WMO INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE UNEP

IPCC/OECD/IEA Programme on National Greenhouse Gas Inventories

Expert Group Meeting on National Feedback on the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories

Havana, Cuba
15-16 September, 1998

Meeting Report

Supporting material prepared for consideration by the Intergovernmental Panel on Climate Change. This supporting material has not been subject to formal IPCC review and approval processes.

Preface

The *IPCC Guidelines for National Greenhouse Gas Inventories* were first published in 1995 to assist all Parties to the UN Framework Convention on Climate Change to prepare greenhouse gas (GHG) inventories that are *consistent, comparable, complete, and transparent.* The Guidelines have been widely used, and most non-Annex I Parties countries have followed the IPCC default methods by source and sink categories, including the application of default emission factors and assumptions. The Guidelines were revised and expanded in 1996 (*Revised Guidelines*) to improve methods and include new gases.

The IPCC identified as a priority area the assessment of national feedback on the use of the *Revised Guidelines.* This to assure that country experience is incorporated into future methods development. Twenty experts, mainly from non-Annex I Parties, contributed to the definition of issues and procedures for the assessment.

The Inventories Programme Secretariat developed and distributed a questionnaire to facilitate the compilation and evaluation of national feedback. The questionnaire was sent to IPCC focal points and national experts on GHG inventory in 60 countries. Nineteen non-Annex I Parties and sixteen Annex-I Parties completed the questionnaire at various levels of detail. The answers to the questionnaires are summarised in a background paper prepared by the secretariat.

The IPCC *Expert Meeting on the National Feedback on the Revised Guidelines* was held in Havana, Cuba, 15-16 September 1998, back-to-back with the UNFCCC *Workshop on Emission Factors and Activity Data* (16-18 September). Participants from both meetings were asked to consider issues raised in the background paper and recommend how best to improve the *Revised Guidelines.* All participants were also asked how best to enhance national GHG emissions inventories and to define procedures for data processing, exchange and assessment that could be carried out by countries or group of countries with a common interest. This report summarises the proceedings and recommendations of the meeting.

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Summary

In September 1998, the IPCC/OECD/IEA Inventories Programme held an Expert Meeting in Havana, Cuba, on *National Feedback on the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. The meeting was held back-to-back with the *UNFCCC Workshop on Activity Data and Emission Factors*. Fifty three experts from non-Annex I Parties and thirteen from Annex-I Parties attended both meetings. The objectives of the IPCC meeting were:

- to develop recommendations for improving the *Revised 1996 IPCC Guidelines*;
- to identify priorities for improving national greenhouse gas emissions inventories.

To address these issues, the meeting participants were divided into three working groups: Africa, Asia and Latin America. The main conclusions of the meeting are summarised below.

Effective use of the *Revised Guidelines* depends on several factors, including the completeness of the *Revised Guidelines*, the adequacy of methods themselves, how well they are described, the validity of assumptions used, and the adequacy and availability of data. The meeting addressed all of these issues.

On the whole, participants are satisfied with the methods provided by the *Revised Guidelines.* However, participants identified methods that need to be improved or developed as well as options to make the *Revised Guidelines* more user-friendly. Some participants wanted more detailed methods while others felt that they should be simplified. Better judgements on the priorities for improvements may be made once the Revised Guidelines are broadly used as many non-Annex I countries have not yet begun to use the new or revised methods. But as part of an on-going process for improving the *Guidelines*, several methodological gaps are apparent. For instance, the meeting recommended developing or enhancing methods for estimating:

- non-CO_2 emissions from charcoal production
- CH_4 from hydroelectric dams
- CH_4 from enteric fermentation
- NMVOCs from solvents and other product use,
- CO_2 from changes in soil carbon.

The issue of data availability arises in most non-Annex I countries. It is well known that country-specific emissions factors are often inadequate or lacking at the national level and that activity data for some sources are not reliable. The meeting identified several steps at the institutional level for overcoming data needs. The first step is to compile and review available data. The second step is to ensure that the data are accessible to experts in developing countries. This constraint was identified as critical in many countries. To disseminate data, the meeting suggested the use of regional networks such as expert groups and institutions. Finally, data collection programmes, which can be costly, should only be initiated once the data gaps are identified. The UNFCCC Workshop on Activity Data and Emission Factors developed further proposals for data

compilation, review and collection, a primary objective of that meeting. By building on existing programmes, many of the identified processes can be cost-effective, particularly if implemented at the regional level.

These suggestions are documented in this meeting report and could be addressed in the next iteration of the *Revised Guidelines.* As there are no immediate plans for revision of the *Guidelines*, the meeting suggested that updates could be provided in the interim.

For most sectors, the application of global default values was considered questionable. The development of regional default values, or algorithms that take into account region- or country-specific circumstances, is recommended as a first step.

The meeting felt that improving the clarity of the *Revised Guidelines* was a priority. The user-friendliness of the *Revised Guidelines* could be greatly enhanced by presenting the information more concisely and by minimising duplication in the *Reference Manual* and *Workbook*.

Participants also identified the priorities for improving national GHG inventories. One such priority is the strengthening of countries' capacities for compiling inventories. This could be achieved through the implementation of three different activities:

- developing adequate institutional frameworks for the long-term monitoring and assessment of emission sources and sinks;
- providing training to ensure successful compilation of inventories; and
- establishing sectoral and regional networks of experts to exchange information and assist in the preparation of inventories, particularly for countries undertaking the process for the first time.

In addition, the *Revised Guidelines* have to be widely available to and understood by users. The meeting recommended that the *Revised Guidelines* be translated into different languages, made more widely available to users and that they be disseminated through training and other means. As the IPCC does not have a mandate to implement these tasks, existing processes for translation, dissemination, and training may need to be strengthened under the United Nations Framework Convention on Climate Change (UNFCCC).

Participants considered that providing relevant and up-to-date information and establishing self-verification procedures should also be a high priority for improving GHG inventories. The meeting recommended the development of an archive or a database of sources of activity data, emission factors, and ancillary information, preferably organised on a regional basis. Inventory verification could be achieved through the use of top-down and bottom-up approaches, and national data comparisons with independently derived data or international statistics for countries or regions with broadly similar socio-economic and bio-physical circumstances. Finally, the importance of transparency in the reporting process, for countries to document fully their data sources and assumptions, was stressed by most working groups.

1. Background

The Intergovernmental Panel on Climate Change (IPCC) has been assessing the use of the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (*Revised Guidelines*) by soliciting national feedback through the use of a questionnaire. The aim of the assessment is to identify problems faced by countries in preparing their national inventories. The questions covered four different aspects:

- the institutional frameworks that have been established in order to produce national GHG inventories;
- the main problems faced when using the *Revised Guidelines*;
- the priorities for improving both the *Revised Guidelines* and national greenhouse gas (GHG) inventories;
- the work being carried out within countries to improve methods and data availability.

The questionnaire was sent to IPCC focal points and national experts on greenhouse gas (GHG) inventory in 60 countries. Responses were received from 12 Annex I and 18 non-Annex I Parties. Responses to the questionnaire were analysed in the background paper, *National Feedback on the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, prepared by the IPCC/OECD/IEA Inventories Programme secretariat.

In general, the respondents believed that the *Revised Guidelines* provide adequate methods and guidance for preparing national GHG inventories. Nevertheless, the respondents identified deficiencies and developed recommendations to improve the *Guidelines*. Some relevant issues identified in the background paper are summarised below:

- The use of default emission factors was considered by many to be a major source of uncertainty in compiling national inventories. Most non-Annex I Parties, for example, currently have to rely on the IPCC default emission factors because they lack appropriate national data.

- The available scientific information may be used to a greater extent when compiling activity data and emission factors.

- The advantage of developing regional emission factors was stressed. If countries could obtain better activity data and use more applicable emission factors the reliability of their national GHG inventories would be enhanced. To this end, many Annex-I Parties and some non-Annex I Parties are now implementing initiatives designed to improve their activity data and derive national emission factors.

- The respondents also called for clearer guidance on how to report country-specific sources and sinks that do not fit clearly into the IPCC reporting framework. The differences between natural and anthropogenic sources and sinks within the land-use change and forestry sector, and for agricultural soils, also need clarifying.

- Several respondents suggested ways to make the *Revised Guidelines* more user-friendly. These included clarifying the scientific rationale for the methods used; providing complete examples of how to calculate the more complicated emissions; improving the consistency of wording between the *Reference Manual* and *Workbook*, minimising repetition; ensuring similar levels of detail among sectors; and improving the description of the background to and procedures for estimating uncertainties.

- Supplying the *Revised Guidelines* and software together to facilitate compiling and electronic reporting of national inventories was also recommended.

2. Objectives of the Meeting

The overall objective was to identify ways of improving the *Revised 1996 IPCC Guidelines for National GHG Inventories (Revised Guidelines)* as a means of enhancing national GHG emissions inventories.

To discuss these topics, the meeting divided into three regional working groups representing Africa, Asia and Latin America. Representatives from other regions distributed themselves among these groups.

3. Issues

A number of issues were identified during the working group and plenary sessions. These issues are summarised below. In general, the participants agreed with the conclusions reached from the analysis of the responses to the questionnaire but amplified some points and added others.

Use of the Revised Guidelines. The meeting affirmed that effective use of the *Revised Guidelines* depends on several factors, including the adequacy of methods used, how well they are described, the validity of assumptions underpinning the methods, and the adequacy and availability of data. The *Revised Guidelines* also have to be widely available to and understood by users. The meeting recommended that, as a priority, the *Revised Guidelines* should be made more widely available to users and that they be disseminated through training and other means. As the IPCC does not have a mandate to implement this task, existing procedures for distributing the *Revised Guidelines* will need to be reviewed and strengthened under the Framework Convention on Climate Change.

Availability of data. Country-specific data on both emissions factors and activity are often inadequate or lacking. Several steps for overcoming these deficiencies were identified. First, there is a need to compile and review the available data, both in the scientific literature and in unpublished reports to encompass key information and understanding. Second, efforts are needed to ensure that the available data are more widely accessible to countries. This is a critical need in many countries. Regional networks of experts and institutions could be appropriate vehicles for disseminating data. The possibility of developing a database of activity data, emission factors and other relevant information was suggested. Building on existing programmes, particularly at a regional level, could enhance the cost-effectiveness of these initiatives; the importance of a regional approach was stressed several times. Finally, research

programmes aimed at collecting new data, which can be costly, should be initiated only after the real data gaps are identified. The UNFCCC *Workshop on Activity Data and Emission Factors* developed further proposals for data compilation, review and collection (this was a primary objective of that meeting). Participants emphasised the need for undertaking these initiatives within a broader institutional framework.

Completeness of the Guidelines. The methods provided by the *Revised Guidelines* are generally considered to be acceptable though some deficiencies were noted. Particular deficiencies are present in the land-use change and forestry sector and in estimating emissions from agricultural soils. Some participants wanted more detailed methods, others felt that they should be simplified. It will take several years, however, before the utility of the *Revised Guidelines* can be fully assessed as most non-Annex I countries initiated their national inventories before the *Revised Guidelines* were completed. Nevertheless, as part of the process of improving the *Guidelines*, several methodological issues can be identified. These include developing or enhancing methods for estimating emissions from:

- non-CO_2 emissions from charcoal production
- CH_4 from hydroelectric dams
- CH_4 from enteric fermentation
- NMVOCs from solvents and other product use,
- CO_2 from changes in soil carbon.

These and other suggestions are elaborated below. Most of the suggestions could be addressed in the next iteration of the *Revised Guidelines* but, as there are no immediate plans for revision of the *Guidelines*, the meeting suggested that updates should be provided in the interim.

Clarity of the Revised Guidelines. Improving the clarity and user-friendliness of the *Revised Guidelines*, particularly the *Workbook*, was considered to be a priority. The utility of the *Revised Guidelines* could be greatly enhanced by presenting the information more concisely and by minimising duplication in the *Reference Manual* and *Workbook*. These suggestions could be implemented in possible future iterations of the *Revised Guidelines*.

4. Recommendations

Recommendations for improvements to the Revised 1996 IPCC Guidelines

Recommendations for improving the *Revised Guidelines* fell into various categories:

- novel or overlooked emission sources requiring the development of new methods;
- modifications to existing methods;
- revisions of default values;
- examples of calculations, especially for the more complicated methods; and
- improvements to the layout and design of the *Revised Guidelines.*

New methods. Methods are needed to account for emissions from a number of sources currently not included in the *Revised Guidelines*. Among these are methane emissions

from charcoal production and flooded vegetation during the construction of hydroelectric dams. Algorithms for estimating variable emission factors, such as those associated with biomass burning and CH_4 emissions from domestic livestock, should be developed. Tiered approaches for calculating emissions from the agriculture sector and in land-use change and forestry are also needed.

Methods are also required for calculating GHG emissions from the following sources: waste incineration, anaerobic polluted lagoons, septic tanks, and mining of cobalt and nickel. At least one group felt that the development of methods for these sources of emissions should be accorded low priority. They could be dealt with in the proposed section for special cases and country-specific emissions. In this case, the methods used to estimate the emissions would be the responsibility of the country concerned to develop and report (see below: *Improved layout*).

Modifications to existing methods. The proposed modifications include the need for some emissions pathways to be elaborated in greater detail, simplification or clarification of methods, and revision of emission factors.

Overall, there was concern about the adequacy of methods in the land-use change and forestry sector. In particular, the method for calculating changes in soil carbon in agricultural soils was considered difficult to apply. A less complex method is required. The inconsistency in land-cover classification between the *Forest and Grassland Conversion* module (based on vegetation cover) and that for *CO_2 Emissions and Uptake by Soils from Land-Use Change and Management* (based on land use) was especially noted. For many countries, the forest and grassland categories given in the *Guidelines* (based on the FAO classification) do not clearly correspond to those used within countries, nor is it always clear how the national data can be aggregated into the categories used in the *Revised Guidelines*. While there is a rational for using the FAO classification (many default values are derived from FAO data and given in relation to these categories), further consideration needs to be given to making the classification scheme more widely acceptable.

Where the information required for default approaches is complex and not typically available at the national level, simpler methods need to be provided in addition to the existing ones. Examples included the estimations of emissions in land-use change and forestry and emissions of N_2O from agriculture. The existing methods could become Tier 2 methods with the new methods being Tier 1.

More detailed background information and better explanation is needed for emissions from agricultural soils, non-CO_2 emissions from fuel combustion, and the combustion of a range of traditional biomass fuels. (these include wood, charcoal, agricultural waste, animal dung). Clarification is needed on whether emissions from charcoal production should be counted in the energy sector or under land-use change and forestry. Currently, they do not seem to be accounted for at all. Methane, in particular, is emitted in significant amounts during the production of charcoal.

The current Tier 2 approach for methane emissions from enteric fermentation in ruminants needs to be extended to other livestock species (e.g. llamas in South America). The current default values are limited to only a few of the domestic livestock species and do not cover some species that are important in some regions. Methane

production by ruminants is a function both of the body size of the animal concerned and of the energy content of the diet. These emissions might be better estimated through the development and use of algorithms rather than the application of simple default values (see *New methods* above).

Other suggested modifications to existing methods include:

- Revisions to some of the equations proposed for Tier 2 calculations of CH_4 emissions from enteric fermentation. Some participants suggested that for certain regions these equations may incorrectly estimate emission factors (e.g. . equation 13 of Tier 2 approach seems to assume zero growth for mature animals while this may not be the case in some countries).
- Emission factors are needed for sugar production from sugar cane. The current emission factors are based on the processing of sugar beet.
- Default factors for the proportion of venting and flaring by region should be developed. It is doubtful if a single default value will apply as the proportions are likely to vary considerably among countries and regions.
- Better methods are needed to account for fugitive emissions. Losses of fuel and gas, during transportation may be important sources of CH_4 emissions and need to be included.
- Better methods are needed for estimating carbon storage in non-energy products.
- The explanations of how to calculate and manage uncertainties were considered to be insufficient and needing improvement. In part, this could be done by developing tiered approaches for calculating uncertainties.

Relevant information from recent scientific research carried out in several parts of the world, particularly in non-Annex I countries, needs to be incorporated into the *Revised Guidelines*. This includes information on activity data and emission factors for forest fires, carbon density in forests and forest soils, carbon density in agricultural soils, CH_4 emissions from domestic livestock, and the combustion of traditional biomass fuels.

Revisions to default emission factors. Better default values are needed. For most sectors, the application of global default values is questionable. The development of regional default values, or algorithms that take into account region- or country-specific circumstances, is recommended as a priority. This would include providing Tiered approaches for the calculation of emission factors in order to allow countries to apply them on the basis of best available data. The parallel development of regional databases would greatly facilitate this process. More information is also needed on how the existing and any future default values are derived. This includes providing information on scientific background of algorithms and default emission factors.

When emission factors have a range of values, additional information is needed to explain the circumstances under which the different values in the range apply. This would help in determining the uncertainties associated with these factors.

The need for worked examples. The *Workbook* provides examples of some of the calculations required for calculating emissions. More examples are needed to cover the remaining calculations, particularly where these are not straightforward. Examples of uncertainty calculations were considered as important. Overall, these examples should

probably not be included in the Workbook because this would make it too bulky. Instead, the examples could be issued as a separate volume or on request.

Improved layout. The considerable duplication of information in the *Reference Manual* and *Workbook* was noted. Whereas some working groups supported the idea of merging the *Reference Manual* and *Workbook*, others felt that this was not feasible as the resulting product would be too bulky. Instead, it was agreed that the duplication of information should be reduced. This would be done in a possible future revision of the *Guidelines*. The *Workbook* needs to contain all the essential information required for completing the worksheets. The *Reference Manual* should provide the scientific background and key references needed to understand the emissions pathways, methods, default factors and assumptions used in the *Workbook*.

A list of required activity data and emission factors needed to complete the calculations on each worksheet should be provided at the head of each worksheet. This would make it clearer what information needs to assembled beforehand.

Assumptions underlying the calculations in the inventory need to be specified and clearly explained. An auxiliary worksheet could be added in which the assumptions can be stated, thereby making them more transparent. Examples include the assumptions made in tracking changes in land area under different land uses through time, estimates of deforestation rates, and the rates of conversion of forest and grassland to other land uses. In particular, it is necessary to specify whether the estimates are derived solely from data collected for the assessment period in question, extrapolation from earlier studies, or interpolation between earlier and subsequent figures (this would apply particularly when recalculating earlier inventories). In the last two cases, the underlying assumptions need to be given.

Methods with different levels of complexity for estimating and reporting uncertainty should be developed. This could include providing more clear guidance on how expert judgement can be used to assess uncertainty and step-by-step examples of different approaches.

A section is needed in the *Workbook* to deal with special cases or country-specific sources of emissions. In these cases, responsibility for developing a method for estimating the emissions would lie with the country concerned. The methods, assumptions and data used in the assessment would need to be reported in an annex to the national GHG emissions inventory.

Guidelines and software need to be translated into a wider range of languages. The current *Workbook* is available in English, Spanish and Russian, and will soon be available in French. Provision of the *Reference Manual* and software in Spanish, Russian and French is also desirable.

Priorities for improving national GHG emissions inventories

As with the recommendations for amending the *Revised Guidelines*, the priorities for improving the national GHG emissions inventories can be arranged into a number of groups. Many of the recommendations fall outside the mandate of the IPCC, but they are reported here as a record of the working groups' discussions and because they

address larger issues relating to the framework within which national GHG emissions inventories are carried out.

Capacity building. The working groups identified the need to strengthen national capacities for compiling national GHG inventories. This could be achieved through the implementation of three different activities: developing adequate institutional framework, providing training, and establishing experts networks.

Institutional development. It is crucial to institutionalise the process of compiling national GHG emissions inventories and preparing national communications to the UNFCCC. Without this, it will not be possible to internalise the process and make it sustainable. This institutional development is ultimately a national issue. A key aspect is the need to show that the benefits of supporting expanded institutional capacities outweigh the costs. Strong institutions would provide the basis for long-term monitoring and assessment of emission sources and sinks, including developing a national databank. It would also encourage greater continuity, and hence lower turnover, among the technical personnel responsible for compiling inventories, thereby increasing the cost-effectiveness of training programmes.

Training. To ensure successful compilation of inventories on an continuing basis requires appropriate training of the personnel involved. Experience gained in doing an inventory is itself a form of training. However, there is still need for specialist training courses similar to those run under the US Country Studies Program and the UNITAR:CC Train initiative. Nevertheless, the long-term effectiveness of these courses has been somewhat diminished by the subsequent high turnover among the personnel who attended the courses, and because key people do not always receive training. The issue of training falls outside the mandate of IPCC though it remains a key factor affecting the quality and comprehensiveness of the national GHG emissions inventories. In turn, this can affect the timely submission of national communications.

Networking. The working groups recommended the establishment of sectoral and regional networks of experts to exchange information about compiling inventories and to advise on and assist with the preparation of inventories, particularly for countries undertaking the process for the first time. Among other things, these networks would provide opportunities to collate information on activity data and emission factors for emission sources not covered in the *Guidelines*. The experts could also provide technical peer review of national GHG inventories, though some participants stressed that this should remain a national responsibility. Obviously, any peer review at an international level would have to be by invitation of the host country.

These networks of experts could also assist with further reviews of the *Revised Guidelines* as well as providing regular feedback to the IPCC on their utility. All these benefits would be enhanced if the networks were institutionalised on some basis, not yet clearly defined.

Dissemination of the Revised 1996 IPCC Guidelines. Almost all the working groups stressed the need for wider dissemination of the *Revised 1996 IPCC Guidelines*. At present, copies of the *Guidelines* are sent to national focal points but further distribution is limited in some countries. Although the *Guidelines* are available on the World Wide

Web, access to the Internet is still limited for many in the developing world. Moreover, while copies of the *Guidelines* are freely available, on request, this fact is not widely known. Efforts should be made to put the *Guidelines* on CD-ROM and other electronic media, and to advertise their availability more widely. Producing the *Reference Manual* in languages other than English would also help accelerate uptake.

Data management. Three issues were raised concerning data management. First, participants identified the need for an archive or a database of sources of activity data, emission factors, and ancillary information, preferably organised on a regional basis. This would contribute greatly to improved GHG inventories by providing relevant and up-to-date information to specialists compiling inventories who might not have their own. Second, the sources of data used in preparing the national GHG emissions inventories need to be cited, either as footnotes in the National Communication or in an Annex. Not only would this promote transparency in reporting, but it would also contribute to building a database of information on the emissions of greenhouse gases. Third, there is a need for liaison among institutions to collate a list of activity data and emission factors for methods that are not provided for in the *Guidelines* (see *Networking* above). More discussion of this issue is found in the meeting report of the UNFCCC *Workshop on Emission Factors and Activity Data.*

Top-down and bottom-up approaches. The need to estimate emissions from fuel combustion using both top-down and bottom-up approaches was stressed by a number of working groups. This is considered to be important for self-verification purposes. Differences in the estimated emissions between the two approaches need to be analysed. The top-down approach would normally be expected to give higher estimates than those calculated from the bottom up. If the bottom-up estimate is higher it indicates a possible error in the data or the calculation. If the top-down approach produces much higher estimates than the bottom-up approach this could indicate substantial losses from flaring in the transportation and distribution of fossil fuels. For some countries, statistical differences between production and consumption are reported in energy statistics and the *Revised Guidelines* could specify whether such differences ought to be reported.

Assessment. One working group recommended that activity data and emission factors in one country could be evaluated by comparing these with independently derived data or international statistics for countries or regions with broadly similar socio-economic and bio-physical circumstances. This could help to identify apparently anomalous data and stimulate further consideration of the sources prior to incorporation of the data into the national GHG emissions inventory. Nevertheless, there are problems. First, to take account of differences in population, such assessments need to be done with data expressed on a per capita or per household basis (*e.g.* fuel wood consumption; household energy consumption); the population data may not always be reliable. Second, it may not always be easy to find countries with sufficiently comparable socio-economic and environmental conditions. Finally, if done at all, this assessment would need to be done prior to completion and submission of the national GHG emissions inventory, and only on a voluntary basis for Parties to the Convention.

Reporting. The provision of the software for the Workbook in electronic format was welcomed as a positive move towards electronic reporting of emissions inventories. Further developments in this field were recommended.

The importance of transparency in the reporting process, for countries to document fully their data sources and assumptions, was stressed by most working groups. Without this, the process of improving both inventories and *Guidelines* is ineffective.

5. Conclusions

The meeting participants broadly concurred with the findings of the paper on the *National Feedback on the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. Whereas the *Revised Guidelines* are not perfect, they represent a significant step towards the goal of complete, accurate, consistent, comparable, and transparent accounting of anthropogenic greenhouse gas emissions. A full analysis must wait until the *Revised Guidelines* have been used more widely, particularly within non-Annex I countries. This process will likely take several years. Nevertheless, it is apparent that there is room for improvement, in both the short and the long-term. Many of the recommendations contained in this report concern the way the *Guidelines* are used. Substantive changes to the content of the *Guidelines* will need to wait until they are revised, something for which there is no immediate provision. In the interim, minor additions to existing methods could be prepared and circulated as addenda to the present *Guidelines.*

ANNEX I: Working Group Reports

(Havana, 15-16 September 1998)

Working Group 1: Africa
Day 1

Co-chairs: Faouzi Senhaji, Todd Ngara
Rapporteurs: Wilfred Kipondya, Katarina Mareckova

Working group participants were asked to review and make additions to Sections 3 of the background document. Additions are highlighted.

The Revised 1996 IPCC Guidelines for National GHG Inventories

Some of the issues identified by countries in the use of the *Revised Guidelines* are summarised below.

Applying the Methods.
Several Parties believed the *Revised Guidelines* need to include all the relevant information from scientific research carried out at regional or national levels. With a few exceptions, however, no specific references were made to the type of research missing. Some countries attributed these information gaps to the fact that some research work was only available after the *Revised Guidelines* were completed. Furthermore, only two countries reported that, in some cases, the background information provided is peripheral to the task of estimating GHG emissions. Instead, they suggested that the *Revised Guidelines* should focus on the most relevant components of national inventories.

The *Revised Guidelines* allow countries to use their own inventory methods with the proviso that countries report these methods. With very few exceptions, non-Annex I Parties are using the default methods for all sectors. The methods in the *Workbook* are considered to be adequate in most cases, but some countries reported that national circumstances were not always reflected in these methods. Rather than using different methods, however, several countries changed the assumptions underlying the default methods or the breakdown of IPCC categories (e.g., CH_4 emissions from enteric fermentation in cattle, emissions of N_2O in the manufacturing of fertiliser).

Countries also reported the difficulties encountered when applying the methods. These difficulties refer either to unclear instructions or to the complexity of the method itself (e.g. the number of steps and assumptions used in the method) such as in calculating N_2O emissions from agricultural soils.

The main suggestions for improving the methods in the *Revised Guidelines* can be grouped as follows:

- Simplifying methods where the required information is complex and is not usually available at the national level: land-use change and forestry, N_2O from agriculture.

- Developing methods for sources that are not included in the *Revised Guidelines*: solvent and other products use, anaerobic polluted lagoons, waste incineration, septic tanks.
- Providing more detailed information for some methods: non-CO_2 emissions from fuel combustion, traditional biomass fuels; methane emissions from charcoal production; CO_2 emissions from harvesting the gas from underground sources for industrial and other purposes (Tanzania).
- Including relevant information from scientific research carried out in several parts of the world: forest fires, domestic animals, and agricultural soils.

Reporting Instructions

The *Reporting Instructions* contain the reporting framework for national GHG inventories and the section on Managing Uncertainties. In general, the reporting framework covers the relevant sources and sinks and provides clear definitions of these categories. Nevertheless, some respondents felt that the categories were too rigid and suggested that they should be more flexible. Although the *Revised Guidelines* allow reporting of country-specific sources and sinks under 'other', several respondents felt that more guidance or clarification was needed about how to report such categories.

The section on Managing Uncertainties was generally considered to be useful, though many countries felt that the information provided is limited. Several suggestions were made for improving this section to provide more effective guidance on how to estimate and report uncertainties in emission estimates. In summary, these are:

- Clearer guidance is needed on how to report country-specific sources and sinks that do not neatly fit within the IPCC reporting framework.
- Differences between natural and anthropogenic sources and sinks in land-use change and forestry, and in agricultural soils should be clearly established.
- Methods with different levels of complexity for estimating and reporting uncertainty should be developed. This could include providing clearer guidance on how expert judgement can be used to assess uncertainty and step-by-step examples of different approaches.
- A section needs to be inserted in the Workbook to cater for special cases and country-specific activities and associated emissions. *Guidelines* may need to be developed to explain the use of this section.
- Assumptions used in the calculations of the inventory need to be specified and clearly explained. Required headings and sections might assist this process.
- Citations of data or annexes should provided, where necessary, to ensure transparency (e.g. energy balances).
- Describe sectors and how information is handled in introductory sections.

Layout of the *Revised Guidelines*

Several countries suggested ways to make the *Revised Guidelines* more user-friendly. The main suggestions were:

- Establish clearer links between the scientific background and the methods for estimating emissions
- Provide examples of the calculations
- Make chapters more consistent and wording better

- Include a section on Managing Uncertainties in the Introduction of the *Revised Guidelines* in order to provide the user with basic knowledge on uncertainties at the beginning of inventory preparation. The level of detail is not sufficient and it should be improved.
- Supply the *Revised Guidelines* and software together to facilitate the compilation and electronic reporting of national inventories.
- List of activity data and emissions factors needed to complete the calculations at beginning of each worksheet.
- Add a diagram showing relationships and linkages between sectors and possible overlapping or double counting.
- Merge the reference manual and the workbook.
- Move towards electronic reporting.

There were various views on the role of the *Workbook* and the *Reference Manual*. One suggestion was that they should be merged to reduce duplication; another was that the *Workbook* should be made more self contained and that the *Reference Manual* be a supporting volume providing additional detail.

In addition to the changes highlighted above, a number of cross-cutting issues were identified. These were:

- Ensure adequacy of training in order to successfully complete inventories with the aim of making this a continuous process.
- Establish a formal network on a sectoral and regional and/or a global basis in order to assist preparation of inventories.
- Liase with institutions to generate a list of sources for which methods are not provided in the *Guidelines.*
- *IPCC Guidelines* for emissions inventory and the UNFCCC guidelines on national communications need to be better co-ordinated.
- *Guidelines* and software should be translated in a wider range of languages.

Group 1: Africa
Day 2

Co-chairs: Youba Sokona, Willie Makundi
Rapporteurs: Bubu Jallow, Vicky Simpson

Working group participants were asked to review and make additions to Sections 5 of the background document. Additions are highlighted.

Priorities for Improving National GHG Inventories
Based on the priorities defined by countries and the types of initiatives being undertaken, the improvements needed in national inventories can be grouped into short-term (less than 3 years) and long-term priorities (more than 3 years). Addressing these issues depends on what technical and financial resources are needed and can be provided; on the time frame involved; and on possible institutional constraints. They too can be categorised into those that can be addressed at a national level, by individual countries, and those that have to be dealt with at the international level, by bodies such

as IPCC and UNFCCC. These are summarised as follows:

National Level

1) Identify areas in which minor changes can be made to improve the procedures for collection activity data. – include procedures for analysis of data; improve sharing of data between departments; ensure data is collected in units that is appropriate for climate change (e.g. to express the impact of deforestation in tons of carbon per hectare). Provide guidance for solvent sector.

2) Compare activity data, emission factors or emission estimates with independent sources or international statistics, where feasible, to identify discrepancies and possible sources of errors. Suggest comparison of statistics (e.g. per capita basis with similar socio-economic and biophysical circumstances).

3) Establish procedures to check on the reliability of the data used, especially for the historical activity data needed for agriculture and land-use change and forestry (*e.g*. getting information on how the data are collected). Document procedure to check reliability and to ensure transparency of inventory process, particularly data collection. While interpolation can be a useful tool, extrapolation may not be appropriate.

4) Develop procedures for expert peer review of the data used in the preparation of national inventories. Develop mechanisms for technical peer review of the nation inventories to enable positive feedback.

5) Where possible examine assumptions used in the IPCC methods (including default emission factors) by comparing the defaults with specific local circumstances to assess their applicability.

6) Priorities should always be given to time series where available.

7) Promote wider circulation of *Revised Guidelines* within countries using a range of media.

Long-term priorities: These include activities that might involve reorganisation of data collection procedures at the national level; implementation of specific studies to improve activity data or generate new data not available in the country; and carrying out research studies to develop and validate emission factors. They also include efforts to co-ordinate government departments, universities, research institutions, and the private sector in standardising the collection, archiving and storage of data in the relevant sectors. Some of the priorities include:

1) Exchanging information with the relevant institutions at the national level to establish consistent approaches for data collection. Develop a database specifying the nature and sources of data sets relevant to approaching GHG inventories.

2) Improving the collection of activity data by modifying procedures or (re)assigning resources in national statistics systems. This would include sectors in which data are routinely collected, such as energy and agriculture production, as well as those in which information is not generated on a regular basis, such as land-use change and

forestry. This activity would involve developing adequate co-ordination for data collection with relevant government institutions, trade associations and the private sector, among others. Investigate means to develop legislation to obtain necessary information from all relevant institutions. Institutionalise process of compiling national GHG inventories and preparing national communications. This will require obtaining necessary long-term funding.

3) Using statistical procedures to assess the reliability of the data used in national inventories. This activity may include assessment and revision of sampling methods and techniques for ensuring data quality.

4) Adopting cost-effective ways of collecting and processing activity data. This may include the use of remote sensing techniques and geographical information systems to monitor land-use changes, or carrying out surveys to verify the reliability of the data in particular sectors. It should be recognised that data are used for multiple purpose and wider range of benefit, therefore spreading costs.

5) Carrying out focused research to improve activity data and develop country-specific emission factors. This would involve close co-operation with universities and research institutes to take advantage of the existing scientific infrastructure and expertise. Due to the cost involved, many countries may not have the resources required to pursue this option at a large scale.

International Level

1) Ensuring dissemination of the *Revised Guidelines* in a wider range of languages.

2) Provide regular and adequate training, especially for non-Annex I Parties.

3) Wider review of scientific literature to establish the range of emission factors found under conditions similar to those occurring in individual countries and regions. Deriving regional emission factors and activity data to improve national inventories. This may have implications in terms of costs, time frame, representativeness of data, number of countries involved, methodological approaches adopted, institutional arrangements, and funding. Conversely, there would be benefits in terms of availability of more applicable data, improved national GHG emissions estimates, improved technical capacity, and establishment of a framework for regular updating and compiling of data.

4) Providing clearer guidance and regular feedback to countries on how to improve national inventories. This may involve developing good practices guidelines for collecting activity data and developing emission factors, for setting up procedures for internal verification, and for developing the institutional framework.

5) Establishing a forum for the exchange of information and experience among countries. This would help inventory experts learn what countries are doing to improve their national inventories and assess whether similar approaches could be applied to address similar problems.

Priorities

The working group considered that the issues raised in the background paper and during the working group discussions were all both important and urgent, although the need for wider dissemination of the *Revised Guidelines* within countries was a priority. The need for region-specific emission factors was also emphasised.

Working Group 2: Asia
Day 1

Co-Chairs: Wanna Tanuchaiwatana, Rizaldi Boer
Rapporteurs: Rajarathnam Uma, Geoff Salway

Suggestions for Improving the *Revised Guidelines*

The suggestions in Section 3 of the Draft Background Paper were accepted with minor changes, namely:

- Provision of simpler methods in addition to the existing ones where the required information is complex and is not usually available at the national level: land-use change and forestry; N_2O from agriculture. The existing methods would then be Tier 2 and the new methods would be Tier 1.
- Providing more detailed information for some methods: non-CO_2 emissions from fuel combustion; traditional biomass fuels
- Including relevant information from scientific research carried out in several parts of the world: domestic animals and agricultural soils

It was felt, however, that the suggestion to add methods for the sources: solvent and other product use; anaerobic polluted lagoons ; waste incineration; septic tanks; forest fires which are not currently included in the *Revised Guidelines* should be given low priority. An improved methodology for open dumping was more important

Additional suggestions for the proposed list were:

- There should be improved guidance on the reporting of CO_2 emissions from sources where fuels are used as feedstocks (*e.g.* Ammonia production) in order to prevent double counting between the energy and industrial processes modules.
- More scientific information should be provided on stored carbon .
- It was noted that there will be a difference in the top down reference approach and the more detailed bottom up approach. Normally the top down approach would be expected to give higher estimates than the bottom up method. However if the bottom up approach shows a higher value it would indicate an error in the statistical data. If the top down approach is very much higher than the bottom up, this could be indicative of losses in transportation and distribution of fuels. In some countries, statistical differences between production and consumption are reported in energy statistics so the *Revised Guidelines* should specify whether such differences should be reported.
- Tier 2/3 methods produce estimates which are less uncertain but Tier 2/3 methodologies should only be used where the data is of good quality. Where the data is of poor quality or limited, this will produce poor estimates. In such cases Tier 1 should be used.

The draft suggestions for improving the reporting instructions were accepted, namely:

- Clearer guidance is needed on how to report country specific sources and sinks that do not fit clearly fit within the IPCC reporting framework

- Methods with different levels of complexity for estimating and reporting uncertainty should be developed. This could include providing clearer guidance on how expert judgement can be used to assess uncertainty and step-by-step examples of different approaches

On the first point there was considerable discussion on land use change and forestry. The methods were thought to be adequate but significant improvements were required in the definitions given and clarity of the *Reference Manual* and *Workbook*, in particular:

- More detailed information is needed particularly on the definitions for all data in the worksheet.
- Definition of the distinction between managed and natural forests is not clear. All forests could be considered as anthropogenic sources and sinks.
- Categories in the *Guidelines* did not match countries' categorisation systems. Background information on the characteristic properties of each category should be provided to enable countries to best apply their data.
- Commercial harvest could be changed to commercial use and traditional use.
- Fractions for on site, off site burning and decay need clearer definition.
- Data on land use changes over 20 years or more are not feasible. Alternative approaches to derive the data may need to be explained.
- Categories for soil types in the *Guidelines* are not familiar.

Some additional points on reporting were made:

- *Revised Guidelines* define certain levels of disaggregation that can be used for reporting. However, for some sources (e.g. coal mining), a certain minimum level of detail is necessary in order that the estimates are transparent, whilst for others the less detailed level is sufficient. The *Guidelines* should indicate where a high level of detail is necessary
- The *Guidelines* invite the reporting of halocarbons disaggregated by species if available. The format to be used to report this data should be specified and appropriate columns should be inserted in the tables.
- Table 8A reports the level of documentation and disaggregation for each sector but not each gas. They may differ.

The following points from the Draft Background Paper for revising the layout of the *Revised Guidelines* were accepted:

- Establish clearer links between the scientific background and the methods for estimating emissions.
- Harmonise the numbering of tables and sections in the different volumes of the *Revised Guidelines.*
- Include a section on Managing Uncertainties in the Introduction of the *Revised Guidelines* in order to provide the user with basic knowledge on uncertainties at the beginning of inventory preparation.
- Supply the *Revised Guidelines* and software together to facilitate the compilation and electronic reporting of national inventories.

The proposed example calculations should not be included in the *Workbook* as this would make it too bulky. Examples could be issued as a separate volume or on request. Examples of uncertainty calculations were considered the most important.

The issue of whether the *Workbook* and the *Reference Manual* should be remain separate or be merged was discussed. It was considered that the key aims were to avoid duplication and to achieve a self contained *Workbook.* Hence the *Workbook* would contain the worksheets, details of the methods and sufficient scientific information to apply them. The reduction in repetition would provide more space in the *Reference Manual*, which could then contain more detailed scientific information which would supplement the *Workbook.*

Working Group 2: Asia
Day 2

Co-Chairs: Sharmila B. Srikanth, Xu Deying
Rapporteurs: Kansri Boonpragob, Jan Spakman

Suggestions for priorities to improve National Greenhouse Gas Inventories

Priorities at the National level

Urgent:

- In addition to the issues mentioned in Section 5 of the Draft Background Paper, the Asia working group addressed. Fuel losses as a very important potential source of emissions. For example, transportation losses of coal in China can be as large as 10%. The same goes for natural gas losses in pipelines, causing major emissions of methane (CH4).
- Improving access to existing satellite data in order to obtain better activity data on forestry and land use change.
- Establish networking on data collection. Many Asian countries experience difficulties with the existence of different data sets within the country, stemming from various institutions.
- Data formats from different sources (like institutions, ministries, etc.,) should be more compatible with the reporting format of the inventory.
- Establish an institutional framework for national GHG inventory.

Less urgent, though important:

- Stimulate peer review, but only within the country as there is no mandate for international peer review
- Comparison of emission factors and emission estimates with data from independent sources (international statistics). Although in the Draft Background Paper, it was suggested to also compare activity data, the working group found that this is less useful countries themselves usually have better knowledge on actual activity data then international institutes.
- Test the assumptions used in the IPCC methods (default values) to assess their applicability under specific local circumstances.

- Establish procedures to affirm the reliability of the data, such as gathering information on the methods of data collection. This is particularly important for historical data..
- Modify the procedures to improve the collection of activity data, especially the data which are not collected on a regular basis. This requires coordination of data collection within relevant national institutions, etc. This implies networking, mentioned above in the urgent priorities.
- Introduction of statistical procedures (like sampling methods and control techniques) to assess the reliability of the data used in the national inventories.
- Management Information Systems (MIS), with other words: hardware. Some countries do not have access to Internet-data connection.
- Establishment of new Remote Sensing techniques for better analyses and activity data on forestry and land use change.

Priorities at the International Level

Urgent

- Wider dissemination of the *Guidelines* through Internet or other ways (hard copies) as well as ensuring that they are received by the right persons. Improve circulation of the *Guidelines* within a country.
- Provide regional / international training on the use of the *Guidelines*. The most efficient way to do so is let the countries learn by practice and then give positive feedback.
- Better activity data and emission factors on a regional basis must be obtained by arrangements between international institutes.
- Guidance on how to improve inventories by establishment of standard procedures on collecting and handling data, internal verification, developing emission factors, etc. Remark: this point does not include guidance on how to use the *Guidelines* themselves. (This was already dealt with in the urgent training issue, see above).
- Immediate funding for activities on the deriving of country-specific emission factors.

Less urgent, though important

- Establishment of the range of emission factors and source / sink categories applicable under conditions similar to those in individual countries. This should be done by reviewing the scientific literature.
- Establish an international or regional forum for exchange of information and experiences.

Working Group 3: Latin America
Day 1

Co-chairs: Newton Parcionik, Ana Rita Chacon
Rapporteurs: Omar Masera and Javier Hanna

The Revised 1996 IPCC Guidelines for National GHG Inventories

Some of the issues identified by countries in the use of the *Revised Guidelines* are summarised below.

Applying the Methods.
The *Revised Guidelines* allow countries to use their own inventory methods with the proviso that they report these methods. With very few exceptions, non-Annex I Parties are using the default methods for all sectors. The methods in the *workbook* are considered to be adequate in most sectors but at the same time there is still room for improvement.

The main improvements in the *Revised Guidelines* can be as follows:

- Develop tier approaches for other sectors, including agriculture, land use change.
- Include algorithms that allow the development of emission factors, where appropriate (e. g. CH4 emissions from domestic livestock).
- Improve information on default values. Data should be disaggregated by region. There should be a database with regional default values. More information is needed on how these default values were derived. When emission factors have a range of values, additional information is needed to explain the circumstances under which the different values in the range apply. This will also help determine uncertainties associated to these factors.
- An auxiliary worksheet should be added in which assumptions can be specified. This should help to make the assumptions more transparent (e.g., tracking country land area by land use along time, deforested area by land conversion use)
- Develop methods for sources that are not included in the *Revised Guidelines*: solvent and other products use, anaerobic polluted lagoons, waste incineration, septic tanks, and CH_4 emissions from hydroelectric dams.
- Provide more detailed background information and better explanation for some methods: non-CO_2 emissions from fuel combustion, traditional biomass fuels, emissions from agricultural soils.
- Include relevant information from scientific research carried out in several parts of the world, particularly in non-Annex I countries: forest fires, carbon density in forests and soils, domestic animals, agricultural soils, combustion of traditional fuels.
- Include background information on how to develop emission factors.

More specific points by sector are provided below.

Global Warming Potentials

- There should be agreement on the time scale of Global Warming Potentials (GWP) to be used for each gas. It is important to have GWP for all greenhouse gases.

Agriculture

- Revise the equations proposed for Tier 2 calculations of CH_4 from enteric fermentation.
- Emission factors for enteric fermentation in llamas and guanacos should be included. These species of domestic animals are important in the Andean Region.
- More background information is required for agriculture soils.

Industrial Processes

- Emission factors are needed for sugar production from sugar cane. The current emission factors are those for sugar beet.
- Methods are required for calculating GHG emissions from the mining of cobalt and nickel.

Energy

- CO_2 accounting should discount losses from oil production (in CO_2 form) not as CH_4 fugitive emissions. Currently, the method assumes that all the energy is burned. An option is to include losses as an increment in the stock.
- Natural gas flaring should distinguish between the gas burned and not burned. However, it is difficult to generalise an assumption for the whole Latin American region. Country data should be used as much as possible.
- Clarification is needed on where to include emissions from the transformation of fuelwood to charcoal (e.g. whether these emissions should be reported in the energy sector or in the land-use change and forestry sector).

Land-Use Change and Forestry

- Some methods are not adequate, particularly regarding land clearing, abandoned lands, and wood harvesting.
- There are inconsistencies between the forest classification required for the land-clearing module and the one used for soil carbon (e.g. the first is based on vegetation types while the second is based on land use).
- Guidance for differentiating between natural and anthropogenic forest fires should be provided.
- The method for estimating carbon emission from soils needs to be improved. Currently, the method is not easy to apply.

Layout

- Assure consistency between the Reference Manual, Workbook and Reporting Instructions.
- Include a checklist with the information needed for the compilation of national GHG inventories.
- The workbook should contain the essential information needed to do the calculations. Additional information should be added in the reference manual.
- Improve distribution of the *Revised Guidelines*. There is a need to update the list of

IPCC focal points to assure that national experts in charge of developing GHG inventories get the *Revised Guidelines.*

Working Group 3: Latin America
Day 2

Co-Chairs: Luis Ruiz Suarez, Eduardo Calvo
Rapporteurs: Ismael Sanchez, Virginia Sena

Priorities for Improving National GHG Inventories

Based on the priorities defined by countries and the types of initiatives being undertaken, the improvements needed in national inventories can be grouped into short-term (less than 3 years) and long-term priorities (more than 3 years). Addressing these issues depends on what technical and financial resources are needed and can be provided; on the time frame involved; and on possible institutional constraints. They too can be categorised into those that can be addressed at a national level, by individual countries, and those that have to be dealt with at the international level, by bodies such as IPCC and UNFCCC. These are summarised as follows:

National Level

Short-term priorities

These may include activities designed to improve national inventories without introducing significant changes to data compilation procedures or demanding high financial and technical resources for implementation. Some of these priorities include:

1) Provide training on the methodological scope and use of *IPCC Guidelines* for national teams belonging to countries that have not yet prepared inventories.

2) Identify areas in which minor changes can be made to improve the procedures for collecting activity data.

3) Identify national priorities in the collection of activity data so as to focus investment in those areas where data are most urgently needed, for example where there are gaps in the data or where it is necessary to disaggregate the activity data to a finer scale.

4) Compare activity data, emission factors or emission estimates with independent sources or international statistics, where feasible, to identify discrepancies and possible sources of errors, especially on the sectors that presents more problems: *e.g.* Agriculture and Land-Use Change and Forestry sectors. For countries with few independent national data sets, comparisons could be made with data from countries with similar socio-economic, biological and physical conditions.

5) Establish procedures to check on the reliability, origin and means of collection of data used in an inventory, especially historical activity data used in the Agriculture and Land-Use Change and Forestry sectors.

6) Develop procedures for expert peer review of the data used for preparing national

inventories.

7) Test assumptions (including default emission factors) used in the IPCC methods by comparing these with specific local circumstances to assess their applicability. The exchange of experiences among researchers in a region would be helpful.

8) Collect data on the origin and consumption of traditional fuels (biomass, natural gas) and improve information on their respective emission factors. Firewood is important as a source of energy within the region, especially at a residential level.

9) Revise the framework for national statistics to include those data sets needed for compiling the inventories, and propose how best to include them.

10) Take advantage of GHG emissions-related data generated by other national activities (such as environmental auditing by industry) to compile a database that can be used for developing local emission factors for GHG emissions inventories.

11) Aim to heighten the priority given to initiating, updating and improving inventories through sensitising policy makers by distributing information about the GHG emissions inventory process.

Long-term priorities

These include activities such as reorganising national data collection procedures; implementing studies designed to improve existing or generate new activity data; and carrying out research studies to develop better emission factors or validate existing ones. They could also include efforts to co-ordinate the standardisation of data collection procedures among government departments, universities, research institutions, and the private sector. Some of the priorities include:

1) Exchanging information with relevant national institutions to establish consistent approaches for data collection.

2) Improving the collection of activity data by modifying procedures or (re-)assigning resources in national statistics systems. This would include sectors in which data are routinely collected, such as energy and agriculture production, as well as those in which information is not generated on a regular basis, such as land-use change and forestry. This activity would involve developing adequate co-ordination for data collection with relevant government institutions, trade associations and the private sector, among others.

3) Introducing statistical procedures to assess the reliability of the data used in national inventories. This activity may include sampling methods and control techniques.

4) Adopting cost-effective ways of collecting and processing activity data. This may include the use of remote sensing techniques and geographical information systems to monitor land-use changes, or carrying out surveys to verify the reliability of the data in particular sectors.
5) Carrying out focused research to improve activity data and develop country-specific emission factors. This would involve close co-operation with universities and research institutes to take advantage of the existing scientific infrastructure and

expertise. Due to the cost involved, many countries may not have the resources required to pursue this option at a large scale.

6) Providing solid long-term institutional support to ensure the maintenance and improvement of national technical capabilities acquired during the inventory process, and to incorporate expertise that was not involved in compiling the initial inventory.

International Level

The following international efforts are needed to improve the basis for compiling national GHG emissions inventories:

1) Update and improve the mailing list for distributing the *Revised Guidelines.*

2) Provide adequate training, especially to non-Annex I Parties.

3) Review the scientific literature to establish the range of emission factors found under similar bio-physical and socio-economic conditions.

4) Provide clearer guidance on how to improve national inventories. This could involve developing guidelines on 'best practices' for collecting activity data and developing emission factors; for setting up procedures for internal verification; and for developing an appropriate institutional framework.

5) Improve national inventories by obtaining regional emission factors and activity data. This may have implications in terms of costs, time frame, representativeness of data, number of countries involved, methodological approaches adopted, institutional arrangements, and funding. This would be offset by the benefits of having more applicable data, better national GHG emissions estimates, improved technical capacity, and the establishment of a framework for regular updating and compiling data.

6) Establish a forum for exchanging information and experience among individuals and institutions in different countries. This would help inventory experts to learn what countries are doing to improve their national inventories and assess whether similar approaches could be applied to their own national situations.

7) Establish mechanisms to ensure adequate and timely funding the allow countries to develop better emission factors and improved activity data. Priority should be given to the largest national sources of GHG emissions.

8) Take advantage of OLADE's network of regional partners to establish mechanisms for collecting, comparing and distributing the results of national GHG inventories and local emission factors, to make these more readily available to the countries of the region.

9) Define and establish a regional organisation, such as OLADE, to address issues in the non-Energy sectors.