

# ipcc

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ENGLISH ONLY

## **SIXTH ASSESSMENT REPORT (AR6) PRODUCTS**

### **Outline of the Methodology Report(s) to refine the 2006 IPCC Guidelines for National Greenhouse Gas Inventories**

(Submitted by the Co-chairs of the Task Force on National Greenhouse Gas Inventories)

#### **Disclaimer**

**Posted as adopted subject to copy editing**

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**Decision (IPCC/XLIV-XX) Outline of the Methodology Report(s) to refine the 2006 IPCC Guidelines for National Greenhouse Gas Inventories**

*The Intergovernmental panel on Climate Change decides:*

1. To prepare a Methodology Report to refine the 2006 IPCC Guidelines for National Greenhouse Inventories” with the following format and title:
  - The format should be one single Methodology Report comprising an Overview Chapter and five volumes following the format of the *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines)*.
  - The title of the Methodology Report should be “*2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*”.
2. To adopt the terms of reference for the production of a Methodology Report to refine the 2006 IPCC Guidelines for National Greenhouse Gas Inventories as contained in Annex 1 to this Decision.
3. To adopt the table of contents of the Methodology Report as contained in Annex 2 to this Decision.
4. To take note of document IPCC-XLIV/INF.7.
5. That the budget for the production of this Methodology Report is as contained in Decision (IPCC/XLIV-XX) on the IPCC Trust Fund Programme and Budget.

## Terms of Reference for the production of a Methodology Report to refine the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

### Background

1. The 26<sup>th</sup> Meeting of Task Force Bureau (TFB) (28 - 29 August 2014, Ottawa) concluded that:
  - The *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines)* provide a technically sound methodological basis of national greenhouse gas inventories, and therefore fundamental revision is unnecessary.
  - To maintain the scientific validity of the *2006 IPCC Guidelines*, certain refinements may be required, taking into account scientific and other technical advances that have matured sufficiently since 2006.
2. Following these conclusions by the TFB and approval by the IPCC at its 40<sup>th</sup> Session, the Task Force on National Greenhouse Gas Inventories (TFI) started a technical assessment of IPCC Inventory Guidelines through an on-line questionnaire survey and four expert meetings in 2015 and 2016. The technical assessment revealed that there has been abundant new scientific and empirical knowledge published since 2006 which the IPCC should take into account, particularly with respect to data for emission factor development for some categories and gases. Consequently, the necessity and usefulness of *refining* the current methodological guidance (e.g. updating default emission factors) has been recognized by TFB.
3. A refinement of the *2006 IPCC Guidelines* is required as early as possible in order to address the issues that were identified through the technical assessment referred to in paragraph 2 above. The refinement will help all UNFCCC Parties use good practice inventory methodologies based on up-to-date scientific knowledge.

### Scope

4. The IPCC at its 43<sup>rd</sup> Session (11-13 April 2016, Nairobi) approved the proposal on "Refinement of 2006 IPCC Guidelines for National Greenhouse Gas Inventories, including production of a Methodology Report(s)" as contained in the Decision IPCC/XLIII-8 "Update of methodologies on National Greenhouse Gas Inventories", and decided to consider the draft Methodology Report(s) at a Plenary session of the IPCC in May 2019 as contained in the Decision IPCC/XLIII-7 "Sixth Assessment Report (AR6) Products. Strategic Planning".
5. The overall aim of the refinement of the *2006 IPCC Guidelines* is to provide an updated and sound scientific basis for supporting the preparation and continuous improvement of national greenhouse gas inventories.
6. In order to achieve the overall aim, the Methodology Report will:
  - Provide supplementary methodologies for sources or sinks of greenhouse gases only where currently there are gaps or where new technologies and production processes have emerged requiring elaborated methodologies or for sources or sinks that are not well covered by the *2006 IPCC Guidelines*;
  - Provide updated default values of emission factors and other parameters based on the latest available science only where significant differences from currently adopted factors are identified;
  - Provide additional or alternative up-to-date information and guidance, where possible, as clarification or elaboration of existing guidance in the *2006 IPCC Guidelines*.
7. In line with paragraph 6 above, the Methodology Report will clearly indicate what type of refinement is provided in each section. The types of refinement are defined in Appendix 1. These terms should be used consistently throughout the Methodology Report.

8. For the purpose of elaborating on and clarifying the existing IPCC guidance, the Methodology Report should aim to address any important needs for clarification arising from GHG inventory reviews or the technical analysis of inventories as part of biennial update reports under the UNFCCC if such needs are identified in time during the elaboration of the report.
9. The refinement work will not revise the *2006 IPCC Guidelines*, but will update, supplement and/or elaborate the *2006 IPCC Guidelines* where gaps or out-of-date science have been identified. The Methodology Report will not replace the *2006 IPCC Guidelines*, but will be used in conjunction with the *2006 IPCC Guidelines*.

## **Approach**

10. The result of this work will be an IPCC Methodology Report “2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories”.
11. The authors will follow Appendix 2 “Instructions to Experts and Authors” to ensure a consistent and coherent approach across all the volumes or chapters, including the use of common terminology.
12. Literature will be considered up to a cut-off date at the start of the Government/Expert Review.
13. Table 1 provides the time table for this task.

**Table 1: Work Plan**

Date	Action	Comments
October 2016	IPCC-44	IPCC Plenary approves ToR, chapter outline, work plan and guidance to authors
November 2016	Call for Nomination of Authors and Review Editors	IPCC invites nominations from governments and international organizations
February 2017	TFB select Authors and Review Editors	Selection by TFB considering expertise and geographical coverage
June 2017	1 <sup>st</sup> Lead Author Meetings	LAM1a (non-AFOLU) and LAM1b (AFOLU) and LAM1c (General Guidance and Reporting). To develop zero order draft
September 2017	2 <sup>nd</sup> Lead Author Meeting	To develop first order draft for review
December 2017– January 2018	Expert Review	8 weeks review by experts
March 2018	Science Meeting	A small meeting of CLAs and some LAs to discuss specific issues that require intensive discussion to reinforce the writing process.
April 2018	3 <sup>rd</sup> Lead Author Meeting	To consider comments and produce second order draft for review
xxx 2018	Literature cut-off date	Only papers published before this date will be considered
July-August 2018	Government & Expert Review	8 weeks review by governments and experts
October 2018	4 <sup>th</sup> Lead Author Meeting	To consider comments and produce final draft
January 2019	Government Review	Distribute to governments for their consideration prior to approval (at least 4 weeks prior to the Panel)
May 2019	Adoption/acceptance by IPCC-49	Final draft submitted to IPCC Panel for adoption/acceptance
xxx 2019	Distribute Report	Distribute to governments and international organizations

## Appendix 1: Types of refinement

The following three refinement types should be indicated in the refined sections of the Methodology Report.

<b>1. Update</b>	<p>This is to update existing guidance (table, section, or an entire chapter) to address the needs explained in the first or second bullet under paragraph 6 in this TOR. New elements that do not change default approaches in the existing guidance is considered "update". A typical example is to provide new default values for EFs contained in a table in the <i>2006 IPCC Guidelines</i>, and in this case it is considered "Update of Table X.X (on default EFs)".</p> <p>Update of section or entire chapter is to rewrite an existing section or chapter including existing information and new information in the case it is difficult to provide only the new information without overlap with existing guidance.</p> <p>From the inventory compiler's view point, "update" of existing guidance means that they are encouraged to use the table/section/chapter in the new Methodology Report <b><u>instead of</u></b> the corresponding table/section/chapter in the <i>2006 IPCC Guidelines</i>.</p>
<b>2. Elaboration</b>	<p>This is to elaborate existing guidance to address the needs explained in the first or third bullet under paragraph 6 in this TOR.</p> <p>New elements that may be added to default approaches in the existing guidance is considered "elaboration". Also, additional or alternative up-to-date information and guidance provided to clarify existing guidance is considered "elaboration". A typical example is to include the contents in FAQs in TFI website in the new Methodology Report(s).</p> <p>Elaboration of section or entire chapter is NOT to rewrite an existing section or chapter, but to provide a sub-section or section which contains additional or alternative up-to-date information without overlap with existing guidance.</p> <p>From the inventory compiler's view point, "elaboration" of existing guidance means that they are encouraged to use the table/section/chapter in the new Methodology Report <b><u>in conjunction with</u></b> the corresponding table/section/chapter in the <i>2006 IPCC Guidelines</i>.</p>
<b>3. New guidance</b>	<p>This is to add completely new guidance on issues for which there is essentially no guidance in the <i>2006 IPCC Guidelines</i> to address the needs explained in the first bullet under paragraph 6 in this TOR.</p> <p>Creation of default approaches to issues that are not well covered in the 2006 IPCC Guidelines is considered "new guidance".</p> <p>From the inventory compiler's view point, "new guidance" means that they are encouraged to use the section/chapter in the new Methodology Report <b><u>without reference to</u></b> specific sections/chapters in the <i>2006 IPCC Guidelines</i>, recognizing that there is essentially no corresponding guidance in the <i>2006 IPCC Guidelines</i>.</p>

Besides, "**No refinement**" should indicate that no refinement has been made in that section.

## Appendix: Instructions to Experts and Authors

### Instructions to Experts and Authors

1. Work on a Methodology Report to refine the *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines)* will be guided by the IPCC procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of the IPCC Reports (Appendix A to the Principles Governing the IPCC Work<sup>1</sup>). This document is consistent with the IPCC procedures, and applies to all experts engaged in the production of a new Methodology Report.
2. In this document the term “experts” covers Co-Chairs, members of the TFI Bureau (TFB), TSU Staff, Coordinating Lead Authors (CLAs), Lead Authors (LAs), and Review Editors (REs) as well as Contributing Authors (CAs) and Expert Reviewers.
3. These notes are intended as guidance to experts contributing to a new Methodology Report. They are intended to ensure a consistent and coherent approach across all the volumes or chapters and to promote common terms used.

### **Confidentiality**

4. Authors meetings are closed meetings. Any discussions are confidential except for any published report of the meeting. This is to ensure that experts participating in the meetings can express themselves and discuss issues freely and openly.
5. The IPCC considers the drafts of a new Methodology Report, prior to acceptance, to be pre-decisional, provided in confidence to reviewers, and not for public distribution, quotation or citation.
6. The TSU will keep drafts of a new Methodology Report sent for the IPCC review, any comments received on them and the responses by authors. All written expert and government review comments will be made available to reviewers on request. These will be made available on the IPCC website as soon as possible after the acceptance by the Panel and the finalisation of the report.

### **Conflict of Interest**

7. It is important that all experts involved in the IPCC activities avoid any conflict of interest or the direct and substantial appearance of a conflict of interest. It is recognised that many experts in Emission Inventories are employed by, or funded by, parties with some interest in the outcome (e.g. most inventory compilers are funded by national governments or industry). It is therefore important to be open and transparent about financial and other interests.
8. The IPCC implements a Conflict of Interest (COI) Policy<sup>2 3</sup> that applies to all individuals directly involved in the preparation of IPCC reports, including senior IPCC leadership (IPCC Chair and Vice-Chairs), other Bureau and Task Force Bureau members, authors with responsibilities for report content (CLAs, LAs), Review Editors and staff of the Technical Support Units. The overall purpose of this policy is to protect the legitimacy, integrity, trust, and credibility of the IPCC and of those directly involved in the preparation of reports, and its activities.

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<sup>1</sup> <http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles-appendix-a-final.pdf>

<sup>2</sup> <http://www.ipcc.ch/pdf/ipcc-principles/ipcc-conflict-of-interest.pdf>

<sup>3</sup> The IPCC COI Policy including the COI Form is currently being reviewed and may be revised at the 44th Session of the IPCC in Bangkok, Thailand, on 17-20 October 2016. If it is revised at that session of the IPCC, paragraphs 8-11 of this document will be revised accordingly.

9. Before an individual is appointed as a CLA, LA and RE for a new Methodology Report, the TFB will request the individual to complete a Conflict of Interest Disclosure Form (“the COI Form”) contained in Annex B to the COI Policy which will be submitted to the TFI TSU. The TFB will then evaluate the form to determine whether the individual has a conflict of interest that cannot be resolved.
10. All CLAs, LAs and REs will inform the TFI TSU annually of any changes in the information provided in their previously submitted COI Form. The TFB will evaluate the revised information.
11. All COI Forms and any records of the deliberations of the COI Expert Advisory Group, deliberations and/or decisions of the COI Committee in relation to conflict of interest issues in respect of specific individuals and any information disclosed by individuals for the purposes of the COI Policy will be transferred to the Secretariat after they have been reviewed and will be securely archived by the Secretariat and retained for a period of five years after the end of the assessment cycle during which the relevant individual contributed, after which the information will be destroyed. Subject to requirement to notify the existence of a conflict of interest to others, the information referred to above will be considered confidential and will not be used for any purpose other than consideration of conflict of interest issues under these Implementation Procedures without the express consent of the individual providing the information.

### **Responsibilities of authors and other experts**

12. The role of authors is to impartially assess ALL the available literature and to describe the best methodologies available. Experts should be impartial. Authors should review all literature available up to a cut-off date to be decided by the TFB as part of the agreed work plan.
13. After drafting the report authors will be asked to consider all comments received on the drafts and to adjust and revise the text accordingly. They should document their responses. If they do not accept a comment this should be explained. Review Editors should check whether the accepted changes were fully incorporated in the revised text.
14. Responsibilities and duties of authors and other experts are currently explained in more detail in the IPCC procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of the IPCC Reports (Appendix A to the Principles Governing the IPCC Work).

### **Literature**

15. The use of literature should be open and transparent. In the drafting process, emphasis is to be placed on the assurance of the quality of all cited literature. Priority should be given to peer-reviewed scientific, technical and socio-economic literature if available.
16. It is recognized that other sources provide crucial information for IPCC Reports. These sources may include reports from governments, industry, and research institutions, international and other organizations, or conference proceedings. Use of this literature brings with it an extra responsibility for the author teams to ensure the quality and validity of cited sources and information. In general, newspapers and magazines are not valid sources of scientific information. Blogs, social networking sites, and broadcast media are not acceptable sources of information for IPCC Reports. Personal communications of scientific results are also not acceptable sources.
17. For any sources written in a language other than English, an executive summary or abstract in English is required.
18. All sources will be integrated into a reference section of an IPCC Report.
19. For more details of the procedure on the use of literature in IPCC Reports, see Annex 2 to the IPCC procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of the IPCC Reports (Appendix A to the Principles Governing the IPCC Work).



## Principles of the new Methodology Report

20. Guidance in the **new Methodology Report** should be understandable and easy to implement. Lead authors should make efforts to balance the need to produce a comprehensive self-contained report with reasonable limits to the length and detail of the guidance. In particular:
- The guidance should follow a cookbook approach by providing clear step by step instructions. It should not try to be a textbook. Detailed background information on emission processes, scientific studies, etc. is generally referenced rather than included.
  - Lead authors must consider all recent scientific developments and national methods used by countries in their inventories.
  - Significant changes from the *2006 IPCC Guidelines* will have significant implications for all countries. Parties to the UNFCCC use the IPCC Guidelines to prepare national inventories and national communications. Substantial changes should only be introduced if they can be justified on sound scientific and technical grounds.
  - Authors should bear in mind that the target audience is a diverse group of readers who are primarily concerned with the elaboration of national inventories. For this reason, the emphasis should be on ensuring clear communication of practical and understandable guidance.
21. This work aims to cover all IPCC inventory sectors but only those categories where the science is considered to have sufficiently advanced since the 2006 or where new or additional guidance is required, namely the categories that were selected through technical assessment carried out in 2015 and 2016 and the Scoping Meeting held in August 2016 using the significance and prioritization criteria as shown below. However, authors should also develop modifications for other parts of the *2006 IPCC Guidelines* if deemed necessary to achieve consistency with the refinements mandated by the IPCC Plenary. On the other hand, authors may conclude no refinement should be made even for the categories that were selected through the process mentioned above, after comprehensive review of available literature.

### Significance and prioritization criteria

- Significance of the source/sink and the gas within the sector on a global scale. Sources significant only for a limited number of particular countries, currently or in the foreseeable future, may not meet this criterion. The adequacy of the existing guidance for a particular category should be considered, as should the likelihood that new information would lead to a definite improvement in the IPCC Guidelines.
- Availability of relevant new scientific results.
- Sufficient data availability and maturity of scientific advances since 2006 to provide a basis for methodological development or refinement, including:
  - Ability to develop new or updated default emission/removal factors
  - Feasibility of obtaining the necessary data to implement the methods
- Emergence of new sources or gases meeting these criteria

22. The new Methodology Report will cover the same greenhouse gases and precursors as included in the *2006 IPCC Guidelines*.
23. The general structure, approach and definitions used in the *2006 IPCC Guidelines*, such as tiered approach and decision trees will be followed. Annexes may be used where necessary to contain additional data to support the methodologies, although large numbers of annexes will probably not be necessary. Appendices are not ruled out where scientific knowledge is insufficient for countries to agree full methodologies, but please avoid as far as possible work on areas that have to be relegated to an appendix. Appendices should be sub-titled by “Basis for future methodological development”.

## Reporting Tables and worksheets

24. Refinement of worksheets and reporting tables may be required. Worksheets reflect the application of tier 1 methods only, due to the varied implementation of higher tier methods by countries. Lead authors should stress the importance of documentation and archiving of particular types of information of relevance to each category, although advice may be given of what needs to be reported for transparency at higher Tiers.

## Emission factors and methods

25. Authors should provide default emission factors. In doing this work, they should draw on the widest possible range of available literature, including the IPCC Emission Factor Database (EFDB), scientific articles and country reports.
26. All new default data should be evaluated for scientific and technical appropriateness, and their development should be clearly described and referenced. The attached form (Appendix 3) should be used as the means for documenting data and the derivation procedure which will also facilitate future integration of the EFDB and the archiving of the derivation. Lead authors should be familiar with the draft cross-cutting guidance on data collection in Volume 1 and the guidance on cross-cutting issues in this note on terms, data types, data demands of methods and stratification requirements. Default data should also meet the EFDB evaluation criteria – robustness, documentation, and applicability.
27. Authors should develop guidance to provide additional information on rationale, references and background information on parameters used for estimating of default values where such information is available (similar to Annex 3A.3 of Wetland Supplement), with a view to enhancing the transparency and applicability of default values presented in the new Methodology Report.
28. IPCC default factors should in principle be presented as regional factors. In case regional factors are unavailable, single IPCC default factors might be provided, ensuring that the default are representative of typical conditions as far as can be determined. It may be necessary or appropriate to provide a range of default factors along with clear guidance about how countries should select from within the range. Lead authors may also provide multiple default emission factors, disaggregated by region, technology, or another classification scheme (e.g., livestock type),
29. It is important to provide more default emission factors that reflect the unique conditions of developing countries. Default emission factors for Tier 1 should represent emissions without category-specific mitigation measures.
30. Users of the guidelines should be encouraged to develop and use country specific data. Emission factors for higher tiers need not be specified in the *2006 IPCC Guidelines*. Default information is included primarily to provide users with a starting point from which they can develop their own national assumptions and data. Indeed, national assumptions and data are always preferred because the default assumptions and data may not always be appropriate for specific national contexts.
31. The basic principle concerning national methods will continue to apply – countries are encouraged to use national data or methods so long as they are consistent with the IPCC Guidelines.

## Decision trees

32. Consistent with the format and structure the *2006 IPCC Guidelines*, the new Methodology Report may contain a decision tree for some sub-categories to assist countries in selecting from the IPCC methods. These decision trees link the choice of IPCC methods to national circumstances via specific questions about data availability and status as a key source category<sup>4</sup>.
33. To ensure consistency in decision tree logic and format across categories, lead authors should adhere to the following requirements:
- a. The decision trees should be based on a series of questions with clear yes/no answers, and two subsequent branches along yes/no paths.
  - b. The decision trees should start with assessing data availability for the highest tier method, and then direct countries step-wise towards lower tier methods if activity data, emission factors or other parameters are not available.
  - c. The decision tree should indicate the lowest tier method that is judged to be appropriate for estimating emissions/removals from a key category.
  - d. If data are not available for the method referred to in 3, the 'No' response should direct the reader to the question "Is this a key category?" If the answer to this is 'Yes', the decision tree should recommend that the country collect the necessary data to implement a higher tier method. If the answer is 'No', then the decision tree can recommend a lower tier method. There is no need to deal with the case for a key source where a country does not have the resources to gather additional data needed to implement higher Tier methods. This is dealt with in Volume 1 of the *2006 IPCC Guidelines*.
  - e. The branches of the decision trees should end in 'out-boxes' that correspond to specific tiers identified in the guidance for that category and are labelled by Tier. Lead authors may also recommend out-boxes for hybrid tiers.
  - f. Lead authors may develop separate decision trees for different sub-categories. Alternatively, they may include decision tree options for selecting different tiers for different sub-categories. This second option is appropriate if it is advantageous to recommend a higher tier method only for significant sub-categories rather than for the entire category. **Decision trees that use the 'significance' criterion must include the "25-30% rule" (i.e., a significant sub-category is one that makes up more than 25-30% of emissions/removals from a category).**

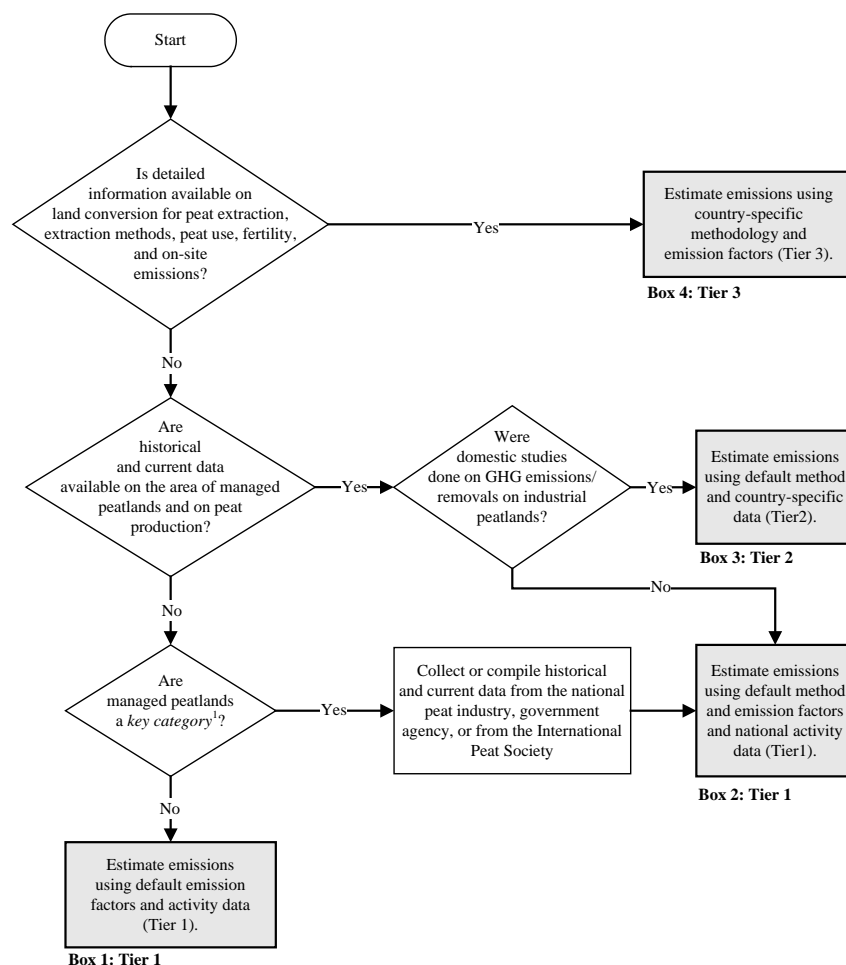
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<sup>4</sup> The most appropriate choice of estimation method (or tier) may also depend on national circumstances, including the availability of resources and advice on this will be given in the cross-cutting volume.

34. Additional Formatting Guidelines (see example):

- a. Decision trees should be drafted in separate Microsoft Word files. The TSU will integrate these files into the main text at a later date.
- b. Decision trees should NOT ask the question: “Does this source occur in the country?” This is because decision trees will only be used for sources which occur.
- c. There should be a “START” box.
- d. “Diamonds” should be used for questions/decisions.
- e. “Squares” should be used for all other information.
- f. The out-boxes should be individually numbered.
- g. The text font should be Times New Roman 10pt.
- h. Text should be centred within the boxes.

Decision tree to estimate CO<sub>2</sub>-C and N<sub>2</sub>O emissions from *Peatlands Remaining Peatlands*



Note:  
1: See Volume 1 Chapter 4, "Methodological Choice and Identification of Key Categories" (noting Section 4.1.2 on limited resources), for discussion of *key categories* and use of decision trees.

IPCC Emission Factor Database (EFDB)

35. The EFDB is an important resource for this work, both as a source of emission factors for consideration by the LAs and as a repository of emission factors once agreed for use in the guidelines.
36. The new Methodology Report may contain Tier 1 methods and the corresponding default emission factors (once the guidelines are approved by the IPCC, the default emission factors cannot change). These defaults need to be recorded in to the EFDB, either because they are already there, or they will have to be entered as a result of the process of developing the

Methodology Report. Preferably the EFDB should be populated with new emission factors as the Methodology Reports are drafted, but if this proves impossible the guideline emission factors should be entered in the EFDB with the underlying documentation information in the property fields as soon as possible, after guidelines completion.

37. The evolving information on peer reviewed emission factors in the EFDB will also be a useful source of information for countries to refer to in applying Tier 2 and 3 methods. In applying these methods (Tier 2 and/or 3) it will remain the country's responsibility to ensure that the choice of emission factors properly reflects national circumstances and is consistent with the requirements of the *2006 IPCC Guidelines*, and to document that this is the case.
38. It should be noted that Methodology Reports go through IPCC reviews, but the EFDB does not. The EFDB is a long(er)-term exercise. The TSU will provide technical advice/information to authors for their consideration.

## Definitions

39. The following terms will be used throughout the new Methodology Report, and it is essential that all Lead Authors have a common understanding of their meaning and relevance:
40. **Tier** A Tier refers to a description of the overall complexity of a methodology and its data requirements. Higher tier methods are generally more complex and data-intensive than lower tier methods. The guidance for each category should contain at least a Tier 1 method, and in many cases there will be a Tier 2 and Tier 3. The general expectation is that Tier 2 and Tier 3 methods will both be consistent with good practice guidance for key sources, although in some cases Tier 3 will be preferred, for example with methane from coal mines where Tier 1 is a global default value, Tier 2 basin specific and Tier 3 mine specific.
41. **Tier 1** approaches are simple methods that can be applied by all countries in all circumstances. Default values for the emission factors and any other parameters needed must be supplied (see below for documentation needed).
42. **Tier 2** methods should in principle follow the same methodological approach as Tier 1, but allow for higher resolution country specific emissions factors and activity data. In some categories, this may not be the case. These methods should better replicate the parameters affecting the emissions. Country specific emission factors are needed and possibly more parameters will also be needed.
43. **Tier 3** methods give flexibility either for country specific methods including modelling or direct measurement approaches, or for a higher level of disaggregation, or both. This is a more complex method, often involving a model. This will replicate many features of nation emissions and require specific parameters for each country.
44. **Default information** is data that is appropriate for use where there is no better detailed, country specific information. If appropriate, authors may specify regional default data. Users of the guidelines should be encouraged to try to find better country specific data. Default data are appropriate for Tier 1 methods and the guidelines should contain all the default values needed. Emission factors for higher tiers need not be specified because it is a function of higher tier methods to find data reflecting national circumstances. Volume 1 of the *2006 IPCC Guidelines* suggests that the EFDB may help identify data reflecting national circumstances, but reference to the EFDB should in no case be used as a device for evading the necessity of finding data for default methods. Default information is included primarily to provide users with a starting point from which they can develop their own national assumptions and data. Indeed, national assumptions and data are always preferred because the default assumptions and data may not always be appropriate for specific national contexts. In general, therefore, default assumptions and data should be used only when national assumptions and data are not available.
45. **Decision Trees**. A decision tree is a graphical tool to assist countries in selecting from the IPCC methods.

46. **Sector** refers to the four sectors of the guidelines (Energy; Industrial Process and Product Use (IPPU); Agriculture, Forests and Other Land Use (AFOLU) and Waste) these are divided into source/sink categories and sub categories.
- Sector 1
  - Category 1.A
  - Sub-category 1st order 1.A.1
  - Sub-category 2nd order 1.A.1.a
  - Sub-category 3rd order, 1.A.1.a.i,
47. **Worksheets**. These will be printed versions of spreadsheet tables, that, when filled in, enable the user to perform the emission estimation. They should contain all the calculations and written text with any formulae. Additional worksheets may be required to compile the results of the worksheets into the reporting tables.
48. **Reporting Tables** are tables that present the calculated emission inventory and sufficient detail of other data used to prepare the inventories for others to understand the emission estimates.
49. Usage:
- Good Practice**, is defined as a set of procedures intended to ensure that greenhouse gas inventories are accurate in the sense that they are systematically neither over nor underestimates so far as can be judged, and that uncertainties are reduced so far as possible. Inventories consistent with good practice are those which contain neither over nor under-estimates so far as can be judged, and in which uncertainties are reduced as far as is practicable. To say that “It is Good Practice to do x” implies x is part of the good practice procedures.
  - “Shall”** should not be used. Either say “Good Practice is...” or say what needs to be done or what should be done. These all indicate what needs to be done to comply with Good Practice.
  - “Be encouraged to”** indicates a step or activity that will lead to higher quality inventory, but are not required for ensuring consistency with the IPCC Guidelines.
  - “Recommend”** should not be used. In the GPG2000, the word “recommend” was avoided and “Suggested” was used instead.
  - “Inventory agency”** is the body responsible for actually compiling the inventory, perhaps from contributions from a number of other bodies while **“inventory compiler”** is the person actually compiling the inventory,

## Units

50. SI units shall be used throughout: in text, equations, worksheets and tables. Emissions have to be expressed in mass units and units have to be used consistently within the each sector. When similar activity data is used for different sectors same units need to be used (CLAs have to take care about such harmonisation). Conversion factors have to be provided (for example to estimate N<sub>2</sub>O from N). Where input data available may not be in SI units conversions should be provided.
51. Standard abbreviations for units and chemical compounds are given in Appendix 4. (See also a complete discussion available at <http://www.bipm.org/en/publications/si-brochure/>)
52. For the purpose of reporting, the sign convention is positive (+) for emissions, and negative (-) for removals (uptake). Where needed, for estimation of removals and carbon stock increases are counted positive, and the sign reversed for reporting purposes. This is consistent with the 2006 IPCC Guidelines and other Methodology Reports on national GHG inventories in the past.

### Appendix 3. Data Documentation

This form should be used to document all data used in the new Methodology Report. This gives the minimum information that should be considered by the authors.

Author <sup>1</sup>					
IPCC Source/Sink Category					
Fuel <sup>2</sup> (applicable only in the Energy Sector):					
Gas <sup>3</sup> :	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O		
Value:					
Unit:					
Uncertainty (as +/-% or 2.5 and 97.5 percentiles ) <sup>4</sup>					
<b>Applicability<sup>5</sup></b> – fill in as necessary if data not generally applicable. Describe appropriate Technologies, Practices, Abatement Technologies, Region, and/or Regional Conditions					
Source of data (chose one)	Measurement - Scientific Literature Other Measurement National Inventory Report Calculated Based on fuel quality Expert Judgement				
Method of derivation of the value (e.g., arithmetic mean, weighted mean, adjustment of a literature data by expert judgment etc.					
Reference <sup>6</sup>					

Note:

The author is the LA/CA/CLA who writes the relevant section and proposes the data.

Fuels as defined in the Energy volume

Add additional gases as required

As defined by cross-cutting volume

Only to be completed where it is necessary to specify the applicability of the data

As reference to document, report, calculation or if expert judgement to those involved (Names or group e.g.

“Waste BOG on Solid Waste Disposal Sites”)

## Appendix 4 Units and Abbreviations

### *Abbreviations of, and how to Spell, Chemical Compounds*

CH <sub>4</sub>	Methane
N <sub>2</sub> O	Nitrous oxide <sup>5</sup>
CO <sub>2</sub>	Carbon dioxide
CO	Carbon monoxide
NO <sub>x</sub>	Nitrogen oxides
NMVOCS	Non-methane volatile organic compounds
NH <sub>3</sub>	Ammonia
CFCs	Chlorofluorocarbons
HFCs	Hydrofluorocarbons
PFCs	Perfluorocarbons
SF <sub>6</sub>	Sulphur hexafluoride
CCl <sub>4</sub>	Carbon tetrachloride
C <sub>2</sub> F <sub>6</sub>	Hexafluoroethane
CF <sub>4</sub>	Tetrafluoromethane
S	Sulphur

### *Units and abbreviations*

cubic metre	m <sup>3</sup>
hectare	Ha
gram	g
gigagram	Gg
tonne	T
gigatonne	Gt
joule	J
degree Celsius	°C
calorie	Cal
year	Yr
capita	Cap
gallon	Gal
dry matter	Dm

<sup>5</sup> In the IUPCA N<sub>2</sub>O is officially named “Dinitrogen Oxide”. However, “nitrous oxide” is widely used and understood in the emission inventory community and by the UNFCCC and so, to avoid confusion, will be used.



### *Prefixes and multiplication factors*

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

### *Standard equivalents*

1 tonne of oil equivalent (toe)	1 x 10 <sup>10</sup> calories
10 <sup>3</sup> toe	41.868 TJ
1 short ton	0.9072 tonne
1 tonne	1.1023 short tons
1 tonne	1 megagram
1 kilotonne	1 gigagram
1 megatonne	1 teragram
1 gigatonne	1 petagram
1 kilogram	2.2046 lbs
1 hectare	10 <sup>4</sup> m <sup>2</sup>
1 calorie <sub>T</sub>	4.1868 joule
1 atmosphere	101.325 kPa

## Draft Table of Contents

## 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

## Draft Table of Contents

Introductory Note

The *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (2019 Refinement) will be a single Methodology Report comprising an Overview Chapter and five volumes following the format of the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (2006 IPCC Guidelines).

- Overview Chapter
- Volume 1: General Guidance and Reporting
- Volume 2: Energy
- Volume 3: Industrial Processes and Product Use
- Volume 4: Agriculture, Forestry and Other Land Use
- Volume 5: Waste

The draft table of contents is presented below for each volume. Its structure is the same as that of the *2006 IPCC Guidelines* so as to make it easier for inventory compilers to use this Methodology Report with the *2006 IPCC Guidelines*. For those Chapters/Sections/Subsections where refinement is expected, the following three elements are explained.

- **Issue** (which needs to be addressed)
- **Location in 2006 IPCC Guidelines** (location of relevant guidance in the *2006 IPCC Guidelines*)
- **Type of refinement** (Update, Elaboration or New guidance, as explained in the draft Terms of Reference)

On the other hand, for those Chapters/Sections/Subsections where refinement is NOT expected, “**No refinement**” is indicated.

However, the following two principles need to be noted.

- Authors should develop modifications even for those Chapters/Sections/Subsections where “No refinement” is indicated in this draft table of contents, if deemed necessary to ensure consistency with the refinements made in the other Chapters/Sections/Subsections.
- Authors may conclude no refinement should be made even for the Chapters/Sections/Subsections where refinement is expected in this draft table of contents, after comprehensive review of available literature.

In addition, authors should develop modifications for Annexes (e.g. Worksheets) at the end of each volume as well, if deemed necessary to ensure consistency with the refinements made in Chapters/Sections/Subsections in the same volume, even though those Annexes are not explicitly included in this draft table of contents.

**Overview Chapter**

- Background – Technical Assessment of IPCC Inventory Guidelines
- Fundamental principle (not revising, but refining)
- Relationship with the 2006 IPCC Guidelines
- Policy Relevance

# Volume 1: General Guidance and Reporting

## Chapter 1 Introduction to the 2006 Guidelines

**Issue 1:** Provide a better description on how to implement a national inventory management system that manages all parts of Volume 1, implements continuous improvement and leads to the development of mature inventories.

**Location in 2006 IPCC Guidelines:** New Section in Chapter 1

**Type of refinement:** New guidance

**Issue 2:** Clarify the concept of “anthropogenic emissions and removals”.

**Location in 2006 IPCC Guidelines:** Section 1.1 Concepts, with Guidance contained in the IPCC KP Supplement Chapter 2.3.4 and 2.3.5 and the IPCC Wetlands Supplement

**Type of refinement:** Update

## Chapter 2 Approaches to Data Collection

**Issue 1:** Add guidance for the development of country-specific emission factors, focusing on developing countries.

**Location in 2006 IPCC Guidelines:** New guidance in Chapter 2

**Type of refinement:** New guidance

**Issue 2:** Add guidance for activity data collection; technical survey indicated there is a capacity problem to gather and manage national data which can be addressed by an additional guidance.

**Location in 2006 IPCC Guidelines:** New guidance in Chapter 2

**Type of refinement:** New guidance

**Issue 3:** Add guidance on the integration of GHG emissions reported from facilities into national GHG inventories

**Location in 2006 IPCC Guidelines:** New guidance in Chapter 2

**Type of refinement:** New guidance

## Chapter 3 Uncertainties

**Issue:** Refine guidance on uncertainty based on the latest scientific knowledge and simplification of guidance by providing more default values, calculation examples and best practices.

**Location in 2006 IPCC Guidelines:** Chapter 3

**Type of refinement:** Update

## Chapter 4 Methodological Choice and Identification of Key Categories

**Issue:** Add guidance on key category analysis to address treatment of disaggregation of categories, trend analysis, equations for trend analysis and the need for consistent definition of significant subcategories across the different volumes of the *2006 IPCC Guidelines*.

**Location in 2006 IPCC Guidelines:** Chapter 4 (and relevant guidance in the other Volumes)

**Type of refinement:** Elaboration

## Chapter 5 Time Series Consistency

**Issue:** Provide practical guidance on how to apply existing guidance on time series consistency because this proved to be a problem for many countries.

**Location in 2006 IPCC Guidelines:** Chapter 5

**Type of refinement:** Elaboration

## Chapter 6 Quality Assurance / Quality Control and Verification

**Issue 1:** Add guidance on the use and reporting of models

**Location in 2006 IPCC Guidelines:** New Section in Chapter 6

**Type of refinement:** New guidance

**Issue 2:** Elaborate user-friendly description of verification, validation, audit and QA/QC because users are unclear on their IPCC meanings compared to other definitions, such as ISO as used by CDM.

**Location in 2006 IPCC Guidelines:** Section 6.1, Box 6.1

**Type of refinement:** Elaboration

**Issue 3:** Update/elaborate verification guidance because the existing guidance is outdated (especially the guidance on comparisons with atmospheric measurements and new datasets).

**Location in 2006 IPCC Guidelines:** Section 6.10

**Type of refinement:** Update/Elaboration

## **Chapter 7 Precursors and Indirect Emissions**

**Issue:** Elaborate clearer guidance for the calculation of indirect CO<sub>2</sub> emissions.

**Location in 2006 IPCC Guidelines:** Section 7.2.1.5

**Type of refinement:** Elaboration

## **Chapter 8 Reporting Guidance and Tables**

No refinement

# **Volume 2: Energy**

## **Chapter 1 Introduction**

No refinement

## **Chapter 2 Stationary Combustion**

### **2.1 Overview**

No refinement

### **2.2 Description of sources**

No refinement

### **2.3 Methodological issues**

**Issue:** Link to issue related to biomass combustion and methodologies for Harvested Wood Products (HWP)

**Location in 2006 IPCC Guidelines:** Section 2.3.3.4

**Type of refinement:** Elaboration

### **2.4 Uncertainty assessment**

No refinement

### **2.5 Inventory Quality Assurance/Quality Control QA/QC**

No refinement

### **2.6 Worksheets**

No refinement

## **Chapter 3 Mobile Combustion**

No refinement

## **Chapter 4 Fugitive Emissions**

### **4.1 Fugitive emissions from mining, processing, storage and transportation of coal**

**Issue1:** Elaborate chapter to include guidance on emissions from exploration and CO<sub>2</sub> emissions (Underground coal mines, Surface coal mining)

**Location in 2006 IPCC Guidelines:** Sections 4.1.3 and 4.1.4 (Sections 4.1.1, 4.1.2 and 4.1.6 are relevant)

**Type of refinement:** Elaboration

**Issue2:** Include new section on abandoned surface coal mines

**Location in 2006 IPCC Guidelines:** Not applicable. (Next to Section 4.1.5. Sections 4.1.1, 4.1.2 and 4.1.6 are relevant)

**Type of refinement:** New guidance

## 4.2 Fugitive emissions from oil and natural gas systems

**Issue:** Update chapter including update/inclusion of EFs representative for current practice. Additional guidance for unconventional oil and gas production and abandoned wells.

**Location in 2006 IPCC Guidelines:** Sections 4.2

**Type of refinement:** Update

## 4.3 Fuel transformation [New]

**Issue:** Include new section on fuel transformation

**Location in 2006 IPCC Guidelines:** New Section in Chapter 4 (Next to Section 4.2)

**Type of refinement:** New guidance

## Chapter 5 Carbon Dioxide Transport, Injection and Geological Storage

No refinement

## Chapter 6 Reference Approach

No refinement

# Volume 3: Industrial Processes and Product Use

## Chapter 1 Introduction

No refinement

## Chapter 2 Mineral Industry Emission

No refinement

## Chapter 3 Chemical Industry Emissions

### 3.1 Introduction

No refinement

### 3.2 Ammonia production

No refinement

### 3.3 Nitric acid production

**Issue:** Update guidance on appropriate emission factors to use for dual pressure technologies for Nitric Acid Production

**Location in 2006 IPCC Guidelines:** Section 3.3.2.2 and Table 3.3

**Type of refinement:** Update

### 3.4 Adipic acid production

No refinement

### 3.5 Caprolactam, glyoxal and glyoxylic acid production

No refinement

### 3.6 Carbide production

No refinement

### 3.7 Titanium dioxide production

No refinement

### 3.8 Soda ash production

No refinement

### 3.9 Petrochemical and carbon black production

No refinement

### 3.10 Fluorochemical production

**Issue:** Update guidance and default Tier 1 emission factors for production of fluorinated compounds other than HCFC-22

**Location in 2006 IPCC Guidelines:** Section 3.10.2.2

**Type of refinement:** Update/Elaboration

### 3.11 Hydrogen production [New]

**Issue:** Develop guidance for estimating GHG emissions from hydrogen production

**Location in 2006 IPCC Guidelines:** New Section in Chapter 3 (Next to Section 3.10)

**Type of refinement:** New guidance

## Chapter 4 Metal Industry Emissions

### 4.1 Introduction

No refinement

### 4.2 Iron & steel and metallurgical coke production

**Issue:** Update emission factors for Iron and Steel Production and elaborate methodological guidance.

**Location in 2006 IPCC Guidelines:** Section 4.2.2

**Type of refinement:** Update/Elaboration

### 4.3 Ferroalloy production

No refinement

### 4.4 Primary aluminium production

**Issue:** Elaborate guidance and emissions factors to incorporate "low-voltage anode effect" PFC emissions and integrate this guidance into the existing methodology on "high-voltage anode effect" PFC emissions. Update of the Tier 1 and Tier 2 defaults.

**Location in 2006 IPCC Guidelines:** Section 4.4

**Type of refinement:** Update/Elaboration

**Issue:** Develop a new methodology for the CO<sub>2</sub> emissions from the alumina production. Ensuring completeness and avoiding double counting

**Location in 2006 IPCC Guidelines:** New guidance in Section 4.4

**Type of refinement:** New guidance

### 4.5 Magnesium production

No refinement

### 4.6 Lead production

No refinement

### 4.7 Zinc production

No refinement

#### 4.8 Rare Earth elements [New]

**Issue:** Develop a new guidance on GHG emissions (PFCs and CO<sub>2</sub>) from production of Rare Earth elements

**Location in 2006 IPCC Guidelines:** New Section in Chapter 4 (Next to Section 4.7)

**Type of refinement:** New guidance

### Chapter 5 Non-Energy Products from Fuels and Solvent use

No refinement

### Chapter 6 Electronics Industry Emissions

**Issue:** Update guidance and default Tier 1 and Tier 2 emission factors for Semiconductor Industry, improvement of the Tier 3 guidance and elaboration of guidance on generation of by-products from abatement technologies (CF<sub>4</sub> from NF<sub>3</sub>)

**Location in 2006 IPCC Guidelines:** Section 6.2.1 and 6.2.2, and 6.3.1 (uncertainty, to the extent necessary)

**Type of refinement:** Update/Elaboration/New guidance

### Chapter 7 Emissions of Fluorinated Substitutes for Ozone Depleting Substances

#### 7.1 Introduction

No refinement

#### 7.2 Solvents (non-aerosol)

No refinement

#### 7.3 Aerosols (propellants and solvents)

No refinement

#### 7.4 Foam blowing agents

No refinement

#### 7.5 Refrigeration and air conditioning

**Issue:** Add examples (collection of activity data, distribution of ODS substitutes by application within countries). Elaborate by adding a box with "recipe-style" guidance on how to launch the ODS substitutes inventory. Elaborate the reference to Montreal Protocol. Update emission factors by further segregating equipment types, regions, and time periods where possible.

**Location in 2006 IPCC Guidelines:** Sections 7.5.2.1 - for the recipe, 7.5.2.2 - for emission factors, 7.5.2.3 - for activity data

**Type of refinement:** Update/Elaboration

#### 7.6 Fire protection

No refinement

#### 7.7 Other applications

No refinement

### Chapter 8 Other Product Manufacture and Use

#### 8.1 Introduction

No refinement

#### 8.2 Emissions of SF<sub>6</sub> and PFCs from electrical equipment

No refinement

#### 8.3 Use of SF<sub>6</sub> and PFCs in other products

Issue 1: Develop guidance for PFCs (GHG) emissions from Textile Industry.

**Location in 2006 IPCC Guidelines:** New guidance in Section 8.3

**Type of refinement:** New guidance

Issue 2: Develop guidance for PFCs (GHG) emissions from water-proofing electronic circuit boards

**Location in 2006 IPCC Guidelines:** New guidance in Section 8.3

**Type of refinement:** New guidance

## 8.4 N<sub>2</sub>O from product uses

No refinement

# Volume 4: Agriculture, Forestry and Other Land Use

## Chapter 1 Introduction

No refinement

## Chapter 2 Generic Methodologies Applicable to Multiple Land-use Categories

### 2.1 Introduction

No refinement

### 2.2 Inventory framework

No refinement

### 2.3 Generic methods for CO<sub>2</sub> emissions and removals

#### 2.3.1 Change in biomass carbon stocks (above-ground biomass and below-ground biomass)

Issue 1: Develop guidance on the use of allometric equations for biomass estimation

**Location in 2006 IPCC Guidelines:** New Subsection in Section 2.3.1

**Type of refinement:** New guidance

Issue 2: Develop guidance on how to use biomass density (amount per unit area) maps generated from remote sensing data for biomass estimation

**Location in 2006 IPCC Guidelines:** New Subsection in Section 2.3.1

**Type of refinement:** New guidance

#### 2.3.2 Change in carbon stocks in dead organic matter

Issue 1: Update default values for litter stocks and develop default values for deadwood stocks

**Location in 2006 IPCC Guidelines:** Section 2.3.2.1, IPCC default values for litter and dead wood (Table 2.2),

**Type of refinement:** Update/Elaboration

Issue 2: Develop equation 2.18 for estimating DOM<sub>out</sub> and associated default values

**Location in 2006 IPCC Guidelines:** Section 2.3.2.1, IPCC default values for litter and dead wood (Table 2.2)

**Type of refinement:** Elaboration

#### 2.3.3 Change in carbon stocks in soils

Issue 1: Update reference carbon stocks.

**Location in 2006 IPCC Guidelines:** Section 2.3.3.1, Table 2.3

**Type of refinement:** Update

Issue 2: Develop new Tier 2 method for mineral soils that requires less activity data than the current default method

**Location in 2006 IPCC Guidelines:** New guidance in Section 2.3.3.1



Type of refinement: New guidance

Issue 3: Elaborate Tier 3 Methodologies with case study examples for soils.

Location in 2006 IPCC Guidelines: Tier 3 methods, Section 2.3.3.1,

Type of refinement: Elaboration

## 2.4 Non-CO<sub>2</sub> emissions

Issue: Replace defaults for cropland mass of fuel with crop residue estimation method in Chapter 11 for soil N<sub>2</sub>O method to ensure consistency in the calculation of residues between the two categories, and provide a basis to estimate mass of fuel for all crops instead of just the 4 crops listed in Table 2.4.

Location in 2006 IPCC Guidelines: Section 2.4, Table 2.4

Type of refinement: Update

## 2.5 Additional generic guidance for Tier 3 methods

Issue 1: Provide guidance on how to address inter-annual variability

Location in 2006 IPCC Guidelines: Chapter 2.5

Type of refinement: Elaboration

Issue 2: Elaborate guidance on the use of Tier 3 methods

Location in 2006 IPCC Guidelines: Sections 2.5.1 and 2.5.2

Type of refinement: Elaboration

## Chapter 3 Consistent Representation of Lands

### 3.1 Introduction

No refinement

### 3.2 Land-use categories

No refinement

### 3.3 Representing land-use areas

Issue: Develop guidance on how remotely sensed data, ground based data, and ancillary data can be integrated and used to derive consistent time series estimates of land use and land-use change

Location in 2006 IPCC Guidelines: Section 3.3 and Annex 3A.1 and 3A.2

Type of refinement: Update/Elaboration/New guidance

### 3.4 Matching land areas with factors for estimating greenhouse gas emissions and removals

Issue: Provide guidance on how to use methodologies within different methodological tiers in combination with different approaches for land representation

Location in 2006 IPCC Guidelines: New Subsection in Section 3.4

Type of refinement: New guidance

### 3.5 Uncertainties associated with the Approaches

No refinement

#### Annex 3A.1 Examples of International land cover datasets

(See the above issue under Section 3.3)

#### Annex 3A.2 Development of land-use databases

(See the above issue under Section 3.3)

## Chapter 4 Forest Land

### 4.1 Introduction

No refinement

## 4.2 Forest Land Remaining Forest Land

### 4.2.1 Biomass

No refinement

### 4.2.2 Dead organic matter

No refinement

### 4.2.3 Soil carbon

**Issue:** Provide guidance and develop new Tier 2 method for mineral soils that requires less activity data than the current default method

**Location in 2006 IPCC Guidelines:** New guidance in Section 4.2.3

**Type of refinement:** New guidance

### 4.2.4 Non-CO<sub>2</sub> greenhouse gas emissions from biomass burning

No refinement

## 4.3 Land Converted to Forest Land

(All issues for Section 4.2 above apply to this Section similarly.)

## 4.4 Completeness, time series, QA/QC, and reporting and documentation

**Issue:** Develop guidance on how to ensure methodological consistency of time series, such as through the use of age class structure data

**Location in 2006 IPCC Guidelines:** Section 4.4.2 on time series consistency

**Type of refinement:** Elaboration

## 4.5 Tables

**Issue:** Update values for BEF/BCEF and root/shoot ratio, average biomass stocks, and average biomass increments

**Location in 2006 IPCC Guidelines:** Tables 4.4, 4.5, 4.7, 4.8, 4.9, 4.10, 4.11A and 4.11B, 4.12

**Type of refinement:** Update/Elaboration

## Chapter 5 Cropland

### 5.1 Introduction

No refinement

## 5.2 Cropland Remaining Cropland

### 5.2.1 Biomass

**Issue:** Update default biomass carbon parameters.

**Location in 2006 IPCC GL:** Section 5.2.1.2, Tables 5.1, 5.2, 5.3

**Type of refinement:** Update

### 5.2.2 Dead organic matter

No refinement

### 5.2.3 Soil carbon

**Issue 1:** Update carbon stock change factors.

**Location in 2006 IPCC Guidelines:** Section 5.2.3.2, Table 5.5

**Type of refinement:** Update

**Issue 2:** Develop new Tier 2 method for mineral soils that requires less activity data than the current default method

**Location in 2006 IPCC Guidelines:** New guidance in Section 5.2.3

Type of refinement: New guidance

#### 5.2.4 Non-CO<sub>2</sub> greenhouse gas emissions from biomass burning

No refinement

### 5.3 Land Converted to Cropland

(All issues for Section 5.2 above apply to this Section similarly.)

### 5.4 Completeness, time series, QA/QC, and reporting

No refinement

### 5.5 Methane emissions from rice cultivation

Issue: - Develop regionally specific default EFs

Location in 2006 IPCC Guidelines: Section 5.5.2, Tables 5.11 to 5.14,

Type of refinement: Update

#### Annex 5A.1 Estimation of default stock change factors for mineral soil C emissions/removals for cropland

(See the above issues under Section 5.2.3.)

## Chapter 6 Grassland

### 6.1 Introduction

No refinement

### 6.2 Grassland Remaining Grassland

#### 6.2.1 Biomass

Issue: Update default biomass carbon parameters.

Location in 2006 IPCC Guidelines: Section 6.2.1.2, Table 6.1

Type of refinement: Update

#### 6.2.2 Dead organic matter

No refinement

#### 6.2.3 Soil carbon

Issue 1: Update carbon stock change factors.

Location in 2006 IPCC Guidelines: Section 6.2.3.2, Table 6.2

Type of refinement: Update

Issue 2: Develop new Tier 2 method for mineral soils that requires less activity data than the current default method

Location in 2006 IPCC Guidelines: New guidance in Section 6.2.3

Type of refinement: New guidance

#### 6.2.4 Non-CO<sub>2</sub> greenhouse gas emissions from biomass burning

No refinement

### 6.3 Land Converted to Grassland

(All Issues for section 6.2 above apply to this Section similarly.)

### 6.4 Completeness, time series, QA/QC, and reporting

No refinement

#### Annex 6A.1 Estimation of default stock change factors for mineral soil C emissions/removals for grassland

(See the above issues under Section 6.2.3.)

## Chapter 7 Wetlands

### 7.1 Introduction

No refinement

### 7.2 Managed peatlands

No refinement

### 7.3 Flooded Land

**Issue:** Update CO<sub>2</sub> emission factors for land converted to flooded land (Wetlands) and to develop, on the basis of comprehensive review of available literature, consistent methodologies that take into account factoring out of emissions and removals that would otherwise occur in the absence of the flooded area for estimating CO<sub>2</sub> and CH<sub>4</sub> emissions from flooded lands (both land converted to flooded land and flooded land remaining flooded land).

**Location in 2006 IPCC Guidelines:** Section 7.3 and associated good practice guidance in Section 7.4, and Appendices 2 and 3; also relevant to Chapter 2, Section 2.3 (Generic Methodologies for CO<sub>2</sub> emissions and removals).

**Type of refinement:** New guidance/Update

### 7.4 Completeness, time series consistency, and QA/QC

No refinement

### 7.5 Future methodological development

**Issue:** Clarify that this section of the 2006 IPCC Guidelines is no longer relevant

**Location in the 2006 Guidelines:** Section 7.5

**Type of refinement:** Elaboration

### 7.X. Additional guidance on Tier 2 method for mineral soils [New]

**Issue:** Develop guidance to implement new Tier 2 method for mineral soils that requires less activity data than the current default method, taking into consideration Chapter 5 of the *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*.

**Location in 2006 IPCC Guidelines:** New Section in Chapter 7 (Between Sections 7.3 and 7.4)

**Type of refinement:** New guidance

## Chapter 8 Settlements

### 8.1 Introduction

No refinement

### 8.2 Settlements Remaining Settlements

#### 8.2.1 Biomass

**Issue:** Update default biomass carbon parameters.

**Location in 2006 IPCC Guidelines:** Section 8.2.1.2,

**Type of refinement:** Update

#### 8.2.2 Dead organic matter

No refinement

#### 8.2.3 Soil carbon

**Issue:** Develop new Tier 2 method for mineral soils that requires less activity data than the current default method

**Location in 2006 IPCC Guidelines:** New guidance in Section 8.2.3

Type of refinement: New guidance

### 8.3 Land Converted to Settlements

(All Issues for section 8.2 above apply to this Section similarly.)

### 8.4 Completeness, time series consistency, QA/QC and reporting

No refinement

### 8.5 Basis for future methodological development

Issue: Clarify the elements in this section of the 2006 IPCC Guidelines that are no longer relevant

Location in the 2006 Guidelines: Section 8.5

Type of refinement: Elaboration

## Chapter 9 Other Land

### 9.1 Introduction

No refinement

### 9.2 Other Land Remaining Other Land

No refinement

### 9.3 Land Converted to Other Land

#### 9.3.1 Biomass

No refinement

#### 9.3.2 Dead organic matter

No refinement

#### 9.3.3 Soil carbon

Issue: Develop new Tier 2 method for mineral soils that requires less activity data than the current default method

Location in 2006 IPCC Guidelines: New guidance in Section 9.3.3

Type of refinement: New guidance

### 9.4 Completeness, time series, QA/QC and reporting

No refinement

## Chapter 10 Emissions from Livestock and Manure Management

### 10.1 Introduction

No refinement

### 10.2 Livestock population and feed characterisation

Issue 1: Update Section 10.2.2 to include guidance on improved description of feeding systems

Location in 2006 IPCC Guidelines: Section 10.2.2

Type of refinement: Update

Issue 2: Develop consistent system descriptions for manure management between source categories (regionally/climatically stratified) for basic and enhanced characterisation for livestock populations

Location in 2006 IPCC Guidelines: Section 10.2.2

Type of refinement: Update

### 10.3 Methane emissions from enteric fermentation

Issue: Improve parameters based on different feeding strategies for cattle and sheep.

Location in 2006 IPCC Guidelines: Section 10.3.2, Table 10.11 and Table 10.12

Type of refinement: Update

#### 10.4 Methane emissions from manure management

**Issue 1:** Update methodology, temperature relationships, Tier 1 Emission Factors and Tier 2 parameters for different manure management systems

**Location in 2006 IPCC Guidelines:** Section 10.4.2

**Type of refinement:** Update

**Issue 2:** Update guidance on how to deal with non-CO<sub>2</sub> emissions due to biogas production.

**Location in 2006 IPCC Guidelines:** Section 10.4.2, Table 10.17

**Type of refinement:** Update

#### 10.5 N<sub>2</sub>O emissions from manure management

**Issue 1:** Update N excretion parameters for all livestock categories considering updated livestock characterization in Section 10.2.

**Location in 2006 IPCC Guidelines:** Section 10.5.2

**Type of refinement:** Update

**Issue 2:** Update emission factors for N<sub>2</sub>O for manure management system descriptions.

**Location in 2006 IPCC Guidelines:** Section 10.5.2, Table 10.21

**Type of refinement:** Update

**Issue 3:** Update manure management volatilization and leaching factors with manure management systems identified in Section 10.2.

**Location in 2006 IPCC Guidelines:** Section 10.5.4, Tables 10.22 and 10.23,

**Type of refinement:** Update

**Issue 4:** Provide text on quality control procedures that use a mass balance approach to evaluate C and N flows through animal management systems.

**Location in 2006 IPCC Guidelines:** Section 10.5.6

**Type of refinement:** Elaboration

### Chapter 11 N<sub>2</sub>O Emissions from Managed Soils, and CO<sub>2</sub> Emissions from Lime and Urea Application

#### 11.1 Introduction

No refinement

#### 11.2 N<sub>2</sub>O emissions from managed soils

##### 11.2.1 Direct N<sub>2</sub>O emissions

**Issue 1:** Update N<sub>2</sub>O EF1, stratification by climate

**Location in 2006 IPCC Guidelines:** Section 11.2.1.2, Table 11.1

**Type of refinement:** Update

**Issue 2:** Update crop parameters for calculating residue quantity and N.

**Location in 2006 IPCC Guidelines:** Section 11.2.1.4, Table 11.2

**Type of refinement:** Update

**Issue 3:** Update the EF3 for N applied to soils, pasture, range and paddock by grazing animals.

**Location in 2006 IPCC Guidelines:** Section 11.2.1, Table 11.1

**Type of refinement:** Update

**Issue 4:** Update emission factor for rice production (N<sub>2</sub>O)

**Location in 2006 IPCC Guidelines:** Section 11.2, Table 11.1

**Type of refinement:** Update

##### 11.2.2 Indirect N<sub>2</sub>O emissions

**Issue:** Evaluate emissions factors for indirect N<sub>2</sub>O, both the amount of leaching/runoff and volatilization, as well as the indirect emission factor.

**Location in 2006 IPCC Guidelines:** Section 11.2.2, Table 11.3

**Type of refinement:** Update

### 11.2.3 Completeness, Time series, QA/QC

No refinement

### 11.3 CO<sub>2</sub> emissions from liming

No refinement

### 11.4 CO<sub>2</sub> emissions from urea fertilization

No refinement

### Annex 11A.1 References for crop residue data in Table 11.2

No refinement

## Chapter 12 Harvested Wood Products (HWP)

**Issue 1:** Update the relevant technical parameters, maintaining the existing approaches in the 2006 IPCC Guidelines

**Location in 2006 IPCC Guidelines:** Chapter 12

**Type of refinement:** Update

## Volume 5: Waste

### Chapter 1 Introduction

No refinement

### Chapter 2 Waste Generation, Composition and Management Data

#### 2.1 Introduction

No refinement

#### 2.2 Waste generation and management data

**Issue:** Update default data on Municipal Solid Waste (MSW) generation and management

**Location in 2006 IPCC Guidelines:** Section 2.2.1, Table 2.1

**Type of refinement:** Update

#### 2.3 Waste composition

**Issue 1:** Update default data on MSW composition data

**Location in 2006 IPCC Guidelines:** Section 2.3.1, Table 2.3

**Type of refinement:** Update

**Issue 2:** Add information on nitrogen (N) content, Biochemical Oxygen Demand (BOD) or Chemical Oxygen Demand (COD) of sludge

**Location in 2006 IPCC Guidelines:** New guidance in Section 2.3.2

**Type of refinement:** New guidance

### Annex 2A.1 Waste Generation and Management Data - by country and regional averages

**Issue:** Update default data on MSW generation and management

**Location in 2006 IPCC Guidelines:** Table 2A.1

**Type of refinement:** Update

### Chapter 3 Solid Waste Disposal

### 3.1 Introduction

### 3.2 Methodological issues

Issue 1: Elaborate on the First Order Decay (FOD) method taking into account active aeration of landfills

Location in 2006 IPCC Guidelines: New guidance in Section 3.2.1.1

Type of refinement: New guidance

Issue 2: Elaborate on default DOC which decomposes ( $DOC_d$ ) values for different waste components

Location in 2006 IPCC Guidelines: Section 3.2.3 (Fraction of degradable organic carbon which decomposes ( $DOC_d$ ))

Type of refinement: Elaboration

### 3.3 Use of measurement in the estimation of $CH_4$ emissions from solid waste disposal site (SWDS)

No refinement

### 3.4 Carbon stored in SWDS

No refinement

### 3.5 Completeness

No refinement

### 3.6 Developing a consistent time series

No refinement

### 3.7 Uncertainty assessment

Issue: Update uncertainty for  $DOC_d$  values

Location in 2006 IPCC Guidelines: Section 3.7.2

Type of refinement: Update

### 3.8 QA/QC, reporting and documentation

No refinement

#### Annex 3A.1 First Order Decay Model

No refinement

## Chapter 4 Biological Treatment of Solid Waste

No refinement

## Chapter 5 Incineration and Open Burning of Waste

### 5.1 Introduction

No refinement

### 5.2 Methodological issues

No refinement

### 5.3 Choice of activity data

No refinement

### 5.4 Choice of emission factors

Issue 1: Update oxidation factors for open burning of MSW

Location in 2006 IPCC Guidelines: Section 5.4.1, Table 5.2 (Oxidation factor for open burning of MSW)

Type of refinement: Update/Elaboration



**Issue 2:** Elaborate on EF for CH<sub>4</sub> from incineration related to new technologies (gasification, pyrolysis, and plasma technology)

**Location in 2006 IPCC Guidelines:** Section 5.4.2, Table 5.3

**Type of refinement:** Elaboration

**Issue 3:** Elaborate on EF for N<sub>2</sub>O from incineration related to new technologies (e.g. gasification, pyrolysis, and plasma technology)

**Location in 2006 IPCC Guidelines:** Section, 5.4.3, Table 5.4

**Type of refinement:** Elaboration

## 5.5 Completeness

No refinement

## 5.6 Developing a consistent time series

No refinement

## 5.7 Uncertainty assessment

No refinement

## 5.8 QA/QC, reporting and documentation

No refinement

# Chapter 6 Wastewater Treatment and Discharge

## 6.1 Introduction

**Issue 1:** Update introduction language to reflect current understanding of CH<sub>4</sub> and N<sub>2</sub>O emissions from wastewater treatment.

**Location in 2006 IPCC Guidelines:** Section 6.1

**Type of refinement:** Elaboration

**Issue 2:** Update Figure 6.1 and Table 6.1 to reflect additional types of treatment and disposal systems, such as aerobic/anaerobic treatment systems (e.g., anaerobic/anoxic/oxic (A2O), nitrification/denitrification, etc.) and constructed wetlands, as well as various types of septic systems (e.g., bottomless systems).

**Location in 2006 IPCC Guidelines:** Section 6.1

**Type of refinement:** Elaboration

**Issue 3:** Discuss updates/changes from 2006 IPCC Guidelines.

**Location in 2006 IPCC Guidelines:** Section 6.1.1

**Type of refinement:** Elaboration

## 6.2 Methane emissions from wastewater

### 6.2.1 Methodological issues

### 6.2.2 Domestic wastewater

**Issue 1:** Update Section 6.2.2.1. Some inventory compilers are misinterpreting Equation 6.1 and combining zero emissions from aerobic systems with recovered methane from sludge digestion, but missing the step of calculating emissions from sludge digestion.

**Location in 2006 IPCC Guidelines:** Section 6.2.2.1

**Type of refinement:** Update

**Issue 2:** Develop new Methane Correction Factors (MCFs) to reflect treatment processes that may be a combination of aerobic and anaerobic or anoxic zones (e.g., anaerobic/anoxic/oxic (A2O), modified Ludzack-Ettinger (MLE), etc.).

**Location in 2006 IPCC Guidelines:** Section 6.2.2.2

**Type of refinement:** Update

**Issue 3:** Consider the development of new MCFs to reflect different types of septic system (e.g., bottomless) and also to consider the effect of temperature on the MCF.

**Location in 2006 IPCC Guidelines:** Section 6.2.2.2

**Type of refinement:** Potential update

**Issue 4:** Elaborate guidance on what systems are classified as “not well managed”/overloaded for centralized aerobic treatment plants.

**Location in 2006 IPCC Guidelines:** Section 6.2.2.2

**Type of refinement:** Elaboration

**Issue 5:** Provide guidance on estimating emissions from septic systems that are connected to larger centralized treatment plants.

**Location in 2006 IPCC Guidelines:** Section 6.2.2.2

**Type of refinement:** Elaboration

**Issue 6:** Determine whether methane emissions from treated effluent should be included, particularly that discharged to stagnant water or overloaded receiving waters.

**Location in 2006 IPCC Guidelines:** Section 6.2.2.2

**Type of refinement:** Update

**Issue 7:** Provide guidance on the origin of the (maximum CH<sub>4</sub> producing capacity) Bo values presented in the chapter.

**Location in 2006 IPCC Guidelines:** Section 6.2.2.2

**Type of refinement:** Update

### 6.2.3 Industrial wastewater

**Issue 1:** Develop new MCFs to reflect treatment processes that may be a combination of aerobic and anaerobic or anoxic zones (e.g., anaerobic/anoxic/oxic (A2O), modified Ludzack-Ettinger (MLE), etc.).

**Location in 2006 IPCC Guidelines:** Section 6.2.3.2

**Type of refinement:** Update

**Issue 2:** Elaborate guidance on what systems are classified as “not well managed”/overloaded for centralized aerobic treatment plants

**Location in 2006 IPCC Guidelines:** Section 6.2.3.2

**Type of refinement:** Elaboration

**Issue 3:** Determine whether methane emissions from treated effluent should be included, particularly that discharged to stagnant water or overloaded receiving waters.

**Location in 2006 IPCC GL:** Section 6.2.3.2

**Type of refinement:** Update

**Issue 4:** Update uncertainty tables to include new EFs and AD

**Location in 2006 IPCC Guidelines:** Section 6.2.3.5

**Type of refinement:** Update/Elaboration

## 6.3 Nitrous oxide emissions from wastewater

### 6.3.1 Methodological issues

**Issue 1:** Address “indirect” emissions and how this terminology interacts with Chapter 7.3, Volume 1 of the 2006 IPCC Guidelines.

**Location in 2006 IPCC Guidelines:** Section 6.3.1.1

**Type of refinement:** Elaboration

**Issue 2:** Add discussion on the latest research related to how N<sub>2</sub>O is formed and emitted in treatment system

**Location in 2006 IPCC Guidelines:** Section 6.3.1.1

**Type of refinement:** Elaboration

**Issue 3:** Consider introducing Tier 1 and Tier 2 methods, similar to the CH<sub>4</sub> section.

**Location in 2006 IPCC Guidelines:** Section 6.3.1.1

**Type of refinement:** Update

**Issue 4:** Correct EF for nitrification/denitrification and develop N<sub>2</sub>O emission factors for additional treatment system configurations (aerobic/anaerobic/anoxic systems) as well as activated sludge systems.

**Location in 2006 IPCC Guidelines:** Section 6.3.1.2

**Type of refinement:** Update/Elaboration

**Issue 5:** Add EF for septic systems.

**Location in 2006 IPCC Guidelines:** New guidance in Section 6.3.1.2

**Type of refinement:** New guidance

**Issue 6:** Update text regarding N (influent) to make consistent with Table 6.11.

**Location in 2006 IPCC Guidelines:** Section 6.3.1.3

**Type of refinement:** Elaboration

**Issue 7:** Clarify Food and Agriculture Organization (FAO) data in relation to protein supplied vs protein consumed

**Location in 2006 IPCC Guidelines:** Section 6.3.1.3

**Type of refinement:** Elaboration/Update

**Issue 8:** Addition of N<sub>2</sub>O emission calculation for centralized plants and septic systems

**Location in 2006 IPCC Guidelines:** Sections 6.3.1.3/6.3.1.1

**Type of refinement:** Update

**Issue 9:** Improve the calculation of Neffluent

**Location in 2006 IPCC Guidelines:** Section 6.3.1.3

**Type of refinement:** Update/Elaboration

**Issue 10:** Addition of N<sub>2</sub>O from industrial wastewater

**Location in 2006 IPCC Guidelines:** New guidance in Sections 6.3.1.1 and 6.3.1.3

**Type of refinement:** New guidance

### 6.3.2 Time series consistency

No refinement

### 6.3.3 Uncertainties

**Issue:** Update uncertainty tables to include new EFs and AD

**Location in 2006 IPCC Guidelines:** Section 6.3.3

**Type of refinement:** Update/Elaboration

### 6.3.4 QA/QC, completeness, reporting and documentation

No refinement