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# Report of the individual review of the greenhouse gas inventory of Switzerland submitted in 2005*

* In the symbol for this document, 2005 refers to the year in which the inventory was submitted, and not to the year of publication.

CONTENTS

# I. Overview

## A. Introduction

1. This report covers the centralized review of the 2005 greenhouse gas (GHG) inventory submission of Switzerland, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 17 to 22 October 2005 in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: Generalists – Mr. Art Jaques (Canada) and Ms. Inga Konstantinaviciute (Lithuania); Energy – Mr. Matej Gasperic (Slovenia), Ms. Sophia Mylona (Norway) and Ms. Roberta Quadrelli (International Energy Agency (IEA)); Industrial Processes – Ms. Marisol Bacong (Philippines), Mr. Domenico Gaudioso (Italy) and Ms. Birna Hallsdottir (Iceland); Agriculture – Mr. Steen Gyldenkaerne (Denmark) and Mr. Vlad Trusca (Romania); Land Use, Land-use Change and Forestry (LULUCF) – Mr. Aquiles Neuenschwander Alvarado (Chile) and Mr. Nijavalli H. Ravindranath (India); Waste – Mr. Eduardo Calvo (Peru) and Ms. Sirintornthep Towprayoon (Thailand). Ms. Sirintornthep Towprayoon and Mr. Art Jaques were the lead reviewers. The review was coordinated by Mr. Matthew Dudley (UNFCCC secretariat).

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

## B. Inventory submission and other sources of information

3. In its 2005 submission, Switzerland submitted a complete set of common reporting format (CRF) tables for the years 1990–2003 and a national inventory report (NIR). Where needed the expert review team (ERT) also used previous years' submissions, additional information provided during the review, and other information. The full list of materials used during the review is provided in the annex to this report.

4. In 2003, the most important GHG in Switzerland was carbon dioxide ($CO_2$), contributing 85.6 per cent to total[1] national GHG emissions expressed in $CO_2$ equivalent, followed by methane ($CH_4$), 7.0 per cent, and nitrous oxide ($N_2O$), 5.9 per cent. Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride ($SF_6$) taken together contributed 1.5 per cent to the overall GHG emissions in the country. The Energy sector accounted for 81.1 per cent of total GHG emissions, followed by Agriculture (10.3 per cent), Industrial Processes (5.1 per cent), Waste (3.2 per cent) and Solvent and Other Product Use (0.2 per cent). Total GHG emissions amounted to 52,235.74 Gg $CO_2$ equivalent and had decreased by 0.4 per cent from 1990 to 2003. Total GHG emissions with Land-use Change and Forestry (LUCF) included amounted to 50,469.29 Gg $CO_2$ equivalent and decreased by 1.4 per cent over the same period.

[1] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of $CO_2$ equivalent excluding LULUCF, unless otherwise specified. Switzerland has not provided the tables of the common reporting format for LULUCF as required by decision 13/CP.9 using the land-use categories of the Intergovernmental Panel on Climate Change *Good Practice Guidance for Land Use, Land-use Change and Forestry*. Instead it has used the common reporting format tables for Land-use Change and Forestry as contained in the common reporting format adopted by decision 18/CP.8, which are based on the categories of the Intergovernmental Panel on Climate Change *Revised 1996 Guidelines for National Greenhouse Gas Inventories*.

## C. Key categories

5. Switzerland has reported a key category tier 1 analysis, both level and trend assessment, as part of its 2005 submission. The key category analyses performed by the Party and the secretariat[2] produced different results. Switzerland performed its analysis at a much more disaggregated level than previously, resulting in 34 key categories, 19 of which are in the Energy sector; the secretariat's analysis produced 22 key categories at a more aggregated level.

## D. Main findings

6. Switzerland's inventory submission generally adheres to the UNFCCC "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the revised UNFCCC reporting guidelines). A full set of CRF tables for all sectors and all years has been provided, with the exception of the new LULUCF tables as required by decision 13/CP.9. It was clear to the ERT that Switzerland is focusing on improvements to key categories as time and resources permit. The NIR is well laid out and follows the structure of the revised UNFCCC reporting guidelines, including those related to the individual sectors, with few exceptions. The ERT noted that the NIR could be improved with additional explanations of the data used and choice of methodologies, including references. The ERT also noted that the Swiss inventory, while showing improvement, would benefit from a fully implemented quality assurance/quality control (QA/QC) plan.

7. The ERT noted that the inventory would benefit from a formalized review process within Switzerland as part of its QA plans, but recognizes that the Swiss inventory team is aware of these deficiencies and is currently examining how best to address them.

## E. Cross-cutting topics

### 1. Completeness

8. Overall, the Swiss inventory is complete. It covers all years, all of Switzerland,[3] and the six mandatory GHGs, and includes an NIR, a complete set of CRF tables, and estimates of emissions for all major sources. Switzerland has not, however, provided data for the LULUCF sector in the required format as required by decision 13/CP.9. The inventory contains time-series estimates for the whole period 1990–2003 of the indirect GHGs (nitrogen oxide (NOx), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide ($SO_2$)). The NIR states that all key categories are included and identifies known sources that are missing, indicating that they are marginal. They include $CH_4$ from composting, all emissions from industrial waste-water treatment plants, emissions from conversion of grassland to settlement, and $CH_4$ from storage lakes. No explanations for why these sources are excluded are provided in the NIR or in CRF table 9.

[2] The secretariat identified, for each individual Party, those source categories which are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the Intergovernmental Panel on Climate Change *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Key categories 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 category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key category assessment conducted by the secretariat.

[3] Switzerland notes in the NIR that with the 2006 submission the energy-related emissions from Liechtenstein, currently included, will be excluded from the inventory.

## 2. Transparency

9. The inventory is generally transparent. In line with the revised UNFCCC reporting guidelines, the NIR contains a general description of institutional arrangements, QA/QC procedures, uncertainty assessments, estimation methods, key category analysis, references to key category estimation methods, a summary of trends in emissions by gas, recalculations, and explanations of the minor differences between the reference and the sectoral approaches. In addition, a quantitative tier I assessment of uncertainties as required by the revised UNFCCC reporting guidelines is provided, along with a description of checks relating to completeness.

10. During the 2004 in-country review, the ERT noted that one area of particular importance that requires improvement is that of documentation. The ERT commends the Swiss inventory team for the efforts made over the last year to implement some of the recommendations suggested by the 2004 review report, and in particular documentation related to the parameters used in various models. Nevertheless, in some areas a more detailed explanation for the choice of a particular source of data, emission factor (EF) or model is needed in order to ensure full transparency and permit reconstruction of the estimates. During the 2005 centralized review, the ERT was hampered to some degree by the lack of clarity in some areas of the NIR. The ERT reiterates the recommendation that Switzerland should fully implement a formal QA/QC plan and central archiving system so as to ensure full transparency, while acknowledging that Switzerland notes that it has developed a formal QA/QC system that is being implemented.

## 3. Recalculations and time-series consistency

11. The ERT noted that recalculations reported by the Party for the period 1990–2002 for all sectors had been undertaken to take into account changes in methodologies, or reallocation of emissions, or the inclusion of new sources in all sectors. The major changes include: updated activity data (AD) for most sources, and updated EFs for manufacturing industries, mineral products, and domestic waste-water handling. The rationale for these recalculations is provided in the NIR and appears to the ERT to be justified. The recalculations resulted in decreases in the estimates of total $CO_2$ equivalent emissions (without LULUCF) of 1.3 per cent in 1990 and 2.04 per cent in 2002.

## 4. Uncertainties

12. Switzerland has used a tier 1 method, as outlined in the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance), to make an assessment of uncertainty in the emissions inventory. A quantitative uncertainty analysis is presented for the first time. The uncertainty of key categories is based on the IPCC good practice guidance tier 1 methodology. For fluorinated gases (F-gases), a Monte Carlo methodology (tier 2) is used. The overall uncertainty is calculated to be approximately 3 per cent for the level assessment and 1.7 per cent for the trend assessment.

## 5. Verification and quality assurance/quality control approaches

13. The NIR states that since the autumn of 2004 the national inventory system, including the QA/QC system, has been under implementation. No external reviews in the formal sense of quality assurance have been carried out. The ERT commends Switzerland for these activities, takes note of the additional documentation provided on the QA/QC plan, and encourages Switzerland to fully implement its national system as soon as possible.

6. Follow-up to previous reviews

14. As noted, Switzerland underwent an in-country review in 2004. At the time the ERT recommended that Switzerland provide in the NIR additional documentation to further improve the transparency of the methods used, data and assumptions; provide more detailed analysis of emission trends, by gas and source/sink category; develop and implement a QA/QC plan and a more formal central archiving system; provide quantified uncertainty estimates; provide more precise descriptions for country-specific methodologies; and develop a way to separate Liechtenstein's emissions from the inventory by 2006. Switzerland has acted on some of these recommendations, as is evidenced by the inclusion of additional explanatory material in the NIR. The ERT, however, noted that there still is room for improvement, particularly with respect to transparency and documentation, which should flow from a good QA/QC system.

### F. Areas for further improvement

1. Identified by the Party

15. The NIR identifies several areas for improvement and provides a detailed Inventory Development Plan in annex 4. The ERT was impressed with this plan, which describes specific activities for improvement, cross-referenced to recommendations of the 2004 in-country review report, along with priorities, a time schedule for implementation, responsibilities, and how the work is progressing, that is, whether it has started, is in progress or is completed. Areas identified as completed are refinement of the key category analysis in a more detailed fashion, and ensuring consistency between the CRF and the NIR. In progress are the development of better explanations for particular country-specific approaches in the Agriculture and LULUCF categories, consistent use of the notation keys, and documentation and justification of decisions to use country-specific approaches. In addition, the NIR identifies several areas for improvement, including the creation of a centralized database for data and documentation, and the documentation of all QA/QC activities.

2. Identified by the ERT

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

(a) Ensure that the inventory development plan is fully realized; and, in particular,

(b) Improve the transparency of the NIR by providing more extensive documentation, particularly with respect to country-specific approaches, the rationales for their use, and the external review procedures undertaken.

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

## II. Energy

### A. Sector overview

18. In 2003, the Energy sector accounted for 81.1 per cent of the total GHG emissions of Switzerland (without LULUCF). Within the sector, $CO_2$ emissions were responsible for 98.5 per cent of total emissions. Total emissions from the Energy sector were 3.4 per cent higher than in 1990, mainly due to an increase in emissions from Transport. In 2003, Other sectors (mainly Residential) and Transport (mainly Road Transportation) were the largest source categories, contributing, respectively, 42.7 and 36.8 per cent to the total GHG emissions of the Energy sector.

19. For the Energy sector, the 2005 submission is generally complete and transparent. For its next submission, the Party plans to add more information on the variation over time of the EFs and heating values, which are currently assumed to be constant over time. The ERT commends this intention and encourages the Party also to provide a complete national energy balance for the base year (1990) and the most recent year. With respect to the use of the notation keys, the ERT recommends that the Party complete table 9 in its future submissions. The reference to the Swiss statistics web site given in a documentation box in table 1.A(c) should be updated.

20. Recalculations have been provided for some Energy subsectors (1.A.1–1.A.4) for the period 1990–2002. Explanations are provided in CRF table 8 and in the NIR. As a result of the recalculations, the estimates of energy-related $CO_2$ emissions in 1990 increased by 1.5 per cent, mainly because of the reallocation of emissions from waste incineration with energy recovery from the Waste to the Energy sector, done in response to the 2004 review report.

21. The Party has provided a key category analysis by both level and trend. According to the Swiss analysis, which is more highly disaggregated for the most important source categories than the secretariat's key category analysis, 19 key categories belong to the Energy sector.

22. The Party is commended for having started a quantitative uncertainty analysis and for its plan to motivate data suppliers to provide more information on uncertainties together with their data. Concerning the uncertainty analysis, the ERT recommends that the Party explain the following issues: for gaseous and liquid fuels, only uncertainties on NCVs are used, while uncertainties on EFs are not taken into account; and for liquid fuels, one uncertainty on the aggregated AD and one extrapolated uncertainty on NCVs are used instead of uncertainties on EFs and AD of individual products.

## B. Reference and sectoral approaches

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

23. Reference and sectoral approach estimates of $CO_2$ emissions are provided for all years. The differences between the two approaches in 2003 are 0.4 per cent for $CO_2$ emissions and 1.5 per cent for energy consumption. The Party is encouraged to include information or relevant notation keys concerning biomass in table 1.A(b) and to explain the use of the notation key "included elsewhere" ("IE") concerning solid fuel stock changes.

24. The oxidation factor is constant, equal to 1, for all products (instead of IPCC default values being used) on the assumption that combustion is generally very good in Swiss installations. The Party plans to further investigate the issue of oxidation factors for its future submissions.

### 2. International bunker fuels

25. The Party acknowledges that very small quantities of fuel consumption for international navigation may be included in national navigation, and states that the estimates of emissions from marine bunkers are under revision. As for aviation, the Party relies on expert judgement for the allocation of fuel consumption between national and international aviation, as the available information is not complete. The assumption used is that 99 per cent of jet kerosene at international airports is used for international aviation. The ERT recommends that the Party make efforts to obtain more information on the international/national split of fuel consumption for aviation.

### 3. Feedstocks and non-energy use of fuels

26. No apparent consumption (i.e. imports, exports and stock changes) of fuels used as feedstocks is reported in table 1.A(b), and only bitumen is reported as a feedstock, both in table 1.A(b) and in the background table 1.A(d). According to the IEA data, other products (such as naphtha, lubricants, etc.)

appear in the national energy balance. However, during previous stages of the 2005 review, the Party responded that the CRF data are consistent with the statistics of the Swiss Petroleum Association. The ERT recommends that the Party further investigate and discuss this discrepancy in its next submission.

## C. Key categories

### 1. Manufacturing industries and construction: All fuels – all gases

27. The ERT commends the effort made by the Party to provide in this submission the disaggregation required by the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) for subsector 1.A.2 Manufacturing Industries and Construction. The Party has used: for all sources with assumed homogeneous EFs, a top–down method, based on aggregated AD and a model for the split of emissions into each source category (1.A.2a–1.A.2f); and for sources with heterogeneous EFs, a bottom–up method, based on measurements and data from individual point sources. For its future submissions, the Party plans to revise some details and to resolve the inconsistency in AD between source categories 1.A.2a Iron and Steel and 2.C.1 Iron and Steel Production.

### 2. Stationary combustion: Other fuel – $CO_2$

28. The Party reports preliminary results from a review of the disaggregated NCVs and EFs of waste-derived fuels used in the cement industry. The ERT commends this effort and supports the plan to refine these values further.

29. The Party has acknowledged that the reporting of the energy content for Public Electricity and Heat: Other Fuels was incorrect, and stated that this will be corrected in its next submission.

### 3. Mobile combustion: Road transportation – all gases

30. $CO_2$ emissions from the Road Transportation sector have been computed using a tier 1 (top-down) approach, with AD based on fuel sold and country-specific EFs. Non-$CO_2$ emissions have been estimated by using a national road traffic model, with EFs derived from a measurement programme developed in collaboration with Austria, Germany and the Netherlands. Non-$CO_2$ emissions due to the quantities of fuel that is sold in Switzerland but consumed abroad ("tank tourism"), which are not captured by the model, have been added to the national totals.

31. The average $CH_4$ EFs used for gasoline and diesel oil have decreased constantly since 1990, and the average $N_2O$ EF for gasoline has decreased from 1999 onwards. The Party explained that these changes are due to the gradual but progressive implementation of more restrictive regulations governing road transport emissions. The Party also noted that the $N_2O$ EFs were substantially reduced for this submission, based on new emissions data that became available in 2004. The ERT recommends that the Party provide quantitative information about the national vehicle fleet with respect to emission categories. It also noted that the units in the diagram of figure 34 of the NIR appear to be incorrect.

### 4. Fugitive emissions: Oil and natural gas– $CH_4$

32. The Party reports fugitive emissions from refining/storage of oil, transmission leakages (pipelines and one compressor station) and from venting and flaring at the oil refinery. The Party is encouraged to provide in the NIR more transparent documentation on its EFs, which are partly based on expert judgement. The Party is commended on its plan to add in its future submissions fugitive emissions from transmission due to a high-pressure pipeline which crosses Switzerland from France to Italy.

# III. Industrial Processes and Solvent and Other Product Use

## A. Sector overview

33. In 2003, total emissions from the Industrial Processes sector in Switzerland amounted to 2,686 Gg $CO_2$ equivalent. The contribution of Industrial Processes to total national emissions decreased from 6.2 per cent in 1990 to 5.1 per cent in 2003. The drop in emissions from the sector between 1990 and 2003 is estimated at 16.8 per cent. Mineral production remains the major source in the sector, contributing to 61.5 per cent of total sectoral emissions.

34. $CO_2$ is the dominant gas in the Industrial Processes sector, contributing 67 per cent of its total GHG emissions in 2003. $CO_2$ emissions show a decline in 2003, by 64 per cent compared with the 1990 level. Emissions of F-gases show a considerable increase in 2003, by 174 per cent compared with the 1990 level. The declines in cement production (by 30 per cent) and in aluminium production (by 50 per cent) between 1990 and 2003 are the primary reasons for the lower $CO_2$ emissions in 2003.

35. The 2005 NIR and CRF tables are generally complete, covering all source categories suggested in the Revised 1996 IPCC Guidelines. The CRF tables, however, need to be completely filled in using the appropriate notation keys to improve the transparency of the inventory and make cross-referencing between the tables and the NIR easier. The NIR sufficiently supports the CRF in terms of AD, EFs, methodology and trends.

36. Uncertainties have generally been estimated using a tier 1 methodology. For the F-gases, a Monte Carlo methodology (tier 2) has been used. The activity data used for mineral and metal production have low uncertainty, as these are stated to come from the industry and are therefore plant-specific. Emission factors have generally higher uncertainties. The combined uncertainty of the Industrial Processes sector emissions, as a percentage of total national emissions, ranges from 0.009 to 0.2. Quality control activities have been administered at all levels, from data collection to the processes of preparing and managing the NIR and the CRF, to ensure that the information provided complies with the requirements of the revised UNFCCC reporting guidelines.

## B. Key categories

### 1. Cement production – $CO_2$

37. In 2003, $CO_2$ from cement production accounted for 89 per cent of the total emissions of the Industrial Processes sector. The relative change of $CO_2$ emissions from cement production from 1990 to 2003 is –35.9 per cent and is attributed to the decline in cement production over the same period.

38. The Party reports using the tier 2 methodology with some modifications by including the magnesium oxide (MgO) content of clinker (of 2 per cent), but has not considered the non-carbonate feed. The $CO_2$ EF reported is 525 kg per tonne of clinker, which is also the default value recommended by the World Business Council for Sustainable Development but higher than the IPCC default value of 507.1 kg per tonne of clinker. The ERT calculated the EF on the basis of the calcium oxide (CaO) and MgO content in clinker provided in the NIR, and the result was 532 kg $CO_2$/t clinker instead of the 525 kg $CO_2$ per tonne of clinker used in the calculation. The party states this difference can be attributed to the CaO-content value inaccurately rounded off and reported. The Party is encouraged to collect plant-specific CaO content of clinker and the amount of non-carbonate feeds.

39. It was not clear to the ERT why $CO_2$ emissions from the blasting operation have been included in this sector. If this involves the use of fuel for energy use, the emissions should be reported in the Energy sector. The Party is therefore encouraged to provide qualifying information that would show that the $CO_2$ emissions from the blasting operation are from non-energy sources.

### 2. Aluminium production – $CO_2$

40. $CO_2$ emissions from aluminium production account for about 3.9 per cent of the total emissions in the Industrial Processes sector. It is considered a key category by the trend analysis because of its sharp decrease between 1990 and 2003. This was attributed to the 50 per cent decrease in aluminium production between 1990 and 2003.

41. The emission factor used by the Party is country-specific, with a value of 1.6 tonnes of $CO_2$ per tonne of aluminium. The value is between the recommended values of the Revised 1996 IPCC Guidelines for aluminium production using the pre-baked anode process (1.5 tonne $CO_2$ per tonne aluminium and the Soderberg Process (1.8 ton $CO_2$ per tonne of aluminium). The Party is encouraged to report the process used in the aluminium industry in the interests of comparability with other Parties' inventories.

42. According to the Party, the uncertainty of the AD is low (3 per cent) as the industries themselves provide the data; the EF uncertainty is higher at 20. The EF was estimated from measurements and data supplied by the industry and expert estimates. The Party is encouraged to conduct plant measurements and apply QA/QC checks to improve the accuracy of the data.

### 3. Aluminium production – PFCs

43. In 2003, emissions of tetrafluoromethane ($CF_4$) and hexafluoroethane ($C_2F_6$) from aluminium production contributed 51 per cent and 10.5 per cent, respectively, of total sectoral emissions. This is the only source of PFC emissions in the Metal Production source category. It is considered a key category by trend analysis because of its sharp decrease from 1990 to 2003. This is attributed to a 50 per cent decrease in aluminium production and a declining EF from 1990 to 2003.

44. In section 1.4 of the NIR, the Party reports using a tier 3b methodology in calculating PFC emissions and country-specific emission factors, but in section 4.4.2 it indicates a tier 3a methodology. The EFs reported by the Party for $CF_4$ and $C_2F_6$ decreased consistently from 1990 to 1999 and since 2003 have been 0.0360 kg/tonne aluminium for $CF_4$ and 0.004 kg/tonne aluminium for $C_2F_6$. Compared to the 1990 levels, both EFs are 4.25 times lower in 2003. The ERT encourages the Party to further explain the technology changes that have reduced PFC emissions. The NIR does not, however, elaborate on the process by which the EFs are derived and thus did not allow the ERT to verify the use of tier 3a or 3b methodologies. The IPCC good practice guidance recommends that the necessary information be presented to ensure transparency of emissions estimates (see table 3.11 of the IPCC good practice guidance): annual production by smelter technology, anode effect minutes per pot day (non-Pechiney cells), anode effect overvoltage (Pechiney cells), emission coefficients, EFs, and global warming potential (GWP).

### 4. Consumption of halocarbons and $SF_6$

45. Consumption of halocarbons and $SF_6$ is considered a key category by trend analysis because of its sharp increase from 1990 to 2003. Actual emissions of HFCs and PFCs have increased from being nearly non-existent in 1990 to 529 Gg $CO_2$ equivalent and 54 Gg $CO_2$ equivalent, respectively, in 2003. On the other hand, emissions from consumption of $SF_6$ have declined from 179 Gg $CO_2$ equivalent in 1990 to 141 Gg $CO_2$ equivalent in 2003, by 21 per cent. Emissions from "Other Use" of $SF_6$ have declined from 114 Gg $CO_2$ equivalent in 1990 to 32 Gg $CO_2$ equivalent in 2003, or by 72 per cent.

46. Actual emissions from the consumption of halocarbons and $SF_6$ have been estimated using a data model that is consistent with the tier 2 methodology in the IPCC good practice guidance. Potential emissions have been estimated as well. Activity data are taken from industry information and national statistics. Some data for subsources are confidential since there is only one importer/user. The

emissions estimates appear to be complete. The Party should fill in potential emissions by sources in CRF table 2(I): Sectoral Report for Industrial Processes.

# IV. Agriculture

## A. Sector overview

47. In 2003, emissions from the Agriculture sector in Switzerland amounted to 5,372.4 Gg $CO_2$ equivalent, or 10.3 per cent of total national GHG emissions, the Agriculture sector being the second most important source of emissions after the Energy sector. During the period 1990–2003, emissions from the sector decreased by 11.7 per cent, mainly due to a decrease of $CH_4$ and $N_2O$ emissions caused by the reduction of cattle population and reduced input of mineral fertilizers. The submission is complete in terms of gases, sources, and years covered; the additional information tables and documentation boxes in the CRF have been provided, except for the tier 2 table for Enteric Fermentation. Rice cultivation and prescribed burning of savannas do not occur in Switzerland, but the notation key "not occurring" ("NO") is used only in the documentation boxes and not in the source-specific tables. The field burning of agricultural residues is of minor importance in Switzerland and only $CH_4$ emissions from the burning of branches in agriculture and forestry are reported.

48. The information on activity data presented in the CRF tables and the NIR is generally consistent and the CRF tables show consistency across the years, as the same methodologies and sources of AD have been used throughout the time series. One-year average AD have been used for all livestock population characterization, as presented in the CRF documentation boxes. A possible important inconsistency with the IPCC good practice guidance was identified in the number of livestock characterizations over the entire time series in table 4.B(b) compared with tables 4.A and 4.B(a). Also, as requested in the previous (2004) review report, Switzerland is encouraged to provide detailed information in the NIR regarding the methodology used for calculating and using "animal places" instead of "number of animals" in table 4.B(b). The transparency of the methodologies used could be improved with the inclusion of information from technical documents such as from FAL/RAC (2001) and Schmid et al (2000).

49. The methodologies used are country-specific, which is in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance for key categories; however, more detailed information is needed in the NIR to facilitate the understanding of some methodological approaches (e.g. for $N_2O$ emissions from manure management). The activity data used were obtained from the Swiss Farmers' Union (SBV), the Swiss Federal Statistical Office (SFSO), and the Swiss Federal Research Station for Agroecology and Agriculture (FAL). An inconsistency was identified between CRF Summary table 3, where it is mentioned that country-specific emission factors were used in the Agriculture sector, and the NIR, which specifies that for manure management ($N_2O$ emissions) and agricultural soils IPCC default EFs were used. The country-specific EFs used in the Agriculture sector were provided mainly by the Swiss Agency for the Environment and Forests and Landscape (SAEFL), and sufficient information is provided in the NIR to support the calculation or selection of the EFs used.

50. A list of general references is presented at the end of the NIR, including documents that are quoted in the Agriculture sector. A presentation of the sectoral institutional arrangements is also included in the introductory chapter of the NIR.

51. The Party has performed a key category analysis for the Agriculture sector which was entirely consistent with the one performed by the secretariat. Recalculations are reported in CRF table 8(a) for 2002 for Enteric Fermentation and Manure Management for the years 1997–2002, but no explanatory information is provided in table 8(b), and the NIR only briefly describes the recalculations for all sources in chapter 9. The Party is encouraged to provide detailed information on source-specific recalculations

in the Agriculture sector. Source-specific planned improvements are mentioned in the Agriculture sector, mostly relating to uncertainty estimates.

## B. Key categories

### 1. Enteric fermentation – $CH_4$

52. The AD used are taken from the SBV and the SFSO and are one-year average data. Switzerland is encouraged to provide more explanatory information in the NIR regarding the different trends in animal populations. Buffalo, camels and llama populations are reported in the CRF tables as "NO". Cattle represent the most important animal species, contributing 94 per cent to total $CH_4$ emissions from enteric fermentation, and Switzerland mentions that an enhanced livestock characterization for cattle was used as requested by the previous (2004) review. However, not enough explanation is provided in NIR to support the information presented. The Party is planning to further disaggregate the dairy and non-dairy cattle populations and to estimate the gross energy intake of young cattle.

53. The Party has used the IPCC tier 2 method for all animal species, which is in line with the IPCC good practice guidance. Country-specific emission factors for all animal species have been developed and calculated based on the IPCC good practice guidance. Switzerland informed the ERT that the $CH_4$ implied emission factors (IEFs) for dairy and non-dairy cattle fluctuate due to the fluctuation of feed intake and differences in slaughter weight. The Party is recommended to provide more information in its next submission to support these trends.

### 2. Manure management – $CH_4$

54. $CH_4$ emissions decreased from 1990 because of a reduction in the cattle population. The Party has applied the IPCC tier 2 method for $CH_4$ emissions for all animal species and used country-specific emission factors, which is in line with the IPCC good practice guidance. The AD used are taken from the SBV and the SFSO and are one-year average data. The calculation of EFs is based on a national methodology which includes $CH_4$ production potential and amount of volatile solids (VS) excreted combined with country-specific and default IPCC parameters. Plans to improve the uncertainty estimates are mentioned in the NIR.

### 3. Manure management – $N_2O$

55. The AD used are taken from the SBV and the SFSO. An inconsistency related to animal population (sheep, goats, and swine) data used in the calculation of $N_2O$ emissions is presented in the sector overview (paragraph 47) above. Nitrogen excretion (Nex) for sheep has been estimated at 12 kg nitrogen (N)/head/yr, which is lower than the IPCC default value of 20 kg N/head/yr. At the same time, for calculating $N_2O$ emissions, Switzerland uses a number for sheep (sheep places) that is lower than the number provided for Enteric Fermentation. The same issue was identified for swine and goats.

56. A recalculation has been made for Nex for sheep. It has been changed from 16 to 12 kg N/head/yr from 1994, without sufficient information being provided in the NIR to support this selection, which could introduce a time-series inconsistency. The NIR would benefit from more information supporting the rationale for the change.

57. The Party has applied a national method for calculating Nex/animal/year together with default IPCC EFs for estimating $N_2O$ emissions. This methodology raises several questions, e.g. Nex from fattening calves < ½ year is estimated to 8 kg N/head. From information provided by the Party and from Walther et al. (1994) it is concluded that this value is Nex per stable place for cattle from 0–3½ months and not for calves <½ year. The methodology used does not appear to introduce larger uncertainties in

the estimation of total Nex for fattening cattle. However, to improve transparency, the Party is encouraged to provide more information in the NIR explaining the rationale for the chosen methodology.

4. Agricultural soils – direct $N_2O$

58. According to the IPCC good practice guidance, the N amount of animal wastes returned to soil in CRF table 4.D should be the amount of N intentionally applied to soil adjusted to account for the amount that volatilizes as ammonia ($NH_3$) and NOx as given in table 4.B(b). The Party is therefore recommended to review its estimation methodology according to the IPCC good practice guidance or to give further explanation in the NIR on the country-specific method used.

59. Switzerland has developed its own methodology for crop residues returned to soil, and it is described in the NIR. The Party has included crop residues from cereals, fodder crops and grass. It is estimated to 34,000 tonnes N, or 34 per cent of the N applied minus N leached. The Party indicates in the CRF that only 39 per cent of the crop residues are returned to soil. Additional information is presented in annex 3.5 of the NIR, but this does not clarify the issue. The Party is encouraged to provide further explanatory information in the NIR.

60. The Party has used the same methodology for estimating emissions from N-fixing crops as for the crop residues returned to soil, including N fixation from clover in grassland. The ERT was unable to understand how the fixation is calculated, especially given that it is assumed that: "3.5 per cent of N in the dry matter of clover and 80 per cent of the N in clover stemming from biological nitrogen fixation" (NIR page 124). In CRF table 4.D the fraction of N in N-fixing crops has been estimated to less than half of the fraction of N in non-N-fixing crops. This is in contradiction to the Revised 1996 IPCC Guidelines, where N-fixing crops have a concentration which is twice that of non-N-fixing crops. Switzerland is encouraged to provide a clear description of the methodology used in the NIR.

5. Agricultural soils – indirect $N_2O$

61. The Party has used a national approach for estimating indirect $N_2O$ emissions from $NH_3$ and NOx. $NH_3$ emissions are equal to the emissions reported under CORINAIR. The emission factor $Frac_{GASM}$ is much higher than the default IPCC value and higher than the reported values of other, similar Parties. The use of the high ammonia EFs – up to 54 per cent of excreted N – may imply an underestimation of the N left for manure application, which may affect the estimated $N_2O$ emissions from leached N. The Party is recommended to give more information in the NIR on how the ammonia emissions have been estimated for the different climatic zones in Switzerland for purposes of comparison with other Parties' inventories.

# V. Land Use, Land-use Change and Forestry

## A. Sector overview

62. Switzerland has reported a LUCF inventory using the approach of the Revised 1996 IPCC Guidelines and the relevant CRF tables, instead of using the newer tables for LULUCF, which has replaced the LUCF sector, as required by decision 13/CP.9. In 2003, the LUCF sector was a net sink of 1,766.45 Gg $CO_2$ equivalent and during the previous three years (2000–2002) it was a net source. According to the NIR, this fluctuation from a source to a sink is due to natural disturbance. The size of the sink increased by 38 per cent over the period 1990 to 2003. Switzerland has provided the LUCF sector inventory estimates for all the years 1990–2003. On the basis of the CRF tables of the Revised 1996 IPCC Guidelines, the inventory reporting is nearly complete.

63. The ERT has not undertaken a detailed review of the CRF tables for the LUCF sector as they are based on the "old" CRF tables. Switzerland is encouraged to adopt the new IPCC *Good Practice*

*Guidance for Land Use, Land-use Change and Forestry* (hereafter referred to as the IPCC good practice guidance for LULUCF). The ERT also recommends the development of a land use-change matrix for Switzerland.

64. The estimates of emissions from soils are constant for the whole period 1990–2003 at 613.21 Gg per year. This is based on a carbon (C) budget prepared for 1985. Switzerland could consider conducting a new soil C inventory or budgeting for future inventories. Switzerland could also, if a new soil C inventory is not possible, explore the possibility of using the IPCC default values for soil C stock changes or use regional emission factors from neighbouring countries. Switzerland could also carry out a key category analysis using the IPCC good practice guidance for LULUCF for its next inventory.

# VI. Waste

## A. Sector overview

65. In 2003, the Waste sector emitted 3.2 per cent of total national emissions in Switzerland. Within the sector, 2.3 per cent of total national emissions came from waste incineration ($CO_2$ emissions), and 0.7 per cent from managed solid waste disposal on land (mainly $CH_4$), while 0.2 per cent was $N_2O$. From 1990 to 2003 total GHG emissions from the Waste sector showed a decreasing trend (18.2 per cent) driven by a decrease in $CH_4$ emissions. Over this period the amount of solid waste disposed to managed solid waste disposal sites was reduced from 964 Gg to 64 Gg per year (according to information provided in the NIR), which corresponds to a 93.4 per cent reduction.

66. The calculations of GHG emissions are based on country-specific methodologies and emission parameters. The methodologies used are tier 2 for solid waste, tier 1 for waste water, and tier 2 for waste incineration.

67. The CRF includes estimates of all gases and most sources from the Waste sector, as recommended by the Revised 1996 IPCC Guidelines. Not included are other sources of $CH_4$ under table 6.A, such as composting, and other sources of $N_2O$ and $CH_4$ under table 6.B, such as on-site waste-water treatment for commercial sources and industrial waste water. The Party is encouraged to implement the improvements it plans in order to be able to cover all sources comprehensively in its 2006 submission.

68. There are other, 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 and degradable organic carbon (DOC) degraded) is not entered in the CRF but is provided in the NIR. In CRF table 6.B for 2003, the $N_2O$ IEF is shown as "0.00". The Party is encouraged to implement the planned improvements.

69. The qualitative assessment of uncertainties ranks the uncertainties for emissions from the Waste sector as medium. No quantitative assessment has been done.

## B. Key categories

### 1. Solid waste disposal on land – $CH_4$

70. Solid Waste Disposal on Land has been identified as a key category by both level and trend assessment. The NIR does not provide enough information on solid waste recycling activities, although in CRF table 6.A the fraction of recycled municipal solid waste (MSW) is given as 0.43. The ERT recommends that the Party incorporate more information about recycling in the NIR. Background information on the methodology and EFs used is not fully provided. The Party is encouraged to make further improvements in these matters.

2. Waste incineration – $CO_2$

71. Waste Incineration was a key category for $CO_2$ emissions in 2003 by both level and trend assessment. Emissions arose from the incineration of municipal waste and special waste, as well as black liquor used as fuel in paper pulp production. The NIR identifies all types of waste incinerated and lists data sources. All incineration facilities are taken into account. A country-specific methodology is applied in the calculation of $CO_2$ emissions. The EFs used for each type of waste are documented. The estimates of $CO_2$ emissions from municipal waste incinerators, households and construction sites are based on the constant assumption that the fraction of fossil carbon in waste is 40 per cent and the biogenic fraction is 60 per cent. 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 Revised 1996 IPCC Guidelines. The issues of the biogenic and non-biogenic fractions of incinerated waste have only been partly addressed. The Party is encouraged to work further on these issues.

3. Solid waste disposal on land – $CO_2$

72. Solid Waste Disposal on Land has been identified as a key category by trend assessment. Due to the banning of the disposal of combustible solid waste in landfills from 1 January 2000, open burning of waste has been reduced by 99.2 per cent.

## C. Non-key categories

1. Waste-water handling – $N_2O$ and $CH_4$

73. In the existing method, GHG emissions are calculated by multiplying the number of inhabitants connected to waste-water plants by EFs. This methodology only gives a general estimate and does not take into account some important factors, for example, the maximum methane-producing potential (Bo) of each waste type and the methane conversion factors of different waste-water treatment systems.

74. In previous reviews, the Party was encouraged to fill in the AD in the CRF tables, and to reflect important information in the documentation box. Information on human sewage (population, protein consumption, N fraction, and $N_2O$ emissions) has still not been 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 on these matters.

2. Waste incineration – $N_2O$

75. Emissions are calculated using emission factors which are based on incineration plants equipped with pollution control devices to reduce emissions of nitrogen oxides (DeNOx). The National air pollution database (EMIS) is outdated and the Party is planning to improve it. The ERT encourages the improvement.

3. Other – $CO_2$

76. Switzerland is planning to include in its next submission $CO_2$ emissions from car shredding, waste recycling, and disposal of organic waste. The ERT encourages Switzerland to provide transparent and complete methodologies and data in the NIR and the CRF.

Annex

# Documents and information used during the review

## A. Reference documents

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

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

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

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

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

UNFCCC secretariat. Status report for Switzerland. 2005. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/2005_status_report_Switzerland.pdf>.

UNFCCC secretariat. Synthesis and assessment report on the GHG inventories submitted in 2005. FCCC/WEB/SAI/2005. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/sa_2005_part_i_final.pdf>.

UNFCCC secretariat. Switzerland: Report of the individual review of the GHG inventory submitted in the year 2004. FCCC/WEB/IRI/2004/CHE. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/2004_irr_in-country_review_switzerland.pdf>.

## B. Additional information provided by the Party

Switzerland provided the ERT the following technical documents:

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

Schmid, M., A. Neftel and J. Fuhrer, 2000, Lachgasemissionen aus der Schweizer Landwirtschaft, Schriftenreihe der FAL 33, 2000.

Walther, U. et al. 1994. Grundlagen für die Düngung im Acker- und Futterbau, Agrarforschung, 7, 1994.

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