking and updating of AD and EFs as a part of the QA/QC improvement.

34. During the review Switzerland indicated that its plan for the future includes:

c) Preparation of the National Inventory System as an outcome of the Climate Reporting Project, launched in 2003 (to terminate in 2006);

d) Information on the preparation of an Inventory Development Plan; and

e) Linking the National Inventory System with the national registry system.

Identified by the ERT

35. The ERT identifies the following cross-cutting issues for improvement. Switzerland should:

a) Develop a plan for implementing all the improvements identified as needed, setting annual priorities, time frames and resource allocation, within the framework of the Climate Reporting Project for 2003–2006;

b) Organize all the information and background documentation related to the inventory preparation in a more systematic way to ensure that they are available for the replication of the inventory;

c) Improve the transparency of the national GHG inventory by:

(i) Including more extensive background information and references in the NIR;

(ii) Documenting EFs, AD and underlying assumptions; Switzerland should be especially careful with the use of national methodologies and EFs and ensure that they accurately reflect the national circumstances and improve the accuracy of the inventory;

(iii) Providing reasons for and background data on the recalculations in tables 8(a) and 8(b) and in each sector chapter of the NIR;

(iv) Using notation keys properly and consistently throughout all the CRF tables and making more extensive use of the documentation boxes in the CRF;

d) Provide quantified uncertainty estimates, ensuring that uncertainties established for AD and EFs are well referenced;

e) Provide more precise descriptions of methodologies that differ from those recommended by the IPCC;

f) Improve its QA/QC management system in accordance with the IPCC good practice guidance based on the outcomes of the Climate Reporting Project; it should focus primarily on key sources;

g) Find an appropriate way to split the Swiss GHG inventory and that of Liechtenstein as of the 2006 submission, as the two countries are separate Parties to the UNFCCC.

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

II. ENERGY

A. Sector overview

37. In the year 2002, fuel combustion and fugitive emissions from the Energy sector in Switzerland contributed 40,545 Gg CO_2 equivalent to total national GHG emissions, representing 77.6 per cent of the total national. CO_2 accounted for 97.5 per cent of emissions in the sector in 2002. CH_4 and N_2O emissions accounted for 0.8 per cent and 1.6 per cent, respectively. The largest contributors to emissions from the Energy sector in Switzerland in 2002 were Other Sectors, contributing 43.2 per cent of

emissions from the sector; Transport, contributing 38.9 per cent; and Manufacturing Industries and Construction, with a share of 12.6 per cent. Within these sources, in 2002 emissions from fossil fuel combustion were greatest from Residential and Commercial from Other Sectors, and from Road Transportation from the Transport sector.

38. Between 1990 and 2002, emissions in the Energy sector decreased by 0.6 per cent. The trend has fluctuated across the time series. Emissions from the sector fell from 2001 to 2002 by 1,085 Gg CO_2 equivalent. Most emissions from subsectors decreased, mainly the emissions from the Other Sectors (Commercial/Institutional and Residential).

Completeness

39. The inventory for the 1990–2002 time series includes estimates of most gases and sources of emissions from the Energy sector, as recommended by the *Revised IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC Guidelines). Not included are CH_4 and N_2O emissions from the combustion of fuel by cement plants (see areas for further improvement identified by the Party) and CO_2 emissions from oil refinery fugitives, which are minor gases within each source. Emissions from international marine bunker fuels were not calculated because, as described in the NIR, although there may be some bunker fuel uses on the River Rhine and Lake Geneva, Switzerland believes the emissions to be rather small in comparison to emissions from domestic navigation.

Transparency

40. Switzerland's 2004 NIR details its emission calculations. The ERT has, however, identified a number of issues regarding the overall transparency of the NIR. While all sources are described in the NIR, the levels of explanation vary. The area of greatest transparency in the NIR is the use of the UNFCCC reporting guidelines structure for the NIR and the use of tables to provide specific references for AD and EFs. For some sources, the references are expanded upon and individual source AD and EFs are provided, as well as emissions calculated for a given sub-source. For a few sources, only references are provided for AD and EFs. The ERT recommends a consistent approach in the NIR to providing AD, EFs and emissions calculated.

41. Within the discussion of AD in the NIR, greater efforts should be made to acknowledge which fuel consumption statistics are collected annually and which are interpolations or extrapolations from the previous year's data. For those sources for which AD are interpolated and/or extrapolated in the emission calculations, details should be provided on the method of interpolation and/or extrapolation. Not only would this improve transparency; such a discussion can be helpful in determining the comparative accuracies of certain sources.

42. For EFs, initial efforts have been made in the NIR to provide details on the EFs used in the calculation of emissions (annex 2). Further details should be provided in future submissions on the use of EFs across the time series. In addition, in some of the discussions of methodology the NIR states that a weighted EF was used without providing the EF or the method used to determine it. For the CO_2 EF currently reported in the NIR, the source referenced does not provide sufficient detail as to the carbon content or the heating value of the fuel. The IPCC good practice guidance recommends that sufficient documentation be provided on such details, and the ERT suggests that these details be provided in annex 2.

43. For the majority of sources the NIR provides detailed methodologies as well as tier levels from the IPCC good practice guidance, so transparency is primarily needed in its description of AD and EFs. The Party's use of references for AD and EFs (without tables giving numerical information) does conform to the IPCC good practice guidance requirements for methodological transparency, with the exception of the CO_2 EF mentioned above.

Recalculations and time-series consistency

44. The 2004 NIR provides limited information on the recalculations for the 2002 inventory. Civil aviation emissions were recalculated based on new data for the years 2000 and 2001. (The ERT learned during the in-country review that civil aviation AD always lag behind by a year. This is another instance where the NIR should provide greater transparency about AD sources.) In addition, the Swiss Off-Road

model for the estimation of emissions from off-road activities underwent improvements which resulted in a recalculation of the time series. Continued improvements in the Off-Road model are expected which should continue to improve the accuracy of the estimates, although the precise improvements are not detailed in the NIR. The ERT recommends that the Swiss NIR include an expanded discussion of recalculations in future submissions, if relevant.

45. With regard to time-series consistency, an internal network of spreadsheets from which the Swiss Energy sector emissions are calculated are consistent in their application of methods across the entire time series. The CRF details the use of a consistent oxidation factor for all fuels across the time series. An examination of the time series did show consistent CO_2 implied emission factors (IEFs) for all combusted fuels in Switzerland, with the exception of an inconsistent IEF in the 1994 CRF tables for biomass from commercial/institutional; this is a reporting error which Switzerland intends to correct for its 2005 submission.

46. A noticeable trend within the Energy sector is due to the distribution of emissions to the Manufacturing Industries and Construction and Other Sectors categories. Because of difficulties in the disaggregation of the Swiss national energy statistics, the share of emissions shifts between the two categories in the late 1990s. If the inventory agency could coordinate with the Swiss energy statistics agency to reconcile consumption patterns in earlier years it would help to improve the time-series consistency of fuel consumption in these categories (see areas for further improvement identified by the Party below).

Uncertainties

47. Currently only a qualitative analysis of uncertainty has been conducted for the Energy sector. According to this analysis CO_2 emissions from fossil fuel combustion exhibit "low" uncertainty (5 per cent or less). Some AD are based on limited annual data points, so a quantitative analysis of uncertainty should be conducted to determine the accuracy of the estimates based on these data. In addition, the same CO_2 EF for fossil fuel combustion was applied across the entire time series. While the fuels primarily used in Switzerland are processed homogenous secondary fuels, and are likely to show only small year-to-year variations, a quantitative uncertainty analysis would make it much easier to understand the accuracy of the emissions estimates.

Verification and quality assurance/quality control approaches

48. Currently no systematic approach to QA/QC or verification has been implemented in the Swiss inventory. General checks are made to see if the fossil fuel combustion spreadsheets are properly linked. The implementation of a QA/QC plan in the calculation of emissions from the Energy sector, as well as a plan for the verification of AD provided by outside agencies, is strongly recommended for future inventory submissions. As an example, the differing trend shown for iron and steel combustion emissions and iron and steel process emissions (i.e., emissions in the Energy and Industrial Processes sectors) points to the need for a QA/QC system to ensure the accuracy of the many interpolated and extrapolated AD.

B. Reference and sectoral approaches

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

49. Estimates from the reference and sectoral approach have been presented in the CRF for the entire time series. The two approaches are in good agreement throughout the time series, with the reference approach generally showing a 2 per cent difference in fuel consumption and a 1–2 per cent difference in CO_2 emissions. The energy consumption provided across the time series in the CRF tables matches the trends seen in the official energy statistics of the SFOE.

International bunker fuels

50. Only aviation bunker fuels are reported in the 2004 inventory submission. The NIR states that international marine bunker fuels are probably only consumed on the Rhine River, on Lake Geneva and on Lake of Constance, and provides details on the assumption that domestic navigation accounts for by far the greater part of fuel consumption. This assumption is in compliance with the IPCC good practice guidance.

51. International aviation bunker fuels account for vastly more emissions than civil aviation in Switzerland. The country-specific methodology used for allocating the aviation share is detailed in the NIR. The Swiss FOCA has developed a model which tracks fuel consumption and calculates emissions from all aviation sources within Switzerland's borders (including overflights and outbound and inbound international flights to the Swiss border). As these data do not match the data requirements for the CRF, assumptions must be made. Switzerland being a small country with an extensive rail system, the assumption was made that 99 per cent of aviation in Switzerland is international. Thus, only 1 per cent of aviation fuel consumption is considered to be domestic.

52. As the international aviation bunker fuels' share of emissions is so much greater than that of domestic aviation, the ERT recommends that continued investigations be made into the best way in which to allocate aviation fuels to domestic and international bunker uses. The current method details how the FOCA model is analysed to extract the best data it has calculated, but the determination of international bunker fuel consumption beyond the Swiss borders (on both out-bound and in-bound flights) is not adequately described.

Feedstocks and non-energy use of fuels

53. According to the Swiss petroleum industry association, bitumen is the only non-energy product produced in Switzerland in this subcategory. The default carbon storage factor from the IPCC Guidelines has been applied. Given the good agreement between the reference and sectoral approaches across the entire time series of the inventory, the calculation appears to be correct.

C. Key sources

1.A.4 Other sectors: liquid and gaseous fuels – CO_2

54. For the sub-sources 1.A.4a Commercial/Institutional and 1.A.4b Residential, a top–down tier 2 method is applied based on aggregated fuel consumption data from the SFOE energy statistics (specifically from the SFOE categories of Services and Households). Fuel consumption data for these categories are provided annually by the SFOE. The NIR provides a table of EFs used in the calculation of CO_2, CH_4 and N_2O. It also includes a discussion of how a weighted CO_2 EF was used for light fuel oil in this sector. Non-CO_2 gas EFs were developed using life-cycle analyses of combustion boilers in these sectors, noting the reference document. The estimates provided in the Swiss inventory seem to be accurate and complete for the 1.A.4a and 1.A.4b sub-sources.

55. For the 1.4.4c Agriculture/Forestry sub-source, a tier 3 method has been used with a split between the emissions related to off-road machinery and those related to grass-drying equipment. The off-road emissions make use of the Swiss Off-road model, with fuel consumption based on 1990, 1995 and 2000 data, with other years interpolated or extrapolated within the model. The EFs were developed using an analysis of the engine types used in this source (described in the NIR in the 1.A.5 Other source category). For grass-drying equipment, a 1990 analysis of fuel consumption was used, with AD held constant throughout the time series. Although Agriculture/Forestry is small sub-source of the 1.A.4 Other Sectors source category, the entire source category was determined to be a key source in the Swiss inventory. As a result, it is recommended that AD, if available, should be improved (e.g., to avoid holding grass-drying activity level constant from 1990). Further details could be provided in the NIR on the methods used by the Off-Road model (see 1.A.5 Others below) for the source calculated from it.

1.A.3 Transport: gasoline and diesel – CO_2, gasoline – N_2O

56. Transportation is the second-largest source in the Energy sector. CO_2 from transport diesel and gasoline and N_2O from transport gasoline are key sources. Energy consumption statistics for transportation fuels are collected by the SFOE annually. The trend in Road Transportation (the largest sub-source) has moved towards decreasing gasoline use and higher diesel use, which accounts for the flattening trend in fuel consumption and emissions when compared to the increasing trend in kilometres travelled detailed in the NIR. Switzerland uses a combination of tier 1 top–down methods with tier 2 country-specific methods to calculate emissions.

57. For the sub-source 1.A.3b Road Transportation, a tier 1 top–down method was used based on the annual SFOE transportation fuel statistics and the measured Swiss fuel carbon contents for CO_2 estimates. For non-CO_2 gases, a detailed traffic model developed in Switzerland was used based on surveys of the characteristics of the Swiss fleet (kilometres travelled, vehicle categories, fleet composition, driving behaviour) and EFs developed in a trilateral partnership with Austria and Germany. Both approaches seem to be accurate given the national circumstances. In addition, given Switzerland's multiple borders and small size, a correction has been made to the non-CO_2 gases which improves the accuracy of the emission calculations. Because of fuel price differences, Swiss fuel stations sell gasoline to foreigners. In accordance with the IPCC Guidelines, the fuel purchased has been captured in the national fuel statistics and corresponding CO_2 emission calculations, and allocated to the Swiss emissions total. However, as the non-CO_2 emissions calculations are determined by a model based on kilometres driven by cars within Switzerland, additional emissions must be allocated to the Swiss inventory for these gases. This is done by using the difference in apparent fuel consumption derived by the Swiss model and the actual consumption determined by the national fuel statistics. The sub-source 1.A.3b Road Transportation is by far the most important contributor to the Transport source category (representing 98 per cent of 1.A.3 Transport emissions).

58. The sub-source 1.A.3a Civil Aviation consists of domestic aviation and Swiss military aviation. Military aviation emissions are determined by a tier 1 method based on a bottom-up approach and the flight log books of aircraft; AD are available for 1990, 1995 and 2002. Although some fuel might be consumed abroad (and therefore be an international bunker fuel), the split is uncertain and emissions have been allocated instead to domestic use. For commercial and private domestic aviation, detailed bottom–up fuel consumption and emissions are provided by a FOCA model based on individual aircraft movements in Swiss air space. The FOCA model determines consumption and emissions from civil landing and take-offs (LTOs) and civil cruise. LTO is modelled from Swiss international airports (Basel, Geneva, Zurich) and domestic aerodromes. Civil cruise includes domestic flights, international flights (bunkers) to and from Swiss airports from and to the Swiss border, and overflights within the Swiss borders. The NIR details this information and discusses the method of apportioning these modelled data to the proper IPCC CRF format. This entails removing overflight data, splitting domestic from international bunker consumption, and allocating only outbound international LTO consumption to bunker fuels. The current approach assumes that 99 per cent of flights in Switzerland are international, throughout the time series. As international bunker fuel consumption and emissions far outweigh domestic (in 2002, consumption of 56,442 TJ versus 2,898 TJ), improvements are planned to better estimate total fuel consumption by outbound international Swiss flights. The ERT recommends that Switzerland make efforts to investigate the current discrepancies with the international data. Fuel consumption for domestic flights shown in the CRF is much lower than that shown in the International Energy Agency (IEA) data (the difference is 32 per cent for jet kerosene in 2002). In addition, further details should be provided on the military and civil aviation calculations, which are only discussed briefly in the NIR (and the use of interpolated and extrapolated AD is not apparent).

59. Both the 1.A.3c Railways and the 1.A.3d Navigation sub-sources are calculated using the Swiss Non-Road model. The documentation in the NIR does not fully explain the level of detail employed in the Off-Road model (see 1.A.5 Others below).

1.A.2 Manufacturing industries and construction: solid, liquid and gaseous fuels – CO_2

60. The NIR and CRF tables state that, as a result of the difficulties with the disaggregation of the Swiss fuel statistics discussed above, sub-sources 1.A.2b, 1.A.2c, 1.A.2d, and 1.A.2e (Non-ferrous Metals, Chemicals, Pulp, Paper and Print, and Food Processing, Beverages and Tobacco) are included in 1.A.2f Other. The calculations of this source category combine top–down and bottom–up approaches and are reconciled with the SFOE aggregated fuel consumption statistics for industry.

61. Calculations for sub-source 1.A.2a Iron and Steel are based on the fuel combusted at iron and steel facilities, both coal and gas. The amount of fuel used in the process has been subtracted from the fuel consumption to avoid double counting. The method uses a bottom–up approach for iron and steel, based on AD provided by the industry association (VSM) on fuel consumption in 1990. Data have been

extrapolated by expert estimation from 1995 onwards, but the NIR does not provide further details on this extrapolation. It is recommended that more detail be provided as to the extrapolation procedure in the NIR, especially given the volatility experienced in the Swiss iron and steel industry since 1990. An examination of the time-series emission trend between 1.A.2a Iron and Steel and 2.C.1 Iron and Steel Production shows a consistent upward trend in fossil fuel combustion emissions while the process emissions vary from year to year. This discrepancy should be corrected in future inventory submissions.

62. For the sub-source 1.A.2f Others, bottom–up calculations of fuel consumption by the cement, lime and glass industries have been performed, with top–down calculations of fuel consumption from other manufacturing industries and construction. For those sources which use bottom–up fuel consumption data, those data are reconciled with the top–down estimates provided by the SFOE. Currently, EF profiles for combustion boilers have been applied across all sources, although future investigations may attempt to disaggregate fuel consumption to stationary engines and apply emission profiles as appropriate. This is considered a minor concern given that CH_4 and N_2O emissions in this sub-source are comparatively small and that the emission profiles of boilers and stationary engines are likely to be fairly similar.

63. Emissions from cement production, which have been subsumed under 1.A.2f Others, are calculated using a bottom–up approach and annual production data and AD on fuel consumption provided by the Swiss cement industry (since 1992: assumptions for 1990 and 1991 are listed in internal spreadsheets). The ERT recommends that the Party provide further details on the extrapolations and assumptions used in calculating 1990 and 1991 fuel consumption and emissions. The internal Swiss calculation spreadsheet contains annual cement production, and fuel consumption for heavy fuel oil, natural gas, coal and waste fuels (with specific consumption amounts for wood and sewer sludge). The NIR does not provide a table with the CO_2 EFs used in the calculations, although internal spreadsheets show CO_2 EFs for heavy fuel oil, natural gas and coal similar to those used throughout the Energy sector. Total consumption of waste fuels is known, as are the amounts of wood and sewer sludge used, and the difference when consumption of these fuels is subtracted from total waste combusted is considered to be the consumption of lubricants, waste oils and the like; and a light fuel oil CO_2 EF was applied. CH_4 and N_2O emissions from fuel consumption are not calculated, and it is recommended that they be calculated in future inventory submissions for the sake of completeness. Details should also be provided in the NIR on the use of waste fuels by the cement industry and on what data have been provided by the Swiss cement industry as opposed to being inferred (e.g., the Swiss inventory team assumes that remaining waste fuel use beyond wood and sewer sludge is lubricants, waste oils etc.; although this information has been provided by the Swiss cement industry, it has not yet been included in the inventory completely). Internal spreadsheets indicate the CO_2 EF, which was based on Swiss expert judgment and is the same as the EF for light fuel oil. It is recommended that this waste EF be investigated, as the current EF seems to be low considering the contents of the Swiss waste combusted. Also, as described below (see areas for further improvement identified by the ERT), emissions from consumption of waste fuels in cement production are included in the Waste sector (6.C Waste Incineration), although in this case the incineration of waste is used for energy purposes.

64. Emissions from lime and glass production have been calculated using a bottom–up approach and annual production data and AD on fuel consumption provided in 1995 by the Swiss glass industry. These data have been extrapolated, although no description of the assumptions is provided in the NIR: for example, it is not entirely clear for how many years of the time-series AD had to be based on extrapolation rather than actual data. In the internal spreadsheets, fuel consumption was provided for lime and glass production with cement production. No AD or CO_2 EFs are provided in the NIR, although internal spreadsheets show a CO_2 EF consistent with the rest of the Energy sector.

1.A.1 Energy industries: liquid fuels – CO_2

65. Public electricity and heat generation (that is, energy sold to the public according to the Swiss definition) is primarily from hydroelectric (56 per cent in 2002) and nuclear (40 per cent in 2002) facilities. Emissions from the sub-source 1.A.1b Petroleum Refining were calculated from production data (from the annual report 2002 of the Swiss Petroleum Association) and the split of gas between liquefied petroleum gas (LPG) and heavy fuel oil used in fuel combustion. Emission calculations based on these AD and EFs are

listed in the NIR. Weighted fuel averages were used in the calculations of emissions but, as with many other emission sources, there is no transparent discussion of these calculations in the NIR. Otherwise, the emission calculations from this source seem to be accurate and complete.

1.A.5 Other: liquid fuels – CO_2

66. The Swiss NIR explains that the source category 1.A.5 Other includes off-road emissions from construction (construction vehicles and machinery), hobby activities (household and gardening machinery and motorized equipment), industry (industrial off-road vehicles and machinery), and the military (tanks and similar, but not military aviation). Emissions were calculated using the 2000 Off-Road databank. Non-CO_2 emissions were calculated based on number of vehicles, vehicle-kilometre load factors, engine power and operating hours, all contained within the 2000 Off-Road databank. The AD used in the calculations were provided by modelled results presented in document "Pollutant emissions and fuel consumption of the off-road sector" (title translated from German). The underlying AD were from 1990, 1995, and 2000, with data interpolated and extrapolated in years not modelled, although the NIR does not present this transparently. Although it is only available in German, the 2000 Off-Road databank appears to be a thorough assessment of the characteristics of these sources. The Swiss inventory team indicated that improvements to the model are planned in the near future (see areas for further improvement identified by the Party).

D. Non-key sources

1.B.2 Fugitive emissions from fuels: oil and natural gas – CH_4

67. For this source category, Switzerland has included emissions from refining/storage of oil; emissions from gas pipelines and the single Swiss compressor station; and emissions from the release/combustion of excess gas at oil refineries. For distribution of oil products, AD were reported; however, corresponding emissions were indicated as "not occurring" ("NO"). Emissions from oil refining and storage have been calculated using a tier 1 method and country-specific EFs based on expert opinion. While these are only a very minor source of emissions in Switzerland, the ERT recommends that CO_2 emissions should also be calculated for completeness, using the default IPCC EFs.

68. Emissions of CH_4 from leaks in natural gas pipelines have been estimated using a tier 3 method, based on total gas consumption and the type, pressure, and total length (in kilometres) of transmission pipeline in Switzerland (pipeline data are available for 1990–1993 and 1996, and other years are interpolated). EFs were developed by the Swiss natural gas industry in 1992–1993. According to the NIR, one planned improvement for this source is to include fugitive emissions from a high-pressure natural gas transfer pipeline crossing Switzerland from France to Italy. The ERT recommends that the Swiss inventory account for fugitive emissions from all pipelines within its borders and include this source in the next submission.

69. Emissions from venting and flaring have been calculated on the basis of a tier 1 method and annual production and consumption of oil. Country-specific EFs were derived from industry sources, according to the NIR, but the actual values are not included in the NIR. In the CRF tables, the IEF for flaring of oil is an outlier, and this should be investigated, given the development of country-specific EFs in Switzerland.

E. Areas for further improvement

Identified by the Party

70. Several planned improvements are mentioned in the Swiss NIR. The most significant is the construction of a new EMIS database with updated AD and EFs. The 1995 EMIS database is the foundation for many of the Swiss emission calculations, and this will represent a major upgrade. Plans include the incorporation of more data sources, and then updating and migrating the file to a new software platform. The AD and EFs will also be checked and updated. The planned new EMIS database will allow automated completion of the CRF tables for the Swiss inventory submission.

71. Other planned updates include new estimates of the share of engines and total fuel consumption in the source categories 1.A.1 Energy Industries and 1.A.2 Manufacturing Industries and Construction, as well as the use of different EFs for industrial boilers and engines. In addition, CH_4 and N_2O emissions from the cement industry, currently not reported, will be calculated. Switzerland also hopes to improve the disaggregation of its energy statistics (Swiss global energy statistics) to correct the distortion in the time series between the source categories 1.A.2 Manufacturing Industries and Construction and 1.A.4 Other Sectors (in particular between 1998 and 1999). Switzerland plans to begin a study to disaggregate emissions to the individual sub-sources within 1.A.2b-f (Non-ferrous Metals; Chemicals; Pulp, Paper and Print; Food Processing, Beverages and Tobacco; Other).

72. In source category 1.A.3 Transport, a new modelling of the aviation emissions according to the IPCC instructions is planned. In the off-road Sector (under 1.A.4c Agriculture/Forestry and 1.A.5 Other), including 1.A.3c Railways and 1.A.3d Navigation, revisions are planned in time for the 2005 submission to establish a new model with capabilities similar to the Swiss On-Road traffic model. Similar planned improvements are expected in source category 1.A.4 Other for its off-road sources, which include construction, hobby activities, industry and the military.

Identified by the ERT

73. Currently, Switzerland applies a 100 per cent oxidation factor for fuel combustion sources in the inventory. The most important fossil fuel combustion sources, based on sub-source emission totals, are from road transportation and residential heating, for which processed homogeneous secondary fuels are mostly used. For these sources, a 100 per cent oxidation factor is not illogical and only results in the overestimation of CO_2 emissions (although an uncertainty estimate of this assumption is recommended in the next inventory submission). However, the IPCC Guidelines do not recommend the assumption of 100 per cent oxidation in the combustion of coal. In addition, the fuel consumption trend in Switzerland across the time series indicates a reduction in the use of coal since 1990. The overestimation of CO_2 emissions that will occur as a result of this assumption would therefore have the greatest impact on the estimates of emissions in 1990. The ERT recommends that the Party use the oxidation factor for coal from the IPCC Guidelines for the entire time series in its 2005 inventory submission.

74. In the 2004 inventory submission, Switzerland has included emissions arising from electricity generation by municipal waste combustion in the Waste sector. This is not in accordance with the IPCC good practice guidance, and it is recommended that the emissions be included correctly in the Energy sector (under Other Fuels) in future submissions.

75. Switzerland collects EF data on combustion and industrial emissions through the cantons, primarily for information purposes relating to traditional pollutants. In 1998 and 1999, a thorough carbon content analysis was performed, which forms the basis of the CO_2 EF used throughout the time series. However, the NIR does not provide the proper level of detail on the carbon content analysis, and it is not apparent that applying one CO_2 EF per fuel throughout the entire series produces an accurate result. As Switzerland begins its efforts to quantify uncertainty in its inventory submissions, it is recommended that the application of this CO_2 EF across the whole time series be examined. While Switzerland primarily combusts processed secondary fuels which do not exhibit overt year-on-year variability, the results of an uncertainty analysis on this assumption would provide additional insight into the accuracy of the Swiss CO_2 emission calculations.

III. INDUSTRIAL PROCESSES AND SOLVENT USE

A. Sector overview

76. In the year 2002, the Industrial Processes sector accounted for 5.1 per cent of Switzerland's total CO_2 equivalent emissions, less than in 1990 (when it was 6.1 per cent), while the share of the Solvent and Other Product Use sector grew from 0.20 per cent to 0.23 per cent over the same 13 years. The emissions of the Industrial sector have been dominated by CO_2 emissions from cement production, although its contribution decreased from 78.2 per cent in 1990 to 62.5 per cent in 2002. On the other hand, emissions from ozone depleting substance (ODS) substitutes (sub-sources 2.F.1, 2.F.2, 2.F.3, 2.F.4 and 2.F.5) have increased from

0.07 Gg CO_2 equivalent in 1990 to 546.6 Gg CO_2 equivalent in 2002 (corresponding to a 8,401 times increase), although their share in 2002 was only 1.0 per cent of the total national GHG inventory.

77. According to the NIR, CO_2 emissions from 2.A Mineral Products and 2.F Consumption of halocarbons and SF_6 were identified as key sources according to level assessment. Regarding the trend assessment, besides these two categories, CO_2 and PFC emissions from 2.C Metal Production were also identified as key sources. For the Industrial Processes sector, the ERT encourages Switzerland to use a more detailed category disaggregation for the key source analysis in order to make it easier to identify important sub-sources.

78. For the Industrial Processes and Solvent and Other Product Use sectors, the SAEFL is in charge of gathering the information and completing the CRF tables, with the help of the external consultant Carbotech for the estimation of the synthetic gases. The SAEFL also receives information from national associations, such as Cemsuisse for cement, the Swiss Aluminium Association and others.

Completeness

79. All IPCC source categories and relevant gases have been reported. Some of them do not occur and have been properly assigned using the appropriate notation keys, except in a few cases as explained below (see the section on 2.C.2 Ferroalloys Production). Some subcategories were marked "included elsewhere" ("IE") – emissions from pig iron, sinter and coke, which were included in 2.C.1 Iron and Steel Production; and those from pulp and paper and food and drink, which were included in aggregate form together with emissions from crematoria under 2.G Other.

Transparency

80. The information provided in the NIR allows for an overall understanding of the CRF data. AD for some categories are marked as confidential ("C") but were made available to the ERT during the review for the following sources: 2.B.4 Carbide Production, 2.F.2 Foam Blowing, 2.F.4 Aerosols, 2.F.5 Solvents, 2.F.6 Semiconductor Manufacturing and 2.F.7 Other. These sources, in 2002, were responsible for only 0.4 per cent of total national CO_2 equivalent emissions.

Recalculations and time-series consistency

81. Switzerland has recalculated its CO_2 and PFC emissions from 2.C.3 Aluminium Production and 2.F Production and Consumption of HFC and SF_6 for the whole time series from 1990 to 2001.

82. The major change was for SF_6 emissions in the year 1990, estimates of which were revised upwards by 58.5 per cent. No explanatory information is given in CRF table 8(b). The NIR explains that the change was due to the updating of AD and the extension of the modelling procedures for synthetic gases. Further information provided by the Party explained that SF_6 emissions in sub-source 2.F.7 Electrical Equipment were not reported in the 2003 submission for the period 1990–1994. For this sub-source Switzerland is using in the 2004 submission a new model, on the basis of a mass balance approach, for the 2000 inventory and onwards. For the years prior to 2000 no data are currently available to make it possible to use this model to recalculate the entire time series, and a simple extrapolation was used to link partial information from the main importer. The ERT encourages the Party to undertake an assessment of the possible effect of this methodological change on the consistency of the time series and to consider possible ways of achieving a consistent time series for SF_6 emissions from electrical equipment, if required.

Uncertainties

83. Based on expert judgement, the qualitative assessment of CO_2 emissions from industrial processes is that they are of high quality, and the assessments of all the other gases are of medium quality. The only detailed assessment on uncertainty using Monte Carlo analysis was carried out for the year 2001 on 2.F.1 Refrigeration and Air Conditioning Equipment, which had a 0.8 per cent share in total national CO_2 equivalent emissions in 2002. According to this analysis only mobile air conditioning (36 per cent of the sub-source 2.F.1) had a low uncertainty, of 7 per cent.

Verification and quality assurance/quality control approaches

84. The Party stated that some QA/QC activities recommended by the IPCC had been applied during the process of preparing the NIR and that extended cross-checks between the SAEFL internal GHG files and the CRF had been made. Nevertheless some inconsistencies both within the CRF and between the CRF and the NIR were found. These relate, for example, to different data being reported in the trend tables, as well as reporting of wrong units in the NIR.

85. Although the Party affirmed that most of these inconsistencies have been resolved, the ERT recommends that it improve its cross-checks of the various input materials to the CRF and the NIR in order to enhance coherence in the information and data provided within each submission.

B. Key sources

2.C Mineral production – CO_2

86. This key source is represented almost exclusively by the sub-source 2.C.1 Cement Production, which accounted for 98 per cent of the emissions from the source in 2002.

87. Clinker production decreased by 34 per cent between 1990 and 2002. This was explained by Switzerland as a consequence of the reduction in building activities in the country since then.

88. Although Switzerland states that a tier 2 methodology was used for cement production, regarding calcination, this would imply keeping track of the lime (CaO) content of clinker and possible non-carbonate feeds to kiln. The ERT encourages the Party to conduct research on this. Switzerland has used a country-specific EF taking into account a magnesium oxide (MgO) content in clinker of 2 per cent, following the World Business Council on Sustainable Development default EF. The value of 0.525 kg CO_2/t clinker is higher than the IPCC default (0.510 kg CO_2/t clinker) and is not fully transparent. The ERT recommends the Party to review the assumptions regarding this EF. For non-CO_2 emissions from cement calcination, a country-specific approach was applied.

89. In addition to calcination emissions, small CO_2, NO_x, CO and SO_2 emissions resulting from blasting operations during the working of limestone are included in the estimate of cement production, following a country-specific method based on CORINAIR.

90. AD are obtained from Cemsuisse, which holds the country figures of all plants, and are considered the most suitable data. There is a remarkable difference between these AD for 2002 and the United Nations data for that year, which are 27 per cent higher, and this was not explained during the in-country review due to time constraints. No comparison was available for the other years. The NIR shows a decreasing proportion of clinker in cement, from 94 per cent to 84 per cent over the period 1990–2002. This was reported as different proportions of blended and Portland cement.

2.F Consumption of HFCs and SF_6

91. The F-gases have been properly estimated using the tier 2 methodology for estimation of actual emissions. Potential emissions have also been estimated. Specific models have been used to obtain the EFs, with some IPPC good practice guidance recommended parameters and other reasonable country-specific ones.

92. There are issues of confidentiality with some of the sub-sources because there is only one importer/producer. The ERT was able to view these data during the visit through Excel spreadsheet models, but was not able to examine them in detail because of shortage of time and because they were in German. Some errors in filling in the IEF values in the CRF tables were found, but these did not affect the emissions.

93. The Party has applied updated AD and extended the modelling procedures compared with the 2003 submission, thus improving the accuracy for this source.

94. Switzerland reports the use of SF_6 in sub-source 2.F.5 Solvents as a cleaning solvent for the electronic industry, which is not covered by the IPCC good practice guidance.

2.C Metal production – CO_2

95. This source has two main contributing sub-sources: 2.C.1 Iron and Steel and 2.C.3 Aluminium Production. In both cases country-specific EFs have been used for CO_2, with no further details on how they have been obtained. For Iron and Steel, the IEFs differ between the few countries for which they can be calculated due to the difficulty of separating fuel used for process from fuel used for combustion. For Aluminium, the Swiss IEF is within the range between the two main processes.

96. The source is a key source by trend. Emissions from both sub-sources decreased over the period 1990–2002 (by 25 per cent in the case of Iron and Steel, and by 54 per cent in the case of Aluminium). This could be explained by the slowing down in construction activities in this period. In addition, two aluminium plants closed down in 1993.

2.C Metal production – PFCs

97. This source covers PFCs from aluminium production. It is a key source by trend because of the overall decrease in emissions, which has been caused by both falling AD (by 54 per cent in the period 1990–2002) and a decreasing EF (by 76 per cent over the same period).

98. Emissions are calculated by multiplying annual production by EFs. The EFs for tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6) are addressed in the NIR as part of a tier 3b approach but are not consistent with the IEF shown in the CRF. The Party stated that the EFs reported in the NIR represent medium values for European countries. As for the Swiss EFs, the only Swiss factory has its own measurements for 1990, 1999 and 2000, which demonstrate smaller EFs (by factors of 3.9, 4.7 and 5.1, respectively, for those years). Switzerland has therefore adopted a "general reduction factor" of 4.0 for both gases. This puts the Swiss EFs among the lowest among Annex I Parties. The ERT encourages Switzerland to extend its own measurements for other years in order to revise these EFs.

C. Non-key sources

2.A.2 Lime production – CO_2

99. The question of the relatively low CO_2 EF for this source was addressed in the previous review of the Swiss inventory submission (2001 desk review). Switzerland explained that the CO_2 EF of 0.37 t/t was calculated from the difference between total and combustion emissions, as follows: measurements in 1990 gave an EF for total emissions of a plant of 0.79 t CO_2 /t of lime produced; and the mix of fuels (mainly combustion) used in the process resulted in an EF of 0.42 t CO_2 /t lime produced. This value has been kept constant over time. The nature of the energy mix may introduce large variations in the process emissions relative to non-process emissions. As this procedure can lead to a reasonable underestimation of the process emissions, the Party was encouraged to review this EF and to calculate those emissions instead using the IPCC methodologies and obtaining the energy emissions by difference, but this is still to be done, as the ERT was informed.

100. AD after 1995 have been kept constant using the 1995 value, as a conservative assumption given that construction activities have decreased in the period, because of lack of data. The ERT encourages the Party to update the figures.

2.C.2 Metal production: ferroalloys production – CO_2, CH_4 and N_2O

101. Even though Switzerland reported AD and emission estimates on 2.C.2 Ferroalloys Production in the CRF, the national experts concluded during the in-country visit that it is very likely that ferroalloys production does not occur in Switzerland. The Party recognizes that the AD and emissions on Ferroalloys Production given in the CRF are in fact from the production of non-ferrous metals and that they are only energy-related; therefore they should be included in 1.A.2b, and Data regarding ferroalloys production should have been reported as "IE" (i.e., in the iron and steel production estimate) for the time being. The Party indicated that it will investigate this.

2.C.4 Metal production: – SF_6 used in aluminium and magnesium foundries

102. The NIR states that SF_6 has been used in magnesium foundries since 1995 but emissions are reported only from 1997 on. The Party stated that the information in the NIR is incorrect, and the date should be 1997. As no AD are entered, for reasons of confidentiality, the notation key "C" should be used in the corresponding tables of the CRF.

2.F Consumption of halocarbons and SF_6 – CF_4 and C_3F_8

103. A 90 per cent decrease in CF_4 emissions between 2000 and 2001 in the sub-source 2.F.6 Semiconductor Manufacture was identified by the Party as being due to the large import of CF_4 in 2000 for semiconductors for technology research purposes.

104. For perfluoropropane (C_3F_8), the ratio of potential to actual emissions was below 1 (0.19). This was identified as the result of data for potential emissions from refrigeration having been omitted.

D. Areas for further improvement

Identified by the Party

105. Improvements to the uncertainty estimates following the IPCC good practice guidance are planned for the 2005 submission.

106. Redesign of the EMIS database will give actual figures for many sources which are currently estimated by extrapolation or expert judgement.

107. Part of the documentation that is now only available in German or in French will also be made available in English.

Identified by the ERT

108. The ERT encourages the Party to implement the planned improvements and to take into consideration the specific recommendations made above.

IV. AGRICULTURE

A. Sector overview

109. In the year 2002, emissions from the Agriculture sector represented about 10.3 per cent of total CO_2 equivalent emissions. For 1990, Switzerland's emissions from the Agriculture sector were estimated to be 6,091 Gg CO_2 equivalent. By 2002 they had decreased by about 10.9 per cent to 5,425 Gg CO_2 equivalent. The decreasing trend is explained by a reduction in the animal populations and reduced fertilizer use.

110. Categories 4.A CH_4 from Enteric Fermentation and 4.D Agricultural Soils were identified by Switzerland as key sources for the year 2002. Enteric fermentation contributed 85.9 per cent of the total CH_4 emissions from the Agriculture sector, and agricultural soils contributed 84.0 per cent of the total N_2O emissions from agriculture in 2002. For the identification of its key sources, Switzerland considers the entire Agricultural Soils category without any further disaggregation into sub-sources. Disaggregation of category 4.D for the purpose of key source analysis into the subgroups (1) direct and indirect N_2O emissions from agricultural soils and (2) direct N_2O emissions from animal production would enable the Party to identify the sources that make this category a key source.

Completeness

111. The CRF includes estimates of most gases and sources of emissions from the Agriculture sector, as recommended by the IPCC Guidelines. Not included are emissions of N_2O from the burning of agricultural residues. The Agriculture chapter in the NIR describes all the important sources but does not give enough information about the country-specific methods and EFs used. The ERT encourages the

Party to include more descriptions of the country-specific values in the NIR, especially since many of the background documents referenced are not available in English.

Transparency

112. The information given in the NIR is not transparent enough for the ERT to be able to follow the methodology used or to give the background for the country-specific EFs used. Parts where more information is needed are specified in the following paragraphs under each source category. The ERT encourages the Party to improve the documentation in the NIR for its 2005 submission.

Institutional arrangements

113. The inventory for agriculture is prepared under the auspices of the Swiss Federal Office for Agriculture by the Swiss Federal Research Station for Agroecology and Agriculture (FAL). AD are collected by the Swiss Farmers' Union (SBV), the Swiss Federal Statistical Office (SFSO) and provided to the FAL, which is responsible for the estimation of emissions. However, the chapter in the NIR, including documentation of the methodology used, is prepared by the external consultancy firm INFRAS. This institutional arrangement may present additional challenges with regard to QA/QC activities.

Recalculations and time-series consistency

114. Several recalculations have been made in categories 4.A, 4.B, 4.D and 4.F because of the inclusion of new sources and the updating of AD and EFs. They have been made in a consistent manner over the time series. The recalculations have resulted in higher total agricultural emissions of CH_4 and N_2O since last year's submission, both for 1990 and for 2001.

Uncertainties

115. The uncertainty analyses for the two key sources 4.A Enteric Fermentation and 4.D Agricultural Soils are based on expert judgement. The ERT questioned the estimated low uncertainty given for 4.A, ±5 per cent. The Party responded that the uncertainty of the animal population data was low, but that for the EFs was higher. The uncertainty estimate "low" was based on information in a report published by the SAEFL in 1998. The ERT encourages the Party to incorporate a quantitative uncertainty analysis following the IPCC good practice guidance.

Verification and quality assurance/quality control approaches

116. No source-specific QA/QC activities have been carried out, although an internal quality control is done regularly. Regarding record keeping and archiving, the estimated data are saved twice a day at the FAL and the SAEFL also has a copy of all the calculations. An overview and a manual for the calculations are given in an internal document.

B. Key sources

4.A Enteric fermentation – CH_4

117. Dairy cattle contribute 61.9 per cent and non-dairy cattle 32.5 per cent of the CH_4 emissions from this source category. Although this is a key source, no enhanced livestock characterization was performed for the significant animal species (dairy and non-dairy cattle). The Party has more disaggregated data for animal population but not for the country-specific value for GEI (gross energy intake). The ERT encourages the Party to disaggregate the livestock characteristic more for the significant animal categories dairy and non-dairy cattle, and preferably to try to disaggregate the country-specific values for GEI as well, but if this is not possible then to use the IPCC tier 2 methodology to derive new EFs for the subcategories of livestock.

118. The NIR does not include enough information on the country-specific method used for calculating GEI to allow the ERT to understand the underlying assumptions. However, during the visit, the Party gave the ERT a detailed description of the calculation of GEI, which is based on data for the

fodder demand for every animal group. No description of the method used for estimating the country-specific CH_4 conversion rate for poultry is given in the NIR.

4.D Agricultural soils – N_2O

119. Direct soil emissions contribute 59.3 per cent of the N_2O emissions from this source category, and indirect emissions 33.2 per cent. The emissions from sewage sludge and compost used for fertilizing on agricultural fields are now included in the emissions from synthetic fertilizer in the CRF. The ERT encourages the Party to report these emissions in CRF table 4.D under the category Other and to specify the AD in its 2005 submission.

120. In the NIR (table 73, p. 99) there is some inconsistency regarding the units for the EFs used for calculating emissions from crop residues and nitrogen (N)-fixing crops (kg N_2O-N/kg N for pasture, range and paddock and kg N_2O-N/kg N dry biomass for other crop), which may lead to misunderstanding on the validity of the emissions estimates reported. The Party responded that this would be corrected for its 2005 submission. This does not affect the calculations, which are correct.

121. For emissions of N_2O from cultivation of organic soils, a constant estimation has been used for all years for the area of cultivated organic soils. The same area estimate is used as in the calculations of CO_2 from organic soils in the LUCF sector. The Party responded that the area estimate is an average of estimates based on five different calculation methodologies, where data from different literature sources and digital soil maps were used. At the moment no better estimates are available.

122. For leaching and run-off, the country-specific $Frac_{LEACH}$ value should be referenced, and the method used for deriving it should be described or a reason should be given for the measurement-based estimate of 0.2, which is lower than the default value of 0.3 for this parameter.

123. The ERT encourages the Party to specify more clearly in the NIR which N input values are used as AD for the calculation of indirect emissions of N_2O from leaching and run-off, and how they are consistent with the N amounts used for calculating N_2O direct soil emissions from synthetic fertilizer and manure applied on fields.

124. For deposition, the NIR does not contain enough information on the methodological details. The ERT encourages the Party to specify more clearly in the NIR which ammonia (NH_3) input values are used as AD for calculating indirect emissions of N_2O from deposition to show that they are consistent with the NH_3-N amounts that the N_2O-N amounts have been corrected for when calculating the direct soil emissions of N_2O from synthetic fertilizer use and manure applied on fields, and N_2O emissions from pasture. For transparency, the Party is encouraged to show more clearly in the NIR how the losses of NH_3 from pasture are calculated and taken into account in calculating the N_2O emissions.

125. Values calculated for NH_3 losses from manure storage, synthetic fertilizer, manure applied to fields and pasture that are used for correction of the N amount that ends up as N_2O are not presented in the NIR. The ERT recommends that the values calculated for NH_3 losses, which are used for correction of the N amount that ends up as N_2O, be presented in a table in the NIR in order to enhance the transparency of the inventory.

126. The tables for reporting additional information (fractions used for the estimation of N_2O from agricultural soils) in the CRF are not filled in properly. For $Frac_{BURN}$ and $Frac_{FUEL}$ the notation key "NO" would be more appropriate, given that the corresponding activities do not occur in Switzerland. For some fractions ($Frac_{GRAZ}$, $Frac_{NCRB}$F, $Frac_{NCRO}$ and $Frac_{R}$) mean values can be given. The ERT recommends that the information that is currently given in table 4.F of the CRF about ratios of N in crop residues and dry matter fraction in different crop residues be given instead in a table in the NIR in the 2005 submission.

C. Non-key sources

4.B Manure management – CH_4

127. The NIR does not include enough information regarding the method used for calculating the country-specific values for volatile solids (VS) for the different animal groups. The ERT encourages the Party to document this better in its 2005 submission.

4.B Manure management – N_2O

128. The ERT questioned whether the Party considers that "liquid system" and "solid storage and dry lot" covered all the manure management systems used in Switzerland. In the NIR (p. 93) there is a comment that "other manure management systems" are "not considered". The same distributions are used for all years. The Party answered that all manure management systems used are covered. The ERT recommends that for transparency the NIR should mention on what basis the distribution between the management systems has been made (survey or expert judgement). A report by the FAL (FAL 1997, p. 34) states that the distribution is based on results from a survey for dairy cows and expert judgement. The ERT encourages the Party to improve the documentation in its 2005 submission.

129. The use for AD of "animal places" instead of "number of animals", without explaining the meaning of "animal places" in the NIR, produces the impression of an inconsistency in the AD used in table 4.B(b), compared with tables 4.A and 4.B(a). The ERT encourages the Party to explain the methodology used for calculating animal places in the NIR, so that it becomes clear that it is only one single livestock characteristic, and that the same number of animals is being used in 4.B(b) as in 4.A and 4.B(a).

4.F Field burning of agricultural residues – CH_4 and N_2O

130. Burning of branches in agriculture and forestry is included in this emission source category. For calculating emissions from the burning of branches CORINAIR default EFs are used, but no EF for N_2O is provided, although the IPCC provides a default value. In the CRF emissions of N_2O are entered as "NO", which is incorrect. The AD are from 1995, and the same value is used for every year. The ERT encourages the Party to use the IPCC methodology (IPCC Guidelines, pp. 4.83–4.84) for calculating the EF for this emission source and to establish annual AD.

Other non-key sources

131. In the CRF tables for 4.C Rice Cultivation and 4.E Prescribed Burning of Savannas the notation key "NO" should be used, since these sources do not occur in Switzerland.

D. Areas for further improvement

Identified by the Party

132. The Party plans to verify the AD and EF for the burning of branches (source category 4.F) in connection with the reconstruction of the EMIS database. A study on nitrogen mass flows in soils is ongoing at the Institute for Applied Agriculture in Zollikofen.

Identified by the ERT

133. The main recommendation for future improvements is that the Party should improve the documentation in the NIR for the 2005 submission. Source category-specific recommendations for further improvements are given earlier in this section under each emission source category.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

134. In the year 2002, the LUCF sector constituted a net source of CO_2 emissions, with net CO_2 emissions of 285.4 Gg CO_2. These net emissions result from a balance of emissions and removals from

5.A Changes in Forest and Other Woody Biomass Stocks, which constitutes a net sink of CO_2, and emissions from 5.D CO_2 Emissions and Removals from Soils, for which only emissions were reported. Adding the net CO_2 emissions of the LUCF sector to the total national inventory increases the total GHG emissions by 0.55 per cent. While highly fluctuating annual net emissions/removals are reported under 5.A for the period 1990–2002, ranging from removals of 3,287 Gg CO_2 in 1997 to removals of 163 Gg CO_2 in 2001, emissions from 5.D are reported unchanged during the time series. Inter-annual changes in net removals from sector 5.A are strongly influenced by the "Vivian" and "Lothar" storms (in February 1990 and December 1999, respectively) which affected forest stock significantly. Non-CO_2 gas emissions from burning of forestry branches not due to forest conversion are reported under Agriculture.

135. One important issue for this sector was the change from a net sink during the period 1990–1999 to a net source of emissions from 2000 onwards, which is explained by the occurrence of the "Lothar" storm in 1999. Since the annual figures are three-year averages, the effect of the storm on biomass is also reflected in the figures for the years following the storm.

Institutional arrangements

136. The LUCF inventory is prepared by the SAEFL on the basis of data provided by the Swiss Federal Forest, Snow and Landscape Research Institute (WSL), which delivers background data based on the National Forest Inventory (NFI), for forests; by the FAL for soils; and by the SAEFL for burning of biomass. Internally, the SAEFL distributes the tasks for preparing the inventory and producing the CRF tables, and delivers the information to the external authors of the NIR (INFRAS) for inclusion in the NIR.

137. According to information provided during the review, Switzerland considers that there is a need to define the institutional arrangements and responsibilities for collecting AD on land-use changes.

Completeness

138. The CRF only includes estimates of CO_2 emissions and removals from 5.A Changes in Forest and Other Woody Biomass Stocks and partially from 5.D CO_2 Emissions from Agricultural Soils. CO_2 estimates from 5.A integrate those effects of land-use changes concerning forests, such as forestry conversion and conversion from cropland or grassland to forests, as they are not accounted separately. Emissions of non-CO_2 gases from biomass burning, except for N_2O emissions, are accounted under the Agriculture sector, although no AD are provided for agricultural and forestry residues burned. CO_2 emissions and removals from liming of agricultural and forest soils are not estimated because of lack of AD. The NIR (chapter 7) is not complete as not enough information is provided on how annual changes in forest area from annual forest statistics are combined with NFI data, or the process followed to estimate cultivated organic soil area. The ERT recommends the Party to include this information in its future submissions.

Transparency

139. The information provided in the NIR on forest AD is not enough to allow the ERT to understand the underlying assumptions and to follow the estimation process through. This mainly concerns the sources of AD for forest area, the methodological approach applied to build up the NFI (plots, field measurements, others) and the methodological approach to estimating the area covered by cultivated organic soils. Nevertheless, the ERT received very detailed explanations on these issues during the in-country review. The ERT recommends the Party to improve the transparency of the NIR, incorporating more detailed information on these topics and referencing all the methodological issues.

Recalculations and time-series consistency

140. Recalculation is reported in this submission because of changes in the values for gross annual growth rate of timber in managed forest (for temperate evergreen, from 5.01 to 4.47 Mg dm/ha; for temperate deciduous, from 7.33 to 6.48 Mg dm/ha); for 2001, these changes resulted in a decrease of 89.3 per cent in the CO_2 net sink from 5.A Changes in Forest and Other Woody Biomass Stocks. The time series is consistent because the EFs were applied consistently every year.

Uncertainties

141. In both categories reported (5.A and 5.D) uncertainties have been qualitatively assessed by expert judgement. For 5.A statistical differences between NFI and Forest Statistics in the AD are given quantitatively in the NIR. The ERT encourages the Party to incorporate quantitative estimates of uncertainties.

Verification and quality assurance/quality control approaches

142. No formal QA/QC procedures have been adopted. Cross-checks are performed at 10-year intervals between two consecutive NFIs and the stocked area is checked annually in the process of compiling the annual forest statistics. No specific QA/QC has been carried out for the cultivated organic soil area.

143. Some minor inconstancies were detected in the CRF tables in regard to the use of notation keys and lack of AD in table 5.D for cultivated organic soils.

B. Sink and source categories

5.A Changes in forest and other woody biomass stocks – CO_2 emissions and removals

144. Switzerland has applied a country-specific method (including country-specific EFs) to estimate CO_2 emissions and removals from the temperate forest area, disaggregated into deciduous and evergreen forests (30 and 70 per cent, respectively, for 2002). The ERT concluded that this methodology, based on an NFI supported by direct field measurements, is appropriate to the country and conducive to accurate estimation of emissions and removals, but also considered that the Party would be in a position to disaggregate the information that it collects to capture annual land use changes (defined as mean changes from observing periods which are separated by several years) and allocate these data under 5.B Forest and Grassland Conversion and 5.C Abandonment of Land.

145. Documentation and detailed and transparent information were provided during the in-country review, and this allowed the ERT to gain a clear idea of how the inventory related to sector 5.A was produced and the problems that the national team are facing in the effort to build up AD and EFs. The AD were taken from the NFI complemented by the annual forest statistics to estimate annual changes in the forest area. Gross annual growth of timber from deciduous and evergreen temperate forests was estimated using models fed by field measurements from 70,000 trees in 6,000 plots and photographic interpretation of 160,000 plots (500m x 500m grid). The national team has to face the problem of having three main sources of AD which do not match completely because their definitions of forest differ.

146. The application of this country-specific methodology produces an integrated value for the forest area, which does not allow disaggregation into categories 5.A, 5.B and 5.C. Because of a forest protection law, conversion of forests must be minor or negligible. Nevertheless, the ERT estimates that the methodological approach and the available AD would allow the Party to produce more disaggregated estimates of CO_2 emissions/removals, with results that would fit better with the IPCC categories for LUCF.

147. New gross annual growth of timber for both types of temperate forest existing in the country have been estimated for the 2004 submission and used consistently across the whole time series. The values are significantly lower than those applied in previous submissions but are still among the highest values reported by Annex I Parties for the same forest types particularly for deciduous trees.

148. Non-forest trees are not reported but the ERT estimates that the Party has enough AD to incorporate the annual net increase from orchard trees in the LUCF inventory. The AD for annual forestry biomass residues are taken from EMIS but need to be validated.

5.D CO_2 emissions/removals from soils – CO_2 emissions

149. Only CO_2 emissions from cultivated organic soils are estimated under category 5.D. Removals are reported as “not estimated” (“NE”). According to information provided by the national team, no AD

are available for lime application to soils or CO_2 emissions from agricultural and forest soils. The ERT recognizes the efforts the Party has made to include this sub-source category and encourages the Party to keep incorporating emission/removal sources that were previously not estimated.

150. Neither AD nor EFs are reported in table 5.D of the CRF. Switzerland does not have direct spatial data available for managed organic soils (only for protected histosols according to the Swiss peat land inventory). The AD were estimated using five different approaches. The CO_2 emissions estimates include two sources of error: area estimated and flux estimate (no own flux measurements are available, but peat subsidence rates have been measured). The peat decay rate is based on data taken from the literature, ranging from 7.34 to 11.68 t CO_2-C ha^{-1} yr^{-1}, with a mean value of 9.52 t CO_2-C ha^{-1} yr^{-1}.

151. As far as the ERT was able to assess, the methodology seems to be appropriate but the high uncertainty of the AD and the EFs should be improved in order to provide more reliable and accurate estimates of CO_2 emissions.

C. Areas for further improvement

Identified by the Party

152. The ERT received the information that the national team is studying new methods to estimate above-ground and below-ground carbon budgets in forest area with the help of recalibrating the Finnish soil model (YASSO), and validation of carbon budgets with the help of other models (EFISCEN, SILVA, BIOME-BGC); it is expected that these improvements will be ready by 2006.

153. The ERT was also informed of the efforts of the national forest team to reduce the uncertainties associated with the AD related to process in disturbed soils, the decomposition rates of litter components and the estimation of initial carbon content in soils.

154. The national team informed the ERT of a current research project for an experimental calibration of soil organic carbon (SOC) pools in soil organic matter (SOM) turnover models (or fitting pools to experimental data) in order to enable initialization of SOM models for particular sites and to use models for land-use change scenarios in agriculture.

Identified by the ERT

155. One of the areas for further improvement is the need for quantitative estimates of uncertainties for each sub-source category. The ERT recognizes the efforts being made (mentioned in para. 141 above) and encourages the Party to extend them to cover the entire LUCF sector.

156. The ERT encourages the Party to develop and adopt formal QA/QC procedures for verification and validation of AD.

157. The ERT considers that accounting for land-use changes would be possible for the Party with probably only minor additional effort and encourages the Party to pursue this in the interest of closer conformity with the IPCC Guidelines.

158. There are two areas of institutional arrangements that the ERT considers need some minor improvements: (1) establishing arrangements that enable the provision of data on land-use changes on an annual basis (defined as mean changes from observing periods which are separated by several years), and (2) improving the flow of information needed for completion of the CRF tables and compilation of the NIR. With regard to this last issue, the ERT considers that the NIR is of good quality but that additional information, mainly on methodological issues (the processes by which the NFI is compiled, for example), needs to be included in the NIR for a fully transparent submission.

VI. WASTE

A. Sector overview

159. In the year 2002, the Waste sector emitted a total of 3,515 Gg of GHG, which is equivalent to 6.7 per cent of all emissions from this country. It accounted for 23.4 per cent of total CH_4 emissions and 5.2 per cent of total CO_2 emissions in 2002. Within the sector, 68 per cent of emissions stems from waste incineration (the greater part being CO_2 emissions), and 30.4 per cent is from managed solid waste disposal on land (mainly CH_4 emissions), while 1.6 per cent comes from waste-water treatment plants (the major part being N_2O emissions). From 1990 to 2002 total GHG emissions from the Waste sector showed an increasing trend caused by rising emissions of CO_2 and N_2O, while CH_4 emissions showed a decreasing trend. During this period the amount of solid waste disposed to managed solid waste disposal sites (SWDS) was reduced from 1,172 Gg to 98.6 Gg per year (according to information provided in the NIR), which corresponds to a 91.6 per cent reduction. The amount of waste incinerated for purposes of energy recovery in both private and public incineration facilities increased from 3,025 Gg to 3,701 Gg; this is a 22.3 per cent increase.

160. The existing national regulations prohibit the disposal of combustible waste on landfill. These restrictions, coupled with the adoption of waste management strategies, have played a major role in reducing the amount of waste going into managed SWDS. In addition, in 2000 Switzerland adopted a CO_2 law which, among other things, sets national targets for the reduction of CO_2 emissions from fossil fuel combustion. This has influenced the allocation of waste incineration CO_2 emissions in the CRF tables: they have now been reported under the Waste sector instead of under the Energy sector, as recommended in the IPCC good practice guidance.

161. Most of the information given in the NIR is based on reliable information sources on waste at the SAEFL. These include CORINAIR, the EMIS database on waste and studies on waste carried out by the SAEFL in 1995, 2001 and 2003. The calculations of GHG emissions are based on country-specific methodologies and emissions parameters. The methodologies are tier 2 for solid waste, tier 1 for waste water and tier 2 for waste incineration.

Completeness

162. The CRF includes estimates of all gases and most sources from the Waste sector, as recommended by the IPCC Guidelines. Not included are other sources of CH_4 under 6.A, such as composting, and other sources of N_2O and CH_4 under 6.B, such as on-site waste-water treatment for commercial sources and industrial waste water. For some of the incinerated waste AD are roughly estimated, for example, amounts of clinical waste, construction waste, hazardous waste and insulation materials used for cables. Switzerland plans to improve its database on waste by covering sources that are not included in the inventory. Some of the missing data need to be sourced from industries and individual households and commercial establishments. The Party is encouraged to implement the improvements it plans in order to be able to cover all sources comprehensively in its 2005 submission.

163. Other gaps emerge in the information in the CRF tables. In some cases notation keys are not used or not used appropriately, thus leaving unexplained information gaps in the CRF, although information is provided in the NIR. For example, some of the information required in table 6.A (e.g., methane correction factor (MCF), degradable organic carbon (DOC) degraded) and for CH_4, CO_2 and N_2O in table 6.C is not entered in the CRF but is provided in the NIR. Furthermore, the various fractions (fraction of municipal solid waste (MSW) disposed on land, fraction of waste incinerated and fraction of waste recycled) given as additional information to table 6.A do not add up to 1. In table 6.B of the 2002 CRF, the N_2O IEF is shown as 0.00. The IEF values in tables 6.B and 6.C are not indicated, although EF values are provided in the NIR.

Transparency

164. The NIR does not provide adequate basic information about the existing model used in the calculation of CH_4 from managed solid waste disposed on land. Moreover, the assumptions made, basic calculation methods and parameters used are not provided. The existing model follows a kinetic approach,

which is different from the one recommended by the IPCC Guidelines. The Party has clearly stated its intention to redesign the existing model, which has many inconsistencies and faults. Because the revision of the existing model is already ongoing and will be implemented in time for the next submission, the existing model was not examined in detail during the in-country review. On waste water and waste incineration, the NIR does not elaborate on how the country-specific EFs for all the gases have been derived, including the main assumptions made, the type of facilities available and how they operate, and existing management practices. AD on some of the waste being incinerated are only roughly estimated (e.g., amounts of clinical, construction and hazardous wastes and insulation materials used for cables), and the assumptions made to arrive at these figures are not explained in the NIR. These gaps made review work difficult as the ERT had to rely on presentations made by the Party in which this information was also not fully revealed. The Party plans to improve its database on waste by covering sources that are not incorporated in the NIR. These plans if given due priority will fill gaps in all subsectors and improve understanding of the Party's calculation models. The Party is encouraged to implement the planned improvements.

Recalculations and time-series consistency

165. The NIR (chapter 9) states that a recalculation was done on CO_2 for category 6.A Solid Waste Disposal on Land because an EF for burning of CH_4 on landfills was updated. The changes did not significantly affect the emissions trends of this gas. It is not clear whether the EF changed was for CH_4 flared or open burning of waste in landfills (a practice no longer allowed under the current regulations). The NIR does not mention whether recalculation was required by previous reviews. The time series is consistent according to the reporting requirements.

Uncertainties

166. The qualitative assessment of uncertainties ranks the uncertainties for emissions from the Waste sector as medium. No quantitative assessment has been done. Since the Party is using methods of higher tiers than the default in all of the calculations of GHG emissions, a thorough assessment of the uncertainties is highly recommended, to begin with the Waste sector because of its high uncertainty due to the varying reliability of the AD.

Verification and quality assurance/quality control approaches

167. At present there is no well-established verification or QC/QA system. Until the system is implemented the Party is encouraged to establish an effective mechanism for verification in the Waste sector from the point of data gathering, the operation of the waste management facilities and management practices, the calculation models in place and the emissions data. This will improve the quality of the NIR and make it possible to take into account specialized knowledge in waste management outside the regulatory institutions.

B. Key sources

Solid waste disposal on land – CH_4

168. Solid waste disposal on land has been identified as a key source by both level and trend assessment. It is noted that the AD for the period 1992–2002 are actual figures of waste generated in the country, while for the years 1990 and 1991 they are estimates because no records could be retrieved. Since AD are available and reliable, Switzerland opted to use a country-specific methodology. The use of country-specific methods is recommended by the IPCC good practice guidance, but the existing methodology is based on a kinetic approach which is contrary to the first-order decay (FOD) method recommended by the IPCC Guidelines. Whereas the kinetic approach assumes that CH_4 emissions for a given amount of waste increase with time, the FOD approach is the opposite. Hence the two are not comparable. Notably, the kinetics model does not comprehensively take account of degradation processes; hence parameters such as generation rate constant, half life, MCF, DOC and degradable organic carbon assimilated (DOCf) are not applicable. The IEF for CH_4 in 2002 is 0.5, which seemed rather high compared to the IEFs from other Parties. It was explained that this may be attributable to the effects of a kinetic approach which results in an increased CH_4

emission rate over time. Switzerland indicated that it will investigate this further. In addition, the existing model factors in the open burning of waste as a means of reducing waste before it undergoes anaerobic decomposition – a practice which is no longer permitted.

169. The NIR does not provide any information on whether or not CH_4 gas which is recovered for energy generation and flaring is metered. Eleven out of 52 SWDS have CH_4 recovery systems for co-generation. However, it is assumed that the amounts recovered are small and hence do not necessitate quantification. The IPCC good practice guidance encourages the installation of meters to gauge recovered gas and documentation of the data. For purposes of reporting in the NIR, the amount of CH_4 recovered for co-generation is calculated from energy generated. The IPCC good practice guidance encourages Parties to establish an inventory of recovery systems. This measure can not only help the authorities to know the amounts of CH_4 generated but will also enable them to monitor the efficiency of the systems and provide the necessary guidance when needed.

170. The NIR does not provide information on solid waste recycling activities, although in CRF table 6.A the fraction of recycled MSW is given as 0.25. Information on types of waste recycled, quantities and plans needs to be provided in the NIR and reflected in CRF table 6.A in the subsector Other Waste. During the visit the Party informed the ERT that recycling of various kinds of MSW exists, namely, organic waste (composting), plastics, construction materials (particularly wood), aluminium cans and waste paper. Further, the Party informed the ERT that data on composting activities are available at the SAEFL since 1985. To date there are 333 plants, which process 728,400 tonnes of MSW to produce 438,400 tonnes of compost annually. The process is aerobic; hence some CO_2 and CH_4 are emitted. Since recycling is one of the waste management practices in use in Switzerland, it is advisable for the Party to incorporate recycling information in the NIR as sources of GHG while also reflecting its importance in reducing GHG emissions. Previous reviews indicated the need to provide background information on methodology and EF values used, as well as AD, in the NIR. As regards the CRF tables the Party was encouraged to complete them correctly and to provide AD in order to enable the calculation of IEFs. The submission under review has taken some of these recommendations into account, particularly the submission of an NIR that provides data on recovered CH_4, AD and EFs. However, background information on methodology and EFs is not fully provided, particularly on the key issues about the model, the calculations made and the assumptions made. As for the CRF tables, not much improvement was noted compared to earlier submissions. The Party is encouraged to make further improvements in these matters.

Waste incineration – CO_2

171. Waste incineration was a key source for CO_2 emissions in 2002 by level and trend assessment. Emissions arose from the incineration of municipal waste and special waste as well as waste used as fuel in cement production. The NIR identifies all types of waste incinerated and lists data sources. All incineration facilities are taken into account. The NIR (p. 120) states that AD for some waste streams are based on rough estimations. These include clinical and special waste. The database for these wastes is under development and is scheduled for completion this year.

172. A country-specific methodology is applied in the calculation of CO_2 emissions. Specific EFs for each type of waste are employed. No information on how these EFs were developed is provided in the NIR. CO_2 emissions from municipal waste incinerators are based on the constant assumption that the fraction of fossil carbon in waste is 40 per cent and the organic fraction is 60 per cent. Most waste is incinerated in these incinerators, including clinical waste. The value of the organic fraction is higher than the default value, which ranges from 33 per cent to 50 per cent (or an average of 40 per cent), provided in the IPCC Guidelines. The values for these parameters for other types of waste, particularly the construction, clinical and special wastes, differ. The various combustion burn-out efficiencies for different kinds of waste are not taken into account. Since emissions of CO_2 are likely to increase as more combustibles are incinerated in future, it is advisable for the Party to take a closer look at the methodology currently being applied to address gaps. As explained in paragraph 160 above, CO_2 arising from waste incineration for purposes of energy production is accounted for under the Waste sector (category 6.C) instead of under the Energy sector under Other Fuels, as specified in the IPCC good practice guidance. The

ERT in the previous reviews requested information on methodology, AD and EFs, and recommended that the methodology for estimating CO_2 emissions should take into account the biogenic fraction and the non-biogenic fraction in each type of waste that is incinerated. In the NIR, AD and EFs are provided. However, the information on the methodology used is not adequate in that there is no mention of the basic assumptions made or how the design of incinerators influences the combustion of each type of waste. In the CRF tables the IEFs are not calculated because notation keys are used instead of providing disaggregated AD for the amounts of waste incinerated. The Party has made improvements in some of these areas, in particular as regards the AD and EFs in the NIR, although there are gaps in the CRF tables with regard to the IEFs. The issues of biogenic and non-biogenic fractions of incinerated waste have only been partly addressed, for municipal waste only. The Party is encouraged to work further on these issues.

C. Non-key sources

Waste-water handling – N_2O and CH_4

173. The inventory covers N_2O from municipal waste-water treatment plants only for the population connected to the sewerage systems. GHG emissions from industrial waste-water treatment plants and on-site disposal facilities owned by some of the commercial establishments are not covered, although these sources exist. Existing industries whose waste-water plants are potential sources of N_2O include paper and pulp, food and beverages, and wood processing. These need to be covered also. The Party has stated in the NIR its intention to improve the database on waste, which at present covers to a great extent municipal waste water and is relatively undeveloped where other sources are concerned, particularly those related to the increase of CH_4 and N_2O emissions. This information has not been updated recently.

174. The calculation of CH_4 from municipal waste water is based on country-specific method and EFs. In the existing method GHG emissions are calculated by multiplying the number of inhabitants connected to the waste-water plants by EFs. This methodology only gives a general estimate and does not take into account some of the important factors, for example, the maximum methane-producing potential (B_0) of each waste type and the MCF of different waste-water treatment systems, which depend on operational practices and have effects on the amount of CH_4 generated. The MCF is an estimate of the fraction of biochemical oxygen demand (BOD) or chemical oxygen demand (COD) that will ultimately degrade anaerobically. The MCF is dependent on the design of a waste-water treatment plant. The degradation patterns inherent in the various waste-water treatment plants (they differ from one plant to another) would have to be considered as part of any improvement of these emission estimates.

175. Previous reviews asked for information to be provided on the methodology used to obtain EF values and for AD. The Party was encouraged to fill in the AD in the CRF tables and hence the IEFs, and to reflect important information in the documentation box. There are some improvements in the CRF tables, although information on human sewage (population, protein consumption, N fraction and N_2O emissions) is still not provided. In the NIR only the EF is provided, whereas the other parameters are not covered under the existing methodology. The Party is encouraged to make further improvements in these matters.

D. Areas for further improvement

Identified by the Party

176. The improvements planned for the Waste sector include the creation of an updated EMIS database based on recent studies on AD and fraction of organic matter in some wastes; planned surveys for waste streams currently not adequately covered by NIR; and redesign of the model for calculation of CH_4 emissions arising from managed SWDS.

Identified by the ERT

177. The ERT supports the improvements planned by Switzerland and further encourages Switzerland to take into account the recommended improvements indicated above.

ANNEX 1: MATERIALS USED DURING THE REVIEW

A. Support materials used during the review

2003 and 2004 Inventory submissions of Switzerland. 2004 submission including a set of CRF tables for 1990–2002 and an NIR.

UNFCCC secretariat (2003). "Report of the individual review of the greenhouse gas inventory of Switzerland submitted in the year 2001 (desk review)". FCCC/WEB/IRI(1)/2001/CHE (available on the secretariat web site <http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/2767.php>

UNFCCC secretariat. "2004 Status report for Switzerland" available on the secretariat web site <http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/2994.php>

UNFCCC secretariat. "Synthesis and assessment report of the greenhouse gas inventories submitted in 2004. Part I": *F*CCC/WEB/SAI/2004 (available on the secretariat web site <http://unfccc.int/resource/webdocs/sai/2004.pdf>) and Part II – the section on *Switzerland*) (unpublished).

UNFCCC secretariat. Review findings for Switzerland (unpublished).

Switzerland's comments on the draft "Synthesis and assessment report of the greenhouse gas inventories submitted in 2004" (unpublished).

UNFCCC secretariat. "Handbook for review of national GHG inventories". Draft 2004 (unpublished).

UNFCCC secretariat. "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories", "Part II: UNFCCC reporting guidelines on national communications" and "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention." FCCC/CP/1999/7 (available on the secretariat web site <http://www.unfccc.int/resource/docs/cop5/07.pdf>).

UNFCCC secretariat. "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC Reporting guidelines on annual inventories" and "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention." FCCC/CP/2002/8 (available on the secretariat web site <http://unfccc.int/resource/docs/cop8/08.pdf>).

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B. Additional materials

Responses to questions during the review, including additional material on the methodology and assumptions used, were received from Mr. Paul Filliger and Mr. Andreas Liechti (Bundesamt für Umwelt, Wald und Landschaft, BUWAL) in addition to the national experts present at the respective sectoral sessions.

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Bundesamt für Energie (BFE) (2002), *Schweizerische Gesamtenergiestatistik.*

Carbotech (2002), *Swiss Greenhouse Gas Inventory: PFCs, HFCs and SF_6 Emissions*. Basel, April.

FAL (1997), Ammoniak-Emissionen in der Schweiz: Ausmass und technische Beurteilung des Reduktionspotenzials. Menzi, H., R. Frick and R. Kaufmann, Schriftenreihe der FAL 26, Zürich-Reckenholz.

FAL (2000), Lachgasemissionen aus der Schweizer Landwirtschaft. Schmid M., A. Neftel and J. Fuhrer, Schriftenreihe der FAL 33, Zürich-Reckenholz (available in German only).

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FAL / RAC (2001), Grundlagen für die Düngung im Acker- und Futterbau 2001. Eidgenössische Forschungsanstalt für Agrarökologie und Landbau / Eidgenössische Forschungsanstalt für Pflanzenbau, Agrarforschung, Zürich-Reckenholz / Nyon, June (also available in French).

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SAEFL (1998), Methanemissionen der schweizerischen Landwirtschaft. BUWAL, Schriftenreihe Umwelt Nr. 298, Bern (including English summary).

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Swiss Global Energy Statistics 2002 (Excerpt: Energy consumption in Switzerland 2002: A Survey), July 2003.

Williams E.J., G.L. Hutchinson and F.C. Fehsenfeld (1992), NO_x and N_2O emissions from soil. In: *Global Biogeochemical Cycles*, 6(4): 351–388.

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