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REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY OF SWITZERLAND SUBMITTED IN THE YEAR 2001[1]

Desk review

I. OVERVIEW

A. Introduction

1. The Conference of the Parties (COP), at its fifth session, by its decision 6/CP.5, adopted guidelines for the technical review of greenhouse gas (GHG) inventories from Parties included in Annex I to the Convention, hereinafter referred to as the review guidelines,[2] for a trial period covering the GHG inventory submissions for the years 2000 and 2001. The COP requested the secretariat to conduct individual reviews of GHG inventories for a limited number of Annex I Parties on a voluntary basis. In so doing, the secretariat was requested to use different approaches to individual reviews by coordinating desk reviews, centralized reviews and in-country reviews.

2. In response to the mandate by the COP, the secretariat coordinated a desk review of five national GHG inventories (Bulgaria, France, Iceland, Latvia and Switzerland) submitted in 2001, which took place from 19 November to 14 December 2001. The review was carried out by a team of nominated experts from the roster of experts. The members of the team were: Mr. Jose Ramon Villarin (Philippines), Mr. Arthur Rypinski (United States of America), Professor Anthony Adegbulugbe (Nigeria), Mr. Domenico Gaudioso (Italy), Ms. Nadzeya Zaleuskaya (Belarus), Dr. Lorna Brown (United Kingdom), Ms. Punsalmaa Batima (Mongolia), Mr. Rizaldi Boer (Indonesia), Mr. Josef Mindas (Slovakia), and Mr. Charles Jubb (Australia). The review was coordinated by Ms. Astrid Olsson (UNFCCC secretariat). Professor Anthony Adegbulugbe and Mr. Charles Jubb were the lead authors of this report.

3. The principle objective of the review of the GHG inventories was to ensure that the Conference of the Parties had adequate information on the inventories. The review should also further assess the progress of the Parties toward fulfilling the requirement outlined in the UNFCCC reporting guidelines[3] on annual inventories (FCCC/CP/1999/7). In this context, the review team checked the responses of the Parties to questions raised in the previous stages of the review process and the consistency of the inventory submission with the UNFCCC reporting

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[1] In the symbol for this document, 2001 refers to the year in which the inventory was submitted, and not to the year of publication. The number (1) indicates that this is a desk review report.

[2] Document FCCC/CP/1999/7, in particular the UNFCCC review guidelines (pages 109 to 114), and decision 6/CP.5 (pages 121 to 122).

[3] The guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories (FCCC/CP/1999/7), are referred to in this report as the UNFCCC reporting guidelines.

guidelines and the Revised 1996 IPCC Guidelines (hereinafter referred to as the IPCC Guidelines), and identified possible areas for improvement in the inventories of the five Annex I Parties. Each inventory expert reviewed the information submitted for specific IPCC sectors and each sector was reviewed by two experts, with the exception of the general material and the waste sector which were reviewed by one expert only.

4. The ERT also considered and commented upon the extent to which the reporting fulfilled the requirements included in the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (hereinafter referred to as the IPCC good practice guidance).[4]

5. In accordance with the UNFCCC review guidelines, a draft version of this report was communicated to the Government of Switzerland, which provided comments that were considered and incorporated, as appropriate, in this final version of the report.

B. Inventory submission and other sources of information

6. The desk review team was provided with common reporting format (CRF) tables for 1999. The 2001 status report, synthesis and assessment (S&A) report 2000 and the draft S&A report 2001, and the Party's responses to the S&A reports were also made available to the review team as was the preliminary key source analysis[5] prepared by the UNFCCC secretariat. A national inventory report (NIR) was not submitted. Switzerland in its response to the draft desk review report, advised that an NIR will be submitted in April 2004.

7. Other sources of information used during the review include: the preliminary guidance for experts participating in the individual review of GHG inventories, the UNFCCC reporting guidelines and the review guidelines.

8. In response to the S&A reports, Switzerland stated that its 1998 CRF tables contained all the sectoral background data tables for 1998. These tables were not, however, available to the review team. In its next submission, the country stated that it would send a detailed CRF for 1990. This undertaking was reiterated by the Party in its response to the draft review report.

C. Emission profiles, trends and key sources

9. Switzerland's main emissions are CO_2 (carbon dioxide), contributing 83.7% of total emissions (without CO_2 from land-use change and forestry (LUCF)) in 1999, a proportion unchanged from 1990. Emissions of CH_4 (methane) have decreased from 9.6% to 8.5% over the same period. N_2O (nitrous oxide) emissions have increased slightly as a proportion of total emissions, from 6.6% to 6.8%. Hydrofluorocarbon (HFC) emissions contribute around 1% of emissions in 1999. Emissions for 1990 are shown as not estimated (NE) but it is likely that they were negligible. Perfluorocarbon (PFC) emissions have declined by 54.1% from 1997 with earlier years shown as NE. SF_6 (sulphur oxide) emissions are 0.2% of total emissions. Switzerland's emission trends are summarised by GHG and sector in tables 1 and 2.

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[4] According to the conclusions of the Subsidiary Body for Scientific and Technological Advice (SBSTA) at its twelfth session, the IPCC good practice guidance should be applied by Annex I Parties as far as possible for inventories due in 2001 and 2002, and should be used for inventories due in 2003 and beyond.

[5] The UNFCCC secretariat had identified, for each individual Party, those source categories that 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 which provided a full CRF for the year 1990. The key sources presented in this report are based on the secretariat's preliminary key sources assessment. They might differ from the key sources identified by the Party itself.

Table 1. GHG emissions by gas, 1990–1999 (Gg CO_2 equivalent)

GHGs	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)									
CO_2 emissions (without LUCF)	44,409	46,285	45,990	43,566	42,928	43,805	44,212	43,549	44,814	44,826
CH_4	5,080	5,100	5,050	5,004	4,917	4,896	4,830	4,762	4,660	4,567
N_2O	3,516	3,548	3,568	3,581	3,592	3,584	3,582	3,555	3,624	3,615
HFCs	NE	NE	NE	NE	NE	NE	NE	355	468	366
PFCs	NE	NE	NE	NE	NE	NE	NE	61	70	28
SF_6	NE	NE	NE	NE	NE	NE	NE	172	153	125
Total (with net CO_2 emissions/ removals)	49,817	51,676	51,252	47,826	47,097	47,975	48,164	47,818	49,220	49,301
Total (without CO_2 from LUCF) [(a)]	53,005	54,933	54,607	52,151	51,437	52,285	52,624	52,454	53,790	53,527

(a) LUCF: Land use change and forestry
(b) NE: Not estimated

Table 2. GHG emissions by sector, 1990–1999 (Gg CO_2 equivalent)

GHG SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)									
Energy	40,569	42,808	42,832	40,614	39,814	40,803	41,615	40,957	42,301	42,279
Industrial processes	3,471	3,142	2,843	2,653	2,836	2,727	2,325	2,900	3,001	2,863
Solvent and other product use	108	110	112	114	117	119	119	120	120	121
Agriculture	6,032	6,042	5,984	5,942	5,846	5,806	5,733	5,654	5,541	5,443
LUCF	–3,188	–3,257	–3,355	–4,325	–4,340	–4,310	–4,460	–4,636	–4,570	–4,226
Waste	2,826	2,831	2,836	2,828	2,824	2,830	2,831	2,823	2,827	2,822
Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

(a) LUCF: Land use change and forestry
(b) NO: Not occurring

10. Switzerland's emission profile is similar to that of other Annex I Parties. CO_2 is the main GHG emitted followed by CH_4 and N_2O. To the extent that data have been provided, emissions of HFCs are consistent with the trend towards increased use of these substances as they displace ozone-depleting substances (ODSs). The HFC data is limited and appears to be volatile, with emissions increasing by 31.8% from 1997 to 1998 and falling by 21.8% from 1998 to 1999.

11. The country's overall 1999 emissions with or without LUCF have not significantly changed relative to the base year, 1990. Considerable shifts are observed, however, in the sectors comprising this total. Most notable are the LUCF sector, in which carbon sinks increased by 33% relative to 1990, and the agriculture sector, in which sources decreased by 10%. Both these sectors contributed to a decrease in CO_2 equivalent emissions. This trend is opposed by a 4% increase in emissions from the energy sector, which comprise the majority of Switzerland's total emissions.

12. The draft S&A report 2001 commented on several issues relating to emission trends. In particular:

(a) Changes from 1990 to 1999, for CH_4 emissions from 1.A.2 Manufacturing industries and construction and 6.C Waste incineration;

(b) Changes from 1990 to 1999, for N_2O emissions from 6.C Waste incineration and 1.A Fuel combustion (mainly, 1.A.3 Transport);

(c) Annual changes for CO_2, CH_4 and N_2O emissions from 1.A.1 Energy industries and 1.B.2 Oil and natural gas; and

(d) Annual changes for CH_4 emissions from 6.C Waste incineration.

13. Switzerland responded to the draft S&A report 2001 by stating that the non-CO_2 concerns cited by the report were actually minimal. In respect of the annual changes from 1.A.1 Energy industries, the Party stated that most of the changes stemmed from variations in electricity production at a plant in Vouvry, the only fossil fuel plant in the country.

14. Switzerland did not undertake a key source assessment. The Party advised that a key source analysis for level and trends will be included in future NIRs. The UNFCCC secretariat's preliminary key source analysis is shown in table 3. The analysis shows CO_2 stationary combustion – oil (31.9%), mobile combustion – road vehicles (28.0%), CO_2 stationary combustion – gas (11.2%), and CO_2 stationary combustion – other fuels (5.0%) as the most significant key sources. Together they contribute in excess of 75% of the Party's emissions, with two of the sources each contributing around 30% of emissions. Of the 19 key sources identified by the analysis, eight are in the energy sector and four of these are part of the stationary combustion category. There are four key sources in the waste sector, three in the agriculture sector, three in the industrial processes sector, and one in the solvent and other product use sector. No key source trend assessment is available. Switzerland stated in its response to the draft desk review report that a key source analysis will be included in the first NIR.

Table 3. Key sources Switzerland: Level assessment (UNFCCC secretariat)[(a)]

Key source	Gas	Level assessment %	Cumulative total %
Stationary combustion – oil	CO_2	31.9	32
Mobile combustion – road vehicles	CO_2	28.0	60
Stationary combustion – gas	CO_2	11.2	71
Stationary combustion – other fuels	CO_2	5.0	76
Enteric fermentation in domestic livestock	CH_4	4.6	81
Cement production	CO_2	3.9	84
Solid waste disposal sites	CH_4	2.4	87
Waste incineration	CO_2	2.4	89
Mobile combustion – road vehicles	N_2O	1.2	90
Manure management	N_2O	0.8	91
Manure management	CH_4	0.7	92
ODS substitutes	HFCs and PFCs	0.7	93
Fugitive emissions: oil and gas operations	CH_4	0.5	94
Mobile combustion – aircraft	CO_2	0.5	94
Solid waste disposal sites	CO_2	0.3	94
Solvent and other product use	N_2O	0.2	94
Stationary combustion – coal	CO_2	0.2	94
Nitric acid production	N_2O	0.2	94
Waste incineration	N_2O	0.1	95

[(a)] See footnote 5 to this report.

D. General assessment of the inventory

1. Institutional arrangements

15. Review of institutional arrangements is more appropriately undertaken during in-country reviews. No descriptive information on institutional arrangements has been made available to

the desk review. In its response to the draft review report Switzerland explained that a national system will be developed and that related information will be included in the first NIR.

2. Cross-cutting issues

Completeness

16. The CRF tables are largely complete, with appropriate notation keys, and complete coverage of all sources and gases. The inventory covers the direct GHGs: CO_2, CH_4, N_2O, and reporting of both potential and actual emissions of HFCs, PFCs and SF_6. No estimates for PFCs, HFCs and SF_6 are provided in the trend tables for 1990 to 1997, and table 10s4 shows emissions for 1997 as IE (included elsewhere) with no explanation provided. More detailed data on HFCs, PFCs and SF_6 are included in the 2002 submission. Calculated emissions associated with waste incineration and sinks associated with abandoned lands have been moved to other CRF tables, with adequate explanation for these changes in CRF table 9.

Transparency

17. The inventory is not fully transparent, in that CRF tables for 1999 only are available and the Party has not submitted an NIR. Some of the information in the CRF also requires clarification, such as the notation keys in table 10s4 referred to above. Specific sectoral issues are discussed in the sectoral reviews.

Recalculations and changes in relation to previous years

18. Recalculations were performed from 1990 to 1998. Changes were to be found mainly in the LUCF sector, with some of these changes reaching as high as 25% for a given recalculated year. These changes are due largely to the updating of the Swiss second national forest inventory. This is explained in the documentation box of CRF table 8(b). More extensive explanation of this would be appropriate in an NIR.

Uncertainties

19. According to the response to the draft S&A report 2001, following the CORINAIR methodology, the uncertainties have been quantified at an aggregate level: CO_2 ±10%, N_2O ±50%, and all other gases ±20%. In response to the draft S&A report 2001, the Party stated that detailed uncertainty analysis following the IPCC good practice guidance had not been undertaken.

20. Qualitative assessments of uncertainty for all sources and gases have been reported in the CRF.

Verification and QA/QC approaches

21. In its response to the draft S&A report 2001, Switzerland states that self-verification takes place when emission calculations obtained by CORINAIR methods are compared with those obtained from the CRF tables. Moreover, indirect GHGs can be validated by ambient air quality measurements.

3. Areas for further improvement

Issues identified by the Party

22. The Party has not suggested any improvements. However, in its response to the draft review report, the Party states that in future submissions, completeness, transparency, changes in

relation to previous years, uncertainties, QA/QC and consistency will be discussed in the NIR and a full set of CRF tables will be submitted.

Issues identified by the ERT

23. The review noted the following areas for improvement that have been accepted by the Party in their response to the draft review report:

(a) *Reporting:* Where notation keys such as IE are used (for example, table 10s4) explanations are provided. Submission of an NIR summarizing methodologies, data sources and sources of emission factors would be of assistance;

(b) *Uncertainty:* The Party endeavours to implement the IPCC good practice guidance on uncertainty analysis and provides an explanation of all assumptions used for uncertainty analysis;

(c) *Trends:* Sufficient information is provided to enable a key source trend assessment to be compiled.

4. Consistency with the UNFCCC reporting guidelines and the IPCC Guidelines

24. Inventory methods and emission factors used by Switzerland were taken largely from a combined application of country-specific and CORINAIR methodologies. The IPCC reference approach and tier methods were used for emissions relating to the energy and industry sectors (see CRF table summary 3). The Swiss GHG inventory is substantially consistent with the IPCC Guidelines. With regard to the UNFCCC reporting guidelines for reporting emissions, the submission is not yet fully consistent with these requirements in that the Party has not submitted CRF tables for all years from 1990; nor has it submitted an NIR. The Party stated, in response to the draft review report, that submission of a full set of CRF tables and an NIR will be addressed in future inventory submissions.

II. ENERGY SECTOR

A. Sector overview

25. Switzerland's energy-related emissions are 42,279 Gg CO_2 equivalent, or 79% of total emissions (excluding LUCF) in 1999. Most energy-related emissions (97%) are in the form of CO_2 from fossil fuel combustion.

26. In view of this dominance, this section of the review will focus largely on CO_2 emissions from fossil fuel combustion. The Swiss energy sector has several relatively unusual features that shape Switzerland's emission profile and emission inventory.

(a) Switzerland is a significant net exporter of hydroelectric power. There are essentially no emissions from the electric power sector. Fluctuations in precipitation produce fluctuations in electricity exports, but almost all domestic power consumption is supplied by hydroelectric and nuclear power in both dry and wet years;

(b) Switzerland has no reported domestic production of any fossil fuel. Consequently there are no emissions connected with the production of oil, gas or coal. Switzerland has two petroleum refineries, and so both crude oil and refined products are imported;

(c) As a landlocked country, Switzerland has no significant maritime fuel consumption, and no reported international marine bunker usage. Pursuant to the decision of the

Conference of the Parties (COP), some 95% of jet fuel consumption is attributed to "international aviation bunkers";[6]

(d) The Swiss inventory indicates that many EU citizens take advantage of lower Swiss gasoline prices by driving to Switzerland to purchase gasoline, while Swiss citizens buy lower-priced diesel fuel outside Switzerland. In the CRF, the Swiss inventory takes special account of this situation, which is called "fuel tourism".

27. Swiss energy-related CO_2 emissions have been roughly constant over the past decade, though close analysis indicates slow growth since 1994 (an annual rate of 1.2%), following a dip in the early 1990s. The absence of electric power-related emissions has probably reduced the impact of annual weather fluctuations on emissions; so emissions are less volatile than in many other countries with significant hydroelectric resources.

1. Completeness

28. The CRF tables for 1999 have been completed and appear to cover all sources and gases. Tables for the years 1990 to 1998 are not provided. Switzerland has not submitted an NIR nor provided any materials relating to key sources.

2. Transparency

29. The absence of an NIR diminishes the transparency of the inventory. Considerable insight into how the inventory was prepared has been achieved by reverse engineering the submission in the CRF.

3. Methodology, emission factors and activity data

30. The CRF indicates that the CORINAIR system has been used to calculate emissions from stationary combustion and the industrial sector.

31. The CRF also indicates that a transport model (a tier 2 approach) has been used for road sector emissions, but it seems that additional liquid transport fuels have been added separately into the source category "Other" as fuel tourism until the sectoral fuel consumption (in TJ) was reconciled with the national energy statistics. The Party advised that "fuel tourism" will be cancelled from the CRF tables to avoid misinterpretations. For CO_2 emissions, consumption data are available and fuel tourism does not play any role. CH_4 and N_2O emissions are based on the results of traffic model and some correction of model output is necessary to ensure consistency with CO_2 emissions. The method will be described in detail in the NIR which will be included with future submissions.

32. The source of the activity data for the source category agriculture/forestry/fisheries is unclear. The source category other appears to have been used as a balancing item. Appropriate changes will be implemented in future submissions.

33. No documentation for emission factors is included. Some of the important fuel-specific emission factors (for example motor gasoline) are at the top end of the expected range.

[6] Reviewer's calculation: The Swiss inventory indicates international aviation bunkers of 61,748 TJ, and domestic aviation consumption of 3,483 TJ. The total is consistent with the energy statistics of the Bundesamt fuer Energie. Apparent consumption of jet fuel (domestic plus international) has risen 36% between 1990 and 1999.

4. Recalculations

34. No material recalculations relating to the energy sector have been submitted.

5. Uncertainty

35. No material relating to uncertainty estimates has been submitted. Qualitative assessments of the estimates are reported in table 7.

B. Conformity with the UNFCCC reporting guidelines and the IPCC Guidelines

36. In general, the inventory appears to have been prepared in conformity with the relevant UNFCCC reporting guidelines and IPCC Guidelines, except for the reference approach and the matter of defining diesel fuel or gasoline used for particular purposes as an other fuel rather than as a liquid fuel. Changes will be made in future submissions.

C. Reference and sectoral approach

1. Comparison between reference and sectoral approaches

37. The Swiss inventory has prepared a comparison between a sectoral approach, using the CORINAIR method, and a reference approach, using IPCC emission factors and "apparent consumption energy data". Total reported energy-related CO_2 emissions are almost identical: 41,256 Gg CO_2 for the reference approach, and 41,104 Gg CO_2 for the national (sectoral) approach, a difference of only 0.37% in 1999. The reported energy consumption is 11,340 TJ, 1.95%, higher in the reference approach. Although the difference is less than 2%, the Party has provided an explanation for it.

38. As noted in the draft S&A report 2001, there are several inconsistencies associated with table 1.A(b), the background data for the calculation of the reference approach. The International Energy Agency (IEA) data show that Switzerland imports crude oil and natural gas. These imports are not included in the reference approach and all fuels are considered as secondary fuels. The Party advised that this will be corrected in future submissions.

39. In the IEA database, 1999 Swiss emissions under the reference approach are about 3% lower than under the sectoral approach, which probably illustrates the approximate magnitude of the difference between the two approaches. The reason for this difference needs to be clarified. The Party is aware of these differences and recognises that further investigation is needed.

40. There are wide differences in the distribution of fuels, and in the apparent choice of emission factors (implied or actual). These differences include:

(a) The Swiss inventory places 19,661 TJ of fuel consumption in the source category other fuels in the sub-source transport and describes it as fuel tourism. Emissions of fuel tourism account for about 3.7% of Swiss energy-related emissions. Fuel tourism is a net figure, defined as inferred retail sales of gasoline within Swiss borders and exported within vehicle fuel tanks, subtracted from inferred purchases of diesel fuel outside Switzerland by Swiss citizens and imported back to Switzerland. The amount of fuel tourism is calculated by the difference between reported retail sales of gasoline and diesel and inferred domestic consumption from a Swiss transport model. This approach is not in line with the UNFCCC reporting guidelines;

(b) Implied emission factors (IEFs) for Swiss gasoline are unusually high. Investigation shows that this is not a compositional effect (due to a heavier fuel mix) but due to

the choice of emission factors. The Party responded that the emission factor is based on measurements of Swiss Federal Laboratories for Materials Testing and Research. The emission factor will be checked and documented in the NIR;

(c) The treatment of statistical discrepancies in the inventory is unclear. Swiss energy statistics seem to add statistical discrepancies into the source category agriculture/forestry/fisheries under the sub-source other fuels. Swiss energy balancing items are uniformly positive (that is, more fuel is reported to be imported into Switzerland than can be accounted for by reported sales or consumption). The Swiss appear to have excluded balancing items from their national approach, with the exception of some inferred consumption from agriculture. An explanation of statistical discrepancies will be provided in the Party's NIR;

(d) Refinery gas is defined as a gaseous fuel in the inventory. Many other countries (and the Swiss Federal Energy Office) define refinery gas as a liquid fuel. This has no material significance for the results of the inventory, but complicates cross-country comparisons and reconciliation with other data sources.[7] The Party has stated that changes will be made in future submissions.

2. Treatment of feedstocks and non-energy use of fuels

41. Switzerland does not appear to have a large petrochemical industry. Consequently, the treatment of non-energy use of fuels does not comprise an important feature of the Swiss inventory. The Swiss account for feedstock use of fuels in the industrial processes sector. Feedstock emissions of CO_2 in the industrial processes sector amount to 132 Gg CO_2 from aluminium smelting, iron and steel, and food processing. No emissions from solvents or lubricants are explicitly reported.

42. The Swiss Federal Energy Office (SFEO) report indicates that 7,950 TJ of petroleum products were consumed for non-energy purposes in 1999.[8] No further breakdown by type of petroleum product is provided. However, the IEA reports non-energy petroleum product usage of about 17,208 TJ.[9] The IEA reports consumption of bitumen (11,974 TJ), lubricants (2,889 TJ), petroleum coke (1,000 TJ), white spirit (711 TJ), unidentified petroleum products (377 TJ), paraffin wax (209 TJ), and coal (41 TJ). These differences are being investigated by the Party.

43. Some of the non-fuel usage of petroleum products reported to the IEA ought to result in CO_2 emissions. In particular, it would be reasonable to expect that petroleum-based solvents, initially emitted as volatile organic compounds, would weather into CO_2. Some fraction of lubricants consumed may be expected to be oxidized, particularly in two-stroke internal combustion engines and defective automobile engines, but also through "recycling" of used

[7] The draft S&A report 2001 notes that Switzerland's emissions coefficient for gaseous fuels used in the refinery sector is the highest of Annex I Parties, and that the liquid fuels coefficient is also unusually high. This is because for most countries, refinery gas is a liquid fuel, while the Swiss inventory treats it as a gaseous fuel. Thus, the Swiss gaseous IEF appears high by comparison with other countries (because refinery gas is included) at the same time as the liquid IEF also appears high (because refinery gas is *not* included.). According to the IEA, the only fuels used in Swiss refineries were refinery gas and heavy fuel oil. This raises a possible issue of completeness (no catalyst coke?) but the refinery liquid fuel emissions coefficient is reasonable for heavy fuel oil.

[8] Bundesamt für Energie [Swiss Federal Energy Office], *Schweizer Gesamtenergiestatisk/Statisque Globale Suisse de L'energie 1999*, table 4, p. 7.

[9] IEA, *Energy Balances of OECD Countries* (database 2001, Switzerland). IEA data are reported in net calorific value (lower heating value) million tons of oil equivalent (MTOE). Conversion from native units into MTOEs by the national authorities, and back into Terajoules by this reviewer using standard conversion factors, will often introduce a degree of imprecision into the reported data.

lubricants into boiler fuel, and through weathering of spilled lubricants. In its response to the draft review report, the Party has undertaken to enquire into this issue.

44. The only non-fuel usage reported is bitumen (11,999 TJ), 100% sequestered, entailing some 263 Gg of stored carbon. If IEA data are considered, one would expect about 36 Gg of emissions (and 36 Gg sequestered) from lubricants, and 15 Gg of emissions (and none sequestered) from solvents. Emissions from non-fuel use of petroleum coke (in the form of sacrificial anodes in aluminium smelting) appear to be properly accounted for under industrial processes.

3. International bunker fuels

45. Since Switzerland is landlocked, only aviation bunker fuels are reported. The inventory reports international aviation bunkers of 61,748 TJ, with CO_2 emissions of 4,520 Gg. According to the documentation box, international aviation bunkers are calculated as the fuel sold at the main international airports of Zurich, Geneva and Basle, subtracted from total jet fuel and aviation gasoline sales.

46. The IEF (73.20 t CO_2/TJ) is slightly higher than the default (72.6 t CO_2/TJ), but is not unreasonable. The inventory reports combining jet fuel (more than 99% of the total) together with tiny amounts of aviation gasoline.

47. The SFEO reports total jet fuel and aviation gasoline consumption 65,231 TJ, which is exactly the sum of the 61,748 TJ reported by the inventory for international aviation bunkers and the 3,483 TJ reported for civil aviation.[10]

D. Key sources

48. The Party has not submitted a key source analysis. The UNFCCC secretariat's preliminary key source assessment defined CO_2 stationary combustion – oil as the largest single source in 1999, accounting for some 31.9% of emissions. Stationary combustion from gas was third, accounting for 11.2% of emissions, and stationary combustion from other fuels (in the Swiss inventory, liquid fuels) for 5.0%. The secretariat identified eight key sources in the energy sector. In this review, we shall operationally define two "key sources":

(a) Fossil fuel CO_2 emissions from stationary combustion (that is, energy industries, manufacturing, other sectors, and other-other), amounting to 25,814 Gg and accounting for 63% of energy-related emissions and 48% of total emissions, excluding LUCF;

(b) Fossil fuel CO_2 emissions from transport, amounting to 15,316 Gg and accounting for 37% of energy-related CO_2 emissions and 29% of total emissions, excluding LUCF;

49. This grouping corresponds reasonably well with the methods apparently used by the Party to construct the inventory, and encompasses the points raised in this review.

[10] Bundesamt für Energie [Swiss Federal Energy Office], *Schweizer Gesamtenergiestatisk/Statisque Globale Suisse de L'energie 1999*, table 20, p. 29, reports 1999 final consumption of *Flugtreibstoffe/carburants d'aviation* of 1,517,000 metric tons. Using the listed Swiss conversion factor of 43.0 MJ/kg, this equates to 65,231 TJ. This report does not distinguish between jet fuel and aviation gasoline. The IEA database indicates that the division is 5,000 tons of oil equivalent (TOE) of aviation gasoline to 1,610,000 TOE of jet fuel, with essentially all of the aviation gasoline attributed to domestic aviation. While it is possible to use a separate aviation gasoline emission factor, the difference would be so small as to be invisible within the CRF.

1. Stationary combustion: coal, oil and gas – CO_2

50. Stationary combustion accounts for about 63% of Swiss energy-related CO_2 emissions.

Trends

51. Trends in stationary combustion emissions do not show any large variations over the years 1990 to 1999.

Completeness

52. Emission estimates for most of the categories of emissions required in the CRF have been included. However, a review of the solid fuel emission estimates according to the inventory and Swiss national statistics suggests that coal consumption could be under-reported and, hence, emissions. It is likely that about 2,500 TJ of coal and coke have not been included in the emission estimates. The result is a very small (about 100 Gg) possible underestimate of CO_2 emissions. The Party advised that coal consumption is almost exclusively in the cement sector and is included in that sector in the CRF tables, and there is no underestimate of CO_2 emissions from coal. Allocation of fuel emissions to industrial processes (cement) is not in accordance with the IPCC Guidelines and it is considered that future submissions should allocate fuel emissions to the energy sector, with appropriate recalculations undertaken for earlier years.

53. Manufacturing industries CO_2 emissions are not divided into individual industrial sectors, though IEA data make such a division. In aggregate, the IEA manufacturing sector energy data closely match SFEO data, though not energy data reported in the inventory. The Party commented that the problem is due to a structural break in the time series at the sub-sector level due to a change in energy statistics in 1999. Due to this change, the sub-sector time series of the IEA statistics are not consistent either and should not be taken as a reference.

Methodology

54. The inventory indicates that CORINAIR methodology has been used to estimate emissions from stationary combustion. Although no explicit statement is made, it would appear that national energy statistics have been used for the residential and commercial sector.

Activity data

55. The activity data used in the Swiss inventory largely match the energy data published by the SFEO. A review of this data, however, reveals several differences:

(a) The source category energy industries energy use (public electricity and refining) corresponds well;

(b) Manufacturing industries and construction energy use does not correspond well. Consumption of identified fuels is 28,000 TJ lower than reported by the SFEO. Presumably this reflects the use of CORINAIR, rather than aggregate energy data. Adding back 18,000 TJ of other fuels may be a balancing item intended to reconcile CORINAIR data partially with national energy data. Even so, manufacturing energy consumption in the inventory is still 10,000 TJ lower than manufacturing energy consumption reported by SFEO. The Party responded that the difference is due to the allocation of emissions from waste incineration with these emissions reported in the waste sector, irrespective of whether the emissions are related to energy production. This allocation, although inconsistent with the IPCC Guidelines, is used for consistency with Swiss law;

(c) The sub-source commercial energy consumption has an extra 5,300 TJ of natural gas consumption. The source of this is not clear and should be explained. In its response to the draft review report, the Party stated that allocation in the SFEO is not the same as in the CORINAIR approach of the GHG inventory. Agriculture consumption in the CRF covers only machinery and grass drying activities, and room heating is included under commercial/institutional;

(d) The sub-source residential energy consumption in the inventory and SFEO data are identical;

(e) The activity data in the sub-source agriculture/forestry/fisheries corresponds neither with the SFEO energy data nor with the IEA energy data. The 7,800 TJ of other fuels described as gasoline should be explained;

(f) The nature of the activity data associated with the source category other-other is not clear. The 9,865 TJ of other fuels does not correspond with other sources. The Party explained that the activity data covers all off-road activities of the commercial and industrial sector. Due to data allocation difficulties this sub-sector cannot be disaggregated;

(g) The statistical discrepancy in the SFEO data is 7,360 TJ (mostly natural gas). There is no corresponding entry in the Swiss inventory. However, a summary table on CO_2 emissions in the SFEO annual report suggests that statistical discrepancies are included in the national emission estimate. This may indicate that the other fuels reported are also intended to encompass the statistical discrepancy. The Party commented that the SFEO has taken the statistical discrepancies as consumption and the same approach has been used in the CRF.

56. Overall, manufacturing energy consumption seems to be 10,000 TJ too low, while some 23,000 TJ of other fuels seems to have been added back into the commercial, agriculture/ forestry/fisheries, and other-other sectors. The add-backs may be more in the nature of balancing items than measured consumption. With respect to discrepancies in sectoral energy consumption, the Party responded that these are due to allocation questions. In future submissions, the fuel category “Other fuels”, which created allocation problems in the CRF, will be eliminated.

Emission factors

57. The CRF provides IEFs by dividing reported carbon dioxide emissions by reported energy consumption. In stationary combustion (as distinct from transport), the CRF does not permit the identification of particular solid or liquid fuels, though gaseous fuels may reasonably be assumed to be homogenous.

58. As aggregate averages, the IEFs used for stationary combustion appear reasonable. It would be laborious to attempt to verify the emission factors by using SFEO data to decompose liquid fuel consumption into its constituent fuels. However, if the aggregate fuel data do not correspond well with the SFEO data (as is the case for manufacturing industries and construction), it would not be possible to be confident that the disaggregation is correct.

59. The Swiss reports certain volumes of other fuels in the source categories agriculture/ forestry/fisheries and other/other. These other fuels are marked as gasoline, with an IEF slightly lower than that of road transport gasoline.

2. Transport – oil and carbon dioxide

Trends

60. Only a 1999 CRF has been submitted for review. However, time series transport emission data from prior Swiss inventories have been drawn from the UNFCCC database. In addition, historical energy consumption data have been combined with the implied liquid fuels transport emission factor from the 1999 inventory and aviation bunker data to create a pro-forma SFEO emission series.

61. 1990–1998 inventory emissions match the pattern of SFEO emissions almost perfectly, but calculated emissions are 900–950 Gg higher than reported emissions. In 1999, the levels match almost perfectly. This would suggest that there was some change in the way 1999 emissions were calculated, compared with previous years. The Party advised that these discrepancies have been corrected with recalculations in the 2002 submission.

Completeness

62. Transport emissions appear to be completely reported, with one small (and probably unimportant) exception. No estimate is shown of fuel consumption for natural gas pipeline operations. A review of SFEO and IEA data reveals no independent estimates of energy consumption from this source. Nonetheless, it is unlikely that there are no operating compressor stations in Switzerland. The amount of gas consumed by such stations is probably small, but accounting for this source would also help to reduce the probable natural gas statistical discrepancy in Swiss energy statistics. The Party stated that emissions from the only operating compressor station in Switzerland are included in table 1.B.2, fugitive emissions (natural gas).

Methodology

63. The CRF indicates that road transport emissions (which account for the bulk of transport emissions) have been estimated based on the output of a transport model. Additional emissions are indicated as other fuels based upon the difference between fuel sales data and the output of the transport model.

64. The use of the transport model is nominally a tier 2 method, although adding back the missing fuel makes the total primarily the product of a tier 1 method.

Activity data

65. Once the other fuel is understood to correspond to gasoline and diesel, as described in the Swiss inventory, the reported 1999 activity data correspond well to other information sources.

Emission factors

66. The IEFs used for motor gasoline seem unusually high.

67. The IEF used in the inventory are puzzling and should be clarified. It is surprising that motor gasoline has a higher emission factor than either jet fuel or diesel.

68. IEFs may not accurately reproduce the actual emission factors used by the national authorities, for several reasons:

(a) If more than one fuel type is included under a rubric such as liquid fuels, then the IEF will be a weighted average of a set of individual emission factors;

(b) If the emission data come from one source (such as emission monitors) while the energy data is from a different source (such as fuel sales), the IEFs will incorporate all of the definitional differences and measurement errors in the two data sets;

(c) Non-fuel CO_2 emissions (such as CO_2 from limestone in scrubbers) may be incorporated in emission statistics, biasing IEFs upwards.

E. Non-key sources

69. There are no emissions relating to the manufacture of solid fuels and other energy industries. Emissions of CH_4 and N_2O relating to energy account for about 3% of energy-related GHG emissions.

(a) Some 31% of energy-related CH_4 emissions are attributable to emissions from biomass combustion, largely from the residential sector. This corresponds well with experience in other countries, although such emissions are universally difficult to estimate accurately;

(b) Some 89% of energy-related N_2O emissions are attributable to emissions from road transport, presumably nitrous oxide emissions from motor vehicle catalytic converters.

70. The estimates seem reasonable. However, the appropriate emission factor for CH_4 is very sensitive to inferred combustion conditions. CH_4 emissions from biomass can be very high when wood is burned in open fireplaces or old stoves, but are much lower for larger commercial or industrial boilers. Residential wood consumption is universally difficult to measure accurately, since large volumes of wood flow through non-commercial or informal channels.

71. In the case of N_2O from motor vehicles, emission estimates are typically sensitive to the share of vehicles in the fleet using catalytic converters, and to the vintage of catalytic converter used. Reviewing the Swiss work is beyond the scope of this report.

F. Areas for further improvement

1. Issues identified by the Party

72. The Party has not suggested any possible improvements.

2. Issues identified by the ERT

73. The following improvements are suggested by the review team:

(a) The Swiss inventory would be improved if the matters mentioned above regarding the reference approach tables 1.A(b) and 1.A(c) were further investigated and clarified;

(b) Allocating gasoline and diesel fuel consumption from fuel tourism as other fuels in the inventory confuses two unrelated concepts (the type of fuel burned) and legal or sectoral responsibility (the industry or subsector responsible for burning the fuel). It would be best if consumption of liquid transport fuels were attributed to liquid fuels, preferably in the transport sector. As mentioned earlier, the reporting of fuel tourism is not in line with the UNFCCC reporting guidelines. The Party can provide adjusted data separately, and preferably in the NIR;

(c) If certain fuels and sectors are used as balancing items to reach a known total, it would be helpful if these calculations were shown somewhere in the inventory, perhaps as a table in the NIR. The use of the category other fuels as a balancing item should be avoided. Other-other distributed by fuel type is more accurate and easier to reconcile.

(d) The treatment of statistical discrepancies should be made explicit.

The Party has stated that these recommendations will be taken into account in future submissions.

III. INDUSTRIAL PROCESSES

A. Sector overview

74. In 1999, industrial processes (including solvent and other product use) accounted for 5.6% of Switzerland's total GHG emissions, expressed as CO_2 equivalent emissions (excluding LUCF); the industrial processes share is 5.4%, whereas the solvents and other product use share is 0.23%.

75. Based on the secretariat's preliminary key source analysis, the key sources included in this sector are: CO_2 from cement production, ODS substitutes and solvent and other product use, and N_2O from nitric acid production. No assessment of key sources is reported by the Party.

76. Total GHG emissions have decreased by 16.62% from 1990 to 1999.

1. Completeness

77. The sector is completely covered in terms of IPCC source categories and GHGs: The notation key NO (not occurring) has been used where no other information has been provided. The notation key IE has been used for emissions from the two subcategories 2.D.1 Other production – pulp and paper and 2.D.2 Other production – food and drink, which have been reported in aggregate form under 2.G Other – food, drink, pulp, paper, crematoriums.

2. Transparency

78. The information reported in the CRF is detailed and self-explanatory; however, the submission of an NIR could have improved the overall transparency of the inventory, especially as concerns the choice of emission factors. Detailed and useful information was made available by the Party in its response to the draft S&A report 2001. The only confidential information mentioned in the inventory is the split of activity data for the two subcategories of carbide production, silicon carbide and calcium carbide; aggregate activity data are reported for the whole category.

3. Methodologies, emission factors and activity data

79. Emissions from industrial processes have been estimated using CORINAIR methodologies and emission factors. Information on the source of activity data has not been provided.

80. Emissions from solvent and other product use, for which no IPCC methodology is available, were estimated on the basis of country-specific methodologies and emission factors. Information on the source of activity data has not been provided.

4. Recalculations

81. Switzerland has provided recalculated estimates (table 8(a)) and explanatory information for these recalculations (table 8(b)) for the years 1990 to 1998. No recalculation has been performed for industrial processes and solvent and other product use.

5. Uncertainties

82. Qualitative assessments of the estimates are provided in CRF table 7. The Party did not provide an uncertainty estimate for each of the source categories of this sector. However, Switzerland explained that, within the framework of the CORINAIR inventory, uncertainty estimations were done on a more or less aggregated level. The results for total emissions are: CO_2 ±10%, N_2O ±50% and all other gases ±20%. Detailed analysis according to the IPCC good practice guidance has not yet been prepared.

6. Verification and QA/QC approaches

83. In comments on the draft S&A report 2001, the Party stated that in the preparation of the inventory, self-verification procedures were implemented through systematic comparison of the CRF calculations with those performed for the CORINAIR inventory. Furthermore, for CO, NO_X and SO_2 an additional control of overall emissions is possible through comparison of the measured annual mean values of the corresponding ambient air concentrations; this allows verification of absolute levels and trends of the overall emissions. This is done in Switzerland's clean air concept study, which is updated regularly.

B. Consistency with the UNFCCC reporting guidelines and the IPCC Guidelines

84. The submission is basically consistent with the IPCC Guidelines. The CRF has been provided for 1999 and includes all requested tables. Notation keys have been widely used in the CRF tables. Switzerland has not submitted an NIR or CRF tables for the years 1990–1998, which are required for full conformity with the requirements of the UNFCC reporting guidelines.

C. Key sources

1. Cement production – CO_2

85. Cement production contribute 3.9% to the total GHG inventory in 1999. The Party reports that it used the CORINAIR method and emission factors for the category 2.A Mineral products.

86. CO_2 emissions have increased by 1.4% in comparison to 1998, which is the only year, other than 1999, for which figures are available. The CO_2 IEF (0.59 t/t) for cement production is the second highest of the reporting Parties and higher than the IPCC default value (0.499 for cement) and even higher than the updated values for clinker production in the IPCC good practice guidance, table 3.1 (0.526 t/t). The Party explained the relevant calculations in its response to the draft S&A report 2001. In its response to the draft review report, the Party commented that a new emission factor of 0.525t/t will be adopted and this will be validated based on empirical evaluation of CaO content of clinker.

2. Nitric acid production – N_2O

87. Nitric acid production contributes 0.2% to the total GHG inventory in 1999. The Party reports that it used the CORINAIR method and emission factors for the category 2.B Chemical industry.

88. N_2O emissions are equal to the value for 1998, which is the only year, other than 1999, for which figures are available. The activity data for 1999 are equal to the figures for 1998; no comparison with the United Nations statistics is possible, since the figure for 1999 is not yet available. The N_2O IEF is in the middle of the range of values reported by Parties.

3. Consumption of halocarbons and SF_6

89. Consumption of halocarbons and SF_6 contribute 0.7% to the total GHG inventory in 1999. The Party reports that it used IPCC tier 2 methodology and emission factors derived from a model. No explanation of the model is available.

90. Comparisons with previous years are not possible, due to the lack of data. For HFC-23 and HFC-43-10mee, potential emissions are reported, whereas the notation key NO is used for actual emissions. It is suggested that NE is the correct notation key here.

4. Solvent and other product use

91. Solvent and other product use contribute 0.2% to the total GHG inventory in 1999. The Party reports that it used country-specific methodologies and emission factors.

92. NMVOC, N_2O and other precursor gases emission estimates are reported; however, no corresponding activity data are reported for the subcategories 3.A, 3.B and 3.D. CO_2 emissions from 3.A Paint application and 3.B Degreasing and dry cleaning are reported as NO.

5. Results from previous reviews

93. In the S&A report 2000, it was noted that the CO_2 IEF for cement production is higher than that of most countries and higher than the IPCC default value. In its comments on the draft S&A report 2001, the Party explained that this figure is based on measurements made in 1990, and then kept constant over time. The Party also provided explanations in respect of queries about lime production, aluminium production, and solvent and other product use.

D. Non-key sources

94. Estimations for non-key sources are generally in line with the IPCC Guidelines. Methodologies and emission factors are largely based on the CORINAIR project. For some activities, activity data are not reported in the CRF.

1. Lime production

95. The CO_2 IEF (0.37t/t) is the second lowest of the Parties and lower than the IPCC default value (0.79–0.91t/t). The Party explains that this figure is based on measurements made in 1990, and kept constant over time. The Party has stated that more complete documentation will be provided in the NIR.

2. Ammonia production

96. CO_2, CH_4 and N_2O emissions from this activity are reported as NO. The Party reports that only NH_3 is emitted.

3. Iron and steel production – CO_2

97. A noticeable difference is reported between available production data and United Nations data (30.7%).

4. Aluminium production – CO_2, PFCs

98. No activity data for CF_4 and C_2F_6 are specifically given in the CRF tables.

99. From 1998–1999, CO_2 emissions increased 30% and CF_4 emissions decreased 78%.

5. SF_6 used in aluminium and magnesium foundries

100. No activity data are given in the CRF tables.

6. Other

101. Emissions from the two subcategories 2.D.1 Other production – pulp and paper and 2.D.2 Other production – food and drink have been reported in aggregate form under 2.G Other – food, drink, pulp, paper, crematoriums. No explanation for this has been provided.

E. Areas for further improvement

1. Issues identified by the Party

102. The Party advised that a detailed CRF calculation for 1990 will be included in the next submission, thus allowing sectoral comparisons with the base year.

2. Issues identified by the ERT

103. The Party should focus its efforts on gradual implementation of the IPCC good practice guidance, starting from key sources assessment and detailed uncertainty analysis. It is suggested that the Party should review the emission factors for cement production and lime production.

104. Reporting of heterogeneous activities under a single item, as in 2.G Other, is not recommended, since it reduces the overall transparency of the inventory.

105. The submission of an NIR including brief descriptions of methods, emission factors and the source and frequency of collection of activity data would be of assistance in improving the quality of the inventory.

IV. AGRICULTURE

A. Sector overview

106. The agricultural sector accounts for 71% of Switzerland's N_2O emissions, and 63% of its CH_4 emissions. CH_4 and N_2O emissions from agriculture have decreased by 9.7% and 9.9%, respectively, in the period 1990–1999. N_2O emissions from agriculture have decreased by 1.3% between 1998 and 1999.

107. The key sources for CH_4 are enteric fermentation (4.6% of national GHG emissions) and manure management (0.7% of national GHG emissions). For N_2O the key source identified by the secretariat is manure management. Direct soil emissions and indirect emissions are not identified as key sources by the secretariat, but each have significantly larger emissions than manure management. Key sources are not identified by the Party.

1. Completeness

108. Switzerland has provided a CRF for 1999 only. No NIR has been supplied. No source information is provided for activity data and emission factors.

109. All agricultural sources are estimated for N_2O and CH_4. Estimates are included for all years in table 10s2 and 10s3. The gaps are appropriately noted in the CRF. As CRF tables have been provided for 1998 and 1999 only, it is not possible to compare activity data and so on over the full period.

2. Transparency

110. Transparency is limited by the lack of an NIR and other further information relating to the derivation or source of activity data and emission factors. However, additional information is given in the CRF (such as on crop residues) which improves clarity in some sections.

3. Methodologies

111. Country-specific methodology and emission factors were used for CH_4, but no details are provided (no NIR). For N_2O, no method is specified in CRF table summary 3, but the method used appears to be based on IPCC methodology, with some country-specific sections (such as N from crop residues and N fixation). Most of the IEFs were the same as, or very close to, the IPCC default.

112. The methodology includes a more detailed breakdown of animal classes. Such an approach could usefully be adopted by other Parties.

113. Switzerland uses country-specific values for N excretion by livestock. The country-specific value for dairy cattle (109.1) is higher than the IPCC tentative value (100) and at the high end of the range given by reporting Parties. Calculation of a weighted average for non-dairy cattle from table 4.B(b) gives 39.29, which is lower than the IPCC tentative value (70) and is at the low end of the range given by reporting Parties. Excretion values from swine, sheep and poultry are also at the low end of the range given by reporting Parties and lower than the IPCC tentative value. These N excretion values have implications for estimates of N_2O emissions from animal production, manure management, direct soil and indirect sources. No source information is given for the country-specific N excretion values.

4. Recalculations

114. There are no recalculations relating to agriculture.

5. Uncertainties

115. Switzerland categorized uncertainty of the estimate for agriculture (in table 7) as M (medium) for CH_4 from agriculture (high for enteric fermentation, and low for manure management), and low for N_2O. In its comments on the draft S&A report 2001, Switzerland estimated the uncertainty as ±50% for N_2O and ±20% for CH_4, on an aggregated level (that is, not sector-specific).

B. Consistency with the IPCC Guidelines and the UNFCC reporting guidelines

116. There is general accord with the IPCC methodology, but the requirement of the UNFCCC reporting guidelines for an NIR has not been met. The methodology cannot therefore be reviewed, which is of particular importance in the case of the country-specific factors and estimations. The IPCC good practice guidance is adhered to in relation to the selection of a country-specific approach to the key source of enteric CH_4, and country-specific fractions are used in the direct soil and indirect sources (both key sources), but no documentation on the derivation of these fractions and emission factors is supplied.

C. Key sources

1. Enteric fermentation – CH_4

Trends

117. CH_4 from enteric fermentation represents 54% of total national CH_4 emissions. These emissions have shown a reduction in the period 1990–1999 of 9.7%, in line with the overall trend in CH_4 emissions from agriculture. The change from 1998 to 1999 is a reduction of 2.4%. Data are not available for the whole of the period 1990–1999 for individual animal classes and IEFs, but are available for 1998 and 1999 only. For dairy cattle there was a reduction between 1998 and 1999 of IEF (–0.4%) and emissions (–2%), whereas for non-dairy cattle, emissions decreased (–1.9%) despite an increase in IEF (0.4%). For sheep there was a reduction in emissions (–1%) and IEF (–1.4%) while for swine there was a reduction in emissions (–2.3%) while the IEF stayed the same. The reason for these reductions is not given, and no information on methodology is available.

Completeness

118. The tables are completed fully. No documentation is provided for country-specific fractions in the soil sector.

Methodology

119. A country-specific method has been used, but no information about it is given.

Activity data

120. The methodology includes a more detailed breakdown of animal classes. Such an approach could usefully be adopted by other Parties.

121. There is a small (0.1%) difference in swine population between the CRF and the United Nations Food and Agricultural Organization (FAO). The source of the activity data is not specified. There are discrepancies between the animal numbers given in 4.B(a) and 4.B(b) for sheep numbers (424 c.f. 222), goats (62 c.f. 37) and, by summation of the classes given in 4.B(b), in swine (1453 c.f. 969). The Party stated that animal places are used instead of animal numbers. However, it is not clear what is meant by animal places and this needs to be further explained in the NIR to be submitted with future inventories.

Emission factors

122. IEFs are described as country-specific. Rigorous documentation, as required by the IPCC good practice guidance, is not supplied and no references are given for their derivation. For CH_4 from enteric fermentation, the country-specific values are all slightly smaller than the IPCC default values for Western Europe/developed countries. Dairy cow IEFs are 100 and 98.9 for IPCC and country-specific IEFs, respectively, IEFs are for non-dairy cattle 48 and 43.2, for sheep 8 and 6.8, and for pigs 1.5 and 1.0, IPCC and country-specific respectively.

2. Manure management – CH_4

Trends

123. CH_4 emissions from manure management account for 8.7% of national CH_4 emissions, and have decreased by 9.3% in the period 1990–1999, in line with the overall trend in CH_4 emissions from agriculture.

Completeness

124. The tables are completed fully.

Methodology

125. The method is described as country-specific. No further information is supplied.

Activity data

126. Disaggregated livestock population data are given. The source of the activity data is not specified. (See point about discrepancies in animal numbers in paragraph 121 above.)

Emission factors

127. The emission factors are described as country-specific. There is no further information about their derivation.

128. For CH_4 from manure, the dairy IEF (13.94) is very similar to the IPCC default for cool Western Europe (14). For non-dairy cattle, the IEF (3.38 overall, by calculation from the categories given) is lower than the IPCC default (6) and is at the low end of the range given by reporting Parties. The IEFs for sheep and swine are also smaller than the IPCC default values.

D. Non-key sources

1. Direct emissions from soil – N_2O

129. Direct soil emissions make up 49% of total N_2O emission from agriculture. The method of calculation and emission factors used were not specified.

130. For N_2O from soils (table 4.D), the IEF for N from fertilizers and applied animal wastes and N excretion on pasture, range and paddock is the same as the IPCC default emission factor for direct emissions (EF_1 – IPCC Guidelines, table 4-18). The IEF from crop residue and N fixation is at the low end of the range given by reporting Parties.

131. Fractions are given in the additional information table of 4.D, but not for fractions $Frac_{NCRBF}$, $Frac_{NCRO}$ and $Frac_R$. It states in the documentation box that these values are not required for the calculation, but the method used for calculating N_2O from these sources is not fully specified (see methodology above).

132. Switzerland provides an additional table reporting N incorporation with crop residues, dry matter production, N_2O emissions from crop residues, N fixed and N_2O emission from N fixation.

133. The value of $Frac_{GASF}$ is smaller than the IPCC default, but is within the range of fractions used by reporting Parties.

134. Burning of residues is reported as 0.0.

2. Indirect emissions – N_2O

135. Indirect emissions account for 29% of total N_2O emissions from agriculture.

136. The value used for $Frac_{LEACH}$ is smaller than the IPCC default, but is within the range of fractions used by reporting Parties.

137. The IEFs for atmospheric deposition and leached nitrate are very similar to the IPCC defaults.

3. Manure management – N_2O

138. $Frac_{GASM}$ is provided in a detailed breakdown of animal classes. The overall value is greater than the IPCC default and is the second highest value of all reporting Parties. No source is given for these values.

139. There is a small (0.1%) difference in swine population between the CRF and the FAO figures. The source of the activity data is not specified. There are discrepancies between the animal numbers given in 4.B(a) and 4.B(b) for sheep numbers (424 c.f. 222), goats (62 c.f. 37) and, by summation of the classes given in 4.B(b), in swine (1453 c.f. 969).

E. Results from previous reviews

140. The draft S&A report 2001 noted that CH_4 enteric fermentation IEFs for sheep and swine were among the lowest across the reporting Parties and lower than the IPCC default, and that the manure management CH_4 IEFs were among the lowest of the reporting Parties. The discrepancy in sheep numbers between tables 4.A, 4.B(a) and 4.B(b), and the relatively high dairy cattle N excretion rates and relatively low sheep excretion rates, were also noted.

141. For non-key sources, the draft S&A report 2001 noted that the IEFs for N-fixing crops and crop residues were among the lowest values of the reporting Parties, and that no information was provided on $Frac_{NCRBF}$, $Frac_{NCRO}$ and $Frac_R$.

142. The Party has not responded to these points.

F. Areas for further improvement

1. Issues identified by the Party

143. The Party has not suggested any areas for improvement.

2. Issues identified by the ERT

144. The methodology (country-specific) for the calculation of animal waste applied to soil is specified as “Animal wastes applied to soil: total N excretion minus N excreted on pastures minus ammonia volatilization from solid and liquid manure”. The Party might consider subtracting the N lost as N_2O in animal waste management systems (AWMS) from this N pool before application, to prevent this N being counted twice. The transparency of the submitted inventory would be improved by the submission of an NIR, particularly since the Party has adopted country-specific methodologies. Derivation or source of the county-specific IEFs should be explained. In its response to the draft review report, the Party has undertaken to provide complete documentation of emission factors, activity data, methods and trends in the NIR to be included with future submissions.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

145. Estimates of GHG emissions and removals are provided for the whole period 1990–1999. The LUCF category represents more than 9% of the total non-LUCF CO_2 emissions. Net CO_2 removals represent 4,226 Gg CO_2 (1999); during the whole period 1990–1999 these were in the range from –3,188 to –4,636 Gg CO_2. In table 5 Switzerland reports net CO_2 emissions and removals; removals for the category temperate forests are reported in table 5.A Changes in forest and other woody biomass stocks. Switzerland has used a country-specific method and emission factors for reporting net emissions/removals in tables 5 and 5.A. There is no detailed information about activity data and land-use change activities.

1. Completeness

146. Estimates of GHG emissions and removals are provided for 1990–1999 (CRF table 10s1). CRF table 5 gives the data for net CO_2 emissions/removals for temperate forests only. Individual sectoral tables (5.B–5.D) do not report any data. Table 5.A contains calculations of gross emissions and removals as well as net removals. Table 5 is not fully consistent with table 5.A. The Party stated that these tables will be harmonized in future submissions.

2. Transparency

147. The reporting of this sector is transparent for category changes in forest and other woody biomass stocks. The NIR is not available and no detailed information about country-specific data and calculation methods has been provided. Relevant activity data are missing for land use and land-use change (5.B, 5.C and 5.D).

3. Recalculation

148. Recalculations in table 8(a) for LUCF report the values for the period 1990–1998. Table 8(b) notes the reason for the recalculations. Detailed activity data are not provided.

4. Uncertainties

149. The Party has not provided quantitative uncertainty estimates for any source categories. Qualitative uncertainty assessment is provided in the CRF.

5. Verification and QA/QC approaches

150. No information is available on internal and/or external verification procedures.

B. Conformity with the UNFCCC reporting guidelines and the IPCC Guidelines

151. The country-specific method was used for calculation of net emissions/removals in subsource temperate forest biomass stocks. This method corresponds well with the IPCC method for subsource 5.A. Detailed information is not available. Results presented for this sector do not fully conform to the UNFCCC reporting guidelines due to incomplete CRF tables and the absence of an NIR.

C. Sinks and sources

1. Changes in forest and other woody biomass stocks

152. In table 5 only net emissions/removals are reported and gross emissions and removals are reported in table 5.A. Net removals are reported for the period 1990–1999 in the range –3,188 to –4,636 Gg CO_2. Information about year-to-year variations in removals is not available. It is suggested that reported values in tables 5 and 5.A should be harmonized. As noted above, the Party stated that these tables will be harmonized in future submissions.

Methodology

153. The country-specific method for calculation of net emissions/removals from temperate forests in Switzerland has been used. The method is consistent with IPCC methodology.

Emission factors

154. The country-specific emission factors have been used. The average annual growth rate for temperate forests of 7.33 t dm/ha/yr seems to be very high in comparison to other countries in the temperate zone. These values need to be checked and documented by the Party.

Activity data

155. No detailed information about the activity data for category 5.A are available. There is no information about the land-use and land-use change activity data.

D. Areas for further improvement

1. Issues identified by the Party

156. The Party has suggested no areas for improvement.

2. Issues identified by the ERT

157. The following areas for improvement are recommended:

(a) Information about land use and land-use change activities in Switzerland should be prepared;

(b) Reported data in tables 5 and 5.A should be harmonized;

(c) Any additional information on methods or techniques used to estimate or develop emission factors (such as expert judgement, field measurements or remote sensing) should be reported in order to improve the quality and better understanding of the estimates.

The Party indicated in their response to the draft review that the need for improvement has been recognised and two studies have been undertaken on forest and agriculture. More time is needed for the adaptation and improvement of calculation methods and emission factors. As these improvements are implemented, corresponding documentation will be provided in the NIR.

VI. WASTE

A. Sector overview

158. Emissions from the waste sector contribute 5.3 % of total emissions (excluding CO_2 from LUCF) in 1999; this is unchanged from 1990. CH_4 and CO_2 emissions are the major GHGs from

this sector. CH_4 emissions declined by 8.6% from 1990 to 1999, and CO_2 emissions increased by 13.7% from 1990 to 1999. The waste sector has four key sources: CH_4 from 6.A Solid waste disposal on land, which represents 2.4% of total emissions, CO_2 from 6.C Waste incineration, representing 2.4% of total emissions, CO_2 from 6.A Solid waste disposal on land, comprising 0.3% of total emissions, and N_2O from 6.C Waste incineration which contribute 0.1% of total emissions.

1. Completeness

159. All CRF tables specific to the waste sector contain data and notation keys, although there are some omissions from the tables. Table 6 Sectoral report for waste is complete with data or notation keys for all sub-sources and gases. The sectoral background data tables are substantially incomplete. This lack of supporting information was commented upon in the S&A report 2000 and the draft S&A report 2001. The Party has not responded to these S&A report comments.

160. No information is provided on CH_4 recovery from solid waste disposal on land.

161. Emissions from industrial waste water are shown as IE. No explanation is provided in table 9. The documentation box for table 6.B explains that no distinction is made between industrial and domestic and commercial waste water it is assumed, therefore, that domestic and commercial waste water includes all emissions from waste-water handling.

162. The Party has noted that waste gas recovery appliances reduce emissions from waste water. No estimate of CH_4 recovery is included.

163. N_2O emissions from human sewage are provided in the sectoral report. However, the section in table 6.B has not been completed.

2. Transparency

164. The CRF tables provide a moderate level of transparency. The methodology used for estimating emissions from solid waste disposal on land is summarized in a supporting document provided to the review (waste disposal model, Einzelblatt). The Party has not provided an NIR which would assist in increasing the transparency of the inventory, especially in respect of the models used for estimating emissions from waste water and incineration, and with regard to the approach used for estimating CH_4 recovery, which is omitted from the CRF.

3. Uncertainties

165. No quantitative uncertainty analysis has been provided. Qualitative assessments of the estimates for all gases are noted in table 7 of the CRF.

4. Recalculations

166. The Party has provided recalculation tables for all years from 1990. There have been no recalculations affecting emission estimates for the waste sector.

B. Consistency with the IPCC Guidelines and the UNFCCC reporting guidelines

167. Under the IPCC Guidelines, Parties are permitted to develop and apply country-specific methodologies to estimate emissions provided that the methodologies are transparent and documented. The IPCC Guidelines do not reference methodology tiers for the waste sector. The IPCC good practice guidance does classify waste methodologies as tier 1 (IPCC default) and tier 2 (first order decay or more complex country-specific time-dependent methodologies).

168. All methods and emission factors are shown as country-specific (table summary 3). Estimation of emissions from the key sources is consistent with the tier 2 methodologies.

169. The reporting of emissions from this source is not yet consistent with the UNFCCC reporting guidelines because CRF tables have not been submitted for all years, and neither has an NIR. The inventory is substantially consistent with the IPCC Guidelines, apart from the points referred to under completeness above.

C. Key sources

1. Solid waste disposal on land – CH_4

170. CH_4 emissions declined by 9.0% from 1990 to 1999 and by 1.6% from 1998 to 1999. There is no estimate of CH_4 recovery and to this extent the reporting is incomplete.

Methodology

171. CRF table summary 3 shows the methodology as country-specific. The methodology is summarized in a brief supplementary document provided to the review. No information is included on the treatment of CH_4 recovery.

Activity data

172. No information on activity data is provided.

Emission factors

173. The CRF (table summary 3) notes the emission factor as country-specific. Emission factors are implied from the model results and total waste relevant to the model. No IEFs are included, as noted in the S&A reports.

2. Waste incineration – CO_2

174. Emissions of CO_2 increased by 7.9% from 1990 to 1999 and by 1.0% from 1998 to 1999. The estimates cover all sources and are complete according to the documentation box.

Methodology

175. The methodology is stated to be country-specific. No further information is provided.

Activity data

176. No information on activity data is included.

Emission factors

177. No information on emission factors is available.

3. Solid waste disposal on land – CO_2

178. Emissions of CO_2 declined by 2.2% from 1990 to 1999 and were constant from 1998 to 1999. No information has been provided that can be used to determine whether the estimates are complete.

Methodology

179. The methodology is stated to be country-specific. No further information is provided.

Activity data

180. No information on activity data is included.

Emission factors

181. No information on emission factors is available.

4. Waste incineration – N_2O

182. N_2O emissions increased by 59.2% from 1990 to 1999 and by 3.7% from 1998 to 1999. The estimates cover all sources and are complete according to information provided in the documentation box. The substantial increase in emissions is explained by the requirement for all combustible waste to be incinerated.

Methodology

183. The methodology is stated to be country-specific. No further information is provided.

Activity data

184. No information on activity data is included.

Emission factors

185. No information on emission factors is available.

D. Non-key sources

186. There are no non-key sources.

E. Results from previous reviews

187. Several of the issues referred to above were raised in the S&A report 2000 and draft S&A report 2001. Specifically, the lack of activity data and IEFs were commented on in both reports. In addition, the S&A report 2000 noted that biogenic and non-biogenic wastes were reported together. The draft S&A report 2001 commented on the absence of information on N_2O from human sewage. Although the N_2O from human sewage table has not been completed, the documentation box for the 2001 submission states that N_2O is estimated and that the estimate is included in table 6 Sectoral report. No response from the Party to the S&A reports was available to the review.

F. Areas for further improvement

1. Issues identified by the Party

188. The Party has not suggested any improvements.

2. Issues identified by the ERT

189. In future inventories it is recommended that the Party ensures that:

(a) All CRF tables are completed;

(b) All cells in the background CRF tables contain a figure or notation key;

(c) More detailed explanations of methodologies, sources of activity data and sources of emission factors are provided. It would be of assistance if the Party submitted an NIR.

190. Further clarification is needed on accounting for CH_4 recovery. When it is included, recalculations for all years should be presented in order to ensure comparability of sectors over time.

191. Emissions from waste incineration should be reported in the energy sector, in accordance with the IPCC Guidelines, unless the wastes are combusted at waste disposal sites and this constitutes a waste management practice. The Party explained the allocation of waste incineration emissions in the context of discrepancies identified in the energy sector (see paragraph 55(b)).

192. In their response to the draft review, the Party recognise that reporting of the waste sector requires some improvement. The methane model used by the Party will be documented in the NIR.

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