UNITED NATIONS

Framework Convention on Climate Change

Distr.
GENERAL

FCCC/SBSTA/1999/INF.2
25 February 1999

ENGLISH ONLY

SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE
Tenth session
Bonn, 31 May - 11 June 1999
Item 4 (a) of the provisional agenda

# NATIONAL COMMUNICATIONS FROM PARTIES INCLUDED IN ANNEX I TO THE CONVENTION

## GUIDELINES FOR THE PREPARATION OF NATIONAL COMMUNICATIONS

## Comparison of greenhouse gas inventories submitted by Parties using own national methodologies with those obtained using the IPCC default methodologies

**Note by the secretariat**

CONTENTS

# I. INTRODUCTION

## A. Mandate

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its seventh session, invited Annex I Parties to make available to the secretariat by 6 June 1998, for purposes of comparison and transparency, their complete 1996 greenhouse gas (GHG) inventories obtained using, when possible, best available methodologies and those obtained using the current Intergovernmental Panel on Climate Change (IPCC) default methodologies. The SBSTA requested the secretariat to draw upon the roster of experts to analyse and compare the results and assess the adequacy of information and the implications for meeting emissions limitation or reduction objectives (FCCC/SBSTA/1998/14, para. 16 (b)). At its eighth session, the SBSTA extended the deadline of the above-mentioned submissions to 15 August 1998 (FCCC/SBSTA/1998/6, para. 40 (c)).

2. The SBSTA, also at its eighth session, requested the secretariat to organize a workshop with the participation of methodological experts from the roster, as well as from other relevant organizations, to develop proposals to resolve the methodological issues identified by Parties and by the secretariat while processing GHG inventories included in second national communications. The conclusions of such a workshop, and of any workshop organized by the secretariat related to possible additions and/or amendments to the revised guidelines for the preparation of national communications by Annex I Parties (decision 9/CP.2) were to be made available for the tenth session of the SBSTA (FCCC/SBSTA/1998/6, para. 40 (d)).

## B. Background

3. In response to the above mandate, the secretariat prepared an informal paper: "Comparison of GHG inventories submitted by Parties using own national methodologies with those obtained using the IPCC default methodologies" based on the submissions received from Parties.

4. The informal paper was presented to experts at a workshop organized by the secretariat on methodological issues related to GHG inventories, that was held in Bonn, from 9 to 11 December 1998. The present note, prepared by the secretariat, is a revised version of the informal paper and considers comments provided by experts from the roster.

## C. Scope of the note

5. This note provides a comparison of GHG emission estimates obtained using national methodologies and the current IPCC default methodologies based on submissions[1] from five

[1] The submissions from Norway and the United Kingdom were distributed at the workshop as they contained detailed supplementary explanations. New Zealand provided detailed explanations on the differences in estimates arising from the use of the two different methodologies, which were also distributed.

Parties (Austria, New Zealand, Norway, Switzerland and the United Kingdom of Great Britain and Northern Ireland) and one international programme (IPCC-OECD-IEA Programme for National Greenhouse Gas Inventories). The paper analyses the differences in annual inventories, as well as differences in the trend over the period 1990 to 1996, resulting from the use of different methodologies.

### D. Possible action by the SBSTA

6. The SBSTA may wish to consider the information provided in this note and to determine whether additional analyses are warranted. If so, the SBSTA may wish to request Parties that have not yet provided the data mentioned above, to provide such data before its eleventh session. It may also wish to consider broadening the scope of the current request to Parties to include inventory data for the period 1990-1996, instead of for a single year. This would enable a further assessment of the impacts of different methods on trends. The SBSTA may also wish to provide guidance to the secretariat on any future analyses including the questions it wishes the secretariat to address. Such analysis could be reflected in the work programme of the secretariat in the next biennium in the context of the work on methodological issues related to Articles 5, 7 and 8 of the Kyoto Protocol (FCCC/SB/1999/2).

## II. DIFFERENCES IN THE SCOPE OF SUBMISSIONS FROM PARTIES

### A. Coverage

7. In response to the request noted in paragraph 1, the submissions of Parties varied, regarding the gases and sectors reported on, degree of completeness, approach (reference or sectoral) used for comparing results in the energy sector, and level of explanation given for the differences arising from the comparison.

8. The IPCC Guidelines for National Greenhouse Gas Inventories were developed for a wide range of users, and they allow Parties great flexibility in estimating their GHG inventories.[2] Parties may use default or more advanced methodologies, either from the IPCC Guidelines, which provide methodologies with different levels of complexity (tiers), or national or other compatible methodologies. The choice of emission factors is also flexible. This means that even the application of IPCC default methodologies may imply some differences in their use.

9. Two Parties, Norway and the United Kingdom, provided their complete 1996 carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$) emissions inventories estimated by using both the IPCC default and national methodologies. These Parties went beyond the SBSTA request by estimating their complete inventories for the years 1990 to1996 inclusive. This provides a preliminary opportunity to assess the implications of using different methodologies,

---

[2] Detailed information on the multiple approaches which Parties can use to estimate their emissions in each different sector of their GHG inventories, is provided in document FCCC/SBSTA/1998/7, paragraph 13.

not only for annual emission estimates, but also for analyses of trends. The United Kingdom[3] also provided estimates of hydrofluorocarbon (HFC), perfluorocarbon (PFC) and sulphur hexafluoride ($SF_6$) emissions based on the IPCC default and a national methodology. The secretariat did not include the comparison of these gases in the main tables of this paper because this information was provided by only one Party. However, the information is presented in the annex to this paper.

10. New Zealand[3] submitted data on $CO_2$, $CH_4$ and $N_2O$ emissions from the *energy* sector, and $CH_4$ emissions from the *agriculture* sector, that were obtained by using the IPCC default and national methodologies. Two Parties, Austria and Switzerland, calculated their $CO_2$ emissions from the *energy* sector using the IPCC reference approach. The secretariat compared these estimates with those estimates provided in the annual 1996 inventory, which were estimated using national methodologies. The IPCC-OECD-IEA Programme for National Greenhouse Gas Inventories conducted a comparison between the IPCC default methodology and national methodologies used by Australia and the United States of America for estimating $CH_4$ emissions from livestock for 1990.

11. When comparing national methodologies to the IPCC default methodologies, the most important elements that differ are emission factors, calculation methods, and allocation of certain emission sources to sectors. This paper does not try to isolate the effect of each of these elements. Nevertheless, for purposes of consistency, the secretariat, as well as some Parties which submitted comparisons, has made adjustments to the estimates in order to consider emissions from source categories in the same sector. Therefore, the comparison of methodologies for total GHG emissions shows, where possible, the overall effect on emission estimates of using different calculation methods and emission factors. Nevertheless, the effect of including additional source categories in the two compared methodologies is also considered.

12. An overview of gases, sectors and years for which data comparison between IPCC default methodologies and national methodologies is available in submissions from Parties as provided in table 1.

---

[3] Emission estimates from international bunkers and for the precursor gases and sulphur dioxide ($SO_2$), obtained by using default methodologies, were provided by New Zealand and the United Kingdom, but have not been considered in this paper.

**Table 1. Gases, sectors and years for which data comparison is available in submissions by Parties**

| Gas | Sector | Austria | New Zealand | Norway | Switzer-land | United Kingdom | IPCC-OECD-IEA | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Australia | United States |
| **$CO_2$** | Energy reference approach | X | X | X | X | X | | |
| | Energy sectoral approach | | X | X | | X | | |
| | Non-energy | | | X | | X | | |
| **$CH_4$** | Energy | | X | X | | X | | |
| | Agriculture | | X | X | | X | X | X |
| | Waste | | | X | | X | | |
| **$N_2O$** | Energy | | X | X | | X | | |
| | Agriculture | | | X | | X | | |
| **Year/s** | | 1996 | 1996 | 1990 - 1996 | 1996 | 1990 -1996 | 1990 | 1990 |

## B. National methodologies used by Parties for estimating GHG emissions

13. An overview of the national methodologies[4] used by Parties is shown in table 2. Details on methodologies used by Parties are provided in the annex, which includes comparison tables between the national and the default methodology for each Party.

[4] The information on national methodologies used by Parties is taken from second national communications, supplementary material and submissions on comparisons provided by Parties.

**Table 2. National methodologies used by Parties for estimating national GHG emissions**

| Sector | Austria | New Zealand | Norway | Switzerland | United Kingdom |
|---|---|---|---|---|---|
| **Energy**<br>Methodology | CORINAIR | Tier 1 (sectoral) | CS, (similar to Tier 2) | CORINAIR | national/ CORINAIR |
| Emission factors | CS / CORINAIR defaults | CS / IPCC defaults | CS | CORINAIR defaults /CS | CS/defaults |
| **Energy - Reference approach** | | EF: CS / IPCC defaults | | EF: CORINAIR defaults | EF: CS / IPCC defaults |
| **Fugitive fuel emissions**<br>Methodology | | Tier 1 | Tier 1 / Tier 3 | | CS |
| Emission factors | | CS / IPCC defaults | CS | | CS |
| **Industrial processes**<br>Methodology | | | Tier 1 | | CS |
| Emission factors | | | CS | | CS/defaults |
| **Agriculture**<br>Methodology | | CS | Tier1/ CS (similar to tier 2) | | Tier 2 |
| Emission factors | | CS | CS/IPCC defaults | | IPCC defaults/CS |
| **Waste**<br>Methodology | | | CS | | CS |
| Emission factors | | | CS | | CS |

*Note:*
CS stands for country-specific. EF stands for emission factors.
Tiers refer to the IPCC 1996 Revised Guidelines for National Greenhouse Gas Inventories.

## C. Default methodologies used by Parties

14. Parties estimated their default inventories by following the methodology recommended in the IPCC Guidelines, but there were differences in approach. This is a consequence of the different levels of complexity identified in the IPCC Guidelines. An overview of the approaches used by Parties when estimating and reporting their GHG emissions according to the methodologies provided in the IPCC Guidelines is given in table 3.

**Table 3. Approaches used by Parties for obtaining default estimates following the IPCC Guidelines**

| Sector | Austria | New Zealand | Norway | Switzerland | United Kingdom[a] |
|---|---|---|---|---|---|
| **Energy** Methodology | Reference approach | Sectoral[b] tier 1 | Reference and Sectoral approach tier 1 | Reference approach | Sectoral[b] tier 1 |
| Presentation of results | Worksheet 1-1 | Worksheets 1-2, 1-3 | Worksheets 1-1, 1-2, 1-3 | Worksheet 1-1 | Sectoral table, worksheets 1-2, 1-3 |
| **Fugitive fuel emissions** Methodology | | Tier 1 | Tier 1 | | Tier 1 |
| Presentation of results | | Worksheets 1-6, 1-7 | Worksheet 1-7 | | Sectoral table, worksheets 1-6, 1-7 |
| **Industrial processes** Methodology | | | Tier 1a / 1b | | Tier 1 |
| Presentation of results | | | Worksheet 2-1, 2-2, 2-3, 2-4, 2-6, 2-9, 2-11, 2-10, 2-7 | | Sectoral table, worksheets 2-1 to 2-4, 2-6 to 2-11 |
| **Agriculture** Methodology | | Tier 1 | Tier 1 | | Tier 1 |
| Presentation of results | | Worksheet 4-1 | Worksheet 4-1, 4-5, 4-5A, 4-5B | | Sectoral table, worksheets 4-1, 4-5, 4-5A, 4-5B |
| **Waste** Methodology | | | Tier 1 | | Tier 1 |
| Presentation of results | | | Worksheet 6-1, 6-1A, 6-1C, 6-2, 6-4 | | Sectoral table, worksheets 6-1, 6-1C, 6-2, 6-4 |

[a] The United Kingdom also provided estimates from the *land-use change and forestry* sector based on the IPCC default methodology. This sector has not been considered in this report as methodological work is still in progress in this sector. The Party further submitted IPCC worksheets for estimation of HFCs, PFCs and SF6. As these gases were not considered in the comparison, these worksheets have not been listed in this table.

[b] New Zealand and the United Kingdom also provided an estimate for $CO_2$ emissions from *energy* using the reference approach (worksheet 1-1) but applying mainly own emission factors. The comparison with the national inventory was limited to estimates obtained using the sectoral approach.

# III. COMPARISON

## A. Differences in annual estimates

15. The percentage differences between the IPCC and national emission estimates for each individual sector are listed in table 4. For each source category considered, those differences show a high degree of variation from Party to Party.

16. In the *energy sector (fuel combustion* and *fugitive fuel emissions)* $CO_2$ emissions estimated using IPCC default methodologies range from 4 per cent below to plus 5 per cent above national estimates. In Austria,[5] however, an important deviation of approximately 19 per cent is observed. This difference appears to be the consequence of a different allocation of emissions to different sectors in the two methodologies. In the national methodology, $CO_2$ emissions from the use of hard coal in the iron and steel industries are included in the *industrial processes* sector, while in the reference approach all hard coal is considered in the *energy* sector. Where a reference approach was used, estimates for $CO_2$ fuel combustion emissions were always higher than when using the sectoral approach.[6] In contrast, when using the sectoral approach applying the default methodology, estimates were lower than national ones for two out of three Parties.

17. For $CH_4$ and $N_2O$ emissions, the percentage differences in estimates are generally much higher than for $CO_2$. However, these differences have large variations among sectors. For example, differences between $CH_4$ estimates obtained using different methodologies in *enteric fermentation* are generally lower than for *manure management,* whilst differences in $N_2O$ estimates in *agricultural soils* are generally lower than for *fuel combustion*.

18. Analysis revealed that different allocations of source categories to sectors, or the inclusion in the national methodologies of additional source categories not part of the IPCC default methodologies, had the most significant impact on differences in estimates between the national and default methodologies, therefore causing higher differences than the use of different calculation methods or emission factors (see annex, table 3.A). Examples of the first case are emissions resulting from the production of iron and steel, and, of the second case, waste incineration, industrial waste or offshore oil and gas.

---

[5] Austria provided an additional explanation, stating that as they used CORINAIR it is not possible to clearly differentiate between emissions resulting from combustion and from industrial processes in the industrial sector.

[6] Detailed explanations of these differences were provided in the submissions of Norway, “Emissions of greenhouse gases in Norway - estimated by the default IPCC methodologies and the Norwegian national inventory model”, and the United Kingdom, “Comparison between the IPCC default and UK detailed inventories 1990-1996" on pages 13-15 and 9, respectively.

19. For the sake of consistency, the secretariat applied adjustments for source categories not included in one or the other methodology to the estimates provided by Norway and the United Kingdom, being the only Parties that provided full GHG inventories.[7] The application of adjustments ensures that the same sources have been accounted for with both methodologies and that the deviations between the methodologies are mainly a consequence of the use of different emission factors and calculation methods, and not of different source accounting.

[7] Norway and the United Kingdom also considered adjustments in their respective submissions, where detailed explanations on this issue can be found. For the United Kingdom, the secretariat used the adjusted values provided by the Party. These adjustments exclude the source categories not considered in the IPCC but considered in the national methodology. In order to apply the same kind of adjustments to both Parties' estimates, values provided by Norway have basically been adjusted by excluding from the national estimates those source categories not included in the IPCC methodology.

**Table 4. Differences between IPCC default and national estimates for 1996**
(Difference relative to the estimates obtained using national methodologies, national estimates = 100 per cent)

| Gas | Sector | Difference in annual estimates (per cent) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Austria | New Zealand | Norway | Switzer-land | United Kingdom | IPCC-OECD-IEA 1990 | |
| | | | | | | | Austra-lia[a] | United States[a] |
| $CO_2$ | **Fuel combustion reference approach** | 18.8 | | 5.0 | 2.2 | | | |
| | **Fuel combustion sectoral approach** [b] | | -0.2 | 0.7 | | -4.0 | | |
| | **Industrial processes** | | | | | 120 | | |
| | **Non-combustion (industrial processes and other)** [b] | | | -0.8 | | | | |
| | **Total (fuel combustion and other sectors)** [b] | | | **0.4** | | **- 1.3** | | |
| $CH_4$ | **Fuel combustion** | | -42 | -49 | | -18.8 | | |
| | **Fugitive: oil and gas** | | -65 | 75.0 | | 2.3 | | |
| | **Coal mining** | | -43 | 0 | | -1.4 | | |
| | **Enteric fermentation** | | -34.5 | -4.3 | | 1.6 | -6.6 | -3.8 |
| | **Manure management** | | 927 | -25.0 | | 4.6 | 263 | -43.1 |
| | **Total livestock** | | -23 | -7.3 | | 2.0 | 0.6 | -16.2 |
| | **Waste** [b] | | | -27.0 | | 10.0 | | |
| | **Total adjusted** [b] | | | **-32.7** | | **5.1** | | |
| $N_2O$ | **Fuel combustion** | | -59 | -89 | | -44.6 | | |
| | **Agricultural soils** | | | 27.3 | | 27.0 | | |
| | **Total adjusted** [b] | | | **-1.6** | | **4.0** | | |
| **Aggregate GHG ($CO_2$ equivalent)** [b] | | | | **-5.2** | | **-0.2** | | |

[a] Comparison carried out by the IPCC-OECD-IEA Programme for National Greenhouse Gas Inventories: "Comparison of methane emissions from agriculture using IPCC default methodology and two national methodologies", Pierre Boileau, OECD. The comparison is based on 1990 instead of 1996 figures. Results given in this table differ slightly from those given in the IPCC-OECD-IEA submission as the secretariat used another approach for estimating the differences between methodologies, setting the national estimates at 100 per cent.

[b] Adjustments made for sources not included in the default or the national methodology, as explained in paragraph 18 of this paper. For further details on the adjustments made for Norway, please refer to annex, table 3.A.

20. The allocation of source categories to different sectors when using different methodologies does not affect the total GHG emissions, either on a gas-by-gas basis or on an aggregated $CO_2$ equivalent basis. However, different allocations could lead to large differences in the estimates of GHG emissions for individual sectors or subsectors.

21. On the other hand, the inclusion or omission of particular source categories could lead to large differences in emission estimates by sector, as well as in totals on a gas-by-gas basis or aggregate $CO_2$ equivalent basis. For example, in some cases, the IPCC default methodologies do not include some source categories which were included in the national methodologies of Norway and the United Kingdom, causing differences in estimates. The magnitude of these differences can be observed in table 5, where the column "without adjustments" presents the differences in results with the inclusion of additional source categories in the national methodologies. These results indicate the importance of complete reporting of all existing source categories, because without the adjustments the differences appear to be larger.

**Table 5. Differences in annual total national GHG emission estimates between national and default methodologies deriving from the inclusion of additional source categories (1996)**

| **Gas** | | **Difference in annual estimates (per cent)[a]** | | | |
|---|---|---|---|---|---|
| | | **Norway** | | **United Kingdom** | |
| | | Without adjustments | With adjustments[b] | Without adjustments | With adjustments[b] |
| **$CO_2$** | Total | -5.1 | 0.4 | -2.7 | -1.3 |
| **$CH_4$** | Total | -45 | -33 | 5.1 | 5.1 |
| **$N_2O$** | Total | -30 | -1.6 | 4.2 | 4.0 |
| **Aggregate GHG ($CO_2$ equivalent)** | | -15 | -5.2 | -1.3 | -0.2 |

[a] Difference relative to the estimates obtained using national methodologies, which are set at 100 per cent in this table.

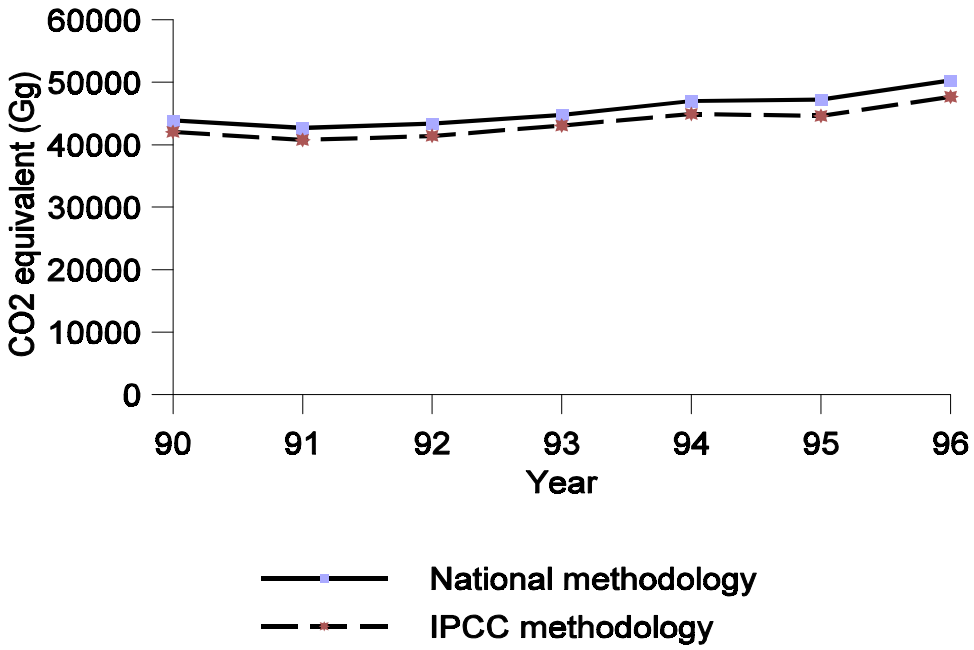
[b] Adjustments made for sources not included in the default or the national methodology, as explained in paragraph 18 of this paper. For further details on the adjustments made for Norway please refer to annex, table 3.A. In both cases, the "with adjustments" column reflects only the differences deriving from the use of different emission factors and calculation methods.

## B. Differences in trends[8] over the period 1990 to 1996

22. For the two cases examined, Norway and the United Kingdom, it appears that differences in emission estimates for various sectors using two methodologies are much lower as related to a trend over several years, 1990 to 1996, than for an individual year, as can be seen in table 6.

23. Estimates of aggregate emissions, expressed in $CO_2$ equivalent, obtained with the IPCC default methodologies and with the more comprehensive methodologies of Norway and the United Kingdom range from approximately 6 per cent lower to 1 per cent higher for a single year. However, when looking at trends, differences between the results obtained with the two methodologies are much smaller, the trend in the default estimates being 0.5 to 1.2 percentage points lower than the trend obtained using the national methodologies. The differences in absolute units are illustrated in figures 1 and 2. From both figures, it is evident that the use of either methodology is no impediment to tracking the trend of aggregate GHG emissions over a given period of time.

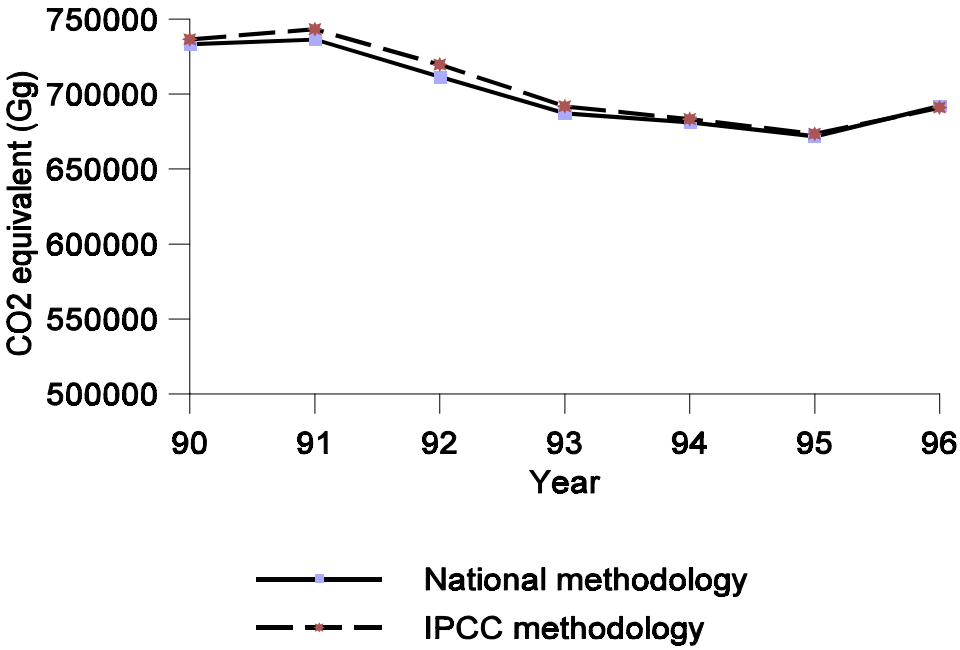
**Figure 1. Trend in aggregate GHG emissions[a] estimated with the IPCC and the national methodology in Norway**




[a] This figure is based on adjusted values (for adjustments see annex, tables 3.A and 4.A).

[8] The term "trend" in this report indicates the change of GHG emissions over the period 1990 to 1996. This approach is used because the estimation of inventory data over a given period of years, such as in commitment periods, will be an important element for consideration of compliance under the Kyoto Protocol.

**Figure 2. Trend in aggregate GHG emissions[a] estimated with the IPCC and the national methodology in the United Kingdom**




[a] Based on adjusted values provided by the Party.

24. Regarding $CO_2$ emissions, similarities in the trend can be found for all relevant emission sources considered. When using the IPCC default methodology, the percentage reductions or increases in relation to the 1990 base year are fairly close to trends obtained with the national methodology for both Parties considered here. This is true both for the individual source categories of *fuel combustion* and *industrial processes*, and for total $CO_2$ emissions. In the United Kingdom, total $CO_2$ emissions are shown to have decreased by 3.1 per cent using the national methodology and 3.7 per cent using the default methodology between 1990 and 1996, whereas for Norway the percentage changes were increases of 14.9 and 15.8 per cent, respectively. Therefore, for total $CO_2$ emissions, the difference in the trend was 0.9 and -0.6 percentage points for Norway and the United Kingdom, respectively.

25. The situation is different with respect to trends in $CH_4$ emissions, for which the agreement between the different methodologies is lower than for $CO_2$ (-9.9 and 1.9 percentage points difference for Norway and the United Kingdom, respectively). Furthermore, the situation is different for different source categories. For both Parties, significant discrepancies between default and national estimates have been found for individual source categories. There are similarities in the trends for *fuel combustion* (-1.3 and -4.8 percentage points), *coal mining* (0.0 and -0.4 percentage points) and *livestock* (0.6 and -0.7 percentage points), but significant discrepancies have been found for individual source categories, for example for *oil and natural*

*gas* and *waste*. In both sectors, no common pattern has been found; opposite trends emerged from the use of the default methodology for one of the Parties, while for the other Party the trend was similar to the national one[9] (see annex, tables 4.A and 7.A).

26. The differences in the emission trends for total $N_2O$ emissions are in a similar range as for $CH_4$ (7.0 and 2.6 percentage points lower for Norway and the United Kingdom, respectively). Opposite trends in emissions estimated with the two methodologies have not been observed for any single source category. However, in some cases, the difference in the trends was significant, such as for *fuel combustion* in Norway, where the default methodology gave a trend 42 percentage points lower than the national one. On the other hand, in the case of Norway, the use of different methodologies would result in opposite trends for total $N_2O$ emissions if source categories included in the national but not in the default methodologies were not accounted for.

[9] In the case of Norway, $CH_4$ emissions from the waste sector showed an increase of 44 per cent when using the national methodology, but a decrease of 8 per cent using the IPCC default methodology. For oil and natural gas the trends were similar, showing an increase of 60 and 56 per cent with the national methodology and the IPCC default methodology, respectively. By contrast, for the United Kingdom, emissions from the waste sector decreased by 9 and 14 per cent when using the national methodology and the IPCC default methodology, respectively. For oil and natural gas the use of the national methodology resulted in a decrease of 8 per cent over the period 1990 to 1996, compared with an increase of 64 per cent using the IPCC default methodology.

**Table 6. Range of differences in annual estimates obtained using national and default methodologies, and differences in the trend over the period 1990 to 1996 for Norway and the United Kingdom**

| Gas | Sector | Range of differences in annual estimates over the period 1990 to 1996 [a] (per cent) | | Difference in the trend over the period 1990 to 1996 (percentage points) [b] | |
|---|---|---|---|---|---|
| | | Norway | United Kingdom | Norway | United Kingdom |
| $CO_2$ | Fuel combustion reference approach | 4.2 to 18.1 | | 0.9 | |
| | Fuel combustion sectoral approach [c] | 0.1 to 1.1 | | 0.5 | |
| | Non-combustion (industrial processes and other) [c] | -3.5 to 2.6 | | 2.6 | |
| | Total (fuel combustion and other sectors) [c] | -0.5 to 0.9 | -0.6 to -1.3 | 0.9 | -0.6 |
| $CH_4$ | Fuel combustion | -50 to -47 | -12 to -7 | -1.3 | -4.8 |
| | Fugitive: oil and gas | 25 to 80 | -43 to 2.3 | -4.4 | 72 |
| | Coal mining | 0 | -1.4 to 1.0 | | -0.4 |
| | Enteric fermentation | -4.6 to -3.4 | | 0.3 | |
| | Manure management | -31 to -20 | | 2.4 | |
| | Total livestock | -8.3 to -6.7 | 2.0 to 4.4 | 0.6 | -0.7 |
| | Waste [c] | -27 to 13.7 | 10.1 to 16.7 | -52 | -5.2 |
| | Total adjusted [c] | -34 to -26 | 2.8 to 5.1 | -9.9 | 1.9 |
| $N_2O$ | Fuel combustion | -89 to -84 | | -41.9 | |
| | Industrial processes | | -13.7 to 5.7 | | -8.8 |
| | Agricultural soils/ agriculture | 22.5 to 27.8 | 25.5 to 33 | 3.3 | 1.9 |
| | Total adjusted [c] | -1.6 to 5.3 | 4.3 to 14.8 | -7.0 | -2.6 |
| **Aggregate GHG ($CO_2$ equivalent)[c]** | | **-5.6 to -3.8** | **-0.1 to 1.1** | **-1.2** | **-0.5** |

[a] Difference relative to the estimates obtained using national methodologies, which are set at 100 per cent in this table. A positive difference denotes that estimates obtained with the IPCC default methodology are higher than those obtained with the national one.

[b] Results given in this column present the difference between the trend (in per cent) obtained using national methodologies and the trend (in per cent) using IPCC default methodologies, expressed as percentage points.

[c] Adjustments made for sources not included in the default or the national methodology, as explained in paragraph 18 of this paper. For further details on the adjustments made for Norway please refer to annex, table 4.A.

For the cases of Norway and the United Kingdom, it has also been observed that the inclusion of additional source categories in national methodologies does not have a large impact on the trend of aggregate GHG emissions expressed as $CO_2$ equivalent. For example, in the case of Norway, the results in the trends obtained using the IPCC default methodology without inclusion of the additional source categories considered in the national methodology only differ by 0.3 percentage points[10] in relation to the national methodology (see annex, table 4.A). It is clear that the impact of a given source category on the aggregate GHG emissions of a Party will depend on the relative contribution of this source category to the Party's aggregate GHG emissions.

## IV. CONCLUSIONS

### A. Annual estimates

27. Differences in annual estimates between sectors arising from the use of different methodologies vary widely according to the sectors and the specific greenhouse gases. For $CO_2$ emissions from the *fuel combustion* sector these differences are generally lower than 5 per cent, while in the case of $CH_4$ and $N_2O$ differences in estimates are mostly in the order of several tens of per cent.

28. Extremely high differences in annual estimates arising from the use of different methodologies have been detected for particular sectors or subsectors, such as $CH_4$ emissions from *oil and natural gas* or *manure management*, and $N_2O$ emissions from the *fuel combustion* sector. For these sectors, emission factors and calculation methods are based on completely different assumptions in the two methodologies.[11] Depending on the relative contribution of a given source category to a Party's aggregate emissions, the impact on the annual national inventory can be more or less significant.

29. Results obtained from Norway and the United Kingdom reveal that differences in estimates for total annual $CO_2$ emissions are small, default estimates being approximately 0.4 per cent higher and 1 per cent lower than estimates obtained with the national methodology. Results obtained for total $CH_4$ emissions differ from Party to Party, showing differences of 5 to -33 per cent. In the case of total $N_2O$ emissions, differences are lower than 5 per cent for both Parties. This small difference does not reflect agreement between methodologies for this gas, but is mainly an effect of positive values cancelling out negative values at the sectoral level when

---

[10] The difference of 0.3 percentage points between the increases of aggregate GHG emissions expressed as $CO_2$ equivalent (11.7 per cent with the national methodology and 12 per cent with the IPCC default methodology) are equivalent to a difference of 2.5 per cent, setting the increase obtained with the national methodology at 100 per cent.

[11] Different assumptions in national methodologies refer to country-specific studies or to consideration of country-specific conditions, which results in different and more detailed disaggregation of certain source-categories. For example, in the agricultural sector, when estimating $CH_4$ emissions from manure management, some Parties take into account their national conditions where manure is voided on pasture and degrades aerobically, and therefore produces little or no $CH_4$ emissions.

aggregating to total $N_2O$ emissions.

30. The different allocation or inclusion in the national methodologies of additional source categories which are not part of the IPCC default methodologies have the most significant impact on the differences between annual estimates obtained using the national and default methodologies. These appear to cause higher differences in annual emission estimates than the use of different methodologies or emission factors. This fact highlights the importance of full reporting of all relevant GHG emission source categories by Parties.

## B. Trends

31. GHG emission estimates obtained using the IPCC default methodologies differ from estimates obtained using national methodologies to a lesser extent for a consecutive set of years (such as a commitment period) than for annual estimates. Even if the percentage deviation in annual estimates is very high, it may not affect the emission trend.

32. The results in estimates of aggregate GHG emissions expressed in terms of $CO_2$ equivalent obtained using IPCC default methodologies and the more comprehensive methodologies of Norway and the United Kingdom show differences of around 1 percentage point (-1.2 and - 0.5 percentage points, respectively), for the years 1990 to 1996 as a whole period, described as the "trend".

33. Trends in $CO_2$ emissions obtained using IPCC defaults and the national methodologies of Norway and the United Kingdom are also fairly close, the differences in the trends being 0.9 percentage point for Norway and 0.6 percentage point for the United Kingdom. The situation is slightly different with respect to $CH_4$ and $N_2O$ emissions, where the trends differ by 9.9 percentage points (Norway) and 1.9 percentage points (United Kingdom) for $CH_4$, and by 7 percentage points and 2.6 percentage points for $N_2O$. However, since the relative share of these greenhouse gases in the aggregate GHG emissions of these two Parties is less significant, the differences in the respective trends are not significant enough to affect the aggregate.

34. For most of the source categories, similarities in the results using the two methodologies have been found for the three main greenhouse gases $CO_2$, $CH_4$ and $N_2O$. In general, the trends in emission estimates obtained using national and IPCC default methodologies have the same direction (+ or -) in relation to the base year. For the *waste* sector and for fugitive $CH_4$ emissions from *oil and natural gas* opposite trends emerged from the use of the default methodology for one of the Parties. Values for trends of greenhouse gas emissions estimated using national and IPCC defaults methodologies differed substantially for the *waste* sector for both Parties and for $N_2O$ *fuel combustion* and *industrial processes* emissions for one Party.

35. The above-mentioned conclusions could have important policy implications for the way in which GHG inventory data are considered. However, it must be borne in mind that they were based upon the comparison of only two Parties. More comparisons would be necessary in order to draw definitive conclusions and to properly assess the implications.

36. The implications presented below may be relevant for the purpose of analysing trends and for meeting emissions limitation or reduction commitments under the Kyoto Protocol. However, the implications should not necessarily be applied to emissions trading and to accounting for emission reductions through projects under Article 6 or 12 of the Protocol.

37. Taking into account the fact that Norway and the United Kingdom have very comprehensive national methodologies for estimating GHG emissions, and in general use high tier levels for most of the sectors, some possible implications derived from the conclusions of this paper are as follows:

(a) The current flexible approach of using different methodologies for the estimation of GHG emissions is not an impediment to meeting emissions limitation or reduction commitments under the Kyoto Protocol;

(b) IPCC default methodologies could be sufficient to ensure the appropriate estimation of trends for national aggregate GHG emissions expressed as $CO_2$ equivalent and for emissions of several IPCC source categories, assuming they are applied well;

(c) The improvement of the quality of activity data could have a higher priority than the attempt to use higher tiers for those source categories where the approximation to national comprehensive methodologies is good.

## C. General

38. All those Annex I Parties which use national methodologies for estimating their GHG emission inventories should be further encouraged to carry out a comparison of GHG emission inventories obtained using best available methodologies with those obtained using the IPCC default methodologies for the years 1990 to 1996. This information would be useful to assess the implications of the use of different methodologies for meeting emissions limitation or reduction commitments.

39. Full reporting of all relevant source categories is important. In order to facilitate this task, it would be useful to develop default methodologies for common existing source categories in many Parties, such as *waste incineration* and offshore emissions, for which IPCC default methodologies are not available so far.

40. There is a clear need to improve the IPCC default methodologies or to develop best appropriate national methodologies for those source categories where the differences both in annual estimates and in trends with the more accurate national methodologies are significant, such as in the *waste* and the *oil and natural gas* sector.

Annex

## COMPARATIVE TABLES FOR INDIVIDUAL PARTIES

Comparative tables of GHG emissions for each individual Party are presented in this annex. The tables contain information for each individual gas and are organized by sector. Estimates obtained both with the Party's national and with the IPCC default methodology are given in full mass units (Gg) for each individual sector, while differences are given in full mass units (Gg) and in per cent. Where possible, aggregated GHG emission estimates in terms of $CO_2$ equivalent are also given. Differences given in the tables are relative to the estimates obtained using national methodologies, which are set at 100 per cent. This means that positive differences in all cases denote that estimates obtained with the IPCC methodology are higher than estimates obtained with the national methodology.

### Table 1.A. Comparison of GHG inventories obtained using national and IPCC default methodologies: Austria, 1996

| Gas | Sector | Emissions estimate in Gg | | Difference | |
|---|---|---|---|---|---|
| | | National method (sectoral approach) | IPCC default (reference approach) | Gg | % |
| **$CO_2$** | Fuel combustion | 50 800[a] | 60 358 | 9 558 | 18.8 |

[a] Value reported in the national 1996 GHG inventory.

Remarks:
Austria followed a sectoral approach using the CORINAIR methodology with a mix of CORINAIR default and national emission factors for estimating its national GHG inventory. These emission estimates obtained for $CO_2$ from *fuel combustion* are compared to $CO_2$ emission estimates obtained using the default IPCC reference approach, although for some fuel types national conversion factors have been applied.

The reference approach gives estimates 19 per cent higher than the estimates using the national methodology. This is mainly due to the fact that in the Austrian national GHG inventory $CO_2$ emissions from the use of hard coal in the iron and steel industries are included in the *industrial processes* sector. As in the industrial sector there is no distinction between combustion and process emissions, all emissions resulting from this sector are allocated to the *industrial processes* sector. National inventory experts informed the secretariat that approximately 70 per cent of the *industrial processes* emissions are combustion emissions, but this adjustment has not been included in the estimate given in table 1.

Another difference between the two compared methodologies lies in the feedstocks, which have been considered in the reference approach but not in the national inventory, since they are not explicitly accounted for in the CORINAIR methodology. However, the national inventory considers non-biogenic $CO_2$ emissions from waste incineration.

## Table 2.A. Comparison of GHG inventories obtained using national and IPCC default methodologies: New Zealand, 1996

| Gas | Sector | Emissions estimate in Gg | | Difference | |
|---|---|---|---|---|---|
| | | National method | IPCC default | Gg | % |
| $CO_2$ | Fuel combustion reference approach [a] | 25 590 | | | |
| | Fuel combustion sectoral approach | 24 671 | 24 620 | -51 | -0.2 |
| | Fugitive fuel emissions [b] | 672 | 672 | 0 | 0 |
| $CH_4$ | Fuel combustion | 10.8 | 6.3 | -4.5 | -41.7 |
| | Solid fuels [b] | 20.1 | 11.6 | -8.5 | -42.5 |
| | Oil and natural gas [b] | 8.6 | 3.1 | -5.6 | -64.5 |
| | Enteric fermentation | 1 414 | 926 | -488 | -34.5 |
| | Manure management | 17.1 | 176.0 | 159 | 927 |
| | Total livestock | 1 431 | 1 102 | -329 | -23.0 |
| $N_2O$ | Fuel combustion | 0.7 | 0.3 | -0.4 | -59.2 |

[a] This value is given for information purposes but has not been included in the comparison.

[b] Fugitive emissions from geothermal activities have been reported as an additional source category but are not listed separately in this table since there is no difference in the estimates (2.5 Gg $CH_4$ and 362 Gg $CO_2$ with both methodologies). Emissions from this source are accounted for in both values given for $CO_2$ fugitive fuel emissions.

Remarks:

New Zealand, in its submission, used the IPCC tier 1 (sectoral approach) to estimate emissions from the energy sector, both for the national and for the default estimate. A mix of country-specific and default emission factors derived from the 1995 IPCC Guidelines was applied in the national methodology. For fugitive fuel emissions, a tier 1 approach was followed in both methodologies. Based on national values a reference approach for estimating $CO_2$ emissions from the energy sector was also provided.

For *agriculture* (*enteric fermentation* and *manure management*) New Zealand used a national methodology that was based on a country study, using national emission factors. National emission factors for *enteric fermentation* are higher than those from the IPCC for all animal types (cattle, sheep, goats and deer). Of significance are the very different emission factors for *manure management* from dairy and non-dairy cattle. For these types of animals IPCC default values are significantly higher, changing total $CH_4$ emissions from this subsector by an order of magnitude. The significantly lower national emission factors result from the assumption that most animal waste decomposes aerobically on pasture, which results in relatively low levels of $CH_4$ emissions from *manure management*. Emissions from deer are considered in the national inventory but not in the default one. Adjusting the default estimates by adding emissions from deer would result in a difference between the two methodologies of 20 per cent for total livestock.

Further details on differences in emission factors and methodologies used can be found in the explanatory comments provided in the New Zealand submission, which was distributed at the workshop.

**Table 3.A. Comparison of GHG inventories obtained using national and IPCC default methodologies: Norway, 1996**

| Gas | Sector | Emissions estimate in Gg | | Difference | |
|---|---|---|---|---|---|
| | | National method | IPCC default | Gg | % |
| $CO_2$ | Fuel combustion: reference approach | 32 485 | 34 114 | 1 629 | 5.0 |
| | Fuel combustion: sectoral approach | | 31 286 | -1 199 | -3.7 |
| | Fuel combustion (sectoral approach) adjusted [a] | 31 082 | 31 286 | 204 | 0.7 |
| | Non-combustion (industrial processes and other [b]) | 8 063 | 7 208 | -855 | -10.6 |
| | Non-combustion, adjusted [c] | 6 964 | 6 906 | -58 | - 0.8 |
| | **Total** | **40 548** | **38 494** | **-2 054** | **-5.1** |
| | **Total adjusted[d]** | **38 046** | **38 192** | **146** | **0.4** |
| $CH_4$ | Fuel combustion | 21 | 11 | -10 | -49 |
| | Oil and natural gas | 24 | 42[e] | 18 | 75.0 |
| | Coal mining | Same methodology used | | 0 | 0 |
| | Enteric fermentation | 93 | 89 | -4 | -4.3 |
| | Manure management | 16 | 12 | -4 | -25.0 |
| | Total livestock | 109 | 101 | -8 | -7.3 |
| | Waste | 237 | 107 | -130 | -54.7 |
| | Waste, adjusted [f] | 147 | 107 | -40 | -27.0 |
| | **Total** | **485** | **266** | **-219** | **-45.2** |
| | **Total adjusted [g]** | **395** | **266** | **-129** | **-32.7** |
| $N_2O$ | Fuel combustion | 3.06 | 0.35 | -2.71 | -89 |
| | Agricultural soils | 9.45 | 12.03 | 2.58 | 27.3 |
| | **Total** | **18.1** | **12.7** | **-5.4** | **-29.8** |
| | **Total $N_2O$ adjusted [h]** | **12.9** | **12.7** | **-0.2** | **-1.6** |
| **Aggregate GHG ($CO_2$ equivalent)** | | **56 344** | **48 017** | **-8 327** | **-14.8** |
| **Aggregate GHG ($CO_2$ equivalent) adjusted [i]** | | **50 336** | **47 707** | **-2 629** | **-5.2** |

[a] The national estimate has been adjusted by excluding $CO_2$ emissions from flaring offshore, special waste, and waste combustion and flaring of landfill gas, as they were not considered in the IPCC default methodology.

[b] The following source categories, in addition to industrial processes, are included in the national methodology: oil and gas exploration, oil drilling/leakage, gas terminal, extraction of coal, distribution of gasoline, refinery, petrochemical production, liming in agriculture, waste treatment, use of solvent, and liming industrial waste.

[c] The national estimate has been adjusted by excluding $CO_2$ emissions not considered in the IPCC methodology, listed in footnote b. The estimate obtained using the IPCC default methodology has been adjusted by excluding sources not included in the national methodology, which are production of lime, and use of soda ash and calcium carbide.

[d] Total $CO_2$ emissions obtained using the national methodology have been adjusted by excluding emission sources not included in the IPCC: flaring offshore, special waste, waste combustion and flaring of landfill gas, oil and gas exploration, oil drilling/leakage, gas terminal, extraction of coal, distribution of gasoline, refinery, petrochemical production, liming in agriculture, waste treatment, use of solvent, and liming industrial waste. The value obtained with the IPCC default methodology has been adjusted by excluding emission sources not considered in the national methodology: production of lime, and use of soda ash and calcium carbide.

[e] An emission range was given by the Party, from 42 to 78 Gg, using both the highest and the lowest emission factor from the interval given by the IPCC. This table shows $CH_4$ emissions from the IPCC method using the lowest emission factor.

[f] The emission estimate for waste obtained using the national methodology has been adjusted by excluding $CH_4$ emissions from industrial waste, as the IPCC methodology does not include this source category.

[g] The estimate for total $CH_4$ emissions obtained using the national methodology has been adjusted by excluding $CH_4$ emissions from industrial waste, waste combustion and flaring offshore, as these emission sources are not included in the IPCC methodology. Total $CH_4$ emissions obtained using the IPCC methodology have been adjusted by excluding emissions from 'production of other chemicals' as they are not included in the national methodology.

[h] Total $N_2O$ emissions calculated with the national methodology include 5.2 Gg $N_2O$ from the production of nitric acid (fertilizer), which have not been estimated with the IPCC methodology for 1996. An adjustment has been made by excluding this source from the estimate obtained with the national methodology. Total $N_2O$ emissions include emissions from human sewage, accounting for 0.36 Gg with both methodologies.

[i] Sum of the adjusted total for each gas.

**Table 4.A. Range of differences in annual estimates obtained using national and default methodologies, and differences in the trend over the period 1990 to 1996: Norway**

| Gas | Sector | Range of differences in the period 1990 to 1996 [a] | | Trend over the period 1990 to 1996 in per cent | | |
|---|---|---|---|---|---|---|
| | | Full mass (Gg) | Per cent | National method | IPCC default | Difference[ab] |
| $CO_2$ | Fuel combustion reference approach | 1 177 to 4 890 | 4.2 to 18.1 | 15.5 | 16.4 | 0.9 |
| | Fuel combustion sectoral approach | -1 434 to -815 | -5.1 to -3.0 | | 17.2 | 1.7 |
| | Fuel combustion (sectoral approach) adjusted [c] | 38 to 308 | 0.1 to 1.1 | 16.7 | 17.2 | 0.5 |
| | Non-combustion (industrial processes and other) | -860 to 143 | -11.3 to 2.0 | 10.0 | 2.1 | -7.9 |
| | Non-combustion adjusted [d] | -213 to 161 | -3.5 to 2.6 | 7.3 | 9.9 | 2.6 |
| | Total | -2 054 to -828 | -5.1 to -2.3 | 14.4 | 14.1 | -0.3 |
| | Total adjusted [e] | -175 to 309 | -0.5 to 0.9 | 14.9 | 15.8 | 0.9 |
| $CH_4$ | Fuel combustion | -10 to -8 | -50 to -47 | 23.5 | 22.2 | -1.3 |
| | Fugitive: oil and gas | 6 to 18 | 25 to 80 | 60.0 | 55.6 | -4.4 |
| | Coal mining | same method | 0 | | | |
| | Enteric fermentation | -4 to -3 | -4.6 to -3.4 | 6.9 | 7.2 | 0.3 |
| | Manure management | -5 to -3 | -31 to -20 | 6.7 | 9.1 | 2.4 |
| | Total livestock | -9 to -7 | -8.3 to -6.7 | 6.9 | 7.4 | 0.5 |
| | Waste | -130 to -86 | -55 to -42.6 | 17.3 | -7.8 | -25.1 |
| | Waste adjusted [f] | -40 to 14 | -27 to 13.7 | 44.1 | -7.8 | -51.9 |
| | Total | -235 to -190 | -47.8 to -43 | 9.7 | 5.6 | -4.1 |
| | Total adjusted [g] | -135 to -90 | -34.4 to -26.3 | 15.5 | 5.6 | -9.9 |
| $N_2O$ | Fuel combustion | -2.7 to -1.5 | -89 to -84 | 58.5 | 16.7 | -41.8 |
| | Agricultural soils | 2.1 to 2.6 | 22.5 to 27.8 | 0.4 | 3.7 | 3.3 |
| | Total | -6.1 to -3.6 | -33.2 to - | -1.6 | 3.3 | 4.9 |
| | Total adjusted [h] | -0.2 to 0.6 | -1.6 to 5.3 | 10.3 | 3.3 | -7.0 |
| **Aggregate GHG ($CO_2$ equivalent)** | | **-8 327 to -6 486** | **-15.0 to -12.8** | **11.7** | **12.0** | **0.3** |
| **Aggregate GHG adjusted [i]** | | **-2 629 to -1703** | **-5.6 to -3.8** | **14.6** | **13.4** | **-1.2** |

[a] A positive difference denotes that estimates obtained with the IPCC default methodology are higher than those obtained with the national methodology, both in annual estimates and in trends.

[b] Results given in this column present the difference between the trend (in per cent) obtained using national methodologies and the trend (in per cent) using IPCC default methodologies, expressed as percentage points.

[c] The national estimate has been adjusted by excluding $CO_2$ emissions from flaring offshore, special waste, and waste combustion and flaring of landfill gas, as they were not considered in the IPCC default methodology.

[d] The national estimate has been adjusted by excluding $CO_2$ emissions not considered in the IPCC methodology, namely oil and gas exploration, oil drilling/leakage, gas terminal, extraction of coal, distribution of gasoline, refinery, petrochemical production, liming in agriculture, waste treatment, use of solvent, and liming industrial waste. The estimate obtained using the IPCC default methodology has been adjusted by excluding sources not included in the national methodology, which are production of lime, and use of soda ash and calcium carbide.

[e] Total $CO_2$ emissions obtained using the national methodology have been adjusted by excluding emission sources not included in the IPCC: flaring offshore, special waste, and waste combustion and flaring of landfill gas, oil and gas exploration, oil drilling/leakage, gas terminal, extraction of coal, distribution of gasoline, refinery, petrochemical production, liming in agriculture, waste treatment, use of solvent, and liming industrial waste. The value obtained with the IPCC default methodology has been adjusted by excluding emission sources not considered in the national methodology: production of lime, and use of soda ash and calcium carbide.

[f] The estimate for waste obtained using the national methodology has been adjusted by excluding $CH_4$ emissions from industrial waste, as a methodology for this waste is not included in the IPCC methodology.

[g] The estimate for total $CH_4$ emissions obtained using the national methodology has been adjusted by excluding $CH_4$ emissions from industrial waste, waste combustion and flaring offshore, as these emission sources are not included in the IPCC methodology. Total $CH_4$ emissions obtained using the IPCC methodology have been adjusted by excluding emissions from "production of other chemicals" as they are not included in the national methodology.

[h] Total $N_2O$ emissions obtained with the national methodology have been adjusted by excluding emissions from the production of nitric acid (fertilizer), as this source category has been estimated with the IPCC methodology only for the years 1990 and 1991. For the sake of consistency, this adjustment has been made to all years considered here.

[i] Sum of the adjusted total for each gas.

## Table 5.A. Comparison of GHG inventories obtained using national and IPCC default methodologies: Switzerland, 1996

| Gas | Sector | Emissions estimate in Gg | | Difference | |
|---|---|---|---|---|---|
| | | National method (sectoral approach) | IPCC default (reference approach)[a] | Gg | % |
| **$CO_2$** | Fuel combustion | 41 300[b] | 42 209 | 909 | 2.2 |

[a] An estimate using the reference approach but applying default CORINAIR emission factors was also provided, giving 41 325 Gg $CO_2$.

[b] Value reported in the national 1996 GHG inventory.

Remarks:

For estimating $CO_2$ emissions from the *energy* sector, Switzerland followed a sectoral approach using the CORINAIR methodology and its default emission factors, since for $CO_2$ these are practically identical to values measured in Switzerland. For estimating $CO_2$ emissions from *energy* using the IPCC default methodology, the reference approach with its default conversion and emissions factors has been applied. A national emission factor has only been used for natural gas.

Switzerland also provided an estimate for $CO_2$ from the energy sector by using the IPCC reference approach but applying national and CORINAIR default emission factors, which gave an estimate of 41,325 Gg $CO_2$. For this Party, there was practically no difference between the results obtained with the sectoral approach and those obtained with the reference approach if the same emission factors were applied.

**Table 6.A. Comparison of GHG inventories obtained using national and IPCC default methodologies: United Kingdom, 1996**

| Gas | Sector | Emissions estimate in Gg | | Difference | |
|---|---|---|---|---|---|
| | | National method | IPCC default | Gg | % |
| **$CO_2$** | Fuel combustion reference approach | 557 466 | | | |
| | Fuel combustion sectoral approach [a] | 543 880 | 522 346 | -21 534 | -4.0 |
| | Fugitive fuel emissions | 7 488 | 0 | | |
| | Industrial processes [a] | 11 703 | 25 745 | 14 042 | 120 |
| | Waste | 378 | 0 | | |
| | **Total [b]** | **563 451** | **548 091** | **-15 359** | **-2.7** |
| | **Total adjusted [c]** | **555 585** | **548 091** | **-7 494** | **- 1.3** |
| **$CH_4$** | Fuel combustion | 93.5 | 75.9 | - 17.6 | -18.8 |
| | Solid fuels (coal mining) | 338 | 334 | -4.8 | -1.4 |
| | Oil and natural gas | 462 | 472 | 10 | 2.3 |
| | Fugitive fuels emissions | 800 | 806 | 6 | 0.8 |
| | Industrial processes | 0.7 | 7.5 | 6.8 | 971 |
| | Enteric fermentation | 940 | 955 | 15 | 1.6 |
| | Manure management | 124 | 129 | 5.7 | 4.6 |
| | Agriculture | 1 064 | 1 085 | 21 | 2.0 |
| | Solid waste (landfill) | 1 720 | 1 894 | 174 | 10.1 |
| | Waste water | 34.0 | 34.3 | 0.3 | 0.9 |
| | Waste | 1 754 | 1 929 | 175 | 10.0 |
| | **Total** | **3 712** | **3 903** | **191** | **5.1** |
| **$N_2O$** | Fuel combustion | 20.5 | 11.4 | -9.1 | -44.6 |
| | Industrial processes | 70 | 61 | -9.7 | -13.7 |
| | Manure management | 5.07 | 6.53 | 1.5 | 28.8 |
| | Agricultural soils | 93.2 | 118.4 | 25.2 | 27.0 |
| | Agriculture | 98 | 125 | 26.7 | 27.1 |
| | Waste | 0.2 | 0.5 | 0.3 | 132 |
| | **Total** | **189** | **197** | **8** | **4.2** |
| | **Total adjusted [d]** | **189** | **196.5** | **7.5** | **4.0** |
| **Aggregate GHG ($CO_2$ equivalent)** | | **699 993** | **691 124** | **-8 869** | **-1.3** |
| **Aggregate GHG ($CO_2$ equivalent) adjusted [c,d]** | | **692 127** | **690 969** | **-1 158** | **-0.2** |

**Table 6.A.** (continued)

| Gas | Sector | Emissions estimate in Gg | | Difference | |
|---|---|---|---|---|---|
| | | **National method** | **IPCC default** | **Gg** | **%** |
| **HFCs (actual)** | Industrial processes [e] | 2.150 | 2.144 | -0.006 | -0.3 |
| **PFCs (actual)** | Industrial processes [e] | 0.079 | 0.078 | -0.001 | -1.3 |
| **$SF_6$ (actual)** | Industrial processes [e] | 0.035 | 0.041 | 0.006 | 17.1 |

[a] An explanation for the differences resulting from the use of the two methodologies in the energy/industrial processes sectors can be found on page 2 of the submission from the Party which was distributed to the participants during the workshop.

[b] The Party also considered emissions/removals from the *land-use change and forestry* sector in its estimates, but for consistency purposes this sector has been excluded from the comparison.

[c] Adjustments made by the Party have been applied, which exclude from the national total obtained using the national methodology the sources offshore oil and gas and waste incineration because they are not included in the default inventory.

[d] Emission estimates from human sewage have been excluded from the default inventory as this source is not included in the national inventory.

[e] Estimates for potential emissions were also provided by the Party, but have not been presented in this table because they are the same for both inventories.

**Table 7.A. Range of differences in annual estimates obtained using national and default methodologies, and differences in the trend over the period 1990 to 1996: United Kingdom**

| Gas | Sector | Range of differences between the national and the IPCC methodologies in the period 1990 to 1996 [a] | | Trend over the period 1990 to 1996 in per cent | | |
|---|---|---|---|---|---|---|
| | | Full mass (Gg) | Per cent | National method | IPCC default | Difference [a b] |
| $CO_2$ | Total (reference approach) [c] | 10 400 to 18 400 | 1.9 to 3.3 | -3.0 | -3.1 | -0.1 |
| | Total (sectoral approach) adjusted [d] | -7 500 to -3 500 | -1.4 to -0.6 | -3.1 | -3.7 | -0.6 |
| $CH_4$ | Fuel combustion and other [e] | -11 to -7 | -11.8 to -7.1 | -11.3 | -16.2 | -4.8 |
| | Oil and natural gas | -213 to 11 | -42.5 to 2.3 | -7.8 | 64 | 72 |
| | Coal mining | -4 to 3 | -1.4 to 1.0 | -58.7 | -59.1 | -0.4 |
| | Total livestock | 21 to 47 | 2.0 to 4.4 | -2.4 | -3.1 | -0.7 |
| | Waste (landfill) | 174 to 317 | 10.1 to 16.7 | -9 | -14.2 | -5.2 |
| | Total | 125 to191 | 2.8 to 5.1 | -16.4 | -14.5 | 1.9 |
| $N_2O$ | Industrial processes | -9.7 to 5.0 | -13.7 to 5.7 | -26.3 | -35.1 | -8.8 |
| | Agriculture | 26 to 32 | 25.5 to 33.0 | -5.8 | -3.8 | 1.9 |
| | Total | 8 to 27 | 4.3 to 14.8 | -12.1 | -14.7 | -2.6 |
| **Aggregate GHG ($CO_2$ equivalent) adjusted [f]** | | **-1 009 to 8 062** | **-0.1 to1.1** | **-5.6** | **-6.2** | **-0.5** |
| **Industrial processes [g]** | **HFCs** | -5.5 to 1.1 per cent | | 105 | 102 | 0.3 |
| | **PFCs** | 6.0 to 57.2 per cent | | -74.2 | -61.7 | -12.5 |
| | **$SF_6$** | 15.4 to 21.2 per cent | | 45.4 | 45.2 | 0.2 |

[a] A positive difference denotes that estimates obtained with the IPCC default methodology are higher than those obtained with the national methodology, both in annual estimates and in trends.

[b] Results given in this column present the difference between the trend (in per cent) obtained using national methodologies and the trend (in per cent) using IPCC default methodologies, expressed as percentage points.

[c] In order to take into account in the comparison only those sources included in the reference approach, national total $CO_2$ emissions given here include only $CO_2$ emissions from fuel combustion plus sources involving fuel consumption in solid fuel transformation, iron and steel, and ammonia production.

[d] Adjustments made by the Party have been applied, which exclude from the national total obtained using the national methodology the sources offshore oil and gas and waste incineration because they are not included in the default inventory.

[e] "Other" includes emissions from industrial processes and waste incineration.

[f] Aggregate GHG emissions have been calculated on the basis of total $CO_2$ emissions estimated with the sectoral approach. The national estimate has been adjusted by excluding emissions from offshore oil and gas and waste incineration because they are not included in the default inventory.

[g] Only estimates for actual emissions were given in this table since potential emissions are the same for both inventories.

**Table 8.A. Comparison of $CH_4$ emissions from agriculture using the IPCC default methodology and two national methodologies carried out by the IPCC-OECD-IEA Programme for National Greenhouse Inventories[a] for Australia and the United States of America**

| Gas | Sector | Emission estimate in Gg | | Difference [b] | |
|---|---|---|---|---|---|
| | | National method[c] | IPCC default | Gg | % |
| **Australia, 1990** | | | | | |
| **$CH_4$** | Enteric fermentation | 2 814 | 2 627 | -187 | -6.6 |
| | Manure management | 78 | 283 | 205 | 263 |
| | Total livestock | 2 892 | 2 910 | 18 | **0.6** |
| **United States, 1990** | | | | | |
| **$CH_4$** | Enteric fermentation | 5 710 | 5 496 | -214 | -3.8 |
| | Manure management | 2 600 | 1 480 | -1 120 | -43.1 |
| | Total livestock | 8 310 | 6 967 | -1 343 | **-16.2** |

[a] "Comparison of methane emissions from agriculture using IPCC default methodology and two national methodologies", Pierre Boileau, OECD Secretariat, IPCC-OECD-IEA Programme for National Greenhouse Gas Inventories.

[b] Results given in this table slightly differ from those given in the IPCC-OECD-IEA submission as the secretariat used another approach for estimating the differences between methodologies, setting the national estimates at 100 per cent.

[c] Data reported to the UNFCCC as at 15 May 1998.

Remarks:

The Australian inventory also considers emissions from buffalo, ostriches, emus, alpacas and deer, which are not considered in the default IPCC methodology. For $CH_4$ emissions from manure, the estimates are significantly different, indicating considerable differences between the methodologies. Since much of the manure generated by Australian beef cattle is voided on pasture, the national methodology assumes these degrade aerobically and therefore produce little or no $CH_4$ emissions, which is reflected in the Australian emission factors. This information is not considered in the default IPCC methodology. However, overall $CH_4$ emissions from livestock differ by only one per cent, indicating, initially, that in the case of Australia the methodologies are comparable.

For the United States the results for enteric fermentation do not differ significantly. This is due to the fact that the FAO, which provides the activity data for the IPCC methodology, obtains animal population statistics from national Governments. Moreover, several of the emission factors used are the same for the two methodologies. For manure management the differences are mainly a result of higher emission factors in the United States methodology for certain types of cattle, pigs and poultry.

- - - - -