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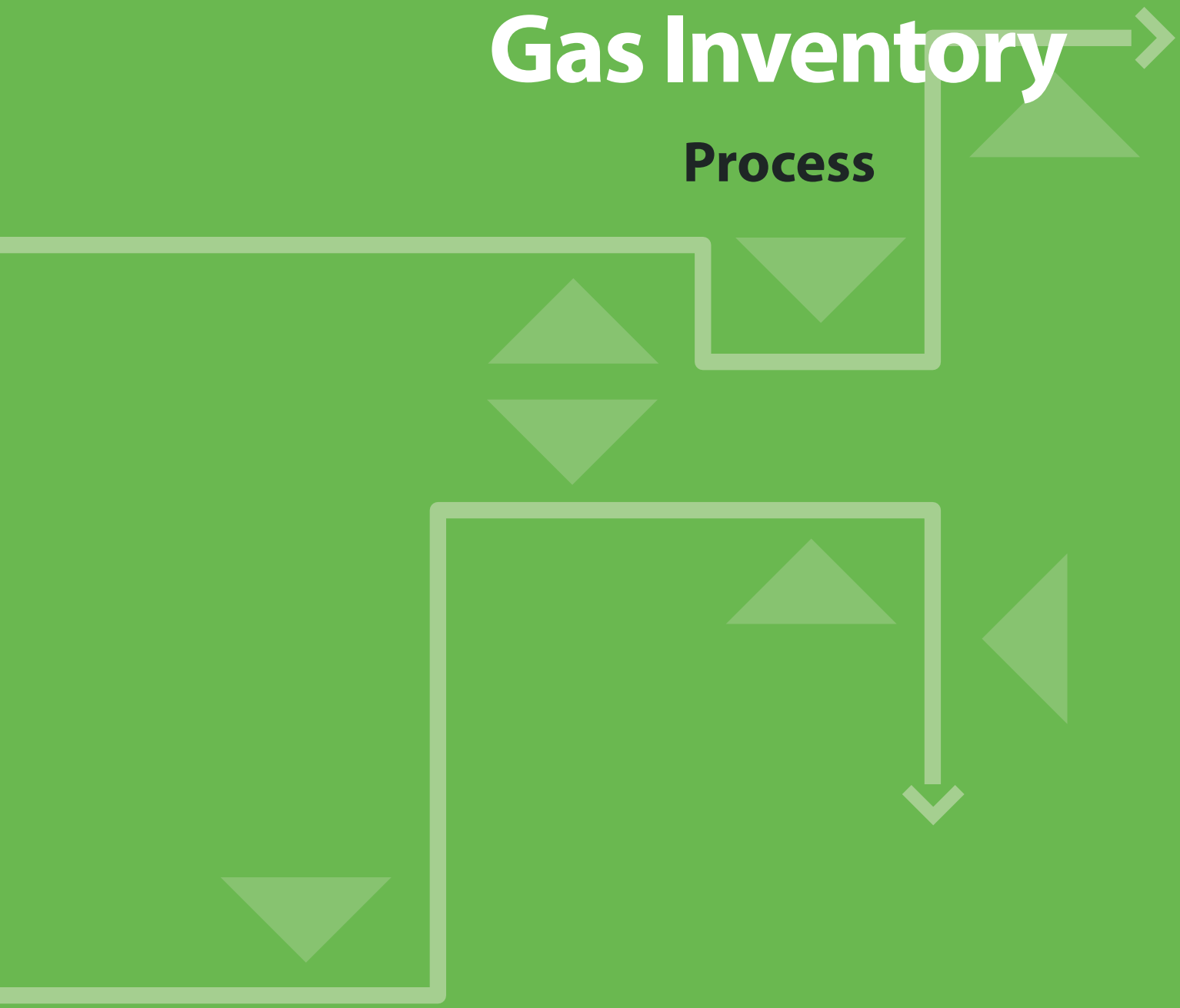
Managing the National Greenhouse Gas Inventory Process



UNDP GEF

NATIONAL COMMUNICATIONS SUPPORT UNIT

HANDBOOK

The user of this handbook is encouraged to read the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and the relevant parts of the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry before starting with inventory preparation.

The National Communications Support Unit would like to thank the authors of this handbook for producing such a useful document, which will be of great assistance to non-Annex I Parties as they commence Second National Communications. We also appreciate the time and contributions of the reviewers who have helped make this handbook a much more practical document.

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National Communications Support Unit
Global Environment Facility
Energy and Environment Group, Bureau of Development Policy
United Nations Development Programme
304 East 45th St, New York, NY 10017, USA
Fax: 1-212-906 6998
Website: *www.undp.org/cc/*

MANAGING THE NATIONAL GREENHOUSE GAS INVENTORY PROCESS

Lead Authors
Barbara V. Braatz[1] and Michiel Doorn[2]

1. Center on Global Change, Duke University (US)
2. ARCADIS, Inc (US)

Lead Reviewers and Contributors
Tomoyuki Aizawa (Japan), Ayite-Lo Ajavon (Togo), Yamil Bonduki (UNDP),
Eduardo Calvo (Peru), Rebecca Carman (UNDP), Moussa Kola Cisse (ENDA), Bill Irving (US),
Dina Kruger (US), Nicolas di Sbroiavacca (Argentina), Ermira Fida (Albania),
Katarina Mareckova (Slovak Republic), Audace Ndayizeye (Burundi),
Natalya Parasyuk (Ukraine), Luis Ruiz Suarez (Mexico), Lambert Schneider (Germany),
Milos Tichy (Czech Republic), Marius Tsaranu (Moldova),
Jose Ramon T. Villarin (Philippines)

Reviewers
Olga Agfanova (Uzbekistan), Hartmut Behrend (EU), Dominique Blain (Canada),
Abdelali Dakkina (Morocco), Ismail El-Gizouli (Sudan), Kenneth Gondwe (Malawi),
Umed Karimov (Tajikistan), Scott McKibbon (Canada), Maharram Mehtiyev (Azerbaijan),
Todd Ngara (IPCC), Balgis Osman (Sudan), Per Rosenqvist (Sweden),
S. Vaughan (New Zealand), Harry Vreuls (The Netherlands)

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FOREWORD

Compiling a national greenhouse gas (GHG) inventory requires a fairly lengthy and interconnected series of tasks, including collecting emission factors and activity data, selecting appropriate methods, estimating GHG emissions and removals, implementing uncertainty assessment and quality assurance/quality control procedures, reporting the results, and documenting and archiving all relevant data and procedures.

This work requires fundamental decisions about data and methods, the establishment of a network of contacts for accessing data and reviewing results and the design of a system for data management, quality assurance, quality control, documentation and archiving. The inventory process should be planned, operated and managed to ensure optimal quality and efficiency, given available resources. This is especially important as countries produce their second and subsequent national inventories.

The handbook was developed by United Nations Development Programme with input from a wide range of institutions and national experts from Annex I and non-Annex I Parties. The objective of the handbook is to provide non-Annex I Parties with a strategic and logical approach to a sustainable inventory process. This should not only help countries produce more accurate inventories, it may also help enhance efficiency and ensure optimum use of scarce financial and human resources. It is recommended that a significant part of a country's inventory improvement efforts focus on documentation and archiving, because this is critical to the long-term sustainability and institutionalisation of the inventory process.

The target audience for this handbook is non-Annex I Party inventory experts concerned with general aspects of GHG inventory planning, preparation and management. As the majority of non-Annex I Parties have prepared at least one national GHG inventory[1], this handbook focuses on improving and updating the GHG inventory and on managing these processes, including improved documentation and archiving. Note that this handbook uses the word "management" in its traditional sense of organising, supervising and arranging activities, data or people. This interpretation is different from the more narrowly defined "inventory management" (UNFCCC 2002) that focuses on archiving.

This handbook is meant as a complement to the Intergovernmental Panel on Climate Change (IPCC) inventory guidance, namely:

- the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 1997),
- the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (IPCC 2000), and
- the *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry* (IPCC 2003).

The *Revised 1996 IPCC Guidelines* include source specific methods, discussions of the scientific basis of the methods, default emission factors, worksheets for performing inventory calculations and reporting instructions. The GPG manuals are comprehensive technical supplements to the *Revised 1996 IPCC Guidelines.* They are intended to assist countries make more accurate GHG estimates by providing guidance to make inventories that are transparent, documented, consistent over time, complete, comparable, assessed for uncertainties, subject to quality control and quality assurance and efficient in the use of resources. This handbook is not a replacement of the IPCC guidance and should be used in conjunction with it. One significant difference is that this handbook explains how to plan, document and manage the national inventory system, while the IPCC guidance contains inventory methods.

This handbook will be translated into Russian, French and Spanish and disseminated to inventory teams in more than 130 non-Annex I countries. The handbook should be considered a "living" document, i.e., future updates are planned to incorporate feedback from users of the handbook. It is anticipated that much of this feedback will be provided from the countries in the Europe and Commonwealth of Independent States and West and francophone Central Africa regions that are participating in two UNDP-GEF projects on "*Capacity Building for Improving the Quality of National GHG Inventories*". An inventory knowledge base will be developed to supplement the handbook with actual country examples. The knowledge base will be hosted by the National Communications Support Unit *(www.undp.org/cc/)*.

[1] Of the 131 non-Annex I countries that received Global Environment Facility funding to prepare their initial national communication, 117 had submitted their national communications to the United Nations Framework Convention on Climate Change by January 2005.

1. INTRODUCTION

1.1 International and Non-Annex I Party Context

On 9 May 1992, the world's governments adopted the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC entered into force on 21 March 1994 and as of 24 May 2004, 189 countries (including the European Community) were Parties to the Convention. The objective of the UNFCCC is to stabilise greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous human-induced interference with the climate system. The ability of the international community to achieve this objective is dependent on an accurate knowledge of emissions trends, and on our collective ability to alter these trends. Article 4, paragraph 1(a) and Article 12, paragraph 1(a), of the Convention provide for each Party to report national emissions and removals to the Conference of the Parties (COP). The key mechanism for reporting is the national communication.

In 1996, guidelines for initial national communications for non-Annex I Parties were adopted by the Second COP under Decision 10/CP.2.[2] In 2002, the Eighth COP adopted new guidelines for the preparation of national communications from non-Annex I Parties, which are contained in the annex to Decision 17/CP.8. Under this decision, "non-Annex I Parties shall estimate national GHG inventories for the year 1994 for the initial national communication or alternatively may provide data for the year 1990. For the second national communication, non-Annex I Parties shall estimate national GHG inventories for the year 2000. The least developed country Parties could estimate their national GHG inventories for years at their discretion".

According to Decision 17/CP.8, non-Annex I Parties should use the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 1997, hereafter referred to *Revised 1996 IPCC Guidelines*) for estimating and reporting their national GHG inventories. In addition, non-Annex I Parties are encouraged to apply the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (IPCC 2000, hereafter referred to as the IPCC GPG 2000) to improve transparency, consistency, comparability, completeness and accuracy in their GHG inventories. Non-Annex I Parties are also encouraged, to the extent possible, to undertake any key source analysis as indicated in the IPCC GPG 2000 to assist in developing inventories that better reflect their national circumstances and to improve inventories in the most cost-effective manner.

In 2003, the Ninth COP adopted decisions regarding use of the *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry* (IPCC 2003, hereafter referred to as the IPCC GPG 2003). According to Decision 13/CP.9, non-Annex I Parties are encouraged to apply the IPCC GPG 2003 as appropriate and to the extent possible, in the preparation of GHG inventories.

Non-Annex I Parties typically develop the national GHG inventory as part of their climate change enabling activity to prepare a national communication funded by the Global Environment Facility (GEF), or as part of other related projects (financed by the GEF or other agencies).

1.2 The Benefits of Developing Inventories

In addition to meeting national UNFCCC reporting obligations, the preparation and reporting of national GHG inventories can provide a number of other benefits to a country. These include:

- Providing information useful to economic development assessment and planning, such as: information on the supply and utilisation of natural resources (e.g., croplands, forests, energy resources) and information on industrial demand and production;
- Providing information useful for addressing other environmental issues (e.g., air quality, land use, waste management, etc.);
- Clarifying national data gaps that, if filled, may be beneficial for other reasons, e.g., vehicle fleet data;
- Evaluating GHG mitigation options; and
- Providing the foundation for emissions trading schemes.

Improving the quality of the national GHG inventory can also be beneficial. More accurate inventories enable non-Annex I Parties to identify major sources and sinks of GHGs with greater confidence, and thus to make more informed policy decisions with respect to appropriate response measures. For example, a technically defensible GHG inventory can serve as the foundation for public policy as it relates to air quality issues. Formulation of appropriate control strategies requires a reliable base of accurate emissions estimates. If the data used to derive control strategies are flawed, the public policy resulting from the strategy may also be in error. These errors can be costly to the public being exposed, the industries or economic sectors that are being controlled and to the environment.

1.3 Purpose and Structure of this Handbook

When the national GHG inventory is being prepared for the first time, the inventory will possibly need to go through several short-term iterations that involve activity data improvements, emission factor and methodology reassessment and/or recalculation of emission estimates. When the

[2] Decision 10/CP.2 and other key COP decisions on non-Annex I National Communications can be found at: *http://unfccc.int/documentation/decisions/items/2646.php.*

inventory is compiled for the second time, these iterations are likely to be less extensive for the simpler, straightforward source categories. Any freed resources could be used to: i) improve more complex and/or data-poor source categories; ii) to add new source categories; or iii) to add new years for assessment. Therefore, inventory work can be viewed as cyclical, both within one inventory cycle and across multiple cycles.

Each new inventory builds on the information gathered during the previous inventory effort, as well as on the planning, management, co-ordination and execution systems that were established to carry out the inventory assessment. It is for this reason that rigorous systems should be established and maintained for reporting, documentation and archiving of data, data sources, methods, assumptions, uncertainties and results. Without such systems, inventory teams and the national inventory itself, will not be able to benefit from the work that has been done before. Each new inventory is an opportunity to not only improve the accuracy and comprehensiveness of emission estimates, but also to improve the management systems designed to carry out all phases of the inventory.

The purpose of this handbook is to provide overall guidance on inventory planning and preparation so that each round in the cyclical process of inventory assessment builds on the previous round. The handbook focuses on inventory management rather than the "nuts and bolts" procedures of inventory accounting, which are covered in detail in the IPCC guidance. As such, this handbook is intended to assist countries in planning, designing and implementing the most effective and efficient inventory assessment systems possible, given human and financial resources available. It is written to be accessible to all levels of inventory expertise.

The remainder of this handbook is composed of three sections, a reference section, a list of additional resources and a set of annexes:

Section 2 briefly describes climate change and GHGs, outlines the basic elements of a GHG inventory and the general principles of obtaining a good quality inventory. This section will be most informative for experts with little inventory experience.

Section 3 focuses on planning the inventory work and key elements of national inventory system. It describes what planning tasks need to be undertaken and by whom, and emphasises the importance of clearly articulated instructions for the inventory team.

Section 4 addresses the actual inventory preparation. An important part of this section deals with reporting, documentation and archiving.

The *References* section contains complete references for the citations in the main body of the handbook. The *Resource Locations* section contains a list of websites and addresses from which various inventory materials can be obtained. The *Annexes* contain supplementary information that is referred to in the sections of the handbook.

2. BASIC PRINCIPLES OF GREENHOUSE GAS INVENTORIES

This section provides basic information on climate change, GHGs, inventories and inventory quality. If you are familiar with the general inventory process, you may want to skip Sections 2.1 and 2.2 and possibly Section 2.3.

2.1 Climate Change and Greenhouse Gases

The UNFCCC defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. Human activities are changing the atmospheric concentrations and distributions of GHGs and aerosols (airborne solid or liquid particles). These changes can produce a radiative forcing by changing the reflection or absorption of solar radiation, or the absorption or emission of terrestrial radiation (IPCC 1996). The objective of a national GHG inventory is to determine the magnitude of national GHG emissions and removals that are directly attributable to human activity.

According to Decision 17/CP.8,3 each non-Annex I Party shall, as appropriate and to the extent possible, provide in its national inventory, on a gas-by-gas basis and in units of mass, estimates of anthropogenic emission of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) by sources and removals by sinks. Non-Annex I Parties are encouraged, as appropriate to provide information on anthropogenic emissions by sources of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

Carbon dioxide, **methane** and **nitrous oxide** are the most important **direct-induced GHGs** considered under the IPCC inventory guidance.

Globally, the most important of these direct-induced GHGs is **carbon dioxide** (CO_2). The largest source of CO_2 globally, and for many countries, is combustion of fossil fuels. However, for many non-Annex I Parties, land-use change and forestry activities are also important, both for CO_2 emissions (especially from deforestation) and CO_2 uptake (i.e., CO_2 removals, especially from tree planting and forest management). Certain industrial production processes also emit CO_2, but these sources are very minor.

Livestock production, flooded rice cultivation, and fossil fuel production, processing and transport (especially coal production and natural gas production and transport) are the most important sources of **methane** (CH_4) globally. Methane emissions can be significant in countries in which fossil fuel combustion is relatively low (e.g., where most electricity is imported and/or electricity is produced primarily from hydroenergy, nuclear energy and/or biomass) and in countries with relatively low energy consumption. Countries with large oil and gas production, coal mining, rice cultivation and/or livestock production can also expect that CH_4 emissions are important.

The global importance, as well as national importance, of **nitrous oxide** (N_2O) is substantially lower. N_2O emissions are most significant in countries with an important agriculture sector, where they originate primarily from fertiliser application, biomass burning and animal manure management. Road transport can also be a significant source, as can the production of adipic and nitric acids, but most production of these acids occurs in industrialised countries (RIVM 2002).

The "fluorine-containing" or "F" gases – **hydrofluorocarbons** (HFCs), **perfluorocarbons** (PFCs) and **sulphur hexafluoride** (SF_6) – make only a small contribution to global GHG emissions in spite of very high radiative forcings and long atmospheric lifetimes, but their use is increasing rapidly in some countries. Emissions of these gases result primarily from electrical transmission and distribution, and several industrial production processes, especially HCFC-22 production, aluminium production, magnesium production and processing, and semiconductor manufacture.

Non-Annex I Parties are encouraged under Decision 17/CP.8 to report on emissions of "indirect" GHGs. Indirect GHGs are those gases that contribute indirectly to radiative forcing through their influence on atmospheric chemistry – more specifically, by altering the formation and/or atmospheric lifetime of direct GHGs (gases that contribute directly to radiative forcing) or by contributing to the formation of aerosols. The most important of these indirect GHGs are **carbon monoxide** (CO), **nitrogen oxides** (NO_x), **non-methane volatile organic compounds** (NMVOCs) and **sulphur dioxide** (SO_2). Emissions of the first three gases contribute to the formation of ozone in the lower atmosphere (i.e., tropospheric ozone, which is a direct GHG)[4] and change the lifetime of CH_4. SO_2 emissions contribute to the

[3] Decision 17/CP.8 and other key COP decisions on non-Annex I national communications can be found at: *http://unfccc.int/documentation/decisions/items/2646.php.*

[4] Tropospheric ozone is not emitted by human activities, but its atmospheric abundance is controlled primarily by emissions of CH_4, CO, NOx and NMVOCs.

formation of sulphate aerosols. In addition contributing indirectly to radiative forcing, emissions of CO, NO_X, NMVOCs and SO_2 are the primary causes of smog, acid rain and regional haze, so compiling data on these gases will benefit air quality monitoring programmes.

2.2 Elements of a National Greenhouse Gas Inventory

A national GHG inventory, in the context of the UNFCCC, is a comprehensive listing, by source,[5] of annual GHG emissions and removals resulting directly from human activities in the reporting country. An inventory may estimate emissions and removals for one year or a number of years. A GHG inventory could contain the following information:

1. Tables of annual emission and removal estimates by source, with estimates expressed in units of mass/year and the year or years represented clearly noted;
2. Worksheets (calculation sheets) showing how emissions are calculated, including all parameters used for calculations;
3. For each source, a description of the methodology, the sources of data (activity data, emission factors, methodologies), the actual data and a description of uncertainties, including, if possible, quantitative assessment of uncertainties; and
4. Other informative background data (e.g., a national energy balance, a description of GHG sources that are believed to be important but cannot be estimated).

The IPCC inventory guidance (IPCC 1997, 2000, 2003) defines six inventory sectors: **Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land-Use Change and Forestry** and **Waste.** Within these sectors, individual sources are defined. Parties to the UNFCCC are required to report their inventories consistent with the definitions and structure of these six sectors, and the sources and sinks within each sector, so that reporting is consistent among all Parties.

2.2.1 Methods

In its most basic form, the method used to estimate an emission or removal from a specific source is as follows:

Emission estimate = Activity data x Emission factor
where:

- **Activity data** describe the annual, national magnitude of an activity (e.g., tonnes of coal mined nationally in a given year) and the
- **Emission factor** is the mass of GHG emitted per unit of activity (e.g., Gg CH_4 per tonne of coal mined)

> The Introduction to both Volume 1 and 2 of the Revised 1996 IPCC Guidelines include useful reference tables on the standard equivalents for units, such as tonne, Gg, etc. and the abbreviations that should be used when preparing the inventory.

In many cases, the activity data available are not exactly what is required given the particular emission factor that will be used. In these cases, the activity data must be derived by applying "**conversion factors**" to other data, which are referred to here as "**proxy activity data**". In this case, the basic method is:

Emission estimate = [Proxy activity data x Conversion Factor(s)] x Emission Factor

For example, the emission factors typically used to estimate CH_4 and CO_2 emissions from crop residue burning are in units of mass of gas emitted per unit of crop residue carbon combusted. The activity data required by such emission factors (annual amounts of crop residue carbon that undergo combustion) are rarely, if ever, compiled. However national crop production statistics typically are available, as are conversion factors for converting crop production statistics to the activity data needed. In this case, the conversion factors are residue/product mass ratios to convert crop product mass to crop residue mass, carbon/biomass mass ratios to convert crop residue mass to carbon mass, and data on the fractions of crops burned each year.

There are usually different methods that can be used to estimate emissions. The selection of a particular method will depend on the desired degree of estimation detail, the availability of activity data and emission factors, and the financial and human resources available to complete the inventory. In IPCC terminology, the lowest ranking or simplest method is "**Tier 1**", while more elaborate methods are "**Tier 2**" or "**Tier 3**". Tier 1 methods typically utilise IPCC default emission factors and require the most basic, and least disaggregated, activity data. Higher tiers usually utilise more elaborate methods and source-specific, technology-specific, region-specific, and/or country-specific emission factors, which are often based on measurements, and typically require more highly disaggregated activity data.

[5]The strict definition of the term "source" in the context of GHG inventories is a process that releases GHG emissions, such as fossil fuel combustion. Conversely, the term "sink" connotes a process that results in uptake of carbon from the atmosphere, or carbon removal. In this sentence, and henceforth in this handbook, the term "source" is used more broadly to encompass both sources and sinks. This is a common practice that is used in GHG accounting literature to avoid wordiness. Similarly, the term "emissions" will be used in this handbook to connote both emissions and removals, unless the context requires more specificity.

For example, N_2O emissions from road transport may be estimated from national fossil fuel consumption statistics disaggregated by fuel type and default fuel-specific emission factors (the Tier 1 method) or from national fuel consumption disaggregated by fuel type, vehicle type and emission control technology, and default fuel- and technology-specific or country-specific emission factors (the Tier 2 and 3 methods).

Obtaining highly disaggregated activity data and country-specific emission factors can be time-consuming and costly, and may not contribute significantly to increased accuracy of the GHG inventory. Therefore, efforts to move to a higher tier should only be concentrated on the most significant key source categories. The process by which a country determines its most significant key categories is discussed in Section 4.2.6.

2.2.2 Time Series and Base Year Estimates

A listing of emission estimates for a number of years is called a **time series**. In order to allow the comparison of emissions between different years of the inventory, the time series must be internally consistent, i.e., the methods, emission factors and assumptions must be the same for all inventory years. Ideally, the data sources used for the activity data will be the same for all years, but this is not always possible. Although time series are not required by the UNFCCC reporting requirements under Decision 17/CP.8, some non-Annex I Parties have estimated emissions for more than one year, so this issue is mentioned here.

The first year in a time series is called the **base year**. To compare emissions between different countries, it is helpful to use the same base year. Thus, Decision 17/CP.8 states that:

> *"Non-Annex I Parties shall estimate national GHG inventories for the year 1994 for the initial national communication or alternatively may provide data for the year 1990. For the second national communication, non-Annex I Parties shall estimate national GHG inventories for the year 2000. The least developed country Parties could estimate their national GHG inventories for years at their discretion."*

2.2.3 Recalculations

An inventory may be recalculated for different reasons. Sometimes, improved methodologies, emission factors and/or activity data become available, e.g., as a result of new research or as a result of emission measurements. Sometimes, earlier estimates are found to have been based on wrong assumptions or miscalculation. If improved methods or emission factors are used, they should be used to recalculate the entire inventory time series. To avoid confusion, it is important to clearly report recalculations and to document the recalculations, including when recalculations were performed and what methods, emission factors and activity data were used in different versions of the inventory. For more information on recalculations, see Preparation Task 2 in Section 4.

2.2.4 Reporting, Archiving and Documentation

One of the main purposes for compiling a national GHG inventory is to report to national or international entities. Reported information should be transparent and complete, with all the information required to produce the national inventory estimates documented and archived. It is not practical to include all this information in the inventory report; however summary information and references to source data could be included.

2.3 Inventory Quality

According to the IPCC GPG manuals, inventory estimates should be the best attainable, given current scientific knowledge and available resources. The IPCC GPG manuals assist countries in meeting these requirements by providing guidance on:

- Choice of **estimation method**;
- **Quality assurance** and **quality control** procedures to provide cross-checks during inventory compilation;
- **Data** and information to be **documented, reported** and **archived** to facilitate review and assessment of emission estimates;
- Quantification of **uncertainties** at the source level and for the inventory as a whole, so that the resources available for research can be directed toward reducing uncertainties over time, and the improvement can be tracked; and
- Determination of the **most significant sources** so that appropriate decisions can be made about the allocation of resources for inventory improvements.

The basic principles of obtaining a high quality inventory are **completeness, consistency, comparability, transparency** and **accuracy**, which are described in Box 2-1.

Box 2-1: Data Quality Indicators

Completeness: Completeness means that an inventory covers all sources and sinks, as well as all gases included in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, in addition to other existing relevant source/sink categories which are specific to individual Parties (and therefore may not be included in the IPCC Guidelines). Completeness also means full geographic coverage of sources and sinks of a Party. Completeness means that estimates of both key and non-key sources are provided, because when an estimate has not been made, it is not possible to know if a source is key or not. Where a source is omitted due to inadequate data, it should be noted in the report. Key and non-key sources are discussed in Section 4.1.

Consistency: Consistency means that an inventory should be internally consistent in all its elements over a period of years (time series). An inventory is consistent if the same methodologies and assumptions are used for all years. Internal consistency means that emission estimates or removals from distinct sources that rely in the same type of information (e.g. population, energy consumption) and assumptions should use the same data sets.

Comparability: Comparability means that estimates of emissions and removals reported in inventories should be comparable among Parties. This means that appropriate source categories, methodologies (IPCC or comparable), definitions and units for activity data and emissions factors are to be used. It is recommended that Countries follow the instruction in the *Revised IPCC 1996 Guidelines* and in the *IPCC Good Practice Guidance*; Annex I Parties should follow the UNFCCC Reporting Guidelines as well.

Transparency: Transparency means that the assumptions and methodologies used for an inventory should be clearly explained so that users of the inventory can evaluate the information, do the calculations and get the same results. It is recommended that all sources of activity data and methods/emission factors are documented. It should be clear how emissions were calculated, and all data used should be archived. This also means that the use of confidential data should be kept to a minimum.

Accuracy: Accuracy is a relative measure of the exactness of an emission/removal estimate. Estimates should be "accurate" in the sense that they are systematically neither over nor under true emissions or removals, as far as can be judged, and that uncertainties are reduced as far as practicable.

Source: IPCC 2000

3. INVENTORY PLANNING

This section describes the elements of the planning phase prior to preparing the national GHG inventory. Inventory development is a resource-intensive enterprise, which means countries may need to prioritise among key categories and estimation methods, while noting that data and methods quality may improve over time (IPCC 2000, 2003). Given the resource constraints facing non-Annex I Parties, planning is critical to ensure that: i) systems and procedures for efficient inventory preparation are in place, and ii) comprehensive documentation and archiving takes place so that each new inventory builds from the previous version. This is especially important since there may be an interval of several years between inventories for non-Annex I Parties.

3.1. Outputs of the Planning Phase

There are three outputs of the planning process: 1) an **inventory workplan**, 2) **overall inventory preparation instructions** and 3) **source(s) preparation instructions**. Before you start the planning, it is important to know the deadline for delivery of the final product and resources available so that you can work back to assess how when you need to begin the inventory work. This initial outline can be developed based on expert judgement and does not need to be too detailed, as shown in Figure 3.1.

During the planning phase it is also important to look at the National Inventory System as a whole – what relationships exist and which need to be developed – and to ensure the system is documented (Box 3.1).

The **inventory workplan** is a document which may have an audience larger than the inventory team. It describes the anticipated tasks, who will do them and by what date, the expected actions and/or products at each stage and the resources budgeted. As with any project-oriented work, the workplan should define the objectives, the scope of the work, the tasks needed to accomplish the objectives, the staff that are responsible for each task, and the timeline for completing all tasks.

Box 3-1: The National Inventory System

A National Inventory System is set of relations between people and institutions that is described in several documents to ensure: i) the sustainability of the inventory preparation in the country, ii) consistency of reported emissions, and iii) standard quality of results.

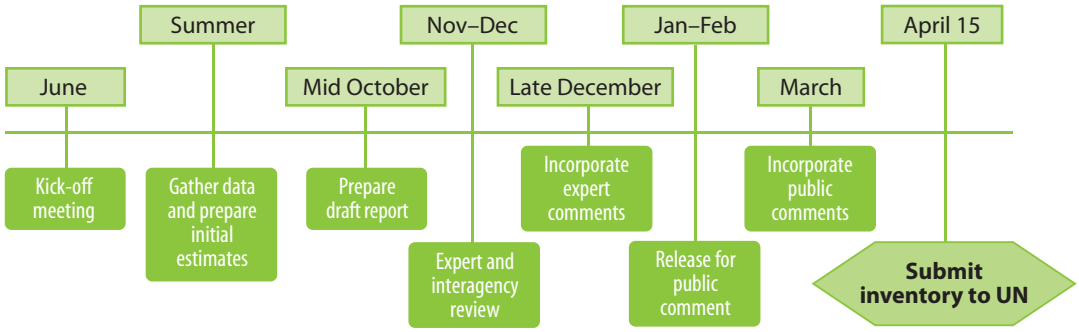
Documentation falls into two categories:

1. Inventory documents describing:
   - what was calculated,
   - how was it calculated, and
   - what does it mean (e.g., chapter in national communication, national inventory report, reporting tables, worksheets, archive, references, etc).
2. Documents "around" the inventory describing how to make an inventory (e.g., workplans, manual of procedures, inventory improvement strategy, legal and organisational bases, responsibilities, reporting obligations, etc).

The **overall inventory preparation instructions** (or national manual of procedures) contains the more detailed, specific instructions the inventory team needs to:

- complete their sections of the inventory:
  - on time,
  - with consistency across source categories, and
  - in a format that allows for efficient compilation of the entire inventory;
- perform adequate quality assurance/quality control and

Figure 3-1: Example: US Inventory Cycle



uncertainty assessment; and
- undertake complete documentation and archiving.

The instructions should contain:

- a detailed timeline with all interim products and deadlines noted;
- a matrix of staff and responsibilities; and
- information about how the inventory should be prepared, including:
  - file management,
  - quality assurance/quality control procedures,
  - uncertainty assessment, and
  - reporting instructions (both content and format), documentation and archiving procedures.

There will be some overlap between the inventory workplan and the overall inventory preparation instructions (e.g., the timeline and staffing plan), but it is recommended to keep the two documents separate because their intended audiences are so different. The overall inventory preparation instructions are an internal document meant for the inventory team only, while the workplan is essentially an external document. Also, the overall inventory preparation instructions will contain great deal of information that only the inventory team will need to see.

The **source(s) preparation instructions** contain any source-specific instructions that each source(s) team needs that are not contained in the overall inventory preparation instructions.[6] These instructions could contain information such as:

- internal deadlines;
- research guidance;
- data-sharing procedures (e.g., the person collecting manure management data is to give these data to the person collecting soil management data by a certain date);
- editorial directions (e.g., source-specific acronym instructions, instructions about what data to present in tables); and
- additional information on staff and responsibilities as needed.

The source(s) preparation instructions, together with the overall inventory preparation instructions, provide the written guidance (or "blueprint") that the inventory team members need to complete all phases of inventory preparation. Ideally, these instructions should be detailed enough that any outside expert could come in and understand how to prepare the national GHG inventory.

The parameters that will limit the overall scope and comprehensiveness of the inventory will be cost (likely to be expressed in allocated personnel hours and/or monetarily) and the deadline by when the entire project needs to be completed. These parameters will also affect the detail and complexity of the workplan and the overall inventory and source(s) preparation instructions.

Inventory managers may find it useful to review the workplans and related documents of other countries. For example, the United States describes its national inventory process and organisational structure in the *Background* volume of its *Quality Assurance/Quality Control and Uncertainty Management Plan for the US Greenhouse Gas Inventory* (USEPA, 2002) (Chapters 2-4) which is available online.[7]

3.2 Tasks in the Planning Phase

There are two components to the planning process:

1. Planning the overall preparation of the inventory and
2. Planning the preparation of individual sources.

The outputs of the first component are the inventory workplan and the overall inventory preparation instructions. The output of the second component is the source(s) preparation instructions.

Each component of planning includes a set of tasks:

- *Overall Inventory Planning Tasks*
  1. Appoint "National Entity"[8] and "Inventory Co-ordinator"[8]
  2. Define Inventory Products and Plan Results Dissemination
  3. Assign Other Inventory Personnel
  4. Establish Rules of Procedure for Overall Inventory Preparation
  5. Establish Overall Inventory Preparation Schedule
  6. Establish Major Legal and/or Collaboration Arrangements
  7. Prepare Budget
  8. Complete and Distribute Workplan

[6] The "source(s) team" is defined here as the group of inventory preparers who are responsible for preparing the inventory for a discrete source or group of sources. The number of individual sources covered by a "source(s) team" may range from several sources within an inventory sector (e.g., enteric fermentation and manure management), to several sources in more than one inventory sector, to an entire sector (e.g., Agriculture). The number and complexity of sources covered by an individual team will depend on the financial and human resources devoted to the national GHG inventory.

[7] Go to: *yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SLUZ5EBLT3/$File/background02.pdf*

[8] Quotes are placed around these titles because they are not official terms. A country may choose to name these entities differently or use a different organisational structure.

9. Complete Overall Inventory Preparation Instructions and Distribute with Supporting Materials

- *Source-specific Planning Tasks*
  10. Assess Sources, Determine Priorities and Assign Staff Responsibilities
  11. Establish Rules of Procedure for Source Preparation
  12. Establish Source(s) Preparation Schedule
  13. Complete Source(s) Preparation Instructions and Distribute with Supporting Materials

In general, all overall inventory planning tasks will need to be completed before the source-specific planning tasks can begin. However in cases where the inventory team is mature, i.e., the team has completed at least several versions of the inventory, the source-specific tasks may begin in parallel with the overall inventory tasks. In addition, many of the planning tasks are not absolutely discrete, i.e., the analytical work undertaken to complete a number of the planning tasks will inform the analytical work needed for other planning tasks. For these reasons, the tasks are not called "steps" which might imply that one task must be completed before the next can begin.

Generally, the institution that has legal responsibility for producing the inventory, which is referred to here as the "**National Entity**", will appoint an overall "**Inventory Co-ordinator**" who oversees the entire inventory. The Inventory Co-ordinator is responsible for planning the overall preparation of the inventory (except the first task) and, as the inventory is prepared, provides overall coordination, management and technical oversight. In addition, there are individual **source(s) team leaders**, each of whom is responsible for inventory planning for his or her source(s), as well as overseeing the inventory preparation for his or her source(s).

Under the overall planning, the schedule for completion of the inventory is set, the rules of procedure that must be followed by the source(s) team leaders as their sections of the inventory are prepared are set and, typically, the overall budget is set. (In some countries, source(s) team leaders may have control over their own separate budgets.) Therefore, the overall planning, in effect, drives the source(s)-specific planning.

Completing both the overall inventory planning tasks and the source-specific planning tasks requires an understanding of not only how to administer a large and complex analytical process, but also the technical requirements of compiling a national GHG inventory. Therefore, the Inventory Co-ordinator and the source(s) team leaders should possess both administrative and technical expertise. In addition, they should confer with one another throughout the planning process to ensure that the planning is internally consistent, complete and logical.

3.2.1 Overall Inventory Planning Tasks

Planning Task 1. Appoint National Entity and Inventory Co-ordinator

The appointments of the National Entity and Inventory Co-ordinator are probably two of the most important tasks to ensure that the preparation of the national GHG inventory is successful.

The National Entity is defined here as the institution that has the legal authority within the national government to prepare the national GHG inventory. Typically, the National Entity is a government ministry, department or agency. Ideally, this institution also contains a significant portion of the technical expertise needed to prepare the inventory.

The Inventory Co-ordinator is the individual who is designated by the National Entity to provide overall planning, co-ordination, management and technical oversight of the inventory. This person should have technical and administrative expertise, as well as formal government authority. In this context, it may be advisable to encourage the appointment of a scientist with managerial abilities into a special position in state administration (e.g., adviser to the Minister or appointee with special tasks).

Box 3-2 (overleaf) contains a list of activities that the Inventory Co-ordinator and source(s) team leaders should undertake to prepare for their planning responsibilities.

Planning Task 2. Define Inventory Products and Plan Results Dissemination

As part of inventory planning, non-Annex I Parties must decide which inventory products they will prepare and what will be contained in each of those products. At a minimum, Parties must produce a GHG inventory as part of their national communication. The COP gives non-Annex I Parties a great deal of discretion regarding the scope, detail and format of that inventory. The national communications inventory might just include the completed IPCC worksheets (i.e., the worksheets from Volume 2 of the *Revised 1996 IPCC Guidelines*) and the completed IPCC sectoral and summary report tables (i.e., the reporting tables from Volume 1 of the *Revised 1996 IPCC Guidelines*).[9] However, the inventory can be more informative if additional information about data, methods, uncertainties, etc, are included. In addition, countries may want to consider preparing additional reports separate from the national communication. These reports

[9]The IPCC software provides for automated reporting with all of these worksheets and tables. The software can be downloaded from: *http://www.ipcc-nggip.iges.or.jp/public/gl/software.htm*

Box 3-2: Recommended Planning Preparation Activities for the Inventory Co-ordinator and Source(s) Team Leaders

Obtain and review the workplan from the previous GHG inventory.

Obtain and review the previous GHG inventory, including the key source analysis if completed, and the inventory improvement strategy if prepared.

Review the UNFCCC and IPCC inventory reporting guidance, specifically:

- The COP guidelines for non-Annex I inventories (contained in Decision 17/CP.8, including Tables 1 and 2 in the Annex to this decision);
- The IPCC sectoral and summary report tables (contained in Volume 1 of the IPCC *Revised 1996 IPCC Guidelines*); and
- The IPCC worksheets (contained in Volume 2 of IPCC *Revised 1996 IPCC Guidelines*).

Review the relevant sections of the IPCC inventory guidance materials, specifically:

- *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*;
- *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*; and
- *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry*.

Review the organisational chart from the previous GHG inventory and assess current availability of previous team members.

Identify other national air pollutant inventory efforts (e.g., ozone, sulphur dioxide, nitrogen oxides, carbon monoxide, particulates) and international air quality reporting requirements. These may offer opportunities for co-operation and sharing of data.

Broadly review GHG inventories from neighbouring countries of similar circumstances (e.g., those with inventory sectors of similar relative importance).[10] It may be useful to initiate a dialogue with the National Entities from these neighbouring countries to identify common approaches and issues for the GHG inventories. The National Communications Support Unit may be able to assist countries in initiating such a liaison.

might be more or less detailed and are intended for different audiences. (See Preparation Task 7, Section 4).

If an inventory improvement strategy (Preparation Task 10, Section 4) was prepared as part of a previous inventory, then the strategy should be reviewed during this planning task. The improvement strategy may describe plans to improve on, or expand, previous reporting procedures, which can be used as a starting point for planning the products of this inventory assessment.

Section III.B. of the annex to COP Decision 17/CP.8 contains the UNFCCC guidelines for reporting of national GHG inventories by non-Annex I Parties, as part of their national communications. These guidelines encourage Parties to report on all gases, to use various reporting tables, and to include additional information on data collection and archiving procedures, institutional arrangements, data sources and inputs, methodologies, assumptions, data improvement needs and uncertainties. In addition, Section III.A. of this annex encourages non-Annex I Parties to undertake key source analysis and, together with Decision 13/CP.9, encourages non-Annex I Parties to apply the IPCC GPG. However, it is up to each Party to decide what will be reported, in what format, and whether and how key source analysis will be undertaken and IPCC GPG applied.

The Inventory Co-ordinator, in consultation with the National Entity, will need to decide on all these issues and relay the decisions to the inventory team.[11] It is recommended that this information be relayed using a detailed outline of the national communication inventory. The Inventory Co-ordinator would prepare this outline as part of Planning Task 2.

Finally, consideration could be given to disseminating the results of the national GHG inventory to a broader audience, including public and private decision-makers to encourage broader participation in the inventory accounting process (beyond the inventory team and National Entity). This dissemination might include preparing a separate National Inventory Report and/or an Executive Summary or booklet for distribution to the general public. It may also be useful to circulate an inventory summary document to decision-makers in government ministries.

Public meetings to disseminate such reports and discuss the results could also be considered. The National Entity and inventory staff could take this opportunity to identify target audiences (e.g., a private industrial entity with which a partnership could be developed for future inventories) and

[10] The UNFCCC posts copies of all Annex I and non-Annex I national communications and Annex I national GHG inventories on its website (unfccc.int). Look under National Reports.

[11] Source(s) teams generally do not need to receive information about whether key source analysis will be undertaken since this work is completed after the source teams have completed their work. However, if key source analysis will be undertaken, this should be included in the inventory outline.

the products that might be helpful in reaching those audiences. Workshops with the government entities, private industry entities and research institutions that provided data and/or reviewed the inventory may also be useful, particularly if they are likely to continue to be partners in the future.

Planning task 2 should include the preparation of an outline of each additional inventory product that will be prepared, as well as a plan for each meeting or workshop that will be undertaken. Note that planning and implementing such optional inventory reports and meetings can be done incrementally over several inventories, and built into an inventory improvement strategy (Preparation Task 10, Section 4).

Planning Task 3. Assign Other Inventory Personnel

In addition to the Inventory Co-ordinator, the inventory team typically includes individual source(s) team leaders and, if resources are sufficient, assistants to the source(s) team leaders and the Inventory Co-ordinator. The Inventory Co-ordinator may also act as an individual source(s) team leader.

The individual source(s) team leaders are responsible for planning and overseeing the preparation of a source, or group of sources. Source(s) support staff undertake activities such as research, data collection, calculations, writing, quality control, and archiving and documentation. The assistant to the Inventory Co-ordinator might be designated for tasks such as overall quality assurance/quality control co-ordination and/or overall data and document management. Sometimes the Inventory Co-ordinator will also be responsible for overall quality assurance/quality control co-ordination, as well as overall data and document management. However, it is recommended that a separate individual be assigned to overall data and document management, as implementing this task is time-consuming and complex, and is critical to the long-term improvement of the inventory. This individual, who will be referred to here as the "**Inventory Compiler**," would act as the receiver of all the pieces of the inventory from source(s) teams (i.e., all the spreadsheets and text sections) and would be responsible for combining these pieces into one cohesive document. The compiler would possibly also create the summary tables and text and complete the key source analysis.

The inventory team members may be personnel from the National Entity or from other government departments, or they may be experts from non-governmental institutions, such as research institutions, industry or consulting firms. The number and types of staff assigned to the inventory team will depend largely on the financial and human resources available, as well as on the relative importance of individual sources. When assigning personnel, it is important to remember that lower level personnel and/or students may be less expensive (or even free) than experienced senior and mid-level experts, but there may be costs incurred with training. One advantage of using students is to encourage linkages with universities and other research institutions. It is important to assign staff appropriately, given the expertise and costs of specific individuals, and the expertise and schedule required by various tasks.

Teams should be structured to take advantage of existing institutional strengths as much as possible, e.g., by using staff from government departments with relevant expertise and data. Once source(s) team leaders are assigned, it is recommended that the Inventory Co-ordinator and source(s) team leaders review the previous inventory organisational structure and results, and determine the best procedures for the next inventory. Ideally, previous inventory team members will be available to continue in their previous, or, at a minimum, a related, inventory role or to provide information on their experience (both positive and negative) in preparing the previous inventory.

One of the final steps in inventory preparation is key source analysis (see Preparation Task 6, Section 4). *Key category analysis enables countries to prioritise sources in terms of their contribution to total emissions and to the trend in emissions.* This step cannot be undertaken until *after* all emission calculations and QA/QC are completed. If a key source analysis was prepared as part of a previous inventory, then the results of that analysis should be used to concentrate staff resources on the most important sources. If a key source analysis has not yet been prepared, those non-Annex I Parties that have already completed their initial national communications might wish to carry out the analysis of the first inventory as part of Planning Task 3.

It is recommended that an organisational chart be created as part of this planning process, even if the inventory team is very small. Figure 3.2 (overleaf) contains an example from the Republic of Moldova.

Planning Task 4. Establish Rules of Procedure for Overall Inventory Preparation

Rules of procedure for completing the inventory should be defined and distributed to the inventory team *prior* to starting work on inventory preparation. This will help to ensure consistency across source categories and contribute to the inventory team's overall efficiency. These rules of procedure will constitute a significant part of the overall inventory preparation instructions. If a country has not previously documented rules of procedure, they may wish to do so as part of the next inventory cycle. Doing so could ensure a far more sustainable inventory process in the future.

The rules of procedure should contain requirements and guidelines on:

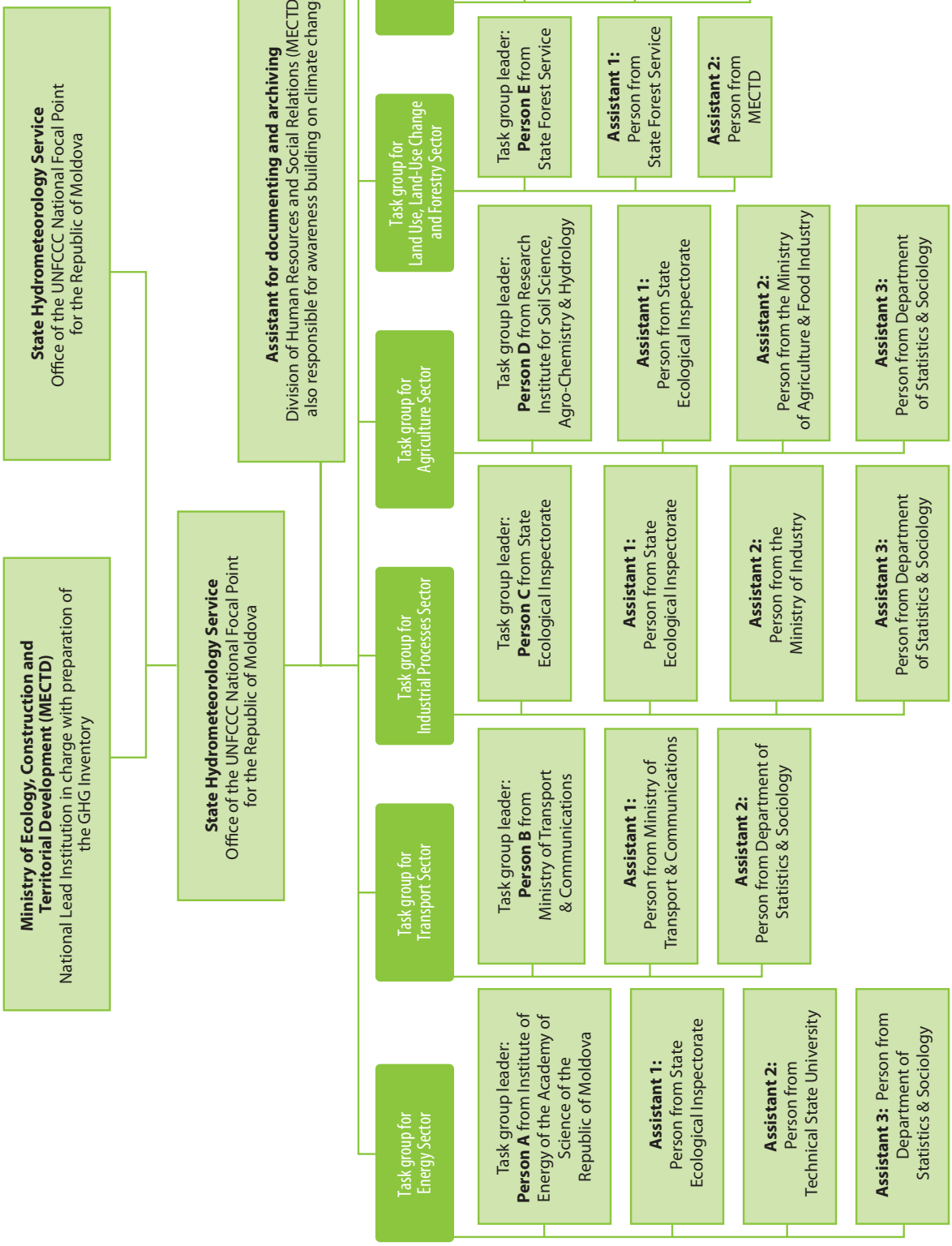


Figure 3.2: Institutional Organisational Chart for the National Inventory System in the Republic of Moldova

- **Documentation.** The rules will include requirements for i) referencing data sources in spreadsheets, ii) dating files and iii) maintaining paper copies of references for archiving. Because inventory staff change from one inventory to the next and a number of years may elapse between inventories, accurate and detailed documentation must be maintained to ensure consistency across inventories as well as encourage efficiency in inventory preparation.

- **Spreadsheet management**: This will include directions regarding whether and how the IPCC software is to be used[12]; requirements for managing electronic files, especially version control (e.g., who will distribute the files from the last inventory, how to name files so there is no confusion about which version is the most current, who will collect revised files, etc); requirements and guidelines for spreadsheet layout and content if the IPCC software will not be used, including sheets required for compiling the entire inventory; requirements for calculations and references (e.g., no non-calculated values that are not referenced); and requirements for use of global warming potentials (i.e., the values that must be used and how to include them in the spreadsheets).

- **Report write-ups**: Any reporting that accompanies the inventory listing of annual emissions and removals (e.g., a simple report that is part of the national communications and/or a more comprehensive National Inventory Report) should be consistent across source categories. To achieve this, inventory teams need guidelines on the structure and content of their write-ups (i.e., an outline or description of what should be contained in each section, examples of the required tables and style guidelines, etc) and on formatting (e.g., format for each level of heading, procedures for use of common acronyms and units, reference format, table formats). In some cases, it may be most efficient to distribute templates to inventory teams. Such guidance will avoid time-consuming and laborious harmonising of different formats and styles after report sections are written.

- **Quality assurance/quality control (QA/QC):** A good QA/QC plan[13] (Preparation Task 4, Section 4) is essential to the preparation of a reliable, defensible and accurate GHG inventory. The scale of the QA/QC plan will depend on available resources, but it is recommended that QA/QC procedures include, at a minimum, routine internal review procedures (e.g., spot-checking spreadsheets for correct data entry, consistent formulas and complete documentation) and at least one round of external peer review. The plan should state the minimum levels of QC that need to be met, as well as recommendations for more rigorous QC if source(s) team leaders decide that sufficient resources are available. The plan should also include a schedule for QA procedures, lay out internal responsibilities (e.g., who will distribute materials for external review and will collect and disseminate review comments), contain a list of external reviewers and include instructions for incorporating and tracking revisions based on comments received.

- **Uncertainty analysis**: Non-Annex I Parties are encouraged to provide information on inventory uncertainties (Preparation Task 5, Section 4), which may range from a simple qualitative assessment to a complex quantitative assessment. If uncertainties are to be assessed, the rules of procedure should state the minimum approach to be used and provide recommendations for more rigorous uncertainty assessment should source(s) team leaders decide sufficient resources are available. The plan should also include instructions for documenting and reporting the results of uncertainty assessment.

- **Key source analysis**: Non-Annex I Parties are encouraged to undertake a key source analysis once the inventory is complete (Preparation Task 6, Section 4). The level of analysis undertaken, if any, will depend on the whether a quantitative assessment of uncertainties has been completed. Even though only a small subset of the inventory team will carry out the key source analysis (typically the Inventory Compiler), the rules of procedure should describe the key source analysis that will be undertaken so that the rules are complete and the entire team is aware of how this component of the inventory will be handled.

- **Additional GPG adherence**: The IPCC GPG manuals contain new information regarding QA/QC, uncertainty assessment and key source analysis (relative to the

[12]The IPCC inventory software consists of Microsoft Excel versions of the worksheets in the Workbook (Volume 2) and the reporting tables in the Reporting Instructions (Volume 1) of the Revised 1996 IPCC Guidelines (IPCC 1997). This software does not include any of the changes or new material contained in the IPCC GPG manuals (IPCC 2000, 2003). However, the software can be disabled. Therefore, if a country decides to use the IPCC software and chooses to implement new IPCC GPG methods or data, they will have to disable the software and revise the Excel worksheets to reflect the new methods or data.

[13]"Quality control (QC) is a system of routine technical activities, to measure and control the quality of the inventory as it is being developed" (IPCC 2000). Typically, the inventory team implements QC, and these QC procedures are implemented throughout inventory preparation. "Quality assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process" (IPCC 2000). QA activities generally occur at one or more discrete periods during inventory preparation. See Chapter 8 of IPCC GPG 2000 for a thorough discussion.

Revised 1996 IPCC Guidelines). They also contain new information about emission factors, activity data and method. The IPCC GPG 2003 contains an entirely new accounting structure for the Land-Use Change and Forestry inventory sector. The Inventory Co-ordinator, in consultation with the National Entity, will decide on which components of GPG, if any, the inventory team should adhere to (remembering that non-Annex I Parties are only encouraged to use the GPG). Source-specific technical issues (e.g., whether a revised emission factor from the GPG manuals will be used) should be left to the source(s) team leaders and included in source preparation instructions.

- **Archiving**: Preparation of a national GHG inventory requires the collection, generation, manipulation and storage of large amounts of information. The information is generated by a team of people that is likely to change between inventories. Therefore, a rigorous system for storing this information is necessary for ensuring sustainability of the inventory process. The rules of procedure should contain requirements on what needs to be archived (both electronic and paper records), due dates for delivery and specific formatting or notational instructions. For example, if an activity data source is a very large electronic database that is impractical to archive, then a memo to the inventory archive that contains the title of the database, the website, a description of how the database was used and a paper copy of relevant sections of the database may be sufficient for archiving.

Planning Task 5. Establish Overall Inventory Preparation Schedule

The overall schedule for preparing the GHG inventory is established by the Inventory Co-ordinator, in consultation with the National Entity. *The key date for the entire schedule is the date that the final version of the inventory is due to the National Entity for incorporation into the national communication.*

The Inventory Co-ordinator will create a schedule based on that due date and all the inventory preparation steps that need to be completed prior to, and after, the due date, taking into account the amount of time needed to complete each of those steps. Starting with the due date for the final version of the inventory, and based on a logical sequence of inventory preparation steps, the Inventory Co-ordinator will work backwards to set the due dates for all the previous steps and then work forward to set the due dates for the subsequent steps.

It is suggested that the first date in the overall inventory preparation schedule be the date that Planning Task 13 (Complete Source(s) Preparation Instructions and Distribute with Supporting Materials) is implemented, since this is the date by which all inventory supporting materials will have been distributed to the inventory team.

The kinds of inventory preparation steps that need to be completed *before* the final version of the inventory is due to the National Entity include:

1. Preparation of draft and final versions of each source section of the inventory (including research, data collection, calculations, preparation of text, tables and worksheets, and QA/QC);
2. Possibly, additional internal reviews (QC) and external reviews (QA);
3. Incorporation of revisions based upon QA/QC;
4. Compilation of individual source sections into one cohesive document; and
5. Key category analysis, if undertaken.

It is recommended the Inventory Co-ordinator discuss with the individual source(s) team leaders and the Inventory Compiler to ensure enough time is built into the schedule to allow for these steps. Previous experience in compiling a national GHG inventory will be instrumental in informing this process. Time should also be built into the schedule for establishing legal arrangements with other institutions that might be needed for items such as data collection, as well as for responding to issues raised during QA and QC, such as evaluating government review comments, implementing recalculations and incorporating text revisions.

Ideally, team members will have inventory experience and source expertise. If not, it is important to build time into the schedule for training and the learning process. The schedule should also account for holidays and include contingency time for sick and vacation days, and unforeseen hold-ups such as delays associated with release of funds and obtaining permission to use certain data.

As risks are considered, options for mitigating against these risks should be identified. For example, if there are particular bottlenecks in the process, such as having one person compiling all the inventory sections into one comprehensive document, the Inventory Co-ordinator and source(s) team leaders should consider approaches to alleviate that bottleneck, such as staggering the submission of the inventory sections (e.g., the simplest sections are provided first and the most complex last). Similarly, there may be a particular activity data set that will not be available until later in the timeline than is optimal. In this case, it may be agreed that that particular inventory section be sent to the Inventory Compiler later than other sections.

It is recommended that the overall inventory preparation schedule include periodic meetings of the Inventory Co-ordinator, the individual source(s) team leaders and the Inventory Compiler to discuss progress and problems, and to decide how to address problems before they negatively affect the overall schedule.

Activities that are likely to be undertaken *after* the final version of the inventory is due to the National Entity include:

1. Finalisation of any other inventory products, such as a brochure for public education;
2. Completion of all documentation and archiving of electronic and paper inventory materials;
3. Implementation of public education and outreach activities; and
4. Completion of the inventory improvement strategy (for future inventories).

The overall schedule should list all the steps and deliverables and the dates by which these steps must be completed. Table 3.1 provides a hypothetical example of an inventory preparation schedule for illustration. It may also be useful to create something more complex, such as Gantt chart to help visualise the schedule drivers, roadblocks and overlapping activities. Common project planning software, such as Microsoft Project, can be used to develop such a chart. However, these tools are only suggested to simplify the planning task – a list or table of some kind could just as easily be used.

Planning Task 6. Establish Major Legal and/or Collaboration Arrangements

It is important to identify the various institutions that are the repositories of data that is needed to prepare the inventory. In cases where the information is not publicly available, legal and/or less formal collaboration arrangements may need to be established with the institutions so the data can be obtained in a timely manner and in the format required. (Collaborative arrangements may also be agreed to share staff for inventory preparation as discussed in Planning Task 3.)

Such institutions include national government entities (e.g., statistical offices, government ministries), regional and international organisations (e.g., Food and Agriculture Organization, International Energy Agency), research institutions and private industry. The Inventory Co-ordinator should carry out this task in consultation with the individual source(s) team leaders, and decide whether meetings with key institutions are needed. It is recommended that some form of written agreement (e.g., letter of understanding, letter of intent or a formal agreement) be established between the National Entity and the institutions that hold the most critical data sets (and/or from whom staff will be utilised). Data confidentiality issues may need to be considered during this process, especially when data are to be obtained from industry. Systems will need to be established to ensure data confidentiality where needed.

During the process of identifying these institutions, possible candidates for inventory review (i.e., for expert peer review, or quality assurance) should also be identified. As meetings are held with these groups, it is also recommended to inform them of the overall inventory schedule and encourage them to assist in the process by acting as expert reviewers. If interest is low, but the institution is important to the inventory process, countries might wish to consider an awareness-raising campaign that targets the institution and focuses on benefits of being involved in the process.

Planning Task 7. Prepare Budget

Financial considerations are beyond the scope of this handbook. However, estimating the cost of preparing the inventory is an essential step in preparing the workplan. A significant portion of the costs is likely to be for labour, so it is recommended that a staff matrix that defines person-hours or person-days by person and task be compiled. All tasks should be budgeted, including training, research and data collection, QA/QC, uncertainty assessment, reporting and archiving. In addition, non-labour expenses, such as computer hardware and software, office rental, paper, telephone calls, etc, must be included. The labour costs associated with collecting and processing activity data and possibly data purchase costs, may be the most significant cost for some non-Annex I Parties.

Although not required under the UNFCCC, non-Annex I Parties may want to consider preparing a National Inventory Report or other reports or documents for public dissemination. If so, appropriate budget should be set aside for the preparation, printing and distribution of such reports.

Planning Task 8. Complete and Distribute Workplan

Once the previous tasks have been completed, the workplan can be finalised. It is recommended that at least one draft be prepared and circulated among individual source(s) team leaders, appropriate managers in the National Entity and other relevant government institutions for review and comment before making the workplan final. As with all the other tasks, this task should build upon, and benefit from, previous inventory activities.

Planning Task 9. Complete Overall Inventory Preparation Instructions and Distribute with Supporting Materials

The overall inventory preparation instructions should include the following information:

- A matrix (or graph or list) of staff and responsibilities (output of Planning Tasks 1 and 3);
- An outline and description of each inventory product to be prepared (output of Planning Task 2);
- The inventory preparation rules of procedure (output of Task 4);
- The overall inventory schedule (output of Planning Task 5);

Table 3.1: Hypothetical Example of an Overall Inventory Preparation Schedule

Date	Task & Deliverable	Responsible Party(ies)
March 1	Kick-off meeting to ensure team readiness distribute overall inventory preparation instructions, source preparation instructions and other supporting materials to inventory team.	Inventory Co-ordinator, Source(s) Team Leaders and Inventory Compiler
July 1	Meeting to discuss progress and problems	Inventory Co-ordinator, Source(s) Team Leaders and Inventory Compiler
September 1	Final spreadsheet and text files for each source due to Inventory Compiler	Source(s) Team Leaders
September 2-30	Compiling of 1st draft inventory	Inventory Compiler
October 1	1st draft inventory due to Inventory Co-ordinator	Inventory Compiler
October 3	Distribute 1st draft inventory for internal review	Inventory Co-ordinator
October 4-18	Internal review of 1st draft inventory (QC) submit comments to Inventory Compiler	Inventory Co-ordinator and Source(s) Team Leaders
October 19-22	Distribute source files and internal review comments to source(s) teams for revisions	Inventory Compiler
October 23-November 7	Incorporate internal comments	Source(s) teams and Inventory Compiler
November 8	1st revised final spreadsheet and text files for each source due to Inventory Compiler	Source(s) Team Leaders
November 9-30	Compiling of 2nd draft inventory	Inventory Compiler
December 1	2nd draft inventory due to Inventory Co-ordinator	Inventory Compiler
December 3	Distribute 2nd draft inventory for external review	Inventory Co-ordinator
December 4-January 4	External review of 2nd draft inventory (QA) submit comments to Inventory Compiler	External reviewers
January 4	Meeting to discuss progress and problems	Inventory Co-ordinator and Source(s) Team Leaders and Inventory Compiler
January 4-6	Distribute source files and external comments to source(s) teams for revisions	Inventory compiler
January 6-20	Incorporate external comments	Source(s) teams and Inventory Compiler
January 21	2nd revised final spreadsheet and text files for each source due to Inventory Compiler	Source(s) Team Leaders
February 14	Draft inventory improvement strategy for each source due to Inventory Compiler	Source(s) Team Leaders
February 15-28	Collect all pertinent paper and electronic source materials for archiving place in archive	Source(s) teams
January 22-February 28	Compiling of final inventory and preparation of key source analysis	Inventory Compiler
March 1 (key date)	Inventory due to the National Entity for incorporation into national communications	Inventory Co-ordinator
March 2-15	Compile draft inventory improvement strategy	Inventory Compiler
March 17-24	Prepare draft inventory summary brochure	Inventory Compiler
March 25	Draft inventory summary brochure due to Inventory Co-ordinator	Inventory Compiler

Table 3.1: Hypothetical Example of an Overall Inventory Preparation Schedule (continued)

Date	Task & Deliverable	Responsible Party(ies)
March 26-31	Disaggregate final inventory into final spreadsheet and text files and archive	Inventory Compiler
April 1-7	Incorporate brochure comments	Inventory Compiler
April 8	Final inventory summary brochure due to Inventory Co-ordinator	Inventory Compiler
April 15	Public workshop to present inventory results and distribute brochure	Inventory Co-ordinator, Source(s) Team Leaders and other inventory team members
April 16-23	Collect and archive materials related to brochure and public workshop	Inventory Compiler
April 16-30	Prepare final inventory improvement strategy	Inventory Co-ordinator and Source(s) Team Leaders
May 1	Final inventory improvement strategy due to National Entity	Inventory Co-ordinator
May 2-8	Collect and archive inventory improvement strategy and related materials	Inventory Compiler

Notes:

1. *This schedule is for illustration only.* ***The actual steps and timeline that any country may define could be quite different as they will be specific to a country's situation.*** *For example, this schedule assumes that two inventory products will be produced: 1) the GHG inventory for the national communication, and 2) an inventory summary brochure for public dissemination. The schedule also assumes that after the source(s) teams have finalised their spreadsheets and text sections (during which some level of QC would have occurred), there will be one internal round of review (QC) on the complete inventory and then one external round of review (QA) on the complete inventory.*
2. *There are a number of steps that each source(s) team will need to undertake prior to the date that the final spreadsheet and text files for each source are due to the Inventory Compiler. These will be elaborated below, under Planning Task 12.*

- Information about legal and/or collaboration arrangements for data collection and/or staff sharing (output of Planning Task 6); and
- A budget (output of Planning Task 7).

Under task nine, this information should be compiled into one document (the manual of procedures) and distributed to inventory team members. Various team members may assist in preparation of the overall inventory preparation instructions, but the Inventory Co-ordinator is ultimately responsible for its completion.

There are a number of additional supporting materials that need to be collected and distributed to inventory team members before they can begin inventory preparation. These materials include the IPCC inventory guidance materials. The website for the IPCC inventory software *(http://www.ipcc-nggip.iges.or.jp/public/gl/software.htm)* and copies of the software manual (available from the website) should be distributed to inventory team members if the software is to be used. (See also the list of resources in the back section of this handbook.)

If a national inventory has been prepared before, all the electronic files associated with each source (i.e., spreadsheets and text files) should be distributed to each appropriate source(s) team. It is absolutely critical these electronic files be distributed so that work already completed does not have to be redone, and so that any changes that are made relative to the previous version can be tracked and recorded. Relevant paper files (e.g., reports used as data sources), if they are centrally archived, will need to be distributed, or the location and accessing directions for those files will need to be distributed. Other relevant documents (electronic or paper), such as inventories from other countries, relevant research papers, should be collected and distributed as appropriate.

3.2.2 Source-Specific Planning Tasks

The Planning Tasks 10 through 13 described will be undertaken for each source(s) team.

Planning Task 10. Assess Sources, Determine Priorities and Assign Staff Responsibilities

The first planning task that each individual source(s) team leader should undertake is an assessment of each of their source(s). At a minimum, this will entail (if not already done so):

- Reviewing the relevant sections of the IPCC guidance materials and the UNFCCC reporting guidance so that default methods, data sources, basic QA/QC, uncertainty assessment and reporting procedures are understood;
- Reviewing the overall inventory preparation instructions; and
- Undertaking a *preliminary* assessment of data sources (local, national and regional) that might be available. (In most cases, a thorough assessment of data sources will be done during inventory preparation rather than planning, especially if the source(s) team leader is relatively inexperienced.)

If a national GHG inventory has been prepared before, and the particular source was included, the source(s) team leader should also:

1. Review the relevant section(s) of the previous version of the national inventory;
2. Review any source inventory improvements proposed when the inventory was prepared (these proposals would be part of the Inventory Improvement Strategy);
3. Determine what new data and/or methods have become available since the previous inventory was completed; and
4. Determine linkages with other sources, e.g., the data used to estimate non-CO_2 emissions from woody biofuel combustion (Energy sector) must be consistent with the wood fuel harvest data compiled in the LUCF sector.

All of this information will help the source(s) team leader determine what needs to be done, how long tasks will take, what the research priorities should be, and what co-ordination is needed with other source(s) teams. Once the source(s) team leader has made these determinations, he/she can make specific staff assignments for the team (e.g., which source or sources each team member is responsible for, how much time should be devoted to research on each source, etc.).

If the source(s) team leader is relatively experienced, and the source is complex, it may be beneficial for him/her to prepare a graphical illustration of data flows (from their source to their application) and data manipulations (e.g., data conversion steps) for the team. An example from The Philippines of such a data flow chart, but for an entire inventory sector, is presented in Annex 1. This activity could also be done as part of Preparation Task 1.

Planning Task 11: Establish Rules of Procedure for Source Preparation

There are source-specific rules of procedure that will not be included in the overall inventory preparation instructions but which, if defined and distributed before work begins, will ensure that work on preparing each source proceeds smoothly and efficiently. Such source-specific rules of procedure might include:

- Procedures for data collection and sharing both within, and among, sources (e.g., the person collecting human sewage data for the sewage N_2O component of the Waste sector may need to provide some of these data to the person estimating soil management N_2O emissions for the Agriculture sector);
- File management procedures, especially naming conventions and version control;
- Adherence to GPG (e.g., instructions about use of a new emission factor in the IPCC GPG manuals);
- Editorial directions (e.g., instructions about the use of source-specific acronyms, instructions about the content and format of tables); and
- Additional information on staff and responsibilities as needed (e.g., instructions about who is responsible for archiving what).

Planning Task 12. Establish Source(s) Preparation Schedule

Based on the critical dates given the overall inventory schedule (Planning Task 5) and the results of Planning Task 10, each source(s) team leader should establish a schedule for his/her source(s). A hypothetical example of such a schedule is presented in Table 3.2.

Generally, source(s) team leaders may find there will not be much room in the schedule for contingencies because of the overall inventory deadlines. The many variables (such as the time needed for research and for data collection and processing, and the volume and complexity of comments received from inventory reviewers) will be difficult to predict. *Therefore, the source(s) team leader must try to design his/her schedule so that necessary tasks will be completed on time, and all optional additional tasks are prioritised, defined by time constraints and with "fall-back" plans.*

For example, a source(s) team leader might plan to improve on a previous inventory by revising the method from Tier 1 to Tier 2 and include time in the schedule for the expected research. However, a time limit must be placed on this research so that, if the research is unsuccessful, there is still sufficient time to complete the inventory using the Tier 1 method. The source(s) team leader should also take into account the staff available for undertaking the work and their level of expertise and experience, including the level of training that will be needed.

Table 3.2: Hypothetical Example of a Source(s) Preparation Schedule

*This schedule **only** includes those activities that are not already covered in the Overall Inventory Preparation Schedule (Table 3.1). When developing this schedule, the team leader should take note of the following critical activities from the Overall Inventory Preparation Schedule: internal and external reviews, preparation of the inventory improvement strategy and archiving activities.*

Date	Task & Deliverable	Responsible Party(ies)
March 1	Distribute overall inventory preparation instructions, source preparation instructions and other supporting materials to inventory team	Inventory Co-ordinator and Source(s) Team Leaders
March 2	Kick-off meeting to discuss inventory materials	Source(s) Team
March 2-April 30	Collect activity data, conversion factors and emission factors; and prepare spreadsheets (including QC)	Source(s) Team
May 1	Draft spreadsheets due to Source(s) Team Leader	Source(s) Team
May 2-15	Review of draft spreadsheets	Source(s) Team Leader
May 2-15	Begin preparation of inventory text sections (including QC)	Source(s) Team
May 16	Distribute comments on draft spreadsheets to source(s) team and meet to discuss	Source(s) Team Leader and Source Team
May 17-June 14	Revise draft spreadsheets and text (including QC); undertake further data collection as needed	Source(s) Team
June 15	2nd draft spreadsheets and 1st draft inventory text sections due to Source(s) Team Leader	Source(s) Team
June 16-30	Review of 2nd draft spreadsheets and 1st draft inventory text sections	Source(s) Team Leader
June 16-30	Prepare draft source(s) improvements strategy	Source(s) Team
July 1	Distribute comments on 2nd draft spreadsheets and 1st draft text sections to source(s) team and meet to discuss	Source(s) Team Leader and Source Team
July 2-31	Revise 2nd draft spreadsheets and 1st draft text (including QC) based on comments	Source(s) Team
July 2-31	Undertake uncertainties analysis	Source(s) Team
August 1	3rd draft spreadsheets and 2nd inventory text sections, including uncertainties analysis, due to Source(s) Team Leader	Source(s) Team
August 1-14	Review of 3rd draft spreadsheets and 2nd inventory text sections, including uncertainties analysis	Source(s) Team Leader
August 15	Distribute comments on 3rd draft spreadsheets and 2nd draft text sections to source(s) team and meet to discuss	Source(s) Team Leader and Source Team
August 16-31	Revise 3rd draft spreadsheets and 2nd draft text sections (including QC) based on comments	Source(s) Team
September 1	Final spreadsheet and text files for each source due to Inventory Compiler	Source(s) Team Leader
September 2-15	Revise draft source(s) improvements strategy	Source(s) Team
	2nd draft source(s) improvements strategy due to Source(s) Team Leader	Source(s) Team

Table 3.2: Hypothetical Example of a Source(s) Preparation Schedule (continued)

Date	Task & Deliverable	Responsible Party(ies)
September 16-23	Review 2nd draft source(s) improvements strategy	Source(s) Team Leader
September 24	Distribute comments on 2nd draft source(s) improvements strategy to source(s) team	Source(s) Team Leader
September 25-30	Revise 2nd draft source(s) improvements strategy	Source(s) Team
October 1	3rd draft source(s) improvements strategy due to Source(s) Team Leader	Source(s) Team
January 1-14	Review 3rd draft source(s) improvements strategy, taking into consideration internal and external reviews of inventory	Source(s) Team Leader
January 15-31	Revise 3rd draft source(s) improvements strategy	Source(s) Team
February 1-13	Prepare final source(s) improvements strategy	Source(s) Team Leader
February 13	Meet to discuss final source(s) improvements strategy	Source(s) Team Leader and Source(s) Team

It is recommended that in addition to a source-category kick-off meeting (see Planning Task 13), periodic team meetings be scheduled throughout the inventory preparation process to ensure that problems, such as data collection issues, and questions are addressed in a timely manner.

Planning Task 13: Complete Source(s) Preparation Instructions and Distribute with Supporting Materials

The source category preparation instructions should include:

- A matrix (or graph or list) of personnel responsibilities, guidance on research priorities, guidance regarding coordination with other source(s) teams and estimated level of effort for inventory preparation tasks (output of Planning Task 10)
- The source(s) rules of procedure (output of Planning Task 11)
- The source preparation schedule (output of Planning Task 12)

Under task 13, each source(s) team leader should compile this information into one document (source-specific section of national manual of procedures) and the document should be distributed to his/her source(s) team. It is highly recommended that a kick-off meeting be scheduled immediately after the source category preparation instructions are distributed to discuss the instructions and answer any outstanding questions.

There may be a number of additional supporting materials to be collected and distributed to source(s) team members before they can begin inventory preparation. These materials would include inventory related materials that were not already distributed as part of Planning Task 9, such as reference materials (e.g., books and reports) that were not archived in the central inventory archives.

4. INVENTORY PREPARATION

This section primarily addresses the work associated with the preparation of the national communications GHG inventory. Since it is assumed that an inventory has been prepared at least once before, this section could also be considered "inventory improvement". In particular, this section focus upon approaches for improving the quality of the national GHG inventory, such as key source analysis and complete documentation and archiving. Reports and documents that a non-Annex I Party might choose to produce are also briefly discussed.

4.1 Outputs of the Preparation Phase

The outputs of the preparation phase will be the products that were defined under Planning Task 2 (in Section 3) – that is, the **national GHG inventory** for the national communication and **any other reports or documents** the National Entity decides to produce. As discussed in Planning Task 2, many decisions regarding the scope, detail and format of the GHG inventory are left to the reporting Party. This handbook addresses all the components of a GHG inventory that a non-Annex I Party is either required, or encouraged, to prepare under the UNFCCC.

4.2 The Tasks in the Preparation Phase

The inventory preparation tasks include:

1. Determine Data Availability and Quality;
2. Determine Methods and Compile Data;
3. Conduct Emission Calculations and Complete Text Sections;
4. Complete Quality Assurance/Quality Control Procedures;
5. Complete Uncertainties Analysis;
6. Undertake Key Source Analysis;
7. Complete Reporting;
8. Complete Documentation and Archiving;
9. Undertake Public Dissemination of Results; and
10. Complete Inventory Improvement Strategy.

It is recommended that throughout the inventory preparation process, the inventory team members hold periodic meetings to discuss progress and problems. These meetings will enable the team to decide how to address problems before they negatively affect the overall schedule. It is recommended that meetings regarding overall inventory preparation be held by the Inventory Co-ordinator, the individual source(s) team leaders and the Inventory Compiler, while meetings regarding source(s) preparation be held by each source team. (The sample preparation schedules presented in Tables 3.1 and 3.2 include such meetings.)

Annex 2 outlines the inventory preparation process in Albania. It is provided to illustrate how a non-Annex I Party might prepare a typical GHG inventory.

Preparation Task 1: Determine Data Availability and Quality

This step entails assessing the availability and quality of activity data, conversion factors and emission factors. Completion of this step is necessary before an appropriate method can be chosen and all the data required by that method compiled. The *Revised 1996 IPCC Guidelines* and IPCC GPG manuals provide default emission factors for all sources and fairly comprehensive default conversion factors for the most important sources, but only limited guidance on activity data sources. Therefore, for most non-Annex I Parties, the collection of activity data will be one of the most time-consuming tasks in inventory preparation.

There are a number of barriers to **activity data** collection, which might include the lack of data for a certain year, the complete lack of data for any years, or an inconsistent time series of data due to changes over time in definitions, survey methods, etc. Sometimes the data classification systems used in a country are completely different from either international standards or the IPCC inventory format. This has been a common problem for many countries as they try to compile activity data for the Land-Use Change and Forestry inventory sector.

In addition, access to activity data may be restricted (e.g., confidential industry data), it may be difficult to identify the institution in charge of collecting and compiling certain data, or more than one institution may retain the data because of shifts in responsibility among institutions. There also may be legal issues and/or fees associated with obtaining data from certain institutions.

Activity data sources (national, regional and international) should be identified, as well as barriers (e.g., financial or legal) to obtaining the identified data. If conversion factors are needed, sources for these should be identified. If there are gaps in data (e.g., a particular year is missing), approaches for filling these gaps (e.g., extrapolation, interpolation, derivation from proxy data or scientific studies) should be identified and the sources of proxy data identified. In some cases, the data may simply not exist, and the resources for collecting or deriving the needed data may not be available, so emissions cannot be estimated. However, this is unlikely to be the case except for minor sources, as there are international sources of activity data for the primary sources of CO_2, CH_4 and N_2O.

The default **emission factors** in the *Revised 1996 IPCC Guidelines* and IPCC GPG manuals are likely to be appropriate for those sources that are not highly dependent on local conditions. The different tiers of default emission factors allow for incorporation of site-specific controlling variables for other sources that are highly dependent on local conditions. In those cases in which an emission process is highly site-specific and a key source (see Preparation Task 6) and

the default emission factors are not representative of the relevant conditions, it is recommended that Parties search for more appropriate emission factors, if resources allow. Inventories prepared by countries with similar characteristics may be a useful source of such emission factors, so it is often beneficial to consult with such countries. Academic research, especially in the form of peer-reviewed journal articles, is also a potential source, so literature searches can be useful as well. In addition, the IPCC has developed an online emission factor database that may be helpful *(www.ipcc-nggip.iges.or.jp/EFDB/main.php)*. A country might also use a hybrid Tier 1-Tier 2 approach in which only one or two variables (for which there are data) are improved.

In some cases, a Party may choose to develop a local emission factor. However, developing new emission factors is usually a lengthy and expensive undertaking requiring specific engineering and/or scientific expertise, and should only be undertaken in cases where emissions are highly dependent on local conditions that cannot be represented with a higher tier IPCC method and the source is key. The use of alternative emission factors, i.e., non-default emission factors, must be fully documented and ideally would reference a scientific, mainstream publication. It is recommended that countries submit any local emission factors that they have developed to the IPCC emission factor.

It is important to remember that assessment of the availability and quality of activity data, conversion factors and emission factors is an iterative process. Because resources are limited, this activity will always be constrained by available resources. Additional work that could be done, should additional resources become available, should be noted by each source(s) team as this task progresses and incorporated into an Inventory Improvement Strategy (Preparation Task 10). In addition, Parties should prioritise the activity data, conversion factors and emission factors needing improvement. This can be done through the key source analysis (Preparation Task 6).

The accuracy and appropriateness of the activity data, conversion factors and emission factors should be evaluated qualitatively so that the best data available are used. These QC procedures include assessing:

- The data source (e.g., Are the activity data compiled by a recognised source that has rigorous quality control standards and data collection systems? Is the emission factor from a peer-reviewed publication?);
- The reasonableness of the data (e.g., Is the chosen emission factor consistent with current scientific understanding of the emission process? Is the chosen emission factor consistent with the IPCC guidance? Is the time series of activity data consistent with economic trends?); and
- The quality of the data collection process (e.g., were recognised national or international standards used in measuring activity data or emission levels).

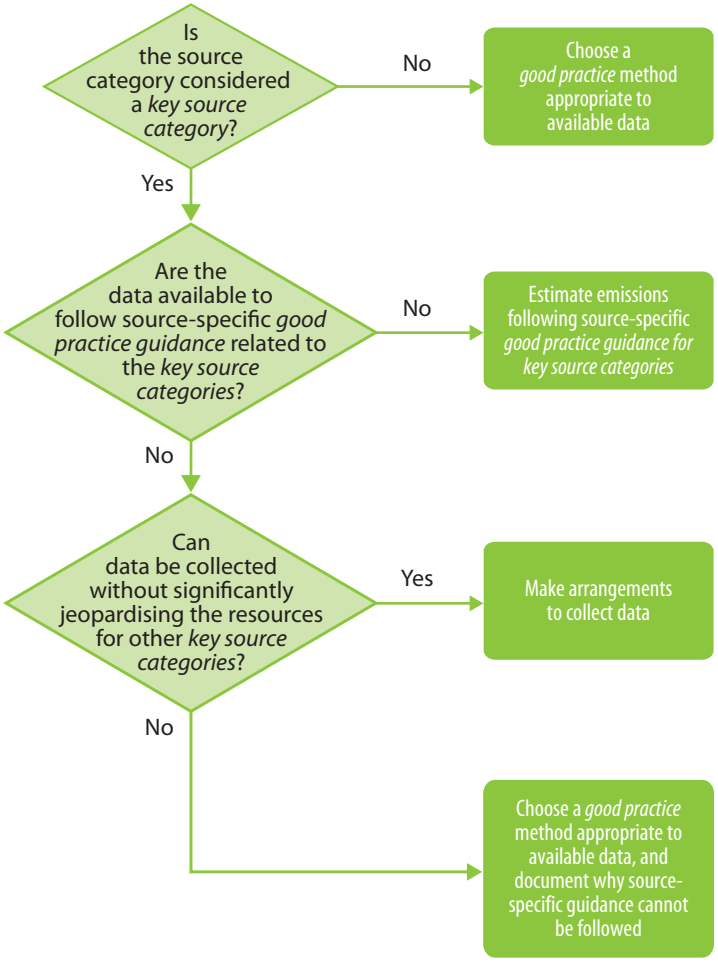
More detailed guidance is provided in the section on source-specific QC procedures in the IPCC GPG 2000 (Chapter 8.7 of IPCC 2000).

Preparation Task 2: Determine Methods and Compile Data

Once an initial assessment of data availability and quality is completed, the appropriate inventory methodology can be determined. In reality, this is sometimes an iterative process, i.e., after data availability and quality are assessed, an initial method is chosen, and more data collection ensues during which more or less data, or data of better or worse quality, are uncovered, and then the initial method or a different method (or different approach with the same method) is finally chosen. As in Preparation Task 1, source(s) teams should note if there is additional work that could be done, but was not done due to resource constraints. This "wish list" of additional activities can then be incorporated into the Inventory Improvement Strategy in Preparation Task 10.

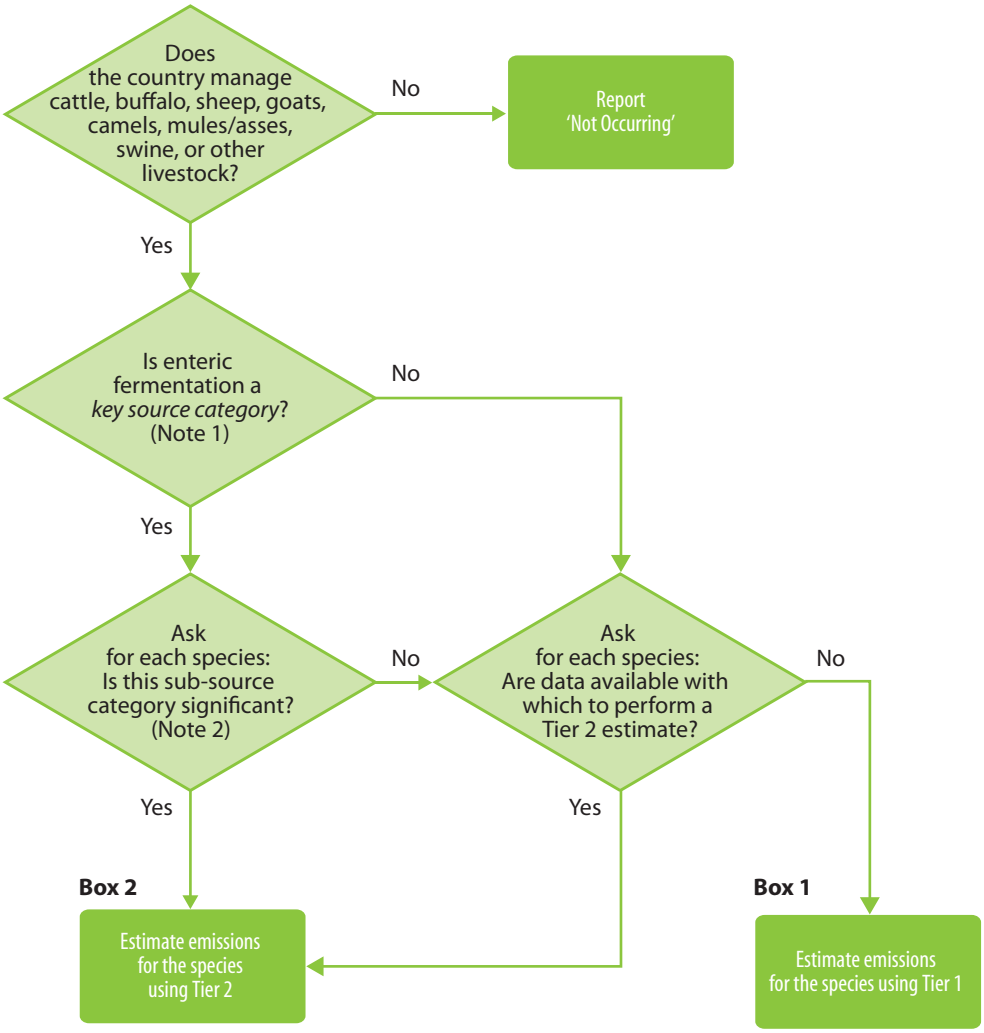
The IPCC GPG manuals contain decision trees to help Parties choose the methodology most suited to national circumstances. The IPCC guidance is organised into tiers that differ mainly in their level of accuracy and complexity. The higher tiers typically require more disaggregated activity data and source-specific, technology-specific, region-specific and/or country-specific emission factors. The most appropriate estimation method depends on whether a source is key, what data are available, and the level of financial and human resources that are available. If a source is key, the IPCC GPG encourages Parties to use the good practice methods for key sources (see Figure 4.1), which are usually Tier 2 or higher, although this is not always the case. Parties should refer to the source-specific decision trees for guidance on the specific application of this principle to each source. Figure 4.2 contains a relatively simple example of a source-specific decision tree. If a country has not undertaken key source analysis, then the choice of method will depend on the availability of data, and financial and human resources. However, policy considerations may also play a role in these decisions, such as the relevance of a source to potential projects under the Clean Development Mechanism (CDM).

Figure 4.1: Decision Tree to Choose a Good Practice Method



Source: Figure 7.4, p. 7.15, Chapter 7, IPCC (2000)

Figure 4.2: An Example of an IPCC GPG Decision Tree



Source: Figure 4.2, p. 4.24, Chapter 4, IPCC (2000)

Note 1: A key source category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions, the trend in emissions, or both. (See Chapter 7, Methodological Choice and Recalculation, Section 7.2, Determining National Key Source Categories.)

Note 2: As a rule of thumb, a sub-source category would be significant if it accounts for 25-30% of emissions from the source category.

Once the method is chosen, the requisite activity data, conversion factors and emission factor must be compiled. Much of this work may have already been done under Preparation Task 1. However, the source team should verify that all the data and all the related information that needs to be documented (e.g., data sources, assumptions in using data and decisions regarding data choice, etc) have been collected and compiled in appropriate formats.

When commencing preparation of a second or subsequent GHG inventory, it is prudent to ask whether the previous choice of method is still appropriate, and if the activity data and emission factor are still the best available. If the answers are yes, then this task will mostly consist of: 1) verifying that the earlier selected methods and data will produce the most accurate estimates (given available resources), and 2) collecting the activity data needed for another year of assessment.

However, as inventory capacity and data availability improve, the methods and data used to estimate emissions should be updated and refined, assuming such changes or refinements result in more accurate and/or complete estimates and sufficient resources are available. These changes or refinements are referred to as **recalculations**.

Recalculations are encouraged as a part of good practice in order to increase inventory accuracy, completeness, consistency and transparency. Chapter 7.3 of the IPCC GPG 2000 defines two types of recalculations:

- A **methodological change** occurs when an inventory agency uses a different tier to estimate emissions from a source category or when it moves from a tier described in the *Revised 1996 IPCC Guidelines* to a national method. Methodological changes are often driven by the development of new and different data sets.
- A **methodological refinement** occurs when an inventory agency uses the same tier to estimate emissions but applies it using a different data source or a different level of aggregation.

There are a number of reasons for considering recalculations when preparing an inventory. These are discussed in detail in Chapter 7 of IPCC GPG 2000 (pages 7.17-7.18). The most important to consider are:

- Are any new data available?
- Are the methods applied consistent with IPCC Good Practice Guidance?
- Has a source become key?
- Does the current methodology reflect mitigation efforts appropriately and transparently?
- Has the national capacity for inventory preparation increased?
- Are new methods available?

In addition, inventory agencies may identify new sources that have not been included in the inventory before, or may find errors in the previous inventory. It is good practice to implement changes in emission estimates due to either of these two circumstances, although such revisions are not formally considered a methodological change or refinement.

All emission estimates in a time series should be consistent, i.e., they should be based on the same method and emission factor and the activity data should be from one source. Therefore, if recalculations are implemented, all previously submitted estimates for all years should be evaluated for consistency and recalculated if necessary. (Some changes or refinements will not be applicable across all years, such as adjustments to account for mitigation implementation midstream in the inventory time series.)

Sometimes it will not be possible to use the same method in all years. For example, the data needed to implement a new method may not be available for all years. IPCC GPG 2000 (Chapter 7, pages 7.18-7.21) describes four types of alternative recalculation techniques that can be used if full recalculation using the same method is not possible:

- *Overlap method:* In which the emission estimates for the years when the new method cannot be used are derived by proportionally adjusting the old method estimates for the missing years based on the relationship (overlap) between the time series using the old method and the time series using the new method;
- *Surrogate method:* In which the missing estimates are derived from trends in underlying activity or other indicative data;
- *Interpolation:* In which the missing estimates are derived by interpolating between estimates; and
- *Trend extrapolation:* In which missing estimates are derived by extrapolating forward or backward in time.

In addition, the IPCC GPG 2000 mentions it may be necessary to develop a customised alternative recalculation technique, when, for example, factors controlling emissions are highly variable over time.

- As always, it is good practice to clearly document and report recalculations. In general, the following information should be provided whenever recalculations are undertaken:
- The effect of the recalculations on the level and trend of the estimate;
- The reason for the recalculation;
- A description of the changed or refined method;
- Justification of the recalculation in terms of improvement in accuracy, transparency, or completeness;
- The approach used; and
- The rationale for selecting the approach.

Preparation Task 3: Conduct Emission Calculations and Complete Text Sections

Under this task, the source team members will prepare the inventory calculation spreadsheets and the inventory text sections. If the inventory team is using the IPCC software, then data will only need to be inputted into the worksheets and tables.

A Party may choose to revise the IPCC software worksheets (e.g., to incorporate revisions from the IPCC GPG manuals or to incorporate new sections for documentation) or design its own worksheets. If a Party designs its own worksheets, it is recommended that particular attention be given to linking source and sectoral spreadsheets to summary spreadsheets so that summary estimates are calculated automatically and data entry errors are minimised. In cases where activity data are used in more than one source (e.g., manure data in CH_4 from manure management, N_2O from manure management and N_2O from agricultural soil management), it may be useful to link the source worksheets so that the activity data will only need to be entered once and data entry errors are minimised. *Note, however, that designing a complete set of worksheets for a national GHG inventory is a complex and labour-intensive process and should* ***only*** *be undertaken if it will not compromise a Party's ability to complete an accurate, complete, consistent and transparent inventory.*

The worksheets and text sections should follow the content and format instructions outlined in the overall inventory preparation instructions and the source(s) preparation instructions, and according to the schedules in these instructions. It is likely that several versions of both the spreadsheets and text sections will be prepared, with internal or external reviews between each version, as was illustrated in the hypothetical schedules in Tables 3.1 and 3.2. As described below under Preparation Task 4, thorough QC procedures (internal reviews) should be undertaken throughout implementation of this task. Both the spreadsheets and text should also include complete documentation (see Preparation Task 8). Additional forms of documentation may be needed, such as memos describing how a particular method was implemented, especially if the IPCC software is used, because these worksheets in general do not provide space for documentation.

Preparation Task 4: Complete Quality Assurance/Quality Control (QA/QC) Procedures

A good QA/QC plan is important for the preparation of a reliable, defensible emissions inventory. This task describes the procedures for implementing QC and QA on GHG inventories as described in Chapter 8 of the IPCC GPG 2000. While not obligatory for non-Annex I Parties, it is recommended that countries institute some level of both QC and QA, depending on resources available, as this will contribute to improved transparency, consistency, comparability, completeness and confidence in the national inventory.

QA/QC procedures that are considered minimal under good practice guidance are:

1. Tier 1 General Inventory Level QC procedures (see below); and
2. A peer review of the inventory (i.e., one round of QA).

Although QA/QC procedures can take significant time and effort, their implementation will save time in the long run by reducing invalid results and ensuring transparency. In addition, a thorough QA/QC system ensures confidence in the inventory, and QA may uncover new data and methods.

QC and QA, as defined by the IPCC GPG 2000, are two distinct processes.

- **QC** is a system of routine, planned technical activities to measure and control the quality of the inventory as it is being prepared. The inventory team typically implements the QC procedures, which include:
  - Routine and consistent checks to ensure data integrity, correctness and completeness;
  - Routine and consistent checks to identify errors and omissions;
  - Accuracy checks on data acquisition and calculations and the use of approved standardised procedures for emissions calculations, emissions measurements, estimating uncertainties, documentation, archiving and reporting; and
  - Technical reviews of data, methods and results.

- **QA** is a planned system of review, and sometimes audit, procedures conducted by personnel not involved in the inventory development process. Reviews, preferably by independent third parties, are performed on a finalised inventory following implementation of the QC procedures. These reviews:
  - Verify that data quality objectives were met;
  - Ensure that the inventory represents the best possible estimates of emissions and sinks given current scientific understanding and data availability; and
  - Support the QC programme.

The level of QA/QC activities that should be implemented will depend on practical considerations such as: i) available resources and expertise, ii) the overall inventory schedule, and iii) the particular characteristics of the inventory, especially the tiers of methods used to estimate emissions. Resources should be focused on priority areas, such as key categories and sources for which data or methodological changes have occurred since the last inventory. The appropriate level of QC should be performed *prior* to releasing the inventory to outside reviewers. All QC and QA must be

completed before submitting the inventory to the UNFCCC Secretariat.

Quality Control Procedures

There are two tiers of inventory QC:

1. Tier 1: General QC Procedures; and
2. Tier 2: Source-Specific QC Procedures.[14]

The Tier 1 procedures are generic to the entire inventory, while the Tier 2 procedures are directed at the specific data and methods of a particular source. Unlike inventory accounting methods, the Tier 2 QC procedures are in *addition* to the Tier 1 procedures. Both tiers of QC should only be implemented for those sources for which the methods and data warrant Tier 2 QC, if sufficient resources are available.

The **Tier 1: General QC Procedures** encompass all the routine checks that an inventory team should make as they compile the inventory to ensure that processing, handling, documenting, archiving and reporting procedures are correct and complete. These procedures, which pertain to both spreadsheets and inventory text sections, are listed in Table 4.1. Automated checks are encouraged where possible, but a combination of automated and manual checks is most effective.

QC procedures should be applied irrespective of the type of data used to develop the inventory, and are equally applicable to default data and national data. Even if QC procedures have already been implemented on official national statistics that are used in the inventory, it is good practice to confirm that procedures equivalent to those in Table 4.1 have been implemented. In cases where outside consultants or agencies prepare the inventory estimates, the outside entities should perform these procedures and their results reviewed by the inventory team.

The QC procedures to be carried out by the inventory team should be clearly defined and the results of these procedures documented. It is recommended that non-Annex I Parties consider developing standardised checklists for this task. These checklists could be based on Table 4.1, with columns added for the names of the responsible parties and a description of the actions taken. Typically, one checklist for each source would be compiled.

Table 4.1: Tier 1 General Inventory Level QC Procedures

QC Activity	Procedures
Check that assumptions and criteria for the selection of activity data and emission factors are documented.	• Cross-check descriptions of activity data and emission factors with information on source categories and ensure that these are properly recorded and archived.
Check for transcription errors in data input and references.	• Confirm that bibliographical data references are properly cited in the internal documentation. • Cross-check a sample of input data from each source category (either measurements or parameters used in calculations) for transcription errors.
Check that emissions are calculated correctly.	• Reproduce a representative sample of emissions calculations. • Selectively mimic complex model calculations with abbreviated calculations to judge relative accuracy.
Check that parameter and emission units are correctly recorded and that appropriate conversion factors are used.	• Check that units are properly labelled in calculation sheets. • Check that units are correctly carried through from beginning to end of calculations. • Check that conversion factors are correct. • Check that temporal and spatial adjustment factors are used correctly.

[14]The terminology used in the IPCC GPG manuals is slightly different. The IPCC GPG 2000, which just addresses emission processes (i.e., all inventory sectors except LUCF), refers to the Tier 2 procedures as "Source Category-Specific QC Procedures." The IPCC GPG 2003, which addresses carbon 'emission and sequestration processes (sources and sinks) refers to the Tier 2 procedures as "Source or Sink Category-Specific QC Procedures." This handbook uses the term "Source-Specific QC Procedures" so that terminology is internally consistent, but this term is meant to encompass QC procedures for both sources and sinks.

Table 4.1: Tier 1 General Inventory Level QC Procedures (continued)

QC Activity	Procedures
Check the integrity of database files.	• Confirm that the appropriate data processing steps are correctly represented in the database. • Confirm that data relationships are correctly represented in the database. • Ensure that data fields are properly labelled and have the correct design specifications. • Ensure that adequate documentation of database and model structure and operation are archived.
Check for consistency in data between source categories.	• Identify parameters (e.g., activity data, constants) that are common to multiple source categories and confirm that there is consistency in the values used for these parameters in the emissions calculations.
Check that the movement of inventory data among processing steps is correct.	• Check that emissions data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries. • Check that emissions data are correctly transcribed between different intermediate products.
Check that uncertainties in emissions and removals are estimated or calculated correctly.	• Check that qualifications of individuals providing expert judgement for uncertainty estimates are appropriate. • Check that qualifications, assumptions and expert judgements are recorded. Check that calculated uncertainties are complete and calculated correctly. • If necessary, duplicate error calculations or a small sample of the probability distributions used by Monte Carlo analyses.
Undertake review of internal documentation.	• Check that there is detailed internal documentation to support the estimates and enable duplication of the emission and uncertainty estimates. • Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review. • Check integrity of any data archiving arrangements of outside organisations involved in inventory preparation.
Check methodological and data changes resulting in recalculations.	• Check for temporal consistency in time series input data for each source category. • Check for consistency in the algorithm/method used for calculations throughout the time series.
Undertake completeness checks.	• Confirm that estimates are reported for all source categories and for all years from the appropriate base year to the period of the current inventory. • Check that known data gaps that result in incomplete source category emissions estimates are documented.
Compare estimates to previous estimates.	• For each source category, current inventory estimates should be compared to previous estimates. If there are significant changes or departures from expected trends, recheck estimates and explain any difference.

Source: Table 8.1, p. 8.8-9, Chapter 8, IPCC (2000)

The **Tier 2: Source-Specific QC Procedures** encompass activities that evaluate the: 1) emission factors, activity data and conversion factors used in the inventory; 2) the resultant emission estimates; and 3) the uncertainty estimates. These activities include:

- Assessing the applicability of default emission factors;
- Assessing the adequacy of QC and QA performed during development of country-specific emission factors, and assessing the reasonableness and applicability of country-specific emission factors;
- Checking the quality of direct emission measurements;
- Assessing the consistency, completeness and reasonableness of emission estimates and of trends in emission estimates;
- Evaluating the QA/QC performed on activity data and conversion factors obtained from secondary sources (e.g., national or international data sets) and checking the reasonableness of these data;
- Undertaking QC checks on site-specific activity data; and
- Undertaking QC checks on uncertainty estimates.

Specific guidance on how to implement these activities is provided in section 8.7 of Chapter 8 and the source-specific chapters of IPCC GPG 2000 and Chapters 3 and 5 of IPCC GPG 2003. A much more detailed explanation of QA/QC procedures can be found Chapter 8 and the source-specific chapters of the IPCC GPG 2000, and Chapters 3 and 5 of the IPCC GPG 2003.

Quality Assurance Procedures

The purpose of implementing QA procedures is to independently assess the quality of the inventory and to identify where improvements could be made. It is recommended countries use reviewers who have not been involved in preparing the inventory and complete QA activities sufficiently in advance of UNFCCC submission to be able to correct problems that are identified during QA (see Table 3.1 for an example of such scheduling).

If there is insufficient local capacity to carry out QA procedures, non-Annex I Parties may approach regional institutions or international organisations. The UNDP and UNEP will offer feedback on the GHG inventory to any non-Annex I Party that requests this service through the National Communications Support Programme. Nonetheless, local peer reviews should be considered a very useful capacity building task. Similarly, undertaking peer review for other Parties can be a worthwhile opportunity to build capacity by learning from others' experiences.[15]

The IPCC GPG 2000 identifies two types of QA: 1) expert peer review; and 2) audits. An **expert peer review** is a technical review of calculations and assumptions by experts in relevant fields. It is usually accomplished by reviewing the inventory documentation and ensuring that assumptions and procedures are reasonable, and the inventory is transparent and complete. It usually does not include rigorous certification of data, results or references. Expert review should be undertaken after all QC has been completed and revisions resulting from QC have been implemented, because expert review will not uncover simple errors such as data entry errors and incorrect unit conversions.

No specific tools are required to conduct a peer review, but the use of review forms is recommended, both for instructing the reviewers and for documenting the reviewers' findings. Instructions ensure that reviewers have a clear understanding of what they are expected to do (see Annex 3 for an example). Each reviewer should carefully document the results of their review, preferably using a standardised form or report, such as a checklist.

An **audit** is also an independent review of the inventory, but may occur at any time during inventory preparation, and typically is used either to evaluate how well the inventory team has complied with the minimum QC specifications outlined in their QC plan, or may entail a rigorous certification of inventory data, results and references.

Preparation Task 5: Complete Uncertainties Analysis

Under Decision 17/CP.8, non-Annex I Parties are encouraged to provide information on the level of uncertainty associated with inventory data and their underlying assumptions, and to describe the methodologies used, if any, for estimating these uncertainties. It is important that Parties develop and report qualitative and, if possible, quantitative estimates of uncertainty as part of their GHG inventories because such information can help prioritise efforts to improve the accuracy of inventories in the future and guide decisions on methodological choice.

Uncertainties in national GHG inventories arise from three different processes (IPCC 2000):

- Uncertainties in definitions of sources or sinks or other;
- Uncertainties from natural variability of the process that produces an emission or uptake; and
- Uncertainties resulting from the assessment of the process or quantity, including (depending on the method used):
- uncertainties from measuring;

[15]Non-Annex I Party experts can register their interest in becoming involved in the UNFCCC Annex I review process if they are on the UNFCCC Roster of Experts. The guidelines can be found on the UNFCCC website (unfccc.int) under Parties and Observers.

- uncertainties from sampling;
- uncertainties from reference data that may be incompletely described; and
- uncertainties from expert judgement.

Use of the IPCC inventory guidance, especially the reporting structure, should eliminate most, if not all, of the first type of uncertainty and help to minimise the other types of uncertainty. However, despite efforts to reduce uncertainties, significant uncertainties are likely to remain, and they will vary widely among sources, gases and countries.

The IPCC inventory guidance provides for several levels of uncertainty assessment. The inventory reporting tables presented in Volume 1 of the *Revised 1996 IPCC Guidelines* include a section for reporting of a simple *qualitative* assessment of uncertainty for each source (see Table 8A and the associated notation key in IPCC [1997]). This assessment entails evaluating whether confidence in the emission estimation is "high", "medium" or "low." Non-Annex I Parties are encouraged, at a minimum, to complete this table.

The *Revised 1996 IPCC Guidelines* also provide some initial guidance for developing *quantitative* uncertainty information (in Annex 1, Volume 1). Uncertainties in the emission factors and activity data are expressed as the 95% confidence intervals. (Note that the sector-specific chapters of IPCC inventory guidance provide quantitative estimates of uncertainties for some default emission factors). Annex 1 also describes briefly procedures for combining emission factor and activity data uncertainties to derive uncertainties for source emission estimates and for total emission estimates for each gas. If quantitative uncertainty ranges are estimated using these methods, they should be reported in a second set of Sectoral and Summary Report Tables (the first set would include the point estimates – see Step 2, Chapter 2 of Volume 1 of the *Revised 1996 IPCC Guidelines*).

Chapter 6 of IPCC GPG 2000 includes much more comprehensive information on identifying and quantifying uncertainties, and more sophisticated methodologies. More detailed guidance on estimating uncertainties associated with different types of emission factors and activity data (i.e., on estimating 95% confidence intervals), both from empirical data and through the use of expert judgement, are presented. Thorough descriptions of Tier 1 and Tier 2 methodologies for combining uncertainties are also presented. Both tiers include methods for estimating uncertainties in absolute emission levels as well as in the trends.

The **Tier 1 method** is essentially a significantly expanded and more comprehensive version of the method described in the *Revised 1996 IPCC Guidelines*. It is relatively easy to implement, and the spreadsheet that can be used for calculations and reporting is included in the manual (Table 6-1 of IPCC [2000]). The **Tier 2 method** uses Monte Carlo techniques to estimate uncertainties at the source level, the gas level and for the inventory as a whole. It is more complicated that the Tier 1 method, and requires the purchase of software to implement.[16] The IPCC GPG 2000 provides a table for reporting the results of the Monte Carlo analysis (Table 6-2). The reader should refer to Chapter 6 of IPCC GPG 2000 for a thorough discussion of these methodologies.

Preparation Task 6: Undertake Key Source Analysis

When preparing the inventory for the first time, a Party prepares estimates for all emissions and removals requested by the UNFCCC, as appropriate and to the extent possible. For future inventories, the IPPC GPG manuals recommend that inventory improvements focus on **key sources** to make the best use of available financial and human resources. In particular, the IPCC GPG recommends that higher tier methods be applied to key sources and that key sources receive additional attention with respect to QA and QC. Therefore, it is recommended that Parties undertake key source analysis after they have completed one GHG inventory.

A key source is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct GHGs[17] in terms of the absolute level of emissions, the trend in emissions, or both (IPCC 2000, 2003).[18] A Party that has prepared one emissions inventory will be able to identify key sources in terms of their contribution to the absolute level of national emissions. For those Parties that have prepared a time series, key sources can be identified in terms of their contribution to both the absolute level and the trend in emissions, i.e. not just the largest sources (level) but also the sources that are growing more rapidly or more slowly than total national GHG emissions (trend). This type of analysis will indicate which sources are likely to become more, or less, important in the future.

[16]There are several commercially available software tools that can be used to perform Monte Carlo simulations. Several are discussed in Chapter 6 of IPCC (2000).

[17]The direct GHGs in a national GHG inventory are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

[18]The terminology used in the IPCC GPG manuals is slightly different. The IPCC GPG 2000, which just addresses emission processes (i.e., all inventory sectors except LUCF or LULUCF), uses the term "key source categories". The IPCC GPG 2003, which addresses carbon emission and sequestration processes (sources and sinks) uses the term "key categories". This handbook uses the term "key sources" so that terminology is internally consistent, but this term is meant to encompass procedures for both key sources and key sinks.

The first step in a key source analysis is to define the level of detail at which the analysis will be done. Table 4.2 lists the sources that should be analysed according to IPCC good practice.[19]

Table 4.2: Suggested IPCC Sources to be Included in Key Source Analysis a,b

Source Categories to be Assessed in Key Source Category Analysis	Special Considerations
ENERGY	
CO_2 Emissions from Stationary Combustion	Disaggregate to the level where emission factors are distinguished. In most inventories, this will be the main fuel types. If emission factors are determined independently for some sub-source categories, these should be distinguished in the analysis.
Non-CO_2 Emissions from Stationary Combustion	Assess CH_4 and N_2O separately.
Mobile Combustion: Road Vehicles	Assess CO_2, CH_4 and N_2O separately.
Mobile Combustion: Water-borne Navigation	Assess CO_2, CH_4 and N_2O separately.
Mobile Combustion: Aircraft	Assess CO_2, CH_4 and N_2O separately.
Fugitive Emissions from Coal Mining and Handling	If this source is key, it is likely that underground mining will be the most significant sub-source category.
Fugitive Emissions from Oil and Gas Operations	This source category comprises several sub-source categories which may be significant. Inventory agencies should assess this source category, if it is key, to determine which sub-source categories are most important.
INDUSTRIAL PROCESSES	
CO_2 Emissions from Cement Production	
CO_2 Emissions from Lime Production	
CO_2 Emissions from the Iron and Steel Industry	
N_2O Emissions from Adipic Acid and Nitric Acid Production	Assess adipic acid and nitric acid separately.
PFC Emissions from Aluminium Production	
Sulfur hexafluoride (SF_6) from Magnesium Production	
SF_6 Emissions from Electrical Equipment	
SF_6 Emissions from Other Sources of SF_6	

[19]This table does not include sources and removals in LUCF inventory sector. A similar table that includes the LUCF sector (renamed LULUCF) is included in IPCC GPG 2003 (Table 5.4.1); this table should be followed by those Parties that have moved to the accounting system defined by IPCC GPG 2003. If a Party wishes to include the LUCF sector in its key source analysis, but is not yet ready to use the accounting system defined by IPCC GPG 2003, it is suggested that the sources and sinks defined by the IPCC reporting structure for LUCF (contained in Table 5 of the reporting tables in Volume 1 of IPCC [1997]) could be used. The absolute values of the net flux estimates for these sources and sinks would be used in the analysis, and the analysis should be performed both without LUCF and then with LUCF, as is done with LULUCF in IPCC GPG 2003.

Table 4.2: Suggested IPCC Sources to be Included in Key Source Analysis a,b (continued)

Source Categories to be Assessed in Key Source Category Analysis	Special Considerations
INDUSTRIAL PROCESSES (Continued)	
SF_6 Emissions from Production of SF_6	
PFC, HFC, SF_6 Emissions from Semiconductor Manufacturing	Assess emissions from all compounds jointly on a GWP-weighted basis, since they are all used in similar fashions in the process.
Emissions from Substitutes for Ozone Depleting Substances (ODS Substitutes)	Assess emissions from all HFCs and PFCs used as substitutes for ODS jointly on a GWP-weighted basis, given the importance of having a consistent method for all ODS sources.
HFC-23 Emissions from HCFC-22 Manufacture	
AGRICULTURE	
CH_4 Emissions from Enteric Fermentation in Domestic Livestock	If this source category is key, it is likely that cattle, buffalo and sheep will be the most significant sub-source categories.
CH_4 Emissions from Manure Management	If this source category is key, it is likely that cattle and swine will be the most significant sub-source categories.
N_2O Emissions from Manure Management	
CH_4 and N_2O Emissions from Savannah Burning	Assess CH_4 and N_2O separately.
CH_4 and N_2O Emissions from Agricultural Residue Burning	Assess CH_4 and N_2O separately.
Direct N_2O Emissions from Agricultural Soils	
Indirect N_2O Emissions from Nitrogen Used in Agriculture	
CH_4 Emissions from Rice Production	
WASTE	
CH_4 Emissions from Solid Waste Disposal Sites	
Emissions from Wastewater Handling	Assess CH_4 and N_2O separately.
Emissions from Waste Incineration	Assess CO_2 and N_2O separately.
OTHER	Other sources of direct greenhouse gas emissions not listed above should also be included, if possible.

[a] The LUCF sector is not included in this table. In principle, the LUCF sources and sinks, as defined by the IPCC reporting structure (see Table 5 of the reporting tables in Volume 1 of IPCC [1997]), could be included by using absolute values of the net flux estimates for these sources and sinks. If a Party has moved to LULUCF accounting, as defined by IPCC (2003), that Party should use Table 5.4.1 in IPCC (2003).

[b] In some cases, inventory agencies may make some modification to this list of IPCC source categories to reflect particular national circumstances.

Source: Table 7.1, p. 7.7, Chapter 7, IPCC (2000)

Parties should use the following guidelines when determining the appropriate level of analysis (see section 7.2 of IPCC [2000] for more detail):

- Perform the analysis at the level at which the IPCC methods are described and use emission estimates in CO_2-equivalent units;
- In general, for sources that emit more than one gas, treat each GHG separately (it may make sense to combine HFCs and PFCs for some sources);
- Aggregate sources that use the same emission factors based on common assumptions.

In addition, it is recommended that inventory teams determine, for each key source, if certain sub-sources (e.g., cattle within CH_4 Emissions from Enteric Fermentation) represent a significant share of emissions. It may be appropriate to focus methodological improvement efforts on the most significant sub-sources.

The IPCC GPG manuals provide both quantitative and qualitative approaches to identifying key sources, both of which should be undertaken if resources allow. These approaches are described below. The quantitative approaches include both Tier 1 and Tier 2 methods. For most sources, the Tier 1 quantitative method is simple to perform and can be easily calculated in a spreadsheet. The more sophisticated Tier 2 quantitative approach uses the results of uncertainty analysis, so it requires that source uncertainties have been calculated. The results of the key source analysis should be fully documented.

Quantitative Key Source Analysis Methods

The **Tier 1 quantitative method** to identify key sources includes a level assessment and a trend assessment. The **Tier 1 level assessment** ranks each source according to its contribution to the total GWP-weighted emissions. Key sources are defined as those which, when summed together in descending order of magnitude, add up to over 95% of total emissions. This cumulative emissions threshold is based on research that indicates that for most inventories, a 95% threshold will capture 90% of the inventory uncertainty. (For a more detailed explanation of how the threshold of 95% was chosen, refer to pages 7.10-7.12. of IPCC [2000] and pages 5.42-5.44 of IPCC [2003]).

The **Tier 1 trend assessment** will identify those sources that have a trend that is different from the trend in total GHG emissions. In the Tier 1 trend method, the absolute value of the difference between the source trend and the total emissions trend is calculated, and this absolute value is weighted by the source level assessment (see pages 7.9-7.10 of IPCC [2000] for the equation and guidance). The source trend assessments are summed together in descending order of magnitude, and those that account for 95% of the total trend are considered key. *At least two years of inventory data are needed to implement this method.*

The **Tier 2 quantitative method** uses source uncertainties. In the **Tier 2 level assessment**, the Tier 1 level assessment for each source is multiplied by its uncertainty. Note that the result will be identical to that of the Tier 1 source uncertainty assessment, so if a Tier 1 source uncertainty assessment has been performed, it is not necessary to undertake the Tier 2 level assessment. In the **Tier 2 trend assessment**, the Tier 1 trend assessment for each source is multiplied by its uncertainty. The results of both the Tier 2 level and trend assessments should be summed together in descending order of magnitude, as in the Tier 1 methods, but the key source threshold can be adjusted, if necessary, to explicitly reflect 90% of the uncertainty in the national inventory. If available, source uncertainties generated by Monte Carlo analysis can be used in these methods. For a more detailed explanation of the Tier 2 key source assessment methods, refer to pages 7.12-7.13 of IPCC (2000).

Qualitative Key Source Analysis Methods

The quantitative analysis of key sources may not identify all sources that should be considered key, so the IPCC GPG manuals provide a list of qualitative criteria to address specific circumstances that cannot be readily reflected in the quantitative assessment. These criteria should be applied to categories not identified in the quantitative analysis and, if additional sources are identified, they can be added to the list of key sources. The criteria are:[20]

- Sources that are being reduced, or sinks that are being increased, through the use of GHG mitigation technologies should be identified as key.
- Sources or sinks that are expected to grow significantly in the future should be identified as key. For non-Annex I Parties, economic changes may be among the most drivers of such growth in emissions.
- If uncertainties are not taken explicitly into account in the key source analysis (via a Tier 2 analysis), inventory teams should consider identifying the more uncertain sources as key.
- If emissions or removals are unexpectedly high or low, they should be identified as key.
- Sources or sinks that result from changes in large carbon stocks may become significant if higher tier methods are used to estimate flux.
- If emissions from deforestation are significant, deforestation may be defined as a specific source and considered key.
- If the inventory is not complete (i.e., all sources have not

[20] These criteria are from IPCC (2003), which is a refined version of the criteria listed in IPCC (2000).

been estimated), potential sources should be evaluated using these qualitative criteria to determine if there are any potential key sources. Inventories of countries with similar circumstances can give indications of potential key sources.

Some general, tentative rules of thumb for assessing key sources in non-Annex I countries are provided in Box 4.1 *This advice should be used with great care and only in cases where better information is not available.*

Preparation Task 7: Complete Reporting

Reporting of the national GHG inventory for the national communication by non-Annex I Parties is governed by decisions of the COP, which uses guidance prepared by both the COP and the IPCC. These aspects of reporting, as well as optional additional reporting, are discussed below.

UNFCCC Reporting Guidance

COP Decision 17/CP.8 contains the UNFCCC guidelines

Box 4.1: General Rules of Thumb to Assess Key Sources in Non-Annex I Parties

Energy
- CO_2 emissions from stationary combustion and road transport are key in many non-Annex I countries.
- For CH_4 and N_2O emissions from combustion, particular attention should be paid to biomass combustion and road transport.
- Fugitive emissions of CH_4 from coal mining and processing and oil and gas operations, can be expected to be key in countries with a high level of production and/or a high level of gas transport.

Industrial Processes
- If a certain industrial process is performed in the country on a significant scale it should initially be expected to be key.
- The most common sectors are the iron, steel and cement industries.
- Lime production, ammonia production and aluminium production may also be key

Agriculture
- CH_4 emissions from enteric fermentation are likely to be key in countries with large ruminant populations (cattle and sheep are the most likely contributors).
- CH_4 emissions from manure management are likely to be key in countries with large confined animal operations (cattle and swine are the most likely contributors).
- N_2O emissions from agricultural soils may be key in countries that use large amounts of fertilizer or that cultivate large quantities of legumes.
- CH_4 emissions from rice production are likely to be key in countries where rice production is significant.
- CH_4 and N_2O emissions from savannah burning and burning of agricultural residues may be key in some countries.

LUCF[1]
- CO_2 removals from changes in forest and other woody biomass stocks may be key in countries in which large areas are being planted with trees and/or large areas of managed forests are young and growing rapidly.
- CO_2 emissions from forest and grassland conversion may be key in countries with high rates of deforestation.
- CO_2 emissions and removals from soil may be key in countries with high rates of land-use change, particularly deforestation and in countries with large areas of land under cultivation with traditional tillage practices.

Waste
- CH_4 emissions from solid waste disposal may be key in non-Annex I countries that manage solid wastes in landfills.

SF_6, PFCs, HFCs
- For many countries, these gases have little effect on the level determination.
- In countries producing aluminium, PFCs from this process may be key.
- In countries producing magnesium, SF_6 emissions from this process may be key.

[1] This section assumes that a Party has not yet moved to LULUCF accounting, as defined by IPCC (2003), but is interested in evaluating its LUCF sector for key sources.

that non-Annex I Parties should use for the preparation of their second national communication, and third and initial national communications if appropriate, as of November 2002. For reporting the national GHG inventory component of the national communications, these guidelines encourage non-Annex I Parties to:

- report on all gases;
- include additional information on data collection and archiving procedures, institutional arrangements, data sources and inputs, methodologies, assumptions, data improvement needs and uncertainties; and
- undertake key source analysis.

In addition, Parties are directed to report emissions from international aviation and marine bunker fuels separately and to use the 100-year global warming potentials from the IPCC's Second Assessment Report for reporting aggregated emissions. Together with COP Decision 13/CP.9, these guidelines encourage non-Annex I Parties to apply the IPCC GPG as appropriate.

For reporting inventory input data and results, the UNFCCC guidelines in Decision 17/CP.8 encourage non-Annex I Parties to use tables 1 and 2 contained therein, as well as the sectoral tables and worksheets (in both electronic and hard copy format) of the IPCC (these are the "sectoral and summary report tables" contained in the Reporting Instructions of the *Revised 1996 IPCC Guidelines* and the "worksheets" contained in the Workbook of the *Revised 1996 IPCC Guidelines*, both of which are included the IPCC inventory software).[21] Collectively, these tables and worksheets will provide a reader of the national inventory with a good understanding of the data inputs and results. However, if Parties choose to provide additional information about data collection and archiving, institutional arrangements, data sources and inputs, methodologies, assumptions, data improvement needs, numerical uncertainties and key sources, additional material will need to be included in the inventory component of the national communication.

Decision 17/CP.8 also invites non-Annex I Parties, when preparing their national communication, to use elements from the guidelines for the preparation of national communications from Annex I Parties. The portion of these Annex I guidelines that pertain to inventories is entitled *"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines of annual inventories"*. Several versions of the Annex I inventory guidelines have been completed since the UNFCCC entered into force; the two most recent versions may be relevant here:

1. The guidelines adopted at COP8 and contained in COP document FCCC/CP/2002/8[22] reflect the *Revised 1996 IPCC Guidelines* and *IPCC GPG 2000* and are to be used by Annex I Parties starting with inventories that were due in 2004.
2. The guidelines adopted at COP9 and contained in COP document FCCC/SBSTA/2004/8[23] are the same as those in FCCC/CP/2002/8 except that revisions required by *IPCC GPG 2003* have been incorporated. These guidelines are to be used by Annex I Parties for a trial period starting with inventories that were due in 2005.

These UNFCCC inventory guidelines for Annex I Parties contain the **common reporting format** (CRF) tables, which non-Annex I Parties may want to consider using for reporting. The CRF tables contain less information than the combination of completed tables 1 and 2 contained in the annex to Decision 17/CP.8 and the completed IPCC sectoral and summary report tables,[24] but they reflect the IPCC GPG. The CRF software (i.e., MS Excel versions of the tables and a manual) are available on the UNFCCC website.[25]

Non-Annex I Parties may also wish to review and take into consideration the *"UNFCCC guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention (Greenhouse gas review guidelines)"*. These guidelines describe the procedures for UNFCCC review of Annex I inventories and are contained in COP document FCCC/CP/2002/8.

Finally, countries may find it useful to review Annex I inventories. At its eighth session, the COP requested the UNFCCC Secretariat to publish the officially submitted annual inventory submissions, consisting of the National

[21]Note that the information in table 1 of the annex to Decision 17/CP.8 is the same as in table 7a of the sectoral and summary report tables in the Reporting Instructions, and the information in table 2 of the annex to Decision 17/CP.8 is an expanded version of what is contained in table 7a of the sectoral and summary report tables. Until recently, the notation keys in tables 1 and 2 of Decision 17/CP.8 could not be used in the sectoral and summary report tables if the IPCC software was used, unless the software was disabled. A new version of the IPCC software that includes Table 1 and Table 2 of the UNFCCC guidelines is now available at: *http://www.unfccc.int/program/mis/ghg/index.html*.

[22]COP document FCCC/CP/2002/8 can be searched for at *http://maindb.unfccc.int/library/*

[23]COP document FCCC/SBSTA/2004/8 can be searched for at *http://maindb.unfccc.int/library/*

[24]Annex I Parties supplement the CRF with extensive additional information in their national inventory report, including whatever additional information would be provided in a completed set of the IPCC worksheets.

[25]Go to: *http://unfccc.int/national_reports/annex_i_ghg_inventories/reporting_requirements/items/2759.php*

Inventory Report and the CRF, of all Annex I Parties, along with any websites.[26]

IPCC Reporting Guidance

The Reporting Instructions contained in Volume I of the *Revised 1996 IPCC Guidelines* provide step-by-step directions for assembling, documenting and transmitting completed national inventory data and results consistently, regardless of the methods used to produce the estimates. These instructions are intended for all users of the *Revised 1996 IPCC Guidelines* and provide the primary means of ensuring that all reports are consistent and comparable. The Reporting Guidelines instruct Parties to complete and provide the IPCC worksheets (contained in Volume 2 of the *Revised 1996 IPCC Guidelines*) and the sectoral and summary report tables (contained in Volume 1 of the *Revised 1996 IPCC Guidelines*) as far as possible.

NOTATION KEY

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

When completing the IPCC sectoral and summary report tables, Parties should use the notation keys shown in the box above.[27] For each source that a Party believes has zero emissions, the emissions should be listed as "0". Where countries have opted not to estimate a particular source (e.g., for example, a source is believed to be very minor and/or activity data are not available), the emissions from the source should be listed as "NE". Data problems may limit the possibility of separating out each source individually. In this case, the emissions from the source under which the emissions are not reported should be listed as included elsewhere ("IE") and a footnote included in the table indicating where the emission has been reported. IE should also be used in cases where there is choice as to where an emission can be reported (e.g., CO_2 emissions/removals from agricultural soils). Finally, countries may report a particular category as not occurring (NO) in their country.

The use of the IPCC software[28] significantly facilitates the electronic submission of the IPCC inventory worksheets as well as the sectoral and summary report tables. However, not all source subcategories and methods available in *Revised 1996 IPCC Guidelines* are covered, none of the changes and new material from IPCC GPG are included, and the notations described above cannot be input without disabling some of the software functions. Even so, the IPCC software is the most recommended software for non-Annex I Parties, as it covers all simplified methods and improves comparability and reporting. If more detailed or different calculations are used, or if additional sources are included, this information can be submitted in the form of supplementary spreadsheets.

National Inventory Report and Other Optional Reporting Documents

In addition to the official documentation that is required by the UNFCCC, a non-Annex I Party may have decided during planning to prepare additional reports for dissemination, such as a National Inventory Report or summary reports. Any reports planned under Planning Task 2 (Section 3) would be completed under this task.

It is recommended that non-Annex I Parties consider preparing a National Inventory Report, if budget and personnel allocation allows. *While a workplan describes what needs to be done, the National Inventory Report describes accurately and in detail what actually was done, how it was done and what the results were and who did the work.* The National Inventory Report could have an Introduction and an Executive Summary, and is usually more detailed than the inventory component of the national communication. Usually there is one chapter for each of the inventory sectors. The Executive Summary can be a stand-alone, memo-style section, which can then be used to raise awareness. A list of acronyms and definitions is recommended.

Countries may find it very useful to review the *UNFCCC Guidelines for National Inventory Reports* (in FCCC/CP/2002/8 and FCCC/SBSTA/2004/8). Although non-Annex I Parties are not required to use this guidance, they may find it helpful in defining the structure and content of their National Inventory Report.

[26]Go to: *http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/2761.php.*

[27]These notations have been revised several times for Annex I Party reporting in order to improve the logic and completeness of reporting. Instead of using the notations presented here (from the Revised 1996 IPCC Guidelines), it is recommended that non-Annex Parties consider using the notations in the UNFCCC inventory reporting guidelines for Annex I Parties that pre-date the GPG guidance. These guidelines, which are to be used by Annex I Parties for their inventories due in 2000 through 2003, are contained in FCCC/CP/1999/7. This COP document can be found at: *http://maindb.unfccc.int/library/*. The notations are described on pages 8-9. Non-Annex I Parties that are using IPCC GPG may want to consider using the notations in the more recent UNFCCC guidelines for Annex I Parties, which are in FCCC/CP/2002/8 (the version without LULUCF GPG, notations are on page 9) and in FCCC/SBSTA/2004/8 (the version with LULUCF GPG, notations are on page 9).

[28]The URL for the IPCC inventory software is: *http://www.ipcc-nggip.iges.or.jp/public/gl/software.htm*

The primary objective of the National Inventory Report is to describe data inputs, methods and results. The level of detail will depend on time and resource constraints. For example, sector chapters could contain a section for each source that describes how data and methods were selected and collected; institutional, legal, or procedural barriers and how these barriers were overcome; as well as data and method locations (e.g., references, URLs, page and equation numbers, expert contacts). The Report may summarise uncertainties, review emission trends, describe QA/QC procedures, present key category results and include suggestions for improvements to the entire inventory process.

Other objectives of the National Inventory Report can include:

- To efficiently document the knowledge associated with conducting the inventory process. In this regard, the NIR would be like a manual to be used the next time the inventory is to be prepared.
- To have tangible documentation of all the work undertaken (official and "behind the scenes") that can be presented to the national government and other interested parties.
- To serve as a basis to raise awareness within the national Government and with other parties. The Executive Summary may be sufficient for this purpose.
- To propose detailed recommendations for improving the inventory process in the future.

The Report could also describe the institutional, legal and procedural arrangements established for planning and preparing the inventory, as well as institutional, legal, or procedural barriers to collecting data and how the barriers were overcome.

Preparation Task 8: Complete Documentation and Archiving

Documentation and archiving are a crucial part of any sustainable GHG inventory effort. The IPCC GPG is founded on the principles of transparency, completeness, consistency, accuracy and comparability. It is good practice to complete and archive full documentation for every inventory produced, so that each inventory is transparent, all inventories are consistent, and the next version of the inventory can be produced efficiently, even if the inventory team changes. A new inventory team should not have to redo work that has already been done to prepare a previous inventory. In addition, full documentation and archiving may be necessary to justify the inventory work to political officials or the public.

It is important to use a standardised documentation and archiving system for both numerical and qualitative information and to undertake documentation *throughout* the inventory preparation process. Documentation and archiving procedures, which will have been defined during planning, will include standardised procedures for documenting spreadsheets and text sections (e.g., instructions for referencing data sources in spreadsheets, instructions for describing methods and data and uncertainties in the inventory text), as well as procedures for dating files and for keeping paper and electronic copies of files, reference materials and other sources of data.

In addition, inventory source(s) teams should compile:

- complete descriptions of the data assessment and manipulation processes, including the sources of data that were evaluated;
- why a particular data source was chosen for use in the inventory and why others were not chosen;
- what assumptions were made in manipulating or choosing data for final use;
- complete references for the data;
- why recalculations were made and what those recalculations were; and
- responses to internal and external review comments.

Much of this information is unlikely to be included in the national communication inventory, or perhaps even in a National Inventory Report, in which case it should be collected in memo or other format, and that material should be archived with all the other inventory materials. Some Parties have found it useful to prepare a country-specific version of the IPCC Reference Manual and Workbook, which can then be used to prepare the subsequent inventory.

Table 4.3 (overleaf) provides a sample tool for compiling such documentation for an individual source. Each inventory team member would complete the top row and right column of this table for each source that he/she is responsible for. The advantage of a table such as this is that it provides a check-list to help insure that documentation procedures are followed. It is recommended that non-Annex I Parties refer to the IPCC GPG manuals for source-specific documentation guidance.

Even though there is no COP requirement for non-Annex I Parties to develop and maintain an archived inventory system, non-Annex I Parties are encouraged to do so for sustainability, transparency and completeness of the inventory process. Archiving should consist of both electronic and paper documentation, all organised in a logical fashion and with back-ups of electronic files. If some paper documents are particularly voluminous (e.g., a National Inventory Report), a duplicate paper copy of each of these is recommended as well. It is important that the archiving system is transparent, well designed and well managed. The archive should reside at, and be managed by, the National Entity.

It is recommended that the following materials be archived in both electronic and paper format:

- The workplan;
- The overall inventory preparation instructions;
- All the source(s) preparation instructions;
- The inventory of the national communication;
- Any other inventory reports, such as a National Inventory Report;
- Final inventory spreadsheets and text files for each source; and
- All other documentation materials (e.g., memos), internal and external reviews, inventory improvement strategy.

In addition, paper copies of all reference materials should be archived. In cases where a source of information is a book and it would be impractical to archive the book in a central location, a paper copy of the book title page, a list of the pages or sections used, and a note explaining where the book is archived, are sufficient for archiving. In cases where a source of information is a database, and storing a paper copy of the database is impractical, the physical location or website for the database, the date the database was accessed, and copies of the relevant database sections are sufficient for archiving.

Preparation Task 9: Undertake Public Dissemination of Results

Once the inventory reporting is complete, the process by which inventory information is disseminated beyond the UNFCCC Secretariat can be undertaken. This process would have been defined during the planning stage (as part of Planning Task 2, Section 3) and might include a report distribution plan, and plans for workshops to both disseminate results, and encourage feedback from, and the future engagement of, interested parties.

If a country has an awareness-raising strategy, it would be implemented under this task.

Preparation Task 10: Complete Inventory Improvement Strategy

The **inventory improvement strategy** will consist of a prioritised list of tasks for improving and refining the inventory over the medium- and longer-term. It is important to remember that this strategy is also part of the cyclical inventory process and should be reviewed for each new inventory. The inventory improvement strategy should include a description of the general objectives and scope of the work, as well as source-specific improvements that would have been compiled by each source(s) team as they prepare the inventory. The strategy should also broadly describe how these objectives will be met and by when, with priorities clearly delineated, as the level of resources that will be available in future years may be uncertain. The key source and uncertainties analyses, if undertaken, will inform the priority setting process.

Items that could be included in an inventory improvement strategy are:

- a more rigorous QA/QC plan;
- source-specific ideas for further research;
- corrections and/or peer review comments that did not get entered because time ran out;
- reporting and documentation improvements;
- possible new data sources and methodologies; and
- archiving improvements.

Countries could also make emission factor improvement a part of their long-term inventory improvement strategy, focusing on the highest priority emission factors. The strategy could also include:

- awareness raising with Government, academia and the public;
- feedback to Government and other associated institutions; and
- training of inventory personnel.

Annex 4 provides the inventory improvement strategy of The Philippines as an example.

Table 4.3: Sample Documentation Tool for Source-Specific Tasks

Source	
Person Responsible:	
Task	**Information sources,[1] assumptions, data manipulations, items for inventory improvement strategy and other notes [2]**
Assess data availability and quality	
Determine method	
Collect activity data and conversion factors	
Choose emission factor	
Conduct calculations	
Conduct uncertainty analysis	
Conduct QC procedures on spreadsheets	
Complete text sections	
Conduct QC procedures on text sections	
Incorporate revisions based on internal review	
Incorporate revisions based on external review	
Complete documentation and archiving	
Compile inventory improvement list	

[1]Provide *complete* data source information, e.g., a complete reference for published information, an URL for web information and the date the website was accessed, and complete contact information for individuals who provide unpublished data.

[2]Other notes might include data difficulties, information about when annual activity data become available, difficulties in meeting deadlines and why (e.g., activity data release date delayed).

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RIVM (2002). Applications of EDGAR: Emission Database for Global Atmospheric Research. National Institute of Public Health and the Environment, P.O. Box 1, 3720 BA the Netherlands. ISBN 905851 0778.

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USEPA (2002). *Quality Assurance/Quality Control and Uncertainty Management Plan for the U.S. Greenhouse Gas Inventory.* United States Environmental Protection Agency, Office of Atmospheric Programs, Washington DC. EPA 430-R-02-007. Available at: *http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SLUZ5EBLT3/$File/background02.pdf*

USEFUL RESOURCES

Intergovernmental Panel on Climate Change– National Greenhouse Gas Inventories Programme (IPCC-NGGIP). Website: *http://www.ipcc-nggip.iges.or.jp/*

This programme has been undertaken since 1991 by IPCC Working Group I in close collaboration with the Organisation for Economic Co-operation and Development and the International Energy Agency. In 1999, a Technical Support Unit was set up at the Institute for Global Environmental Strategies in Japan to oversee the IPCC-NGGIP.

At this site, countries can download:

- *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm)* (in English, French, Spanish, Russian)
- *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (http://www.ipcc-nggip.iges.or.jp/public/gp/english/)* (in English, French, Spanish, Russian, Chinese, Arabic)
- *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm)* (in English)
- IPCC Inventory Software *(http://www.ipcc-nggip.iges.or.jp/public/gl/software.htm)* (in English)

A CD-Rom containing the IPCC inventory guidance can be ordered from: Technical Support Unit, IPCC National Greenhouse Gas Inventories Programme, c/o Institute for Global Environmental Strategies, 1560-39 Kamiyamaguchi, Hayama, Kanagawa, 240-0198 Japan. E-mail: *tsu@iges.or.jp.* Phone: +81-468-55-3750. Facsimile: +81-468-55-3808.

For the IPCC Emission Factor Data Base, go to: *http://www.ipcc-nggip.iges.or.jp/EFDB/main.php*

The IPCC is currently preparing *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, which will fully integrate Good Practice Guidance into five volumes:

- Cross-Cutting Issues;
- Energy,
- Industrial Process and Product Use;
- Agriculture, Forestry and Other Land Use; and
- Waste.

Reports from the author/expert meetings to prepare the 2006 Guidelines are available at: *http://www.ipcc-nggip.iges.or.jp/meeting/meeting.htm*

United Nations Framework Convention on Climate Change (UNFCCC). Website: *http://unfccc.int*

The UNFCCC site includes a large, searchable database of all documents from the Subsidiary Body and Conference of the Parties meetings. Non-Annex I Parties will also find specific information on national communications in the "National Reports" section of the website – including newsletters and updates.

Guidance for Non-Annex I Parties

Guidelines for the preparation of initial national communications from non-Annex I Parties were adopted at COP 2 in Geneva in 1996. COP 5 (Bonn, 1999) initiated a process of reviewing the guidelines, with the aim of improving them and established a Consultative Group of Experts on National Communications from non-Annex I Parties (CGE) in order to improve the process of preparation of national communications by non-Annex I Parties. The CGE made major contributions to the review of the guidelines. At COP 8 (New Delhi, 2002) Parties adopted revised guidelines, which will be the basis for the preparation of second and, where appropriate, third and initial national communications.

- *Decision 10/CP.2: "Communications from Parties not included in Annex I to the Convention: guidelines, facilitation and process for consideration"* (contained in FCCC/CP/1996/15/Add.1)
- *Decision 17/CP.8: "Guidelines for the preparation of national communications by Parties not included in Annex I to the Convention"* (contained in FCCC/CP/2002/7/Add.2)

The UNFCCC Non-Annex I Implementation Subprogramme has developed a user manual which provides non-Annex I Parties with guidance on what information should be reported in the national communication, according to Decision 17/CP.8, with some suggestions on how this information can be obtained:

- *Reporting on Climate Change: User Manual for the Guidelines on National Communications from non-Annex I Parties (http://unfccc.int/national_reports/non-annex_i_natcom/guidelines_and_user_manual/items/2607.php)* (in English, French, Spanish)

Guidance for Annex I Parties
(that may be of interest to non-Annex I Parties)

- *"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines of annual inventories"* (contained in FCCC/CP/1999/7)
- *"Review of the implementation of commitments and of other provisions of the Convention. National communications: Greenhouse gas inventories from Parties including Annex I to the Convention. UNFCCC guidelines on reporting and review"* (contained in FCCC/CP/2002/8; see also guidance contained in FCCC/SBSTA/2004/8)
- *Decision 13/CP.9: "Good practice guidance for land use, land-use change and forestry in the preparation of national greenhouse gas inventories under the Convention"* (contained in

FCCC/CP/2003/6/Add.1)
- *"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines of annual inventories (Following incorporation of the provisions of decision 13/CP.9)"* (contained in FCCC/SBSTA/2004/8)
- Common reporting format tables in MS Excel (software and manual) *(http://unfccc.int/national_reports/annex_i_ghg_inventories/reporting_requirments/items/2759.php)*

Annex I National Inventory Reports, CRF tables and websites (where available) can be found at:

- *http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/2761.php*

GEF/UNDP/UNEP National Communications Support Programme. Website: *www.undp.org/cc/*

This handbook will be available on the website in English, French, Spanish and Russian. An inventory knowledge base will also be developed to supplement the handbook.

Capacity Building for Improving the Quality of Greenhouse Gas Inventories (Europe/CIS Region). Website: *http://www.rec.org/REC/Programs/UNDP-GHGInventories/Default.html*

Twelve countries are participating in this UNDP-GEF regional project which aims to:

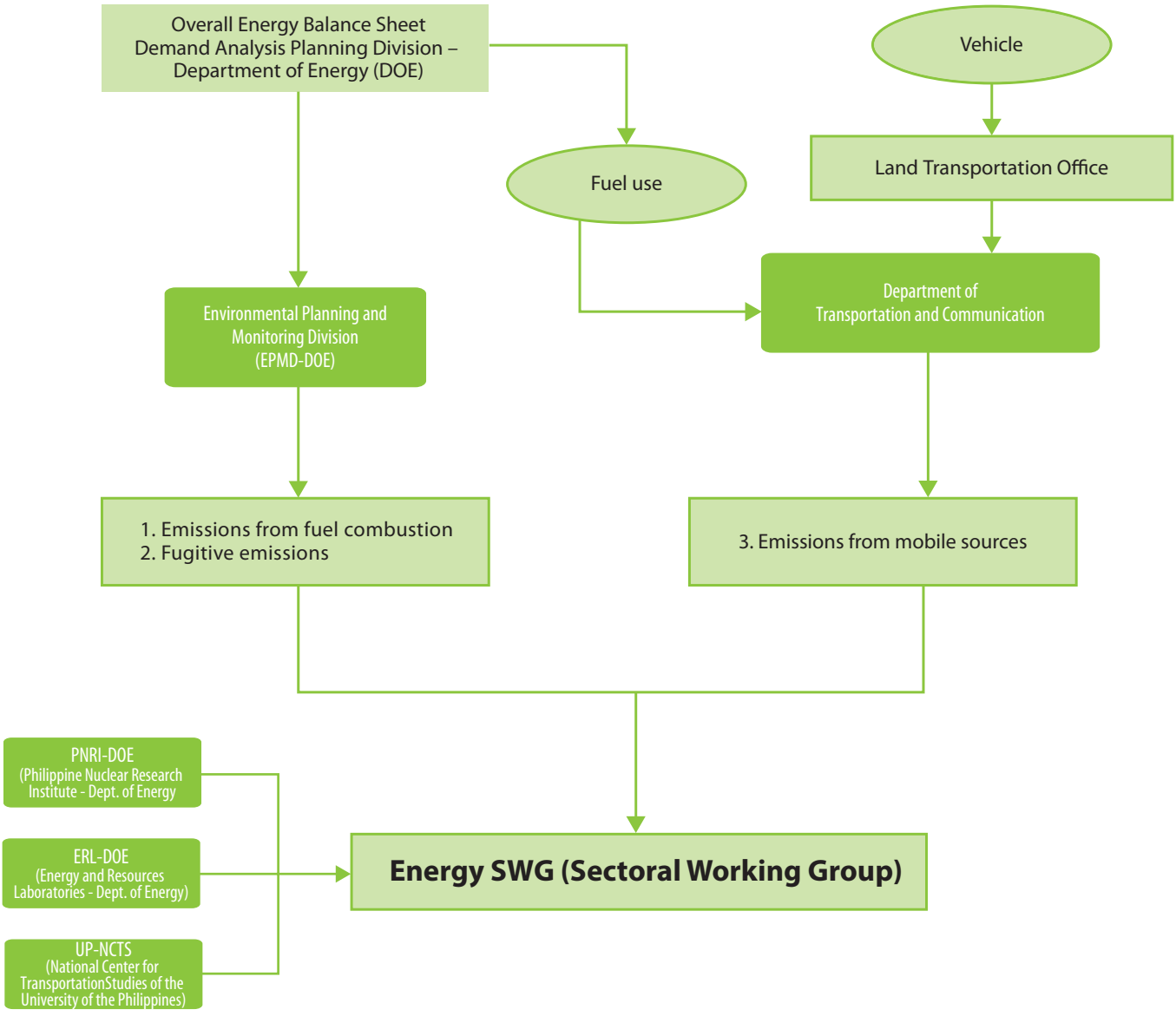
i) Strengthen institutional arrangements for compiling, archiving, updating, and managing greenhouse gas inventories;

ii) Create Sustainable Inventory Process;

iii) Enhance technical capacity for preparing national inventories; and

iv) Improve methodologies and emission factors. The site includes workshop documents and a database of regional experts. Good practice examples from countries will be included in the future.

ANNEX 1: DATA FLOW CHART FOR THE ENERGY SECTOR



ANNEX 2: OUTLINE OF THE INVENTORY PREPARATION PROCESS IN ALBANIA

This case study describes the inventory process in Albania. It shows the availability, scope, organisational and institutional framework, methodological approach, quality indicators of GHG inventory, constraints and challenges faced with and the efforts made for improvement of the quality, and ensuring sustainability of this exercise This case shown also that efforts to mainstreaming climate change issues into national development agenda and policy have affected the quality and sustainability of the GHG inventory exercise.

Edited for length from paper prepared by Ermira Fida, Manager, Climate Change Unit, Ministry of Environment of Albania[29]

1. The GHG inventory in Albania

The first GHG inventory for Albania was developed on 1999, under the UNDP-GEF funded project, "*Enabling Albania to prepare its first National Communication to the UNFCCC",* which aimed at building national capacities to respond to the country commitments to the Conference of the Parties and addressing climate change issues in the national planning process. A national GHG inventory of sources and removals by sinks for the base year 1994 was one of the most important project outcomes.

In 2004 the GEF provided funding for a stocktaking exercise to design the project proposal for the Second National Communication (SNC). After the successful completion of a stakeholder consultation process, Albania began its SNC project in March 2005. A GHG inventory will be estimated under this project for the base year 2000, as indicated in the new guidelines of Decision 17/CP.8. A time series for 1990-2000 will also be developed.

2. Organisational and administrative arrangements

The lead agency responsible for the GHG inventory preparation in Albania is the Ministry of Environment through its Climate Change Unit. The Unit was established in 1998 when the GEF provided the funding for the preparation of the Albania's First National Communication (FNC). With the capacity of UNFCCC Focal Point, this Unit is responsible for the implementation of the UNFCCC. To date, the Unit has mainly worked in a project-based approach[30].

A manager responsible for the daily management of the projects, including GHG inventory, leads the Unit. A GHG inventory team leader is hired on an ad hoc basis to perform technical backstopping to the manager on the inventory exercise. Experts from key government ministries and agencies, research institutes and academia are involved. Technical review meetings, hands-on training workshops, joint meetings of the Project Steering Committee and experts, national workshops and seminars have been, and are, an essential part of the process. These consultations are considered a key element not only for the enhancement of the quality of the GHG inventory work, but also for raising awareness among different stakeholders to facilitate the sustainability and institutionalisation of this exercise. The UNFCCC Secretariat and UNDP-GEF National Communications Support Unit have also assisted the Albanian team in the inventory preparation.

3. Scope of the inventory

Albania's first GHG inventory covered all sources and sinks, as well as all gases, as mandated by Decision 10/CP.2. Estimates of key sources were provided, along with aggregated GHG emissions and removals expressed in CO_2 equivalents. Indicators such as CO_2/GDP and CO_2/Capita are estimated, mainly for comparability purposes. The GHG inventory reports on methodological approaches used; data sources; data gaps; a quantitative assessment of uncertainties; and constraints and problems.

All activity data for Albania are national. The main data sources were INSTAT[31], line ministries, research institutions, academia, and prior and ongoing activities at that time. INSTAT was the main data producer and disseminator, but unfortunately it hasn't the status and resources to influence other data producers.

Inventory estimates are not based on any calculated method, but they are real figures collected by GHG inventory team. In most cases the default emission factors provided by the IPCC 1996 Revised Guidelines were used. There is one national emission factor for fuel burned in small industrial boilers.

Tier 1 and Tier 2 methods were elaborated for Albania's GHG inventory. Emissions of CO_2 from energy and transport were estimated using two approaches: top-down and bottom-up. According to the first approach, CO_2 emissions were estimated for each fuel type, based on the total national consumption[32], and the values were summarised (top-down). According to the second approach, emissions for each sub-sector and source category were estimated, and then emissions were also summarised (bottom-up). Through the application of both approaches, the inventory team was able to judge the

[29]The complete version of this paper can be found on the NCSP website *(www.undp.org/cc)* with this handbook.

[30]For more information visit the national climate change homepage: *http//: www.ccalb.org*

[31]National Institute of Statistics

[32]The data on national consumption are taken from the national energy balance.

fuel spectrum of the CO_2 emissions (top-down) and the distribution according to the economic sectors (bottom-up).

Use of both the top-down and bottom–up approaches for CO_2 emissions from energy and transport enabled the inventory team to estimate the difference between two approaches, which was shown to be about 3.01%. The overall uncertainty estimated for the inventory is 17.03%[33], with the CO_2 equivalent emissions from fuel wood category contributing significantly with 79.23%. This comes especially from the large degree of uncertainty of activity data for this subcategory (especially fuel wood self-collected from rural areas). The most significant share of the combined uncertainty for CO_2 emissions belongs to LUCF (13.5%), followed by transport (4.39%), and stationary fuel combustion, energy industries, manufacturing industries and construction (totalling 3.79%). The uncertainty for CH_4 emissions comes mainly from enteric fermentation (42.88% against the total of 52.13%), while the main sources of uncertainty for N_2O are, respectively, stationary fuel combustion, energy industries, manufacturing industries and construction with a combined uncertainty value of 353.59%. However, both CH_4 and N_2O emissions have very low impact on overall national uncertainty because of their very small value.

The first national GHG inventory was reported according to the UNFCCC guidelines in Decision 10/CP.2. The revised guidelines in Decision 17/CP.8, which were at draft form at that time, were also taken into consideration in most cases. The estimates of GHG emissions and sinks were developed according to the *1996 Revised IPCC Guidelines*. The IPCC Good Practice Guidance was used for the uncertainty assessment and key source estimates. CORINAIR was referred to for the solvent category.

4. Constraints, gaps and limitations

The major technical constraints that faced the GHG inventory process were related to the activity data gaps and the use of IPCC default emission factors that did not reflect the country's situation.

Activity data gaps identified in Albania's first GHG inventory were mainly related to the data availability (disaggregated activity data or inconsistency with IPCC format) and their variability after the 1990s. In most cases, activity data were reported in an aggregate form or inconsistent with the IPCC format, which made the estimation of the emissions very difficult. Most activity data were characterised for their variability after the 1990s when the country entered a rapid development. In addition, the problem of data gaps becomes significant when source categories for which data cannot be obtained are identified as key. This is the case for mobile combustion, enteric fermentation, fuel combustion in industry, fuel wood burned for energy purposes and solid waste treatment.

There were some methodological constraints identified in the course of preparation of the inventory, namely: (i) the discrepancy of local classification of forests to that of IPCC[34] methodology; (ii) lack of the case of burning waste and open dumps under the IPCC methodology; and (iii) lack of methodology for solvents category.

Institutional problems and constraints identified during the preparation of the FNC were related to the lack of an institutional and legal framework necessary to support and facilitate the FNC exercise. The problems identified represent the institutional problems and constraints not only for inventory preparation process, but for all components of the national communication, which need to be overcome and to be improved. The most significant problems identified are related to: (i) the lack of institutionalisation and reporting obligations to enforce relevant state and especially private sector data provision; (ii) the weak co-operation between national institutions for getting the necessary data due to the lack of institutionalisation[35] of this process; and (iii) the lack of awareness on climate change issues among different stakeholders. There is also a lack of awareness among all categories of stakeholders regarding climate change issues.

In terms of resources available, constraints have been related to: (i) the lack of previous experience in preparation of GHG inventories, and (ii) the lack of appropriate financial resources for development of the GHG inventory.

5. Mainstreaming the GHG inventory into the development agenda

While working with UNDP Albania as the implementing agency for the climate change projects funded by GEF, all climate change project activities were aligned with the UNDP country office mission to reach the Millennium Development Goals[36] (MDGs) and respond to other national priorities through the human development approach. Albania is a pioneer country in the preparation of a national

[33]The combined uncertainty reported under Albania's FNC is found to be higher (19%). The above value of 17.03% is a corrected one estimated after the peer reviews of the GHG inventory.

[34]A national nomination is designed for such category (fruit trees are included).

[35]Sometimes it was difficult to get the necessary data, free of charge, from relevant institutions.

[36]Millennium Development Goals are a set of 8 goals which came out from the Millennium Declaration made from 189 nations which have resolved to halve the extreme poverty by 2015.

MDG monitoring report in Europe. As a consequence of this participatory process, GHG reporting has been integrated as a part of the MDG reporting system – the main GHG inventory indicators are integrated into the MDG monitoring indicators, making the MDG targets and indicators more country-specific and measurable. Also, the majority of the MDGs use GHG mitigation as a criteria for prioritisation of technology needs. The Government of Albania is including the MDGs into national planning monitoring and evaluating system. In this context, the climate change strategy and related indicators are successfully addressed in the newly adopted National Energy Strategy, which is a part of the National Strategy for Socio-Economic Development. This progress came also as a consequence of a broad participatory process and stakeholder consultation. The main lesson learned from this process is that working with UNDP to mainstream MDGs can help countries to mainstream the GHG inventory and climate change issues under the national planning.

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ANNEX 3: EXAMPLE OF PEER REVIEW QUESTIONS

Prepared by Dr. Ayite-Lo N. Ajavon, FDS/Université de Lomé, BP. 1515, Lomé, Togo. The questions are based on the UNFCCC review questions for Annex I GHG inventories, adapted to the non-Annex I Party context. These questions are provided as an example only of the types of questions that might be considered during the review of the national GHG inventory.

A. What needs to be done?

1. The review experts should check consistency with the UNFCCC guidelines, including IPCC guidelines, look at the institutional arrangements, documentation and archiving procedures, questions raised in previous stages of inventory submission as well as questions raised in previous submission for the whole inventory and for each sector and key source. The review experts should also identify areas of improvement in the inventory submission as a whole and for the methodologies used and the reporting of inventory information.

B. How should the work be done?

2. The inventory submission should include enough information for the reviewers to be able to perform their task. If there is not enough information in the inventory submission to enable a full review, the Party has not fully implemented the UNFCCC Reporting Guidelines. In this case, information should be requested as appropriate. This should be noted in the review report.

3. This checklist should be used as a guide to the reviewers to ensure that all aspects of the inventory submission are checked. The reviewers are not limited to the items identified in the list.

C. General assessment of the inventory

4. Has the inventory submission detailed estimates of all direct greenhouse gases?
5. Are summary level estimates for indirect greenhouse gases provided?
6. Are there complete and consistent time series for all sources and all years?
7. Note if the inventory submission has omitted any table for any years.
8. Is there a complete geographic coverage for the whole country of the national GHG inventory?
9. Does the inventory submission describe and explain the methodologies used in a transparent manner? Are all assumptions and references documented?
10. Generally, do the selected methodologies reflect the overall importance of the source categories?
11. Does the inventory submission provide explanation for the selection of emission factors and activity data? Are references provided?
12. Is there an explanation of any recalculations related to previously submitted data?
13. Are uncertainty estimates provided for all sources? What is the nature of the uncertainty estimates (i.e. quantitative vs. qualitative)? Does the Party note plans to improve the uncertainty analysis?
14. Is there a general explanation of the QA/QC procedures implemented in preparing the inventory submission? Does the Party expect to phase in comprehensive QA/QC procedures in the next 2-3 years?
15. Is there a separate section that clearly identifies changes of the GHG inventory with respect to previous years? Are there significant changes?
16. Does the inventory submission identify areas for further improvement? How are theses areas linked to the key source analysis and the results of the inventory review?
17. Which minor sources should be reviewed in future years?

D. Prioritise source categories for review

18. The review team should focus on the most important source categories because of the limited time available for review. These source categories should be selected using the following criteria:
    - The source categories identified as key sources;
    - The synthesis and assessment report identifies issues/questions about the source;
    - An important source category that has not been reviewed extensively in the previous years.

E. Detailed review of each source category to be reviewed

19. Start with the largest key source for each sector and go to the small ones. Check that the key source assessment identifies a typical selection of source categories. If the key source assessment is not typical, can it be explained by the national circumstances of the country.
20. For each key source category, review the following topics:

- *Completeness*

21. Are all sub-sources estimated? If not, are the omitted sub-sources likely to be significant on the basis of the reviewer's judgement?
22. Are there estimates for all years in the time series?
23. Are emissions of all gases from a source category included?
24. Does the inventory submission explain the reason for any gaps? Are gaps noted appropriately in the CRF (i.e. NE, NO, NA, C)?
25. Does the inventory submission describe plans to fill in gaps in the future?

- *Methodologies*

26. Does the inventory submission provide a description of the method used to estimate emissions or removals?
27. Is there a sufficient explanation of the general approach and the steps taken to estimate emissions or removals?
28. Identify the method used (e.g. IPCC Tier 1, Tier 2, Tier 3, country-specific, CORINAIR etc.).
29. Is the method a hybrid of one or more standard methods?
30. If the method uses a sophisticated model, is the model explained clearly?
31. Is the method reasonable/suitable given the importance of the source to the overall inventory, the availability of data, and national characteristics of the submission?
32. Has the method been chosen in accordance with the good practice guidance (see corresponding decision tree)?
33. Are there aspects of the method that could be used by other countries to improve their inventories?
34. How could the Party improve his method or the application of his method?

- *Emission factors*

35. What types of emission factors or parameters are used to estimate emissions?
36. Are the sources of emission factor data identified? Are the emission factors country-specific or default values?
37. Are the country-specific emission factors based on literature values, plant-specific measurements, surveys, or expert judgement?
38. Are any emission factors not presented for reasons of confidentiality?
39. Are there any additional emission factor comparisons that could be done, e.g. additional data sets, comparisons with similar countries etc.?
40. Has the good practice guidance been followed for the choice of emission factors?

- *Activity data*

41. What types of activity data are used for the source category?
42. Are the sources of activity data documented?
43. Do the activity data come from surveys, samples, measurements, or estimates?
44. Are the data collected by government agencies or private entities? Is there any information on the procedures used to collect the data?
45. Are any of the activity data confidential? Is the reason for the confidentiality clearly explained?
46. Are there data sets from international statistics for the same activity data? How do they compare? Can the differences be explained?
47. Has the good practice guidance been followed for collection of activity data?

- *Recalculations*

48. If the reviewed submission has made major recalculations the reviewer should pay special attention to this part of the inventory, especially if it is a key source.
49. Are the activity data and emission factors consistent throughout the time series?
50. Is more than one method used to estimate the time series? Have the methods been combined according to IPCC good practice recommendations?
51. Are there abrupt changes or gaps that are not explained?
52. Does the inventory submission explain the rationale for the recalculation together with a description of the new methodology and changes to the previous one?
53. Is the new methodology an improvement over the previous one?

- *Uncertainty*

54. Has the inventory submission estimated the uncertainty of the estimate?
55. Is the methodology for the estimation explained?
56. How do the estimates compare with the default values provided in IPCC good practice guidance?
57. Is there a qualitative discussion of the contributors to uncertainty?

- *Improvements*

58. Does the inventory submission identify expected areas for future improvement?
59. Are there other areas in which the estimate could be improved?
60. Does the inventory contain improvements to existing methodologies or new methodologies that would be useful for other Parties, or for updating the IPCC Guidelines?

- *Results from previous reviews*

61. Has the inventory submission addressed issues or problems with this source that were identified in previous reviews?
62. If the inventory submission has not addressed these issues or problems, are they mentioned in possible areas for future improvement?

F. QA/QC

63. Does the inventory submission address the issue of QA/QC? Is this done generally or on a source category basis?
64. Are there any obvious errors or inconsistencies in the reporting?

ANNEX 4: INSTITUTIONALISING THE PHILIPPINE GHG INVENTORY PROCESS: THE INVENTORY IMPROVEMENT STRATEGY

Edited for length from paper prepared by J. T. Villarin, M. L. Baylon, M. B. Dychinco, M. Y. Ajero, F. B. Avila, and J. Pater, Climate Change Information Center, Manila Observatory, the Philippines[37]

1. Introduction

As a Party to the United Nations Framework Convention on Climate Change, the Philippines is bound by its commitment to prepare and submit its national communication. An important component of this communication is the GHG inventory. In the initial national communication submitted in 1999, the Philippines included an inventory using 1994 as the baseline year. Prior to this, an inventory for 1990 was compiled through the assistance of the US Country Studies Program and the Asian Development Bank-sponsored Asia Least-cost Greenhouse Gas Abatement Strategy (ALGAS) initiative. The 1990 inventory was conducted under the leadership of the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) – the national meteorological agency – in co-operation with various government agencies.

The preparation of the 1994 inventory was made possible under the Global Environment Facility-funded enabling activity, *"Enabling the Philippines to Prepare Its First National Communication in Response to its Commitment to the UNFCCC"* through the United Nations Development Programme. Following Decision 10/CP2, the country adopted 1994 as the national baseline for its GHG emissions inventory. Actual project implementation of the inventory component of the national communication was undertaken by the Manila Observatory, in close co-ordination with public and private institutions, with a view to ensuring the sustainability of this initiative.

The Philippine Inter-Agency Committee on Climate Change (IACCC) was tasked with oversight and thus co-ordinated the whole enabling activity project. Since its establishment in 1991, the IACCC has actively co-ordinated various climate change-related activities, proposed climate change policies, and prepared the Philippine positions to the international climate change negotiations. Its multi-agency structure, shown in Figure 1, reflects the importance of engaging the various institutions needed to comprehensively address the complex issue of climate change.

2. The Philippine GHG Inventory Experience

The first step taken by the Manila Observatory was to convene a small team to gather the information needed to compile the emissions of the five sectors indicated in *Revised 1996 IPCC Inventory Guidelines*. The 1994 baseline data was collected from a number of government agencies and the private sector. International databases such as those of the FAO were used as well. As stipulated by the IPCC Guidelines, default values were used in the absence of local data. Locally sourced information was available mainly from the LUCF, agriculture and waste sectors.

During the process of data collection and analysis (which took about a year), focus group meetings (on a sectoral basis) were continually held among the agencies concerned. A training-cum-consultation workshop was organised at the end to finalise the results of the 1994 inventory calculation and to discuss data/institutional issues and concerns. Training consisted of disseminating the IPCC-based inventory methodology, which included spreadsheet software slightly modified to account for Philippine categories, but based nonetheless on the IPCC Guidelines.

As a means to ensure sustainability of this activity, a national inventory report that also served as a training manual was written by the Observatory team to enable agencies to conduct a similar exercise on their own (Villarin et al., Tracking Greenhouse Gases: A Guide for Country Inventories, 1999).

In compiling the 1994 Philippine GHG inventory, the main problems encountered were:

- incompleteness and/or unavailability of required databases in government and private agencies;
- lack of networking and coordination among and within government agencies;
- lack of clarity in policies regarding accessibility to public files and data;
- difficulties in data sharing; and
- absence of a managed system (flow) of information despite availability of data.

3. Establishing a GHG Inventory System

Although the Philippines has been able to produce two inventories, country capacity to sustain this activity is severely hampered by a number of factors. These are tabulated on a sectoral basis in the Philippine national communication. The agriculture sector is reproduced in the table below for illustrative processes.[38] In summary, these factors revolve around data and institutional issues that constrain the country's capability to regularise its inventory activity.

Data issues include the availability, accessibility, accuracy and variability of activity data and emission factors. In the

[37]The complete version of this paper, which covers all GHG inventory sectors, will be listed on the NCSP website (www.undp.org/cc) with this handbook.

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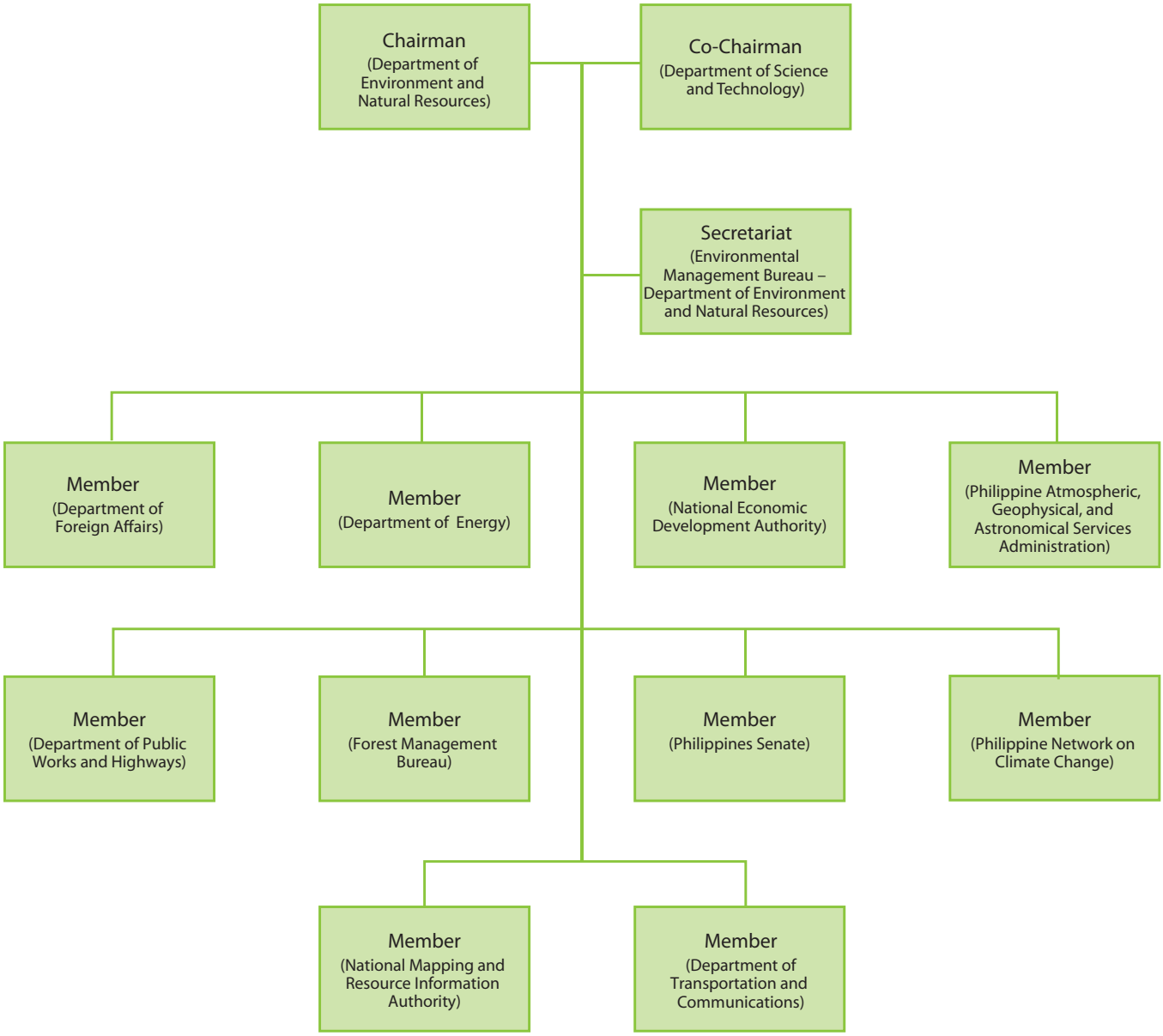
Figure 1. Organisational structure of the Philippine Inter-Agency Committee on Climate Change



Organisational structure of the Philippine Inter-Agency Committee on Climate Change: The constituent agencies are the Department of Environment and Natural Resources, Department of Science and Technology, Environmental Management Bureau-DENR, Department of Foreign Affairs, Department of Energy, National Economic Development Authority, Philippine Atmospheric, Geophysical, and Astronomical Services Administration, Department of Public Works and Highways, Forest Management Bureau, National Mapping and Resource Information Authority, and the Philippine Network on Climate Change, a coalition of NGOs involved in climate change.

Table 1: GHG Inventory Sectoral Issues and Concerns for Agriculture

Problems/Issues/Concerns	Recommendation
• Deficiency of country-specific factors and data. Default factors not representative of country's actual situation.	• Generate local statistics by conducting researches and surveys to be conducted by the involved agencies such as Bureau of Agricultural Statistics, Bureau of Animal Industry, International Rice Research Institute, PhilRice, etc.
• Institutionalisation of data flow and information system within BAS, DA	• Establish a statistical framework and a database information system for the inventory.
Domestic Livestock • Current data on distribution of animal manure among animal wastes management systems are estimates only.	• Ascertain ACTUAL distribution of animal manure among the animal wastes management systems.
Prescribed Burning of Savannah • Lack country-specific statistics (biomass density of savannah, fraction of exposed biomass that is burned, etc.) necessary for the estimation of emissions.	• Do research and study. Lead agency, Department of Agriculture/Forest Management Bureau
Burning of Agricultural Residues	• Conduct research/survey on cultural practices of local farmers in order to generate data regarding crop residues
Agricultural Soils Management • No country-specific data and factors	

face of limited resources, there is need to conduct uncertainty and sensitivity analyses to help in prioritising those sectors and source categories that need to be addressed to complete the inventory. Quality assurance and quality control (QA/QC) procedures remain to be implemented. The development of local or country specific data and methodologies is of prime concern.

Institutional issues include the sustainability of human, financial, and technical resources needed by the concerned agencies to compile the GHG inventory. Foremost among these issues are the mandates needed by people and agencies who will be regularly involved in the inventory process, the establishment of a GHG information system on both national and local scales, and structured linkages between academia and government to provide QA/QC and other elements of good practice as these relate to the GHG inventory.

At present, with funding assistance from the GEF-UNDP, the IACCC has commissioned the Climate Change Information Center of the Manila Observatory to study these data and institutional issues, with a view to devising strategies that will lead to the establishment of a system for the regular compilation of the country's GHG inventory. Two preparatory activities aimed at assessing and developing the national capacity to compile sectoral emissions have already been implemented under this project. As a result, relevant agencies have been identified, capacity to train others in the inventory process has been initiated, and institutional arrangements involving these agencies are being explored.

Activities in the immediate future include designing a national GHG information system that will help clarify and organise the flow of information within and among agencies. Parallel to this, inter-agency, multi-sectoral consultations are to be conducted to come up with recommendations that will facilitate and institutionalise the inventory process in the Philippines. One of the possible actions being explored is the institutional strengthening of the IACCC and the setting up of technical working groups within its structure. Another is the formulation of the legal mandates required to mobilise human, financial, and institutional resources in compiling the national GHG inventory.

4. Recommendations for information management practices of the institutionalised GHG emissions inventory, by sector

Agencies identified as potential contributors to the inventory process were consulted on several occasions in drafting recommendations for information management practices. A Technical Working Group composed of representatives

from IACCC, PAGASA, Climate Change Information Center, National Statistical Co-ordination Board and the sectoral lead agencies will serve as the co-ordinating body for the GHG inventory process. Sectoral Working Groups, composed of lead agencies and member agencies for each sector, will provide the GHG data at the sectoral level. The lead agencies will supervise the completion of the inventory worksheets from its member agencies.

Member agencies are organisations that have been identified as participants in the previous GHG inventories, as well as those that can potentially contribute in the succeeding inventories. Table 3 shows a listing of the data requirements of the agriculture sector[39] and the possible contribution of relevant agencies in the GHG emissions inventory.

Table 2: List of Data Requirements and Potential Contributions of Sectoral Working Group Member Agencies for Agriculture

Data Requirements	Agency/Institution/Organisation	Recommended Task/Output
	Bureau of Agricultural Statistics (BAS-DA)	The BAS, which already collects agricultural information relevant to the inventory, can complete most of the worksheets necessary for the Agriculture sector.
Agricultural Residue Burning Emissions		BAS's data on agricultural products and crop production may provide a basis (through crop to residue ratio) for agricultural residue burning
Domestic Livestock Emissions	Bureau of Animal Industry	Calculate emissions from domestic livestock using BAS data on animal inventory.
Agricultural Soils Emissions	Bureau of Soils and Water Management	Provide data on cultivation of organic soils or histosols and complete the related worksheets.
Grassland Burning Emissions	Forest Management Bureau	Provide data on grassland burning and complete the related worksheets.
Agricultural Emissions Research	Philippine Rice Research Institute and International Rice Research Institute	Research on country specific emission factors and other relevant emission parameters for rice and other grain products.
Emissions from Domestic Livestock	Bureau of Animal Industry	Contribute its research and laboratory expertise for animal emission factor research. Calculate emissions from domestic livestock using BAS data on animal inventory.

[39]The complete version of this paper, which covers all GHG inventory sectors, will be listed on the NCSP website *(www.undp.org/cc)* with this handbook.