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METHODOLOGICAL ISSUES

METHODOLOGICAL ISSUES IDENTIFIED WHILE PROCESSING SECOND NATIONAL COMMUNICATIONS: GREENHOUSE GAS INVENTORIES

Note by the secretariat

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I. INTRODUCTION

A. Mandate

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA),at its seventh and eighth sessions, requested the secretariat to prepare, for consideration at its ninth session, a number of documents on methodological issues identified by the secretariat while processing national greenhouse gas (GHG) inventories from Annex I Parties and in the course of in-depth-reviews, taking into account the submissions by Parties (FCCC/SBSTA/1997/14, para. 16 (c) and FCCC/SBSTA/1998/6, para. 40 (a)).

2. The SBSTA, at its eighth session, also requested the secretariat to organize a workshop with participation of experts from the roster, as well as from other relevant organizations, to develop proposals to resolve the methodological issues identified by Parties and the secretariat. The conclusion of such a workshop should be available for the tenth session of the SBSTA (FCCC/SBSTA/1998/6, para. 40 (d)).

3. Also at its eighth session, the SBSTA urged Parties to participate actively in the ongoing activities of the current programme of work on methodologies related to GHG inventories, bearing in mind their relationship with possible additions and/or amendments to the revised guidelines for the preparation of national communications by Annex I Parties, and the longer-term methodological needs of the Kyoto Protocol, inter alia, the development of guidelines for national systems and adjustments under Article 5 of that Protocol (FCCC/SBSTA/1998/6, para. 40 (b)).

B. Scope of the note

4. In response to the above-mentioned mandate, this report provides data based on the analysis of national GHG inventories and information from in-depth-reviews. Parties might also wish to consider document FCCC/SBSTA/1998/8 which identifies policy options based on this document, as well as on views submitted by Parties. The report is intended to be considered in detail during a workshop to be organized by the secretariat on 9-11 December 1998 in Bonn (see para. 2 above). It is also intended for use by the SBSTA as it considers possible additions and/or amendments to the UNFCCC guidelines for the preparation of national communications by Annex I Parties. The issues identified in this report are also relevant to the preparatory work for the first session of the Conference of the Parties (COP) serving as the meeting of the Parties to the Kyoto Protocol (COP/MOP). For example, the SBSTA may find the information helpful when it considers guidelines for national systems to account for greenhouse gas emissions by sources and removals by sinks.

5. The methodological issues identified while processing greenhouse gas inventories contained in national communications were previously analysed and presented in the compilation and synthesis documents prepared by the secretariat (A/AC.237/81; FCCC/CP/1996/12 and Add.1, and FCCC/SBI/1997/19). This report has been prepared to respond to the mandate

mentioned above, but should be considered as an integral part of the compilation and synthesis of the second national communications (FCCC/CP/1998/2).

6. This document is based on the GHG inventory data included in the national communications from 34 countries, among them all Annex I Parties which submitted their national communications before 1 August 1998.[1] The report also considers GHG inventory data submitted separately from the communications of Australia, Bulgaria, Canada, the Czech Republic, Finland, France, Hungary, the Netherlands, New Zealand, Norway, Switzerland, the United Kingdom and the United States of America.

7. This document analyses how Parties followed the Intergovernmental Panel on Climate Change (IPCC) Guidelines for national GHG inventories, and the revised guidelines for the preparation of national communications from Annex I Parties (decision 9/CP.2, annex, FCCC/CP/1996/15/Add.1), referred to below as the UNFCCC guidelines. The analysis of the inventory data was done according to the sectors, subsectors and source categories of GHG emissions corresponding to the Revised 1996 IPCC Guidelines for national inventories referred to below as the IPCC Guidelines. These sectors, subsectors and source categories are identified in italics in the narrative text.

8. Some of the analysis included in the report was carried out also taking into account possible ways in which inventory data could be used under the requirements derived from the Kyoto Protocol. For example, to assess changes in aggregated GHG emissions, the mix of gases and the assumed uncertainties in relation to the base year, the average of the five-year time period 1991-1995 was used. For the sake of brevity, this report sometimes refers to aggregated GHG emissions expressed in CO_2 equivalent as a "basket".

9. In the light of the ongoing work on methodological issues related to the estimation and reporting of emissions by sources and removals by sinks from the land-use change and forestry sector, the report does not provide information on emissions or removals from this sector. Totals, percentages and shares estimated or presented in the report exclude emissions or removals from this IPCC sector, its subsectors and categories.

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[1] The second national communication of the European Economic Community was not considered, owing to the specific characteristics of its GHG inventory. The draft second national communication of the Russian Federation was considered, as were the excerpts from the second national communications containing updated GHG inventories submitted by Italy and Luxembourg. Lithuania and Ukraine have not yet submitted their second national communications; however, their recently submitted first national communications were considered in this report. Romania, which has not yet submitted its second national communication, was not considered because its GHG inventory has not been updated since January 1995. Slovenia (whose name was added to Annex I by decision 4/CP.3) was considered, as it recently submitted its GHG inventory. Monaco and Liechtenstein (whose names were also added to Annex I by the same decision), however, were not considered; in the case of Monaco, this was due to the specific characteristics of its GHG inventory and, in the case of Liechtenstein, because it has not submitted an updated GHG inventory since 1995.

10. This report's illustrative tables are placed at the end of the narrative text. Information sources are provided as well as explanatory notes for clarity as to how the information was processed. In some cases, these explanations are relevant for a full understanding of the narrative text. Some figures in the tables may differ from those submitted to the secretariat as a result of rounding and owing to the conversion of some reported estimates (for consistency and comparability) to carbon dioxide-equivalent units. In all cases the IPCC 1995 global warming potentials (GWP) with 100-year horizons were used.

II. ISSUES RELATED TO FLEXIBILITY[2]

11. This report provides a preliminary analysis of the extent to which Parties have chosen to use different methods, emission factors and other assumptions in preparing their inventories, based on the available information. It also provides insights into whether the current flexible approach makes a significant difference in emission estimates. A detailed consideration of these issues, as well as their implications for meeting emissions limitation or reduction objectives, by experts, Parties and the IPCC is necessary. The presentation of more complete information on national inventory data by most Parties may also be necessary for such a consideration.

A. Methods and emission factors used by Parties

12. The IPCC Guidelines, developed for a wide range of users, allow Parties great flexibility in estimating their GHG inventories. Parties may use default methods or more advanced methods, either from the IPCC Guidelines, which provide methods with different levels of complexity (tiers), or from national or other compatible methodologies, such as CORINAIR[3]. The choice of emission factors also is flexible. The IPCC Guidelines provide default emission factors, but encourage the use of national factors when more appropriate.

13. All 34 Parties whose GHG inventories were analysed by the secretariat declared that they had followed or used the IPCC Guidelines to prepare them, but the approach they used to estimate the inventories varied widely. Parties used either default methods or more advanced methods.[4] Many Parties used either default emission factors, or emission factors developed on their own, or both in different source-categories. Nine Parties used CORINAIR for compiling

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[2] The term "flexibility" is used in this report to indicate the possibility for Parties to choose different methods, emission factors, and assumptions for estimating GHG emissions, as is allowed and encouraged by the IPCC Guidelines.

[3] CORINAIR is the component dealing with air emission inventories of the European Community CORINE (Coordinated Information System on the State of Natural Resources and the Environment. CORINAIR is also used for reporting to the Convention on Long-range Transboundary Air Pollution (LRTAP) under the auspices of the United Nations Economic Commission for Europe.

[4] The IPCC Guidelines use different terms to denominate methods in different sectors, according to their level of complexity. This can be seen in table 1 (page 23). In this document, the expression "simple methods" is used for referring to the IPCC tier 1, basic and default methods. The expression "advanced methods" is used for referring to the IPCC tier 2 and tier 3, kinetic, and also for other national methods.

their GHG inventory and reported them using the IPCC reporting tables. All these different approaches are compatible with the IPCC Guidelines. To illustrate the multiple approaches which Parties can use to estimate their emissions in each different sector of their GHG inventories, the following simplified scheme is provided:

EMISSION FACTORS USED	METHODS USED		
	Tier 1 or other IPCC basic methods	Tier 2/3 or other IPCC advanced methods	National or other compatible methods
Defaults (IPCC or CORINAIR)	√		√
Default + national	√	√	√
National	√	√	√

14. Information provided in table 1 (page 23) clearly indicates that Parties differed in their use of tiers and/or methods to estimate their GHG emissions. Table 2 (page 24) shows that the types of emission factors used by Parties also vary widely. In many cases, because of the lack of information in the national communications, it is not possible to assess either what tier and/or what method or type of emission factors were used. The information provided in both tables indicates that the different approaches described in paragraph 12 above are possible. Most Parties did not provide complete information on what approaches they used.

15. The diversity of methods and emission factors used by Parties reflects different levels of dissagregation and data availability when preparing their national GHG inventories. The IPCC Guidelines have demonstrated their usefulness, enabling Parties to provide inventory data in most source categories and to report the results in a common reporting framework.

B. Impact of the choice of methods, emission factors and activity data on emission estimates

16. To understand whether the current flexible approach in choosing methods, emission factors and assumptions could make a significant difference to a Party's aggregated carbon dioxide (CO_2) equivalent emissions, it is necessary to compare complete GHG inventories prepared using default methodologies and emission factors with those prepared using national assumptions. Since the information available to the secretariat is insufficient for completely reconstructing GHG inventories, this comparison is not possible for most Parties. However, it is possible to identify many examples, which indicate that different approaches could lead to significant differences in emission estimates for particular GHG source categories. If these emissions are large, this could also affect the annual aggregated GHG emission estimates.

1. Methods and/or tiers

17. The use of different methods and/or tiers does not always lead to significant differences in emission estimates. The comparison between the CO_2 fuel combustion emissions estimated using the reference approach (tier 1) with those estimated using detailed methods (tiers 2 and 3) presented in table 3 (page 25) demonstrates the usefulness of this self-verification procedure. Except for Bulgaria, which reported problems with fuel export statistics after 1993, the differences between the two approaches ranged from 0.3 to 4 per cent. Australia, Bulgaria, Germany and the United Kingdom provided data on comparisons for several years while Finland and the United States of America provided data for a single year.

18. For CO_2 fuel combustion emissions, the highly aggregated IPCC tier 1, which is a top-down approach, may in some cases provide more accurate estimates than the disaggregated tiers 2 and 3, which are bottom-up approaches. This is possible in the case of CO_2 fuel combustion emissions because emission factors do not vary much in the sector and because total activity is readily available from national statistics. A disaggregated bottom-up approach could provide more accurate estimates only if reliable data are available for emission factors and activity data in all fuel combustion subsectors. A comparison of the two methods allows for the identification of possible information gaps when the causes of numerical differences among methods are investigated. Parties are requested by the IPCC Guidelines to compare data obtained using both approaches and to explain possible differences. The UNFCCC guidelines request the presentation of the worksheets of the IPCC reference approach but do not request the explanation. An accurate estimation of CO_2 fuel combustion emissions is of fundamental importance, because it represents the largest share of emissions for all Annex I Parties.

19. In its second national communication, Sweden reported emissions using an improved method to calculate CO_2 emissions from road transport based on more disaggregated data. This led to a decrease of 24 per cent in the transport sector emission estimate compared to the estimate in the first national communication. Because of the importance of this sector, this change led to a 10.5 per cent reduction of the base year CO_2 equivalent emissions (see table 11, page 30) in its second national communication. This result provides an example of the importance of comparing the aggregate fuel combustion CO_2 emission estimates of different sectors using detailed technology-based approaches with the aggregated IPCC reference approach. Some Parties which recalculated their original 1990 CO_2 emissions estimates would have detected the problems earlier if they had made this comparison.

20. The data provided in tables 4, 5, and 6 (pages 26-27) demonstrate how the use of different tiers and/or methods affects estimates of sectoral emissions. Table 4 suggests that the use of tier 1, which uses default emission factors, could overestimate emissions, since the use of Czech methods results in methane (CH_4) emissions 31 per cent lower for enteric fermentation and 10 per cent lower for manure management. The information in table 5 shows that using more advanced methods (dynamic or kinetic), compared to basic methods, in the waste sector could give significantly different estimates compared to using default ones in two countries. Table 6 indicates that using the Revised 1996 IPCC Guidelines methodology to estimate

nitrous oxide (N_2O) emissions from agricultural soils could make a significant difference in relation to the 1995 version, owing to the inclusion of new sources. Values presented indicate that the range of this difference varied widely among Parties, from plus 74 per cent for Denmark to minus 45 per cent for Switzerland. The emissions grew for all cases except Switzerland as a consequence of the inclusion of new sources in the estimate. The Swiss authorities explained during the in-depth-review that their emissions decreased, despite using the new guidelines, because the emission factors used were revised.

2. Emission factors and activity data

21. The use of different emission factors could also lead to significant differences in the GHG emissions among sectors. Information provided in tables 7 and 8 (pages 28 and 27) give examples of the wide variations existing between country-specific and IPCC default emission factors. As shown in table 7, in general solid fuel emission factors vary the most, for example lignite (49 per cent), peat (17 per cent) and coke (15 per cent). Differences are generally much greater for sectors with greater uncertainties, such as N_2O from agricultural soils, as is evident from table 8, where a variation of 100 per cent is shown. Table 9 (page 29) shows how different values of emission factors could lead to different CO_2 emission estimates, using emissions from cement production as an example. In three cases the differences between the estimates are negligible, but in the other two cases the differences range from 12 to 18 per cent.

22. It should be noted that the real effect of a given emission factor on the amount of national aggregated GHG emissions depends on the relative share of the emissions estimated with that emission factor. A difference of 100 per cent between values of the emission factors in one sector, for example those in table 8, could have less of an effect on the total GHG estimates than the smaller differences shown in tables 7 and 9.

23. Differences in the gathering of activity data and in the utilization of the data result in disparate emission estimates. Quality of the activity data or the assumptions used for their application also provoke different results of emission estimates. For example, information provided by the Czech Republic indicates that they found differences between activity data from national statistics and sectoral statistics close to 10 per cent for coke, iron and cement production. Finland reported another example of how different national organizations had provided different values of activity data for consumption of hard coal, peat and black liquor, with differences of 6-7 per cent. Information in table 10 (page 29) demonstrates that the way in which such data are used (average of several years or a single year value) also influences these estimates.

C. Recalculation of the base year and subsequent inventories

24. All Parties which submitted a second national communication had recalculated their base year inventories and the subsequent inventories, except for two, as shown in table 11

(page 30).[5] These two Parties have not presented a recalculated figure for their base year in their national communications, although they used updated methods/data for subsequent years. The estimation of GHG emissions for subsequent years using methods, emission factors and activity data other than those which were used for the base year inventory, affects the comparison of the target and base year figures.

25. The differences between the estimates in the first and second national communications were influenced by two factors:

(a) Replacement of the IPCC 1994 global warming potentials used in the first national communications, by the IPCC 1995 GWP in second communications. This factor influences aggregated GHG estimates in terms of CO_2 equivalent, but not the recalculations made on a gas-by-gas basis;

(b) Changes in methods, emission factors and assumptions, as well as an update of activity data and the inclusion of new sources of emissions. These changes, which are referred to in this document as "change in methods/data," are encouraged by the IPCC Guidelines aimed at improving the quality and accuracy of the inventories, and at using more appropriate data.

26. The use of different GWP values, and any associated changes in GHG emission estimates, can be avoided by fixing the GWP values in a given period of inventory date. The Conference of the Parties at its third session decided that Parties should use the IPCC 1995 GWP with a 100-year time horizon (FCCC/CP/1997/7/Add.1, decision 2/CP.3, para. 3). This decision does not imply a change of the necessity of reporting inventories on a gas-by-gas basis, as was decided by the COP at its second session (FCCC/CP/1996/15/Add.1, decision 9/CP.2, annex, para. 11). A similar provision, fixing the GWPs values, has not yet been included by the UNFCCC guidelines.

27. The COP also decided in its decision 2/CP.3 (para. 1) that Parties should use the IPCC Guidelines to estimate and report their emissions. However, owing to the characteristic of these Guidelines, this decision does not imply that Parties should use the same methods for these purposes.

28. The differences between data in the first and second national communications due to changes in methods/data are significant for many countries, as shown in table 11. This is true both for estimates made on a gas-by-gas basis and for those expressed in terms of CO_2 equivalent. The changes on a gas-by-gas basis are generally larger for CH_4 and N_2O than for CO_2, owing to the higher uncertainties inherent in the estimation of their emissions. However, the changes in CO_2 equivalent emissions depend more on the importance of the share of each GHG in the aggregated GHG emissions. Therefore, even minor changes in CO_2 emissions could

[5] Bulgaria reported the same figures for its base year (1988) in both the first and second national communications. Hungary did not present figures for its base year (the average of 1987-1989) in its second national communication.

cause significant changes in CO_2 equivalent emissions, because of the large share of CO_2 in the aggregated emissions. Significant changes in CH_4 and N_2O could cause a similar result.

29. For the most part, changes to the base year were affected by the desire of Parties to calculate their emission estimates more accurately. As methodologies develop, both nationally and internationally, the collection of data improves. Four elements were identified which led to changes in previous estimates submitted by Parties. They are the use of new models or methods for estimating emissions; the application of updated emission factors; the change or updating of activity data; and the change of scope due to the inclusion or exclusion of sources.

30. The application of updated emission factors that reflect actual conditions may or may not lead to the recalculation of the base year and successive years between the two submissions. The emission factors were applied retroactively when this was applicable for the time period, including the base year. However, in some cases new emission factors are applicable only from a given year onwards, when a new pattern of emissions appears as a consequence of technology change. In this case, it is not necessary to recalculate the inventories of those years prior to the change.

31. The recalculation of the base year and successive years was not limited to the inventories contained in first and second national communications. Many Parties recalculated them in each annual submission. Other recalculations were explained during the course of in-depth-reviews or by official letters submitted to the secretariat by Parties. This frequency of changes is a logical consequence of annual updates of inventories carried out in several countries. On the other hand, this high frequency of changes could complicate the assessment of their implications.

32. Inventory data would be totally comparable among countries if all countries estimated their emissions using identical methods. At the moment, there are not two Annex I Parties which use identical methods. A full standardization of inventory methods might ensure truly comparable data, facilitating the review and verification of estimates. However, such an approach ignores the different capacities of countries to prepare inventories. Standardization would affect the necessary upgrading of the inventory quality, and as a consequence, the accuracy of the estimates. A necessary balance between the required accuracy and comparability/consistency of the inventories should be achieved, taking into account the new needs of the Convention process, such as the implications for meeting emissions limitation or reduction objectives.

33. In the event that Parties consider it necessary to recalculate baseline data, this must be carried out in a consistent and transparent way. The SBSTA, at its fourth session, concluded that, to ensure comparability, Parties should recalculate the base year inventory and inventories for any subsequent years when using the 1996 IPCC Revised Guidelines (FCCC/SBSTA/1996/20, para. 30 (a)). However, the SBSTA conclusion does not indicate how to deal with the changes in the estimates introduced for reasons other than the use of the Revised Guidelines, nor does it stipulate what documentation should be provided to ensure transparency in recalculations.

34. Further guidelines for the recalculation of base year estimates, and their revision, may also be necessary. The implications of such recalculations for the comparability and consistency of the data of a given Party over time need to be considered, as well as what process, if any, could be used to review and consider revised inventories. The secretariat notes that heretofore all data have been accepted into its database. The in-depth review process has sought to clarify how GHG inventories were estimated.

III. ISSUES RELATED TO UNCERTAINTIES

35. This report provides a preliminary analysis of the changes in the relative shares of different greenhouse gases in the aggregated GHG emissions and of the changes in uncertainties over time. These changes could be relevant to assessing emission reductions that have actually occurred as well as emission limits, a methodological issue that may be relevant to the Kyoto Protocol. A detailed consideration of these changes, and their implications, by experts, Parties, and the IPCC is necessary.

A. Changes in the relative shares of different greenhouse gases in national aggregated CO_2 equivalent emissions over time

36. Since GHG inventory data are now available for each year between 1990 and 1995 for almost all Annex I Parties, changes in the mix of gases can be assessed over time. The information provided in table 12 (page 32) shows how the proportion of each of the greenhouse gases (CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6))[6] within the aggregated GHG emissions for each Party changed between the base year and the average in the period 1991-1995.[7] It indicates that the mix of gases did not change much, in general, for most Parties within the period 1991 to 1995, compared to 1990. This can be illustrated by reference to CO_2 estimates, which account for the greatest proportion of all Parties' national emissions, with the exception of New Zealand. For CO_2 the mean change between the 1991-1995 average and 1990 was only 2 per cent, with a standard deviation of 3.3. The mode or most frequently reported value of this change was only 0.4 per cent. The median, which is the middle value of the range of values is 1. Six Parties exceeded the mean change. The most significant change was shown by Iceland, whose CO_2 emissions share in its aggregated GHG inventory was 9.2 per cent higher over the period 1991 to 1995 compared to 1990. In principle, a "basket" approach allows the trend of emissions to be assessed with a higher degree of confidence if the mix of gases in the "basket" does not change considerably between the base year and the years included in a given period of time.

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6 HFC, PFC and SF_6 emissions are combined in this table.

7 This period could be viewed as a simulated commitment period with the purpose of managing inventory data over time. Information on the effect of aggregating annual GHG emission estimates for a given period of time can be found in document FCCC/TP/1997/2.

37. The current data allow preliminary insights into whether changes in emission estimates over time are due to socio-economic driving factors or to changes in calculation procedures (table 13, page 34). The first two columns show aggregated GHG emissions in the year 1990 and over the period 1991 to 1995 inclusive, using methods applied in the second national communications. Column C shows the percentage increase or decrease between the two, which represents the real increase or decrease of these emissions in the period. This is used as a proxy for the effect of socio-economic changes.

38. Column D shows the estimate of Parties' aggregated greenhouse gas emissions between 1991 and 1995, using methods applied in the first national communications. Given that the first national communications do not, typically, provide data beyond 1993 to arrive at the estimate for the whole period, the same trend was used, year by year, as the one estimated from the data in the second national communication. The percentage difference as a result of this change in methods/data over the period 1991 to 1995 is shown in column E. These results are comparable to the results shown in the last column of table 11 for the recalculation of the base year due to changes in methods/data. It should be observed that the changes of estimates are larger than 5 per cent for 16 of these Parties.

39. Compared to the first national communication, all Parties used different methods/data for at least some and, in several cases, many source categories in compiling their inventories in the second national communications. In other words, emission estimates for the base year and for the years included in a given period of inventory data (e.g. a "commitment period" under the Kyoto Protocol) can change as a result of these changes. As Parties apply the new methods/data for all years, the effect of these changes is not obvious simply from the inventories provided in second national communications.Only some Parties provided detailed information on changes made in relation to previous inventories. The data presented in table 13 for all Parties that recalculated their baseline year were developed using the information provided by Parties in their first national communications. The information contained in the table could be used to form a preliminary assessment of the effect of these changes.

B. Uncertainties associated with GHG emissions and inventories over time

40. Information as to how Parties reported uncertainty estimates by sectors and by gases is given in table 14 (page 36). The table does not indicate uncertainty estimates for HFCs, PFCs or SF_6, as these are only provided by seven Parties. The secretariat, for purposes of consistency, uses the generic term "confidence level" in the table for other descriptions presented by Parties using different terms: "uncertainty", "emissions range", "quality of the estimate" or "error bounds". The reported confidence levels varied widely among Parties, for the same gases in the same sectors. Although information improved compared to the first national communications, it is clear that the information on uncertainties is still not comparable among Parties.

41. Thirteen Parties provided quantitative estimates about uncertainties on a gas and/or sectoral basis. The level of detail of the information about these estimates varied widely among Parties. Fifteen Parties provided the IPCC overview table, which includes a self-assessment of

the completeness and quality of their inventories. This format classifies the quality of the estimates as "high"(H) , "medium" (M) and "low" (L). The use of these terms, as well as of the quantitative information mentioned above, is not really compatible among Parties. The approaches used by them differ and in many cases are not explained. Twelve Parties (AUT, DEU, EST, FRA, GRE, IRE, LAT, LIT, LUX, POL, SVN, UKR) either did not provide estimates of uncertainties or did so only partially. Five Parties (AUS, CAN, ESP, GBR, USA) provided a detailed analysis of the assumptions used to estimate uncertainties of several sectors and New Zealand only did so for energy-related CO_2 emissions.

42. Information in national communications indicates that the ways of reducing, estimating and reporting uncertainties, and therefore also the data quality of inventories, vary among countries. The qualitative and quantitative information made available by Parties is summarized in the following box:

GHG	Confidence level	Remarks
CO_2	"High" for fuel combustion and industrial processes.	"High" for energy and industrial processes means estimates which have an error range of less than 10 per cent.
CH_4	"Medium" for fugitive fuel emissions.. Predominantly "medium" for fuel combustion, enteric fermentation, animal waste and waste, with some Parties reporting them as "low".	"Medium" for these categories generally means the estimate has an error range of 20 to 50 per cent.
N_2O	Predominantly "high" and "medium" for industrial processes, with two Parties reporting them as "low". Predominantly "low" for fuel combustion, with some Parties reporting them as "medium". All Parties reported "low" for agricultural soils.	"Low" for these categories generally means the estimate has an error range of 50 to more than 100 per cent.
Other GHG	"Medium" and "low" for industrial process emissions "Low" for emissions from consumption	Errors were reported with a range of 50 per cent to a factor of 2. USA reported 20 per cent for industrial emissions of HFC-23.

43. The gaps and differences in the information provided by Parties about the uncertainty of GHG emissions indicate the complexity of this issue. Although Parties provided information about uncertainties associated with annual emission estimates there was no discussion about how uncertainties changed over time. The IPCC Guidelines do not provide guidance on how to estimate uncertainties over time, and neither the IPCC nor the UNFCCC guidelines request this information from Parties.

44. The need for technical and scientific work to develop compatible ways to estimate and report uncertainty of the GHG emission estimates and the overall uncertainty associated with GHG inventories is evident. In addition to the uncertainty of an emission estimate, the uncertainty of an emission reduction may also be relevant. The uncertainty of a given emission estimate may have two implicit types of errors: systematic and statistical. The former refers to

errors in the methods used, and the latter to errors created by imprecise measurements or estimates. In principle, the systematic error may be cancelled out when two emission estimates are compared if the same methods are used over time, but this is not the case for statistical errors. The assessment of the extent to which systematic errors are cancelled in a "basket" approach and the degree to which statistical errors vary over time requires additional technical and scientific work.

45. To provide an insight into the influence of changing uncertainty over time, a simple method was used with the sole purpose of assessing the changes of overall uncertainty associated with national GHG inventories over time. The derived uncertainty values presented in table 15 (page 38) are not true estimates of the uncertainties associated with national GHG inventories but instead are used to illustrate the effect of changes over time.

46. To estimate the true overall uncertainty associated with a GHG inventory it would be necessary to know the inherent quantitative uncertainty for every particular GHG source category obtained from the uncertainty of the data and the associated calculations. Uncertainties for each GHG source category differ as do their share in the aggregated GHG emissions and this should be taken into account. Therefore, overall uncertainty associated with national inventories should be based on the uncertainty of each particular GHG source category emissions weighted by its relative contribution to total emissions. Insufficient data have been provided by Parties to carry out such an exercise. Even though some countries have provided relevant information it is not possible to do comparative analyses.

47. In order to approximate the overall uncertainty associated with each Party's inventory, some simplifying assumptions were made. An uncertainty factor was attributed to the totals of each main GHG emission. The uncertainty factors were approximated on the basis of the summary information presented in table 14 and summarized in paragraph 40. In aggregate, the uncertainty associated with CO_2 was +/- 7 per cent, with CH_4 +/- 35 per cent and with N_2O +/- 80 per cent. For example, this implies that, on average, a Party's CO_2 estimate may be 7 per cent higher or lower than stated. HFCs, PFCs and SF_6 were not considered, as the reporting of these emissions is inconsistent among Parties.

48. The relative shares of each GHG for a given Party presented in table 12 were multiplied by the corresponding uncertainty factors described above, equally for all Parties. The approximated overall uncertainties associated with national greenhouse gas inventories obtained by this approach are presented in the table for the base year, for every year within the period 1991-1995 and for the average of these years. With this approach the only element influencing the results is the differing shares of gases in Parties' aggregated GHG emissions. Though this can be an important source of uncertainty, it is not the only one. This approach does not take into account differences in the quality of GHG inventories between Parties or efforts made by Parties to reduce uncertainties in the period. According to this unique factor for determining uncertainty, the larger the share of CO_2 in the total, the lower the overall uncertainty of the annual inventory, given that this gas has the highest confidence level.

49. The overall approximated uncertainty in the period 1991 to 1995, inclusive, for each Party, can be compared to the approximated uncertainty associated with its inventory in 1990. Any changes will have been due to a change in the composition of the basket. It can be observed from table 15 that the change in uncertainty over time has been considerably less than its absolute level in any particular year for all Parties. Overall, the difference between uncertainties in the period 1991 to 1995 compared to 1990 ranged from 0.5 to 14 per cent. The mean difference was 3.2 per cent with a standard deviation of 4.4, a median of 2.0 and a mode of 0.8.

50. Taking into account that emission estimates throughout the analysed period are calculated using the same methodology, one way to tentatively interpret the results presented in table 15 could be as follows: the change in the approximated overall uncertainty of GHG emissions in the period 1991 to 1995, compared to the base year reflects the extent to which a systematic error remains, or is not cancelled, over time as consequence of using a "basket" approach. This percentage is reflected in column H of the table. For most Parties, as described in paragraph 47 above, this percentage is relatively small. It should be noted that the effect of the uncertainty associated with a reduction of emissions in a given period compared to the base year requires detailed analysis and is beyond the scope of this report.

51. Information as to how changes in the methods/data employed in the first and second national communications could affect, annually and over time, approximated overall uncertainties is provided in table 16 (page 40). The figures have been adjusted to take into account the change in GWP used in the first as compared to the second national communications. The differences of percentages of the approximated overall uncertainty associated with 1990 data, as reported in the second national communications, compared to that reported in the first national communications is presented in column H. The mean of the difference was 1.9 per cent. Similarly, as indicated in column I, the uncertainty associated with data for the period 1991 to 1995 inclusive differed by only 2 per cent, on average, although the standard deviation was somewhat greater at 3.6 compared to 3.2 for the 1990 data. In both cases the mode was 0.3 per cent. The median for 1990 was 1.05 and for 1991-1995 it was 0.9. For 13 Parties, these differences in uncertainty were more than 1 per cent.

52. An attempt is made to assess the impact of changed methodologies and/or data on the amount of uncertainty associated with the inventories over time. Table 16 shows the percentage change in the amount of uncertainty associated with each Party's inventory in 1990, compared to the period 1991 to 1995, inclusive. This is done for uncertainty estimates based on the first national communication (column C) and separately for uncertainty estimates based on the second national communication (column F). Any changes in the composition of the "basket" reported for any particular year will affect the uncertainty attributed to a Party's inventory. For some Parties the share of CO_2 in their total inventory increased and therefore the uncertainty was reduced over time, whereas for others the opposite is true. These changes should not be interpreted as an improvement or deterioration of the quality of the inventory of a given Party over time.

53. The difference between the percentage change over time based on first national communications and that based on second national communications is a consequence of changes in methods/data employed in both communications. Subtracting these two percentages (column F minus column C) results in a difference that is shown in column G of table 16. It can be considered as the change of uncertainty associated with the inventories over time as a consequence of changes in methods/data used. The mean of this difference is 0.77 with a standard deviation of 1.5. The mode is only 0.1 per cent. The median for this column is 0.2. For seven Parties this difference exceeded one percentage point.

54. Clear guidance on how to estimate and consider the influence of changes in methods/data over time is required. This can be illustrated by implications derived from the results of table 16 other than those described in paragraphs 51 and 52. These results could be tentatively interpreted, among other possible interpretations, in the following way:

(a) It is fair to assume that methodologies and data improved between the first and second national communications. If so, then changes in uncertainty between the communications (difference presented in column G) are a reflection of this improvement; and

(b) Variations in methods/data used can limit comparability of data over time and, perhaps, introduce an additional source of uncertainty. Although unlikely, the existing flexibility in choosing methods allows for a selection of methods that favours beneficial performance in any particular period. Furthermore, favourable adjustments to the 1990 base year could also be made as a result of methodological "improvements".

55. A more detailed analysis of the overall uncertainty associated with national inventories can be seen in table 17 (page 42). The analysis is based on the quantitative gas-by-gas sectoral uncertainty estimates provided by five Parties. It should be more accurate than the simplified approach used above. For the sake of comparison, approximated overall uncertainties associated with national inventories are also calculated using the illustrative uncertainty factors provided as an example in the reporting instructions of the IPCC Guidelines. As is to be expected, the divergence in results is large, as well as from the results of approximated uncertainty presented in table 15. It is clear that the overall uncertainty associated with an emissions inventory is highly dependent on the underlying uncertainty factors for each gas, by emissions source.

56. Table 17 suggests that the mix of gases is more important than the quality of national inventory compilation in determining the overall level of uncertainty associated with a given inventory. This is shown using New Zealand as an example, which has a well developed national inventory system yet, a higher overall level of uncertainty, despite the fact that its own uncertainty factors were used for the estimation of its GHG inventory uncertainty. Finally, it can also be observed that differences in overall uncertainties between 1990 and the period 1991 to 1995, inclusive, are considerably less than the annual level of uncertainty associated with the inventory, regardless of what uncertainty factors are used to make the estimations.

IV. ISSUES RELATED TO REPORTING

57. In general, the quality of the inventory data presented in second national communications was higher than in the first communications, but many problems remain which hamper reporting GHG inventories in a transparent, complete and consistent way. This will require an improvement and expansion of the current reporting practices and procedures for meeting emissions limitation or reduction objectives.

A. Completeness

58. Information about how many Annex I Parties report data on different IPCC source categories is provided in table 18 (page 43). The degree of completeness in reporting varies widely. Nevertheless, all or almost all Parties reported the most significant particular GHG emissions (see table 22, page 47), such as CO_2 emissions from fuel combustion and industrial processes, CH_4 emissions from enteric fermentation and waste and N_2O emissions from agricultural soils and fuel combustion. There was little reporting of HFC, PFC and SF_6 emissions, but the number of reporting Parties increased for the year 1995. However, the percentage of reporting Parties is still low (53 for HFCs and PFCs, and 50 for SF_6).

59. It should be noted that some Parties may not have data on particular source category emissions. Many Parties did not report whether missing emissions were “not estimated,” “not occurring” or “included in other sectors.” Some Parties presented aggregated emission figures for broad IPCC sectors only, such as for industrial processes and fugitive emissions, and did not disaggregate their emissions on subsectors and source categories as is requested by the IPCC Guidelines. This affects the transparency and comparability of the data.

60. A comparison of the completeness of GHG emission reporting by Annex II Parties and Parties with economies in transition (EITs) is shown in table 19 (page 44). It indicates a lesser degree of completeness and dissagregation for the latter group of Parties in most subsectors. The main problems identified for EITs relate to the reporting of HFC, PFC and SF_6 emissions (see paras. 77-81) and bunkers (see paras. 82- 84), emissions from industrial processes and the dissagregation of the emissions by subsectors in the fuel combustion sector. This may have implications for the Kyoto Protocol.

B. Transparency

61. In order to ensure transparency, Parties were requested to provide sufficient information for reconstructing inventories from national activity data, emission factors and other assumptions. Table 20 (page 45) indicates how Parties followed key elements of this request.

62. Only 18 Parties provided the IPCC standard data tables, while Ireland presented these tables for 1993 only. The UNFCCC guidelines request that Parties provide these tables. The IPCC standard data tables do not provide the level of detail necessary to reconstruct inventories in all sectors. For this reason the Revised 1996 IPCC Guidelines request countries to submit the

worksheets or equivalent information for all sectors instead of the IPCC standard data tables. The UNFCCC guidelines also request, in addition to the IPCC standard data tables, the provision of the worksheets for fuel combustion, agricultural soils and the land-use change and forestry sector.[8] However, only Bulgaria, Germany, Hungary, Slovakia and the United Kingdom submitted the worksheets, and in all cases only for the fuel combustion sector.

63. There are many reasons why the worksheets used to estimate GHG emissions are not presented. These include the different level of dissagregation of the national inventories, the use of different methods to prepare inventories which do not require worksheets, the large quantity of worksheets, the preparation of worksheets in national languages, and the undefined nature of the terms "worksheet" and "equivalent information", among other possible factors. The level of additional information provided by Parties varies considerably and in general the information was not sufficient for reconstructing the inventories.

64. The usefulness of the worksheets using the IPCC reference approach for CO_2 fuel combustion emissions was discussed in paragraphs 17-19. The importance of these worksheets for verification and self-verification purposes is directly related to the importance of CO_2 fuel combustion in the aggregated GHG emissions. They constituted 50 per cent or more of the aggregated CO_2 equivalent emissions for all Annex I Parties, except New Zealand. For 18 Annex I Parties this share exceeded 75 per cent (see table 22, page 47). It should be noted that in order to carry out a precise comparison between top-down and bottom-up methods it is necessary to have compatible estimations of the CO_2 non-energy use, or feedstocks. In addition, how they were allocated in the different IPCC sectors and source categories must be considered. Feedstocks could constitute close to 10 per cent of the total CO_2 fuel combustion emissions of many Parties. Only 10 out of 34 Parties provided a description of how feedstocks were considered in their inventories.

65. Although the standard data tables of the 1995 version of the IPCC Guidelines do not provide the level of detail necessary to enable the reconstruction of an inventory, they provide information on the aggregated activity data and emission factors used. They serve the purpose of comparing among Parties and checking transparency, and completeness. Undoubtedly, the 18 Parties which provided these tables presented a more transparent inventory than those which did not. Only 15 Parties provided the overview table requested by the IPCC Guidelines, which is part of the reporting format of both the 1995 and the 1996 IPCC Guidelines. This table is very useful in an evaluation of the completeness of an inventory, because it provides the information on the gaps referred to in paragraph 59.

66. All reporting Parties except Canada and Ireland reported nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOC), known as precursors, as requested by IPCC and UNFCCC guidelines. Sixteen Parties optionally reported sulphur dioxide (SO_2) emissions, which is encouraged by the revised versions of both guidelines. These gases are important radiative constituents in the atmosphere, influencing the radiative forcing or

[8] The reporting of land-use change and forestry sector is not covered in this report.

more simply global warming rates. The calculation of specific GWPs for precursors is not currently possible because of the inadequate characterization of many of the atmospheric processes involved. It should be noted that Annex I Parties except Australia, Japan and New Zealand are Parties to the Convention on Long-range Transboundary Air Pollution, which has adopted five protocols. Parties to the Convention and its protocols systematically report the emissions of these gases and have programmes for their reduction.

67. Twenty-seven Parties reported their emissions in terms of CO_2 equivalents. All of these Parties used the IPCC 1995 GWP 100-year horizon, except Lithuania which used an old IPCC GWP. The reporting of GHG emissions in terms of CO_2 equivalent is not required by the IPCC Guidelines and is optional under the UNFCCC guidelines. The latter do not provide guidance on whether the GHG emissions expressed in CO_2 equivalent should be provided at a sectoral or at national level, or on the format (e.g. tables) to be used to present the data. The reporting of CO_2 equivalent emissions should not affect the reporting on a gas-by-gas basis using mass units which is essential for purposes of transparency, as requested by the UNFCCC guidelines.

68. Most Parties did not specifically indicate what IPCC tier or own method they used to estimate their emissions. Nine Parties (AUT, BEL[9], CHE, ESP, FRA, ITA, IRE, LUX, POR) used CORINAIR for compiling their GHG inventory. This is a bottom-up method which is built on a detailed source category split. The quality of the CORINAIR to IPCC conversion seems better in the second national communications than in the first ones, which reflects the progress achieved in the harmonization of these two methodologies. However, the information provided by the Parties using CORINAIR to back up their inventory data differed very much among them and, in general, was not sufficient for reconstructing inventories. This situation is common for most reporting Parties, not only for those that used CORINAIR.

69. In general the documentation on emission factors provided by Parties is poor (see table 21, page 46). Only a few Parties presented a detailed explanation of why they chose country-specific emission factors to estimate their GHG emissions. Many Parties only provided comments in this regard or referred the reader to several sources, which in many cases are in their national languages. Many Parties did not provide any information.

70. The information in table 21 also indicates that many Parties did not provide any numerical values for the emission factors. Many of them only provided aggregated emission factors at the IPCC sectors level, mainly through the IPCC standard data tables. Few Parties presented more disaggregated information, identifying values of specific emission factors which were applied in key sectors. The level of documentation varies widely among Parties. In general, the information presented underlines the fact that the instructions provided in the guidelines for documenting the emission factors used by Parties are vague and need to be improved.

9 Belgium also used a top-down methodology to compile the inventory for some regions.

71. Supporting documents with detailed data on activity statistics, emission factors and methods used could potentially lead to more consistent and transparent inventories. The UNFCCC guidelines request this background documentation without a clear definition of the specific information to be provided. This definition should be improved in the future. For example, the GHG inventory from Spain used 29,738 individual activity data and 2,555 emission factors, 1,225 of them for the estimation of emissions of the main GHGs. The French GHG inventory is built on a detailed source split of more than 500 items that could lead to a larger quantity of emission factors than the previous example. The emission registration system used by the Netherlands to compile its GHG inventory, which includes many point sources, aggregated over 400 compounds in hundreds of subcategories. Therefore, the provision of all basic background data is virtually impossible. Clear guidance as to what background information should be provided under the Convention and Kyoto Protocol is needed.

C. Relative importance of particular GHG emissions from different source categories

72. The aggregated GHG emissions of a given Party is the sum of particular GHG emissions from source categories in the different sectors and subsectors of the IPCC Guidelines. Emissions are estimated on a gas-by-gas basis, because each GHG in each source category requires specific emission factors. In practice, the particular GHG emission estimates from source categories act as individual "blocks" in "building" the inventory. The relative importance of each of these particular GHG emissions can be estimated by considering the percentage share of these emissions expressed in CO_2 equivalent related to the aggregated GHG inventory, expressed in the same units. These data are provided in table 22 (page 47) for the largest, referred to here as the "top," particular GHG emissions for most Parties.

73. This table demonstrates that the relative importance of each particular GHG from source categories varies among Parties, reflecting the differentiated structure of their economies. The top five particular GHG emissions for each Party are shown in bold.

74. The information in table 23 (page 49) indicates the percentage shares of the "top" five, seven, or 10 particular GHG emissions from different source categories of a Party's aggregated GHG emissions inventory. It can be observed that for 90 per cent of the reporting Parties, 30 out of 34, more than 90 per cent of their aggregated GHG emissions is attributable to their five top particular GHG emissions, more than 94 per cent is attributable to their seven top GHG particular emissions and more than 96 per cent of their emissions is accounted for by their 10 top particular GHG emissions. It should be noted that the relative importance of particular GHG emissions from different source categories in the inventory differs by country.

75. The current IPCC sectors and subsectors have at least 60 particular GHG emissions from source categories for which emission factors and activity data are required to estimate emissions. The UNFCCC guidelines request the inclusion of sufficient information to back up the data presented. Given that a limited number of particular GHG emissions from different source categories in each country are responsible for the bulk of emissions, as shown in table 23, emphasis could be placed on giving detailed information on only these emissions for each Party.

76. The extent to which different sources appear in the top five, seven and 10 particular GHG emissions from different source categories of the Parties is provided in table 24 (page 50). The table provides evidence that for most Parties, CO_2 from fuel combustion and industrial processes, CH_4 from enteric fermentation and solid waste and N_2O from agricultural soils and fuel combustion (mainly transport) are among the most common top particular GHG sources.

D. Reporting of HFC, PFC and SF_6 emissions

77. Reporting emissions of HFCs, PFCs and SF_6 on a mandatory basis is a new requirement of the UNFCCC guidelines. Only 21 Parties provided data but not all of them reported the three types of gases. The quality of the data provided by the 21 Parties varies widely, and in general data are incomplete. Of the 13 Parties which did not report these emissions at all, some indicated that emissions of one or more of these gases are negligible. Many of them, mainly those that are undergoing the process of transition to a market economy, reported that they do not have systems in place to estimate these emissions. Only some indicated that they will provide these data in future inventories. Methods for estimating emissions of these gases were included for the first time in the Revised 1996 IPCC Guidelines.

78. The differences between GWP values for different HFC and PFC species are large. Five Parties (BEL, CHE, FIN, ICE, NZL) only reported aggregated figures for HFCs and for PFCs. The UNFCCC guidelines do not provide clear guidance on reporting emissions of these substances in a disaggregated way, that is by the different types of chemicals. Another inconsistency in the reporting mentioned by some Parties is that the HFC, PFC and SF_6 species contained in imported or exported equipment are not reported in the inventories of these emissions.

79. Information on the reporting of actual and potential emissions for these gases is provided in table 25 (page 51). Seven out of 21 Parties which reported HFC emissions used an actual approach. Among them, three (Canada, Denmark and the United Kingdom) also reported estimates using a potential approach. Eight Parties used a potential approach and it is not clear what approach was used by the other five Parties. The reporting of PFCs and SF_6 contained similar problems. Decision 2/CP.3 affirms that actual emissions of these gases should be used for the reporting of these emissions. The SBSTA, at its fourth session, encouraged Parties to report both actual and potential emissions (FCCC/SBSTA/1996/20, para. 31).

80. The differences between the values of emission factors based on different rates of release to the atmosphere are also large. The lower portion of table 25 provides the ratio of potential to actual emissions for those six Parties which estimated both of these for HFCs or SF_6. This ratio is based on the estimated leakage rates of these GHGs in different applications. The reported differences are large, for example 16:1 in Canada, 6:1 in Denmark and 2:1 in the Netherlands. Therefore, estimates for actual and potential emissions can also vary to a significant degree, depending on the mix of different types of HFCs and PFCs. These large differences have implications for estimating the amount of the aggregated GHG emissions of a given Party.

81. The draft of the 1998 United States inventory points out the usefulness of examining atmospheric concentrations in this regard. The actual increase in the atmospheric concentration of SF_6 shows a higher accumulation than could be expected with the leakage rate of one per cent annually claimed by most manufacturers of circuit-breakers and gas-insulated substations. It was assumed that roughly three-quarters of SF_6 production is used in electric equipment. This example suggests the feasibility of using the measurement of the atmospheric concentrations of these gases as a tool to identify real ratios between potential and actual emissions. Also, the example indicates the usefulness of reporting emissions using both approaches, because each of them provides useful complementary information. However, even this approach may not suffice for policy-making related to specific sources and more information may be needed.

E. Reporting of international bunker emissions

82. Bunker emissions were reported separately from fuel combustion emissions by only 27 Parties. The Czech Republic, Estonia, Latvia, Lithuania, Slovakia, Slovenia and Ukraine did not provide this information. The information is requested by the IPCC and the UNFCCC guidelines. Some of these Parties explained that either these emissions are not significant to their aggregated emissions, or their national statistics are currently not able to make this differentiation. The emission share of the bunker emissions to the total GHG emissions of reporting Parties range from 0.1 (United States) to 19 per cent (Netherlands), as shown in table 26 (page 52).

83. Fourteen out of the 27 Parties which reported these emissions separated them into marine and aviation bunkers in their national communications or supporting materials. This separation is requested by the UNFCCC guidelines and COP decision 2/CP.3. The method used to estimate bunkers is also not consistent among Parties. For example, Switzerland only estimated bunker emissions which are emitted from the national territory, whereas Canada and Portugal estimated emissions based on fuel sales to air and marine vessels of foreign registration. Iceland and Denmark estimated emissions on the basis of fuel sold, but not specifying to whom. The UNFCCC guidelines include the same wording for reporting fuel sold without requesting the specification as to whom the fuel was to be sold to. Finland developed its own model to estimate aviation emissions, including international aviation emissions. Most Parties did not specify what methods they used. The impact of different methods on the bunker emission estimate has not been assessed.[10]

84. Eleven Parties reported bunker emissions of CO_2 only. For 13 out of 15 Parties which also reported CH_4 and N_2O bunker emissions the share of the CO_2 emissions in the aggregated GHG bunker emissions is higher than 98 per cent. For Finland it is 89 per cent, but the reasons for this lower figure were not explained. The share was not estimated for Canada as this Party reported only aggregated bunker emissions in terms of CO_2 equivalent.

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[10] Parties may also wish to refer to documents FCCC/SBSTA/1996/9/Add.1 and FCCC/SBSTA/1996/9/Add.2, which provide additional information on bunker emissions.

Table 1. Tiers and methods used by Parties for estimating GHG emissions

IPCC categories	Tier 1	Tier 2	Tier 3	Use of different tiers	No information provided
	Number of reporting Parties[a]				
ENERGY:					
Stationary combustion	7	15		10	
Mobile combustion	3	9	11	7	2
Fugitive solid fuel emissions	12	4	3	1	4
Fugitive oil and gas emissions	13	4	5	1	5
AGRICULTURE:					
Enteric fermentation	15	5		7	6
Manure management	15	6		5	5
	Basic IPCC 1995	Basic IPCC 1996	Country specific	Use of different methods	No information provided
Agricultural soils	12	7	7	2	6
Rice cultivation	8	---	2		2
Field burning of residues	10	---			3
WASTE:	Default	Kinetic	Country specific	Use of different methods	No information provided
Solid waste disposal	16	6	8		3
Waste water	14	---	6	2	3
Waste incineration	4	---	5	1	2

[a] Number of Parties reporting refers specifically to CO_2 emissions from stationary and mobile combustion and waste incineration, to CH_4 emissions from enteric fermentation, manure management, rice cultivation, field burning of residues, solid waste disposal and waste water and to N_2O emissions from agricultural soils. Industrial processes emissions are not considered in the table because the methods and tiers used to estimate most of these emissions are quite similar. Reporting of HFC, PFC and SF_6 emissions is covered in table 25.

Comments

Table 1 indicates the methods chosen by countries within the reporting framework of the IPCC Guidelines. The secretariat has compiled this table based on the information submitted by Parties in their second national communications and supporting materials. In those cases where a clear statement of the method or tier used by Parties was made, this was used as the basis for the allocation. In other cases the allocation was inferred from the relevant narrative text or inventory tables. Some Parties did not provide sufficient information for the allocation of methods used in the IPCC reporting framework. The differences between the number of reporting Parties in the different IPCC source categories is a consequence of the varying degree of completeness in the reporting (see table 18).

Table 2. Types of emission factors used by Parties

IPCC categories	Types of emission factors used: Defaults (IPCC or CORINAIR)	Country-specific (CS)	Mix of defaults/CS	No information provided
	Number of reporting Parties[a)]			
ENERGY:				
Stationary combustion	9	11	5	7
Mobile combustion	10	11	4	7
Fugitive solid fuel emissions	7	7	3	7
Fugitive oil and gas emissions	9	9	2	8
INDUSTRIAL PROCESSES:				
Mineral production	5	7	4	18
Chemical industry	8	5	4	17
Metal production	7	6	5	16
AGRICULTURE:				
Enteric fermentation	12	8	7	6
Manure management	12	8	5	6
Agricultural soils	13	9	3	9
Rice cultivation	5			7
Field burning of residues	4			9
WASTE:				
Solid waste disposal	11	13	1	8
Waste water	9	7	3	6
Waste incineration	4	5	1	2

a) Number of Parties reporting refers specifically to CO_2 emissions from stationary and mobile combustion and waste incineration, to CH_4 emissions from enteric fermentation, manure management, rice cultivation, field burning of residues, solid waste disposal and waste water and to N_2O emissions from agricultural soils. For CO_2 emissions from mineral production the secretariat included those Parties that specifically reported these emissions (23) and those that reported total CO_2 emissions from the industrial processes sector. This was done because some Parties only provide total CO_2 emissions from the industrial processes sector. For the other industrial subsectors emissions of the three main GHGs were considered.

Comments

The table indicates what types of emission factors were used by Parties to compile their GHG inventories. The secretariat has compiled this table based on the information submitted by Parties in their second national communications and supporting materials. In those cases where a clear statement of the type of emission factors used by Parties was provided, this was used as the basis for the allocation. In other cases the allocation was inferred from the relevant narrative text or inventory tables. To the extent possible, the values of reported emission factors were compared with the default ones, if the source of the emission factors was not indicated. Some Parties did not provide sufficient information to allocate the emission factors according to the classification provided in the table. The differences between the number of reporting Parties in the different IPCC source categories are a consequence of the different degrees of completeness in the reporting (see table 18).

Table 3. Comparison of CO_2 emissions from fuel combustion using the reference approach (tier 1) and detailed methods (tiers 2 and 3) (Gg)

	Germany					United Kingdom					USA	Finland
	1990	1991	1992	1993	1994	1990	1991	1992	1993	1994	1990	1994
Reference approach	983 528	948 549	904 325	896 608	--	576 457	586 922	575 049	553 964	554 260	1 424 000	58 281
Detailed technology-based approach	986 640	950 625	901 383	893 100	--	563 908	570 847	555 019	540 454	533 180	1 436 000	58 331
Difference (%)	0.3	0.2	-0.3	-0.4	--	-2.2	-2.8	-3.6	-2.5	-4.0	0.8	0.8

	Bulgaria						Australia					
	1990	1991	1992	1993	1994	1995	1990	1991	1992	1993	1994	1995
Reference approach	78 716	61 286	56 570	61 772	58 041	61 098	262 473	264 642	267 408	271 171	276 771	287 349
Detailed technology-based approach	76 484	60 626	55 416	57 650	54 322	56 255	262 569	270 269	273 031	276 545	280 180	287 144
Difference (%)	-2.9	-1	-2	-6.7	-6.4	-7.9	0.04	2.1	2.1	2.0	1.2	-0.07

Comments
This table is based on the information submitted in national communications and supporting materials.

Table 4. Comparison of CH_4 emissions from enteric fermentation and manure management estimated using tier 1 and tier 2 methods in the Czech Republic

Livestock type	Number of animals	Emission factors enteric fermentation		Emissions from enteric fermentation		Emission factors manure management		Emissions from manure management	
	(thousands)	(kg/head/year)		(Gg/year)		(kg/head/year)		(Gg/year)	
		Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
Dairy cattle	1 195	94.00	67.16	112.33	80.26	6.00	3.29	7.17	3.93
Non-dairy cattle	2 165	48.00	subdivided	103.92	53.00	14.00	1.50	30031	3.25
Sheep	430	8.00	7.87	3.44	3.38	0.19	0.33	0.08	0.14
Goats	42	5.00	4.59	0.21	0.19	0.12	0.21	0.01	0.01
Horses	25	18.00	47.22	0.45	1.18	1.39	3.63	0.03	0.09
Swine	4 569	1.50	3.41	6.85	15.58	3.00	8.80	13.71	40.21
Poultry	33 278	--	0.07	0.00	2.33	0.08	0.02	2.63	0.67
Total				227.2	155.92			53.94	48.29
				Difference	71.28			Difference	5.64
				%	-31.4			%	-10.5

Comments

The data used for comparison in the table were taken from: "Greenhouse Gas Inventories: National Reporting Processes and Implementation Review Mechanisms in the EU. Case Study on the Czech Republic". M. Tichy and W. Katscher, pp. 38-39. Forschungszentrum Jülich GmbH (KFA), Programme Group Technology Assessment (TFF). KFA series 1996. The data presented were reorganized.

Table 5. Comparison of CH_4 emissions from solid waste disposal using basic and more advanced methods in the Czech Republic and Finland

Czech Republic	CH_4 emissions (Gg)	Finland	CH_4 emissions (Gg)
Basic methodology	149	Mass balance	105
Kinetic methodology	125	Dynamic model	71
Difference (%)	16		48

Comments
The information presented in the table was taken from Finland's National Greenhouse Gas Inventory, 1992-1994, supporting material prepared by the Ministry of Environment of Finland, 19.06.1996 and from "Greenhouse Gas Inventories: National Reporting Processes and Implementation Review Mechanisms in the EU: Case Study on the Czech Republic". M. Tichy and W. Katscher, p. 41 Forschungszentrum Jülich GmbH (KFA), Programme Group Technology Assessment (TFF). KFA series 1996.

Table 6. Comparison of N_2O emissions from agricultural soils estimated using the Revised 1996 and 1995 IPCC Guidelines

	N_2O emissions, 1990 (Gg)		
	Revised 1996 IPCC Guidelines	1995 IPCC Guidelines	Difference (%)
Denmark	33.0	8.5	74.2
Finland	6.0	4.0	33.3
New Zealand	44.9	37.0	17.5
Switzerland	9.2	13.4	-45.7
United States	196.0	183.2	6.5

Comments
The information presented in the table was taken from the first and the second national communications submitted by Parties reporting the use of the Revised 1996 IPCC Guidelines for the estimation of N_2O emissions from agricultural soils.

Table 8. Comparison between IPCC default and country-specific emission factors for N_2O emissions from agricultural soils, New Zealand

	IPCC default value	New Zealand value	Difference (%)
Leaching	0.30	0.15	100
Pasture emissions	0.02	0.01	100

Comments
The information presented in the table was taken from the second national communication of New Zealand.

Table 7. Comparison between IPCC default and country-specific emission factors for CO_2 emissions from the fuel combustion sector (t CO_2/TJ)

	Crude oil	Anthracite	Hard coal (coking coal)	Bituminous coal	Sub-bituminous coal (brown coal)	Lignite	Peat	Wood (solid biomass)	Coke (petroleum coke)	Car gasoline	Aviation gasoline	Jet kerosene	Gas/ diesel oil	Residual fuel oil	LPG	Natural gas	Coke oven gas	Blast furnace gas	Refinery gas
Austria			93-97	97	101 108				92- 100	74	74	71	74	77-79	64	55			
Belgium	72.6		92.7						107	69		71	73	77	63	56	46	280	73
Denmark			95					102	102	73	72?	72	74	78	65	57			57
Finland			91.3?				104	109		73	71	72	73 74	77	66	56			
France	73?		94.1	93	96	100		92		72.4		74	74.8	74	64	57	47	268	56
Germany	73			95		95	106		108	69	72	72	74	77	63	56	44		
Greece			92.7			73.2- 122		97.2	92.7- 99.8	68.6			73.3	76.6	62.4	55.8			66.1
Ireland			86				104 115			70		71	73	76	64	55			
Sweden			91				97.1 107.1			73	72	73	75	75.3 76.2	78		60	103	
United Kingdom	73.3	91		90.3	99.6			104.7	106.4	67.3		68.8	69.8	74.1	67.9	55.6			
Default IPCC 1996	73.3	98.3	94.6	94.6	96.1	101.2	106	109.6	108.2	69.3	71.9	71.5	74.1	77.4	63.1	56.1	47.7	242	66.7
Maximum difference (%)	0	-4	3	3	12	21	9	-1	0	7	3	3	1	2	8	2	26		
Minimum difference (%)	-1	-4	-9	-5	0	-28	-8	-16	-15	-3	-1	-4	-6	-4	-1	-2	-8		

Comments

The country-specific emission factors presented in the table were taken from national communications or supporting materials submitted by Parties. Only a group of Parties which presented disaggregated emission factors in the fuel combustion sector were chosen. Other Parties which also provided disaggregated emission factors were not included. Default emission factors were taken from the IPCC Guidelines.

Table 9. Comparison of CO_2 emissions from cement production estimated using IPCC default and country-specific emission factors (1995)

	Quantity of cement produced (kt)	Country-specific emission factor (t CO_2/ t cement produced)	CO_2 emitted (Gg)	IPCC default emission factor (t CO_2/ t cement produced)	CO_2 emitted (Gg)	Difference in emissions estimates (Gg)	Difference in emissions estimates (%)
Australia[a)]	6 116	0.51	3 168	0.50	3 101	67	2
Canada	10 722	0.5	5 361	0.49	5 345	16	0.3
Iceland	81	0.44	50	0.49	41	-4.6	-11.7
New Zealand	989	0.51	503	0.49	492	10	2.2
Norway	1 683	0.5	842	0.49	839	2.6	0.3
Switzerland	420	0.59	248	0.49	210	384	18.4

a) Data for Australia are from 1990. This Party reported emissions based on clinker instead of cement production. Therefore, the emission factors are different from those used by other Parties.

Comments

Activity data and country-specific emission factors presented in the table were taken from standard data tables provided in the national communications of these Parties. Emission estimates made with these data were also taken from the communications. Default emission factors were taken from the IPCC Guidelines. The secretariat estimated emissions using default emission factors and the activity data provided by Parties. Percentage differences were estimated assuming that national estimates were 100 per cent.

Table 10. Change in emission estimates as a consequence of different assumptions used to choose activity data, United States

	N_2O emissions from agricultural soils (Gg)				
	1990	1991	1992	1993	1994
N_2O (1 year)[a)]	184.7	188.3	190.9	190.0	210.9
N_2O (3 years)[b)]	183.2	188.0	189.7	197.3	200.4
Difference (%)	0.8	0.2	0.6	3.7	5.0

a) Activity data correspond to each single year.

b) Activity data correspond to the average of the three previous years.

Comments

Information presented in table 10 was taken from the Inventory of US Greenhouse Gas Emissions and Sinks: 1990-1994, submitted by this Party as supporting material.

Table 11. Differences in GHG emission estimates for the year 1990 due to changes in methods/data used (percentage change)[a)b)]

	A	B	C	D	E	F
				All GHG emission estimates (CO_2 equivalent)		
Party[c)]	CO_2 emission estimates	CH_4 emission estimates	N_2O emission estimates	Total change	Effect of the use of different GWPs	Effect of changes in methods/ data[d)]
Australia	-5.5	-17.1	+31.4	-12.1	-4.4	-7.7
Austria	+4.5	-2.6	+183.2	+3.4	-2.7	+6.1
Bulgaria[e)]	-0.7	+0.8	+31.6	-2.6	-4.1	+1.5
Canada	<1	+3.6	-9.9	-1.9	-2.1	+0.2
Czech Republic	<1	-5.8	+7.5	-2.2	-1.8	-0.4
Denmark	<1	+3.4	+230.1	+9.7	-2.5	+12.0
Estonia	--	-67.4	-4.2	-2.4	-2.8	+0.4
Finland	<1	-2.4	-18.2	-3.8	-1.0	+2.8
France	+3.2	+4.2	+2.8	+0.8	-2.4	+3.2
Germany	--	--	+7.1	-1.4	-1.8	+0.4
Greece	+3	+29.2	+26.0	+4.6	-1.7	+6.3
Iceland	-1.1	-39.1	-30.0	-12.2	-2.0	-10.2
Ireland	--	+1.9	-30.6	-10.8	-5.2	-5.6
Italy	<1	-40.3	+36.7	-5.5	-1.8	-3.7
Japan	-2.6	+14.0	+90.8	-1.3	-0.6	-0.7
Latvia	+7.8	+17.2	+838.8	+29.0	-2.4	+31.4
Luxembourg	+16.3	+0.5	+14.5	+14.7	-0.7	+15.4
Netherlands	--	+4.1	-0.6	-1.6	-2.1	+0.5
New Zealand	--	-14.1	+177.9	-4.5	-7.82	+3.32
Norway	<1	+49.0	--	+3.9	-3.3	+7.2
Poland[f)]	+14.9	-48.2	-4.1	-13.8	-2.0	-11.8
Portugal	+11.8	+257.7	+33.3	+34.1	-4.2	+38.3
Russian Federation	<1	-1.9	+151.9	-2.6	-3.1	+0.5
Slovakia	+3	+17.9	-21.9	0.8	-2.1	+2.9
Spain	<1	+1.4	+0.3	-2.8	-2.8	+0.0
Sweden	-9.5	-1.5	-39.5	-12.2	-1.9	-10.3
Switzerland	--	-26.7	-26.3	-7.6	-1.8	-5.8
United Kingdom	+1.2	-1.5	+10.8	-1.1	-2.3	+1.2
United States	<1	+9.5	+3.3	-0.6	-1.9	+1.3

[a] Percentage deviation of the inventory of the second national communication relative to the inventory submitted in the first national communication. Negative values denote that the latest submitted inventory has a lower figure. All figures rounded.
[b] Where no value is shown this indicates that the difference is zero between the emissions in the first and second national communications.
[c] Hungary was not included because it did not provide a recalculated figure for the base year (average of 1987-1989) or for the year 1990 in its second national communication.
d) This change represents the effects of changes in methods/data. The effect of the use of different GWPs in the first and second national communication is excluded here.
[e] The data for Bulgaria are for 1990 because the base year was not recalculated in the second national communication despite the fact that the years from 1990 and on were recalculated.
[f] Data for Poland represent the changes in their base year (1988).

Comments

Table 11 indicates the effects of changes in methods/data and change of GWP used in the first and second national communications on the aggregated GHG emission estimates for the base year (column F). The total changes of these emissions (column D), including the effect of the use of different GWPs (column E), are also shown. Changes in the estimates on a gas-by-gas basis are also presented (columns A, B, C).

(1) Differences in CO_2 emissions were estimated from the percentage change in estimates between the first and second national communications. The formula used is the following:
Change = 100 (1- (CO_2 2^{nd} NC/CO_2 1^{st} NC)). The results are presented in column A.
Differences in CH_4 and N_2O emissions were estimated in the same way. The results are shown in columns B and C, respectively.
For the estimation of the CO_2 equivalent emission differences, the estimates of CH_4 and N_2O were multiplied by the corresponding GWP and aggregated with the CO_2 estimates. HFC, PFC and SF_6 emissions were not included for purposes of consistency, as the reporting of these gases is inconsistent among Parties.

(2) The procedure used for obtaining the total changes between CO_2 equivalent emissions of the first and the second national communications, as well as the effect of change in methods/data used, was the following:

(a) The value of aggregated GHG emissions from the second national communications obtained using 1995 GWPs was divided by the value of aggregated GHG emissions from the first national communications obtained using the 1994 GWPs to estimate the total changes of estimations between the two communications. To express the value in per cent the following formula was used:
$100*[(\sum CO_2 \text{ eq. } 2^{nd} \text{ NC using GWP 95}/\sum CO_2 \text{ eq. } 1^{st} \text{ NC using GWP 94})-1]$. These results are presented in column D.

(b) The effect of using different GWPs was estimated by dividing the aggregated GHG emissions from the 2^{nd} national communication using the 1995 GWPs by the aggregated GHG emissions of the 2^{nd} NC using the 1994 GWPs. To express the value in per cent the following formula was used:
$100*[(\sum CO_2 \text{ eq. } 2^{nd} \text{ NC using GWP 95}/\sum CO_2 \text{ eq. } 2^{nd} \text{ NC using GWP 94})-1]$. These results are presented in column E.

(c) Finally, the effects of the change in methods/data were estimated by the algebraic subtraction of the effect of the use of different GWPs (E) from the total change (D). As the previous operation was a subtraction of percentages, these results are also expressed in per cent.

Table 12. Changes in the percentage share of emissions of particular GHGs in aggregated national CO_2 equivalent emissions (average for 1991-1995 compared to 1990)

Party	CO_2			CH_4			N_2O			Other GHG		
	1990	1991-95	Diff. (%)[h)i)]	1990	1991-95	Diff.(%)[h)i)]	1990	1991-95	Diff.(%)[h)i)]	1990	1991-95	Diff.(%)[h)i)]
Australia	66.5	68.0	2.3	26.3	25.8	-1.9	6.0	6.1	1.8	1.2	0.1	-91.8
Austria	79.5	79.2	-0.4	15.9	15.6	-1.9	4.6	5.0	7.4	--	0.2	
Belgium	83.2	83.4	0.2	9.5	9.3	-2.2	6.8	6.8	-1.0	0.4	0.5	28.2
Bulgaria[a)]	68.4	68.4	0.0	24.15	25.0	3.4	7.5	6.7	-10.6	--	--	
Canada	81.9	81.0	-1.1	11.9	12.4	4.0	4.7	5.1	8.1	1.6	1.4	-9.7
Czech Republic	86.1	85.8	-0.3	9.7	9.9	2.0	4.2	4.3	3.0	0.0	--	
Denmark	72.8	75.6	3.8	12.3	11.3	-8.8	14.7	12.9	--11.8	0.2	0.1	-60.0
Estonia	92.8	91.9	-1.0	5.4	6.3	14.3	1.8	1.7	-1.8	--	--	
Finland[b)]	83.4	83.8	0.5	8	7.8	-2.6	8.6	8.4	-3.3	--	0.1	
France	74.8	76.4	2.1	12.5	12.1	-3.3	11.1	10.5	-5.5	1.5	1.0	-34.2
Germany	83.6	83.4	-0.2	9.8	9.5	-3.2	5.8	6.2	6.8	0.7	0.9	21.6
Greece	85.2	85.6	0.5	9.4	9.3	-1.1	5.4	5.1	-5.5	--	--	
Hungary[a)c)]	82.3	76.1	-7.5	13.7	20.8	34.1	3.9	3.1	-22.0	--	--	
Iceland	74.3	81.1	9.2	10.2	10.5	2.9	4.5	4.3	-3.7	11.0	4.1	-62.8
Ireland	54	56.8	5.2	30	29.4	-2.0	16.0	13.8	-13.5	--	--	
Italy[d)]	81.1	80.2	-1.1	9.2	10.1	8.9	9.6	9.4	-1.4	0.2	0.3	87.5
Japan[e)]	89.8	89.9	0.1	2.6	2.0	-30.0	2.6	2.1	-21.3	4.9	6.1	24.2
Latvia	69.4	64.2	-7.5	11	11.4	3.5	19.6	24.4	24.7	--	--	
Luxembourg[d)]	94.8	94.0	-0.8	3.6	4.1	12.2	1.5	1.9	29.6	--	--	
Netherlands	77.8	79.2	1.8	10.8	10.2	-5.9	7.4	7.9	7.2	4.1	2.7	-33.7
New Zealand	33	35.7	8.2	46.4	44.8	-3.6	19.2	18.7	-2.5	1.5	0.8	-46.3
Norway	65.8	68.4	4.0	16.8	18.0	6.7	8.6	8.3	-4.0	8.8	5.3	-39.6
Poland[a)f)]	84.5	84.7	0.2	11.7	11.8	0.8	3.5	3.5	0.3	--	--	
Portugal[g)]	68.9	70.2	1.9	24.8	23.8	-4.2	6.3	6.0	-5.1	--	--	
Russian Fed.	78	77.2	-1.0	18.3	19.2	4.7	2.3	1.8	-20.0	1.4	1.8	31.4
Slovakia	82.2	82.5	0.4	11.8	12.3	4.1	5.3	4.5	-16.0	0.7	0.8	17.6
Spain[g)]	75.1	75.4	0.4	15.2	15.5	1.9	9.7	9.1	-6.1	--	--	
Sweden	83.4	84.5	1.3	10.2	9.8	-4.1	4.3	4.2	-1.3	2.0	1.6	-21.6
Switzerland	83.9	83.4	-0.6	9.5	9.4	-1.1	6.6	6.8	2.5	--	0.4	
United Kingdom	80	80.9	1.1	12.8	12.4	-3.2	5.1	4.4	-13.7	2.1	2.3	9.5
United States	85.5	85.2	-0.4	10.7	10.7	0.0	2.3	2.3	2.5	1.5	1.8	18.4

[a] Bulgaria, Hungary and Poland have base years other than 1990. Values here represent 1990.
[b] Finland did not report emissions for 1991. The average represents 1992-1995 emissions.
[c] Hungary did not recalculate its inventory of the year 1990. Therefore, emission estimates for 1991-1995 were calculated using different methods.
[d] Italy and Luxembourg did not report emissions for 1991-1993. The averages represent 1994-1995 emissions.
[e] Japan did not report CH_4 or N_2O emissions for 1995. The separate and aggregated averages for all gases represent 1991-1994 emissions.
[f] Poland did not report emission data for 1991, 1993 or 1995. The average represents 1992 and 1994 data.
[g] Portugal and Spain did not report emissions for 1995. Averages represent 1991-1994 emissions.
[h] The formula used for CO_2, CH_4, N_2O and Other GHG to arrive at the values for the difference is: Difference = $((GHG_{1991-95}-GHG_{1990})*100)/GHG_{1990}$
[i] A negative difference indicates a decrease from 1990 to 1991-1995 in the share of that particular gas, in the mix.

Comments:
This table was prepared by calculating the share of the emissions of each GHG in the aggregated GHG emissions for 1990 and 1991-1995. The values reported by Parties for emissions of each GHG in the year 1990 and in the years between 1991 and 1995 were expressed in terms of CO_2 equivalent, multiplying the emissions estimated by the corresponding 1995 IPCC GWP. The share of each GHG expressed in per cent is calculated in relation to the aggregated GHG emissions of each Party.
The first column for each gas indicates the share for 1990 and the second column shows the average share of the gases for 1991-1995, unless otherwise indicated. The difference is the percentage change from 1990 to 1991-1995. Negative values signify that the relative importance of a particular gas decreased in 1991-1995 in relation to 1990. This could mean a decrease in the emissions of that gas, but also an increase in the emissions of any of the other gases.

Table 13. Changes in aggregated national GHG emissions, expressed in CO_2 equivalent, due to socio-economic driving factors and to changes in methods/data (average for 1991-1995 compared to 1990)[a]

	Aggregated GHG emissions 1990, using the 2nd NCs (Gg) (A)	Average GHG emissions 1991-1995, using the methods from the 2nd NCs[b] (Gg) (B)	Percentage increase or decrease of average aggregated GHG emissions 1991-1995, related to the emissions of the year 1990, reflecting only changes in socio-economic driving factors[c] C=100*((B/A)-1)	Average GHG emissions 1991-1995, using the methods/data from the 1st NCs, assuming the same rate of change reported in column C (Gg) (D)	Percentage of increase or decrease of the average aggregated emissions 1991-1995 due to changes in methods/data in the 2nd NCs.[c] E=100*(1-(B/D))
Australia[d]	405 553	416 211	2.6	450 228	7.6
Austria[d]	77 814	77 507	-0.4	72 846	-6.4
Belgium[d]	138 943	141 933	2.2	116 872	-21.4
Bulgaria[e]	123 432	91 074	-26.2	87 608	-4.0
Canada	557 860	577 110	3.5	576 319	-0.1
Czech Republic	192 130	159 584	-16.9	160 318	0.5
Denmark[d]	71 658	79 991	11.6	71 180	-12.4
Estonia	40 719	28 338	-30.4	31 542	10.2
Finland	64 546	65 834	2.0	67 329	2.2
France[d]	498 067	501 725	0.7	485 670	-3.3
Germany	1 203 537	1 097 797	-8.8	1 093 556	-0.4
Greece[d]	99 232	102 079	2.9	96 234	-6.1
Hungary[e][f]	101 634	80 897	-20.4	68 972	-17.3
Iceland[d]	2 571	2 630	2.3	2 906	9.5
Ireland[d]	56 861	57 506	1.1	61 234	6.1
Italy	532 048	528 168	-0.7	544 157	2.9
Japan	1 190 250	1 242 550	4.4	1 253 912	0.9
Latvia	35 669	23 074	-35.3	17 505	-31.8
Luxembourg	13 448	11 448	-14.9	10 244	-11.8
Netherlands	206 602	216 440	4.8	215 626	-0.4
New Zealand[d]	76 034	75 646	-0.5	72 113	-4.9
Norway[d]	49 266	49 776	1.0	46 732	-6.5
Poland[e]	459 048	438 970	-4.4	565 524	22.4
Portugal[d]	68 442	72 270	5.6	52 954	-36.5
Russian Fed.	2 998 767	2 111 366	-29.6	2 100 614	-0.5
Slovakia	72 496	57 732	-20.4	56 162	-2.8
Spain	301 431	305 190	1.2	305 363	0.1
Sweden[d]	65 101	66 155	1.6	74 057	10.7
Switzerland[d]	53 749	53 381	-0.7	56 489	5.5
United Kingdom	714 691	679 819	-4.9	671 301	-1.3
United States	5 713 320	5 845 742	2.3	5 782 546	-1.1

[a] Parties which have not submitted more than one communication are not included in this table.

[b] When Parties did not provide emissions data for 1990 through 1995, only those years reported were used. Finland's average represents 1992-1995 emissions. Italy and Luxembourg averages represent 1994-1995 emissions. Japan did not report CH_4 or N_2O emissions for 1995. The separate and aggregated averages for all gases represent 1991-1994 emissions. Poland's average represents 1992 and 1994 data. Portugal and Spain averages represent 1991-1994 emissions.

[c] Negative values in columns C and E indicate a decrease in the emissions between 1990 and 1991-1995.

[d] For Australia, Austria, Belgium, Denmark, France, Greece, Iceland, Ireland, New Zealand, Norway, Portugal, Sweden and Switzerland the percentage increase or decrease of the average aggregated emissions 1991-1995 due to changes in methods/data in the second national communication exceeded the percentage increase or decrease of emissions due to change in socio-economic driving factors in the period.

[e] Bulgaria, Hungary and Poland have base years other than 1990. Values here represent 1990.

[f] Hungary did not recalculate its inventory of the year 1990. Therefore, emission estimates for 1991-1995 were calculated using different methods. The situation does not allow changes reflected in columns C and E to be comparable with changes for other Parties.

Comments:

Column A shows the aggregated GHG emissions for the year 1990, taken from the second national communications and using the GWPs from 1995 (CO_2 equivalent = 21 times CH_4 emissions, 310 times N_2O emissions). The table does not include HFCs, PFCs and SF_6. Column B shows the average aggregated GHG emissions for the years 1991 through 1995, except when other years are used, as indicated in the footnotes. The figures are from the second national communications, and the 1995 GWPs are used. Column C shows the percentage change from 1990 to the average of years 1991-1995. Because GWP and other methods are the same for all six years, the change in emissions represented in this difference is due to changes in socioeconomic driving factors. A negative value therefore indicates that there was a decrease in the aggregated emissions between 1990 and 1991-1995.

Column D shows the estimate of Parties' aggregated GHG emissions between 1991 and 1995, using methods applied in the first national communications. The values were estimated using the same trend of emissions related to 1990, year by year, as estimated from the data of the second national communications (reflected in column C) but using the base year estimates provided in the first national communications.

1995 IPCC GWPs were used, therefore changes in base year estimates between first national communications and second national communications are a consequence of changes in methods/data and are not influenced by the use of different GWPs. Column E indicates the effect of a change in methods between the first and second national communications, in per cent, and was calculated using the formula $E=100*(1-(B/D))$. A negative value signifies that the change in methods has caused the emissions to be reported as lower than they would be had the Parties used the methods from the first national communications.

Table 14. Confidence levels[a] (qualitative[b] or quantitative (+/- per cent)) of GHG emission estimates in the main IPCC source categories

Gas and source	AUS	BEL	BUL	CAN	CHE	CZE	DNK	FIN	GBR	HUN	ICE	ITA	JAP	NLD
CO_2		2		4[c]	H	8-10	1-2	H/M	H 5		H			H 2
Fuel combustion	<5		H	3	H	H/M		H	H	4-5	H	10	10	H
Industrial processes	<10		H	15	H			H	H		H	10	10	H
Changes in forest		25	H		H				M			60	60	M
Other LUCF	>80		H									100	100	
CH_4		30		30	M	40	*[d]	M/L	M 25		M/L			M 25
Fuel combustion	>20		M	40	M	20-30		L	M		M			M
Fugitive: oil & gas	>20		M	30	M	20-30		M	M	3-4		60	60	M
: coal	>20		M	40		40-50				5-7		60	60	
Enteric fermentation	20-80		H	30-50	M	20-30		M	M		M	25	25	M
Animal waste	20-80		M	50	M	20-30		M	L		L	20	20	L
Waste	>50		M	30	M			M	M		L	100	100	M
N_2O		50		40	M/L	80-100	*[d]	M	L 50		L			L 50
Fuel combustion	>20		M	50-60	M			M	L		L			L
Inorganic chemicals			M	30	M			M	L			50	50	L
Organic chemicals			M	15								50	50	
Agricultural soils	20-80		M	60-100	L			M	L		L	200	200	L

Gas and source	NOR	NZL	POR	RUS	SLO	SWE	USA
CO_2	H	5			H 10	H/M	H
Fuel combustion	H		H		H	H	1-2
Industrial	H		M	1-2	M	M	H
Changes in forest		25			H 35		L
Other LUCF		35			M		L
CH_4	M	50			M/L 30-50	M/H	M/L
Fuel combustion	H		M		L	M	M
Fugitive: oil & gas	M		M	<30-40	M		+/-40
: coal	M		M	<30-40	M		+/-
Enteric	M		M	L	M	H	+/-20
Animal waste	M		M		M	M	M
Waste	M		L		M/L	M	+/-30
N_2O	L	50			L >100	L	H/L[f)]
Fuel combustion	L		M		L	L	L
Inorganic	M		M	+/-60			H
Organic chemicals	M		M		L	L	H
Agricultural soils	L		M		L	L	L

Comments

Table 14 indicates how Parties reported the uncertainties associated with GHG emissions. The secretariat has compiled this table based on the information submitted by Parties except for Canada. For this Party these factors were taken from: Uncertainties in Canada's 1990 Greenhouse Gas Emission Estimates, an unpublished report of Environment Canada, 1994.

Numerical estimates and classifications of H-M-L by the different Parties presented here are not comparable between Parties because these qualitative evaluations were obtained using different methods.

Spain presented a detailed qualitative estimate of the reliability of its inventory based on the SNAP (selected nomenclature of air pollution) groups according to the label of quality (uncertainty factor) of the CORINAIR methodology. The quantitative information presented by this method cannot be allocated into the table prepared by the secretariat and for this reason it was not included here. The information is provided on pp. 39-40 of the second national communication of Spain.

a) The secretariat uses the term "confidence levels" to consistently compile data provided by Parties using different terms: uncertainties, emissions range, accuracy, etc.

b) High (H); medium (M); low (L). When different benchmarks were reported for the same GHG, the predominant figure is pointed out using a "bold" letter.

c) The emissions range presented by Canada has a different confidence level: 95, 90 and 85 per cent for CO_2, CH_4 and N_2O, respectively.

d) Denmark reported an uncertainty factor of two magnitudes for CH_4 and N_2O.

e) The uncertainty of 20 per cent refers only to underground mining ventilation systems; the uncertainty for surface mining is about 100-300 per cent.

f) Party assigned high confidence level to the uncertainty related to N_2O industrial process emissions but did not specify whether this designation corresponds to the inorganic chemicals or organic chemicals category. In order to present the data consistently the secretariat assigned H to both categories.

Table 15. Approximated overall uncertainties associated with national GHG inventories (+/- per cent) and their change over time (1990) (1991-1995)[a)b)]

	(A) 1990	(B) 1991	(C) 1992	(D) 1993	(E) 1994	(F) 1995	Average uncertainty for 1991-1995 (G) G=(B+C+D+E+F)/5	Percentage difference in uncertainties related to 1990[c)] (H) H=((G-A)*100)/A
Australia	18.9	18.9	18.8	18.7	18.6	18.4	18.7	-1.0
Austria	14.8	14.4	15.1	15.2	15.3	15.1	15.0	1.3
Belgium	14.7	14.5	14.4	14.7	14.6	14.6	14.6	-0.8
Bulgaria[d)]	19.2	20.0	19.6	18.5	17.8	18.4	18.9	-1.6
Canada	13.9	14.0	14.1	14.3	14.4	14.6	14.3	3.2
Czech Republic	12.8	12.7	12.9	12.8	13.1	13.1	12.9	1.1
Denmark	21.2	19.4	20.2	19.8	19.1	19.7	19.6	-7.4
Estonia	9.8	9.8	10.1	10.3	10.1	10.0	10.0	2.1
Finland	15.6		15.4	15.6	14.9	15.2	15.3	-1.7
France	18.8	18.3	17.9	18.1	18.3	18.2	18.2	-3.4
Germany	14.0	14.0	14.4	14.2	14.3	14.3	14.2	1.5
Greece	13.6	13.5	13.4	13.3	13.2	13.2	13.3	-1.9
Hungary[d)e)]	13.7	15.1	15.2	14.8	15.5	14.8	15.1	9.9
Iceland	13.9	13.9	13.4	13.1	13.2	13.3	13.4	-3.8
Ireland	27.1	25.5	25.3	25.6	25.2	25.1	25.3	-6.4
Italy	16.6				17.0	16.5	16.7	0.9
Japan	9.8	9.8	9.7	9.8	9.7	7.0	9.2	-6.1
Latvia	24.4	25.9	27.5	27.6	29.8	29.3	27.8	14.1
Luxembourg	9.1				9.3	9.8	9.5	4.2
Netherlands	15.7	15.7	16.0	15.9	16.0	15.7	15.9	0.8
New Zealand	34.3	33.8	33.1	33.4	33.4	33.5	33.4	-2.6
Norway	19.0	19.5	18.6	18.7	18.4	18.4	18.7	-1.9
Poland[d)]	13.7		12.9		12.9		12.9	-5.9
Portugal	18.6	18.4	17.7	18.1	18.1		18.0	-2.8
Russian Federation	13.9				13.8		13.8	-0.5
Slovakia	14.2	14.3	14.0	13.4	13.7	13.3	13.8	-3.2
Spain	18.3	18.2	17.9	18.0	17.8		18.0	-1.8
Sweden	13.1	13.1	12.9	13.0	12.8	12.7	12.9	-1.6
Switzerland	14.5	14.3	14.5	14.7	14.8	14.7	14.6	0.8
United Kingdom	14.5	14.2	13.9	13.5	13.8	13.7	13.8	-4.4
United States	11.7	11.8	11.8	11.7	11.8	11.8	11.8	0.5

a) Blanks indicate that no emissions data were reported by the Party for the given year, and therefore averages are based on emissions from the other years provided.

b) Parties which have not submitted more than one communication are not included in this table.

c) Negative values indicate a decrease in the approximated uncertainty between 1990 and 1991-1995.

d) Bulgaria, Hungary and Poland have base years other than 1990. Values here represent 1990.

e) Hungary did not recalculate its inventory of the year 1990. Therefore, emission estimates for 1991-1995 were calculated using different methods.

Comments:

The approximated uncertainties presented in this table, estimated by the method described below, cannot provide true estimates of the overall uncertainty associated with a GHG inventory of a given Party. The values of the approximated overall uncertainties reported in this table were estimated with the sole purpose of providing an insight into the influence of changing uncertainties over time.

The approximated uncertainties for each Party are calculated multiplying the percentage share of each GHG emission in the aggregated GHG emissions by the attributed uncertainty factors. These percentage shares were estimated in the same way as described in the comments to table 12, but without considering HFCs, PFCs and SF_6, as reporting of these gases is inconsistent among Parties. The uncertainty factors were assigned as follows: CO_2 +/- 7 per cent, CH_4 +/- 35 per cent, and N_2O +/- 80 per cent, as explained in paragraph 44 of the main text. All shares were based on the emissions estimates reported in the second national communications, or the latest data set submitted to the secretariat. The average approximated uncertainties were based on the data for the years provided among 1991 through 1995. The column H shows the percentage change between the approximated uncertainties calculated in 1990 and those for 1991-1995 using the formula H=((G-A)*100)/A.

A negative value signifies that there was a decrease in uncertainty for the emission estimates for a given Party between 1990 and the average of 1991-1995. This could be caused by a shift in the shares of the mix. For example, a significant increase in N_2O emissions since 1990 could cause greater uncertainty, since N_2O emissions have the highest uncertainty of the three gases.

Table 16. Changes in approximated overall uncertainties associated with national GHG inventories due to changes in methods/data (average of 1991-1995 compared to 1990)[a)]

	Approximated overall GHG inventory uncertainty using the methods of the first national communications[b)]			Approximated overall GHG inventory uncertainty using the methods of the second national communications[b)]				Difference between the approximated overall percentage uncertainty for 1990 and 1991-1995 as reported in the second national communications and that reported in the first national communications	
	A 1990	B 1991-1995	C=((B-A)*100)/A	D 1990	E 1991-1995	F=((E-D)*100)/D	G=(F-C)		
			Percentage difference related to 1990[c)]			Percentage difference related to 1990[c)]	Difference in percentages	H= (D-A) 1990	I= (E-B) 1991-1995
Australia	18.5	18.3	-1.2	18.9	18.7	-1.0	0.23	0.4	0.4
Austria	13.1	13.2	0.4	14.8	15.0	1.3	0.9	1.7	1.8
Bulgaria[d)]	18.1	17.9	-1.1	19.2	18.9	-1.6	-0.5	1.1	1.0
Canada	14.1	14.6	3.3	13.9	14.3	3.2	-0.1	-0.2	-0.3
Czech Republic	12.7	12.8	1.1	12.8	12.9	1.1	0.0	0.1	0.1
Denmark	14.4	13.6	-5.8	21.2	19.6	-7.4	-1.6	6.8	6.1
Estonia	12.4	12.9	4.2	9.8	10.0	2.1	-2.1	-2.6	-2.9
Finland	16.8	16.5	-1.8	15.6	15.3	-1.7	0.1	-1.2	-1.2
France	18.8	18.2	-3.4	18.8	18.2	-3.4	0.0	0.0	0.0
Germany	13.8	14.0	1.4	14.0	14.2	1.5	0.1	0.2	0.3
Greece	12.5	12.3	-1.7	13.6	13.3	-1.9	-0.2	1.1	1.1
Hungary[d)]	13.7	15.0	9.4	13.7	15.1	9.9	0.5	0.0	0.1
Iceland	16.5	15.9	-4.0	13.9	13.4	-3.8	0.2	-2.6	-2.5
Ireland	30.5	28.4	-6.9	27.1	25.3	-6.4	0.5	-3.5	-3.1
Italy	16.2	16.4	1.7	16.6	16.7	0.9	-0.8	0.4	0.3
Japan	8.7	8.3	-4.3	9.8	9.2	-6.1	-1.8	1.1	0.8
Latvia	12.5	13.4	7.8	24.4	27.8	14.1	6.3	11.9	14.4
Luxembourg	9.3	9.7	4.4	9.1	9.5	4.2	-0.2	-0.2	-0.2
Netherlands	15.7	15.8	0.8	15.7	15.9	0.8	-0.0	0.1	0.1
New Zealand	28.4	27.7	-2.8	34.3	33.4	-2.6	0.2	5.9	5.8
Norway	18.0	17.6	-2.3	19.0	18.7	-1.9	0.4	1.0	1.1
Poland[d)]	19.0	18.6	-2.0	13.7	12.9	-5.9	-3.9	-5.3	-5.8
Portugal	14.4	14.0	-2.9	18.6	18.0	-2.8	0.1	4.2	4.1
Russian Federation	13.0	13.1	0.9	13.9	13.8	-0.5	-1.4	0.9	0.7
Slovakia	15.0	14.4	-4.2	14.2	13.8	-3.2	1.0	-0.8	-0.6
Spain	18.2	17.9	-1.8	18.3	18.0	-1.8	0.0	0.1	0.1
Sweden	14.4	14.1	-1.6	13.1	12.9	-1.6	0.0	-1.3	-1.2
Switzerland	16.6	16.8	0.8	14.5	14.6	0.8	-0.0	-2.1	-2.2
United Kingdom	14.2	13.7	-4.2	14.5	13.8	-4.4	-0.2	0.2	0.2
United States	11.5	11.5	0.5	11.7	11.8	0.5	0.0	0.3	0.3

[a] Parties which have not submitted more than one communication are not included in this table.
[b] Values of columns A, B, D and E are expressed in +/- per cent.
[c] Negative values indicate a decrease between the uncertainty in the first national communication and the second national communication for a particular gas.
[d] Bulgaria, Hungary and Poland have base years other than 1990. Values here represent 1990.

Comments:
The approximated uncertainties presented in this table, estimated by the method described below, cannot provide true estimates of the overall uncertainty associated with a GHG inventory of a given Party. The values of the approximated overall uncertainties reported in this table were estimated with the sole purpose of providing an insight into the influence of changing uncertainty over time due to changes in methods/data. The approximated overall uncertainty associated with GHG inventories presented here was estimated using the same approach as described in table 15. In order to assess the changes in uncertainty due to changes in methods/data over time the average approximated overall GHG uncertainties for the years 1991-1995 using methods/data of the first national communications were estimated. The rate of change of the mix of gases used as a basis for the estimation was calculated following the same approach as that one described in the comments to table 13, and more specifically those comments referring to column D of that table.

Column B shows the approximated uncertainty for each Party for the average of years 1991-1995 that would have been had Parties maintained their methods/data from the first national communications. Column A shows the approximated uncertainty associated with 1990 inventory calculated on the basis of the mix of gases reported in the first national communications. GWPs used were adjusted to IPCC 1995 values. Column C indicates the difference between the approximated overall GHG inventory uncertainty of the average for the years 1991-1995 for the first national communications with that of the year 1990, also from the first national communications, expressed in per cent related to the 1990 value, calculated using the formula C=((B-A)*100)/A. Columns D, E and F provide the same information as the columns A, B and C, but using the methods of the second national communications. The results shown in column F are the same as in column H of table 15. Negative values in columns C and F indicated that the uncertainty for 1990 was greater than that of the average for 1991 through 1995. These changes should not be interpreted as an improvement or deterioration of the quality of the inventory over time, but rather seen as a consequence of different changes of the mix of gases in the period.

Column G is the difference between columns F and C which can be considered as the change of uncertainty associated with the inventories as a consequence of changes in methods/data used between the first and second national communications. Columns H and I show the difference between D and A and E and B, respectively. Column H indicates the difference caused by a change in methods/data for two 1990 estimates. Similarly, column I indicates the difference caused by a change in methods/data for the average of the years 1991 through 1995 for estimates obtained using different methods.

Table 17. Changes in approximated overall uncertainties associated with national GHG inventories using different uncertainty factors, selected Parties (1990) (1991-1995)

	Uncertainties associated with national GHG estimates calculated using sectoral uncertainty estimates reported by Parties[a]			Uncertainties associated with national GHG estimates calculated using sectoral uncertainty estimates presented by the IPCC as examples[b]		
	(+/- per cent)			(+/- per cent)		
	1990	1991-1995	Change	1990	1991-1995	Change
Australia	23.7	24.4	1.3	27.8	28.3	0.5
Canada	12.7	13.5	0.8	22	23.6	1.6
Czech Republic	14	17.1	3.1	17.5	19.00	1.5
New Zealand	36.6	35	-1.6	57	55.8	-1.2
Slovakia	19.4	21.3	1.9	23.6	26.4	2.8
United States	7.5	10	2.5	18.7	20.6	1.9

[a] Sectoral uncertainty factors from Parties were taken from national communications, except for Canada. For this Party these factors were taken from: Uncertainties in Canada's 1990 Greenhouse Gas Emission Estimates, an unpublished report of Environment Canada, 1994.
[b] Sectoral uncertainty taken from table A-I of the reporting instructions of the IPCC Guidelines.

Comments
Table 17 shows the uncertainties associated with national GHG inventories applying both sectoral uncertainty estimates reported by Parties as well as those sectoral uncertainty estimates presented in the reporting instructions of the IPCC Guidelines as examples in table A-I of the reporting instructions. Those Parties shown were chosen because of the fact that they reported quantitative sectoral uncertainty factors. Party-specific uncertainty factors were applied to the sectoral shares of GHG emissions of the year 1990 shown in table 22. The same uncertainty factors were applied to these shares of GHG emissions for the years 1991 to 1995, and the annual estimated uncertainties were averaged for the period. When no uncertainty factor was provided by a given Party for a specific sector, the IPCC default uncertainty factors were applied instead. The remaining share of Parties' total emissions not covered by the 11 sources indicated in table 22 was given an uncertainty factor of 80 per cent. For table 17 the share of emissions of HFCs, PFCs and SF_6, considered together, was also included because the shares calculated in table 22 included them. These gases were given an uncertainty factor of 100 per cent in the estimates using own uncertainty factors, as well as in those using the IPCC ones. When approximated overall uncertainties were estimated using the IPCC values, an uncertainty factor of 50 per cent for N_2O NO2 emissions from industrial processes was chosen. The IPCC Guidelines do not provide an uncertainty factor for this source. The formula used to arrive at the value for the changes is: Change = $((U_{1991-95}-U_{1990})*100)/U_{1990}$. A negative value for the percentage change indicates that uncertainties decreased between 1990 and the period 1991-1995.

Table 18. Completeness of reporting by Annex I Parties[a] (1990)

GHG source category	CO_2		CH_4		N_2O	
	Reporting Parties	% of total	Reporting Parties	% of total	Reporting Parties	% of total
IA. Fuel combustion[b]	34	100	34	100	34	100
1. Energy industries	31	91	27	79	28	82
2. Manufacturing industries and construction	31	91	28	82	25	74
3. Transport	32	94	31	91	29	85
4. Small combustion	32	94	29	85	26	76
5. Other	23	68	14	41	11	32
6. Biomass burning	11	32	10	29	6	18
IB. Fugitive fuel emissions	18	53	30	88	3	9
1. Solid fuels	5	15	24	71		
2. Oil and natural gas systems	16	47	28	82	3	9
II. Industrial processes	34	100	18	53	27	79
A. Mineral products	23	68				
B. Chemical industry	11	32	8	24	17	50
C. Metal production	17	50	6	18	1	3
D./G. Other production/Other	11	32	1	3	1	3
E./F. Production and consumption of halocarbons and SF_6 (1995)[c]	(HFCs)		(PFCs)		(SF_6)	
	8 (18)	26 (53)	16 (18)	47	15 (17)	44
III. Solvent use	7	21			8	26
IV. Agriculture	4	12	34	100	34	100
A. Enteric fermentation			33	97		
B. Manure management			31	91	5	15
C. Rice cultivation			12	35	3	9
D. Agricultural soils	4	12	7	21	29	85
E. Prescribed burning of savannas			1	3	1	3
F. Field burning of agricultural residues			13	38	8	24
G. Other						
VI. Waste	14	41	33	97	18	53
A. Solid waste disposal on land	5	15	33	97		
B. Waste water handling	1	3	25	74	8	24
C. Waste incineration	11	32	12	35	14	41
D. Other			2	6		
VII. Other	1	3				
Bunkers	24	71	12	35	12	35

[a] This table takes into account 1990 emission estimates from 34 Parties. Poland data represent its base year, 1988. Data for Bulgaria and Hungary represent 1990 values.

[b] The numeration of the sectors follows that of the IPCC Guidelines. For the purposes of this table, Land-use change and forestry (Sector 5) has been omitted. Other represents emissions from any sources not already covered by the six sectors distinguished by the IPCC Guidelines.

[c] Data for HFCs, PFCs, and SF_6 for 1995 are shown in parentheses.

Comments

All data taken from the secretariat databases prepared on the basis of the second national communications submitted by Parties. Emissions “not estimated,”“not occurring” or “included elsewhere” are not identified in the table because this information was not provided by most Parties.

Table 19. Comparison of completeness of reporting by Annex II Parties and Parties with economies in transition[a] (1990) (percentage)

GHG source category	CO_2		CH_4		N_2O	
	Reporting Parties					
	EIT	Annex II	EIT	Annex II	EIT	Annex II
IA. Fuel combustion[b]	100	100	100	100	100	100
1. Energy industries	82	96	64	87	87	87
2. Manufacturing industries and construction	82	96	73	87	83	87
3. Transport	82	100	73	100	96	83
4. Small combustion	82	100	64	96	78	83
5. Other	56	74	36	43	43	35
6. Biomass burning	36	30	36	26	22	22
IB. Fugitive fuel emissions	18	70	91	87	17	13
1. Solid fuels	9	17	73	70		
2. Oil and natural gas systems	18	61	82	83	17	13
II. Industrial processes	100	100	45	57	64	87
A. Mineral products	82	61				
B. Chemical industry	18	39	18	26	52	52
C. Metal production	27	61	27	13	4	4
D./G. Other production/other	18	39		4	4	4
	(HFCs)		(PFCs)		(SF_6)	
E./F. Production and consumption of halocarbons and SF_6 (1995)[c]	18	70	18	78	9	70
III. Solvent use		30			9	30
IV. Agriculture		17	100	100	100	100
A. Enteric fermentation			91	100		
B. Manure management			91	91	17	22
C. Rice cultivation			36	35	13	13
D. Agricultural soils		17	9	26	96	96
E. Prescribed burning of savannas				4	9	4
F. Field burning of agricultural residues			27	43	26	26
G. Other						
VI. Waste	9	57	91	100	36	61
A. Solid waste disposal on land	9	17	91	100		
B. Waste water handling		4	82	70	18	26
C. Waste incineration		48		52	18	43
D. Other				9		
VII. Other		4				
Bunkers	18	96	9	48	9	52

[a] This table takes into account 1990 emissions from 23 Annex II Parties, namely, Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States, and 11 EIT Parties, namely, Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Russian Federation, Slovenia, Slovakia, and Ukraine.

[b] The numeration of the sectors follows that of the IPCC Guidelines. For the purpose of this table, Land-use change and forestry (sector 5) has been omitted. Other represents emissions from any sources not already covered by the six sectors distinguished by the IPCC Guidelines.

[c] Data for HFCs, PFCs, and SF_6 are for 1995.

Comments

All data taken from the secretariat databases prepared on the basis of the second national communications submitted by Parties. Emissions “not estimated,”“not occurring” or “included elsewhere” are not identified in the table because this information was not provided by most Parties.

Table 20. Reporting of key inventory data requested by the UNFCCC guidelines

Parties	Standard data tables	Overview table	Worksheets	CO_2 equivalent estimates	Precursors	SO_2
Australia	Yes	Yes	No	Yes	Yes	Yes
Austria	No	No	No	Yes	Yes	No
Belgium	Yes	No	No	Yes	Yes	Yes
Bulgaria	Yes	Yes	Yes (fc)[a]	Yes	Yes	No
Canada	Yes	No	No	Yes	No	No
Czech Republic	Yes	No	No	Yes	Yes	No
Denmark	No	No	No	No	Yes	Yes
Estonia	No	No	No	No	Yes	No
Finland	Yes	No	No	Yes	Yes	Yes
France	Yes	No	No	Yes	Yes	Yes
Germany	Yes	No	Yes (fc)[a]	Yes	Yes	No
Greece	No	No	No	Yes	Yes	No
Hungary	No	No	Yes (fc)[a]	No	Yes	No
Iceland	Yes	Yes	No	Yes	Yes	No
Ireland	1993 only	No	No	Yes	No	No
Italy	No	Yes	No	Yes	Yes	Yes
Japan	No	Yes	No	No	Yes	Yes
Latvia	No	No	No	Yes	Yes	Yes
Lithuania	No	No	No	Yes	Yes	No
Luxembourg	No	No	No	No	Yes	No
Netherlands	Yes	Yes	No	Yes	Yes	Yes
New Zealand	Yes	Yes	No	Yes	Yes	Yes
Norway	Yes	Yes	No	Yes	Yes	Yes
Poland	No	No	No	No	Yes	No
Portugal	Yes	Yes	No	Yes	Yes	No
Russian Federation	No	No	No	Yes	Yes	Yes
Slovakia	Yes	Yes	Yes (fc)[a]	Yes	Yes	Yes
Spain	No	No[b]	No	Yes	Yes	No
Sweden	Yes	Yes	No	Yes	Yes	Yes
Switzerland	Yes	Yes	No	Yes	Yes	Yes
Ukraine	No	No	No	Yes	Yes	No
United Kingdom	Yes	Yes	Yes (fc)[a]	Yes	Yes	Yes
United States	Yes	Yes	No	Yes	Yes	Yes

[a] Worksheets were provided only for CO_2 fuel combustion emissions (IPCC reference approach).
[b] A detailed explanation of the reliability of the GHG estimates was provided by Spain.

Comments
This table is based on the information submitted in national communications and supplementary material.

Table 21. Level of documentation on emission factors used

<table>
<tr><th>IPCC category</th><th>Documented</th><th>Commented or referenced</th><th>No information provided</th><th>Specific values given</th><th>Aggregated values given</th><th>Values not given</th></tr>
<tr><td></td><td colspan="6">Number of reporting Parties[a)]</td></tr>
<tr><td>ENERGY:</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Stationary combustion</td><td>4</td><td>13</td><td>15</td><td>11</td><td>11</td><td>10</td></tr>
<tr><td>Mobile combustion</td><td>3</td><td>16</td><td>13</td><td>9</td><td>11</td><td>12</td></tr>
<tr><td>Fugitive solid fuel emissions</td><td>4</td><td>9</td><td>11</td><td>5</td><td>10</td><td>9</td></tr>
<tr><td>Fugitive oil and gas emiss.</td><td>4</td><td>10</td><td>14</td><td>5</td><td>11</td><td>12</td></tr>
<tr><td>INDUSTRIAL PROCESSES:</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Mineral production</td><td>2</td><td>13</td><td>19</td><td colspan="2">21</td><td>13</td></tr>
<tr><td>Chemical industry</td><td>1</td><td>13</td><td>20</td><td colspan="2">18</td><td>16</td></tr>
<tr><td>Metal production</td><td>1</td><td>12</td><td>21</td><td colspan="2">17</td><td>17</td></tr>
<tr><td>AGRICULTURE:</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Enteric fermentation</td><td>3</td><td>15</td><td>15</td><td>8</td><td>13</td><td>12</td></tr>
<tr><td>Manure management</td><td>3</td><td>16</td><td>12</td><td>7</td><td>12</td><td>12</td></tr>
<tr><td>Agricultural soils</td><td>1</td><td>16</td><td>17</td><td>6</td><td>9</td><td>19</td></tr>
<tr><td>Rice cultivation</td><td></td><td>2</td><td>10</td><td></td><td>6</td><td>6</td></tr>
<tr><td>Field burning of residues</td><td></td><td>1</td><td>12</td><td></td><td>6</td><td>7</td></tr>
<tr><td>WASTE:</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Solid waste disposal</td><td>2</td><td>12</td><td>19</td><td>2</td><td>16</td><td>15</td></tr>
<tr><td>Waste water</td><td>3</td><td>6</td><td>16</td><td>1</td><td>16</td><td>8</td></tr>
<tr><td>Waste incineration</td><td>1</td><td>6</td><td>5</td><td>1</td><td>10</td><td>1</td></tr>
</table>

[a)] See footnotes to table 2.

Comments

The table indicates the level of documentation on emission factors used in the GHG inventories provided by Parties. It is based on the information submitted by Parties in their second national communications and supporting materials. In those cases where a detailed explanation was provided on the rationale for a Party's choice of a particular emission factor the information was classified as "documented". Whenever the information was limited to brief comments referring to the basis of selection of a given emission factor, or reference to other materials was made, the information was classified as "commented or referenced". Some Parties did not provide any information. When numerical values of emission factors used in key sectors were provided in a dissagregated way, the level of documentation was classified as "specific values given". When more aggregated emission factors were provided, in many cases through the use of the IPCC standard data tables, the classification of "aggregated values given" was used. When a Party provided both types of emission factors, the secretariat included them as "specific values given." The differences between the number of reporting Parties in the different IPCC source categories is a consequence of the varying degree of completeness in the reporting (see table 18).

Table 22. Percentage share of particular GHG emissions in aggregated GHG emissions by source, expressed in CO_2 equivalent, Annex I Parties, 1990[a)]

	CO_2		CH_4					N_2O				
	Fuel combustion	Industrial processes	Solid fuels	Oil & natural gas	Enteric fermentation	Manure management	Solid waste disposal on land	Fuel combustion	Industrial processes	Agricultural soils	Other GHG	Total
Australia[b)]	64.2	1.6		5.4	14.5	0.4	3.3	0.6	0.1	2.0	1.2	93.4
Austria	62.5	17.1	0.0	0.1	4.1	0.8	5.5	1.8	0.3	1.4	0.0	93.5
Belgium[c)]	75.9	6.6	0.2	0.6	5.6	0.0	2.6	1.7	2.6	2.4	0.4	98.6
Bulgaria[d)]	62.0	5.8	1.3	4.0	3.1	1.3	12.3	3.0	2.4	2.1	0.0	97.2
Canada	75.4	3.9	0.3	4.8	2.4	0.9	3.1	2.0	2.0	0.6	1.6	97.0
Czech Republic	83.3	2.8	4.7	0.6	1.7	0.5	1.4	3.2	0.5	0.4	0.0	98.9
Denmark	70.5	1.4	0.1	0.3	4.9	4.7	2.1	0.9	0.0	14.2	0.3	99.2
Estonia	91.3	1.5	0.0	0.0	0.0	0.0	1.4	1.1	0.0	0.0	0.0	95.3
Finland	81.4	1.9	0.0	0.0	2.9	0.4	3.8	2.4	1.4	2.9	0.0	97.0
France	71.5	3.3	0.9	0.5	6.0	0.7	3.2	0.9	5.6	3.4	1.5	97.6
Germany	81.4	2.8	2.1	0.6	2.5	1.1	3.1	1.0	2.1	2.2	0.7	99.0
Greece	77.4	7.5	0.9	0.0	3.0	0.5	2.2	2.1	0.7	2.6	0.0	96.8
Hungary[d)]	78.8	3.5	4.6	4.7	3.2	1.0	0.0	2.6	0.0	0.0	0.0	98.4
Iceland	58.0	13.2	0.0	0.0	8.0	0.7	1.4	0.4	1.7	2.4	11.0	97.0
Ireland	51.4	2.9	0.0	0.4	20.5	1.9	5.1	1.5	1.4	12.8	0.0	98.0
Italy	76.5	5.3	0.0	1.2	2.6	0.8	1.2	2.7	1.4	3.7	0.2	95.5
Japan	84.1	4.7	0.2	0.1	0.6	0.2	0.7	1.6	0.6	0.1	4.9	97.8
Latvia	67.9	1.6	0.0	3.1	5.8	0.8	1.1	0.2	0.0	19.1	0.0	99.6
Lithuania[b)]	72.4	4.3		1.1	6.4	1.0	6.6	0.6	0.8	0.0	0.0	93.1
Luxembourg	86.3	7.6	0.0	0.3	2.5	0.2	0.5	0.4	0.0	1.1	0.0	98.7
Netherlands	77.0	0.9	0.0	1.8	3.9	1.0	3.7	0.4	2.7	1.1	4.1	96.5
New Zealand	29.2	3.1	0.3	0.4	40.7	0.5	4.1	1.1	0.0	18.1	2.0	98.9
Norway	49.9	12.1	0.2	0.6	3.0	0.6	11.8	1.2	4.0	3.5	8.8	95.4
Poland[d)]	80.9	2.0	3.7	0.9	3.6	0.3	3.5	0.4	1.1	2.8	0.0	99.2
Portugal	63.2	5.0	0.1	0.0	3.8	2.1	15.1	0.8	0.9	3.3	0.0	94.4
Russian Federation	75.9	1.5	2.0	11.1	3.1	0.4	1.3	0.2	0.0	0.0	1.4	96.7
Slovakia	77.6	4.7	1.0	2.5	3.5	1.9	1.5	0.3	0.9	4.0	0.7	98.6
Slovenia	69.2	3.3	5.1	0.4	4.1	0.7	5.4	0.8	0.0	7.4	0.0	96.3
Spain	69.0	5.9	4.3	0.5	2.4	3.2	3.3	2.1	1.1	6.5	0.0	98.3
Sweden	77.7	5.7	0.0	0.0	6.0	0.4	2.7	3.0	1.3	0.1	1.5	98.3
Switzerland	74.5	6.2	0.0	0.8	5.9	0.0	2.6	0.8	0.2	0.0	0.7	91.4
Ukraine	73.8	3.5	6.5	8.0	4.0	1.2	2.1	0.2	0.2	0.4	0.0	99.8
United Kingdom	77.3	1.4	2.4	1.4	2.9	0.4	5.4	0.6	4.0	0.3	2.1	98.1
United States	84.4	1.0	1.5	2.1	2.1	0.9	3.6	0.7	0.5	1.1	1.5	99.3

[a] Figures in bold indicate the top five particular GHG emissions among these 11 categories for each Party.
[b] Australia and Lithuania reported aggregated CH_4 estimates for solid fuels and oil and natural gas emissions.
[c] CH_4 emissions from manure management for Belgium are included in the value for enteric fermentation.
[d] Bulgaria, Hungary and Poland have base years other than 1990. Values here represent 1990.

Comments

The table shows the share of emissions from the 10 most commonly reported sources, plus HFCs, PFCs and SF_6, which were treated together as Other GHG, expressed in CO_2 equivalent. The emissions were calculated by multiplying the emission estimates for the particular GHG emissions from different source categories by the appropriate GWP value. The shares were then estimated by comparing the emissions to the total aggregated GHG emissions for a particular Party. A value of zero indicates that either no value has been reported, or the value is so small that it is less than 0.01 per cent of the total. The column entitled Total shows the percentage of the aggregated total for each Party accounted for by the 11 GHG emissions from different source categories mentioned in the table.

Table 23. Percentage share of the X top particular GHG emissions from different source categories in the aggregated GHG emissions of a given Party (CO_2 equivalent) (1990)[a)]

	X=10	X=7	X=5
Australia	97	93	89
Austria	99	95	92
Belgium	99	97	93
Bulgaria	98	93	87
Canada	97	94	90
Czech Republic	99	98	96
Denmark	100	99	96
Estonia[b)]	100	97	96
Finland	98	97	93
France	96	94	90
Germany	96	95	91
Greece	97	96	93
Hungary	100	99	95
Iceland	100	97	93
Ireland	99	96	93
Italy	97	94	91
Japan	98	97	96
Latvia	100	99	98
Lithuania	94	93	91
Luxembourg	100	99	98
Netherlands	99	96	92
New Zealand	99	98	95
Norway	95	93	87
Poland	100	98	95
Portugal	98	95	91
Russian Federation	97	96	94
Slovakia	98	96	92
Slovenia	99	97	91
Spain	98	95	89
Sweden	100	98	95
Switzerland	94	93	91
Ukraine	100	99	96
United Kingdom	98	95	92
United States	99	96	94

a) The top 10 particular GHG emissions reported here are not necessarily the same as those presented in table 22.
b) Estonia only reported emissions from eight particular GHG emission sources, so they represent 100 per cent of the aggregated GHG emissions.

Comments:
This table shows the percentage of aggregated GHG emissions that each Party's top 10, 7 and 5 particular GHG emissions from different source categories represent. The values were obtained by ranking the reported aggregated GHG emissions for each Party. For certain Parties, these 10 particular GHG emissions from different source categories almost cover 100 per cent of their reported GHG emissions. A value of 100 per cent indicates that other particular GHG emissions from different source categories not included in the top 10 are negligeable (less than 0,04 per cent) in relation to the aggregated GHG emissions.

Table 24. Number of Parties for which emissions from different IPCC sources fall into their X top particular GHG emission sources from different source categories

	IPCC source categories	Gas	Number of Parties X=5	X=7	X=10
IA.[a]	Total fuel combustion	CO_2	34	34	34
		CH_4			7
		N_2O	7	18	32
IB.	Total fugitive emissions	CO_2	1	2	2
		CH_4	2		2
IB1.	Solid fuels	CO_2	1		1
		CH_4	10	11	15
IB2.	Oil and natural gas	CO_2			3
		CH_4	8	10	24
II.	Industrial production	CO_2	28	32	34
		CH_4			1
		N_2O	4	16	23
III.	Solvent use	CO_2			1
		N_2O			1
IV.	Total agriculture	CH_4	1		1
		N_2O		2	2
IVA.	Enteric fermentation	CH_4	30	33	33
IVB.	Manure management	CH_4	1	11	27
		N_2O			3
IVC.	Rice cultivation	CH_4	1	2	3
IVD.	Agricultural soils	CH_4	1	2	5
		N_2O	15	21	23
IVE.	Prescribed burning of savannas	CH_4			1
		N_2O			1
VIA.	Solid waste disposed on land	CH_4	21	28	29
VIB.	Wastewater handling	CH_4		4	10
		N_2O			2
VIC.	Waste incineration	CO_2	2		3
		N_2O			1
VID.	Other waste	CH_4			1
IIE/IIF.	Production and consumption of halocarbons and SF_6	Other GHGs	5	9	13

[a] The numbers to the left of the source titles indicate the numeration of these source categories in the IPCC Reporting Guidelines.

Comments

The table shows for how many Parties the indicated IPCC source categories fall into the top 5, 7 or 10 particular GHG emissions from source categories. This table was prepared by listing the top 5, 7 and 10 particular GHG emission sources for all Parties. The resulting number of Parties was allocated to the corresponding IPCC source categories, split gas by gas.

Table 25. Analysis of the information provided by Parties on HFC, PFC and SF_6 emissions (1995 or 1994)

Party	Reporting of actual (A) and/or potential (P) emissions			% share of total GHG emissions
	HFCs	PFCs	SF_6	
Australia	NR	A (only industrial)	NR	0.33
Austria	P	P	P	0.01
Belgium	P	P	P	0.78
Canada	A/P	A (only industrial)	A (only industrial)	1.39
Czech Republic	?[a)]	NR	?	0.04
Denmark	A/P	A/P	A/P	0.53
Finland	?	?	?	0.26
France	P	A (only industrial)	A	1.06
Germany	?	A	?	1.01
Iceland	P	A (only industrial)	A	2.68
Italy	A	A	A	0.27
Japan	P	P	P	7.2
Netherlands	A	A/P	P	5.21
New Zealand	P	A (only industrial)	A/P	5.87
Norway	P	A (only industrial)	A	4.16
Russian Federation	A	A(only industrial)	NR	1.8
Slovakia	NR	A (only industrial)	NR	0.56
Sweden	?	?	?	2.65
Switzerland	?	?	?	1.88
United Kingdom	A/P	A/P	A/P	2.47
United States	A	A	P	2.22

Parties	Ratio of potential to actual emissions, 1995		
	HFCs	SF_6	Total
Canada	16:1	--	--
Denmark	5.7:1	2:1 (leakage rate: 50%)	4.1:1
France	--	130:1 (leakage rate: <1%)	
Iceland	-	49:1 (leakage rate: 2%)	
Netherlands	1.9:1	--	--
New Zealand	--	8:1 (leakage rate: 12,5%)	--
United Kingdom	--	(leakage ratio 2%)	4.2:1

[a)] A "?" in the table indicates that it was unclear whether the data submitted by a Party represented actual or potential emissions.

Comments

Table 25 indicates the methods chosen by countries within the reporting framework of the IPCC Guidelines for reporting emissions of HFCs, PFCs, and SF_6. It is based on the databases compiled by the secretariat from information submitted by Parties in the second national communications and supporting material. When emissions data for 1995 were not available, data for 1994 were taken. To estimate the percentage share that the emissions of these gases represent in the aggregated GHG emissions the databases mentioned above were used. When a Party provided emissions estimates in mass units, the secretariat estimated the CO_2 equivalent emissions using the corresponding 1995 GWPs. When a Party provided only aggregated HFC and PFC emissions, the secretariat assumed that all these emissions were HFC-134_a or that 90 per cent were CF_4 and 10 per cent C_2F_6, respectively.

Table 26. Reporting of bunker emissions (1995)[a)]

Party	Separate marine/ aviation	GHG reported			Precursors reported	Percentage share of CO_2 in aggregated bunker emissions	Percentage share of bunkers in aggregated GHG emissions
		CO_2	CH_4	N_2O			
Australia	N	x	x	x		99.1	2.0
Austria[b)]	-	x			Y	99.7	1.6
Belgium	Y	x				*[e)]	10.7
Bulgaria	N	x			Y	*	1.0
Canada[c)]	Y	CO_2 equivalent				96	0.8
Denmark	N	x			Y	*	8.9
Finland	Y	x	x	x	Y	89.4	4.8
France	Y	x	x	x	Y	99.6	3.3
Germany	Y	x			Y	0	1.9
Greece	N	x	x	x	Y	98.3	13.2
Hungary	N	x	x	x	Y	99.6	0.7
Iceland	N	x	x	x	Y	100	13.6
Ireland	N	x			Y	*	2.6
Italy	Y	x	x	x	Y	98.2	2.5
Japan	N	x	x	x	Y	100	2.7
Luxembourg[b)]	-	x			Y	*	4.9
Netherlands	Y	x				*	18.9
New Zealand	Y	x	x	x	Y	99.1	3.6
Norway	Y	x	x	x	Y	98.6	4.3
Portugal	N	x	x	x	Y	98.1	2.6
Russian Federation	Y	x	x	x		99.9	0.5
Spain	Y	x	x	x	Y	99.8	6.3
Sweden	Y	x			Y	*	7.8
Switzerland[b)]	-	x				*	4.5
United Kingdom	N	x	x	x	Y	98.4	3.5
United States[d)]	Y	x				*	0.1

[a)] Portugal, Russia and Spain reported values for 1994 rather than for 1995.

[b)] Party is a landlocked nation and does not have marine bunkers.

[c)] Canada reported aggregate emissions from bunker fuels for CH_4, CO_2 and N_2O in CO_2 equivalent. A figure for CO_2 emissions from bunker fuels for 1995 was also provided, which constitutes approximately 96 per cent of the aggregated GHG emissions.

[d)] The United States reported C emissions rather than CO_2 emissions. The secretariat multiplied the figure provided by 3.66 in order to present the data as CO_2 emissions.

[e)] An asterisk indicates that CO_2 was the only gas reported and therefore the share of CO_2 emissions in aggregated bunker emissions cannot be determined.

Comments

This table indicates to what extent GHG emissions from bunkers were reported in the second national communications. Parties which did not report any information on bunkers have been omitted from the table. The percentage share of CO_2 emissions from bunkers in aggregated bunker emissions was calculated by multiplying the CH_4 and N_2O emissions by the appropriate GWP values and adding them to the CO_2 emissions. The share of the total bunker emissions contributed by CO_2 emissions was found by dividing the CO_2 emissions by the total GHG emissions from bunkers. The final operation was to multiply this result by 100 to get a percentage. The percentage share of emissions of all gases from bunkers in the aggregated GHG emissions of a given Party was calculated by taking the total bunker emissions calculated in the previous column and dividing it by the total GHG emissions from all sectors. The final operation was to multiply this result by 100 to get a percentage.

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