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Intergovernmental Panel on Climate Change

Greenhouse Gas Inventory Reporting Instructions

UNEP
DOCUMENTATION

IPCC Guidelines for
National Greenhouse Gas Inventories

Volume I

OECD
OCDE

IEA
AIE

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TO RECEIVE THE UPDATES
TO THE
IPCC GUIDELINES FOR NATIONAL
GREENHOUSE GAS INVENTORIES

The development of the *IPCC Guidelines for National Greenhouse Gas Inventories* is an ongoing process and the first phase has now been completed. The *Guidelines* will need to be updated periodically as better data and scientific understanding support better estimation methods. For this reason, the *Guidelines* have been published in loose-leaf form to allow for the insertion of periodical updates. If you wish to receive information concerning future updates please fill in and return, by mail or fax, the coupon below. This will result in your registration as a Guidelines user and you will be notified of subsequent updates and their price.

Please send any change of address to: IPCC WGI Technical Support Unit, Hadley Centre, Meteorological Office, London Road, Bracknell, RG12 2SY, United Kingdom.

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ACKNOWLEDGEMENTS

The present IPCC Guidelines for National Greenhouse Gas Inventories have been approved by the Scientific Assessment Working Group of the IPCC at Maastricht in September 1994 and subsequently adopted by the IPCC at its 10th session in Nairobi (10-12th November 1994). The Guidelines represent a first and substantial step towards the assembly and wide understanding of the methodologies needed for inventory construction. Their preparation has been a mammoth task involving many hundreds of experts and users and financial and other support from many countries and international organisations. I take this opportunity to acknowledge their financial and non-financial contributions and to thank all the donors sincerely. It would not be practical for me to name individually all those who have so willingly assisted this IPCC/OECD joint programme and helped to bring it to fruition. I would like, however, to identify the key groups and their leader, not only in their own rights but as the representatives of the many who have supported them.

Financial support for the programme was provided by the United Nations Environment Programme/Global Environment Facility, the Environment Directorate of the Organisation for Economic Cooperation and Development, the International Energy Agency, the Commission of the European Communities, and the governments of Australia, Canada, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and the United States of America. Significant non-financial contributions and resources in kind came from the European Environment Agency, IEA, OECD, UNEP, Japan, the Netherlands (in particular, the National Institute for Public Health and Environmental Protection or RIVM), the UK, and the USA.

The major, substantive content of the Guidelines was collected, assessed and assembled by groups of experts each covering the science of emissions within their specialist areas. The leaders of the groups are identified below and they wish to acknowledge, as I do, the crucial part played by the innumerable experts who enthusiastically helped in this undertaking.

The three volumes of the Guidelines were assembled and edited by the Technical Support Unit of Working Group I of the IPCC and the secretariats of the OECD and the IEA. I thank Paul Schwengels (Programme Manager), Jan Corfee-Morlot and Hans Sperling at the OECD and Tim Simmons and Karen Tréanton at the IEA for their leading roles. I, at the same time, recognise the unfailing support of their colleagues over the past three years.

Equally, I would like to express my gratitude to the IPCC/OECD Liaison Group (IOLG) responsible for steering the programme. The IOLG was chaired by Bruce Callander of the IPCC Working Group I Technical Support Unit and included the representatives of the OECD and IEA Secretariats and of donors. In particular, I thank Michael Short (UNEP), Jack Fitzgerald (US Country Studies Programme), Jan Feenstra (Netherlands Institute for Environmental Studies), Gordon McInnes (EEA) and Karl Jörss (German Federal Environment Agency).

These Guidelines form part of the IPCC Special Report to the first session (Berlin, 28 March to 7 April 1993) of the Conference of the parties to the UN Framework Convention on Climate Change. The other parts are:

- Report on Radiative Forcing of Climate Change 1994 with a Summary for Policymakers;
- An Evaluation of the IPCC 1992 Emission Scenarios also with a Summary for Policymakers;
- The IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations.

The first two are published together and the last is a stand-alone volume. The Special Report was adopted by the IPCC at its tenth session (Nairobi, 10-12 November 1994).

Professor B Bolin
Chairman, IPCC

Expert Groups

Methane and Nitrous Oxide Expert Group Steering Committee
André van Amstel, Paul Crutzen, Elaine Matthews, A P Mitra, Nigel Roulet, Paul Schwengels

Methane from Rice Production
Co-chairs: K Minami and M A K Kalil

Methane from Coal Mining
Co-chairs: Alan Williams and Dina Kruger

Methane from Oil and Natural Gas Activities
Co-chairs: Audland Rosland and Craig Ebert

Methane from Ruminant Animals and Waste
Co-chairs: Michael Gibbs, Robert Leng, Jonathan Woodbury, Dr Ramasami

Methane from Landfills and Wastewater Treatment
Co-chairs: Susan Thornloe and Elizabeth Aitchison

GHGs from Land Use Change, Forestry and Burning
Co-chairs: Robert Delmas and Dilip Ahuja

Methane from Industrial Sources
Chris Veldt, Lee Beck, Jan Bertowski and Jos Oliver

Nitrous Oxide from Agricultural Soils
B H Byrnes, A R Mosier, A F Bowman, P A Leffelaar

Nitrous Oxide from Combustion and Industrial Processes
G De Soete and A McCulloch

PREFACE

Signature of the UN Framework Convention on Climate Change (UNFCCC) by around 150 countries in Rio de Janeiro in June 1992 indicated widespread recognition that climate change is potentially a major threat to the world's environment and economic development. Human activities have substantially increased atmospheric concentrations of greenhouse gases, thus perturbing the earth's radiative balance. According to projections from climate models, a global rise of temperature is a likely consequence. The potential impacts of climate change such as sea level rises and changes in local climate conditions including temperatures and precipitation patterns, could have important negative impacts on the socio-economic development of many countries.

The ultimate objective of the Convention is the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level is to be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change. The Convention also calls for all Parties to commit themselves to three objectives:

- To develop, update periodically, publish, and make available to the Conference of Parties their national inventories of anthropogenic emissions by sources and removals by sinks, of all greenhouse gases not controlled by the Montreal Protocol.
- To use comparable methodologies for inventories of greenhouse gas emissions and removals, to be agreed upon by the Conference of Parties.
- To formulate, implement, publish and update regularly national programmes containing measures to mitigate climate change by addressing anthropogenic emissions.

The IPCC *Guidelines* are intended to assist the Parties directly in implementing the first two of these requirements. They have been under development for several years, in anticipation of this need.

By the time of the Second World Climate Conference in Geneva in October - November 1990, the need for a standard methodology for compiling national emission inventories was obvious. Under the auspices of the Organisation for Economic Co-operation and Development (OECD) and the International Energy Agency (IEA), with support from the USA, the UK and Norway, an initial compendium of methods was compiled. This

document covered six direct and indirect greenhouse gases – carbon dioxide, methane, nitrous oxide, carbon monoxide, nitrogen oxide and non-methane volatile organic compounds. Chlorofluorocarbons (CFCs) and other substances already accounted for under the Montreal Protocol were intentionally excluded from the compendium. The document was discussed in detail by a meeting of experts (including many representatives of non-OECD countries) in Paris in February 1991. It was then adopted in a slightly modified form at the fifth session of the Intergovernmental Panel on Climate Change (IPCC) in March 1991 as the starting point for a set of IPCC *Guidelines* to be used by countries drawing up national inventories of greenhouse gas emissions and removals.

Development of the *Guidelines* has been undertaken by the Scientific Assessment Working Group (WGI) of the IPCC, working in close collaboration with the OECD and the IEA under the IPCC/OECD programme on emissions inventories. The objectives of the programme are:

- to develop and refine an internationally agreed methodology and software for calculation and reporting of national net emissions;
- to encourage widespread use of the methodology by countries participating in the IPCC and Parties to the UN Framework Convention on Climate Change;
- to establish procedures and a data management system for collection, review and reporting of national data.

The IPCC *Guidelines for National Greenhouse Gas Inventories* consist of three volumes: the *Greenhouse Gas Inventory Reporting Instructions,* the *Greenhouse Gas Inventory Workbook* and the *Greenhouse Gas Inventory Reference Manual.* The *Guidelines* include simple, default methods and assumptions covering the major sources and sinks of greenhouse gases, and also discuss more detailed methods. Countries have the option of using various methods and levels of detail depending on their own needs and capabilities. The *Guidelines* also provide a common reporting and documentation framework for all inventories. This is needed to allow for consistent comparison of national estimates even though they may have been prepared with varying methods.

It is essential that these *Guidelines* are approved internationally, and considerable effort has been expended to ensure this result. The methodology has been discussed, evaluated and refined through an international process which has included:

- wide dissemination of early drafts and collection of comments from national experts;
- testing of methods through development of preliminary inventories;
- country studies which ensure that methods are tested in a wide variety of national contexts;
- technical workshops held in several locations including Western Europe, Africa, Latin America, Central Europe and Asia;
- informal expert groups convened to recommend improvements on specific aspects of the methodology.

The above activities all contributed to the development of the draft IPCC *Guidelines.* This draft was then circulated world-wide, in six UN languages

for an extensive review by national and other technical experts. This review resulted in significant improvements to the *Guidelines*. The IPCC *Guidelines* were approved in November 1994 and then published. In March 1995, the Conference of the Parties of the Framework Convention on Climate Change will take a final decision about the use of the *Guidelines*, in connection with the UNFCCC.

The development of the IPCC *Guidelines* is an iterative process and Phase 1 of this process has now been completed. It is anticipated that the *Guidelines* will need to be updated periodically for several years as better data and scientific understanding support better estimation methods. Work is continuing on the development of improved methods that can be proposed, reviewed and approved by the IPCC in the future. From this point, the work of the IPCC/OECD programme will continue in several areas:

- some gases not covered in the current draft (e.g., hydrofluorocarbons - HFCs, tetrafluoromethane - CF_4, sulphur hexafluoride - SF_6, and hexafluoroethane - $C_2 F_6$) will be added to the current methodology;
- some gases, e.g., nitrous oxide - N_2O will be given a more complete treatment in future supplements to the *Guidelines*;
- the current methodologies included in the *Guidelines* will be reviewed in the light of evolving scientific understanding and will be updated where appropriate.

Future work in the IPCC/OECD programme will continue to be supported by all of the mechanisms for international communication and consensus (e.g., expert groups, workshops, country studies) that have been used in the past. The scope and timing of future updates to the IPCC *Guidelines* will be determined on the basis of guidance from the IPCC and in consultation with the INC/COP.

OVERVIEW OF THE IPCC GUIDELINES

This document is one volume of the *IPCC Guidelines for National Greenhouse Gas Inventories*.

The series consists of three books:

- THE GREENHOUSE GAS INVENTORY REPORTING INSTRUCTIONS
- THE GREENHOUSE GAS INVENTORY WORKBOOK
- THE GREENHOUSE GAS INVENTORY REFERENCE MANUAL

These books together provide the range of information needed to plan, carry out and report results of a national inventory using the IPCC system.

The *Reporting Instructions* (Volume 1) provides step-by-step directions for assembling, documenting and transmitting completed national inventory data consistently, regardless of the method used to produce the estimates. These instructions are intended for all users of the IPCC *Guidelines* and provide the primary means of ensuring that all reports are consistent and comparable.

The *Workbook* (Volume 2) contains suggestions about planning and getting started on a national inventory for participants who do not have a national inventory available already and are not experienced in producing such inventories. It also contains step-by-step instructions for calculating emissions of carbon dioxide (CO_2) and methane (CH_4), as well as some other trace gases, from six major emission source categories. It is intended to help experts in as many countries as possible to start developing inventories and become active participants in the IPCC/OECD programme.

The *Reference Manual* (Volume 3) provides a compendium of information on methods for estimation of emissions for a broader range of greenhouse gases and a complete list of source types for each. It summarises a range of possible methods for many source types. It also provides summaries of the scientific basis for the inventory methods recommended and gives extensive references to the technical literature. It is intended to help participants at all levels of experience to understand the processes which cause greenhouse gas emissions and removals to occur and the estimation methods used in compiling inventories.

Contents of the IPCC Guidelines

All three volumes begin with the following sections:

The contents of each volume are as follows:

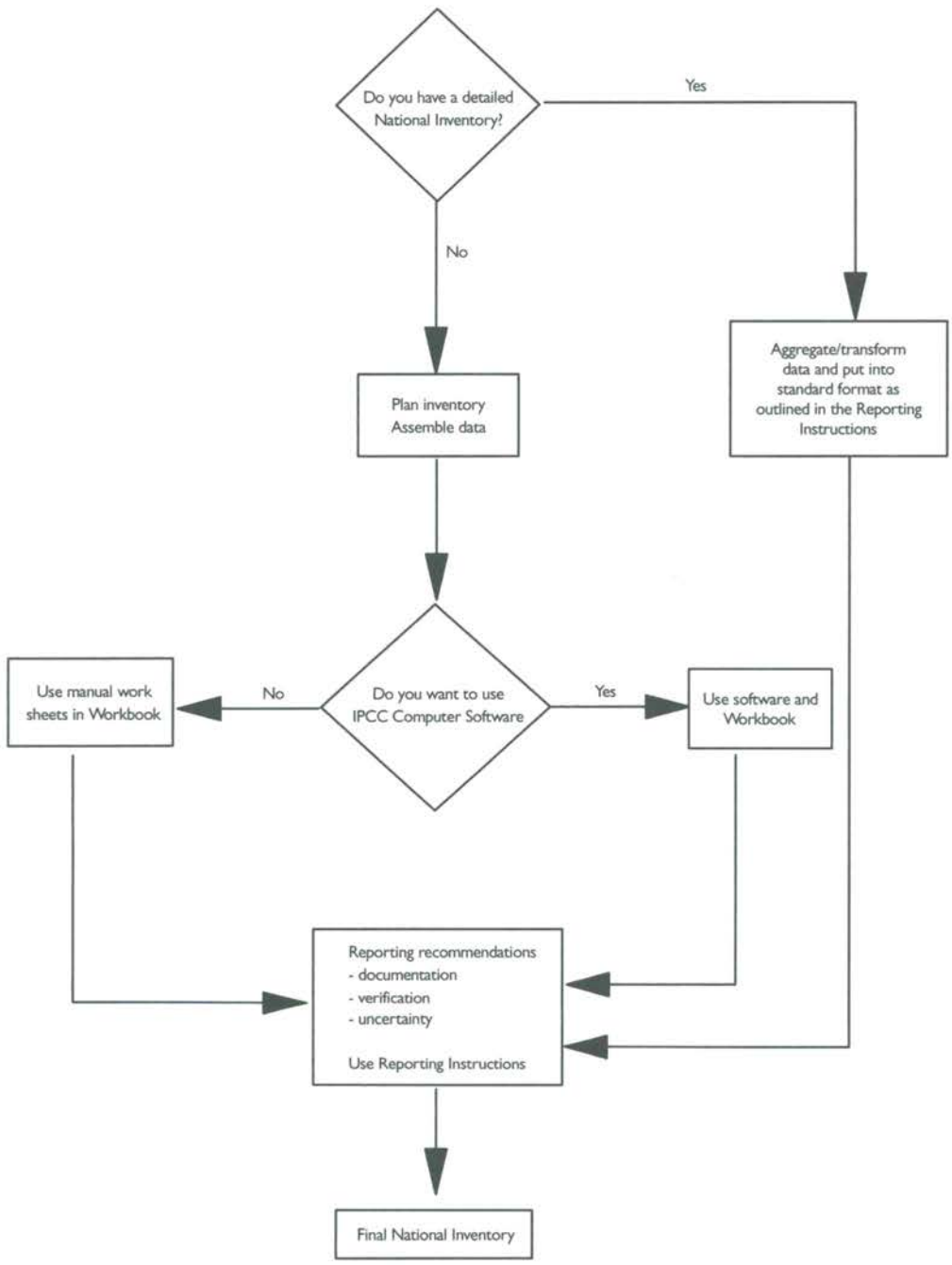
Volume 1: Greenhouse Gas Inventory Reporting Instructions

Volume 2: Greenhouse Gas Inventory Workbook

Volume 3: Greenhouse Gas Inventory Reference Manual

Before you start...

This diagram explains the stages needed to make a national inventory which meets IPCC standards.



The flow diagram above illustrates how the different types of users (working at different levels of inventory detail) can use the various volumes of the *Guidelines*. You should recognise that reality is more complex than this simple explanatory chart. Many countries may have some parts of the inventory complete at a high level of detail but may only be getting started on other parts. It is quite likely that some users will need to do several iterations of the thinking process reflected in the diagram with regard to different parts of their inventory.

The stages outlined in the flow diagram are:

Question 1
Do you have a detailed national inventory?

Answer: Yes

If your country already has a complete national inventory, you should transform the data it contains into a form suitable for use by IPCC. This means transforming it into a standard format. In order to do this, use Volume 1 of the *IPCC Guidelines*, *Reporting Instructions*. This gives details of the way in which data should be reported and documented.

Answer: No

You should start to plan your inventory and assemble the data you will need to complete the Worksheets in this book. Refer to the *Getting Started* section of the *Workbook*.

Question 2
Do you want to use the IPCC computer software?

Answer: Yes

If you want to use the IPCC software, you will still follow the instructions included in the *Workbook* to assemble the data you have collected into an inventory (see margin box). You will use the software instead of the printed worksheets to enter data.

Answer: No

If you do not use the IPCC software, use the *Workbook* and the Worksheets it contains to assemble the data you have collected into an inventory.

Finally...

Inventory data should be returned to IPCC in the form recommended in the *Reporting Instructions*. It is important that, where you have used a methodology other than the IPCC Default Methodology, it is properly documented. This will ensure that national inventories can be aggregated and compared in a systematic way in order to produce a coherent regional and global picture.

AVAILABILITY/USE OF COMPUTER SOFTWARE

IPCC computer software is available with the IPCC Guidelines. The software includes the same simple default methods as presented in the *Workbook* and the Standard Data Tables for reporting inventories, as presented in the *Reporting Instructions*. It is available in English only.

This version of the software should be run on a 386 based PC. The program requires a minimum of 570 kilobytes of free RAM and 2 Megabytes of EXTENDED RAM to run.

If you would like to receive a copy of the software, send a letter or fax to:

IPCC/OECD NATIONAL GHG INVENTORY PROGRAMME
Climate Change Division
OECD, Environment Directorate
2, rue André-Pascal
75775 PARIS CEDEX 16
FRANCE

FAX: (33-1) 45 24 78 76

General Notes on the Guidelines

Scope:

- The IPCC *Guidelines* are designed to estimate and report on national inventories of anthropogenic greenhouse gas emissions and removals. In general terms "anthropogenic" refers to greenhouse gas emissions

and removals that are a direct result of human activities or are the result of natural processes that have been affected by human activities. Users may include any human-induced emissions and removals in their inventory as long as they can be clearly documented and quantified.

- National inventories should include greenhouse gas emissions and removals taking place within national (including administered) territories and offshore areas over which the country has jurisdiction. There are, however, four qualifications of this principle in the *Guidelines*:

  (a) Emissions based upon fuel sold to ships or aircraft engaged in **international** transport should, as far as possible, not be included in national totals but reported separately.

  (b) Emissions from road vehicles should be attributed to the country where the fuel is loaded into the vehicle. The error in national emissions introduced in the case of road transport is expected to be small.

  (c) Emissions from the combustion or decay of wood and wood products are assumed to take place in the country in which the wood was harvested and within a year of harvesting. This is because it has been determined that the most workable approach to estimating CO_2 emissions and removals from forests is to account for changes in stocks of standing biomass in forests and other locations. The simple assumption is that wood removed from stocks releases CO_2 emissions in the year and in the country where the wood was removed. While the IPCC method allows for accounting of exports and carbon stored in products, it does not yet provide a methodology, which is a priority for future work.

  (d) In line with the principle of national emissions, the IPCC methodology accounts for the bulk of greenhouse gas emissions related to fuel combustion in the country in which those emissions are released. The IPCC methodology for carbon stored in non-fuel products manufactured from fuels as raw materials takes into account emissions released from those products during their use or destruction. Emissions are attributed to the country where the conversion to non-energy products takes place, even when the products are traded internationally. This is believed to be a relatively small net error, but it is also a priority for future work.

Data Quality and Time Frame:

- The data available to estimate anthropogenic greenhouse gas emissions resulting from fuel combustion are generally of a better quality than the data available to estimate greenhouse gas emissions and removals in the areas of agriculture and land use change/forestry. Accordingly, while the IPCC *Guidelines* request an emission figure for a single year in most source/sink sectors, three-year averages (with the base year in the middle) are preferred in the areas of agriculture and land use change/forestry. In addition, the IPCC *Guidelines* recognise that greenhouse gas emissions and removals in the area of land use change/forestry can occur over an extended period of time once the activity has been completed. For example, when estimating emissions from the abandonment of forests and grasslands, users are requested to

estimate emissions related to two time periods of previous activity: (a) 0 - 20 years ago, and (b) 20 - 100 years ago.

Default Method:

- The IPCC *Guidelines* contain "default" methodologies for the estimation of greenhouse gas emissions and removals. Users are encouraged to go beyond these minimum default methods where possible, and report the results.

  The IPCC *Guidelines* also include a number of "default" assumptions and data for use in the estimation of greenhouse gas emissions and removals. This default information is included primarily to provide users with a starting point from which they can develop their own national assumptions and data. Indeed, national assumptions and data are always preferred because the default assumptions and data may not always be appropriate for specific national contexts.

  In general, therefore, default assumptions and data should be used only when national assumptions and data are not available. Section 2 of the Introduction to the IPCC Greenhouse Gas Inventory *Workbook* provides information on the quality of the default data available in different greenhouse gas source/sink categories. When it is indicated that the data available are of low quality, users should recognise that the default data do not provide a basis for the development of a definitive inventory of that source/sink category.

- Many of the categories of greenhouse gas emissions and removals can be estimated only with large ranges of uncertainty. Quite naturally, some national experts have developed methods which are designed to produce ranges of estimates rather than point estimates for highly uncertain categories. The IPCC *Guidelines*, however, require that users provide a single point estimate for each gas and emissions/removal category. This is simply to make the task of compilation, comparison and evaluation of national reports manageable. Users are encouraged to provide uncertainty ranges or other statements of confidence or quality along with the point estimates. The procedures for reporting uncertainty information are discussed in the *Greenhouse Gas Inventory Reporting Instructions*.

Double Counting of Emissions:

The methods proposed for the estimation of emissions sometimes simplify the inventory construction in order to use data which are more readily available than those needed for a detailed and more precise approach. In certain cases this may cause or increase the risk of double counting emissions. There are two areas where this may occur in the *Guidelines*.

1) All countries preparing CO_2 inventories using the IPCC *Guidelines* are asked to estimate the emissions from fuel combustion using the IPCC Reference Approach either as the primary means of preparing the inventory or as a verification stage following the preparation of an inventory using national methods. The Reference Approach is a simple procedure which demands relatively little data and lends itself to wide-spread application as a "common denominator".

The Reference Approach provides an upper bound to CO_2 emissions inferred from the country's supply of fossil fuels by identifying the carbon

content, subtracting from it the carbon stored in non-energy products and products made from fuels used as raw material, adjusting for carbon which remains unburnt and multiplying by 44/12. It is an upper bound[1] because some of the carbon will be emitted in forms other than CO_2, in part because fuel combustion is not always complete but also because fuels may leak or evaporate. Consequently the CO_2 emissions figure obtained from the Reference Approach will include carbon emitted as CH_4, CO or NMVOC. At the same time the *Guidelines* encourage countries to estimate separate inventories for these gases and when this is done these gases are reported twice, in their emitted form and as CO_2. It is in this sense that they are "double counted".

Use of the Reference Approach carries with it two consequences which should be carefully noted.

Because the Reference Approach uses fossil fuel supply statistics as a basis for determining the carbon supply

- Not all carbon based emissions from fossil fuel are reported twice. The Reference Approach CO_2 estimate will not include emissions from combustion or release of fossil fuels for which the corresponding quantities (activity data) are not included in national production or import figures. Notable examples of activities which lead to emissions not included are the venting of natural gases from coal mining and handling and oil and gas production. Emissions from the flaring of natural gases are also excluded. As a result, when emissions from these activities are included in the relevant inventories using the fugitive emissions methodologies recommended in the *Guidelines* no "double counting" occurs.

- CO_2 emissions from biomass used as fuels are excluded from the total CO_2 emissions figure. The restriction of the Reference Approach to fossil fuels results from the sustainable nature of biofuels. The CO_2 emissions are, however, reported for information purposes. Note that non-CO_2 emissions from biofuels are included in their respective inventories.

2) Double counting may also occur when *calculated* emissions from the manufacture of products from fuels used as raw materials or from the use of fuels for their physical properties (e.g. lubricants) include emissions produced from the later destruction of these products. The double count will be with any separate reporting within the Waste module of the *Guidelines* of emissions from destruction.

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[1] In practice, because of inaccuracies in the supply statistics and/or emission factors, CO_2 estimates from the Reference Approach may be less than those obtained by summing all CO_2 emissions from the combustion of fuel.

INTRODUCTION TO THE REPORTING INSTRUCTIONS

I Using the Reporting Instructions

If you are engaged in making a national inventory you should read the *Reporting Instructions*. Even if you have already made an inventory, or have started to do so, and are simply reporting existing data to IPCC, you should still read them. These instructions provide the primary means of ensuring that all reports are consistent, transparent and comparable. The remaining chapters in this book are as follows:

Chapter 1: *Understanding the Common Reporting Framework* contains a listing of the categories you should use when reporting emissions and removals. Each of the categories is further broken down into subcategories and given a definition if necessary. It also contains a listing of the basic fuel categories for use in the Energy section, some standard equivalents and unit definitions, and descriptions of the Standard Data Tables and Summary Report Tables used for reporting an inventory in IPCC format.

Chapter 2: *Reporting the National Inventory* contains step-by-step instructions for completing the Standard Data Tables and Summary Report Tables that are used to bring together and make a record of the estimates which have been made in your own inventory or in using the Worksheets in the *Workbook*.

Tables: You will use these tables to assemble data from your national greenhouse gas inventory and present them in the IPCC reporting format. Finally, having completed the Standard Data Tables and the Summary Report Tables, you can assess the quality and completeness of the inventory by completing the Overview Table which provides a synoptic view of the results of the IPCC Greenhouse Gas Inventory.

Annex 1: *Managing Uncertainties* provides guidance on the theoretical considerations involved in taking account of uncertainties in creating an inventory.

Annex 2: *IPCC and CORINAIR Source Categories* looks at the ways in which data assembled for the CORINAIR inventory conducted by the Commission of the European Communities as well as by the UN ECE and IPCC data relate to each other.

Glossary: A glossary containing definitions of terms used in the *Guidelines* can be found at the end of this book.

2 Underlying Principles

The IPCC *Guidelines* allow for the use of a range of methods at different levels of detail, including methods which are appropriate to national conditions. Default methods and assumptions are provided for calculating the major emissions and removals of greenhouse gases at the minimum acceptable level of detail. The IPCC default methods have been developed with efficiency in mind. They build on data that are readily available and should be easily applicable to all countries of the world. More detailed methods are also discussed in the *Guidelines* and national experts are encouraged to use them wherever this is possible and likely to produce more accurate national estimates. In some cases, national experts may choose to use an entirely different methodology if they believe this better reflects their national situation. Common reporting instructions are therefore needed to accommodate inventories developed at different levels of detail and (potentially) different methods. The objective of the instructions is to establish minimum requirements for reporting data which allow for comparison and identification of differences in inventory construction (transparency). For this reason the IPCC recommends that all users of the *Guidelines* follow the *Reporting Instructions* explicitly when they communicate their national inventories to the IPCC or other international bodies.

Several main principles underlie the IPCC *Reporting Instructions*:

- Common Reporting Framework

  The core of the reporting system is the establishment and use of a standard table format using common source/sink categories and common fuel categories. Common definitions of pollutants, units, and time intervals are necessary. Ultimately, all countries should be working toward complete greenhouse gas inventories within each, and across all, greenhouse gases.

  Emission inventory results and all main assumptions (in summary form) should be transmitted using the standard tables, which can be adapted to the level of detail appropriate for the reporting country. Use of these reporting conventions will not only enhance the comparability of data, it will facilitate the speed with which inventories can be processed, made available in summary form, aggregated and reviewed internationally.

- Documentation Standards

  Documentation standards are necessary to ensure transparency of national inventories and hence to allow the inventory to be reviewed. By providing the necessary documentation, the comparability of national inventories can also be evaluated. The IPCC therefore recommends that along with GHG emission figures and standard tables, countries submit a description of the method used, any definitions, activity data and emission factors, as well as other relevant assumptions that cannot be summarised in table form. Enough data should be provided to allow a third party to reconstruct the inventory from national activity data and assumptions (the working definition of *transparency*).

To limit the volume of data to be provided, documentation should focus on describing fully any differences in method and assumptions from the IPCC default methods.

- Verification and Uncertainty Assessment

  To improve the quality of inventory data and to help assess the uncertainty surrounding estimates, IPCC *Reporting Instructions* recommend that inventories be verified through the use of a set of simple checks for completeness and accuracy of submissions. These checks can be performed centrally, although it is preferable for the countries to do as much as possible themselves. Finally, an uncertainty assessment should also be conducted as far as possible and summarised for each major part of the inventory. Conceptual guidance for the assessment of the uncertainty of emission estimates are provided in Annex I *Managing Uncertainties*. Other approaches to describing uncertainty associated with point estimates of emissions and removals are also possible. Whether you use one of the approaches provided by the IPCC or another approach, you should include an uncertainty discussion in your inventory submission.

Each of these three principles is addressed in more detail in the following chapters.

3 Basic Information to Help Work with the IPCC Guidelines

Prefixes and multiplication factors

The following multiplication factors are used throughout the *Guidelines*:

Multiplication Factor	Abbreviation	Prefix	Symbol
1 000 000 000 000 000	10^{15}	peta	P
1 000 000 000 000	10^{12}	tera	T
1 000 000 000	10^{9}	giga	G
1 000 000	10^{6}	mega	M
1 000	10^{3}	kilo	k
100	10^{2}	hecto	h
10	10^{1}	deca	da
0.1	10^{-1}	deci	d
0.01	10^{-2}	centi	c
0.001	10^{-3}	milli	m
0.000 001	10^{-6}	micro	μ

Abbreviations for chemical compounds

The following abbreviations are used in the *Guidelines*:

CH_4	Methane
N_2O	Nitrous Oxide
CO_2	Carbon Dioxide
CO	Carbon Monoxide
NO_x	Nitrogen Oxides
NMVOC	Non-Methane Volatile Organic Compound
NH_3	Ammonia
CFCs	Chlorofluorocarbons
HFCs	Hydrofluorocarbons
PFCs	Perfluorocarbons
SF_6	Sulphur hexafluoride
CCL_4	Carbon tetrachloride
C_2F_6	Hexafluoroethane

Standard equivalents

1 tonne of oil equivalent (toe)	1×10^{10} calories
10^3 toe	41.868 TJ
1 short ton	0.9072 tonne
1 tonne	1.1023 short tons
1 tonne	1 megagram
1 kilotonne	1 gigagram
1 megatonne	1 teragram
1 kilogram	2.2046 lbs
1 hectare	10^4 m^2
1 calorie $_{IT}$	4.1868 Joules
1 atmosphere	101.325 kPa

Units[1] and abbreviations

The following abbreviations are used in the *Guidelines*:

cubic metre	m^3
hectare	ha
gram	g
tonne	t
joule	J
degree Celsius	°C
calorie	cal
year	yr
capita	cap
gallon	gal
dry matter	dm

[1] For decimal prefixes see previous page.

COMMON REPORTING FRAMEWORK

1 UNDERSTANDING THE COMMON REPORTING FRAMEWORK

This chapter contains a listing, with definitions, of the categories you should use when reporting emissions and removals. The source/sink categories have been grouped into sectors as follows:

- *Energy*
- *Industrial Processes*
- *Solvent and Other Product Use*
- *Agriculture*
- *Land Use Change and Forestry*
- *Waste*

The sectors and their source/sink categories are described and discussed in the chapters of the Reference Manual and the modules of the Workbook. This chapter also contains a brief explanation of the principles underlying the Standard Data Tables and Summary Report Tables for reporting national inventories.

1.1 Source/sink categories

- Users of the IPCC *Guidelines* are requested to estimate and report all anthropogenic emissions and removals of greenhouse gases. The numerous sources and sinks are categorised and described on the following pages. The source/sink categories are grouped into the major sectors shown overleaf. The proposed categories should cover most activities emitting or removing greenhouse gases. However, some countries may need to add activities to the "Other" sector in order to cover their particular circumstances. If so, then the nature of the activities should be carefully described so that the list of sectors and their source/sink categories can be updated by the IPCC at a later date.
- Recognising that the IPCC needs to accommodate other existing inventory programmes, Annex 2 *IPCC and CORINAIR Source Categories* provides details of correspondences with CORINAIR, a programme developed by the Commission of European Communities for use in Europe.

	SECTORS	DESCRIPTION OF ACTIVITIES INCLUDED[1]
1	**ENERGY**	Total emission of all greenhouse gases from energy activities (fuel combustion as well as fugitive fuel emissions).
2	**INDUSTRIAL PROCESSES**	Total emissions from industrial processes where greenhouse gases are a by-product of the various production processes. These emissions should be reported by ISIC activity, with separate details of the particular production process noted where possible. Emissions exclude greenhouse gases from the combustion of energy used during the production process (reported under 1 above).
3	**SOLVENT AND OTHER PRODUCT USE**	This category pertains mainly to NMVOC emission resulting from the use of solvents and other products containing volatile organic compounds.
4	**AGRICULTURE**	Describes all anthropogenic emissions from this sector, except for fuel combustion emissions, which are covered in Energy module above.
5	**LAND USE CHANGE & FORESTRY**	Total emissions and removals from forest and land use change activities.
6	**WASTE**	Total emissions from waste management.
7	**OTHER**	Any other anthropogenic source or sink not referred to above (must be appropriately documented).

[1] All activities are limited to anthropogenic activities and related emissions and removals.

1	**ENERGY**	Total emission of all greenhouse gases from energy activities (fuel combustion as well as fugitive fuel emissions). Sum of categories 1 A & B.
1 A	FUEL COMBUSTION ACTIVITIES	Total emissions of all greenhouse gases from all fuel combustion activities as described further below. CO_2 emissions from combustion of biomass fuels are **not** included in totals for the energy sector. They may not be net emissions if the biomass is sustainably produced. If biomass is harvested at an unsustainable rate (that is, faster than annual regrowth), net CO_2 emissions will appear as a loss of biomass stocks in the *Land Use Change and Forestry* module. Other greenhouse gases from biomass fuel combustion **are** considered net emissions and are reported under *Energy*. (Sum of 1 A 1 to 1 A 6). Emissions based upon fuel sold to ships or aircraft engaged in international transport (1A3ai and 1A3di) should, as far as possible, not be included in national totals but reported separately.
1 A 1	ENERGY AND TRANSFORMATION INDUSTRIES	Comprises emissions from fuels combusted by the energy-producing industries and during the conversion of primary forms of fuel to secondary and tertiary forms (e.g. coking coal to coke, crude oil to petroleum products, residual fuel oil to electricity).
1 A 1 a	Electricity and Heat Production	Sum of emissions from electricity generation, combined heat and power generation, and heat plants.
1 A 1 a i	Electricity Generation	Comprises emissions from all fuel use for electricity generation from public, or auto-generation units, except those from combined heat and power plants.
	Public Electricity	Undertakings whose primary activity is to supply the public. They may be in public or private ownership. Emissions from own on-site use of fuel should be included.
	Auto-generation	Undertakings which generate electricity wholly or partly for their own use, as an activity which supports their primary activity. They may be in public or private ownership. Emissions should, if possible, be specified by subsectors that correspond to the International Standard Industrial Classification of All Economic Activities (ISIC).
1 A 1 a ii	Combined Heat and Power Generation (CHP)	Emissions from production of both heat for sale and electrical power, at a single facility; co-generation.
	Public	Undertakings whose primary activity is to supply the public. They may be in private or public ownership. Emissions from own on-site use of fuel should be included.
	Auto-generation	Undertakings which generate heat and power wholly or partly for their own use as an activity which supports their primary activity. They may be in public or private ownership Emissions should, if possible, be specified by subsectors that correspond to the International Standard Industrial Classification of All Economic Activities (ISIC).
1 A 1 a iii	Heat Plants	Production of heat for sale by pipe network.
1 A 1 b	Petroleum Refining	All combustion activities supporting the refining of petroleum products. Does not include evaporative emissions, which should be reported separately under 1 B 2 a below.

1 A 1	c Solid Fuel Transformation and Other Energy Industries	Combustion emissions from fuel use during the manufacture of secondary and tertiary products from solid fuels. Emissions from own on-site fuel use should be included.
1 A 1	c i Solid Fuel Transformation	Combustion emissions arising from fuel transformation for the production of coke, brown coal briquettes and patent fuel.
1 A 1	c ii Other Energy Industries	Combustion emissions arising from the energy-producing industries own (on-site) energy use not mentioned above. This includes the emissions from own-energy use in coal mining and oil and gas extraction. Emissions from pipeline transport should be reported under 1 A 3 f.
1 A 2	INDUSTRY (ISIC - 3RD REVISION)[2]	Emissions from final consumption of fuels in industry; implies that fuel consumed for transformation and for own use of the energy-producing industries is excluded. Also excluded are emissions from the combustion of fuels within industry for the generation of electricity and of heat for sale. Emissions from the industry sector should be specified by subsectors that correspond to the International Standard Industrial Classification of All Economic Activities (ISIC). Energy used for transport by industry should not be reported here but under Transport (1 A 3 below). Emissions arising from off-road and other machinery should, if possible, be broken out as a separate subcategory. For each country, the emissions from the largest fuel-consuming industrial categories (ISIC) should be reported, as well as those from significant emitters of pollutants. A suggested list of categories is outlined below.
1 A 2	a Iron and Steel (ISIC Group 271 and Class 2731)	
1 A 2	b Non-Ferrous Metals (ISIC Group 272 and Class 2732)	
1 A 2	c Chemicals (ISIC Division 24)	
1 A 2	d Pulp, Paper and Print (ISIC Divisions 21 and 22)	
1 A 2	e Food Processing, Beverages and Tobacco (ISIC Divisions 15 and 16)	
1 A 2	f Other	The remaining emissions from fuel combustion in industry should be reported here. Please specify what is reported, as far as possible by ISIC categories.
1 A 3	TRANSPORT	Emissions from the combustion and evaporation of fuel for all transport activity, regardless of the sector, specified by subsectors as follows. Emissions from fuel sold to any air or marine vessel engaged in international transport (international bunker fuels) should as far as possible be excluded from the totals and subtotals in this category and should be reported separately.

[2] International Standard Industrial Classification of all Economic Activities, Series M No. 4, Rev. 3, United Nations, New York, 1990.

1 A 3	a	Civil Aviation	Emissions from international civil aviation and domestic air transport (commercial, private, agricultural, etc.) Exclude use of fuel at airports for ground transport which is reported under 1 A 3 e *Other Transportation* (below). Also exclude fuel for stationary combustion at airports; report this information under the appropriate stationary combustion category.
	i	*International Aviation (International Bunkers)*	Emissions which relate to fuel use for international civil aviation. Note that these emissions are to be excluded as far as possible from national totals but should be reported separately. (In other inventory methodologies, landing and take-off (LTO) cycle emissions are often considered as domestic emissions. For the purpose of greenhouse gas emissions inventories, fuel used during landing and take-off in international aviation are considered to be *International Bunkers*.)
	ii	*Domestic*	Emissions from other air transport fuel combustion not considered to be bunkers.
1 A 3	b	Road Transportation	All combustion and evaporative emissions arising from fuel use in road vehicles, including the use of agricultural vehicles on highways. Evaporative emissions are included here because they are estimated with the same activity data as is used for estimating combustion emissions. Specify by subcategory where possible, as shown below.
	i	*Cars*	Automobiles designated primarily for transport of persons and having a capacity of 12 persons or fewer. Gross vehicle weight rating of 3900 kg or less.
		Passenger cars with 3-way catalysts	Passenger car emissions from vehicles with 3-way catalysts (for NO_x control).
		Passenger cars without 3-way catalysts	Passenger car emissions from vehicles without 3-way catalysts (for NO_x control).
	ii	*Light Duty Trucks*	Automobiles with a gross vehicle weight of 3900 kg or less designated primarily for transportation of light-weight cargo or which are equipped with special features such as four-wheel drive for off-road operation.
		Light duty trucks with 3-way catalysts	Light Duty Truck emissions from vehicles with 3-way catalysts (for NO_x control).
		Light duty trucks without 3-way catalysts	Light Duty Truck emissions from vehicles without 3-way catalysts (for NO_x control).
	iii	*Heavy Duty Trucks and Buses*	Any diesel or gasoline fuelled vehicle rated at more than 3900 kg gross vehicle weight or designed to carry more than 11 passengers at a time.
	iv	*Motorcycles*	Any motor vehicle designed to travel with not more than three wheels in contact with the ground and weighing less than 680 kg.
1 A 3	c	Railways	Includes emissions from both freight and passenger traffic routes.
1 A 3	d	Navigation	Emissions from fuels used to propel water-borne vessels, including hovercraft and hydrofoils.
	i	International Marine (Bunkers)	Comprises emissions from fuels burned by sea-going ships of all flags that are engaged in international transport.. These emissions should as far as possible be excluded from national totals and reported separately.
	ii	Internal Navigation	All internal and coastal navigation, except fishing (which should be reported under 1 A 4 c).

1 A 3	e Other Transportation	All remaining transport activities including pipeline transportation and off-road activities not otherwise reported under 1 A 4 c Agriculture. Military transport should be reported under 1 A 5 (see 1 A 5 *Other*, below).
1 A 4	SMALL COMBUSTION	Emission from small combustion activities as described below.
1 A 4	a Commercial / Institutional	Emission from fuel combustion in commercial and institutional buildings. (All activities included in ISIC categories 4103, 42, 6, 719, 72, 8, and 91-96).
1 A 4	b Residential	All emissions from fuel combustion in households.
1 A 4	c Agriculture / Forestry / Fishing	Emissions from fuel combustion in agriculture, forestry, or domestic inland, coastal and deep-sea fishing. This includes traction vehicles, pump fuel use, grain drying, horticultural greenhouses and other agriculture, forestry or fishing related fuel use. (Activities included in ISIC categories 05, 11, 12, 1302). Highway agricultural transportation is excluded.
	i *Stationary*	
	ii *Off-road Vehicles and Other Machinery*	
1 A 5	OTHER	All remaining emissions from non-specified fuel combustion except from wood and vegetal waste use (see below). Include emissions from military fuel use.
1 A 5	a Stationary	
1 A 5	b Off-road and other Machinery	
1 A 6	TRADITIONAL BIOMASS BURNED FOR ENERGY (Unallocated to subsectors)	Emissions of CO_2, CH_4, CO, N_2O, NO_x and NMVOC from the burning of wood, charcoal and vegetal wastes. Note: CO_2 emissions from combustion of biomass should not be included in totals of national emissions from energy. If there is non-sustainable use of biomass fuels, emissions should be accounted for in loss of biomass stocks and reported in the *Land Use Change and Forestry* module.
1 B	FUGITIVE EMISSIONS FROM FUELS	Fugitive emissions are intentional or unintentional releases of gases from anthropogenic activities. In particular, they may arise from the production, processing, transmission, storage and use of fuels, and include emissions from combustion only where it does not support a productive activity (e.g., flaring of natural gases at oil and gas production facilities). Sum of 1 B 1 & 1 B 2.
1 B 1	SOLID FUELS	Total release of methane during coal mining and post-mining activities. Combustion emissions from colliery methane recovered and used should be excluded here and reported under Fuel Combustion Emissions.

1 B 1	a	Coal Mining	Total emissions from underground and surface mining and post-mining activities.
	i	*Underground Mines*	
		Mining activities	Emissions from underground mines, brought to the surface by ventilation systems.
		Post - mining activities	Emissions from coal after extraction from the ground, which occur during preparation, transportation, storage, or final crushing prior to combustion.
	ii	*Surface Mines*	Total emissions from surface mining and post-mining activities.
		Mining activities	Emissions primarily from the exposed coal surfaces and coal rubble, but also emissions associated with the release of pressure on the coal.
		Post-Mining Activities	Emissions from coal after extraction from the ground, during preparation, transportation, storage, or final crushing prior to combustion.
1 B 1	b	Solid Fuel Transformation	Fugitive emissions arising during the manufacture of secondary and tertiary products from solid fuels.
1 B 1	c	Other	Fugitive emissions from fuel treatment plants not elsewhere specified.
1 B 2		OIL AND NATURAL GAS	Total fugitive emissions from oil and gas activities. Fugitive emissions may arise from equipment exhaust (non-combustion), leakages, upsets and mishaps at any point in the chain from production through final use. Note also that emissions from flaring are included (the combustion is considered a non-productive activity).
1 B 2	a	Oil	
	i	*Exploration*	Fugitive emissions from oil exploration only.
	ii	*Production*	Fugitive emissions from the production of crude oil only.
	iii	*Transport*	Fugitive emissions resulting from the loading and unloading of crude oil from tankers.
	iv	*Refining / Storage*	Fugitive emissions from the refining of oil and from storage in tanks.
	v	*Distribution of Oil Products*	Emissions (primarily NMVOCs) from transport and handling of oil products.
	vi	*Other*	
1 B 2	b	Natural Gas	
	i	*Production/ Processing*	Emissions from the production of gas, gas gathering systems and gas separation plants.
	ii	*Transmission/ Distribution*	Emissions from pipelines for long distance and local transport of methane, compressor stations and their maintenance facilities.
	iii	*Other leakage*	Release of gas at point of use, including residential, commercial, industrial and electricity generation users.

1 B 2	c	Venting and Flaring	The release and/or combustion of excess gas at facilities for the production of oil or gas and for the processing of gas.
		i *Oil*	
		ii *Gas*	
		iii *Combined (in case oil and gas cannot be separated)*	

2	**INDUSTRIAL PROCESSES**		Total emissions of all greenhouse gases from industrial processes where greenhouse gases are a by-product of the various production processes. Emissions are produced from the processes and exclude greenhouse gases from the combustion of energy used during the production process (reported under 1 above). In all cases, emissions data from integrated facilities should be allocated among fuel combustion, fuel transformation and industrial processes. These emissions should be reported by ISIC activity, with separate detail of the particular production process noted where possible. Some of the identified source processes are identified below.
	2 A	IRON AND STEEL	(ISIC[3] Group 271 and Class 2731) Includes ferro-alloy production.
	2 B	NON-FERROUS METALS	(ISIC Group 272 and Class 2732)
		2 B 1 ALUMINIUM PRODUCTION	
		2 B 2 OTHER	
	2 C	INORGANIC CHEMICALS	(Part of ISIC Division 24)
		2 C 1 NITRIC ACID PRODUCTION	
		2 C 2 FERTILISER PRODUCTION	
		2 C 3 OTHER	
	2 D	ORGANIC CHEMICALS	(Part of ISIC Division 24)
		2 D 1 ADIPIC ACID	
		2 D 2 OTHER	
	2 E	NON-METALLIC MINERAL PRODUCTS	(ISIC Division 26)
		2 E 1 CEMENT	
		2 E 2 LIME	
		2 E 3 OTHER	
	2 F	OTHER (ISIC)	

[3] International Standard Industrial Classification of all Economic Activities, Series M No. 4, Rev. 3, United Nations, New York, 1990.

3	**SOLVENT AND OTHER PRODUCT USE**	This category covers mainly NMVOC emissions resulting from the use of solvents and other products containing volatile organic compounds. When the solvents and other products are, or are produced from, petroleum products, the carbon in the NMVOC emissions will be included in the CO_2 inventory if the Reference Approach for CO_2 emissions from energy is used. See note on double counting in "Overview of the IPCC Guidelines".
	3 A PAINT APPLICATION	
	3 B DEGREASING & DRY CLEANING	
	3 C CHEMICAL PRODUCTS, MANUFACTURE & PROCESSING	
	3 D OTHER	

4	**AGRICULTURE**		Describes all anthropogenic emissions from this sector. Fuel combustion emissions from the agricultural sector are covered elsewhere in Energy 1 A. Sum of all agriculture categories 4 A, B, C, D, E, F & G.
	4 A	ENTERIC FERMENTATION	Methane production from herbivores as a by-product of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream. Both ruminant (e.g. cattle, sheep) and non-ruminant animals (e.g. pigs, horses) produce CH_4, although ruminants are the largest source (per unit of feed intake).
		4 A 1 CATTLE	
		4 A 1 a Dairy	Cattle producing milk for commercial exchange and calves and heifers being grown for dairy purposes.
		4 A 1 b Non-Dairy	All non-dairy cattle including: cattle kept or grown for key production, draft animals, and breeding animals.
		4 A 2 BUFFALO	
		4 A 3 SHEEP	
		4 A 4 GOATS	
		4 A 5 CAMELS AND LLAMAS	
		4 A 6 HORSES	
		4 A 7 MULES AND ASSES	
		4 A 8 SWINE	
		4 A 9 POULTRY	
		4 A 10 OTHER	Please specify
	4 B	MANURE MANAGEMENT	Methane is produced from the decomposition of manure under anaerobic conditions. These conditions often occur when large numbers of animals are managed in a confined area (e.g. dairy farms, beef feedlots, and swine and poultry farms), where manure is typically stored in large piles or disposed of in lagoons.
		4 B 1 CATTLE	
		4 B 1 a Dairy	
		4 B 1 b Non-Dairy	
		4 B 2 BUFFALO	
		4 B 3 SHEEP	
		4 B 4 GOATS	
		4 B 5 CAMELS AND LLAMAS	
		4 B 6 HORSES	
		4 B 7 MULES AND ASSES	
		4 B 8 SWINE	
		4 B 9 POULTRY	
		4 B 10 OTHER	

4 C	RICE CULTIVATION	The anaerobic decomposition of organic material in flooded rice fields produces methane, which escapes to the atmosphere by ebullition (bubbling up) through the water column, diffusion across the water/air interface, and transport through the rice plants. It is suggested that these emissions be reported by the irrigation regime subcategories below. Any N_2O emissions from the use of nitrogen-based fertilisers in rice cultivation should be reported under 4 D *Agricultural Soils*.
4 C 1	CONTINUOUSLY FLOODED	Methane from fields inundated with water for the duration of the growing season.
4 C 2	INTERMITTENTLY FLOODED	Methane from fields under water only intermittently, either when water is not readily available (managed irrigation), or when rains do not maintain flooded conditions throughout the growing season.
4 C 3	OTHER	Please specify.
4 D	AGRICULTURAL SOILS Subcategories may be added here as the method evolves.	Emissions and removals of CH_4 and N_2O from agricultural soils. These are influenced by irrigation practices, climatic variables, soil temperature and humidity. Any N_2O emissions from the use of nitrogen-based fertilisers in rice cultivation should be reported here. N_2O emissions may be related to the use of both organic and inorganic fertilisers.. Non-CO_2 greenhouse gas emissions associated with the use of compost and human waste as fertilisers should also be recorded in this category.
4 E	PRESCRIBED BURNING OF SAVANNAS	Emissions of CH_4, CO, N_2O, and NO_x from the burning of savannas*. Savannas are burned to control the growth of vegetation, remove pests and weeds, promote the nutrient cycle and to encourage the growth of new grass for animal grazing. CO_2 from savanna burning is noted for information but is not included in the inventory total since it is assumed that an equivalent amount of CO_2 is removed by regrowing vegetation in the following year. *Savannas are tropical and subtropical formations with continuous grass cover, occasionally interrupted by trees and shrubs, which exist in Africa, Latin America, Asia, and Australia.
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	Emission of non-CO_2 greenhouse gases from burning (in the field) of crop residue and other agricultural wastes on site. These include woody crop residues (e.g. coconut shells, jute sticks, etc.); cereal residues (e.g. rice and wheat straw, maize stalks, etc.); green crop residues (e.g. groundnut straw, soybean tops, etc.). The burning of agricultural waste for energy is excluded here but included under fuel combustion activities in section 1 A 8. At this time, CO_2 from vegetal or biomass burning is noted for information but is not included in the inventory total, since it is assumed that a roughly equivalent amount of CO_2 is removed by regrowth of the next crop.
4 F 1	CEREALS	Emissions from the on-site burning of residue from cereal crops harvested for dry grain, including but not limited to wheat, barley, maize, oats, rye, rice, millet and sorghum.
4 F 2	PULSE	Emissions from the on-site burning of residue from pulse crops harvested for dry grain, including but not limited to pea, bean and soya.
4 F 3	TUBER AND ROOT	Emissions from the on-site burning of residue from tuber and root crops, including but not limited to potatoes, feedbeet, sugarbeet, girasol (Jerusalem artichoke) and peanut.
4 F 4	SUGAR CANE	Emissions from the on-site burning of sugar cane crop residue.
4 F 5	OTHER	Emissions from the on-site burning of residue from crops not included above.
4G	OTHER	Describe each emission source/sink in detail.

5	**LAND USE CHANGE & FORESTRY**		Total emissions and removals from forest and land use change activities as described below. These activities have an impact on three different carbon sources/sinks: aboveground biomass, belowground biomass and soil carbon. Sum of 5 A, B, C & D.
	5 A	CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS	Emissions and removals of CO_2 from decreases or increases in standing biomass stocks due to forest management, logging, fuelwood collection, etc. The category is either a net source if biomass harvest/destruction exceeds regrowth in the inventory year, or a net sink if regrowth exceeds harvest/destruction.
		5 A 1 TROPICAL FORESTS	Emissions or removals from primary and secondary tropical forests as defined below.
		5 A 1 a Plantations	
		5 A 1 b Other Forests	
		5 A 1 c Other (specify)	
		5 A 2 TEMPERATE FORESTS	Emissions from primary and secondary deciduous and evergreen forests.
		5 A 2 a Plantations	
		5 A 2 b Commercial	
		5 A 2 c Other	
		5 A 3 BOREAL FORESTS	Emissions from primary and secondary boreal forests.
		5 A 4 GRASSLAND	
		5 A 5 OTHER	Emissions and removals of CO_2 from other biomass categories, including village and farm trees, etc.[4]
	5 B	FOREST AND GRASSLAND CONVERSION Time period is an important element in estimating emissions from many of these categories. For example, the IPCC default method recommends time periods of 10 years for biomass decay and 20 years for soil carbon loss estimates.	Emissions of CO_2, CH_4, CO, N_2O, and NO_x from the burning and decay of biomass and from the disturbance of soil due to cultivation or tilling of land, where these activities are associated with the conversion of forest by clearing to permanent cropland or pasture. Emissions of CO_2 from the conversion of grasslands to cultivated lands due to the disturbance of the soil and resultant oxidation of the soil carbon.

[4] These categories are organised by ecosystem. The "Other" category is intended to account for biomass which is found in locations other than the major ecosystem types listed. This includes dispersed trees in villages, farms, urban areas, etc., and also includes additional ecosystem types which may be important for biomass accounting in specific countries. Afforestation programmes which create forests will be accounted for in the appropriate forest ecosystem category. Afforestation which produces dispersed trees, e.g., urban tree planting, would be accounted for in "Other."

	5 B 1	TROPICAL FORESTS	
	5 B 1 a	Moist	These are evergreen dense forests which receive significant rainfall evenly throughout the year (i.e., there is not a distinct wet and dry season). Rainfall in these forests is 2000 mm per year or more.
	5 B 1 b	Seasonal	Semi-deciduous forests with a distinct wet and dry season and rainfall between 1200 and 2000 mm per year.
	5 B 1 c	Dry (or Woody Savannas)	Generally consistent with the definition of open forests in previous documents. Less than 1200 mm rainfall per year.
	5 B 2	TEMPERATE FORESTS	
	5 B 2 a	Evergreen	
	5 B 2 b	Deciduous	
	5 B 3	BOREAL FORESTS	
	5 B 3 a	Primary	
	5 B 3 b	Secondary	
	5 B 4	GRASSLANDS	
	5 B 5	OTHER	Emissions from conversion of ecosystem types (e.g. wastelands, desert, etc.) not otherwise covered in any of the above categories.
5 C	ABANDONMENT OF MANAGED LANDS		Removal (sinks) of CO_2 from the abandonment of formerly managed lands (e.g. croplands and pastures). The categories below are determined by the type of biomass which regrows on the abandoned land.
	5 C 1	TROPICAL FORESTS	
	5 C 2	TEMPERATE FORESTS	
	5 C 3	BOREAL FORESTS	
	5 C 4	GRASSLANDS	
	5 C 5	OTHER	Removals from abandoned land regrown to any biomass type other than forests or grasslands.
5 D	OTHER		Emissions and removals (sources and sinks) of CO_2 from land use or land use change activities which can not be included under the categories provided above.

6	**WASTE**		Total emissions from solid waste disposal on land, wastewater, waste incineration and any other waste management activity. Any CO_2 emissions from fossil-based products (incineration or decomposition) should be accounted for here but see note on double counting under Section 2 "Reporting the National Inventory." CO_2 from organic waste handling and decay should not be included (see below). Sum of 6 A, B, C & D.
6 A	SOLID WASTE DISPOSAL ON LAND		Methane is produced from anaerobic decomposition of organic matter in landfills by bacteria. CO_2 is also produced but to the extent that it is organic in origin it is in a closed cycle and therefore not accounted for in inventory totals.
	6 A 1	LANDFILLS	Placement of waste on or in the land, and covering it with soil or other cover materials, thereby producing anaerobic conditions within the landfill.
	6 A 2	OPEN DUMPS	Placement of waste on the land and not covering it with soil or other cover materials.
	6 A 3	OTHER	Other solid waste disposal on land.
6 B	WASTEWATER TREATMENT		Methane is produced from anaerobic decomposition of organic matter by bacteria in sewage facilities and from food processing and other industrial facilities during treatment and disposal. N_2O may also be released from wastewater collection and treatment.
	6 B 1	INDUSTRIAL WASTEWATER	Handling of liquid wastes from industrial processes such as: food processing, textiles, or pulp and paper production. This may involve such things as wastewater collection and treatment, ponds, or discharge into surface water.
	6 B 2	DOMESTIC AND COMMERCIAL WASTEWATER	Handling of liquid wastes from housing and commercial sources (including human waste) through: wastewater collection and treatment, open pits / latrines, ponds, or discharge into surface waters.
	6 B 3	OTHER	
6 C	WASTE INCINERATION		Incineration of waste, not including waste-to-energy facilities. May include open burning of wastes. All non-CO_2 greenhouse gases from incineration should be reported here as well as CO_2 from non-biological waste.
6 D	OTHER WASTE		Release of greenhouse gases from other waste handling activities.

7	**OTHER**	Efforts should be made to fit all emission sources/sinks into the six categories described above. If it is impossible to do so, however, this category may be used, accompanied by a detailed explanation of the source/sink activity. It is hoped that this category will be phased out in a future version of the IPCC *Guidelines*.

1.2 Fuel Categories

Common terms and definitions of fuels are necessary for countries to describe emissions from fuel combustion activities consistently. A list of fuel types is provided below. Definitions for each of these fuels are given in the Glossary included in these *Reporting Instructions*. The list is organised into five major fuel types: liquid, solid, gas, biomass and other. It should be noted that "other fuels" are distinct from fuels listed in the biomass fuels category because they represent fuels that include biomass and non-biomass components. You are asked to separate fuel combustion emissions by fuel when completing the Standard Data Tables. More detailed inventory estimates and supporting data are instructive and your country is invited to provide such information if it is available.

BASIC FUELS HIERARCHY
(Fuel Combustion Only)

MAIN FUEL CATEGORIES (Included in totals of greenhouse gases Sources)		
CATEGORY	*SUBCATEGORY*	
LIQUID (Crude oil and petroleum products)	CRUDE OIL	
	NATURAL GAS LIQUIDS	
	GASOLINE	Motor Gasoline
		Aviation Gasoline
		Jet Gasoline
	(JET KEROSENE)	
	OTHER KEROSENE	
	GAS/DIESEL OIL	
	RESIDUAL FUEL OIL	
	LIQUEFIED PETROLEUM GAS	
	ETHANE	
	NAPHTHA	
	BITUMEN	
	LUBRICANTS	
	PETROLEUM COKE	
	REFINERY FEEDSTOCK	
	OTHER OIL	Refinery Gas
		Paraffin Waxes
		White Spirit
		Other

CATEGORY	*SUBCATEGORY*	
SOLID (Coal and coal products)	ANTHRACITE *	
	COKING COAL	
	OTHER BITUMINOUS COAL	
	SUB-BITUMINOUS COAL	
	LIGNITE	
	PEAT	
	COKE	Coke Oven Coke
		Gas Coke
	BKB/PATENT FUEL	Patent Fuel
		Brown Coal Briquettes
	DERIVED GASES	Gas Works Gas
		Coke Oven Gas
		Blast Furnace Gas
GAS	NATURAL GAS	
OTHER FUELS	MUNICIPAL SOLID WASTE (GARBAGE)	
	INDUSTRIAL WASTE	
BIOMASS (Excluded from CO_2 Emissions totals.)	SOLID	Wood
		Charcoal
		Vegetal Waste
	LIQUID	Bio-alcohol
		Sulphur Lies (Black Liquor)
	GAS	Landfill Gas
		Sludge Gas
TOTAL (Primary fossil fuel supply)		

* If anthracite not separately identifiable, include with Other Bituminous Coal.

1.3 Reporting major sources at differing levels of detail

The Standard Data Tables in this book allow the user to report the inventory at the level of detail that the data permits. There is at least one Standard Data Table for each emission source. The principles underlying the Standard Data Tables are summarised below.

- Energy

  If the Reference Approach for estimation of CO_2 from fuel combustion has been used, the Standard Data Tables are simply the Worksheets from the Energy Module in the Workbook.

  Standard Data Tables for the Detailed Technology Based Approach are provided. Emissions and main assumptions for fuel combustion should be reported by fuel (see section 1.2) and if possible, by transformation and end-use activities.

  If a detailed, technology based approach has been used, you are still asked to complete the Worksheet 1-1 from the Reference Approach for verification purposes and report it as the Standard Data Table - Verification.

  Separate Standard Data Tables are also provided for Traditional Biomass Burned for Energy and for each of the main activities for Fugitive Fuel Emissions (i.e. Coal Mining and Oil and Natural Gas). For these activities, a maximum level of detail is requested for the purpose of methods development.

- Industrial Processes

  Emissions and main assumptions should be described for each individual process that releases greenhouse gases.

- Solvent and Other Product Use

  Emissions and main assumptions should be described for each individual process that releases greenhouse gases.

- Agriculture

  All six activities should be reported at a minimum (enteric fermentation, animal wastes, rice cultivation, agricultural soils, and agricultural waste burning and savanna burning) with sub-activities (e.g. animal type) where relevant. A maximum level of detail is requested for the reporting of emissions from rice and agricultural soils, for the purpose of methods development. Emissions and main assumptions (in aggregate form) should be provided.

- Land use change and forestry

  Each of the three main activities (changes in forest and other woody biomass stocks, conversion of forests and grasslands and abandonment of managed lands) should be reported with as much geographic and species detail as is used in the original calculations. This detail is specifically requested to assist in the improvement of default estimation

methods. Emissions and removals as well as main assumptions should be reported.

- Waste

  Main activities of solid waste disposal on land, wastewater treatment and waste incineration should be included at a minimum. Additional detail is useful, for the purpose of methods development.

1.4 Standard Summary Tables

- As far as possible, countries should use the standard summary tables outlined in this document to summarise final inventory results (e.g. Tables 7A and 7B). The notation shown in the key (see box) should be used to show where countries believe the identified source is zero (0). Where countries have opted not to estimate (NE) a particular source of each greenhouse gas, this should be shown. Data problems may limit the possibility of separating out each source individually; in this case it is included elsewhere (IE) and this should also be included in the table with a footnote indicating where the emission source/sink has been reported. Finally, countries may report a particular category as not occurring (NO) in their country.
- Summary tables may be altered to reflect different levels of detail, for example, countries that lack subsector detail in one or more of the main sectoral categories. The standard notation and terminology shown in the complete list of source categories (above) should always be used.
- Additional gases can be added as thought necessary by the reporting country. Copies of the Summary and Short Summary Report for National Greenhouse Gas Inventories (7A and 7B) include column headings for all known relevant gases (including perfluorocarbons (C_2F_6 and CF_4), sulphur hexafluoride (SF_6), sulphur oxides and HFCs). These gases are known to be relevant to climate change and may be included in future versions of the *Guidelines*. Countries with data on these gases are encouraged to report them. To avoid duplication of effort, reporting of substances covered under the Montreal Protocol is not required. However, countries which wish to report these substances for completeness may do so, using the spare copies of the Summary Report Tables where the column headings have been left blank.
- The Overview Table (8A) should be used by countries to summarise their own assessment of completeness (e.g. partial, full estimate, not estimated) and quality (high, medium or low) of major source/sink inventory estimates. It gives a brief overview of the categories which have been taken into account in the emission inventory, as well as of the level of documentation and disaggregation of the categories (see the Notation Key for a full explanation). The Disaggregation Key (8B) which follows the Overview Table gives a detailed explanation of the key used for the level of disaggregation for an inventory.
- In all tables used by countries to summarise their inventory data, footnotes should be added to indicate if emission estimates are incomplete, or representative of only a part of the total activity, for any particular source or sink category. In this way countries are expected to report on the completeness of each individual emission estimate.

NOTATION KEY

0	Source is estimated to be zero
NE	Not estimated
IE	Estimated but included elsewhere
NO	Not occurring

2 REPORTING THE NATIONAL INVENTORY

This chapter contains step by step instructions for reporting a national greenhouse gas inventory.

How To Report Your Inventory

At the end of these reporting instructions you should have

- filled in the Standard Data Tables
- filled in the Summary Report and Overview Tables
- prepared an Inventory Report which contains the required numerical and text documentation (see step 5)

Do Step 1 if you have an existing inventory and would like to report it to the IPCC. If you are working from a completed CORINAIR inventory see also Annex 2. If you are using the *Workbook* methods and you now want to report your inventory, go directly to Step 2 to begin to fill out the Standard Data tables.

Remember that the *Reference Manual (Volume 3)* contains valuable background information and full explanations of the methodologies referred to here.

STEP 1 REVIEW THE IPCC COMMON REPORTING FRAMEWORK

Inventory Scope

You are requested to provide a complete inventory for 1990. This should include all anthropogenic emissions by source and removals by sink of greenhouse gases and ozone precursors, except those covered by the Montreal Protocol.

The *IPCC Greenhouse Gas Inventory Workbook* describes how to estimate greenhouse gases for all anthropogenic emissions and removals of CO_2 and CH_4. The *IPCC Greenhouse Gas Inventory Reference Manual* also provides background information on estimation for N_2O and tropospheric ozone precursors, i.e. CO, NO_x and NMVOC. The reporting instructions provide detailed instructions for these six gases.

You also have the option to add other greenhouse gases or precursors to your inventory report. If you add other gases you should use the IPCC source category structure as far as possible. If you add or change the definitions of any categories to report these additional gases, you should clearly explain these changes. Use the spare copies of Tables 7A & 7B with blank column headings to report these emissions. Countries that wish to report Montreal Protocol substances for completeness may do so using this procedure.

Standard units (pollutants, activity data and emission factors)

Emission estimates should be reported in total mass of CO_2, CH_4, N_2O and CO. NO_x should be reported as NO_2 mass equivalents, and NMVOC should be reported in estimated total mass of the sum of individual compounds. All estimates should be reported in gigagrams (Gg) of the pollutant.

Preferred units for activity data, emission factors and other data are indicated in each of the standard tables.

Source/sink categories

Your emissions inventories should use the IPCC source/sink categories as far as possible. The structure for reporting inventory information is summarised in the preceding chapter and in the Tables in this book.

Compare the IPCC source/sink categories (Chapter 1: Understanding the Common Reporting Framework) with the categories already used in your national inventory. Where there are differences it may be possible to allocate a larger category among appropriate smaller IPCC categories. Alternatively, if there is no way to allocate the category, you could report several of your smaller categories at a higher level of aggregation in the IPCC structure. Sink categories may be required in the activities described in 4 D, 5 A, 5 C and 5 D of the inventory source and sink category structure.

If your inventory cannot be re-structured to fit the IPCC model, or if you must show estimates under an "other" category, you should:

- explain precisely where there are differences and what they are, and
- explain precisely what is included in "other" categories.

Time Periods

Inventories are prepared on a calendar year basis. In the Agriculture and Land Use Change / Forestry categories, it may be desirable to estimate average emissions over a several year period. The Workbook methods describe default recommendations which are summarised in the table below.

TABLE 2-1
TIME PERIODS

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	PERIOD
1 Energy	
A Fuel Combustion Activities	Yearly figures
B Fugitive Fuel Emission	Yearly figures
2 Industrial Processes	Yearly figures
3 Solvent and Other Product Use	Yearly figures
4 Agriculture	
A Enteric Fermentation	Three-year average
B Animal Wastes	Three-year average
C Rice Cultivation	Three-year average
D Agricultural Soils	Three-year average
E Prescribed Burning of Savannas	Three-year average
F Field Burning of Agricultural Residues	Three-year average
5 Land Use Change/Forestry	
A Changes in Forest and Other Woody Biomass Stocks	Three-year average
B Forest and Grassland Conversion	
- Immediate release from on-site burning	Three-year average
- Delayed release from decay	Previous 10 years average
- Long-term loss of soil carbon	Previous 25 years average
C Abandonment of Managed Lands	1 Cumulative figures over previous 20 years 2 Total figures more than 20 years ago
6 Waste	Yearly figures

Review these assumptions and be prepared to:

- explain if, and precisely where, your inventory has different time period assumptions, and
- explain the reasoning why the averaging periods were chosen.

STEP 2 FILL IN THE STANDARD DATA TABLES

You should fill in a table for each of the main source/sink categories that you have included in your inventory. If differences in data structure prevent you from providing exactly the information requested in each table, please provide data that match as closely as possible the request and explain clearly the differences. If you have estimated ranges of uncertainty for emission or supporting data, read Task (c) of this step before beginning.

Task a: Fill in the activity data and emission estimates columns.

EITHER: transfer data from worksheets

OR convert your existing inventory data into Standard Data Table format. As explained above under Step 1, this may require transforming your data to fit the IPCC source/sink category structure.

CONVERTING CORINAIR INVENTORIES

CORINAIR is one type of detailed inventory system. Guidance for converting a CORINAIR Inventory into an IPCC inventory is given in Annex 2.

Task b: Fill in the aggregate emission factor columns for each table.

CALCULATE:

an aggregate emission factor for each source/sink category and subcategory.

Task c: Report uncertainty ranges

An approach to estimating the uncertainty associated with point emission estimates and emission factors is described in Annex 1.

If you have ranges of uncertainty for point emission estimates by source/sink of greenhouse gas, as well as for emission factors or activity data, you can report the ranges by using the same Standard Data tables. These tables should be in addition to the point estimates that are requested in Task (a) of this Step (above).

If you have ranges that you would like to report, please:

- make copies of the Standard Data tables
- mark them clearly with a heading "UNCERTAINTY RANGES"
- for each data point fill in the ranges if available.

STEP 3 COMPLETE SUMMARY REPORT TABLE

Task a: Complete the Summary Report Table (Table 7A or 7B)

This is done by transferring data from the Standard Data Tables, Emission Estimate columns. If you have estimated ranges of uncertainty, read Task (b) before completing this step.

Task b: Report Uncertainty Ranges.

If you have ranges that you would like to report, please:

- make copies of the Summary Report Table
- mark it clearly with a heading "UNCERTAINTY RANGES," and
- for each data point fill in the ranges available, by transferring from the appropriate column of the Standard Data Tables, Step 2 of Task (c) above.

Task c: Documentation of differences in definitions or structure

If your data do not conform to the IPCC source/sink category structure, you should clearly footnote on this table any differences and provide an explanation of the differences in the documentation note of the inventory.

STEP 4 VERIFICATION

Task a: Checking results

Countries are asked to carry out the following forms of verification and summarise results (in text form) in the inventory report:

- checks for arithmetic errors
- checks of country estimates against independently published estimates
- checks of national activity data with international statistics (default data)
- checks of CO_2 emissions from fuel combustion calculated using national methods with the IPCC Reference Approach (see below).

Further verification checks that may be done centrally, or assisted centrally are:

- cross-country comparisons of estimates through use of a single set of source categories
- cross-country comparisons of emission factors

A more detailed sample set of questions for countries to consider in reviewing the quality of their own inventories is provided below.

Verification

In completing the inventory you should also make a report in which you summarise the verification procedures you have used. This report should include an overall assessment of the quality and completeness of each of the main source and sink estimates for each greenhouse gas. You should ask yourself the following questions about your inventory when attempting to provide an overall assessment of the inventory's quality and completeness.

Method

- Is the approach well documented and reproducible?
- Have results been checked against other methods of estimation?
- Are measurement data part of the estimate? If so, has the source activity been summarised in part (for the remaining non-measured part of the activity) and has it been summarised in total? Have you verified that the emissions from a given activity are not included in several source categories?

Emission estimates

- Have any estimates been compared with measured emission and concentration data?
- In some instances it is possible to cross-check emission estimates against roughly comparable statistics (e.g. for NMVOC, solvent production + imports - exports should equal total of applications). Have these checks been done and if so how do these data compare?
- Have results been compared for reasonableness with outside or independently published estimates? This could include comparison with estimates from a country of similar size or economic profile.

Activity data assumptions

- Does the level of activity reported cross-check reasonably well with other sources of information on this activity, e.g. with international statistics?
- Do units match emission factors reported?

Emission factors

- Do emission factors represent operating cycles or conditions from the region reporting?
- Are the sources of emission factors well documented? Are the conventions the same as those found in the activity data e.g. using net calorific value?
- Have emission factors been compared with other sources (taking into account technologies, maintenance, operating cycles, or other conditions that may influence emission factors)?

If you have already performed some verification, please describe what you did and what you found.

Task b: CO_2 from fuel combustion - standard verification

With respect to CO_2 emissions from energy, all users are asked to provide a standard set of information that will assist the verification process. This means that:

- Users who have estimated their CO_2 emissions from energy using the Reference Approach outlined in *Volume 2* of the *Guidelines* should

include the worksheets used to estimate these emissions in the documentation submitted with their inventory.

- Users who have used their own methodology to estimate CO_2 emissions from energy should present the results of their work in the Standard Data Tables provided in the Reporting Instructions. They should also estimate their CO_2 emissions from energy using the Reference Approach provided in *Volume 2* of the *Guidelines* and present those results on the first sheets of the Standard Data Tables provided in the *Reporting Instructions*. It is recommended that users provide (in text form) an explanation for any significant differences between these two sets of results.

Task c: Assessing quality

Prepare a brief self-assessment of the quality of the resulting inventory and of the verification that has been performed. A simplified format for reporting on the quality and completeness of the inventory is suggested in the Overview Table and Disaggregation Key (Tables 8A and 8B) in this book. This should be included with the other tables in the Inventory Report.

DOCUMENTATION STANDARDS

- National inventory reports should provide minimum information to enable the results to be reconstructed, and to justify the choice of methodology and data used. This means, for example, that to the extent possible, activity data should be provided at the level of detail at which the emissions are estimated.
- If worksheets from *Volume 2* of the *Guidelines* have been used to estimate greenhouse gas emissions in the inventory, these worksheets should be part of the documentation included in the inventory submission.
- Documentation should contain enough information to explain differences between national methods and data, and the IPCC default methods and assumptions. Reasons for the differences should be explained and sources of emission factors and other national data should also be clearly cited. Minimum requirements include: emission factors, activity data, and a list of references documenting any differences from IPCC recommendations.
- Measurement studies containing new values should be referenced, and made available upon request. It is preferable that new emission factors be taken from published sources.
- Any significant changes in emission factors and other assumptions from those used in previous inventories that have been submitted should be clearly referenced and explained.
- Documentation should be kept for future years (by the country and by the IPCC) and countries are encouraged to publish the documentation of their inventories. This extensive record keeping will facilitate the recalculation of historical inventory estimates when changes in national methods or assumptions occur.

STEP 5 DOCUMENTATION

Prepare text to accompany the inventory which:

- describes any differences from IPCC source/sink category structure
- describes any differences from IPCC default methods for the estimation of CO_2 and CH_4
- clearly describes the estimation methods, as well as major assumptions that may not have been captured in the Standard Data Tables, for all greenhouse gases contained in the inventory
- provides complete references to all data sources used to construct the inventory
- highlights any new or interesting data sources, references or research findings used to construct the inventory
- describes any significant changes in emission factors and other assumptions from those used in previous inventories that have been submitted.

You are also invited to report any difficulties you faced in developing and reporting the inventory (e.g. lack of data, lack of resources etc.).

STEP 6 ASSEMBLING AND TRANSMITTING THE INVENTORY

Assemble all elements of the National Inventory, including:

- Standard Data Tables
- Summary Report Tables
- Overview Table
- Uncertainty Estimates (if available)
- Written documentation
- Computer diskette containing data (if applicable)
- Any supporting documents

Mail the complete package to:

IPCC/OECD NATIONAL GHG INVENTORY PROGRAMME
OECD, Environment Directorate
2, rue André-Pascal
75775 PARIS CEDEX 16
FRANCE

FAX: (33-1) 45 24 78 76

TABLES

TABLES

Title of Inventory	
Contact Name	
Title	
Organisation	
Address	
Phone	
Fax	
E-Mail	
Is uncertainty addressed?	
Related documents filed with IPCC	

ALL USERS SHOULD REPORT THEIR INVENTORY INFORMATION IN THE FORMAT PRESCRIBED BY THE FOLLOWING STANDARD DATA TABLES. USERS ARE, OF COURSE, REQUIRED TO FILL IN ONLY THOSE SPACES ON THE TABLES THAT RELATE TO THE GASES AND SOURCE/SINK CATEGORIES THEY HAVE ESTIMATED AND INCLUDED IN THEIR INVENTORY.

REPORTING INSTRUCTIONS - Introduction to Standard Data Tables

Countries are urged to report data at least at the level of aggregation of the Standard Data Tables. The tables are based on the common source/sink categories found in Chapter 1 - Understanding the Common Reporting Framework of Volume 1 of the *Guidelines*. In the event that country inventory methods differ drastically from IPCC methods and cannot be converted immediately, it is requested that a hard copy of the more detailed report be included with the submission, explaining the subsectors that were used and where differences lie.

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 1) - IPCC Reference Approach

Please provide completed copies of all sheets of Worksheet 1-1 contained in the Workbook.

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 2) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factor (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A Fuel Combustion Activities													
(choose relevant fuels from section 1.2 of the Reporting instructions)													

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 3) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factor (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 1 Energy and Transformation Industries													
(choose relevant fuels from section 1.2 of the Reporting instructions)													

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 4) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factors (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 1 a Electricity and Heat Production													
(choose relevant fuels from section 1.2 of the Reporting instructions)													

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 5) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factors (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 1 b Petroleum Refining*													
(Where appropriate, choose relevant fuels from section 1.2 of the Reporting instructions)													

* Record here the consumption and emissions resulting from the combustion of each of the fuels used in refineries.

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 6) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factor (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 1 c Solid Fuel Transformation and Other Energy Industries*													
(Where appropriate, choose relevant fuels from section 1.2 of the Reporting instructions)													

* Record here the consumption and emissions resulting from the combustion of each of the fuels used in solid fuel and other transformation processes.

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 7) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factor (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 2 Industry (ISIC)													
(choose relevant fuels from section 1.2 of the Reporting instructions)													

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 8) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factor (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 3 Transport*													
(choose relevant fuels from section 1.2 of the Reporting instructions)													
* User is encouraged to photocopy this table in order to provide detailed information for subcategories or further breakdown of transport data.													

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 9) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factor (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 3 b Road Transportation*													
(choose relevant fuels from section 1.2 of the Reporting instructions)													

* User is encouraged to photocopy this table in order to provide detailed information for subcategories or further breakdown of transport data.

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 10) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factor (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 4 Small Combustion													
(choose relevant fuels from section 1.2 of the Reporting instructions)													

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 11) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factor (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 4 a Commercial/Institutional													
(choose relevant fuels from section 1.2 of the Reporting instructions)													

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 12) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B (Gg of Full Mass of Pollutant)						C (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 4 b Residential													
(choose relevant fuels from section 1.2 of the Reporting instructions)													

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 13) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factor (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 4 c Agriculture/Forestry/Fishing													
(choose relevant fuels from section 1.2 of the Reporting instructions)													

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 14) - Detailed Technology Based Calculation

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data by fuel	A Consumption (PJ)	B Quantities Emitted (Gg of Full Mass of Pollutant)						C Emission Factor (t Pollutant/TJ) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1 A 5 Other													
(choose relevant fuels from section 1.2 of the Reporting instructions)													

STANDARD DATA TABLE 1

Energy: 1A Fuel Combustion Activities (Sheet 16) - Traditional Biomass Burned for Energy

SECTOR SPECIFIC DATA (UNITS)	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data (units)	A Apparent Consumption (kt dm)	B Quantities Emitted (Gg)						C Emission Factor (t /t dm) C=B/A					
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
Fuelwood													
Agricultural Wastes													
Dung													
Charcoal Consumption													
Charcoal Production													
Other (specify)													

Note: CO_2 emissions from biomass, although reported, should not be included in national total CO_2 emissions.

STANDARD DATA TABLE 1

Energy: 1B1 Fugitive Emissions from Fuels (Coal Mining)

SOURCE AND SINK CATEGORIES	A ACTIVITY DATA Production (Mt)	B METHANE EMISSIONS (Gg)	C EMISSION FACTOR (m^3/t)
			C = B/A
1 B 1 Solid Fuels			
1 B 1 a Coal Mining			
1 B 1 a i Underground Mines			
Underground activities	ditto		
Post-mining activities	ditto		
1 B 1 a ii Surface Mines			
Surface Activities	ditto		
Post-mining activities	ditto		
1 B 1 b Solid Fuel Transformation			
1 B 1 c Other			

STANDARD DATA TABLE 1

Energy: 1B2 Fugitive Emissions from Fuels (Oil and Natural Gas)

SOURCE AND SINK CATEGORIES		ACTIVITY DATA	EMISSIONS ESTIMATES			AGGREGATE EMISSION FACTORS		
		Fuel Quantity (PJ)	CH_4 (Gg)	CO_2 (Gg)	NMVOC (Gg)	CH_4 (kg/GJ)	CO_2 (kg/GJ)	NMVOC (kg/GJ)
1 B 2 a Oil								
i Exploration	(no. of wells drilled)	(1)				(1)	(1)	(1)
ii Production of Crude Oil								
iii Transport of Crude Oil	(Qnty. loaded on tankers)							
iv Refining/Storage	(Qnty. refined)							
v Distribution of Oil Products[2]	(Qnty. consumed)							
vi Other								
1 B 2 b Natural Gas								
i Production/Processing	(Qnty. produced)							
ii Transmission/ Distribution	(Qnty. consumed)							
iii Other Leakage	(Qnty. consumed)							
1 B 2 c Venting and Flaring								
i Oil	(Qnty. produced)							
ii Natural Gas	(Qnty. produced)							
iii Combined	(Qnty. produced)							

[1] Activity data represents the number of wells. Emission factors are Gg/well.

[2] Primarily related to NMVOC emissions. See detailed Standard Data Table (1 B 2 Supplement) to report data by fuel product.

STANDARD DATA TABLE 1

Energy: 1B2 Supplement Fugitive Emissions from Fuels (Distribution of Oil Products)

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSION ESTIMATES	AGGREGATE EMISSION FACTORS
Oil Products (specify)	Consumption (PJ)	NMVOC (Gg)	NMVOC (kg/Gg)

STANDARD DATA TABLE 2

Industrial Processes

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSION ESTIMATES									AGGREGATE EMISSION FACTORS								
	A Production Quantity (kt)	B Full Mass of Pollutant (Gg)									C Tonne of pollutant per tonne of Product (t / t)								
		CO	CO_2	CH_4	N_2O	NO_x	NMVOC	HFCs	PFCs	SF_6	CO	CO_2	CH_4	N_2O	NO_x	NMVOC	HFCs	PFCs	SF_6
A Iron and Steel																			
B Non-Ferrous Metals																			
Aluminium Production																			
Other																			
C Inorganic Chemicals (excepting solvent use)																			
Nitric Acid																			
Fertiliser Production																			
Other																			
D Organic Chemicals																			
Adipic Acid																			
Other																			
E Non-Metallic Mineral Products																			
Cement																			
Lime																			
Other																			
F Other (ISIC)																			

The IPCC *Guidelines* do not provide methodologies for the calculation of emissions of HFCs, PFCs or SF_6 from industrial processes. If you have reported such data, you should provide additional information (activity data and emission factors) used to make these estimates.

STANDARD DATA TABLE 3

Solvent and Other Product Use

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSION ESTIMATES				AGGREGATE EMISSION FACTORS			
	A Quantity Consumed (kt)	B Full Mass of Pollutant (Gg)				C Tonne of Pollutant per tonne of Product (t / t) C=B/A			
		CO_2	N_2O	HFCs	NMVOC	CO_2	N_2O	HFCs	NMVOC
A Paint Application									
B Degreasing and Dry Cleaning									
C Chemical Products Manufacture / Processing									
D Other									

Please account for the quantity of carbon released in the form of NMVOC in both the NMVOC and the CO_2 columns.

Note: The IPCC *Guidelines* do not provide methodologies for the calculation of emissions of HFCs or N_20 from solvent and other product use. If you have reported such data, you should provide additional information (activity data and emission factors) used to make these estimates.

STANDARD DATA TABLE 4

Agriculture: 4A&B Enteric Fermentation & Manure Management

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSION ESTIMATES		AGGREGATE EMISSION FACTOR	
	A	B		C	
	Number of Animals	Enteric Fermentation	Manure Management	Enteric Fermentation	Manure Management
	(1000)	($Gg\ CH_4$)		($kg\ CH_4$ per head per year)	
				C=(B/A) X 1000	
1 Cattle					
a Dairy					
b Non-Dairy					
2 Buffalo					
3 Sheep					
4 Goats					
5 Camels and Llamas					
6 Horses					
7 Mules/Asses					
8 Swine					
9 Poultry					
10 Other					

STANDARD DATA TABLE 4

Agriculture: 4C Rice Cultivation - Flooded Rice Fields

SOURCE AND SINK CATEGORIES	ACTIVITY DATA		EMISSION ESTIMATES	AGGREGATE EMISSION FACTOR
	A Area Cultivated in Megahectares (Mha)	B Megahectare-Days of Cultivation (Mha-days)	C Methane (Gg CH_4)	D CH_4 Average Emission Factor (kg CH_4 per ha-day) D=C/B
1 Continuously Flooded				
2 Intermittently Flooded				
3 Other				

STANDARD DATA TABLE 4

Agriculture: 4D Agricultural Soils

SOURCE AND SINK CATEGORIES	ACTIVITY DATA			EMISSION ESTIMATES			REMOVAL ESTIMATES	AGGREGATE EMISSION FACTOR(S)		
Crop Type	A Amount of Nitrogen Applied in Fertiliser and Manure (t N)	B Area Cultivated (ha)	C Amount of Biological Fixation of Nitrogen (t N)	Emissions of N_2O, CO_2, CH_4 (Gg) D	E	F	G Removals of CO_2 (Gg CO_2)[1]	H (t N_2O/t N) 1000D/A	(t CO_2/ha) 1000E/B	(t CH_4/ha) 1000F/B
				N_2O	CO_2	CH_4		N_2O	CO_2	CH_4
List by type of crop										

[1] Please do not attempt to provide an estimate of both emissions and removals. Instead, you should estimate "net" emissions and place a single number in either the emissions or removals column as appropriate.

Note: The IPCC *Guidelines* do not provide methodologies for the calculation of CH_4 or CO_2 emissions and removals from agricultural soils. If you have reported such data, you should provide additional information (activity data and emission factors) used to make these estimates.

STANDARD DATA TABLE 4

Agriculture: 4E Prescribed Burning of Savannas

ACTIVITY DATA			EMISSION ESTIMATES					AGGREGATE EMISSION FACTORS				
A	B	C	D					E				
Area of Savanna burned (kha / year)	Biomass Burned (Gg dm)	Carbon Fraction (t / t dm)	Full Mass of Pollutant (Gg)					Pollutant per tonne of Dry Matter (kg / t dm) $E = (D/B) \times 1000$				
			N_2O	NO_x	CO	CH_4	CO_2	N_2O	NO_x	CO	CH_4	CO_2

Note: The IPCC *Guidelines* do not provide methodologies for the calculation of CO_2 emissions from savanna burning. If you have reported such data, you should provide additional information (activity data and emission factors) used to make these estimates.

STANDARD DATA TABLE 4

Agriculture: 4 F Field Burning of Agricultural Residues

SOURCE CATEGORIES	ACTIVITY DATA		EMISSION ESTIMATE					AGGREGATE EMISSION FACTORS				
Crop Type	A Annual Burning of Crop Residues (Gg dm)	B Carbon Fraction (t / t dm)	C Full Mass of Pollutant (Gg)					D Pollutant per tonne of Dry Matter (kg / t dm) D=(C/A) x 1000				
			CH_4	N_2O	NO_x	CO	CO_2[1]	CH_4	N_2O	NO_x	CO	CO_2
1 Cereals												
2 Pulse												
3 Tuber and Root												
4 Sugar Cane												
5 Other												

[1] Data related to CO_2 emissions should be recorded here for information purposes only. This data should not be included in total national inventory emission estimates.

Note: The IPCC *Guidelines* do not provide methodologies for the calculation of CO_2 emissions from agricultural waste burning. If you have reported such data, you should provide additional information (activity data and emission factors) used to make these estimates.

STANDARD DATA TABLE 5

Land Use Change & Forestry: 5A (Sheet 1) Changes in Forest and Other Woody Biomass Stocks - Annual Growth Increment

SOURCE AND SINK CATEGORIES			ACTIVITY DATA	UPTAKE ESTIMATES	AGGREGATE UPTAKE FACTOR
Sector Specific Data (units) Land Type			A Area of Forest/Biomass Stocks (kha)	B Total Carbon Uptake Increment (Gg C)	C Carbon Uptake Factor (t C/ha) C=B/A
Tropical Forests	Plantations (specify type)				
	Other Managed Forests	Moist			
		Seasonal			
		Dry (or Woody Savannas)			
	Other				
Temperate Forests	Plantations (specify type)				
	Commercial	Evergreen			
		Deciduous			
	Other				
Boreal Forests					
Other Ecosystem Types					
Non-Forest Trees (specify type)			Number of Trees (1000)	Annual Carbon Uptake (Gg C)	Carbon Uptake Factor (t C/tree) C=B/A

STANDARD DATA TABLE 5

Land Use Change & Forestry: 5A (Sheet 2) Changes in Forest and Other Woody Biomass Stocks - Annual Harvest

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	CARBON EMISSION ESTIMATES	AGGREGATE EMISSION FACTORS
Sector Specific Data (units)	A Amount of Biomass Removed (kt dm)	B Carbon Emission/Removal Estimates (Gg C)	C Carbon Emission Factors (t C/ t dm) C=B/A
Total Biomass Removed in Commercial Harvest			
Traditional Fuelwood Consumed			
Total Other Wood Use			
Total Biomass Consumption			

STANDARD DATA TABLE 5

Land Use Change & Forestry: 5A (Sheet 3) Changes in Forest and Other Woody Biomass Stocks - Net CO_2 Emissions/Removals

SOURCE AND SINK CATEGORIES	A EMISSIONS /UPTAKE C (Gg)	B EMISSIONS/REMOVALS CO_2 (Gg)
		B = Ax(44/12)
Total Annual Growth Increment		
Total Annual Harvest		
NET EMISSIONS (+) OR REMOVALS (-)[1]		

[1] Please put this estimate of "net" emissions of CO_2 in either the CO_2 emissions or CO_2 removals column of the Summary Report (Table 7A), as appropriate. Please note that for the purposes of reporting, the signs for uptake are changed from (+) in the Worksheets to (-) for these standard summary data tables. Similarly the signs for emissions are changed from (-) to (+).

STANDARD DATA TABLE 5

Land Use Change & Forestry: 5B (Sheet 1) Forest and Grassland Conversion - CO_2 Release from Burning Aboveground Biomass

SOURCE AND SINK CATEGORIES			ACTIVITY DATA				EMISSIONS ESTIMATES		AGGREGATE EMISSIONS FACTOR	
Sector Specific Data (units) Land Types			A Area Converted Annually (kha)	B Annual Loss of Biomass (kt dm)	C Quantity of Biomass Burned (on and off-site) (kt dm)		D Quantity of C Released (kt C)		E Carbon Fraction of Biomass Burned E=D/C	
					On Site	Off Site	On Site	Off Site	On Site	Off Site
Tropical Forests	Moist	Primary								
		Secondary								
	Seasonal	Primary								
		Secondary								
	Dry (or Woody Savannas)	Primary								
		Degraded								
Temperate Forests	Evergreen	Primary								
		Secondary								
	Deciduous	Primary								
		Secondary								
Boreal Forests		Primary								
		Secondary								
Grasslands										
Other (specify)										
Total C Released										
Total of On Site and Off Site C Released										
Total CO_2 Released (44/12 x C Released)								(1)		

1 Add total to Sheet 5

STANDARD DATA TABLE 5

Land Use Change & Forestry: 5B (Sheet 2) Forest and Grassland Conversion - Release of Non-CO_2 GHG from On-Site Burning of Forests

SOURCE AND SINK CATEGORIES	ACTIVITY DATA		EMISSIONS ESTIMATES				AGGREGATE EMISSION RATIOS			
Sector Specific Data (units) Land Types	A Carbon Release[1] (Gg)	B Nitrogen Release (Gg)	C Emissions Estimates (Gg)				D Aggregate Emissions Ratios			
							D=C/A		D=C/B	
			CH_4	CO	N_2O	NO_x	CH_4	CO	N_2O	NO_x
On-Site Burning of Forests										

1 Should agree with Column D, Table 5B (Sheet 1)

STANDARD DATA TABLE 5

Land Use Change & Forestry: 5B (Sheet 3) Forest and Grassland Conversion - CO_2 Release from Decay of Aboveground Biomass

SOURCE AND SINK CATEGORIES			ACTIVITY DATA			EMISSIONS ESTIMATES	AGGREGATE EMISSIONS FACTOR
			A 10-Year Average Area Converted (kha/year)	B 10-Year Average Annual Loss of Biomass (kt dm/year)	C Average Quantity of Biomass to Decay (kt dm/year)	D Carbon Released from Decay (kt C)	E Carbon Fraction of Aboveground Biomass E=D/C
Tropical Forests	Moist	Primary					
		Secondary					
	Seasonal	Primary					
		Secondary					
	Dry (or Woody Savannas)	Primary					
		Degraded					
Temperate Forests	Evergreen	Primary					
		Secondary					
	Deciduous	Primary					
		Secondary					
Boreal Forests		Primary					
		Secondary					
Grasslands							
Other (specify)							
Total C Released from Decay							
Total CO2 Released from Decay (C Released x 44/12)							

STANDARD DATA TABLE 5

Land Use Change & Forestry: 5B (Sheet 4) Forest and Grassland Conversion - Soil Carbon Release

SOURCE AND SINK CATEGORIES			ACTIVITY DATA		EMISSION ESTIMATES	AGGREGATE EMISSION FACTOR
Sector Specific Data (units) Land Types			A Average Annual Forest/Grassland Converted to Pasture or Crops over 25 years (kha)	B Carbon Content of Soil Before Conversion (t C/ha)	C Carbon Release from Soil (Gg CO_2)	D Aggregate Emission Factor from Soil Carbon (t C / ha) D=C/A
Tropical Forests	Moist	Primary				
		Secondary				
	Seasonal	Primary				
		Secondary				
	Dry (or Woody Savannas)	Primary				
		Degraded				
Temperate Forests	Evergreen	Primary				
		Secondary				
	Deciduous	Primary				
		Secondary				
Boreal Forests		Primary				
		Secondary				
Grasslands						
Other (specify)						
Total Soil C Released						
Total CO_2 Released (Soil C Released x 44/12)						

STANDARD DATA TABLE 5

Land Use Change & Forestry: 5B (Sheet 5) Forest and Grassland Conversion - Total CO_2 Emissions

CATEGORY	EMISSIONS (Gg)
CO_2 Release from Aboveground Burning of Biomass	
CO_2 from Decay of Aboveground Biomass	
CO_2 from Soil Carbon Release	
TOTAL	

STANDARD DATA TABLE 5

Land Use Change & Forestry: 5C (Sheet 1) Abandonment of Managed Lands - Annual Carbon Uptake from Lands Abandoned Over the Previous 20 Years

SOURCE AND SINK CATEGORIES		AVERAGE ANNUAL TOTAL AREA ABANDONED (PREVIOUS 20 YEARS)			ANNUAL CARBON UPTAKE ESTIMATES			AGGREGATE ANNUAL RATE OF UPTAKE	
Sector Specific Data (units) Land Type		A Total Area Abandoned (Previous 20 Years) (kha)	B Annual Rate of Aboveground Biomass Growth (t dm / ha)	C Carbon Fraction of Aboveground Biomass	D Aboveground Biomass Carbon Uptake (Gg C / yr)	E Soil Carbon Uptake (Gg C / yr)	F Total (Gg C) F=D+E	G Rate of Aboveground Biomass Carbon Uptake (t C / ha / yr) G= D/A	H Rate of Soil Carbon Uptake (t C / ha / yr) H=E/A
Tropical Forests	Moist								
	Seasonal								
	Dry (or Woody Savannas)								
Temperate Forests	Evergreen								
	Deciduous								
Boreal Forests									
Grasslands									
Other (specify)									
Total Carbon Uptake									

STANDARD DATA TABLE 5

Land Use Change & Forestry: 5C (Sheet 2) Abandonment of Managed Lands - Annual Carbon Uptake from Lands Abandoned For More Than 20 Years

SOURCE AND SINK CATEGORIES		AVERAGE ANNUAL TOTAL AREA ABANDONED (20 - 100 YEARS AGO)			ANNUAL CARBON UPTAKE ESTIMATES			AGGREGATE ANNUAL RATE OF UPTAKE	
Sector Specific Data (units) Land Type		A Total Area Abandoned (Longer than 20 Years) (kha)	B Annual Rate of Aboveground Biomass Growth (t dm / ha)	C Carbon Fraction of Aboveground Biomass	D Aboveground Biomass Carbon Uptake (Gg C / yr)	E Soil Carbon Uptake (Gg C / yr)	F Total (Gg C / yr) F=D+E	G Rate of Aboveground Biomass Carbon Uptake (t C / ha / yr) G= D/A	H Rate of Soil Carbon Uptake (t C / ha / yr) H=E/A
Tropical Forests	Moist								
	Seasonal								
	Dry (or Woody Savannas)								
Temperate Forests	Evergreen								
	Deciduous								
Boreal Forests									
Grasslands									
Other (specify)									
Total Carbon Uptake									

STANDARD DATA TABLE 5

Land Use Change & Forestry: 5C (Sheet 3) Abandonment of Managed Lands - Total CO_2 Removals

SINK CATEGORY	A Carbon Uptake (Gg C)	B CO_2 Removals (Gg CO_2) B=A x (44/12)
Lands Abandoned Over the Previous 20 Years		
Lands Abandoned Between 20 + 100 years previously		
Total		

STANDARD DATA TABLE 6

Waste: 6A Solid Waste Disposal on Land, 6 C Waste Incineration, 6 D Other Waste

SOURCE/SINK CATEGORIES	ACTIVITY DATA Gg	EMISSION ESTIMATES Gg						AGGREGATE EMISSION FACTORS kg/t						CH_4 RECOVERED Gg
Disposal Method	A	B[1] CO_2	C CH_4	D	E	F	G	H[1] CO_2	I CH_4	J	K	L	M	N
	Annual DOC Landfilled (Gg)							$\frac{1000B}{A}$	$\frac{1000C}{A}$					
A1 Landfills														
A2 Open Dumps														
	Quantity of Waste Treated (Gg)	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	CO_2 $\frac{1000B}{A}$	CH_4 $\frac{1000C}{A}$	N_2O $\frac{1000D}{A}$	NO_X $\frac{1000E}{A}$	CO $\frac{1000F}{A}$	NMVOC $\frac{1000G}{A}$	
C Waste Incineration														
D Other Waste														

1 Note that CO_2 from Waste Disposal or Incineration should only be included if it stems from non-biologic or inorganic waste sources.

STANDARD DATA TABLE 6

Waste: 6B Wastewater Treatment

SOURCE AND SINK CATEGORIES	ACTIVITY DATA		EMISSION ESTIMATES			AGGREGATE EMISSIONS FACTORS			CH_4 RECOVERED
Wastewater Type	A Annual BOD ($Gg\ BOD_5$)	B Quantity of BOD Anaerobically Treated ($Gg\ BOD_5$)	C Total Methane Released (Gg)	D Carbon Dioxide (Gg)	E Nitrous Oxide (Gg)	F Methane ($Gg\ CH_4/Gg\ BOD_5$) F =C/B	G Carbon Dioxide ($Gg\ CO_2/Gg\ BOD_5$) G = D/B	H Nitrous Oxide $Gg\ N_2O/Gg\ BOD_5$) H = E/B	I Quantity CH_4 (Gg)
B 1 Industrial Wastewater									
B 2 Domestic and Commercial Wastewater									
B 3 Other									

TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES

SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (SHEET 1) (Gg)										
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 Emissions	CO_2 Removals	CH_4	N_2O	NO_x	CO	NMVOC	HFCs	PFCs	SF_6
Total National Emissions and Removals										
1 All Energy (Fuel Combustion + Fugitive)										
A Fuel Combustion										
1 Energy & Transformation Industries										
2 Industry (ISIC)										
3 Transport										
4 Small Combustion										
5 Other										
6 Traditional Biomass Burned for Energy										
B Fugitive Emissions from Fuels										
1 Solid Fuels										
2 Oil and Natural Gas										
2 Industrial Processes										
3 Solvent and Other Product Use										

TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES

SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (SHEET 2) (Gg)										
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 Emissions	CO_2 Removals	CH_4	N_2O	NO_X	CO	NMVOC	HFCs	PFCs	SF_6
4 Agriculture										
A Enteric Fermentation										
B Manure Management										
C Rice Cultivation										
D Agricultural Soils	(1)	(1)								
E Prescribed Burning of Savannas										
F Field Burning of Agricultural Residues										
G Other										
5 Land Use Change & Forestry	(1)	(1)								
A Changes in Forest and Other Woody Biomass Stocks	(1)	(1)								
B Forest and Grassland Conversion										
C Abandonment of Managed Lands	(1)	(1)								
D Other										
6 Waste										
A Solid Waste Disposal on Land										
B Wastewater Treatment										
C Waste Incineration										
D Other Waste										
7 Other										
International Bunkers										

[1] Please do not attempt to provide an estimate of both CO_2 emissions and CO_2 removals. Instead, you should estimate "net" emissions of CO_2 and place a single number in either the CO_2 emissions or CO_2 removals column, as appropriate.

Spare copy of Table 7A

SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (SHEET 1) (Gg)										
GREENHOUSE GAS SOURCE AND SINK CATEGORIES										
Total National Emissions and Removals										
1 All Energy (Fuel Combustion + Fugitive)										
A Fuel Combustion										
1 Energy & Transformation Industries										
2 Industry (ISIC)										
3 Transport										
4 Small Combustion										
5 Other										
6 Traditional Biomass Burned for Energy										
B Fugitive Emissions from Fuels										
1 Solid Fuels										
2 Oil and Natural Gas										
2 Industrial Processes										
3 Solvent and Other Product Use										

Spare copy of Table 7A

SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (SHEET 2) (Gg)										
GREENHOUSE GAS SOURCE AND SINK CATEGORIES										
4 Agriculture										
A Enteric Fermentation										
B Manure Management										
C Rice Cultivation										
D Agricultural Soils										
E Prescribed Burning of Savannas										
F Field Burning of Agricultural Residues										
G Other										
5 Land Use Change & Forestry										
A Changes in Forest and Other Woody Biomass Stocks										
B Forest and Grassland Conversion										
C Abandonment of Managed Lands										
D Other										
6 Waste										
A Solid Waste Disposal on Land										
B Wastewater Treatment										
C Waste Incineration										
D Other Waste										
7 Other										
International Bunkers										

TABLE 7B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES

SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)										
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 Emissions	CO_2 Removals	CH_4	N_2O	NO_x	CO	NMVOC	HFCs	PFCs	SF_6
Total National Emissions and Removals										
1 All Energy (Fuel Combustion + Fugitive)										
A Fuel Combustion										
B Fugitive Fuel Emission										
2 Industrial Processes										
3 Solvent and Other Product Use										
4 Agriculture										
5 Land Use Change & Forestry	(1)	(1)								
6 Waste										
7 Other										
International Bunkers										

[1] Please do not attempt to provide an estimate of both CO_2 emissions and CO_2 removals. Instead, you should estimate "net" emissions of CO_2 and place a single number in either the CO_2 emissions or CO_2 removals column, as appropriate.

Spare copy of Table 7B

SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)										
GREENHOUSE GAS SOURCE AND SINK CATEGORIES										
Total National Emissions and Removals										
1 All Energy (Fuel Combustion + Fugitive)										
A Fuel Combustion										
B Fugitive Fuel Emission										
2 Industrial Processes										
3 Solvent and Other Product Use										
4 Agriculture										
5 Land Use Change & Forestry										
6 Waste										
7 Other										
International Bunkers										

TABLE 8A OVERVIEW TABLE FOR NATIONAL GREENHOUSE GAS INVENTORIES

OVERVIEW TABLE (SHEET 1)																					
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O		NO_x		CO		NMVOC		HFCs		PFCs		SF_6		Documen-tation	Disaggreg-ation	Footnotes
	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality			
Total National Emissions and Removals																					
1 All Energy (Fuel Combustion + Fugitive)																					
A Fuel Combustion																					
1 Energy & Transfor-mation Industries																					
2 Industry (ISIC)																					
3 Transport																					
4 Small Combustion																					
5 Other																					
6 Traditional Biomass Burned for Energy																					
B Fugitive Emissions from Fuels																					
1 Solid Fuels																					
2 Oil and Natural Gas																					
2 Industrial Processes																					
3 Solvent and Other Product Use																					

TABLE 8A OVERVIEW TABLE FOR NATIONAL GREENHOUSE GAS INVENTORIES

OVERVIEW TABLE (SHEET 2)																					
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O		NO_x		CO		NMVOC		HFCs		PFCs		SF_6		Documentation	Disaggregation	Footnotes
	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality			
4 Agriculture																					
A Enteric Fermentation																					
B Animal Wastes																					
C Rice Cultivation																					
D Agricultural Soils																					
E Prescribed Burning of Savannas																					
F Field Burning of Agricultural Residues																					
G Other																					
5 Land Use Change & Forestry																					
A Changes in Forest and Other Woody Biomass Stocks																					
B Forest and Grassland Conversion																					
C Abandonment of Managed Lands																					
D Other																					
6 Waste																					
A Solid Waste Disposal on Land																					
B Wastewater Treatment																					
C Waste Incineration																					
D Other Waste																					
7 Other																					
International Bunkers																					

NOTATION KEY FOR OVERVIEW TABLE							
Estimates		**Quality**		**Documentation**		**Disaggregation ***	
code	*Meaning*	*code*	*Meaning*	*code*	*Meaning*	*code*	*Meaning*
PART	Partly estimated	**H**	High Confidence in Estimation	**H**	High (all background information included)	**1**	Total emissions estimated
ALL	Full estimate of all possible sources	**M**	Medium Confidence in Estimation	**M**	Medium (some background information included)	**2**	Sectoral split
NE	Not estimated	**L**	Low Confidence in Estimation	**L**	Low (only emission estimates included)	**3**	Subsectoral split
IE	Estimated but included elsewhere						
NO	Not occurring						
NA	Not applicable						
* See following table for a complete explanation of each code.							

TABLE 8B EXPLANATION OF DISAGGREGATION KEY FOR OVERVIEW TABLE

DISAGGREGATION KEY FOR OVERVIEW TABLE				
Disaggregation 1	Disaggregation 2		Disaggregation 3	
Total National Emissions and Removals				
1 All Energy				
1 A Fuel Combustion	1 A 1 to 1 A 6	Energy & Transformation Industry to Biomass Burned for Energy	1 A	Any subsectors of 1 A 1 to 1 A 6. For example, rail transport or industry sectors
1 B Fugitive Emissions from Fuels	1 B 1	Solid Fuels	1 B	Any further breakdown, for example gas venting or post-mining activities
	1 B 2	Oil and Natural Gas		
2 Industrial Processes	2A	Iron and Steel	2	Any further quantitative breakdown by industrial sector, for example, paper, nitric acid, cement
	2 B	Non-Ferrous Metals		
	2 C	Inorganic Chemicals		
	2 D	Organic Chemicals		
	2 E	Non-Metallic Mineral Products		
	2F	Other		
3 Solvent and Other Product Use			3	Any further quantitative breakdown by product
4 Agriculture				
4 A Enteric Fermentation	4 A		4 A	Animal types e.g. cattle, goats
4 B Manure Management	4 B		4 B	
4 C Rice Cultivation	4 C		4 C	Any further quantitative breakdown
4 D Agricultural Soils	4 D	Breakdown by type of fertiliser or another characteristic	4 D	Several characteristics taken into account, such as type of fertiliser, soil, crop or area
4 E Prescribed Burning of Savannas	4 E		4 E	
4 F Field Burning of Agricultural Residues	4 F		4 F	Any further quantitative breakdown
4 G Other	4 G		4 G	
5 Land Use Change & Forestry	5 A	Changes in Forests and other Woody Biomass Stocks	5 A	Any further quantitative breakdown, e.g. by type of forest.
	5 B	Forest and Grassland Conversion	5 B	
	5 C	Abandonment of Managed Land	5 C	
	5 D	Other	5 D	
6 Waste	6 A	Solid Waste Disposal on Land	6 A	Any further quantitative breakdown
	6 B	Wastewater Treatment	6 B	
	6 C	Waste Incineration	6 C	
	6 D	Other Waste	6 D	
7 Other				

ANNEX 1 : MANAGING UNCERTAINTIES

ANNEX I
MANAGING UNCERTAINTIES

Uncertainties are inevitable in any estimate of national emissions or removals. Some important causes of uncertainty are:

- *differing interpretations of source and sink category or other definitions, assumptions, units etc.*
- *use of simplified representations with "averaged" values, especially emission factors and related assumptions to represent characteristics of a given population*
- *uncertainty in the basic socio-economic activity data which drives the calculations*
- *inherent uncertainty in the scientific understanding of the basic processes leading to emissions and removals.*

A major objective of the IPCC methodology is to help national experts reduce uncertainty in their greenhouse gas inventories to the minimum level possible. However, the approach also recognises that significant uncertainties will remain despite these efforts, and that these uncertainties will vary widely:

- *between different greenhouse gases*
- *between source categories for each gas*
- *between countries reporting the same gases and sources (depending on approach, levels of detail, use of default or country specific data etc.)*

It is important to provide as thorough an understanding as possible of the uncertainties involved when estimates are provided for scientific or policy uses. A simple method for expressing the confidence or uncertainty of point estimates qualitatively *is given elsewhere in the Reporting Instructions. However it is more useful to express uncertainty* quantitatively *and systematically in the form of well developed confidence intervals. This Annex provides some initial suggestions for developing quantitative uncertainty information. However, at present, it is only possible to provide a conceptual framework which relies on users to supply statistical data or equivalent expert judgement. IPCC/OECD consider the consistent estimation of uncertainty to be critically important, and will make it the focus of future work. Individual experts are encouraged to estimate uncertainty ranges as well as possible and to report results with their inventories. This will be of assistance with the ongoing work of developing methods.*

A1.1 Sources of Uncertainty

Definitions

Use of the IPCC *Reporting Instructions* will minimise variability or uncertainty which would otherwise be introduced by issues of definition. The IPCC *Reporting Instructions* provides common definitions of source categories and other terms, units, procedures, etc. The source categories are set out in Chapter 1 Understanding the Common Reporting Framework.

Estimation Methodology

The IPCC/OECD programme has sought consensus among researchers, sectoral interest groups and national technical experts on the best practicable default estimation procedures for priority gases and sources. These default methodologies are described in Volume 2 of the *Guidelines*, the *Greenhouse Gas Inventory Workbook*. By using these methods countries can minimise variations or uncertainties in national estimates which would be introduced by a *choice* of methodology. However, it must be recognised that default methods represent a compromise between the level of detail which would be needed to create the most accurate estimates for each country and the input data likely to be available or readily obtainable in most countries. In many cases, the simplest default methods are simplifications with general default values which introduce large uncertainties into a national estimate. Within many of the default methods different optional levels of detail are provided to reflect whether users have detailed data for their national situation or have to rely strictly on general default values. There may be considerable variation in how well the general default values represent conditions of the actual population of source activities in a particular country. For example, the uncertainty relating to default carbon emission coefficients for the global population of fossil fuel combustion sources may be characterised as quite low (5-10 per cent) in the IPCC methodology; but national experts for a particular country may know that the characteristics of such fuels in their country vary widely from global average values. In such a country, use of default values would introduce a larger uncertainty. Thus, even for the simplest application of the default methods, it is not possible to provide general uncertainty values for all countries.

The *Reference Manual* provides more options, including ways of doing calculations at greater levels of detail and, in some cases, alternative methodologies. Users of the IPCC *Guidelines* may use their own methodologies if they believe these will provide more accurate results for their national situation. Alternative methods should be carefully documented and results reported in the standard IPCC source and sink categories. Documentation of alternative methods may involve presentation of new empirical data which may in turn provide a basis for the improvement of the default procedures and data. However, whichever methods are used - default methods, more detailed versions of default methods, or entirely different methods - users should determine as far as possible the ranges of uncertainty introduced by the emission factors and other input assumptions used, whatever their source.

Socio-economic Activity Data

The IPCC default methodologies identify activity data from international socio-economic data series wherever possible. International compilations of socio-economic activity data do not generally include quantitative uncertainty estimates around country-level data summaries. Some of the national sources that provide data to the international series may have quantified uncertainty for their own national data. As with uncertainty in methodology and emission factors, the inventory developers must judge the quality of activity data used in their own national inventory.

Underlying Scientific Understanding

Current scientific understanding of the various human-induced processes which lead to emissions and removals of greenhouse gases to and from the atmosphere is incomplete. In some cases, where substantial measurement data exist and have been thoroughly analysed, this understanding provides a basis for accurate calculations of global and national emissions. In many cases, however, data and analysis have not attained this state. This variation affects the uncertainty inherent in the various components of the default methods, as well as the estimates using other methodologies. Table A1-1 provides an *illustrative* assessment of the relative uncertainties in the scientific basis for global emission estimates for some key components of the IPCC methodology. The overall uncertainty ranges shown here are based on an interpretation of the uncertainty information presented by the IPCC (1992). The allocation of overall uncertainty to the emission factor and activity data components has been made for illustrative purposes only on the basis of judgement by the IPCC/OECD technical staff. These values should not be used for estimating uncertainty for a particular national inventory. They are provided to assist users of the *Guidelines* to consider relative uncertainties in the basic science underlying different components of their inventories.

TABLE A1-1
UNCERTAINTIES DUE TO EMISSION FACTORS AND ACTIVITY DATA

1	2	3	4	5
Gas	**Source category**	**Emission factor** U_E	**Activity data** U_A	**Overall uncertainty** U_T
CO_2	Energy	7%	7%	10%
CO_2	Industrial Processes	7%	7%	10%
CO_2	Land Use Change and Forestry	33%	50%	60%
CH_4,	Biomass Burning	50%	50%	100%
CH_4	Oil and Nat. Gas Activities	55%	20%	60%
CH_4	Coal Mining and Handling Activities	55%	20%	60%
CH_4	Rice Cultivation	3/4	1/4	1
CH_4	Waste	2/3	1/3	1
CH_4	Animals	25%	10%	25%
CH_4	Animal waste	20%	10%	20%
N_2O	Industrial Processes	35%	35%	50%
N_2O	Agricultural Soils			2 orders of magnitude
N_2O	Biomass Burning			100%

Note: Individual uncertainties that appear to be greater than ± 60% are not shown. Instead judgement as to the relative importance of emission factor and activity data uncertainties are shown as fractions which sum to one.

A1.2 Procedures for Quantifying Uncertainty

Estimating Uncertainty of Components

To estimate uncertainty by source category and gas for a national inventory, it is necessary to develop information like that shown in Table A1-1, but specific to the individual country, methodology and data sources used. In scientific and process control literature the 95 per cent (± 2) confidence limit is often regarded as appropriate for range definition. Where there is sufficient information to define the underlying probability distribution for conventional statistical analysis, a 95 per cent confidence interval should be calculated as a definition of the range. Uncertainty ranges can be estimated using classical analysis (see Robinson) or the Monte Carlo technique (in Eggleston, 1993). Otherwise the range will have to be assessed by national experts.

If possible ranges should be developed separately for

- emission factors (and other assumptions in the estimation method) (column 3 of Table A1-1).
- socio-economic activity data (column 4 of Table A1-1)

Combining Uncertainties

It is necessary to derive the overall uncertainty arising from the combination of emission factor and activity data uncertainty. IPCC/OECD suggest that emission factor and activity data ranges are regarded as estimates of the 95 per cent confidence interval, expressed as a percentage of the point estimate, around each of two independent components (either from statistically based calculations or informal *ex ante* judgements).

On this interpretation (for quoted ranges extending not more than 60 per cent above or below the point estimate) the appropriate measure of overall *percentage* uncertainty U_T for the emissions estimate would be given by the square root of the sum of the squares of the *percentage* uncertainties associated with the emission factor (U_E) and the activity data (U_A). That is, for each source category:

$$U_T = \pm\sqrt{\left(U_E^2 + U_A^2\right)}; \text{ so long as } |U_E|,\ |U_A| < 60\%\ ^{1}$$

For individual uncertainties greater than 60 per cent the sum of squares procedure is not valid. All that can be done is to combine limiting values to define an overall range, though this leads to upper and lower limiting values which are asymmetrical about the central estimate[2].

Estimated total emission for each gas is of course the summation $\Sigma\, C_i$ where C_i is the central estimate of the emission of the gas in the source category. The appropriate measure of *uncertainty* in total emissions in emissions units (not percentages) is then:

$$E = \pm(1/100)\cdot\sqrt{\left(\Sigma U_{T,i}^2 \cdot C_i^2\right)}$$

where $U_{T,i}$ is the overall percentage uncertainty for the source category of the gas from Table A1-1. Source categories for which symmetrical limiting values cannot be defined (because $|U_E|$ or $|U_A|$ exceeds 60 per cent) cannot sensibly be treated in this way. The uncertainty might be handled by reporting that total emissions from gas X are estimated to be Y Mt, of which Y_1 Mt had an estimated uncertainty of ± E_1 Mt and Y_2 Mt had a range of uncertainty between - L Mt and + U Mt.

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[1] The 60% limit is imposed because the rule suggested for U_T requires σ to be less than about 30% of the central estimate, and we are interpreting the quoted range as $\pm 2\sigma$

[2] If uncertainties due to the emission factor and the activity data are ± E% and ± A% respectively, and the upper and the lower limits of overall uncertainty are U% and L% respectively, then U% = (E+A+E·A/100) and L% = (E+A-E·A/100).

A1.3 Implications

If the assumptions in Table A1.1 are correct then typical uncertainties in national emissions estimates range between:

- ± 10% for CO_2 from fossil fuels although this may be lower for some countries with good data and where source categories are well defined (IPCC, 1993; von Hippel et al., 1993)
- ± 20% and ± 100% for individual methane sources (though the overall error might be ± 30%)
- perhaps two orders of magnitude for estimates of nitrous oxide from agricultural soils

These uncertainties will affect the level of quantitative understanding of atmospheric cycles of greenhouse gases that can be derived using the summation of inventories.

The situation is less critical for monitoring emissions mitigation options, because the profile of the emissions time series will be relatively insensitive to revisions to the emissions estimation methodology. However very different levels of uncertainty for different gases will be inevitable for some time to come, and this will need to be recognised in any move towards a comprehensive approach to greenhouse gas mitigation.

A1.4 References

(IPCC) Intergovernmental Panel on Climate Change (1992), *Climate Change 1992: The Supplement to the IPCC Scientific Assessment.*

The method for combining errors in a multiplicative chain are given in many statistical textbooks, but note Jennifer Robinson's discussion (On uncertainty in the computation of global emissions from biomass burning, *Climatic Change*, 14, 243-262) about the difficulties which arise at high coefficients of variation.

H S Eggleston (1993), "Uncertainties in the estimates of emissions of VOCs from Motor Cars." Paper presented at the *TNO/EURASAP Workshop on the Reliability of VOC Emission Databases*, June 1993, Delft, The Netherlands.

IPCC (1993), "Preliminary IPCC national GHG inventories: in depth review." Report presented at the *IPCC/OECD Workshop on National GHG Inventories*, October 1993, Bracknell, UK.

von Hippel et al. (1993), "Estimating greenhouse gas emissions from fossil fuel combustion", *Energy Policy*, 691-702, June 1993.

ANNEX 2 : IPCC & CORINAIR SOURCE CATEGORIES

ANNEX 2
IPCC AND CORINAIR SOURCE CATEGORIES

This chapter briefly explains the differences and correspondences between the IPCC recommendations and the CORINAIR/UNECE recommendations and outlines an interim proposal on how to report the results from the CORINAIR inventory system in an IPCC format. In addition, the chapter describes the on-going effort to harmonise the inventory recommendations of the two programmes. At present CORINAIR/UNECE is the only known inventory programme used by many countries of which the scope and objectives significantly overlap those of the IPCC. Many individual countries certainly have other detailed national inventory approaches which have similar characteristics to CORINAIR. For these countries this example of reconciling IPCC and CORINAIR source categories may be helpful in addressing similar conversion problems. The IPCC/OECD Programme will work with interested countries and other organisations as far as possible to help achieve correspondence with IPCC categories in order to avoid duplication of effort at national and international levels.

A2.1 Origins

At the present time the IPCC recommends a set of source and sink categories for the estimation and reporting of national inventories of greenhouse gas emissions which is slightly different than categories that have been developed by the Commission of European Communities (CEC) for use in Europe. The reasons for these differences lie, first, in the origin of the two inventory systems and, second, in the primary uses for the inventory data.

Unlike the IPCC, the CEC emission inventory programme (CORINAIR), was initially established to assist in the development of comparable national inventories for "conventional" air pollutants of SO_x, NO_x, and VOC. The first CORINAIR inventories from European Community (EC) Member countries were developed for the year 1985 and were released for the first time in 1990. The next CORINAIR inventory year is 1990 and for this inventory the pollutant list has been extended to include NH_3, CO, CO_2 and N_2O, as well as to separate CH_4 from VOC. A further development of the CORINAIR system came in 1991, when the UNECE helped define the eleven main CORINAIR categories as a basis for reporting under the Long Range Transboundary Air Pollution (LRTAP) Convention. The pollutants of interest in the context of the LRTAP Convention include not only those that are covered in specific protocols limiting emissions (i.e. SO_x, NO_x, and VOC) but also pollutants that influence the critical loads of acidic deposition, hence NH_3. The UNECE also established a Task Force on Emission Inventories, which began in 1992 and has as a main objective to develop a guidebook for emission inventories summarising the CORINAIR/UNECE recommendations on estimation and verification methods. The Task Force is scheduled to complete the first phase of its work including the first edition of the guidebook in 1995 and to continue for a further three years to 1998.

A2.2 Applications

The purpose of inventory development under UNECE is to support the monitoring of progress of the implementation of the LRTAP protocols. One of the principal users of the inventories are modellers who support the implementation of the Protocols under the LRTAP. The main requirement of the modellers is to estimate the sources of SO_x, NO_x, NMVOC, and NH_3 emissions on a 50 km x 50 km square grid basis across Europe. These data are then the basis of the calculations estimating acidic deposition and photochemical oxidants across Europe which tie back to the concepts of "critical loads" for acidificate and "critical levels" for photochemical oxidant. The calculations show national progress or future acquirement to meet these critical thresholds.

A2.3 Differences and Correspondences

The UNECE requirement to establish a much more detailed understanding of the physical source and geographic distribution of emissions has led to source categories based on the physical characteristics of the sources of pollutants. The IPCC has proceeded on the basis that socio-economic sources are the easiest and most appropriate groupings for describing emissions, which in turn will facilitate the use of inventories for policy analysis.

The CORINAIR/UNECE system uses type of physical plant or vehicle, as the fundamental basis for emission estimation. This allows high accuracy in description of individual point or mobile sources and in use of appropriate emission factors for conventional pollutants. However CORINAIR data do not, in general, identify the economic sectors in which the combustion plants are located making the data system less well suited to the investigation of the effects of abatement policies on industrial sectors.

An example of a source that is handled differently is that of industrial co-generation. The IPCC proposed to group all co-generation, in industry or in the power sector, as part of "energy transformation." CORINAIR groups all industrial co-generation together under industrial combustion, since this allows one to consider all similar industrial boilers collectively, and simply to estimate emissions in the same way from like sources.

Table A2-1 in the next section shows how the IPCC and CORINAIR source categories relate to each other.

A2.4 Proposed Interim Solution: Allocate or Aggregate

A proposed interim solution for reporting is summarised in Table A2-1. Here the CORINAIR reporting country is requested either to allocate emissions of the problem subcategory to the appropriate IPCC main category, or to aggregate the two source categories in question and provide them as a combined total.

In addition, large pollution sources are handled individually as point sources which can be allocated to the correct 50 x 50 kilometre grid square.

TABLE A2-1
CORRESPONDENCES BETWEEN IPCC AND CORINAIR MAIN SOURCE CATEGORIES

IPCC		CORINAIR	
	Emissions by Sector		CO_2 Emissions by Sector
1	**Energy**		
1 A	**Fuel Combustion Activities**	**Fuel Combustion Activities**	
1 A 1	Energy and Transformation Industries	01	Public Power, Co-generation and District Heating
1 A 1	Other Energy and Transformation Industries[1]	03	Industrial Combustion
1 A 2	Industry		
1 A 3	Transport	07	Road Transport
		08	Other Mobile Sources and Machinery
1 A 4	Small Combustion	02	Commercial / Institutional / Residential
1 A 5	Other		
1 A 6	Traditional Biomass Burned for Energy[2]	Biomass Fuels in categories 01, 02, 03, 07 and 08.	
1 B	**Fugitive Emissions from Fuels**	**05**	**Extraction and Distribution of Fossil Fuels**
2	**Industrial Processes**	**04**	**Production Processes**
3	**Solvent and Other Product Use**	**06**	**Solvent Use**
4	**Agriculture**	**10**	**Agriculture**
5	**Land Use Change & Forestry**	– not included in 1990 inventory	
6	**Waste**	**09**	**Waste treatment and disposal**
International air/marine bunkers[3]		– not included in 1990 inventory	

1 Include under energy industries if there is no separate breakdown.

2 CO_2 from biomass for energy and agricultural waste burning should not be included in emission total for IPCC.

3 Reported separately (IPCC 1 A 3 a i and 1 A 3 d i).

A2.5 Looking Forward

The development of the CORINAIR/EMEP Joint Guidebook is a major opportunity to extend and publicise the basic set of IPCC default methods on estimation of CO_2 and CH_4 as well as the state of knowledge on N_2O. Because the CORINAIR system has only recently begun to address these pollutants they have not yet elaborated estimation methods for all sources and sinks. The IPCC has recently revised methods for all major sources and sinks of CO_2 and CH_4. This material has been proposed to CORINAIR/UNECE to be considered for inclusion in the Guidebook.

Of course, it will be desirable for countries using CORINAIR to follow the decisions of the CoP on greenhouse gas inventory methodologies. Once initial guidance for inventory development under the UN Framework Convention on Climate Change (FCCC) is issued, further development of detailed default methods could be advocated for use in Europe and North America. In contrast to countries outside of the OECD, more detailed data sets on the relevant source activities should be available. Such methods development could draw on the initial CORINAIR/EMEP Joint Guidebook and would add to the simpler approaches described in this document.

Over the period 1993-94, the IPCC/OECD are investigating options for how more closely to harmonise the reporting recommendations and, in particular, its source categories with those recommended by CORINAIR. It may not be desirable or necessary to harmonise source categories beyond a high level of aggregation due to the very different uses of the data and the need to preserve flexibility among pollutants. For example, for the estimation of CO_2 it is not desirable to consider the physical characteristics of the plant where the fuel combustion occurs. However, for the estimation of NO_x or NMVOC, these data are essential. But, even if differences at a detailed level of estimation are acceptable and in some instances desirable, an aggregate level of reporting should be developed that is completely transferable from one system to another. Complete correspondence at an aggregate level is therefore the objective by the time the Convention comes into force.

A2.6 How to Transform a CORINAIR Inventory into an IPCC Inventory

Table A2-1 gives an overview of the correspondence between CORINAIR and IPCC source/sink categories. The CORINAIR programme has provided an additional computer programme to national experts to facilitate the aggregation and allocation of CORINAIR emission estimates into IPCC reporting tables, including extraction of emission from biomass fuel to the separate Biomass category 1A6.

For most categories there is direct correspondence between CORINAIR and IPCC. Transfer these data directly into the Standard Data Tables and the Master Summary Table.

For the CORINAIR categories in Table A2-2 the computer programme prompts for additional information to help allocate or aggregate the emissions to the appropriate IPCC categories.

TABLE A2-2
ALLOCATING CORINAIR CATEGORIES TO IPCC CATEGORIES

03 - Industrial combustion	Allocate between IPCC categories for "Fuel Combustion": 1A1 - Energy and Transformation Industries and 1A2 Industry.
07 - Road Transport and 08 - Other mobile sources and machinery	Aggregate to IPCC category "Fuel Combustion": 1A3 - Transport.

Some IPCC categories are not yet included in CORINAIR inventories. To complete your IPCC inventory you will need to provide estimates for these categories. These IPCC categories are:

- 5 Land Use Change & Forestry
- International Aviation Bunkers and International Marine Bunkers (as separate from the national inventory)

You may wish to refer to the *Workbook* if you do not already have alternative methods.

GLOSSARY

GLOSSARY

Starred items (*) in the definitions denote headings appearing elsewhere in this Glossary.

Activity data

Data on the magnitude of human activity resulting in emissions or removals taking place during a given period of time. In the energy sector for example, the annual activity data for fuel combustion sources are the total amounts of fuel burned. Annual activity data for methane emissions from enteric fermentation are the total number of animals being raised, by species.

Adipic acid

A material primarily used in the chemical industry as an intermediate step in the production of nylon. The process of producing adipic acid also produces nitrous oxide (N_2O) as a by-product.

Afforestation

Planting of new forests on lands which, historically, have not contained forests. These newly created forests are included in the category Changes in Forest and Other Woody Biomass Stocks in the Land Use Change and Forestry module of the emissions inventory calculations.

See also Reforestation.

Agricultural emissions

The five main types of agricultural emissions included in the *Workbook* are:

- CH_4 emissions from enteric fermentation in domestic animals
- CH_4 emissions from animal wastes
- CH_4 emissions from agricultural soils
- N_2O emissions from the use of nitrogen fertilisers
- Non-CO_2 trace gases from the burning of savannas and agricultural wastes (in the field).

Alcohol

For the purposes of the inventory preparation alcohols include methyl alcohol (methanol), ethyl alcohol (ethanol) and tertiary butyl alcohol (TBA) (2-methyl propan-2-ol).

Alcohol produced from non-biomass sources for use as a blending component in fuels should be included with refinery feedstocks figures in the inventory.

Bio-alcohol used in fuels should be reported as a liquid biomass for information only.

Anaerobic

Conditions in which oxygen is not readily available. These are important for the production of methane emissions. Whenever organic material decomposes in anaerobic conditions (in landfills, flooded rice fields, etc.) methane is likely to be formed.

Andosol

A soil developed in volcanic ash. Generally Andosols have good drainage and are prone to fertility problems

Anthracite

A high rank coal with generally less than 10 per cent volatile matter.

Anthropogenic

Man-made, resulting from human activities. In the *Guidelines*, *anthropogenic* emissions are distinguished from *natural* emissions. Many of the greenhouse gases are emitted naturally. It is only the man-made increments over natural emissions which may be perturbing natural balances.

API Gravity

(American Petroleum Institute Gravity). A measurement scale, related to density, for crude oil or other liquid hydrocarbons, based on the formula

$$\text{degrees API} = \frac{141.5}{\text{specific gravity}} - 131.5$$

where the specific gravity measurement is made at 60°F. Its application enables a linear scale to be used on the stem of a density-measuring device like a hydrometer.

Apparent consumption

A concept used in the calculation of CO_2 emissions from fossil fuel consumption. This concept deals with *apparent* rather than *actual* consumption because it tracks the consumption of primary fuels to an economy with adjustments for net imports and stock changes in secondary fuels. While this procedure ensures that all of the carbon in fuels is accounted for, it is important to note that it does not produce actual consumption by specific fuel or fuel product. In cases where exports of secondary fuels exceed imports, it will produce negative numbers. This is

clearly not an accurate estimate of the consumption of secondary fuel. It is merely an adjustment to the primary fuel supply calculated elsewhere in the worksheet.

Aviation Gasoline

See Gasoline.

Base year

The year for which the inventory is to be taken. This is currently 1990. In some cases (such as estimating CH_4 from rice production) the base year is simply the middle of a three-year period over which an average must be taken.

Benzole

A mixture of light hydrocarbons used as a solvent and sometimes blended into gasoline. Benzole should be included with refinery feedstocks in the inventory.

Biochemical oxygen demand (BOD)

The amount of oxygen consumed by the organic material in wastewater during the decomposition of the waste materials in the wastewater. BOD is used as a measure of the organic content of wastewater. See Section 6.3.2 of the *Reference Manual.*

Biomass

Non-fossilised organic material both above ground and below ground, and both living and dead, e.g., trees, crops, grasses, tree litter, roots etc.. When burned for energy purposes, these are referred to as *biomass fuels.* Biomass fuels also include gases recovered from the decomposition of organic material.

Bitumen

Solid, semi-solid or viscous hydrocarbon with a colloidal structure, brown to black in colour, obtained as a residue in the distillation of crude oil by vacuum distillation of oil residues from atmospheric distillation. It is soluble in carbon bisulphate, non-volatile, thermoplastic (between 150°C and 200°C) with insulating and adhesive properties. Bitumen is used mainly in road construction and is also known as asphalt.

Bituminous Coal

Includes Anthracite*, Steam coal (other than anthracite) and Coking coal*. In the *Guidelines* steam coal is referred to as "Other Bituminous Coal".

Coal with a gross calorific value greater than 23 865 kJ/kg (5 700 kcal/kg) on an ash-free but moist basis and with a mean random reflectance of vitrinite of at least 0.6.

BKB (Braunkohlenbriketts)

A composition fuel manufactured from brown coal. The brown coal is crushed, dried and moulded under high pressure into an even-shaped briquette without the addition of binders. Also includes peat briquettes.

Black Liquor

See Sulphite Lies.

Blast Furnace Gas (BFG)

Obtained as a by-product in operating blast furnaces; it is recovered on leaving the furnaces and used partly within the plant and partly in other steel industry processes or in power stations equipped to burn it. Any Oxygen Steel Furnace Gas should be included in this category.

BOD

See Biochemical oxygen demand.

Boreal

Northern biotic area characterised especially by dominance of coniferous forests.

Bunker fuels (International)

Fuels consumed for international marine and air transportation.

Calcination

Chemical process in the manufacture of cement in which the raw materials (primarily limestone – calcium carbonate) are heated in kilns producing lime and CO_2.

Calorific value

The calorific value of a fuel is a measure of its value for heating purposes. It is expressed in terms of the heat released from a specified unit quantity under defined conditions of complete combustion. The calorific value is sometimes referred to as the heating value of the fuel.

Two measures of calorific value are possible and are referred to as the net (NCV) and gross (GCV) calorific values. Also termed the lower (LHV) and higher (HHV) heating values.

The Gross Calorific Value is the total quantity of heat released during combustion when all water formed by the combustion reaction is returned to the liquid state.

The Net Calorific Value is the total quantity of heat released during combustion when all water formed by the combustion reaction remains in the vapour state.

The Net Calorific Value is therefore less than the Gross Calorific Value. For natural gas this difference is approximately 9-10 per cent whilst for oils and coals the difference is approximately 5 per cent.

Throughout the *Guidelines* net calorific values are used and expressed in SI units, for example TJ/kt. The term *Conversion Factor* has two uses. First, as net calorific value, to convert quantities expressed in natural units to energy units and, secondly as a scaling factor to convert one form of energy unit to another (e.g. Btus to GJ).

CFCs

See Chlorofluorocarbons.

Charcoal

A black, amorphous form of carbon made by heating wood or other organic matter in the absence of air.

Chlorofluorocarbons (CFCs)

Hydrocarbon derivatives consisting of carbon, chlorine and fluorine, in which chlorine and fluorine partly or completely replace the hydrogen. Chlorofluorocarbons are chemical substances which have been used in refrigeration, foam blowing etc.. CFCs contribute to the depletion of the earth's ozone layer in the upper atmosphere. Although they are greenhouse gases, they are not included in the *Guidelines* because they are already being regulated under the Montreal Protocol.

Clinker

An intermediate product created during the manufacture of cement. In the production of clinker, calcium carbonate is heated, producing lime and carbon dioxide. The carbon dioxide is normally released to the atmosphere as a waste product and is a significant global source of CO_2 emissions.

Closed forest

A dense forest with closed canopy through which sunlight does not penetrate sufficiently for grasses to grow on the forest floor. These forests contain a significantly greater amount of biomass per hectare than do open forests.

Coke

Coke is subdivided into:

Coke-oven coke

The solid product obtained from the carbonisation of coal, principally coking coal, at high temperature, low in moisture and volatile matter. Coke oven coke is used mainly in the iron and steel industry acting as energy source and chemical agent. Semi-coke, the solid product obtained from the carbonisation of coal at a low temperature, should be included in this category. Semi-coke is used as a domestic fuel or by the transformation plant itself. This heading also includes coke and semi-coke made from lignite.

Gas coke

A by-product of hard coal used for the production of town gas in gas works. Gas coke is used for heating purposes.

Coke Oven Gas

Obtained as a by-product of solid fuel carbonisation and gasification operations carried out by coke producers and iron and steel plants which are not connected with gasworks and municipal gas plants.

Coking Coal

Coal of calorific value greater than 23,865 kJ/kg (5,700 kcal/kg) on an ash free but moist basis with a mean random reflectance of vitrinite of at least 0.6.

Coal with a quality that allows the production of coke suitable to support a blast furnace charge. The following classification codes cover coals which fall into this category.

- International classification codes: (UN Geneva 1956): 323, 333, 334, 423, 433, 434, 435, 523, 533, 534, 535, 623, 633, 634, 635, 723, 733, 823.
- USA classification codes: Class II Group 2 "Medium volatile Bituminous".
- British classification: Classes 202, 203, 204, 301, 302, 400, 500, 600.
- Polish classification: Classes 33, 34, 35.1, 35.2, 36, 37.

Conference of the Parties (COP)

The Conference of the Parties under the UN Framework Convention on Climate Change.

Continuously flooded (rice fields)

Fields inundated for the duration of the growing season, whether water is provided by managed irrigation or by rain.

Conversion factor

See Calorific value.

Crude Oil

Crude oil is a mineral oil of natural origin comprising a mixture of hydrocarbons and associated impurities, such as sulphur. It exists in the liquid phase under normal surface temperature and pressure and its physical characteristics (density, viscosity, etc.) are highly variable. This category includes field or lease condensate recovered from associated and non-associated gas where it is commingled with the commercial crude oil stream.

Inputs other than crude oil and NGL should be included with crude oil and footnoted. These include hydrogen, synthetic crude oil such as mineral oils extracted from shales, bituminous sand etc. Although they are not hydrocarbons, additives and other chemical alloys such as tetraethyl lead should be included.

Cultivar

In horticulture, a particular strain or selected clone of a given species; a cultivated variety or subspecies (of rice). In taxonomy, a grouping below the subspecies level.

Dairy cattle

Cattle producing milk for commercial exchange and calves and heifers being grown for dairy purposes.

Degradable organic carbon (DOC)

The organic carbon that is accessible to biochemical decomposition. DOC is used in the method for the estimation of CH_4 from solid waste disposal on land. *See* section 6.1.4 of the *Reference Manual.*

Distillate Fuel Oil

See Gas/Diesel Oil.

DM

See Dry matter.

DOC

See Degradable organic carbon.

Dry (forest)

Generally consistent with the definition of open forests in previous documents. Less than 1200 mm rainfall per year.

Dry (rice fields)

Upland fields which are seldom flooded during the growing season.

Dry biomass

See Dry matter.

Dry matter (DM)

In this *Workbook* dry matter refers to biomass which has dried to an *oven dry* state. This means that all loose water has been driven off but water that is part of the carbohydrate molecule and various volatiles still remains. By contrast, dry matter which is only *air dry* may contain 15% moisture.

ECE

Economic Commission for Europe. A United Nations body.

Emission factor

A coefficient that relates the activity data to the amount of chemical compound which is the source of later emissions. Emission factors are often based on a sample of measurement data, averaged to develop a representative rate of emission for a given activity level under a given set of operating conditions.

Enteric fermentation

A process of digestion in herbivores (plant-eating animals) which produces methane as a by-product.

Ethane

A naturally gaseous straight-chain hydrocarbon, (C_2H_6) extracted from natural gas and refinery gas streams.

Evaporative emissions

Evaporative emissions fall within the class of fugitive emissions and are released from area (rather than point) sources. These are often emissions of Non-Methane Volatile Organic Compounds (NMVOCs), and are produced when the product is exposed to the air – for example in the use of paints or solvents.

Excreta

The faecal and urinary excretions of livestock and poultry. They include, but are not necessarily limited to, manure.

FAO

Food and Agriculture Organization of the United Nations.

FCCC

Framework Convention on Climate Change. A United Nations convention.

Flaring

The burning of gas which cannot be contained or used productively. In some cases, when associated natural gas is released along with oil from production fields remote from energy users, the gas is burned off as it escapes, primarily for safety reasons. Some flaring may also occur in the processing of oil and gas.

The IPCC *Guidelines* classify emissions from venting and flaring as fugitive emissions.

See also Venting.

Fossil Fuel

Fossil Fuel comprises combustible fuels formed from organic matter within the earth's crust over geological time scales and products manufactured from them. The fuels extracted from the earth and prepared for market are termed "Primary fuels" (e.g. coal, natural gas, crude oil, lignite) and fuel products manufactured from them are termed "Secondary fuels" (e.g. coke, blast furnace gas, gas/diesel oil.

Fugitive emissions

Fugitive emissions are intentional or unintentional releases of gases from anthropogenic activities. In particular, they may arise from the production, processing, transmission, storage and use of fuels, and include emissions from combustion only where it does not support a productive activity (e.g., flaring of natural gases at oil and gas production facilities).

Gas Coke

See Coke.

Gas/Diesel Oil

Gas/diesel oil is a medium distillate oil primarily distilling between 180°C and 380°C. Several grades are available depending on uses:

- diesel oil for diesel compression ignition (cars, trucks, marine, etc.);
- light heating oil for industrial and commercial uses;
- other gas oil, including heavy gas oils which distil between 380°C and 540°C, and which are used as petrochemical feedstocks.

Gas Works Gas

Covers all types of gases including substitute natural gas produced in public utility or private plants whose main purpose is manufacture, transport and distribution of gas. It includes gas produced by carbonisation (including gas produced by coke ovens and transferred to gas works gas), by total gasification with or without enrichment with oil products (LPG, residual fuel oil, etc.), by cracking of natural gas, and by reforming and simple mixing of gases and/or air.

Gasoline

Gasoline includes the following products:

Aviation Gasoline

This is motor spirit prepared especially for aviation piston engines, with an octane number suited to the engine, a freezing point of -60°C and a distillation range usually within the limits of 30°C and 180°C.

Jet Gasoline (Naphtha type Jet Fuel or JPA)

A light hydrocarbon oil distilling between 100°C and 250°C for use in aviation turbine power units. It is obtained by blending kerosenes and gasoline or naphthas in such a way that the aromatic content does not exceed 25 per cent in volume, and the vapour pressure is between 13.7 kPa and 20.6 kPa.

Motor Gasoline

Motor Gasoline consists of a mixture of light hydrocarbons distilling between 35°C and 215°C. It is used as a fuel for land-based spark ignition engines. Motor gasoline may include additives, oxygenates and octane enhancers, including lead compounds such as TEL (Tetraethyl lead) and TML (tetramethyl lead).

GCV

See Calorific value.

Gley soil (also Gleysol)

Occur on level land, usually with a high water table (poorly drained mineral soil).

Greenhouse gases

The current IPCC inventory includes six major greenhouse gases.

Three direct greenhouse gases are included: Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O) and three precursor gases are included: Carbon monoxide (CO), Oxides of nitrogen (NO_x), Non-Methane Volatile Organic Compounds (NMVOCs).

Other gases which also contribute to the greenhouse effect are being considered for inclusion in future versions of the *Guidelines*.

Gross calorific value (GCV)

See Calorific value.

Hard Coal

Includes Coking Coal*, Anthracite* and other Bituminous Coal*.

Heavy Fuel Oil

See Residual Fuel Oil.

HFCs

See Hydrofluorocarbons.

HHV

See Calorific value.

Higher heat value (HHV)

See Calorific value.

Hydrofluorocarbons (HCFC)

Hyrocarbon derivatives consisting of one or more halogens which partly replace the hydrogen. The abbreviation HCFC followed by a number designates a chemical product of the chlorofluorocarbon (CFC) family.

IEA

The International Energy Agency. An autonomous body attached to the OECD.

See also OECD.

INC

Intergovernmental Negotiating Committee (for a Framework Convention on Climate Change).

Intermittently flooded (rice fields)

Fields not inundated for the duration of the growing season, whether water is provided by managed irrigation or by rain.

IPCC

The Intergovernmental Panel on Climate Change. A special intergovernmental body established by UNEP and the WMO to provide assessments of the results of climate change research to policy makers. The *Greenhouse Gas Inventory Guidelines* are being developed under the auspices of the IPCC and will be recommended for use by parties to the Framework Convention on Climate Change (FCCC).

Jet Gasoline

See Gasoline.

Jet Kerosene

This is a distillate used for aviation turbine power units. It has the same distillation characteristics between 150°C and 300°C (generally not above 250°C) and flash point as kerosene. In addition, it has particular specifications (such as freezing point) which are established by the International Air Transport Association (IATA).

Kerosene (other than Jet Kerosene)

Kerosene comprises refined petroleum distillate and is used in sectors other than aircraft transport. It distils between 150°C and 300°C.

Kilns

Equipment used in the manufacture of cement. Vessels in which the raw materials (primarily limestone - calcium carbonate) are heated to cause a chemical process known as calcination which produces lime and CO_2.

Landfill Gas

The emission of gases from landfills. The two sorts of landfill involved are:

- open dumping
- sanitary land filling

Typically, landfill gas is 50-70 per cent CH_4 and 30-50 per cent CO_2 with traces of other gases.

Land use change emissions

Emissions resulting from changes in the way an area of land is used. The types of changes which produce emissions or removals of greenhouse gases include:

- conversion of forests to non-forests (for example to pasture or cropland)
- conversion of cultivated lands to grasslands
- abandonment of managed lands
- conversion of wetlands to non-wetlands

Although these changes result mainly in emission or removals of CO_2, factors such as clearing by burning release gases other than CO_2.

Conversion of wetlands to non-wetlands results also in a lowering of natural methane emissions.

LHV

See Calorific value.

Lignite

Non-agglomerating coals with a gross calorific value less than 17,435 kJ/kg (4165 kcal/kg) and greater than 31 per cent volatile matter on dry mineral matter free basis.

The distinction between Sub-bituminous Coal* and Lignite is not normally made in Europe.

Liquefied Petroleum Gas (LPG)

LPGs are light saturated paraffinic hydrocarbons derived from the refinery processes, crude oil stabilisation and natural gas processing plants. They consist mainly of propane (C_3H_8) and butane (C_4H_{10}) or a combination of the two. They are normally liquefied under pressure for transportation and storage.

Lower heat value (LHV)

See Calorific value.

LPG

See Liquefied Petroleum Gas.

Lubricants

Lubricants are hydrocarbons produced from distillate or residue, and they are mainly used to reduce friction between bearing surfaces. This category includes all finished grades of lubricating oil, from spindle oil to cylinder oil, and those used in greases, including motor oils and all grades of lubricating oil base stocks.

Manure

Waste materials, produced by domestic livestock, which are managed for agricultural purposes. When manure is managed in a way that involves anaerobic decomposition, significant emissions of methane can result.

Methanol

Methanol produced from natural gas should be included with refinery feedstock figures.

Moist (forest)

These are evergreen dense forests which receive significant rainfall evenly throughout the year (i.e., there is not a distinct wet and dry season). Rainfall in these forests is 2000 mm per year or more.

Montreal Protocol

The international agreement which requires signatories to control and report emissions of CFCs and related chemical substances which deplete the earth's ozone layer. The Montreal Protocol was signed in 1987 in accordance with the broad principles for protection of the ozone layer agreed in the Vienna Convention (1985). The Protocol came into force in 1989 and established specific reporting and control requirements for ozone depleting substances.

MSW

See Municipal solid waste.

Municipal solid waste (MSW)

Solid waste that is collected regularly by municipalities, e.g. household and commercial trash and garbage.

Naphtha

Naphtha is a feedstock destined for either the petrochemical industry (e.g. ethylene manufacture or aromatics production) or for gasoline production by reforming or isomerisation within the refinery. Naphtha comprises material in the 30°C and 210°C distillation range.

Natural Gas

Natural gas comprises gases at normal temperature and pressure occurring in underground deposits. In its marketed state it consists mainly of methane. It includes both "non-associated" gas coming from fields producing hydrocarbons predominantly in gaseous form and "associated" gas produced in association with crude oil. It also includes methane recovered from coal mines (colliery gas).

Production is normally measured dry, i.e. after the removal of the natural gas liquids (NGL) and impurities present in the gas at the well head. It therefore excludes gas re-injected into the wells, gas flared and gas used at the production and treatment plants.

Natural Gas Liquids (NGL)

NGL are liquid or liquefied hydrocarbons recovered from natural gas in separation facilities or gas processing plants. Natural gas liquids include ethane, propane, butane (normal and iso-), (iso) pentane and pentanes plus (sometimes referred to as natural gasoline or plant condensate).

Net calorific value (NCV)

See Calorific value

NGL

See Natural Gas Liquids.

Nitric acid

A raw material used mainly as feedstock in fertiliser production and in the production of adipic acid. The production of nitric acid can also produce nitrous oxide (N_2O).

NMVOC

See Non-Methane Volatile Organic Compounds.

Non-dairy cattle

All cattle which are not dairy cattle, including cattle kept or grown for key production, draft animals and breeding animals.

Non-Methane Volatile Organic Compounds (NMVOCs)

A class of emissions which includes a wide range of specific organic chemical substances. Non-Methane Volatile Organic Compounds (NMVOCs) play a major role in the formation of ozone in the troposphere (lower atmosphere). Ozone in the troposphere is a greenhouse gas. It is also a major local and regional air pollutant, causing significant health and environmental damage. Because they contribute to ozone formation, NMVOCs are considered "indirect" greenhouse gases.

OECD

The Organisation for Economic Co-operation and Development. A regional organisation of 25 free-market democracies in North America, Europe and the Pacific.

Open forests

Open forests are less dense than closed forests, do not have a closed canopy, and have grasses growing on the forest floor. These forests contain less biomass per hectare than do closed forests.

Other Products

The category "Other Products" included in the energy statistics provided by the IEA includes Refinery gas*, White spirit*, Paraffin waxes*, and other products not included elsewhere such as tar, grease and sulphur.

Oxygen steel furnace gas

Obtained as a by-product of the production of steel in an oxygen furnace: it is recovered on leaving the furnace. The gas is also known as converter gas or LD gas. Data should correspond to the quantity of gas used for the production of electricity or in cases where waste heat is recovered from the gas and sold to third parties. Quantities of this gas should be included with Blast Furnace Gas.

Paraffin Waxes

These are saturated aliphatic hydrocarbons. These waxes are residues extracted when dewaxing lubricant oils. They have a crystalline structure which is more-or-less fine according to the grade. Their main

characteristics are as follows: they are colourless, odourless and translucent, with a melting point above 45°C.

Patent Fuel

A composition fuel manufactured from coal fines by shaping with the addition of a binding agent (pitch). Note that the amount of patent fuel produced can be slightly higher than the amount of coal consumed in the transformation process because of the addition of pitch.

Peat

Combustible, soft, porous or compressed sedimentary deposit of plant origin with a high water content (up to 90 per cent in its natural state), easily cut, of light to dark brown colour.

Peat soil (also Histosol)

A typical wetland soil with a high water table and an organic layer of at least 40 cm thickness (poorly drained organic soil).

Perfluorocarbons (PFCs)

Carbon tetrafluoride (CF_4) and hexafluorethane (C_2F_6) which are extremely potent greenhouse gases. The only known major source of these gaseous emissions is aluminium smelting. Production and emission of PFCs results from aluminium smelting during the occurrence of electrical arcing or "anode effects."

Petroleum Coke

Petroleum coke is a black solid residue, obtained mainly by cracking and carbonising residue feedstock, tar and pitches in processes such as delayed coking or fluid coking. It consists mainly of carbon (90 to 95 per cent) and has a low ash content.

PFCs

See Perfluorocarbons.

Process emissions

Emissions from industrial processes involving chemical transformations other than combustion.

Refinery Feedstocks and Blending Components

Refinery feedstocks are processed oils destined for further processing in refineries (e.g. straight run fuel oil or vacuum gas oil). For IPCC purposes they include non-biomass alcohols as oxygenates for blending in motor gasoline whether within or outside refineries.

Refinery Gas (not liquefied)

Refinery gas includes a mixture of non-condensable gases mainly consisting of hydrogen, methane, ethane, and olefins obtained during distillation of crude oil or treatment of oil products (e.g., cracking) in refineries. This also includes gases which are returned from the petrochemical industry.

Reforestation

Planting of forests on lands which have, historically, previously contained forests but which have been converted to some other use. Replanted forests are included in the category "Changes in Forest and Other Woody Biomass Stocks" in the Land Use Change and Forestry module of the emissions inventory calculations.

See also Afforestation.

Residual Fuel Oil

This covers all residual (heavy) fuel oils (including those obtained by blending). Kinematic viscosity is above 10 cSt at 80°C. The flash point is always above 50°C and density is always more than 0.90 kg/l.

Ruminant animals

Herbivores (grazing animals such as cattle, buffalo, sheep, goats and camels) which have a large free stomach or rumen. Digestion in anaerobic conditions in the rumen can create significant emissions of methane from ruminant animals.

Savanna

Savannas are tropical and subtropical formations with continuous grass cover, occasionally interrupted by trees and shrubs. Savannas are found in Africa, Latin America, Asia and Australia.

Seasonal (forest)

Semi-deciduous forests with a distinct wet and dry season and rainfall between 1200 and 2000 mm per year.

Season length (in rice agriculture)

The number of days during which rice is grown *on a given field*. The field is not necessarily flooded for the entire season.

Sequestered carbon

See Stored carbon.

Sludge Gas

Sewage gas and gas from the anaerobic decomposition of animal slurries.

Steam Coal

See Bituminous Coal.

Stored carbon

Carbon retained for long periods of time within non-fuel products manufactured from fuels.

Sulphite Lies (Black Liquor)

An alkaline spent liquor from the digesters in the production of sulphate or soda pulp during the manufacture of paper. The energy content derives from the lignin removed from the wood pulp.

Sub-bituminous Coal

Non-agglomerating coals with a gross calorific value between 17,435 kJ/kg (4165 kcal/kg) and 23,865 kJ/kg (5700 cal/kg) containing more than 31 per cent volatile matter on dry mineral matter free basis.

See also Lignite. The distinction between Sub-bituminous coal and Lignite is not normally made in Europe.

Synthetic crude oil

Synthetic crude oil, including mineral oils extracted from shales, bituminous sand etc. should be included with the figures for crude oil.

Temperate (Rain Forests)

Woodland of temperate but usually rather mild climate areas with heavy rainfall, usually including numerous kinds of trees and distinguished from a tropical rain forest by the presence of a dominant tree.

Temperate Zone

The area between the Tropic of Cancer and the Arctic Circle or between the Tropic of Capricorn and the Antarctic Circle.

Trace gas emission ratios (Non-CO_2)

Ratios for carbon compounds are mass of carbon released as CH_4 or CO (in units of C) relative to mass of total carbon released from burning (in units of C). Those for nitrogen compounds are expressed as the ratios of nitrogen released as N_2O and NO_x relative to the nitrogen content of the fuel (in units of N).

Tropical (Rain Forests)

Tropical woodland with an annual rainfall of at least 100 inches and marked by lofty broad leafed evergreen trees forming a continuous canopy.

UNECE

United Nations Economic Commission for Europe.

UNEP

United Nations Environment Programme.

UNFCCC

United Nations Framework Convention on Climate Change.

US EPA

United States Environmental Protection Agency.

Vegetal Waste

Includes wood waste, straw, bagasse etc.

Venting

The release of gas to the atmosphere which cannot be contained or used productively. In some cases, when associated natural gas is released along with oil from production fields remote from energy users, the gas is allowed to escape into the atmosphere.

The IPCC *Guidelines* classify emissions from venting and flaring as fugitive emissions.

See also Flaring.

Volatile solids

The amount of organic material that disappears after drying.

Water management regime

A variety of practices used to classify rice production into categories for estimating emissions of methane. The two major water management regimes (or practices) are *dry* (or *upland*) production and *continuously flooded* rice paddies. The dry category produces little or no methane, while the continuously flooded category is a significant source.

White Spirit and SBP

White Spirit and SBP are defined as refined distillate intermediates with a distillation in the naphtha/kerosene range. They are sub-divided as:

Industrial Spirit (SBP): light oils distilling between 30°C and 200°C. There are 7 or 8 grades of industrial spirit, depending on the position of the cut in the distillation range. The grades are defined according to the temperature difference between the 5 per cent volume and 90 per cent volume distillation points (which is not more than 60°C).

White Spirit: Industrial spirit with a flash point above 30°C. The distillation range of white spirit is 135°C to 200°C.

WMO

The World Meteorological Organization of the United Nations.

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