

FEDERAL OFFICE FOR THE ENVIRONMENT FOEN

# **CLIMATE REPORTING SWITZERLAND VERIFICATION OF SWISS IMPLIED EMISSION FACTORS**

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## 1. INTRODUCTION

According to its obligations under the UN Climate Convention (UNFCCC/KP), Switzerland submits the Greenhouse Gas Inventory (GHG CRF) and the National Inventory Report (NIR) on an annual basis. Therein activity data, emission factors and respective emissions from all emitting sectors in Switzerland are summarised and sorted by climate relevant gases. Verification of this information is utmost relevant in order to ensure integrity of the CRF and subsequently of the NIR. Therefore the Federal Office for the Environment (FOEN) has decided to strengthen its verification process, focussing on Implied Emission Factors (IEF). EF for the conversion of activity data into emissions, play a critical role in the reporting process. Since some are difficult to obtain, a plausibility check of EF is essential. Consequently this report describes the additional activities conducted for Submission 2012 to put the Swiss EF into the international context. This will give indications for areas where further investigations are required to corroborate Swiss EFs.

This report first describes how the approach is conceptualised. Subsequently the general results from the study are presented. In a separate discussion in the NIR, the analysis of the comparison is conducted by the sectoral experts and subsequently described in the corresponding subchapters “source-specific QA/QC and verification”.

## 2. CONCEPT AND METHODS

The objective for this verification is to deliver a comprehensive reference for the IEF used in the Swiss Greenhouse Gas Inventory. It provides a comparison of Swiss EF with those used in other countries and with the default values proposed by the IPCC und UNFCCC for consideration by the sectoral experts in charge at FOEN and to the reviewers of the UNFCCC. Therefore the ultimate aim is to identify categories in which Switzerland’s IEF differ significantly from other countries IEF or the IPCC default value. These differences will be addressed and explained in the NIR. Where the difference cannot be derived from country-specific circumstances, further scrutiny will be applied and the IEF will potentially be adapted. In order to develop a comparison scheme, the following approach is chosen:

- › selection of relevant categories and subcategories of the inventory,
- › search and compilation of data from all countries and IPCC Guidelines for selected categories,
- › comparison of IEFs and detection of divergences of Swiss IEF.

Selection of relevant sectors and subsectors is required since overall there are large numbers of source and sink categories. Accordingly the Core Group of the GHG Inventory decided that only key categories will be considered, thus 95% of total Swiss emissions are encompassed in this analysis. Some of the key categories can be further disaggregated into subcategories. Particularly in the sector 5 LULUCF such subcategories exist in abundance. Therefore relevant subcategories are selected by expert judgement, according to their contribution to total emissions within the respective sector. From this selection process, a list of 82 categories resulted.

Data on IEF for all relevant categories and gases from other countries is accessible through the data base of the UNFCCC<sup>1</sup>. Furthermore the revised 1996 and 2006 IPCC Guidelines (IPCC 1997, 2006) for National Greenhouse Gas Inventories were screened for proposed EF default values. However not for all categories an equivalent IPCC default value exists. Often the default values of the guidelines are more disaggregated and very detailed (especially in IPCC 2006), thus they are not helpful for an overall comparison of aggregated implied emission factors. Data is compiled in a single Excel sheet and sorted according to the categories chosen. For each category the following information is available:

- › Concise definition of the category, process and gas to be compared,
- › IEF of all countries and respective mean, median, standard deviation and variation coefficient,
- › histogram highlighting the placement of Switzerland's IEF among other countries,
- › IPCC default values (if available),
- › deviation of Swiss IEFs from mean value.

### 3. RESULTS

The results for the sectoral experts are summarised in the Excel sheet “20120113 Auswertung IEF NIR CH 2011.xlsx” and for LULUCF “20111014 Auswertung IEF NIR CH 2011 LU-LUCF.xlsx”. In total, 82 Key Categories are deemed relevant for this analysis. The majority stems from the energy sector, but there are also numerous categories from the agriculture and LULUCF sector. In more than half of all cases the IEFs are related to CO<sub>2</sub>. Additional relevant

<sup>1</sup> <http://unfccc.int/di/FlexibleQueries.do>

gases are CH<sub>4</sub> and N<sub>2</sub>O. Finally Table 1 depicts the results from the comparison of IEFs and Table 2 lists the IEF in Switzerland that diverge more than 10% from the mean value.

| COMPARISON OF IEF   |                     |  |         |           |                    |          |       |  |
|---|---------------------|--|---------|-----------|--------------------|----------|-------|--|
| Source Category   | Direct GHG          | IPCC default                                 | CH      | Mean      | IEF dev. CH/mean % | Std Dev  | V.K.  |  |
| IA1 Gaseous Fuels   | CO2                 |  | 55.00   | 55.34     | -1%                | 3.9      | 7%    |  |
| IA1 Liquid Fuels  | CO2                 |  | 85.90   | 71.61     | -8%                | 4.1      | 6%    |  |
| IA1 Other Fuels   | CO2                 |  | 44.35   | 51.56     | -14%               | 16.8     | 33%   |  |
| IA1 Other Fuels   | N2O                 | 1.4-4  | 6.48    | 4.79      | 35%                | 2.8      | 59%   |  |
| IA2 Biomass   | N2O                 | 4.0  | 2.77    | 3.39      | -18%               | 0.9      | 27%   |  |
| IA2 Gaseous Fuels   | CO2                 |  | 55.00   | 54.85     | 0%                 | 1.9      | 3%    |  |
| IA2 Liquid Fuels  | CO2                 |  | 74.65   | 72.11     | 4%                 | 3.5      | 5%    |  |
| IA2 Other Fuels   | CO2                 |  | 79.08   | 77.38     | 2%                 | 41.1     | 53%   |  |
| IA2 Other Fuels   | N2O                 | 1.4-4  | 14.12   | 3.17      | 346%               | 2.7      | 85%   |  |
| IA2 Solid Fuels   | CO2                 |  | 96.82   | 90.91     | 6%                 | 15.0     | 16%   |  |
| IA3a Civil Aviation                                       | CO2                 |  | 73.20   | 67.92     | 8%                 | 15.9     | 23%   |  |
| IA3b Diesel   | CO2                 |  | 73.60   | 73.04     | 1%                 | 1.5      | 2%    |  |
| IA3b Gasoline   | CH4                 | 20.0   | 8.32    | 10.99     | -24%               | 5.4      | 50%   |  |
| IA3b Gasoline   | CO2                 |  | 73.90   | 70.49     | 5%                 | 2.1      | 3%    |  |
| IA3b Gasoline   | N2O                 | 0.6  | 1.14    | 3.81      | -70%               | 4.1      | 107%  |  |
| IA4a Gaseous Fuels  | CO2                 |  | 55.00   | 55.25     | 0%                 | 1.9      | 3%    |  |
| IA4a Liquid Fuels   | CO2                 |  | 73.50   | 71.87     | 2%                 | 3.7      | 5%    |  |
| IA4b Biomass  | CH4                 | 300.0  | 96.83   | 277.40    | -65%               | 96.8     | 35%   |  |
| IA4b Gaseous Fuels  | CO2                 |  | 55.00   | 55.48     | -1%                | 2.1      | 4%    |  |
| IA4b Liquid Fuels   | CO2                 |  | 73.50   | 69.13     | 6%                 | 4.6      | 7%    |  |
| IA4b Liquid Fuels   | N2O                 | 0.6  | 0.60    | 0.91      | -34%               | 0.8      | 90%   |  |
| IA4c Liquid Fuels   | CO2                 |  | 73.63   | 72.74     | 1%                 | 1.5      | 2%    |  |
| IA4c Liquid Fuels   | N2O                 | 0.6-4  | 2.39    | 7.44      | -68%               | 10.0     | 134%  |  |
| IA5   | vergleich siehe IA3 |  |         |           |                    |          |       |  |
| IB2 Oil and Natural Gas                                   | CH4                 | 300-5000                                     | 1041.67 | 3032.80   | -66%               | 8171.4   | 269%  |  |
| IB2 Oil and Natural Gas                                   | CH4                 | 72'000-133'000                               | 370.26  | 145999.93 | -100%              | 534609.1 | 366%  |  |
| IB2 Oil and Natural Gas                                   | CH4                 | 1'000-3'000                                  | 81.02   | 989.88    | -92%               | 2398.9   | 242%  |  |
| 2A1 Cement Production-CO2                                 | CO2                 | 0.5  | 0.53    | 0.53      | 0%                 | 0.01     | 3%    |  |
| 2A2 Lime Production-CO2                                   | CO2                 | 0.79-0.91                                    | C       | 0.72      |                    | 0.1      | 13%   |  |
| 2A3 Limestone and Dolomite Use-CO2                        | CO2                 | 0.4  | 0.08    | 0.41      | -81%               | 0.1      | 30%   |  |
| 2B2 Chemical Industry                                     | N2O                 | 0.005-0.009                                  | C       | 0.00      |                    | 0.0      | 62%   |  |
| 2C1 Metal Production: Steel Production                    | CO2                 | 1.8-3.6                                      | 0.14    | 0.31      | -55%               | 0.3      | 88%   |  |
| 2F1 Consumption of Halocarbons and SF6; Refrig. & AC Eq.  | HFC-125             | verschiedene Prozesse, siehe Backgroundsheet |         |           |                    |          |       |  |
| 2F1 Consumption of Halocarbons and SF6; Refrig. & AC Eq.  | HFC-134a            | verschiedene Prozesse, siehe Backgroundsheet |         |           |                    |          |       |  |
| 2F1 Consumption of Halocarbons and SF6; Refrig. & AC Eq.  | HFC-143a            | verschiedene Prozesse, siehe Backgroundsheet |         |           |                    |          |       |  |
| 2F1 Consumption of Halocarbons and SF6; Refrig. & AC Eq.  | SF6                 | Keine Daten                                  |         |           |                    |          |       |  |
| 3A Solvent and Other Product Use, Paint Application       | CO2                 |  | 0.06    | 1.62      | -96%               | 1.1      | 65%   |  |
| 3B Solvent and Other Product Use, Degreasing Dry Cleaning | CO2                 |  | NA      | 1.87      |                    | 1.1      | 61%   |  |
| 3C Solvent and Other Product Use, Chemical Product        | CO2                 |  | NA      | 1.69      |                    | 1.3      | 80%   |  |
| 3B Solvent and Other Product Use                          | N2O                 | no default                                   |         |           |                    |          |       |  |
| 4A Enteric Fermentation Dairy Cattle                      | CH4                 | 100.0  | 121.00  | 110.85    | 9%                 | 15.5     | 14%   |  |
| 4A Enteric Fermentation Non-Dairy Cattle                  | CH4                 | 48.0   | 81.00   | 56.08     | 44%                | 11.1     | 20%   |  |
| 4A Enteric Fermentation Sheep                             | CH4                 | 8.0  | 10.70   | 8.38      | 28%                | 1.9      | 22%   |  |
| 4A Enteric Fermentation Swine                             | CH4                 | 1.5  | 1.40    | 1.39      | 1%                 | 0.2      | 14%   |  |
| 4B Manure Management Dairy Cattle                         |                     | 14.0   | 25.66   | 19.80     | 30%                | 17.1     | 86%   |  |
| 4B Manure Management Non-Dairy Cattle                     |                     | 6.0  | 13.30   | 56.08     | -76%               | 5.3      | 81%   |  |
| 4B Manure Management Sheep                                |                     | 0.2  | 1.20    | 0.33      | 268%               | 0.4      | 110%  |  |
| 4B Manure Management Swine                                |                     | 3.0  | 5.43    | 7.98      | -32%               | 6.0      | 76%   |  |
| 4D Nex Dairy Cattle                                       |                     | 100.0  | 110.00  | 101.03    | 9%                 | 18.9     | 19%   |  |
| 4D Nex Non-Dairy Cattle                                   |                     | 70.0   | 80.00   | 52.90     | 51%                | 11.9     | 23%   |  |
| 4D Nex Sheep  |                     | 20.0   | 8.00    | 12.07     | -34%               | 4.7      | 39%   |  |
| 4D Nex Swine  |                     | 20.0   | 9.00    | 12.32     | -27%               | 4.2      | 34%   |  |
| 4D Nex Poultry  |                     | 0.6  | 0.50    | 0.56      | -10%               | 0.2      | 28%   |  |
| 4D FracGRAZ   |                     | no default                                   | 0.19    | 0.28      | -32%               | 0.2      | 67%   |  |
| 4D FracGASM   |                     | 0.2  | 0.33    | 0.19      | 71%                | 0.1      | 43%   |  |
| 4D FracASF  |                     | 0.1  | 0.04    | 0.07      | -45%               | 0.04     | 51%   |  |
| 4D FracEACH   |                     | 0.3  | 0.20    | 0.24      | -15%               | 0.1      | 40%   |  |
| 4D FracNCRBF  |                     | 0.0  | 0.02    | 0.03      | -21%               | 0.01     | 52%   |  |
| 4D FracNCRO   |                     | 0.0  | 0.02    | 0.04      | -63%               | 0.1      | 344%  |  |
| 4D FracR  |                     | 0.5  | 0.70    | 0.47      | 48%                | 0.2      | 50%   |  |
| 5A1 Forest Land Net Carbon Stock Change Living Biomass    | CO2                 |  | 0.10    | 1.11      | -91%               | 2.4      | 214%  |  |
| 5A1 Forest Land Net Carbon Stock Change DOM               | CO2                 |  | 0.15    | 0.09      | 71%                | 0.1      | 91%   |  |
| 5A1 Forest Land Wildfires                                 | CO2                 |  | 27.28   | 96.83     | -26%               | 52.5     | 143%  |  |
| 5A2 Forest Land Net Carbon Stock Change Living Biomass    | CO2                 |  | 0.20    | 1.72      | -88%               | 1.7      | 99%   |  |
| 5A2 Forest Land Net Carbon Stock Change DOM               | CO2                 |  | 0.10    | 0.30      | -66%               | 0.3      | 91%   |  |
| 5B1 Crop Land Net Carbon Stock Change Organic Soils       | CO2                 |  | -9.52   | -6.09     | 56%                | 3.8      | 62%   |  |
| 5C1 Grass Land Net Carbon Stock Change Living Biomass     | CO2                 |  | 0.00    | 0.07      | -96%               | 0.2      | 225%  |  |
| 5C1 Grass Land Net Carbon Stock Change Mineral Soils      | CO2                 |  | 0.00    | 0.03      | -81%               | 0.1      | 428%  |  |
| 5C1 Grass Land Net Carbon Stock Change Organic Soils      | CO2                 |  | -8.41   | -2.48     | 239%               | 2.5      | -99%  |  |
| 5C2 Grass Land Net Carbon Stock Change Living Biomass     | CO2                 |  | -0.93   | -2.17     | -57%               | 6.4      | -298% |  |
| 5C2 Grass Land Net Carbon Stock Change DOM                | CO2                 |  | -0.41   | -0.36     | 17%                | -0.03    | 66%   |  |
| 5C2 Grass Land Net Carbon Stock Change Mineral Soils      | CO2                 |  | 0.63    | 2.45      | -74%               | 5.5      | 225%  |  |
| 5C2 Grass Land Net Carbon Stock Change Organic Soils      | CO2                 |  | -8.32   | -2.20     | 278%               | 2.2      | -101% |  |
| 5E2 Settlements Net Carbon Stock Change Living Biomass    | CO2                 |  | -0.01   | 0.38      | -103%              | 0.9      | 230%  |  |
| 5E2 Settlements Net Carbon Stock Change Soils             | CO2                 |  | -0.02   | -0.14     | -86%               | 0.2      | -155% |  |
| 5F2 Other Land Net Carbon Stock Change Living Biomass     | CO2                 |  | -1.49   | -5.71     | -74%               | 16.2     | -285% |  |
| 5F2 Other Land Net Carbon Stock Change Living Biomass     | CO2                 |  | -0.36   | -2.41     | -85%               | 7.0      | -288% |  |
| 5F2 Other Land Net Carbon Stock Change Living Biomass     | CO2                 |  | -2.47   | -7.57     | -67%               | 19.0     | -251% |  |
| 6A1 Solid Waste Disposal on Land                          | CH4                 |  | NA      |           |                    |          |       |  |
| 6B21 Wastewater Handling                                  | N2O                 |  | NA      |           |                    |          |       |  |
| 6B22 Wastewater Handling                                  | N2O                 |  | 0.01    | 0.01      | 9%                 | 0.002    | 18%   |  |
| 6D Other  | CH4                 | no default                                   |         |           |                    |          |       |  |
| 7 Other   | CO2                 | no default                                   |         |           |                    |          |       |  |

Table 1: Comparison of IEF in Key Categories: IPCC default values, Swiss IEF and divergence from mean value.

| DEVIATION OF SWISS IEF FROM MEAN |  |              |                |         |                |         |          |       |     |
|----------------------------------|--|--------------|----------------|---------|----------------|---------|----------|-------|-----|
| Source Category                  | Direct GHG   | IEF          |                |         |                |         |          |       |     |
|                                  |  | IPCC default | CH             | Mean    | dev. CH/mean % | Std Dev | V.K.     |       |     |
| 5E2                              | Settlements Net Carbon Stock Change Living Biomass | CO2          |                | -0.01   | 0.38           | -103%   | 0.9      | 230%  |     |
| 1B2                              | Oil and Natural Gas                                | CH4          | 72'000-133'000 | 370.26  | 145999.93      | -100%   | 534609.1 | 366%  |     |
| 3A                               | Solvent and Other Product Use, Paint Application   | CO2          |                | 0.06    | 1.62           | -96%    | 1.1      | 65%   |     |
| 5C1                              | Grass Land Net Carbon Stock Change Living Biomass  | CO2          |                | 0.00    | 0.07           | -96%    | 0.2      | 225%  |     |
| 1B2                              | Oil and Natural Gas                                | CH4          | 1'000-3'000    | 81.02   | 989.88         | -92%    | 2398.9   | 242%  |     |
| 5A1                              | Forest Land Net Carbon Stock Change Living Biomass | CO2          |                | 0.10    | 1.11           | -91%    | 2.4      | 214%  |     |
| 5A2                              | Forest Land Net Carbon Stock Change Living Biomass | CO2          |                | 0.20    | 1.72           | -88%    | 1.7      | 99%   |     |
| 5E2                              | Settlements Net Carbon Stock Change Soils          | CO2          |                | -0.02   | -0.14          | -86%    | 0.2      | -155% |     |
| 5F2                              | Other Land Net Carbon Stock Change Living Biomass  | CO2          |                | -0.36   | -2.41          | -85%    | 7.0      | -288% |     |
| 2A3                              | Limestone and Dolomite Use-CO2                     | CO2          | 0.4            | 0.08    | 0.41           | -81%    | 0.1      | 30%   |     |
| 5C1                              | Grass Land Net Carbon Stock Change Mineral Soils   | CO2          |                | 0.00    | 0.03           | -81%    | 0.1      | 428%  |     |
| 4B                               | Manure Management Non-Dairy Cattle                 |              | 6.0            | 13.30   | 56.08          | -76%    | 5.3      | 81%   |     |
| 5C2                              | Grass Land Net Carbon Stock Change Mineral Soils   | CO2          |                | 0.63    | 2.46           | -74%    | 5.5      | 225%  |     |
| 5F2                              | Other Land Net Carbon Stock Change Living Biomass  | CO2          |                | -1.49   | -5.71          | -74%    | 16.2     | -285% |     |
| 1A3b                             | Gasoline   | N2O          | 0.6            | 1.14    | 3.81           | -70%    | 4.1      | 107%  |     |
| 1A4c                             | Liquid Fuels                                       | N2O          | 0.6-4          | 2.39    | 7.44           | -68%    | 10.0     | 134%  |     |
| 5F2                              | Other Land Net Carbon Stock Change Living Biomass  | CO2          |                | -2.47   | -7.57          | -67%    | 19.0     | -251% |     |
| 5A2                              | Forest Land Net Carbon Stock Change DOM            | CO2          |                | 0.10    | 0.30           | -66%    | 0.3      | 91%   |     |
| 1B2                              | Oil and Natural Gas                                | CH4          | 300-5000       | 1041.67 | 3032.80        | -66%    | 8171.4   | 269%  |     |
| 1A4b                             | Biomass  | CH4          | 300.0          | 96.83   | 277.40         | -65%    | 96.8     | 35%   |     |
| 4D                               | FracNCRO   |              | 0.0            | 0.02    | 0.04           | -63%    | 0.1      | 344%  |     |
| 5C2                              | Grass Land Net Carbon Stock Change Living Biomass  | CO2          |                | -0.93   | -2.17          | -57%    | 6.4      | -298% |     |
| 2C1                              | Metal Production: Steel Production                 | CO2          | 1.6-3.6        | 0.14    | 0.31           | -55%    | 0.3      | 88%   |     |
| 4D                               | FracGASF   |              | 0.1            | 0.04    | 0.07           | -45%    | 0.04     | 51%   |     |
| 1A4b                             | Liquid Fuels                                       | N2O          | 0.6            | 0.60    | 0.91           | -34%    | 0.8      | 90%   |     |
| 4D                               | Nex Sheep  |              | 20.0           | 8.00    | 12.07          | -34%    | 4.7      | 39%   |     |
| 4B                               | Manure Management Swine                            |              | 3.0            | 5.43    | 7.98           | -32%    | 6.0      | 76%   |     |
| 4D                               | FracGRAZ   |              | no default     | 0.19    | 0.28           | -32%    | 0.2      | 67%   |     |
| 4D                               | Nex Swine  |              | 20.0           | 9.00    | 12.32          | -27%    | 4.2      | 34%   |     |
| 5A1                              | Forest Land Wildfires                              | CO2          |                | 27.28   | 36.83          | -26%    | 52.5     | 143%  |     |
| 1A3b                             | Gasoline   | CH4          | 20.0           | 8.32    | 10.99          | -24%    | 5.4      | 50%   |     |
| 4D                               | FracNCRBF  |              | 0.0            | 0.02    | 0.03           | -21%    | 0.01     | 52%   |     |
| 1A2                              | Biomass  | N2O          | 4.0            | 2.77    | 3.39           | -18%    | 0.9      | 27%   |     |
| 4D                               | FracLEACH  |              | 0.3            | 0.20    | 0.24           | -15%    | 0.1      | 40%   |     |
| 1A1                              | Other Fuels  | CO2          |                | 44.35   | 51.56          | -14%    | 16.8     | 33%   |     |
| 4D                               | Nex Poultry  |              | 0.6            | 0.50    | 0.56           | -10%    | 0.2      | 28%   |     |
| 5C2                              | Grass Land Net Carbon Stock Change DOM             | CO2          |                | -0.41   | -0.36          | 17%     | -0.03    | 66%   |     |
| 4A                               | Enteric Fermentation Sheep                         | CO2          |                | 8.0     | 10.70          | 8.38    | 28%      | 1.9   | 22% |
| 4B                               | Manure Management Dairy Cattle                     |              | 14.0           | 25.66   | 19.80          | 30%     | 17.1     | 86%   |     |
| 1A1                              | Other Fuels  | N2O          | 1.4-4          | 6.48    | 4.79           | 35%     | 2.8      | 59%   |     |
| 4A                               | Enteric Fermentation Non-Dairy Cattle              | N2O          |                | 48.0    | 81.00          | 56.08   | 44%      | 11.1  | 20% |
| 4D                               | FracR  |              | 0.5            | 0.70    | 0.47           | 48%     | 0.2      | 50%   |     |
| 4D                               | Nex Non-Dairy Cattle                               |              | 70.0           | 80.00   | 52.90          | 51%     | 11.9     | 23%   |     |
| 5B1                              | Crop Land Net Carbon Stock Change Organic Soils    | CO2          |                | -9.52   | -6.09          | 56%     | 3.8      | -62%  |     |
| 4D                               | FracGASM   |              | 0.2            | 0.33    | 0.19           | 71%     | 0.1      | 43%   |     |
| 5A1                              | Forest Land Net Carbon Stock Change DOM            | CO2          |                | 0.15    | 0.09           | 71%     | 0.1      | 91%   |     |
| 5C1                              | Grass Land Net Carbon Stock Change Organic Soils   | CO2          |                | -8.41   | -2.48          | 239%    | 2.5      | -99%  |     |
| 4B                               | Manure Management Sheep                            |              | 0.2            | 1.20    | 0.33           | 268%    | 0.4      | 110%  |     |
| 5C2                              | Grass Land Net Carbon Stock Change Organic Soils   | CO2          |                | -8.32   | -2.20          | 278%    | 2.2      | -101% |     |
| 1A2                              | Other Fuels  | N2O          | 1.4-4          | 14.12   | 3.17           | 346%    | 2.7      | 85%   |     |

Table 2: List of Swiss IEFs that deviate more than  $\pm 10\%$  from the mean value.

## LITERATURE

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

**IPCC 1997:** Greenhouse Gas Inventory Reference Manual, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reporting Instructions. Intergovernmental Panel on Climate Change. <http://www.ipcc-nggip.iges.or.jp/public/gl/invs4.htm>

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