GUIDE FOR PEER REVIEW OF NATIONAL GHG INVENTORIES

United Nations
Framework Convention on
Climate Change

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For further information contact

United Nations Climate Change Secretariat

Platz der Vereinten Nationen

53113 Bonn, Germany

Telephone +49 228 815 10 00

Telefax +49 228 815 19 99

This and other related training materials can be downloaded from https://unfccc.int/7914.php

Disclaimer

The guidance document can also be used as a QA/QC tool for local experts or the inventory compilation team members to review its own GHG inventory and assess its quality in regards to the IPCC principles. This internal review can produce the foundation for the Party to develop its improvement plan for future inventory preparation cycles.

ACKNOWLEDGMENT

As part of the collaboration between the UNFCCC secretariat and the UNDP/UNEP Global Support Programme for National Communications and Biennial Update Reports (GSP), this guide has been prepared in order to assist countries in the development of a robust national greenhouse gas (GHG) inventory system. The secretariat would like to thank the UNDP/UNEP GSP for their kind financial and technical support for the elaboration of this guide. More information about the GSP is available here: http://www.un-gsp.org/

All pictures courtesy of Mr. Jigme

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INTRODUCTION

Parties to the United Nations Framework Convention on Climate Change submit information on the implementation of the Convention, including national actions to mitigate and adapt to the climate change as well as inventory of anthropogenic greenhouse gas (GHG) emissions by sources and removals by sinks. Developing countries submit this information through national communications every four years and biennial update reports every two years. The greenhouse gas (GHG) inventories form the core of part of these reports. Developing a national GHG inventory requires robust institutional arrangements, quality inputs (data, emission factors), understanding of the appropriate calculation methods, and capacity to compile a complete report. Developing countries continue to face challenges at each step of the GHG inventory development process, including the process to establish and apply quality assurance and quality control. With a view to overcoming this challenge, the secretariat, with the support of the Global Support Programme (GSP) for National Communications and Biennial Update Reports (GSP),[1] prepared this guide with the objective of:

- Providing clear guidance for the peer-review of national GHG inventory reports and national GHG inventory management systems, to achieve higher quality reporting, through the use of Quality Assurance and Quality Control procedures in a non-intrusive or punitive manner;
- Achieving enhanced capacity of national experts involved in the process of the preparation of national GHG inventories to develop high quality, transparent, national GHG inventory reports and maintain sustainable national GHG inventory management systems;
- Facilitating the enhanced process of Quality Assurance (QA) and Quality Control (QC) of national GHG inventory reports, both across countries (peer-review) and within countries (expert-review).

[1] *The Global Support Programme for National Communications and Biennial Update Reports (GSP) is a programme funded by the Global Environment Facility and jointly administered by the United Nations Development Programme and the United Nations Environment. For more information on the GSP, see <*http://www.un-gsp.org*>.*

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OVERVIEW

2.1 PURPOSE OF THIS DOCUMENT

The objective of the guidance document is to serve as a manual for experts to assess the GHG inventory and inventory development process. It will describe how to perform a review of national GHG inventory management systems and national GHG inventories for non-Annex I Parties, taking into consideration and ensuring consistency with the Intergovernmental Panel on Climate Change (IPCC) guidelines for national GHG inventories, and the Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention (CGE) and United States Environmental Protection Agency (US EPA) training materials, workbooks, templates on developing sustainable national GHG inventory systems.

The guidance document can also be used as a QA/QC tool for local experts or the inventory compilation team members to review its own GHG inventory and assess its quality in regards to the IPCC principles. This internal review can produce the foundation for the Party to develop its improvement plan for future inventory preparation cycles.

2.2 GENERAL APPROACH

- The user of the guidance document (the Reviewer) will conduct a review of the GHG inventory based on the TAC-CC_2 principles. It will not review the inventory on the level adherence to any UNFCCC reporting guidelines such as "the biennial update reporting guidelines for Parties not included in Annex I to the Convention", or "Guidelines for the preparation of initial national communications from Parties not included in Annex I to the Convention".
- The review is to be a scientific/academic exercise which can be undertaken regardless of the version of the IPCC Guidelines (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, the Good Practice Guidance for Land Use, Land-Use Change and Forestry, 2006 IPCC Guidelines for National Greenhouse Gas Inventories) the Party has used. Therefore, the guidance document should be applicable regardless of the IPCC guidelines.
- The guidance document does not need to mention the existing measurement, reporting and verification (MRV) process under.
- The guidance document will be a concise, user-friendly document that can be easily used for the review.
- The guidance document will be written bearing in mind that the majority of users are non-native English speakers.

2.3 ASSUMPTIONS

- When conducting the review, the Reviewer will have access to the Party's inventory report and all estimation files, including activity data and emission factors, or software that contains the values used in the estimation of GHG emissions and removals.
- The Reviewer has a basic understanding of the methods described in the IPCC Guidelines; therefore there is no need to explain the methodology in the guidance document.
- The output of the review will be a brief "review findings document" that is developed for, and provided solely to, the Party. The guidance document will include a template or outline for the reviewer to produce this document. The Reviewer can make recommendations for improvements, in addition to pointing out problems/issues with the inventory based on the TACCC principles.

[2] *Transparency, accuracy, consistency, comparability, completeness*

3 GUIDANCE TO REVIEWERS

3.1MATERIALS/DOCUMENTS TO BE REVIEWED

3.1.1 THE NATIONAL GHG INVENTORY REPORT

The national GHG inventory report as the main source of information to describe the institutional arrangements in the country and the procedures undertaken to develop the national GHG inventory, describes the methodologies used, available activity data (AD), emission factors (EFs) and the rationale for these choices. Information on the implementation of an uncertainty analysis and QA/QC procedures and information on any recalculations related to previously submitted data are also included. A separate section should be included that identifies changes from previous years regarding methodologies used, sources of information and assumptions, as well as responses to the review process and planned improvements.

3.1.2 ESTIMATION TABLES/FILES AND/OR SOFTWARE

The information provided by the Party in the estimation tables or software data should include all estimates of emissions and removals for the entire time series, AD and other related data, including calculated EFs for all categories. The result of the key category analysis should also be included as part of the inventory submission. The estimation

files or software data are an integral part of the inventory submission and should be consulted together with the national GHG inventory report throughout the entire process of the review.

3.1.3 OTHER MATERIALS/DOCUMENTS

In addition to the GHG inventory report and data used in the GHG emission/removal estimation, the Parties may submit the following documents that may be helpful to the Reviewer:

- Additional estimation files;
- Internal memorandums;
- Schematic of institutional arrangements;
- QC checklists;
- Policy documents and legal documents; and
- Other background information period

3.2 CONFIDENTIALITY

Information provided by Parties under review is provided for the sole purpose of the inventory review and shall not be used by the Reviewer for purposes other than the inventory review. In this regard, the Reviewer shall not disclose any information acquired during the review before finalization and publication of the inventory review report; and shall not disclose any non-published information acquired during the review without the express agreement of the Party concerned. Further, the Reviewer shall not disclose information about the review, including any findings, or the status of internal procedures, to anyone except the Party concerned while the review is being conducted.

The Reviewer has an obligation to protect any confidential information provided in the course of the review both during and after the review. If the expert is specifically authorized to handle confidential inventory information, he or she shall adhere to established procedures for treatment of this information, as instructed by the Party. In this case, the expert shall be informed by the Party that he or she may be personally liable and shall be informed by the Party of the potential consequences, including legal consequences that may arise from disclosure of the confidential information by the Reviewer. The Reviewer shall notify the Party of any known potential conflict of interest relating to specific confidential information submitted by the Party being reviewed before the information is viewed.

3.3 PROFESSIONAL CONDUCT AND COURTESIES

In conducting review activities, the expert shall perform duties in an objective, neutral and professional manner. The Reviewer shall notify the Party of any known potential conflict of interest relating to a specific review activity in which the expert has been invited to participate.

The expert shall work cooperatively with any other review team members with a view to achieving consensus in decision-making within the review team.

The expert will be advised of the time requirements and deadlines for the review process, and will do everything in his or her power to meet these deadlines. If, due to unforeseen circumstances, the Reviewer is not able to perform his or her review duties in the time allotted for them, he or she shall notify the Party as soon as possible.

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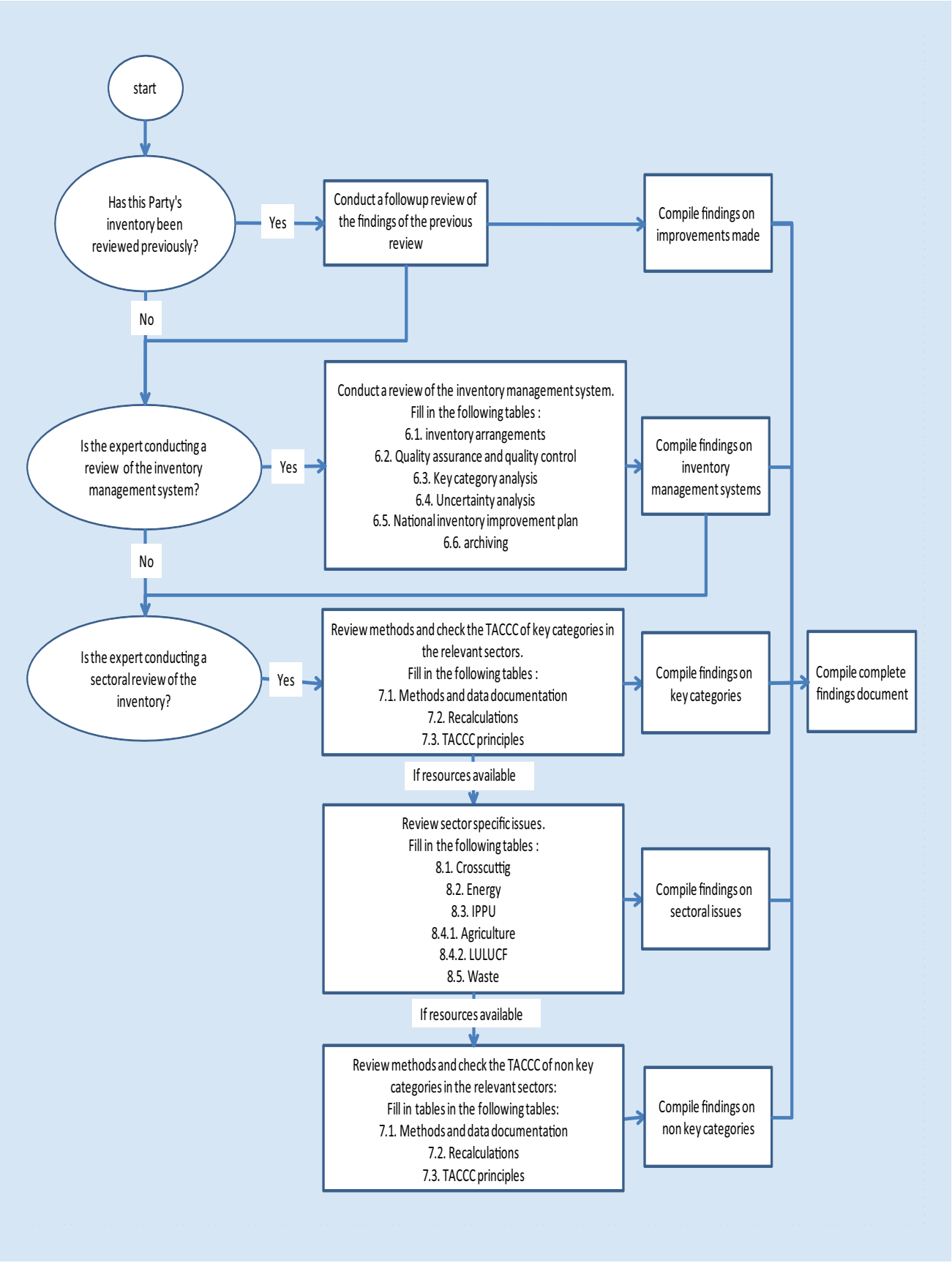
HOW TO USE THIS DOCUMENT

Whether conducting a peer review or an internal QA/QC exercise, the expert(s) will be assessing three general aspects of the GHG inventory: inventory management system; the methods, data, and TACCC issues of specific categories; and other technical sectoral issues. Chapters 6 through 8 provide guidance on how to conduct a review for each of the three aspects of the inventory in the form of checklists that the Reviewer should fill out during the review. The Reviewer should fill out each of the relevant tables with his/her comments under "Findings/recommendations". Note that the tables in chapter 7 are meant to be filled out for each category, therefore, those the reviewer will need to copy all tables in chapter 7 beforehand to make sure all elements are reviewed for each category.

Experts should note that a complete inventory review of all three aspects is generally conducted by a six person team, intensively working over the course of 5 to 6 full days (not including the preparation days). The experts conducting the peer review or QA/QC exercise will need to adjust the depth of the review depending on the scope of the review, number of experts involved, and the number of days available for the review.

The decision tree below provides a guide for experts on which tables to fill out and in what order.

Figure 1 Decision tree for conducting the review



5 REVIEW PHASE/TASKS

5.1 PREPARATION

The Reviewer should download or receive the national GHG inventory report and the estimation files/software files and familiarize themselves with the reported inventory information. In addition, the Reviewer should review the appropriate IPCC Guidelines used by the Party.

The Reviewer should begin filling out the appropriate tables in chapters 6 through 8, filling out the right columns with his/her comments under "Findings/recommendations", and any recommendations for improvement. Reviewers can also prepare questions for the Party to clarify issues to facilitate the review. These questions can be inserted in a separate table that can be found in Annex I: Template for questions to the Party. The Reviewer should be clear and concise in drafting the questions and also be mindful that the Party may not be able to answer all questions in the given timeframe due to time constraints.

5.2 ASSESSMENT BY REVIEWER DURING THE SCHEDULED REVIEW PERIOD

The Reviewer should continue filling out the appropriate tables in chapters 6 through 8, ensuring that their findings are accurate. If the Reviewer sent the questions table to the Party, the Reviewer should keep track of the answers provided and take them into consideration while writing his/her under "Findings/recommendations",.

The Reviewer should complete all relevant tables in accordance with the decision tree shown in chapter 4.

5.3 DOCUMENTATION OF THE FINDINGS INTO A REVIEW FINDINGS DOCUMENT

The Reviewer should compile all his/her comments under "Findings/recommendations", into one document. This is the review findings document, and the output of the peer review/internal QA/QC activity.

A template for the review findings document can be found in Annex II: Template for the review findings .

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GUIDANCE FOR REVIEW OF INVENTORY MANAGEMENT SYSTEM

6.1 INVENTORY ARRANGEMENTS

The national inventory arrangements underpin the inventory development process. The arrangements should be effective and reliable for estimating GHG emissions on a continuous basis. The Reviewer will examine procedures and institutional arrangements for inventory development and management.

GHG preparation process should take an internalized and institutionalized approach, which will support the timely delivery of the required information and more efficient use of available resources by Parties.

Potential key issues	**Processes for data collection, estimation, and approval of the inventory information**		
General references	CGE Training materials for the preparation of BURs: institutional arrangements Managing the national greenhouse gas inventory process, UNDP		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Institutional arrangements	Check if there is one entity that has main responsibility for the inventory preparation.	It is easier to avoid double counting and inconsistencies between different sectors when one entity has overall responsibility.	Reviewer to document any issues, and recommendations on how to address the issue
	Are all relevant government agencies (statistics office, energy, forestry, agriculture agency, etc.) involved in the inventory process?	The inventory agency should include all relevant agencies and organizations that collect necessary data for emission/removal estimates.	
	On what basis do data providers provide data to the inventory agency? Are there potential data providers that are not providing data?	Some countries may need to have legal contracts, MoUs, MoAs, or other legal documents to formally establish a channel for data collection.	
	Check if the experts estimating the emissions and removals and those compiling the inventory have a common understanding of the limitations in the data.	Good communication between the different experts performing the calculations and those collecting the data is important to assure the accuracy of the estimates. This may be part of the quality assurance routines, and it is the responsibility of the lead inventory agency to assure common understanding and implementation of the routines.	
Procedural arrangements	Is there a time line or an inventory preparation schedule that is agreed by all stakeholders? How often is the timeline or schedule updated?	There should be an inventory work plan that has an audience larger than the inventory team. It should describe the anticipated tasks, who will do them and by what date, the expected actions and/or products at each stage and the resources budgeted. This work plan may be part of the Party's QA/QC plan.	

Potential key issues	Processes for data collection, estimation, and approval of the inventory information		
Legal arrangements	Is there a law or regulation that formalizes the institutional setup for the inventory preparation? Are there formal legal contracts between organizations?	In cases where necessary information is not publicly available, legal and/or less formal collaboration arrangements may be need to be established so that data can be obtained in a timely manner and in the format required.	
Documentation	Has the Party described the inventory arrangements in the country?	Party's inventory arrangements should describe the entire inventory process.	

6.2 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

QA/QC system is an important part of inventory development. The general and sector-specific QA/QC elements to consider when compiling an inventory include planning, checks, documentation, verification and review.

Potential key issues	Awareness and appropriate implementation of the QA/QC plan at all levels in the inventory development.		
General references	IPCC good practice guidance chapter 8 2006 IPCC guidelines volume 1, chapter 6		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
General QC procedures	Does the Party have a QA/QC plan? Is it described or summarized in the inventory report?	A set of simplified procedures for QA/QC is provided in the IPCC guidelines. (See the IPCC good practice guidance Table 8.1, chapter 8.) The plan may also contain a schedule for future improvements.	Reviewer to document any issues, and recommendations on how to address the issue
	Are the experts performing the GHG emission/removal estimation also implementing QC procedures?	QC should be an integrated in the procedures for estimating emissions/removals.	
	Are there any obvious errors or inconsistencies in the reporting?	QC checks should be in place to avoid careless errors and/or inconsistencies in reporting (e.g., within the GHG inventory report or between the report and data file).	
	What kinds of checks are in place to reduce estimation error? Is there a QC check for the following: data collection, input, handling; data documentation; calculation checks?	QC activities include general methods such as accuracy checks on data acquisition and calculations, and the use of approved standardized procedures for emission/removal estimation, measurements, estimating uncertainties, archiving information and reporting. QC activities also include technical reviews of categories, AD, EF, other estimation parameters, and methods.	
	Compare emission estimate with those of previous years.	Emissions do not typically change significantly from one year to the next, but tend to display a trend over several years. A time series that is consistent (i.e. calculated using the same methodology) should most often be without large and sudden discontinuities in the annual numbers. (See IPCC good practice guidance chapter 8.7.1.4. page 8.12.)	
	Comparison with international sources	Are there data sets from international statistics (IEA in energy sector, International Industry statistics for IPPU sector, and FAO for the Agriculture sector) for the same activity data? How do they compare? Can the differences be explained?	

Potential key issues	Awareness and appropriate implementation of the QA/QC plan at all levels in the inventory development.		
Verification	Does the Party use other methods to compare the emission/removal estimation results with other tier methods?	Verification refers to those methods that are external to the inventory and apply independent data, including comparisons with inventory estimates made by other bodies or through alternative methods. Verification activities may be constituents of both QA and QC, depending on the methods used and the stage at which independent information is used.	
QA	Who conducts the QA?	Ideally, an expert who is independent of the inventory agency should conduct QA activities. If unavailable, staff from another part of the inventory agency can conduct a review.	
Documentation	Check what routines and findings are recorded for documentation of QA/QC.	The IPCC guidelines provide a list of information which inventory compilers should document and archive. (See IPCC good practice guidance chapter 8.10.1.)	

6.3 KEY CATEGORY ANALYSIS

Key categories have the greatest contribution to the overall level of national emissions. When an entire time series of emission estimates is prepared, key categories can also be identified as those categories that have the largest influence on the trend of emissions over time. In addition, when uncertainty estimates are incorporated into emission estimates, additional key categories are identified.

Potential key issues	**Aggregation of sources into categories in the analysis. If Tier 2 key source analysis is used the estimate of uncertainty may be a potential issue.**		
General references	IPCC good practice guidance chapter 7 2006 IPCC guidelines volume 1, chapter 4		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Purpose of the Key Category Analysis	Is a key category analysis conducted? Check if the Party uses appropriate methodologies for its key source analysis.	Identification of key categories enables limited resources available for preparing inventories to be prioritized. It is good practice to focus the available resources for the improvement in data and methods onto key categories. Also, in general, more detailed higher tier methods should be used for key categories. It is good practice to give additional attention to key categories with respect to QA/QC.	Reviewer to document any issues, and recommendations on how to address the issue
	What is the key category analysis results used for?		
Method	Check if the aggregation of category is at an appropriate level of detail.	The Tier 1 key category analysis is done on a set of categories rather than each individual subcategory. If common assumptions or the same EF are used, the subcategories may be combined. Each GHG should be considered separately unless there is specific reason not to. (See the IPCC good guidance chapter 7, page 5-6.)	
	Is the key category analysis conducted with and without the LULUCF sector?	The key category analysis should be conducted with and without LULUCF sector.	
	Has the Party applied qualitative criteria in the key category analysis?	A few qualitative criteria have been developed to complement the numerical analysis. (See the IPCC good practice guidance chapter 7, page 13.)	
Documentation	Check if the chosen aggregation is documented and explained.	The IPCC guidelines provide reporting tables for key category analysis. (See Table 7.A1-7.A3 of the IPCC good practice guidance.)	

6.4 UNCERTAINTY ANALYSIS

Uncertainty analysis aims to provide a quantitative measure of the uncertainty of the national inventory caused by the emission factors, activity data and the methods used as well as the relative importance of these factors.

Potential key issues	**Expert judgment of the individual uncertainties.**		
General references	IPCC good practice guidance chapter 6 2006 IPCC guidelines volume 1, chapter 3		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Purpose of the Uncertainty Analysis	What is the uncertainty analysis results used for?	An uncertainty analysis should be seen as a means to help prioritize national efforts to reduce the uncertainty of inventories in the future, and guide decisions on methodological choice.	Reviewer to document any issues, and recommendations on how to address the issue
Uncertainty Analysis	Has the inventory submission estimated the uncertainty of the estimate?	Uncertainty estimates should be derived for both the national level and the trend estimate, as well as for the component parts such as EFs, AD and other estimation parameters.	
	Check if the estimates of uncertainty in the categories are reasonable.	Default values for uncertainty are available in the IPCC guidelines in the sector chapters. How do they compare?	
	Is it consistent between the quantitative and the qualitative uncertainty discussion?	Quantifying the uncertainty is often a very difficult task, but should still be consistent with a qualitative evaluation.	
Documentation	Is the methodology for the estimation explained? Is there a qualitative discussion of the contributors to uncertainty?	The description of the uncertainty analysis should begin with a conceptualization, the assumptions and method used, and results of the analysis.	

6.5 NATIONAL INVENTORY IMPROVEMENT PLAN

The purpose of a national inventory improvement plan is to help countries identify and prioritize improvements to their national systems. A completed plan will guide future efforts to increase the transparency, accuracy, consistency, comparability, and completeness of future inventories.

Potential key issues	**A new year's inventory is not building on the previous year's data and experiences.**		
General references	Managing the national greenhouse gas inventory process, UNDP		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
National Inventory improvement plan	Does the Party have an inventory improvement plan? How often is the plan updated?	The periodic review and revision of the QA/QC plan is an important element to drive the continued inventory improvement.	Reviewer to document any issues, and recommendations on how to address the issue
	How are the necessary improvements prioritized within the improvement plan? How is the improvement plan used and implemented?	The results of the key category analysis and uncertainty assessment should be used to prioritize improvements.	
	Does the inventory submission identify expected areas for future improvement? Are there other areas in which the estimate could be improved?	If the Party has identified improvements that need to be made in the future, these should ideally be reported in the national GHG inventory report.	

6.6 ARCHIVING SYSTEM

Data documentation, or archiving is a critical step in the sustainability of the GHG inventory preparation because it serves as the starting point for future inventory teams. Archives refer to a collection of records that have been created during the development of the inventory (references, methodology, expert opinions, revisions, etc.) as well as document the location where these records are kept.

Potential key issues	**Awareness and appropriate implementation of an archiving system at all levels in the inventory development.**		
General references	2006 IPCC Guidelines volume 1 Chapter 6		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Archiving	What documents and files are available from the previous inventory?	It is good practice to document and archive all information relating to the planning, preparation, and management of inventory activities. All QC activities should be archived as well.	Reviewer to document any issues, and recommendations on how to address the issue
	Is there an archiving plan or set of procedures for archiving? Is there an expert in charge of archiving?	Archiving should be conducted as part of the inventory preparation process, with clear allocation of responsibility.	
	Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review.	Records of QA/QC procedures are important information to enable continuous improvement to inventory estimates. It is good practice for records of QA/QC activities to include the checks/audits/reviews that were performed, when they were performed, who performed them, and corrections and revisions to the inventory resulting from the activity.	
	Where are the archived documents stored?	The archive should be closed and retained in secure place following completion of the inventory.	

7

GUIDANCE FOR ASSESSMENT OF METHODS AND TACCC PRINCIPLES

7.1 METHODS AND DATA DOCUMENTATION

The inventory compiler should consult the decision tree and methodological guidance in the latest IPCC Guidelines to select an appropriate method.

Potential key issues	**Processes for data collection, estimation, and approval of the inventory information**		
General references	IPCC good practice guidance chapter 7 2006 IPCC guidelines volume 1, chapter 4		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Choice of Tier	Check if the appropriate choice of Tier has been used for each of the reported emission estimates.	The IPCC guidelines often include alternative methods or Tiers for each category. In general, a higher Tier will yield a more accurate estimate of the emissions/removal, and is therefore preferred. In some cases the use of a higher Tier will not yield a significant increase in accuracy, and the use of lower Tier may be the best option for some categories. The appropriate Tier for the particular category in question will depend on resources and availability of data, and on the decision tree specific to the category.	Reviewer to document any issues, and recommendations on how to address the issue
Higher Tier methods	If a recommended method for a key category has not been used, consider:	The IPCC guidelines provide for consideration of whether "data can be collected without significantly jeopardizing the resources for other key categories." (See IPCC good practice guidance, Figure 7.4.)	
	-How difficult is the collection of data?	Information with respect to resources needed to collect data is given in the IPCC guidelines. (See "Choice of Method" section in the IPCC good practice guidance.)	
	-Does the Party have a plan for reviewing and improving the inventory?	The country may describe its inventory improvement plan in the inventory report.	
	-What other categories have been given priority with regard to collection of data and improvement of method?	The objective is to reduce uncertainty of the overall inventory estimate, and the priority of the resources for different categories should reflect this.	
Country specific methodology	If a country-specific method has been used, consider: -Is the use of a country-specific method justified?	Available data should support the use of the method. Sectoral chapters of the IPCC guidelines provide guidance on whether country-specific emission factors are justified, e.g., the availability of QA/QC procedures, peer-reviewed studies, etc.	
	-Is the method considered more accurate for the country?	The country's assessment of the uncertainty for the estimate should be considered.	

Potential key issues	Processes for data collection, estimation, and approval of the inventory information		
Expert judgement	If expert judgment is used, does an expert judgment protocol exist?	A guide to conduct and record expert judgment is provided in the IPCC guidelines. (See IPCC good practice guidance, chapter 6.2.5.)	
Documentation	Is there sufficient explanation of the general approach and the steps taken to estimate emissions or removals?	An overview of the coverage of the inventory, methods/data used, the GWP used, gases included, sectors covered should be included in the report to give the reader a general overview of the inventory.	
	Does the inventory submission provide a description of the method used to estimate emissions or removals? If the method uses a country specific methodology or sophisticated model, is the model explained clearly?	An inventory report should explain the assumptions and methodologies used to facilitate replication and assessment of the inventory. This includes a description of the basis for methodological choice, EF, AD and other parameters, including references and documentation of expert judgements. If a country specific method is used, the preferred documentation is peer-reviewed articles, but this will rarely be the case. Institute reports may be used to document the national methods and emission factors.	

7.2 RECALCULATIONS

Recalculations refer to a re estimation of the emissions/removals from a category for all years in the time series due to a change in method, activity data or emission factors.

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 category.

Potential key issues	Inconsistency in the time series.		
General references	IPCC good practice guidance chapter 7 2006 IPCC guidelines volume 1, chapter 5		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Recalculations	Why has the particular category been recalculated?	Ideally, the new methodology should be an improvement over the previous one, improving the accuracy of the emission/removal estimation.	Reviewer to document any issues, and recommendations on how to address the issue
	Has the same method been applied to all years in the time series that are recalculated? Are there abrupt changes or gaps that are not explained?	Using the same method is preferable to assure a consistent time series. This may not, however, always be possible and some techniques for splicing of time series are provided in the IPCC guidelines. (See chapter 7.3.1.2 page 7.18 of the IPCC good practice guidance.)	
	How does the recalculation affect the emission, and uncertainty?	Recalculations should increase accuracy of the estimate and may increase or decrease the emission form the source.	
	Is there a plan for review of category that may lead to recalculation?	Reviewing a category and collecting new AD will often lead to more accurate estimates and affect the several years in the emission time series. It may also lead to the use of a higher tier.	
	Are there categories that, from a view of expected data availability, should have been recalculated?	Parties should evaluate the need for recalculation consistent with the plans for improvement of the inventory.	
Documentation	Does the inventory submission explain the rationale for the recalculation together with a description of the new methodology and changes to the previous one?	In order to enhance transparency of the inventory, it is a good practice to report all recalculations in the inventory report. (See IPCC good practice guidance chapter 7.3.3, page20.)	

7.3 TACCC PRINCIPLES

Transparency, accuracy, completeness, consistency, and comparability are key IPCC principles in preparing and reporting GHG inventories and are also indicators of inventory quality. The definitions of the principles are as follows:

- **Transparency;**

  There is sufficient and clear documentation such that all involved can understand how the inventory was compiled and can assure themselves that it meets the good practice requirements for national GHG emissions inventories.

- **Consistency;**

  Estimates for different inventory years, gases and categories are made in such a way that differences between years and categories reflect real differences in emissions. Inventory annual trends, as far as possible, should be calculated using the same method and data sources in all years. They should aim to reflect the real annual fluctuations in emissions or removals and not be subject to changes resulting from methodological differences.

- **Comparability,**

  The national GHG inventory is reported in a way that allows it to be compared with national GHG inventories for other countries. This comparability should be reflected in appropriate identification of key categories; in the use of the reporting guidance and tables; and use of the classification and definition of categories of emissions and removals.

- **Completeness;**

  National, calendar year estimates are reported for all sources and sinks, and gases. Where elements are missing their absence should be clearly documented together with a justification for exclusion.

- **Accuracy;**

  National GHG inventories should contain neither over- nor under-estimates so far as can be judged. This means making all endeavors to remove bias from the inventory estimates.

Potential key issues	**TACCC of the reported information for all categories of the inventory.**		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Completeness	Are all sub-categories estimated? If not, are the omitted sub-categories likely to be significant on the basis of the reviewer's judgement?	National, calendar year estimates are reported for all sources and sinks, and gases indicated in the IPCC. Where elements are missing their absence should be clearly documented together with a justification for exclusion.	Reviewer to document any issues, and recommendations on how to address the issue
	Are there estimates for all years in the time series?		
	Are emissions of all gases from a source category included?		
	Does the inventory submission explain the reason for any gaps? Are gaps noted appropriately in the CRF (i.e. NE, NO, NA, C)?		
	Does the inventory report describe plans to fill in gaps in the future? Does the report explain how and when the gaps will be filled? Does the plan seem reasonable?		

Potential key issues	TACCC of the reported information for all categories of the inventory.		
Transparency	Are the basic reporting elements reported in the inventory report?	Is there sufficient and clear documentation such that all involved can understand how the inventory was compiled and can assure themselves that it meets the good practice requirements for national GHG emissions inventories.	
	Is there a description of any confidential information	Are any AD and/or EFs not presented for reasons of confidentiality? Is the reason for the confidentiality clearly explained?	
	What types of AD are used for the category?	National GHG inventories should contain neither over- nor under-estimates so far as can be judged. This means making all endeavors to remove bias from the inventory estimates.	
	documentation	Are the sources of AD and EF data identified?	
Accuracy	Has the Party used the correct estimation equation?	The basic formula for emissions is the product of EF and AD. However, emissions/removal estimates for many categories are complex. The Reviewer should make sure that the Party has used the EF/AD/other parameters correctly in its estimation.	
	What types of EFs or parameters are used to estimate emissions? Are the EFs country-specific or default values?	Note that for key categories, the IPCC encourages the use of higher tier methods or country specific emission factors which produce more accurate and/or results with less uncertainty.	
	Has the Party used the correct default EFs and/or parameters?	Note that for many categories, different EFs/parameters are provided depending on the national circumstances (technology, climate, etc.)	
	Are the country-specific EF based on literature values, plant-specific measurements, surveys, or expert judgment?	If using a country specific EF, the inventory agency should ensure that the value is representative of the country's circumstances.	
	Are there any additional EF comparisons that could be done, e.g. additional data sets, comparisons with similar countries etc.?	The Reviewer may want to compare the country specific EF with other countries with similar national circumstances or check whether the EF values are within range of the EF provided by the IPCC guidelines.	
	Are the sources of data clear?	Are the data collected by government agencies or private entities? Do the activity data come from surveys, samples, measurements, or estimates?	
	How are the AD data gaps filled?	If AD is estimated, how has the data gaps been filled? Do the assumptions seem reasonable?	
	Category specific QC procedures Are QC checks conducted for the following: applicability of IPCC default factors, review of country specific EF, review measurements, evaluate time series consistency, review national level AD, review site specific AD, uncertainty estimates, GHG estimates?	Category-specific QC complements general inventory QC procedures and is directed at specific types of data used in the methods for individual source or sink categories. Category-specific procedures are applied on a case-by-case basis focusing on key categories. For categories where higher tiers are used, recommended source-specific QA/QC procedures are provided in the source specific good practice guidance.	

Potential key issues	TACCC of the reported information for all categories of the inventory.		
Comparability	Does the Party interpret the scope of individual categories as the IPCC has described them? Are emissions and removals reported correctly?	The national GHG inventory is reported in a way that allows it to be compared with national GHG inventories for other countries.	
	Has the Party allocated emissions according to the IPCC Guidelines?	Parties should make efforts to ensure that there is no misallocation or double counting in its inventory.	
Consistency	Are the AD and EF consistent throughout the time series?	Estimates for different inventory years, gases and categories are made in such a way that differences between years and categories reflect real differences in emissions. Inventory annual trends, as far as possible, should be estimated using the same method and data sources in all years. They should aim to reflect the real annual fluctuations in emissions or removals and not be subject to changes resulting from methodological differences. (Vol.1 Chs.2, 4 & 5). When this is not possible, the Party should provide an explanation as to why this is not possible, and what efforts were made to ensure time series consistency.	

8

GUIDANCE FOR ASSESSING SECTORAL ISSUES

8.1 CROSSCUTTING ISSUES (SECTORAL ALLOCATION ISSUES)

There are several allocation issues that may occur in the inventory. The Reviewer should check whether the Party is interpreting the scope of each category in accordance with the IPCC guidelines, to ensure comparability of the inventory.

Potential key issues	**Potential double counting or omission of emissions/removals.**		
General references	-		
Detailed review element	**Question**	**Elaboration/ clarification**	**Findings/recommendations**
Feedstock	How have the feedstock uses in the chemical industry been identified?	Refer to section 8.2.2. (1) 1)	Reviewer to document any issues, and recommendations on how to address the issue
Reductant	How does the Party estimate CO_2 emissions from the iron and steel industry?	Refer to section 8.2.2. (1) 1)	
Non-energy product use	Does the Party exclude other non-energy use of fuels from activity data in energy sector? In case emissions occur from these non-energy uses, does the Party report those emissions under the IPPU sector?	Refer to section 8.2.1. (1) 1)	
Waste incineration with energy recovery	Is there any energy-use of wastes in the country? If yes, are emissions from combustion of wastes for energy purposes reported in the energy sector? Check if the Party accounts only the fraction of fossil origin carbon in the energy sector.	Refer to section 8.2.2.(1) 2)	
Liming of agricultural soils	Check how limestone is used in the country.	Refer to section 8.3.2.(1)	
Manure burning	If the Party reports that manure is burned with or without energy recovery, is this included in the energy or waste sector, respectively?	Refer to section 8.4.1.(2) 1) (4)	
Urea production	Are the AD based on urea fertilizer use or sales instead of production?	Refer to section 8.4.1.(2) 5) (2)	
Biomass burning	Check misallocation or double counting does not occur for emissions from biomass burning.	Refer to section 8.4.2.(2) 2) (6)	

8.2 ENERGY

8.1.2 GENERAL

1. REFERENCE APPROACH AND SECTORAL APPROACH

The IPCC guidelines provide two approaches for estimating CO2 emissions from fuel combustion: the reference approach and the sectoral approach. The reference approaches is a top-down approach, using a country's energy supply data. On the other hand, the sectoral approach is a bottom-up approach, based on a country's energy

consumption data for each category. The Parties should estimate and report CO2 fuel combustion emissions using both the reference and the sectoral approach and explain any large differences between the two approaches.

This subchapter focuses on the methodology for the reference approach and comparison between the two approaches. Check points on the sectoral approach are covered in other sub chapters 8. 2 .2 (1) Stationary combustion and 8. 2 .2 (2) Mobile Combustion).

Potential key issues	**Misallocation among fuel types, overestimation of emissions (misallocation of carbon that should be excluded from fuel combustion)**		
General references	Revised 1996 IPCC Guidelines – Reference Manual, chapter 1.4 IPCC good practice guidance chapter 2.1 2006 IPCC guidelines volume 2, chapter 6		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology	Does the Party estimate and report CO_2 emissions from fuel combustion using the reference approach? If so, are all of fuels used in the country are covered and allocated to proper fuel types (liquid, solid, gas)?	In the reference approach, apparent energy consumption are calculated based on data for production, imports, exports, international bunkers, stock change. Care should be taken that the production of secondary fuels should be ignored in the reference approach because the carbon in these fuels is included in the supply of primary fuels from which they are derived.	Reviewer to document any issues, and recommendations on how to address the issue
	In the reference approach, is the amount of carbon which does not lead to fuel combustion emissions excluded from the total CO_2 emissions?	Carbon excluded from fuel combustion is either emitted in another sector of the inventory (for example as an industrial process emission) or is stored in a product manufactured from the fuel.	
Documentation	Check if the Party reports the results of the comparison between the reference approach and the sectoral approach. In case there are any large difference between the results of the two approaches, does the Party explain the reason of the differences? Is the Party's explanation reasonable?	In case there are significant discrepancies (over 5%) between the results of the two approaches, the Party should analyze the reason behind the difference. This analysis may help the Party to find room for improvement of estimation methodologies for the energy sector. Possible reasons for large discrepancies between two approaches are listed in the 2006 IPCC guidelines.	

2. CO_2 FROM BIOMASS FUELS

Biomass fuels are included in the national energy and emissions accounts for completeness only. The resultant CO_2 emissions should not be included in national CO_2 emissions from fuel combustion. The release of carbon due to biomass used as energy should be accounted in the land use, land-use change and forestry (LULUCF) sector. Non-CO_2 emissions from biomass combustion, however, should be reported under the energy sector.

Potential key issues	Overestimation of national total CO_2 emissions, omissions or double counting between the energy and the LULUCF sector		
General references	Revised 1996 IPCC Guidelines – Reference Manual, chapter 1.4, 1.5 IPCC good practice guidance chapter 2.1, 2.2 2006 IPCC guidelines volume 2, chapter 1, chapter 2, and chapter 3		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Reporting	Does the Party estimates and report GHG emissions from biomass fuels combustion? If so, check if the CO_2 emissions from biomass fuels excluded from the national totals.	CO_2 emissions from biomass fuel combustion should be reported but should not be included in the national totals to avoid double counting with LULUCF sector. On the other hand, other GHG emissions from biomass fuel should be included in the national total.	Reviewer to document any issues, and recommendations on how to address the issue
Methodology	How are data for biofuel combustion obtained? Check if there are any omissions or double counting with the LULUCF sector.	Biomass data are generally more uncertain than other data in national energy statistics. A large fraction of the biomass, used for energy, may be part of the informal economy, and the trade in these type of fuels (fuel wood, agricultural residues, dung cakes, etc.) is frequently not registered in the national energy statistics and balances. Where data from energy statistics and AFOLU statistics are both available, the inventory compiler should take care to avoid any double counting, and should indicate how data from both sources have been integrated to obtain the best possible estimate of fuel wood use in the country.	

8.2.1 SUBSECTOR

1. STATIONARY COMBUSTION

A) FEEDSTOCK, REDUCTANT, AND NON-ENERGY PRODUCT USE

There are several cases of close interaction between fuel used as energy and fuel used in various industrial processes. In particular, the Reviewer should carefully check to be sure Parties are not double counting or omitting the fuel used in the iron and steel industry and chemical industry. In the iron and steel industry, fuels such as coke oven coke and pulverized coal are injected into blast furnaces as reducing agents. The carbon used as reducing agents basically should be allocated to the IPPU sector. Similarly, emissions from feedstocks use of fuels in the chemical industry should be reported under the IPPU sector. Emissions from other types of non-energy use (for instance, emissions from non-energy use of lubricants) also should be covered in the IPPU sector.

However, there are cases where the splitting of fuel use between the industrial processes and product use and energy sectors is not possible. In such cases, countries typically allocate emissions to one of these two sectors. This might lead to some irregularity in the sectoral emission trends if emissions are allocated differently across years or countries. Parties should provide explanations for their allocation decisions.

Potential key issues	Omissions or double counting between the energy and the IPPU sector		
General references	Revised 1996 IPCC Guidelines – Reference Manual, chapter 1.4 IPCC good practice guidance chapter 2.1, 2.2 2006 IPCC guidelines volume 2, chapter 2		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Feedstocks	Check the methodology to estimate CO_2 emissions from the chemical industry. How have the feedstock uses been identified? Have any omissions or double counting occurred between energy use and feed stock use?	In the chemical industry, fuels are used as feedstocks to produce chemical products. Emissions from feedstock use of fuels should be reported under the IPPU sector. Parties may have difficulty to separate feedstock use from energy use, especially when they use fuel delivery data on the estimation. In that case, the reviewer should carefully check how the Party splits activity data between energy use and non-energy use, and if there are any omissions or double counting.	Reviewer to document any issues, and recommendations on how to address the issue
Reductant	How does the Party estimate CO_2 emissions from the iron and steel industry? How emissions have been divided between fuel combustion and industrial process? Check if there are any omissions or double counting between the two sectors.	Emissions from the iron and steel industry arise from blast furnaces, basic oxygen furnaces, metal processing and power generation. In accordance with the IPCC guidelines, the estimation methodologies should be able to divide emissions between fuel combustion and industrial process, and emission from reductant use of fuels should be allocated to the IPPU sector. However, in light of complex nature of accounting emissions at blast furnaces, the review should focus on ensuring that there is no duplication or omission of emissions rather than precise source categorization.	
Non-energy product use	How does the Party estimate and report the emissions from lubricant use? Are emissions from co-combustion in engines (2-stroke engines) reported in the energy sector? Are emissions from other non-energy use reported in the IPPU sector?	The use of lubricants in engines is primarily for their lubricating properties and associated emissions are therefore considered as non-combustion emissions to be reported in the IPPU Sector. However, in the case of 2-stroke engines, where the lubricant is mixed with another fuel and thus on purpose co-combusted in the engine, the emissions should be estimated and reported as part of the combustion emissions in the energy sector.	
	Does the Party exclude other non-energy use of fuels from activity data in energy sector? In case emissions occur from these non-energy uses, does the Party report those emissions under the IPPU sector?	Other fuels typically consumed for non-energy product use are bitumen, paraffin-waxes, and white spirit. The reviewer should check if the Party excludes these fuels from emissions in the energy sector.	

B) OTHER ALLOCATION ISSUES (AUTO PRODUCER, INTERACTION WITH WASTE)

In estimating emissions from stationary combustion, care should be taken to estimate and report emissions from following sources in the appropriate categories: autoproduction of electricity, and waste incineration with energy recovery.

Potential key issues	Misallocation of emissions between the energy industry and the manufacturing industry, omissions or double counting between the energy and the waste sector		
General references	Revised 1996 IPCC Guidelines – Reference Manual, chapter 1.4 IPCC good practice guidance chapter 2.1 2006 IPCC guidelines volume 2, chapter 1, and chapter 2		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Autoproduction of electricity	Does the Party estimate and report emissions from the autoproduction of electricity. If yes, does the Party report the emissions in the subsectors where the electricity was generated (e.g. manufacturing industry)? Check if there is any double counting with the energy industries subsector.	For various reasons, some companies choose to generate part or all of their own electricity and/or process heat, instead of purchasing it from an energy supplier (e.g. utility). These are called electricity autoproducers, autogenerators, self-generators, or self-producers. Autoproduced electricity should be assigned to the subsectors where it was generated (e.g. manufacturing industries). Care should be taken to ensure that no double counting or omissions of emissions have occurred.	Reviewer to document any issues, and recommendations on how to address the issue
Waste incineration with energy recovery	Is there any energy-use of wastes in the country? If yes, are emissions from combustion of wastes for energy purposes reported in the energy sector? Check if the Party accounts only the fraction of fossil origin carbon in the energy sector.	Emissions relating to the combustion of waste for energy purposes should be accounted for under the energy sector. Only the fraction of carbon in these wastes that is of fossil origin (e.g. plastics) is to be accounted for in the energy or waste sectors because biogenic CO_2 is accounted for under the LULUCF sector.	

2. MOBILE COMBUSTION

A) International aviation and marine bunker fuels

GHG emissions arising from fuels used in ships or aircraft for international transport should not be included in the national total. The quantities of fuels delivered to and consumed by international bunkers should be subtracted from the fuel supply to the country. The calculated bunker fuel emissions should be mentioned in a separate table as a memo item.

Potential key issues	Misallocation of emissions between domestic and international bunker, Overestimation or underestimation of emissions from the transport sector		
General references	Revised 1996 IPCC Guidelines – Reference Manual, chapter 1.4, 1.5 IPCC good practice guidance chapter 2.4, 2.5 2006 IPCC guidelines volume 2, chapter 3		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology	How the Party split between international and domestic bunker fuels? Is the Party's definition of international bunker fuels in line with the IPCC guidelines?	In some cases, the national energy statistics may not provide data for bunker fuels consistent with the definition of the IPCC guidelines. In that case, the Party may use other data sources, such as data from taxation authorities or data from surveys of airline companies.	Reviewer to document any issues, and recommendations on how to address the issue
Reporting	Check if the GHG emissions from bunker fuels is reported separately as a memo item and not included in the national totals.	Emissions from international bunker fuels should be reported separately and excluded from the national totals.	

B) Other allocation issues (military use, mobile sources in agriculture/forestry/fisheries)

Following emission sources should not be included in the transport sector: military use (military aviation and navigation) and mobile sources in agriculture, forestry, and fisheries industry. GHG emissions from these sources should be estimated separately from the transport sector and reported under the appropriate categories.

Potential key issues	Misallocation of emissions between the transport sector and other sectors		
General references	Revised 1996 IPCC Guidelines – Reference Manual, chapter 1.4, 1.5 IPCC good practice guidance chapter 2.3, 2.4 2006 IPCC guidelines volume 2, chapter 3		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Military use	Check if emissions from military aviation and navigation are excluded from the transport sector and reported in the military subcategory.	Care should be taken to ensure that no double counting or omission of emissions due to military use of fossil fuels occurs. In particular, it is necessary to make sure that emissions from mobile sources operated by the country's military are effectively included under the appropriate category.	Reviewer to document any issues, and recommendations on how to address the issue
Mobile sources in agriculture/forestry/ fisheries	Check if emissions from off-road vehicles on farm land and in forests are excluded from the transport sector and reported in the agriculture/forestry/ fisheries subcategory.	Care should also be taken to ensure that emissions from mobile sources used for on-site agricultural/forestry activities and fishing are accounted for under the agriculture/forestry/fisheries subsector and that emissions are not double counted in the transport subsector.	
	Check if emissions from fishing vessels are excluded from the transport sector and reported in the agriculture/ forestry/ fisheries subcategory.		

3. FUGITIVE EMISSIONS

A) Coverage issues

The fugitive emissions subsector comprises all GHG emissions from associated non-combustion sources and venting and flaring activities. It covers the emissions from exploration, production, gathering, processing or refining, transmission, transport, storage and distribution of fossil fuels. The reviewer should check if fugitive emissions are reported for all fuels produced and/or consumed in the country.

In estimating these emissions, fuel production and supply data are typically used as activity data. These data may also be available in the international statistics such as IEA's energy statistics, and the Party's national data sources. The reviewer should check if there are any significant discrepancies between the activity data used by the Party and international or national data sources.

Potential key issues	Overestimation or underestimation of emissions under fugitive emissions subsector		
General references	Revised 1996 IPCC Guidelines – Reference Manual, chapter 1.7, 1.8 IPCC good practice guidance chapter 2.6, 2.7 2006 IPCC guidelines volume 2, chapter 4		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology	Compare the reported activity data against corresponding values published by international agencies.	Energy statistics are available for most countries from the International Energy Agency (IEA), United Nations Statistics Department (UNSD), and the United States Energy Information Administration (EIA). Additional oil and gas data are available from international survey conducted by Oil and Gas Journal. Compare reported AD with these data sources and check if the AD has omissions or large differences.	Reviewer to document any issues, and recommendations on how to address the issue
	Are there any national energy statistics of the Party available? If so, check if the activity data is consistent with these data sources.	The Party's ministry of energy or statistical office may maintain energy statistics. Also, in estimating emissions from fuel combustion, the Party may use its energy balance tables.	

Potential key issues	Overestimation or underestimation of emissions under fugitive emissions subsector		
Completeness	Are fugitive emissions reported for all fuels produced/consumed by the Party?	Note that fugitive emissions occur throughout the lifecycle of the fuel (extraction, production, transport, use). For example, if oil is imported and consumed in the country, the Party should report fugitive emissions from transport and beyond.	

B) Coverage issues

Estimates of venting and flaring emissions are often suspect, because they are usually only rough estimates and are often incomplete. Local reporting requirements may not necessarily require tracking of all vented and flared volumes. Normally there is no metering on vent or flaring systems, especially on emergency-relief and blowdown systems. Even in advanced countries with highly regulated oil and gas industries, it is not uncommon for many operating facilities to incorrectly report zero vented and flared volumes. In many cases, the reported volume is a balancing term calculated to reconcile production accounting reports, and may therefore contain significant uncertainties due both to metering errors and to the fact that substantial venting and flaring may occur upstream of any metering, This latter point is of particular concern in countries where the industry is effectively monopolized by a single national petroleum company, since in such cases there is often metering at the final sales points only. An additional concern is that in cases where vented and flared statistics are provided, they are usually reported as a combined value rather than as separate vented and flared fraction. The actual split has a significant impact on the total CO_2-equivalent emissions from these activities, since unburned methane has a gwp significantly higher than CO_2, which is a product of methane combustion.

Potential key issues	Misallocation of activity data between the venting and the flaring category		
General references	Revised 1996 IPCC Guidelines – Reference Manual, chapter 1.8 IPCC good practice guidance chapter 2.7 2006 IPCC guidelines volume 2, chapter 4		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology	Check if the assumed flaring efficiency (the combustion efficiency for flaring) is reasonable.	Under ideal condition, a combustion efficiency of 98 percent may be achieved for flares and 99 percent for incinerators (U.S. EPA, 1995). However, in cases involving high-velocity flaring events, strong cross-winds, flame stability problems, or flaring of rich/condensing streams such as associated and solution gas, the efficiencies could be appreciably less.	Reviewer to document any issues, and recommendations on how to address the issue
	Do the reported AD correctly distinguish between venting and flaring, or are the two activities reported as an aggregate value? In the latter case, check that a reasonable basis for estimating the split between vented and flared volumes has been used.	Typically, waste gas is flared if it contains hydrogen sulphide or if it is in a populated area and there is an odor potential: otherwise it is vented, since this can be done safely and is a more economical option. This general rule may be used to infer disposal practices at oil and gas facilities, but usually requires an intimate knowledge of the Part's oil and gas industry. In the absence of such information, as a conservative first approximation it should be assumed that all waste gas is vented. Venting rather than flaring is common practice at gas transmission and storage facilities.	

4. CARBON DIOXIDE TRANSPORT AND STORAGE (INCLUDING MONITORING SYSTEMS)

A) Reporting of amount of CO_2 captured and CO_2 leakage from CCS

Carbon dioxide capture and storage (CCS) is a technology to remove CO_2 from the gas streams that would otherwise be emitted to the atmosphere, and transfer it for indefinite long term storage in geological reservoirs, such as depleted oil and gas fields or deep saline aquifers. The 2006 IPCC guidelines introduced this new sub-sector to deal with this technology. In case CCS is implemented in the country, the Party shall estimate and report the amount of captured CO_2 and fugitive CO_2 emissions associated with CO_2 transport, injection and storage process. The amount of captured CO_2 should be reported in the subcategory where the captured CO_2 is generated and subtracted from the CO_2 emissions from that subcategory.

Potential key issues	Lack of completeness and transparency		
General references	2006 IPCC guidelines volume 2, chapter 5		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Reporting	Check if there are any CCS projects in the country.	The database of CCS projects all over the world is available at the website of Global CCS Institute (GCCSI).	Reviewer to document any issues, and recommendations on how to address the issue
	If there are CCS project implemented in the country, does the Party report the captured amount of CO_2 and the fugitive CO_2 emissions in appropriate categories?	Carbon dioxide transport and storage subsector covers fugitive CO_2 emissions associated with CO_2 transport, injection and storage process. Care should be taken that CO_2 emission from CO_2 capture and compression system should be excluded from the amount of captured CO_2 and should not be reported under the carbon dioxide transport and storage subsector.	
	Check a mass balance among captured CO_2, stored CO_2 and fugitive CO_2 emissions.	The Party should check that the mass of CO_2 captured does not exceed the mass of CO_2 stored plus the reported fugitive emissions in the inventory year.	
Documentation	Does the Party report the methodologies and results of monitoring program of the storage site? Are the results of the monitoring program in line with the reported emissions from the CCS projects?	The Party should obtain the information of methodologies and results of the monitoring program, the mass of captured, injected and stored CO_2 in CCS projects, and other relevant information.	

8.3 INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)

8.3.1 GENERAL

1. ALLOCATION ISSUES WITH THE ENERGY SECTOR

The main emission sources from the IPPU sector are from industrial processes that chemically or physically transform materials. However, fossil fuels are also consumed by industry for energy purposes.

Potential key issues	Overestimation of national total CO_2 emissions, omissions or double counting between the IPPU and the energy sectors		
General references	Revised 1996 IPCC Guidelines – Reference Manual, chapter 1.4, chapter 2.3. IPCC good practice guidance chapter 2.1, 2.2, 3.1 2006 IPCC guidelines volume 2, chapter 2, volume 3, chapter 2		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Limestone use in cement manufacturing	Does the Party separate energy and industrial processes and product use emissions in cement manufacturing?	The energy required for the cement production is often obtained from a separate combustion process; emissions from this process should be reported in the Energy sector. When company provided data are used, emissions from combustion in the kiln may be included. These emissions should preferably be reported in Sector 1, Energy. If necessary, the combustion portion of the emissions can be subtracted from the total emissions by using the default emission factor of the Guidelines.	Reviewer to document any issues, and recommendations on how to address the issue
Feedstocks	Refer to section 5.2.2. (1) 1)		
Reductant	Refer to section 5.2.2. (1) 1)		
Non-energy product use	Refer to section 5.2.2. (1) 1)		

2. INCORPORATING ABATEMENT TECHNOLOGY AND/OR MANUFACTURING PROCESSES

The IPPU sector covers a wide range of industries and the facilities may use different technology and/or processes to manufacture the products, which may have significant implication on emission levels. The inventory team will need to conduct a thorough study on the manufacturing process to ensure the correct methodology, AD, and/or EF is being used.

Potential key issues	**Over or underestimation of GHG due to the incorrect use of methodology**		
General references	Revised 1996 IPCC Guidelines – relevant sections on soda ash, ammonia, nitric acid, adipic acid IPCC good practice guidance - relevant sections on soda ash, ammonia, nitric acid, adipic acid 2006 IPCC guidelines - relevant sections on soda ash, ammonia, nitric acid, adipic acid		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology, EF	Check the production process employed and the associated methodology and EF	For example, emissions from soda ash productions vary significantly with the manufacturing process. There are four different processes used to produce soda ash commercially, and the methodology, AD, and/or EF will be different depending on the process.	Reviewer to document any issues, and recommendations on how to address the issue
Methodology	Ammonia	The CO_2 from production of ammonia may be used for producing urea or dry ice. Since this carbon will be stored only for a short time, no adjustment should be made for intermediate binding of CO_2 in downstream manufacturing processes and products.	
Emission control devices	Check for presence of emission control devices.	For example, nitric acid industries different types of systems to control N_2O and NO_X emissions. Emission estimates should reflect efficiencies of abatement systems.	

3. COMPLETENESS OF THE SECTOR

The IPPU sector covers a wide range of industries and not all consumption/production data may be officially captured in national, regional, or industry statistics. The inventory team will need to conduct a thorough study to ensure the completeness of the sector.

Potential key issues	**Possible underestimation due to incomplete coverage of categories or AD**		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Coverage of industries	Is the Party collecting any data from industrial facilities directly?	When Parties are collecting data from individual facilities, care must be taken to: -Ensure the use of proper QA/QC system to check data delivered by the industry to the relevant authorities, and the efficient and accurate transfer of this information to the national inventory. -ensure that smaller enterprises not taking part in a national emissions reporting system are included in the national inventory. -ensure that double counting or data omissions are not occurring.	Reviewer to document any issues, and recommendations on how to address the issue

Potential key issues	Possible underestimation due to incomplete coverage of categories or AD		
Methodology	Check whether extrapolation to include all production facilities has been applied and an appropriate method has been used.	Data may have been reported by the largest industries in an industrial subsector only. In these cases, the Party should have applied an extrapolation to include all production facilities in the subsector or category.	
	Identify the system the party might have in place for QC of emission reports by industries.	A QA/QC system within the country can greatly enhance the level of confidence in the data, particularly when an independent auditing scheme is put in place within the local legal framework and the auditing reports are readily available.	

8.3.2 SUBSECTOR

1. COVERAGE OF MINERAL PRODUCTS

Potential key issues	Incomplete coverage of categories or facilities in the IPPU sector		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Completeness	Check for possible double counting	CO_2 emissions associated with the use of coke in soda ash production should be accounted for separately, and those emissions associated with the non-energy use of coke subtracted from the totals in the energy sector.	Reviewer to document any issues, and recommendations on how to address the issue
Method	Check how limestone is used in the country.	Limestone or dolomite is used in a wide range of industries, namely, cement, lime, magnesium, agricultural activities, glass, etc. The inventory compiler should note that not all uses of limestone result in CO_2 emissions.	
		CO_2 from liming of agricultural soils should be reported in the AFOLU sector.	

2. CHEMICAL PRODUCTS

Potential key issues	Incomplete coverage of categories or facilities in the IPPU sector		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Method	Check flow of CO_2 in chemical process	The CO_2 from production may be used for producing urea or dry ice. Since this carbon will be stored only for a short time, no adjustment should be made for intermediate binding of CO_2 in downstream manufacturing processes and products. Avoid double counting of carbon during feedstock treatment of natural gas in ammonia production.	Reviewer to document any issues, and recommendations on how to address the issue
	Check whether EF is based on natural gas consumed or ammonia produced.	When gas consumption is not available, an alternative method is to calculate the emissions from the ammonia produced.	
Reflecting emission reduction technologies to emission factors	Check the origin of EFs.	Check for presence of emission control devices. The nitric acid industry uses different types of systems to control N_2O and NO_X emissions. Emission estimates should reflect efficiencies of abatement systems. In cases where nitric acid plants control for NO_X emissions, check whether emission factors have been adjusted for plants using non-selective catalytic reduction (NSCR).	

3. METAL PRODUCTION

Potential key issues	Incomplete coverage of categories or facilities in the IPPU sector		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Double counting	Additional emissions occur as the limestone or dolomite flux releases CO_2 during reduction of pig iron in the blast furnace. However, this source category should be covered as emissions from limestone use.	In estimating emissions from this source category, there is a risk of double counting or omission in either the Industrial Processes or the Energy Sector. Since the primary use of coke oxidation is to produce pig iron, the emissions are considered to be industrial processes, and it should be reported as such. If this is not the case it should be explicitly mentioned in the inventory. Inventory agencies should perform a double counting/completeness check. This will require good knowledge of the inventory in that category	Reviewer to document any issues, and recommendations on how to address the issue

4. F GASES

A) Potential emissions vs actual emissions

Potential key issues	Incomplete coverage of categories or facilities in the IPPU sector		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Method	The IPCC provided two tiers for estimating emissions from ozone depleting substitutes (ODS) substitutes. Tier1, the "potential emission" method, estimates emissions based on current consumption, defined as production plust improts minus exports and destruction. There are two options for Tier 2; Tier 2a and 2b. Both of the Tier 2 methods are "actual emissions" methods and are more complex than the tier 1 method. They estimate emissions by taking into account the time period between sales and the use of these chemicals produced by the operational characteristics and lifespan of equipment with use them.	The Tier 2 methods require significantly more data, and are preferred. The Tier 2a approach estimates the emssions of each GHG by tracking the annual vintages of each type of equipment using these gases. Data are collected to estimate the quantity of equipment sold, discarded, or replenished with ODS substitutes in a given year. Leakage rates are then applied to each class of equipment to estimate the total net annual emissions. Note that the 2006 IPCC Guidelines does not consider the potential emissions approach good practice.	Reviewer to document any issues, and recommendations on how to address the issue

8.4 AGRICULTURE, FORESTRY, AND OTHER LAND USE

8.4.1 AGRICULTURE

1. GENERAL

A) Reflection of policy measures

It is important to reflect the reduction of mitigation action to GHG emissions of the GHG inventory.

Potential key issues	Reflection of policy measures		
General references	-		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Recalculations / Consistent time series	Are the results of policy measures reflected in the time series?	In agriculture various technical and policy measures can be taken to reduce emissions. It is important that the methods reflect the results of the actions.	Reviewer to document any issues, and recommendations on how to address the issue

2. SUBSECTOR

A) Enteric fermentation and manure management

i) Livestock population characterization

Livestock characterization, categories and activity data are essential to the GHG inventories of CH_4 emissions from enteric fermentation, CH_4 and N_2O emissions from manure management, and N_2O emissions from agricultural soils. Good practice uses a single livestock population characterization as a framework for estimating CH4 emissions from enteric fermentation, as well as CH_4 and N_2O emissions from manure management.

Potential key issues	Considering livestock characterization		
General references	IPCC GPG chapter 4.1 IPCC Guidelines Reference manual Chapter 4.2 2006 IPCC Guidelines Volume 4 chapter 10.2		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology	If an enhanced characterization is used, is there an expected relationship between digestibility, feed intake and growth (e.g., low digestibility leads to lower feed intake and reduced growth)? Is the feed intake calculated based on the equations from 2006 IPCC guidelines and GPG?	The feed intake is an important factor to calculate GHG emissions from this source. The 2006 IPCC guidelines and GPG provide the equations to calculate the feed intake.	Reviewer to document any issues, and recommendations on how to address the issue
	Has the Party used the same livestock characterization to estimate CH_4 emissions from enteric fermentation, CH_4 and N_2O emissions from manure management?	The livestock characterization must be consistent between enteric fermentation and manure management.	
Activity Data	Are the AD between enteric fermentation and manure management categories consistent?	The AD data must be consistent between enteric fermentation and manure management.	
	What AD has been used? National statistics or other? Have annual population statistics taken into account seasonal births or slaughters? Has migration of livestock within or between countries lead to double counting or under counting of animals?	It is desirable to use national statistics. The Reviewer must check the features of the AD data (E.g. whether seasonal births and slaughters are included or excluded, or three years averages are used). If necessary, the Reviewer can compare AD data and FAO statistics.	
Activity Data /Completeness	Are all possible livestock classes covered? Has the country used animal classes and categories in addition to those listed in the GPG and IPCC Guidelines?	If emissions from animals for which there are currently no IPCC tier 1 or 2 estimation methods (e.g., wapiti, emus, elks) are reported, the Party needs to provide sufficient information. If it is necessary, the Reviewer may compare AD data and FAO statistics.	
Consistent time series	Have rapid changes in livestock population taken place as a result of economic restructuring and changing market conditions? If so, is an adequate time series is developed?	Normally key-attributes do not change rapidly and can be obtained by back-estimating ongoing trends. However, if structural changes have taken place further investigation may be needed.	

ii) Tier 2 method of Enteric fermentation

The tier 2 method is a complex approach that requires detailed country-specific data on nutrient requirements, feed intake and CH_4 conversion rates for specific feed types, which are used to develop emission factors for country-defined livestock categories.

Potential key issues	EF of Tier 2 method of Enteric fermentation		
General references	IPCC GPG chapter 4.2 IPCC Guidelines Reference manual Chapter 4.2 2006 IPCC Guidelines Volume 4 chapter 10.3		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Emission factor	If a country-specific EF is used, are the data developed through the livestock characterization used for developing the EF?	The EF of Tier2 method must be consistent with the livestock characterization.	Reviewer to document any issues, and recommendations on how to address the issue

iii) Manure management system

The CH_4 EFs for Tier 2 method and N_2O EFs are provided in IPCC Guidelines and GPG for each manure management systems. To calculate accurate emissions, the Party needs to use country specific manure management system data.

Potential key issues	Manure management system		
General references	IPCC GPG chapter 4.3,4.4 IPCC Guidelines Reference manual Chapter4.2,4.5.3 2006 IPCC Guidelines Volume 4 chapter 10.4,10.5		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Activity data	Is the information on distribution of manure management systems based on statistics or other information? Is the distribution periodically updated to reflect changing practices?	The Party needs to use the country specific manure management system data affecting national circumstances based on statistics or other reliable sources.	Reviewer to document any issues, and recommendations on how to address the issue
Consistency	Is the manure management system distribution consistently used for estimation of CH_4 and N_2O emissions?	The manure management system data must be consistent between CH_4 and N_2O estimate.	

iv) Other (manure management)

Some other important issues are below.

Potential key issues	Other issues		
General references	IPCC GPG chapter 4.3,4.4 IPCC Guidelines Reference manual Chapter4.2,4.5.3 2006 IPCC Guidelines Volume 4 chapter 10.4,10.5		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Emission factors and parameters	If there are multiple climate zones in the country, has the Party estimated CH_4 emissions regionally, applying appropriate parameters?	For some large countries livestock may be managed in regions with different climates. For each livestock category, the percentage of animals in each climate region should be estimated. In the IPCC Guidelines, CH_4 EFs are defined in each category of average annual temperature.	Reviewer to document any issues, and recommendations on how to address the issue
Activity data	Are direct N_2O emissions estimated based on total N excreted without subtracting the amount of nitrogen (N) lost through leaching and/or volatilization?	AD of direct N_2O emissions from manure management is total N excreted. N lost is not removed from total N excreted.	

Potential key issues	Other issues		
Indirect N_2O emissions	Has the Party reported indirect N_2O emissions from volatilization of NH_3 and NOx and from leaching/runoff during manure management?	Indirect N_2O emissions from volatilization and leaching/runoff are new categories in the 2006 IPCC Guidelines. If the party use 2006 IPCC Guidelines, these categories must be reported. If the Party does not report these categories, the reason must be provided.	
	If indirect emissions are estimated, are these emissions included in the national total?	Indirect N_2O emissions from agriculture have to be included in the national total whereas those from other sources are not. There are two sources of indirect N_2O emissions in 3.D (agricultural soils), too.	
Cross cutting issue	Has the Party correctly allocated direct and indirect emissions from manure excreted in pasture, range and paddock into the agricultural soils category?	Direct and indirect N_2O emissions from manure excreted in pasture, range and paddock should be reported in 3.D (agricultural soils).	
	If the Party reports treatment of manure in anaerobic digesters, is the amount subdivided in different categories considering amount of biogas recovery, flaring and storage after digestion? If biogas is used for energy production, is it included in the energy sector?	Energy use of manure must be reported in the energy sector.	
	If the Party reports that manure is burned with or without energy recovery, is this included in the energy or waste sector, respectively?	Burning manure with energy recovery must be reported in the energy sector. Burning manure without energy recovery must be reported in the waste sector.	

2. RICE CULTIVATION

A) Conditions of rice cultivation

The conditions in which rice is grown may be highly variable and may significantly affect CH_4 emissions. The IPCC method can be modified to account for this variability in growing conditions by disaggregating national total harvested area into subunits (e.g. harvested areas under different water management regimes) and multiplying the harvested area for each subunit by an emission factor that is representative of the conditions that define the subunit.

Potential key issues	Considering the conditions of rice cultivation		
General references	IPCC GPG chapter 4.9 IPCC Guidelines Reference manual Chapter 4.3 2006 IPCC Guidelines Volume 4 chapter 5.5		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology	Does the method used account for the various conditions of rice cultivation within a country?	Seasonal methane emissions are affected by variations in water management practices, organic fertilizer use, and soil type.	Reviewer to document any issues, and recommendations on how to address the issue
Emission factor	Are the EFs specific or default IPCC? Are country specific EFs based on recent research results within the country? Have scaling factors been used?	The following rice production characteristics should be considered in developing EFs: Regional differences in rice cropping practices, Multiple crops, Ecosystem type, Water management regime, Addition of organic amendments, and soil type.	

Potential key issues	Considering the conditions of rice cultivation		
Activity Data	Is the AD assumptions described in detail?	AD consists of rice production and harvested are statistics. The activity data should be broken down by rice ecosystem or water management system type.	
	Is data for all sectors disaggregated to the same level?	It is good practice to match data on organic amendments and soil types to the same level of disaggregation as the AD.	
	Is the total cultivated area consistent with international data sources such as FAO and the International Rice Research Institute?	If the Reviewer wants to check AD, data of cultivated area can be obtained from the FAO or IRRI's World Rice Statistics.	
Completeness	Have all rice system from the IPCC Guidelines and GPG been estimated?	Complete coverage requires estimation of emissions from the following activities: Emissions outside the rice growing season, Other rice ecosystem categories (e.g: swamp, inland-saline or tidal rice fields) , and Different kinds of rice crops.	
	In case of multiple cropping during the same year, is the 'harvested area' equal to the sum of the area cultivated for each cropping?	All cultivated area in a year must be included in emission estimation.	

3. AGRICULTURAL SOILS

A) Completeness

N_2O emissions from agricultural soils are divided into direct and indirect emissions. These emissions are further divided into other emission subcategories.

Potential key issues	Sub-categories of direct and indirect N_2O emissions		
General references	IPCC GPG chapter 4.7,4.8 IPCC Guidelines Reference manual Chapter 4.5 2006 IPCC Guidelines Volume 4 chapter 11.2		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Direct emissions	Are all sub-categories estimated?	The significant sources of anthropogenic nitrogen inputs resulting in direct N_2O emissions from agricultural soils in GPG are: a) application of synthetic fertilizers; b) application of animal manure; c) cultivation of nitrogen-fixing crops; d) incorporation of crop residues into soils; e) soil nitrogen mineralization due to cultivation of organic soils; and (f) other sources such as sewage sludge, which should be included if sufficient information is available. N_2O emissions from pasture, range and paddock manure are to be reported in the agricultural soil category. In the 2006 IPCC Guidelines, direct N_2O emissions from mineralization/immobilization associated with loss/gain of soil organic matter are added as new category.	Reviewer to document any issues, and recommendations on how to address the issue
Indirect emissions	Are all sub-categories estimated?	The significant sources of anthropogenic nitrogen inputs resulting in indirect N_2O emissions from agricultural soils in GPG are: a) volatilization of NH_3 and NOx; b) leaching/runoff. If the Party uses 2006 IPCC Guidelines and calculates direct N_2O emissions from mineralization/immobilization associated with loss/gain of soil organic matter, mineralized/immobilized N is the activity data of indirect N_2O emissions from leaching/runoff.	

B) Nitrogen cycle

The amount of nitrogen (N) of animal manure applied to soils is consistent with the amount of N of animal manure in sector of 3.B (manure management). Nitrogen cycle must connect from manure management to agricultural soils.

Potential key issues	Consistency of animal manure		
General references	IPCC GPG chapter 4.7,4.8 IPCC Guidelines Reference manual Chapter 4.5 2006 IPCC Guidelines Volume 4 chapter 11.2		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Consistency	Are the AD in line with the data provided in CRF table3.B(b) excluding manure in pasture, range and paddock, and taking into account manure used for feed, fuel and construction and loss of N from manure management systems?	The amount of N of animal manure applied to soils must be based on the amount of N of animal manure excreted treated in the sector 3.B. N_2O emissions from pasture, range and paddock manure are to be reported in other sub-category, the amount of N of manure in pasture, range and paddock must be excluded to avoid double counting.	Reviewer to document any issues, and recommendations on how to address the issue
	Is the estimated loss of N from manure management systems in line with estimated nitrogen loss due to volatilisation of N_2O, NH_3 and NOx, and if reported, loss of N through leaching from manure management?	N of gasses volatilizing in manure management must be excluded.	

C) Activity data

Regarding AD for agricultural soils, the reviewer must note consistency and double counting to other sectors and categories.

Potential key issues	Careful point of Activity data		
General references	IPCC GPG chapter 4.7,4.8 IPCC Guidelines Reference manual Chapter 4.5 2006 IPCC Guidelines Volume 4 chapter 11.2		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Direct emissions	Is the fertilizer consumption disaggregated?	It is good practice to collect detailed AD as far as possible. This will allow for a more accurate revision of previously constructed inventories once country or crop-specific EFs become available. The review experts should compare the country synthetic fertilizer consumption to international statistics like IFA and FAO.	Reviewer to document any issues, and recommendations on how to address the issue
	Are the data on crop residues in line with the data reported for field burning of agricultural residues?	The amount of crop residues in 3D (agricultural soils) and 3F (Burning agricultural residue) must be consistent. If the Party uses the 2006 IPCC Guidelines and has no data on removal rate of crop residues from cropland, the assumption that there are no removed crop residues is in line with the 2006 IPCC Guidelines.	
	Is the area of cultivated histosols in line with the area of organic soils in cropland remaining cropland, land converted to cropland, grassland remaining grassland and land converted to grassland reported in the LULUCF sector?	The area of cultivated histosols in 3D (agricultural soils) and LULUCF must be consistent. Large differences (e.g. "NO" reported for this category while organic soils in cropland or grassland occur) in these data may indicate a problem in the inventory	

Potential key issues	Careful point of Activity data		
Indirect emissions	Is the activity data consistent with the calculations in the direct emissions of N_2O from soils?	To ensure consistency the same data as used in previous categories should be used. If this is not the case, the Party should specify the reasons.	
	Does the atmospheric deposition include NOx from burning of savannas and crop residues (should be excluded)?	Avoiding double counting, NOx from biomass burning must not be included in AD of 3.D.	

4. BURNING SAVANNAHS AND AGRICULTURAL RESIDUE

A) National circumstances of burning savannahs

It is important to use appropriate values to estimate CH_4 and N_2O emissions from burning savannahs taking into account national circumstances.

Potential key issues	Considering national circumstances		
General references	IPCC GPG chapter 4.5 IPCC Guidelines Reference manual Chapter 4.4 2006 IPCC Guidelines Volume 4 chapter 2.4		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology	Are all parameters accounted for?	It is good practice to provide values for all aboveground biomass and both the oxidized and carbon fraction in living and dead biomass.	Reviewer to document any issues, and recommendations on how to address the issue
	Has Combustion Efficiency been used to depict the combustion and vegetation conditions?	Combustion Efficiency is defined as the molar ratio of emitted carbon dioxide concentrations to the sum of emitted carbon monoxide and carbon dioxide concentrations from savanna fires.	
	Are all parameters accounted for?	It is good practice to monitor the fraction of burned savanna area, the aboveground biomass density, the percentage of the aboveground biomass burned, and the combustion efficiency.	
Activity Data	Does the activity data account for all parameters?	The activity statistics for each savanna ecosystem includes the values for the fraction of aboveground biomass burned and the carbon and nitrogen content of the biomass. It is good practice for the inventory agency to collect seasonal data on the fraction of savanna burned, the aboveground biomass density, and the fraction of aboveground biomass burned in each savanna ecosystem from the early to late dry season.	
Completeness	Is this inventory complete for all parameters of savanna burning?	National inventories should cover all sources and sinks, and all GHGs, within the national boundaries of the reporting Party.	

B) Activity data of burning agricultural residue

It is important to use appropriate activity data to estimate CH_4 and N_2O emissions from burning agricultural residue, considering mass balance of residue and avoiding double counting.

Potential key issues	Using appropriate activity data		
General references	IPCC GPG chapter 4.5 IPCC Guidelines Reference manual Chapter 4.4 2006 IPCC Guidelines Volume 4 chapter 2.4		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology	Do local and regional practices account for all appropriate factors?	To achieve a complete mass balance of residue, local and regional practices must reflect the following factors: 1) the fraction of residue burned in the field; 2) the fraction transported off the field and burned elsewhere; 3) the fraction consumed by animals in the field; 4) the fraction decayed in the field; 5) the fraction used by other sectors.	Reviewer to document any issues, and recommendations on how to address the issue
Activity Data	Describe the source of activity data.	Crop production data may be obtained either from country specific data or from FAO stat. For country specific data, it is good practice to compile data on the amount of each crop residue burned after harvest and monthly weather data.	
Completeness	Does the mass balance account for all crop residue burned in the field?	National inventories should cover all sources and sinks, and all GHGs, within the national boundaries of the reporting Party.	

5. LIMING AND UREA APPLICATION

A) Activity data (Liming)

For estimating CO_2 emissions from liming, it is important to use appropriate activity data.

Potential key issues	Using appropriate activity data		
General references	2006 IPCC Guidelines Volume 4 chapter 11.3		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Activity data	Are activity data based on actual usage statistics?	It is desirable to use actual usage data. If there are no actual usage data, estimated usage data based on annual sales data or production data may be alternatively used.	Reviewer to document any issues, and recommendations on how to address the issue
	Are the AD available separately for calcic limestone and dolomite or have assumptions been made? Are any assumptions sufficiently justified and documented?	Lime is separated to two types, calcic limestone ($CaCO_3$), and dolomite ($CaMg(CO_3)_2$). The EFs of these are different. Thus, the AD needs to be separated.	

B) Activity data (Urea application)

CO_2 emissions from urea application are new categories on 2006 IPCC Guidelines. For estimating CO_2 emissions, it is important to use appropriate activity data.

Potential key issues	Using appropriate activity data		
General references	2006 IPCC Guidelines Volume 4 chapter 11.4		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Activity data	Does the reporting on urea application cover all land-uses?	Urea is applied to various land-uses, mainly to crop land and forest land. All urea applied should be included in calculation.	Reviewer to document any issues, and recommendations on how to address the issue
	Are the activity data (amount of urea fertilizers used) consistent with the data used in category 3.D?	In category 3.D (Agricultural soil), nitrogen fertilizers are main N_2O emission sources. Containing N, urea is also included in AD of 3.D. Thus, usage data of urea is consistent in 3.D and this category.	
	Are the AD based on urea fertilizer use or sales instead of production?	It is desirable to use actual usage data. But if there are no actual usage data, estimated usage data based on annual sales data may be alternatively used. In IPPU sector, CO_2 emissions from urea production are reported. So, if the party reports CO_2 emissions from urea production under IPPU sector, CO_2 emissions from urea application are removed from CO_2 emissions from urea production, avoiding double counting.	
Completeness	Are other carbon-containing fertilizers except lime and urea used? If other carbon-containing fertilizers are used, is the AD consistent with the data used in category 3.D?	If other carbon-containing fertilizers are used, the party must report CO_2 emissions from applying those fertilizers. And if those fertilizers contain N, N_2O emissions from applying those fertilizers must be reported in 3.D. Thus, usage data of those fertilizers is consistent in 3.D and this category.	

8.4.4 LULUCF

1. GENERAL

A) Choice of IPCC guidelines (for all IPCC guidelines)

The basic structures and the categorization of land use sector are different in the 1996 Revised IPCC Guidelines (LUCF), GPG-LULUCF (LULUCF) and the 2006 IPCC Guidelines (FOLU in the AFOLU). In the 1996 IPCC guidelines, the Land Use Change and Forestry sector has four categories which focus on activities in relation to where emissions or removals occur. The GPG-LULUCF and the 2006 IPCC guidelines have the common structure and categorization in which using land use categories that covers entire national land territory and emissions and removals are estimated and reported in relating land use categories.

The Party should estimate and report GHG emissions and removals in accordance with the methodologies and categorization provided in the IPCC guidelines which party decided to use.

Potential key issues	Use appropriate methods in line with IPCC guidelines		
General references	2006 IPCC Guidelines volume 4 GPG-LULUCF chapter 1, 2, 3 1996 Revised IPCC Guidelines Vol.1, Chapter 1, Vol.2, Chapter 5		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Categorization	Are the GHG emissions and removals estimated and reported in line with the categorization listed in the selected IPCC Guidelines?	The categorization and structure is explained in the introduction section in the IPCC guideline.	Reviewer to document any issues, and recommendations on how to address the issue

Potential key issues	Use appropriate methods in line with IPCC guidelines		
Methodology	Does the Party apply methods provided in the selected IPCC guideline?	Normally, estimations are based on the relevant methods provided by the selected IPCC guideline. In some case, alternative methods or parameters in the recent IPCC guidelines might be applicable. It is not prohibited to use methods provided in the other guidelines, but it is not recommend applying old methods in the older Guidelines than that the party decided to use.	
	When methods in the other guidelines are partly used, is the correct mapping back is applied or not?	Reported categories shall be in line with the selected IPCC guideline. The relationship of categories between LUCF (the 1996 Revised Guidelines) and LULUCF (the GPG-LULUCF and the 2006 IPCC guidelines) is provided in the GPG-LULUCF. Follow the relationship when the party implements mapping back.	

2. CONSISTENT REPRESENTATION OF LAND AREAS (FOR 2006 GL AND GPG-LULUCF)

A) Land representation system

When a Party applies the 2006 IPCC guidelines and the GPG-LULUCF, a Party shall divide its national territory into multiple land use categories and estimate carbon stock changes and GHG emissions/removals associated with land use, land -use change categories. The IPCC guidelines suggest the six broad land use categories (forest land, cropland, grassland, wetlands, settlements and other land). The national classification system should be used consistently over time to avoid gaps and overlaps in land area data.

The 2006 IPCC guidelines and the GPG-LULUCF present three approaches for representing land areas; use of basic land-use data, survey of land use and land-use change and geographically explicit land use data. The choice of the approaches will depend on the national circumstances (e.g. the areas of the country, the land use types and accessibility to all areas), availability of data and resources available to improve the inventory. While the approaches are not mutually exclusive, the mix of approaches selected by an inventory agency should reflect calculation needs and national circumstances. One approach may be applied uniformly to all areas and land-use categories within a country, or different approaches may be applied to different regions or categories or in different time intervals.

Potential key issues	Consistent representation of land		
General references	2006 IPCC Guidelines Volume 4, Chapter 3 GPG-LULUCF, Chapter 2		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Land use categorization	Is the entire national land territory divided into the six main land use categories? Are each land use categories further divided into two subcategories?	LULUCF reporting is done for the six main land-use categories. This is further divided into two subsections based on the status and recent history of land-use: · Lands that begin and end an inventory period in the same use · Conversions to the land use covered by the land-use category	Reviewer to document any issues, and recommendations on how to address the issue
	Are land conversion categories based on a 20 years period?	The period of 20 years (default transition period of mineral soil) is used for separation of remaining land and converted land. If other separation is applied, explanation should be provided.	

Potential key issues	Consistent representation of land		
Land use definition	Is the information on how the Party defines land use categories provided?	Parties will use their own definitions for the land-use categories and sub-categories needed in making the estimates on emissions/removals.	
	How does the country harmonize its national land categories/ definitions into the IPCC land use categories?	Land-use definitions and the correspondence of the classification systems used to the LULUCF categories should be provided.	
Approaches and data for representing land area	Is there an explanation about the way of land representation, including the approaches and source data used?	Approaches used for representing land areas and land-use data bases used for the inventory preparation should be provided.	
	Whether is a single uniform approach used or different approaches used for land representation?	The approaches complement each other and different approaches can be used for different LULUCF categories.	
Possible omissions or double-counting	Are total land areas consistent overtime? If the values are different, is an explanation provided?	Basically the total land areas should be consistent overtime. But, sometimes national land area may change due to expansion of land such as landfill, and/ or improvement of precision about land survey.	
	Is the total land same as the sum of the areas reported in each land use? If the values are different, is an explanation provided?	The total land should be same as the sum of the land use areas reported in each land use. If not, double counting or omission may be occurred. Other land category is allowed to match the total national land area and the sum of land areas reported.	
	For the total area of the inventory of the LULUCF sector, are the overall changes in land-use for the inventory year equal to zero within the confidence limits?	Theoretically, all land use changes (increase of one land use categories and decrease of land use categories) must be balanced. If large inconsistency is appeared, errors of estimation may be happened.	

B) Application of the managed land proxy (for all IPCC guidelines)

In land use sector, some emissions and removals occurred due to anthropogenic reason, while other emissions and removals may be occurred due to non-anthropogenic reasons. Under the UNFCCC, only anthropogenic emissions and removals are addressed in the GHG inventory, however, strict factoring out of non-human effect is scientifically difficult. Therefore, IPCC guidelines apply a concept called the managed land proxy that emissions and removals occurred on managed land are regarded as anthropogenic.

Potential key issues	Application of the managed land proxy		
General references	2006 IPCC guidelines volume 4, chapter 2		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Managed land proxy	Is managed land and unmanaged land identified?	All cropland and settlements are usually considered as managed land. Forest land, grassland and wetland may have unmanaged land. The party may consider all national land as managed.	Reviewer to document any issues, and recommendations on how to address the issue
	If unmanaged land is identified, are emissions and removals occurred on unmanaged land excluded from total national emissions and removals?	The Party shall include only emissions and removals occurred on managed land into national GHG inventory.	

C) Methodological issues (for all IPCC guidelines)

Sampling approach is widely used in LULUCF estimation. Sometimes a single data set and/or a single survey procedure are not able to cover all time series and a combination of multiple data or survey to construct time series data of GHG inventory. Special attentions are necessary in these cases.

Potential key issues	**Sampling and time series construction**		
General references	GPG-LULUCF, chapter 5 2006 IPCC Guidelines, volume 1		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Sampling	Is the inventory or a part of it based on sample survey? How are those components of the inventory covered?	Guidance on Sampling Methods for area estimation is provided in IPCC guidelines. Consider the sampling method satisfies enough representation.	Reviewer to document any issues, and recommendations on how to address the issue
Use of multiple data set for constructing time series	Is definition or survey method of main data used for GHG inventory consistent overtime?	If no, the Party should try to eliminate the effect of definitional change from GHG emissions and removals trend, or provide explanation of potential impacts affected to GHG emissions and removal trend caused by definitional change.	
	• Is the estimate of growing stock with in the same magnitude as in earlier reports? • Are the values for the increment within the same range for the period from 1990 to the inventory year, or is there a trend with it? • Is the trend explained in the inventory report?	Activity data may only be available every few years. Hence achieving time series consistency may require interpolation and extrapolation from longer time series or trends.	
	How have inconsistencies with different databases been harmonized?	On how these data were harmonized should be provided. Additionally, if any inconsistencies remain, they should be documented.	

2. SPECIFIC ELEMENTS

A) Generic estimation methods

i) Carbon pools (for all IPCC guidelines)

In the estimation of CO_2 emissions and removals, carbon stock changes in five carbon pools; above-ground biomass, below-ground biomass, dead wood, litter and soil organic matter are considered in each land use. The 1996 IPCC guidelines provide methods about above-ground biomass and soil only, while the 2006 IPCC guidelines and the GPG-LULUCF provide methods about all five carbon pools basically. The party should estimate carbon stock change in each carbon pool based on a method under an appropriate tier.

Potential key issues	**How carbon stock change in each carbon pool estimated and reported**		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Notation of plus or minus	Are emissions and removals reported as *positive* and *negative* terms, respectively?	CO_2 emissions are reported as positive, and CO_2 removals are reported negative. Special attention is necessary that carbon stock change (CSC) and CO_2 flux are shown as oppositely. For example carbon stock gain (positive value) will result CO_2 removals (negative value). The conversion from CSC to CO_2 flux is multiplying -44/12.	Reviewer to document any issues, and recommendations on how to address the issue

Potential key issues	How carbon stock change in each carbon pool estimated and reported		
Inclusion of carbon pools	Have all important carbon pools been included in the inventory? If some carbon pools/ categories omitted, does the report explain why?	The Parties may use different methods/tiers for estimating the carbon stock changes. In the LULUCF "key" concept is applicable to sub-category level or carbon pool level. The pool has 25-30% contribution is considered key.	
	Do applied methods correctly cover relevant carbon pool?	Although generic methods (gain-loss, stock difference) are commonly applied, biomass, DOM and soil have own estimation equations and different parameters (e.x default transition period of mineral soil is 20 years, but other carbon pools use an annual basis).	
Methodological choice	Is the choice of method appropriate for the national circumstances?	Sometimes different terminology can be used to describe the same parameter, or the same term can have a national definition that is different from that used in the IPCC guidelines. For example organic soil has special definition under the IPCC guidelines and it may be different in meaning from domestic use.	
	Is applying Tier.1 correctly implemented?	Some tier.1 methods for specific carbon pools in specific sector suggest reports carbon stock change as zero. (Mostly DOM or soil pools under remaining land of non-forest land use categories). But other tier.1 provides CSC estimation methods.	
	Is the key assumptions and parameters transparently in the NIR when tier.3 approach is applied?	Sometimes Parties use sophisticated models in estimation of carbon stock changes in the LULUCF.	

B) Subcategorization (for all IPCC guidelines)

Various elements such as forest type, vegetation type, climate condition and magnitude of human intervention (management type) affect amount of carbon emissions and removals. IPCC guidelines propose using proper sub-categories for estimation and present some parameters or emission factors categorized by specific sub-categorization. The choice of subcategories should reflect national circumstances and the level at which the estimates are calculated taking into account available activity data.

Potential key issues	Sub-categorisation		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Application of methods	Are sub-categories such as forest type and/or climate zones used for estimation explained?	A party should explain how sub-category is used in its estimation as a part of methodological information. Parties may use detailed calculations in sub-category level but report only aggregated values.	Reviewer to document any issues, and recommendations on how to address the issue
	Is sub-categorization considered appropriate to the national circumstance? Check that the sum of areas of the subcategories corresponds with the total area of the Party, if data on all land categories is provided	A party has diverse climate and ecological condition may have more than one default parameter applicable to their national land. In this case, sub-categorization may help improvement of LULUCF inventory. Subcategories are linked to the use of emissions factors and parameters in the preparing estimates on carbon stock changes. The sub-categorization should cover all climate zones and forest types in the country.	
	Are proper default parameters and emission/ removal factors used in line with the IPCC guidelines?	Errors may have been made in the choice of default parameters.	

2. SECTOR SPECIFIC ESTIMATION METHODS

A) Forest land

For most country forest land is the most dominant category in the LULUCF. A lot of default parameters and factor are provided in detailed level. The estimation methods depend on available forest information such as national forest inventory and its frequency and quality.

Potential key issues	**Specific issues in forest land**		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Land use category	Does unmanaged forest exist in a party?	Estimation should be done only on managed forest.	Reviewer to document any issues, and recommendations on how to address the issue
	Is the forest definition same as one that reported to FAO? If different, explanation of the difference explained?	FAO FRA also includes forest area data as well as GHG related data. Thus, FAO data is often compared with GHG inventory.	
Methodology	Are carbon stock changes in pools estimated by using appropriate tier?	In forest land, all carbon pools have contribution. The Parties may use different methods and tiers for estimating each carbon stock change The 1996 Revised IPCC guidelines only cover above-ground biomass pool.	
	Is there emissions due to natural disturbance	Carbon stock change due to natural disturbance occurred on managed forest should be estimated and reported in the 2006 Guidelines. In the GPG-LULUCF, if the area of natural disturbance will recover and reach same situation after the event, CO_2 emissions by event and subsequent CO_2 removals by recovery are not necessary estimated.	

B) Cropland and grassland

In cropland and grassland, soil carbon pool is more important than other land uses. The points specified in the following table should be checked.

Potential key issues	**Specific issues in cropland and grassland**		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Land use category	What land use defined national classification system is included in cropland and grassland under IPCC guideline classification?	Rotation of agricultural land sometimes shows transition between cultivated land and land covered with grass. A party can use own classification system of land (the IPCC guidelines include an example of threshold for making separation cropland and grassland.) Although land classification of cropland and grassland has flexibility in some level, methodologies are recommended to use depending on real land use status. (i.e, pasture land is able to classified under cropland but grassland methodology should be applied)	Reviewer to document any issues, and recommendations on how to address the issue

Potential key issues	Specific issues in cropland and grassland		
Methodology-biomass	Is annual cropland and perennial cropland separated? Is carbon stock change in perennial crop estimated?	In remaining land, changes in living biomass are estimated and reported only for perennial crop.	
		In converted land to cropland and grassland; -growth of annual crop up to the average biomass carbon stock is estimated in the first year after conversion. -growth of perennial crop is estimated based on the same method applied to remaining land (usually not only one year). -growth of biomass is estimated in grassland based on methods about woody type and grass vegetation type respectively. If herbaceous biomass is estimated, below ground biomass is more important carbon pool.	
Methodology-DOM	Are annual changes in dead wood and litter estimated?	As carbon stock changes in dead organic matter is likely small. No need of reporting under the 1996 GL, reporting is optional under the GPG-LULUCF and tier 1 (stock change is zero) is applicable under the 2006 IPCC guidelines. DOM losses should be estimated in forest land converted to cropland/grassland.	
Methodology-soil general	Is mineral soil and organic soil separated and are proper equations applied respectively?	Soils are divided to mineral soil and organic soils. Different estimation methods are provided to mineral soil and organic soil.	
	Are emissions and/or removals of soil carbon pool estimated?	The carbon stock changes in soils in cropland and grassland categories are likely to be more significant than changes in the other carbon pools.	
Methodology-mineral soil	Is soil information on agricultural land available?	Default Tier.1 and Tier.2 needs soil information on agriculture land. Crop type and management type are also important information for the estimation. When a party assumes this carbon stock change is zero, to seek information that agriculture practices are not significantly changed over time.	
Methodology-organic soil	Is drainage or cultivation status on organic land available?	Only drained or cultivated organic soil land is included in estimation. Conserved or protected organic soil area is usually excluded from estimation. All countries may not have good statistical data on the areas of organic soils drained for cultivation.	
	Is activity data used in organic soil consistent between agriculture sector and LULUCF sector?	Check consistency of the activity data in reporting of the CO_2 emissions (reported in the LULUCF Sector) and N_2O emissions (reported in the Agriculture Sector) for cultivation of organic soils.	

C) Wetlands

Wetlands have two subcategories; peat extraction and flooded land. The 1996 IPCC guidelines do not provide specific methods. The GPG-LULUCF only covers living biomass carbon loss estimation for land converted to flooded land. The 2006 IPCC Guidelines provide methods on peat extraction and biomass carbon loss estimation for land converted to flooded land. The 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement) provide wider estimation methods relating to peat (organic soil). Estimation methods completely cover GHG emissions and removals in flooded land have not provided yet by the IPCC. A party should focus on the methods covered by the selected IPCC guidelines.

Potential key issues	Specific issues in wetlands		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Subcategory	Does a party specified flooded land area?	Area of flooded land shall be reported as area of wetlands even if estimation of GHG is not implemented. Estimation should be done if land converted to flooded land (ex. creation of new reservoir) exists.	Reviewer to document any issues, and recommendations on how to address the issue
	Does a party specified peat extraction? Is proper EF selected?	This estimation is mandatory from the 2006 IPCC guidelines. Check the area is not categorized under other land uses. A party should select proper default EF or develop CS EF. Wetlands Supplement may provide more appropriate EF.	

D) Settlements and other land

Settlements include all developed land, transportation infrastructure and human settlements of any size, unless they are already included under other land-use categories. There are two main estimations; 1) carbon stock change in each carbon pool associated with land used change to settlements, and 2) removals on urban green area. The target of estimation in relation to conversion to settlements is above ground biomass loss in forest land and grass land conversion under the 1996 Revised IPCC Guidelines, biomass loss in all land conversion to settlements under the GPG-LULUCF and all carbon pools in all land conversion to settlements under the 2006 IPCC Guidelines. The estimation of biomass removals is optional under the GPG-LULUCF and mandatory under the 2006 IPCC guidelines.

Other Land includes bare soil, rock, ice and all unmanaged land areas that do not fall under any of the other five land-use categories. This land-use category is included to allow the total of identified land areas to match the national area. As other land is generally considered as land has no carbon, the methods estimating carbon stock changes are not provided in the IPCC guidelines. Only carbon loss due to land converted to other land should be estimated and reported.

Potential key issues	Specific issues in settlements and other land		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology- settlements remaining settlements.	Are proper activity data and removal factor selected in biomass estimation?	There are two removal factors provided for Tier.2 based on two default methods in the 2006 IPCC guidelines (this is tier.1 in the GPG-LULUCF). The unit of area based estimation is “ha crown cover “ not a simple “ha”.	Reviewer to document any issues, and recommendations on how to address the issue
Methodology- land converted to settlements or other land	Is proper activity data used for biomass estimation and soil?	Biomass estimation needs annual change area, while soil estimation needs area of conversion within 20 years (when default is applied).	
	Are annual changes in dead wood and litter estimated?	DOM losses should be estimated in forest land converted to settlements/other land.	
	Are annual changes in soil estimated?	Default factor of soil carbon losses in land converted to settlements is provided in the 2006 Guidelines. No information on other land use.	

E) Harvested wood products

Estimation methods of harvested wood products (HWP) are provided in the 2006 IPCC guidelines. A party may or may not apply the HWP carbon stock change estimation.

Potential key issues	**Specific issues in HWP**		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology	Is harvested wood estimated as default (instantaneous oxidation) or not? If HWP stock changes are estimated which of three approaches selected?	Three approaches are provided in the 2006 IPCC Guidelines for HWP CSC estimation. The IPCC and UNFCCC have not decided which of them should or shall apply to non- Annex I parties reporting. (Under KP-LULUCF for Annex I countries, the production approach became a standard approach) A party may select any of three approaches when a party wishes to account HWP.	Reviewer to document any issues, and recommendations on how to address the issue
	Are parameters properly used?	Some default parameters are provided in the 2006 IPCC guidelines mostly continent basis.	
	Are activity data properly used?	Tier.1 estimation likes to the FAO forest data. In the 2006 IPCC guidelines, the starting year is 1900 and the method back casting data till 1900 is provided.	

F) Non-CO2 estimations

Some non-CO_2 emissions are relevant to land use activities or management practices. The major part of these emissions is covered in the Agriculture sector. A party should avoid double counting and inconsistent reporting between agriculture sectors and the LULUCF sector.

Potential key issues	**Specific issues in non-CO2 estimation**		
General references	The 2006 IPCC guidelines, Chapter 11.		
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Fertilization	Is separation of nitrogen fertilization for lands other than cropland and grassland?	When only aggregated information on national level is available, parties are allowed to estimate and report all N_2O emissions from nitrogen fertilization in the agriculture sector.	Reviewer to document any issues, and recommendations on how to address the issue
N_2O from organic soil, mineral soils from forest land, wetland, and other.	Is proper activity data used for estimation? Does a party avoid misallocation of reporting?	N_2O emissions from this source in cropland and grassland are included in the agriculture sector. The activity data of drainage soil for CO_2 and N_2O estimation is basically the same.	
	Does rewetting activity exist in a country?	The Wetlands Supplement provides methods, but is treated optional as wetlands supplement was not officially adopted for NAI reporting under the UNFCCC.	
Mineralization	Does a party avoid misallocation of reporting?	The same methods are applied for agricultural land and other land use. The LULUCF sector should include N_2O emissions which are not covered in the agriculture sector	
	Is proper land use covered?	This estimation is not required in the 1996 Revised IPCC Guideline. Emission estimation from land converted to cropland is required under the GPG-LULUCF. Emission estimations from all land and management changes are required under the 2006 IPCC Guidelines	
In direct N_2O emissions from soil	Is consistent activity data applied? Does a party avoid misallocation of reporting?	Indirect N_2O emissions estimation is required in the 2006 IPCC Guidelines. Activity data of indirect N_2O emissions are basically consistent with direct N_2O estimations.	

Potential key issues	Specific issues in non-CO2 estimation		
Biomass burning	Whether are CO2 emissions from biomass burning included in national total or not?	When carbon loss due to biomass burning is already accounted in forest land pools (ex. using stock difference method), CO^2 emissions should not be included in national total.	
	Check misallocation or double counting does not occur.	Non CO_2 emissions from biomass residue burning are covered in the agriculture sector. Non CO_2 emissions from biomass burning (off-site burning) for energy purpose are covered in the Energy sector. Non CO_2 emissions from biomass burning (off-site burning) just for waste management are covered in the Waste sector. If GPG-LULUCF or the 1996 Revised IPCC guidelines are applied, non- CO_2 emissions from biomass burning in savanna are covered in the agriculture sector.	

8.5 WASTE

1. SOLID WASTE STREAM

Potential key issues	Potential over or underestimating emissions from solid waste disposal		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology	Is the same method used for all managed solid waste disposal sites in the category? Is the same method used for all unmanaged solid waste disposal sites?	The two methods for estimating emissions, IPCC default (only when using the 1996 IPCC Guidance) and FOD, can yield quite different estimates. Each time series should be derived from the same method (IPCC GPG, p.5.10).	Reviewer to document any issues, and recommendations on how to address the issue
	Is the fraction of MSW disposed to managed/unmanaged sites consistent with other information on waste disposal provided?	An explanation of the fate of any wastes disposed of in unmanaged sites assists in understanding overall waste management practices and emission sources.	
	Is any information provided on the composition of the non-biogenic material that is combusted?	CO_2 emissions from non-biogenic sources are included in the totals. Information on the composition of non-biogenic waste will assist in determining whether there has been double counting between sectors if the C is fossil-fuel derived (for example, waste oil, plastics).	
Activity Data	If the activity data are default, does the default relate to that country or region? If the activity data default does not relate to that country or region, are the reasons for the choice explained?	Where a default value is not provided for a country or region, it is acceptable to use a default value for a similar country or region (IPCC GPG, p.5.8). Default values are provided in the IPCC Guidelines (Vol.3, Table 6-1, pp.6.6-6.7). The reason for the choice of default needs to be explained (e.g. similar geography, population density, etc - see IPCC GPG, p.5.8).	

Potential key issues	Potential over or underestimating emissions from solid waste disposal		
Completeness	Are all managed waste disposal sites included? Are any industrial sites included?	Data on industrial sites can be difficult to obtain due to confidentiality or other reasons. Therefore data sources need to be documented.	
	Is methane recovered reported? Are any sources included that should not be included?	Sludge from wastewater handling is often disposed of to solid waste sites. Emissions from this sludge should be included under this category and not 6.B Wastewater Handling (IPCC GPG p.5.18).	

2. WASTEWATER TREATMENT

Potential key issues	Potential over or underestimating emissions from waste water treatment		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
Methodology	Are the sources of the method parameters clearly specified?	Note that the default method for estimating N_2O emissions from human sewage is based on per capita protein consumption. This method cannot be applied to industrial wastewater. If N_2O emissions are estimated, a detailed explanation of the method should be provided.	Reviewer to document any issues, and recommendations on how to address the issue
EF	Have different emission factors been used for each wastewater stream?	The organic loads for industrial wastewater are usually expressed as COD.	
	Is the emission factor expressed as per unit of BOD or per unit of COD?	The organic loads for domestic and commercial wastewater are usually expressed as BOD. The same units should be used either BOD or COD.	
AD	Is the activity data obtained from national statistics, or a survey of relevant industries? Is the activity data based on measured or estimated wastewater flows for each industry, or is it based on production multiplied by the average quantity of wastewater generated per unit of output? Are the industries with the largest potential wastewater CH_4 emissions included?	It is sensible to focus on those industries that are likely to contribute the majority of emissions (IPCC GPG, p.5.21).	
	Does the activity data include the total population or the urban population only?	In rural areas in some countries significant amounts of waste degrade aerobically in which case the urban population only should be used to estimate total organic waste (IPCC GPG, p.5.19).	
Completeness	Are all major industrial sources included? Is methane recovered that is reported based on data for each industrial source, or based on an average value applied to total CH_4 generated by industry?	Data availability for industrial wastewater might be difficult to obtain. Industrial sources should be assessed to ensure that the most significant sources are included (IPCC GPG, p.5.21).	
	If emissions are reported for domestic and commercial wastewater (6.B.2), is it clear that emissions have not been double counted? Are the estimates for the total population or the urban population only?	Where emissions are reported for both domestic and commercial wastewater, and N_2O emissions from human sewage, there is potential for double counting.	

3. WASTE INCINERATION

Potential key issues	Potential over or underestimating emissions from waste incineration		
General references			
Detailed review element	**Question**	**Elaboration/clarification**	**Findings/recommendations**
EF	Are different values used for different waste streams incinerated? If average values are used, is the C content the same as the C content of MSW streams treated by other means? If the C content is different, is an explanation provided?	The CO_2 emission factor for waste of fossil origin is a function of the C fraction of waste, the fossil C fraction of waste, and the burn out efficiency (IPCC GPG, p.5.25).	Reviewer to document any issues, and recommendations on how to address the issue
	Does the N_2O emission factor take into account the incinerator type?	The IPCC Guidelines (p.6.29) and IPCC GPG (p.5.30) provide default values for N_2O based on incinerator type.	
AD	Is the activity data consistent with the data on waste quantities disposed of by other means?	The fraction of MSW incinerated should be consistent with the fraction of MSW shown as disposed of to SWDS.	
	Is the activity data obtained directly from incineration plants or estimated?	Activity data obtained directly from plants is likely to be more accurate than data from other sources.	
	Has the activity data been disaggregated into different waste types?	The most accurate estimates are obtained from disaggregated data.	
	Has the activity data been disaggregated so as to exclude data from incinerators with energy recovery?	Emissions from incinerators with energy recovery should be included in the energy sector (IPCC GPG, p.5.25). Refer to the energy sector for information on the composition of biomass fuels.	
Completeness	Are sources included that should not be included?	A source that might be incorrectly included is burning of agricultural waste; this should be included in the agriculture sector.	
	Are non-CO_2 emissions from biogenic sources reported and included in the totals? Are CO_2 emissions from biogenic sources excluded from the totals?	Note that CO_2 emissions from combustion used as a management practice at waste disposal sites are to be included under Solid Waste Disposal.	

ANNEX I: TEMPLATE FOR QUESTIONS TO THE PARTY

	Theme/Sector	Review element/category	Initial finding/potential issue	Question
1	Inventory arrangements			
2	QA/QC			
3	Key category analysis			
4	Uncertainty analysis			
5	National improvement plan			
6	archiving system			
7	Methods and data documentation			
8	Recalculations			
9	TACCC principles			
10	Sectoral specific issues			
11	Energy			
12	IPPU			
13	AFOLU			
14	Waste			

ANNEX II: TEMPLATE FOR THE REVIEW FINDINGS DOCUMENT

FINDINGS FROM THE REVIEW OF THE INVENTORY MANAGEMENT SYSTEM

	Theme/Sector	Review element/category	Finding/potential issue
1	Inventory arrangements		
2	QA/QC		
3	Key category analysis		
4	Uncertainty analysis		
5	National improvement plan		
6	Archiving system		

FINDINGS FROM THE REVIEW OF METHODS AND TACCC PRINCIPLES

	Theme/Sector	Review element/category	Finding/potential issue
1	Methods and data documentation		
	Recalculations		
	TACCC principles		
2	Methods and data documentation		
	Recalculations		
	TACCC principles		
3	Methods and data documentation		
	Recalculations		
	TACCC principles		
4	Methods and data documentation		
	Recalculations		
	TACCC principles		

FINDINGS FROM THE REVIEW OF OTHER SECTORAL ISSUES

	Theme/Sector	Review element/category	Finding/potential issue
1	Crosscutting		
2	Energy		
3	IPPU		
4	AFOLU		
5	Waste		

ANNEX III: GLOSSARY

Accuracy	Accuracy is a relative measure of the exactness of an emission or removal estimate. Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals, so far as can be judged, and that uncertainties are reduced so far as is practicable.
Activity data	A quantitative measure of a level of activity that results in greenhouse gas emissions. Activity data is multiplied by an emissions factor to derive the greenhouse gas emissions associated with a process or an operation. Examples of activity data include kilowatt-hours of electricity used, quantity of fuel used, output of a process, hours equipment is operated, distance travelled and floor area of a building.
Anthropogenic greenhouse emissions	Greenhouse gas emissions resulting from human activities.
Bottom-up data	Data that is measured, monitored or collected (for example, using a measuring device such as a fuel meter) at the source, facility, entity or project level.
Bottom-up methods	Methods (such as engineering models) that calculate or model the change in greenhouse gas emissions for each source, project or entity, then aggregate across all sources, projects or entities to determine the total change in greenhouse gas emissions.
Bunker fuels	A term used to refer to fuels consumed for international marine and air transport.
Calculated data	Data calculated by multiplying activity data by an emission factor, for example, calculating emissions by multiplying natural gas consumption data by a natural gas emission factor.
CO_2 equivalent (CO_2e)	The universal unit of measurement to indicate the global warming potential of each greenhouse gas, expressed in terms of the global warming potential of one unit of carbon dioxide. It is used to evaluate different greenhouse gases against a common basis.
Completeness	Completeness means that the estimates include all sources and sinks for the full geographic coverage, as well as all gases included in the Intergovernmental Panel on Climate Change guidelines.
Consistency	Consistency means that estimates should be internally consistent in all their elements over a period of years. Estimates are consistent if the same methodologies are used for the base year and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks. Parties are encouraged to improve the data and methodologies used over time, while maintaining consistency with the established or, as appropriate, updated reference levels.
Emission factor	A factor that converts activity data into greenhouse gas emissions data. For example, kg CO2e emitted per litre of fuel consumed.
Emissions	The release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time.
Estimated data	In the context of monitoring, proxy data or other data sources used to fill data gaps in the absence of more accurate or representative data sources.

Expert judgment	A carefully considered, well-documented qualitative or quantitative judgment made in the absence of unequivocal observational evidence by a person or persons who have a demonstrable expertise in the given field.
Global warming potential (GWP)	An index representing the combined effect of the differing times greenhouse gases remain in the atmosphere and their relative effectiveness in absorbing outgoing infrared radiation.
Greenhouse gases (GHGs)	The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Less prevalent, but very powerful, GHGs are hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride (SF_6).
Measured data	Direct measurement, such as directly measuring emissions from a smokestack.
Montreal Protocol	The Montreal Protocol on Substances that Deplete the Ozone Layer, an international agreement adopted in Montreal in 1987.National communication: A document submitted in accordance with the Convention (and the Protocol) by which a Party informs the Conference of the Parties of activities undertaken to address climate change. Most developed countries have now submitted their fifth national communications; most developing countries have completed their second national communication and are in the process of preparing their third.
Net greenhouse gas emissions	The aggregation of greenhouse gas emissions (positive emissions) and removals (negative emissions).
Parameter	A variable such as activity data or an emission factor that is part of an emissions estimation method. For example, 'emissions per kilowatt-hour of electricity' and 'quantity of electricity supplied' are both parameters in the equation '0.5 kg CO_2e/kWh of electricity × 100 kWh of electricity supplied = 50 kg CO_2e'.
Peer-reviewed	Literature (such as articles, studies or evaluations) that has been subject to independent evaluation by experts in the same field prior to publication.
Proxy data	Data from a similar process or activity that is used as a stand-in for the given process or activity.
REDD	Reducing emissions from deforestation and forest degradation in developing countries.
REDD-plus	REDD-plus refers to reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries.
Removal	Removal of greenhouse gas emissions from the atmosphere through sequestration or absorption, such as when CO_2 is absorbed by biogenic materials during photosynthesis.
Sink	Any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere.
Source	Any process or activity which releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas into the atmosphere.
Top-down data	Macro-level statistics collected at the jurisdiction or sector level, such as energy use, population, gross domestic product or fuel prices.
Top-down methods	Methods (such as econometric models or regression analysis) that use statistical methods to calculate or model changes in greenhouse gas emissions.
Transparency	In the context of the technical analysis, refers to openness and clarity in the communication of information, to enable others to see, understand and replicate the information reported within the biennial update report. In the context of the REDD plus technical annex, transparency means that the assumptions and methodologies used should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of inventories is fundamental to the success of the process for the communication and consideration of information.
Uncertainty	1. Quantitative definition: Measurement that characterizes the dispersion of values that could reasonably be attributed to a parameter. 2. Qualitative definition: A general term that refers to the lack of certainty in data and methodology choices, such as the application of non-representative factors or methods, incomplete data on sources and sinks, or lack of transparency.

ANNEX IV: ABBREVIATIONS AND UNITS

ABBREVIATIONS

AD	Activity Data
AFOLU	Agriculture, Forest and Land Use
BOD	Biochemical Oxygen Demand
C	Confidential
CCS	Carbon Dioxide Capture and Storage
CGE	Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention
COD	Chemical Oxygen Demand
CRF	Common Reporting Format
CS EF	Country Specific Emission Factors
CSC	Carbon Stock Change
DOM	Dead Organic Matter
EFs	Emission Factors
EIA	United States Energy Information Administration
FAO	Food and Agriculture Organization of the United Nations
FOLU	Forestry and Other Land Use
FRA	Global Forest Resources Assessment
GCCSI	Global CCS Institute
GHG	Greenhouse Gas
GPG-LULUCF	Good Practice Guideline for Land Use, Land-Use Change and Forestry
GSP	Global Support Programme
GWP	Global Warming Potential
HWP	Harvest Wood Product
ICA	International Consultation and Analysis
IE	Included Elsewhere
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IRRI	International Rice Research Institute
KP-LULUCF	Kyoto-Protocol for Land Use, Land-Use Change and Forestry
LUCF	Land Use Change and Forestry
LULUCF	Land Use, Land-Use Change and Forestry
MRV	Measurement, Reporting and Verification
MSW	Municipal Solid Waste
NA	Not Applicable
NAI	Non-Annex I Parties
NE	Not Estimated
NIR	National Inventory Report
NO	Not Occurring
NOX	Nitrogen Oxide
ODS	Ozone Depleting Substitutes
QA/QC	Quality Assurance/Quality Control
REDD	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
SWDS	Solid Waste Disposal Sites
TACCC	Transparency, Accuracy, Consistency, Comparability Completeness
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNSD	United Nations Statistics Department
US EPA	United States Environmental Protection Agency

UNITS

Most common multiple and sub-multiple prefixes

Multiple		Sub-multiple	
10^{1}	deca (da)	10^{-1}	deci (d)
10^{2}	hector (h)	10^{-2}	centi (c)
10^{3}	kilo (k)	10^{-3}	milli (m)
10^{6}	mega (M)	10^{-6}	micro (μ)
10^{9}	giga (G)	10^{-9}	nano (n)
10^{12}	tera (T)	10^{-12}	pico (p)
10^{15}	peta (P)	10^{-15}	femto (f)
10^{18}	Exa (E)	10^{-18}	atto (a)

Conversion equivalents between units of volume

To:	gal U.S.	gal U.K.	bbl	ft^3	l	m^3
From:	multiply by:					
U.S. gallon (gal)	1	0.8327	0.02381	0.1337	3.785	0.0038
U.K. gallon (gal)	1.201	1	0.02859	0.1605	4.546	0.0045
Barrel (bbl)	42.0	34.97	1	5.615	159.0	0.159
Cubic foot (ft^3)	7.48	6.229	0.1781	1	28.3	0.0283
Litre (l)	0.2642	0.220	0.0063	0.0353	1	0.001
Cubic metre (m^3)	264.2	220.0	6.289	35.3147	1000.0	1

Conversion equivalents between units of mass

To:	kg	t	lt	st	lb
From:	multiply by:				
kilogramme (kg)	1	0.001	9.84×10^{-4}	1.102×10^{-3}	2.2046
Tonne (t)	1000	1	0.984	1.1023	2204.6
Long ton (lt)	1016	1.016	1	1.120	2240.0
Short ton (st)	907.2	0.9072	0.893	1	2000.0
Pound (lb)	0.454	4.54×10^{-4}	4.46×10^{-4}	5.0×10^{-4}	1

Conversion equivalents between units of energy

To:	TJ	Gcal	Mtoe	MBtu	GWh
From:	multiply by:				
Terajoule (TJ)	1	238.8	2.388×10^{-5}	947.8	0.2778
Gigacalorie	4.1868×10^{-3}	1	10^{-7}	3.968	1.163×10^{-3}
Mtoe*	4.1868×10^{4}	10^{7}	1	3.968×10^{7}	11630
Million Btu	1.0551×10^{-3}	0.252	2.52×10^{-8}	1	2.931×10^{-4}
Gigawatt-hour	3.6	860	8.6×10^{-5}	3412	1

**Million tonnes of oil equivalent*

ANNEX V: REFERENCES

- "Handbook for review of National GHG inventories"
- Agreement for Expert Review Services
  - http://unfccc.int/files/national_reports/annex_i_ghg_inventories/review_process/application/pdf/agr_ex-prev2015.doc.pdf
- CGE TTE training programme: cluster B
- CGE Training materials for the Preparation of BURS: institutional arrangements
  - Handbook: http://unfccc.int/files/national_reports/non-annex_i_natcom/training_material/methodological_documents/application/pdf/institutional__arrangements_2-handbook.pdf
  - Presentation: http://unfccc.int/files/national_reports/non-annex_i_natcom/training_material/methodological_documents/application/pdf/institutional_arrangements_1-presentation.pdf
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories
  - http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
- Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
  - http://www.ipcc-nggip.iges.or.jp/public/gp/english/index.html
- Good Practice Guidance for Land Use,Land-Use Change and Forestry
  - http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html
- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories
  - http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html
- Managing the National Greenhouse Gas Inventory Process, UNDP, 2005.
  - http://ncsp.undp.org/sites/default/files/461.pdf
- US EPA materials

United Nations
Framework Convention on
Climate Change