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SCOPING OF THE METHOLODLOGY REPORT ON CARBON DIOXIDE REMOVAL TECHNOLOGIES, CARBON CAPTURE UTILIZATION AND STORAGE

Outline of the Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture Utilization and Storage

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

(Submitted by the Secretary of the IPCC)

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SCOPING OF THE METHOLODLOGY REPORT ON CARBON DIOXIDE REMOVAL TECHNOLOGIES AND CARBON CAPTURE UTILIZATION AND STORAGE

Outline of the Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture Utilization and Storage

Background

1. At the 60th Session of the IPCC (16-19 January 2024, Istanbul, Türkiye), the Panel decided that the TFI would hold an Expert Meeting on Carbon Dioxide Removal Technologies, Carbon Capture Utilization and Storage and provide a Methodology Report on these by the end of 2027. This would be developed with the Methodology Report on Short Lived Climate Forcers (Decision IPCC-LX-9).

2. In accordance with this decision the IPCC Expert Meeting[1] for the Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture Utilization and Storage was held on 1-3 July 2024 in Vienna, Austria, with participation of 76 experts (including 21 online) selected by the Bureau of Task Force on National Greenhouse Gas inventories (TFB).

   Subsequently the Scoping Meeting for the Methodology Report was held on 14-6 October 2024 in Copenhagen, Denmark. TFI received 630 nominations, 89 experts were selected, 78 participants (including 18 online) attended the meeting.

   Explanation on the Expert and Scoping Meetings, selection process and the lists of participants are included in the document IPCC-LXII/INF.4.

   The TFI extends its appreciation to the Government of Austria and the Government of Denmark for their support for these meetings.

3. The Scoping Meeting[2] aimed to consider the scope and format of the Methodology Report and to prepare draft terms of reference, draft table of contents, draft instructions to experts and authors, and a draft work plan for the Methodology Report. The Scoping Meeting took full account of the results of the Expert Meeting.

   The outcome of the Scoping Meeting was approved by the TFB at its 37th meeting. As a result, a proposal is made to the Panel on the scope and outline of the Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture Utilization and Storage as contained in this document.

Proposal

4. The TFB, based on the outcome of the Scoping Meeting, proposes to the Panel that:

   - The title of the Methodology Report should be "*2027 IPCC Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture, Utilization and Storage (Supplement to the 2006 IPCC Guidelines)"*

     The reference to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, and thus the notation 2006 IPCC Guidelines, includes the following three methodological reports:

     - *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines)*
     - *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement)*

[1] IPCC Expert Meeting: https://www.ipcc-nggip.iges.or.jp/public/mtdocs/2407_CDR_CCUS.html
[2] IPCC Scoping Meeting: https://www.ipcc-nggip.iges.or.jp/public/mtdocs/2410_CDR_CCUS_Scoping.html

- *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2019 Refinement).*

- The format of the Methodology Report should be as follows:

  2027 IPCC Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture, Utilization and Storage (Supplement to the 2006 IPCC Guidelines) will be a single Methodology Report comprising an Overview Chapter and seven 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*
  - *Volume 6: Carbon Dioxide Capture, Transport, Utilization and Storage*
  - *Volume 7: Direct Removal of CO_2 from Waterbodies. Alkalinity Enhancement of Waterbodies*

  The structure of the Methodology Report 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.

- The scope and outline of the Methodology Report are presented as:
  - the draft terms of reference (TOR) contained in Annex 1 to this document;
  - the draft table of contents (TOC) contained in Annex 2 to this document;
  - the draft instructions to authors in Annex 3; and
  - the draft work plan in Annex 4.

5. In accordance with Section 4.1 of Appendix A to the Principles Governing IPCC Work, the Panel is invited to consider this proposal and to agree on the Terms of Reference, Table of Contents and Instructions to Authors for a Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture Utilization and Storage.

6. The Panel is also invited to note the proposed budget for the production of the Methodology Report contained in Annex 5 to this document.

2027 IPCC Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture, Utilization and Storage (Supplement to the 2006 IPCC Guidelines*)

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*The reference to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, and thus the notation *2006 IPCC Guidelines*, includes the following three methodological reports:

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines)
- 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement)
- 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2019 Refinement).

Background

1. At the 60th Session (IPCC-60) held in January 2024 (Istanbul, Türkiye) the IPCC decided that the Task Force on National Greenhouse Gas Inventories (TFI) will hold an Expert Meeting on Carbon Dioxide Removal Technologies, Carbon Capture Utilization and Storage and provide a Methodology Report on these by the end of 2027 (Decision IPCC-LX- 9).

2. IPCC TFI held the Expert Meeting in July 2024 (Vienna, Austria) and the Scoping Meeting in October 2024 (Copenhagen, Denmark). These meetings considered Carbon Dioxide Removal (CDR) methods mentioned in the AR6 WGIII Report as a starting point for discussion and noted that several CDR activities have been already covered by the existing IPCC Guidelines.

3. The Scoping Meeting produced the draft Table of Contents of the new Methodology Report, which is outlined in Annex 2.

Scope

4. The IPCC Guidelines already cover issues related to Afforestation/Reforestation, Soil carbon sequestration in croplands and grasslands, Peatland and coastal wetland restoration, Agroforestry, Improved Forest Management, Biochar amendments, Carbon Capture and Storage from process gases.

5. The aim of the new Methodology Report is to provide an updated and sound scientific basis for supporting the preparation and continuous improvement of national greenhouse gas inventories in relation to estimation and reporting of carbon dioxide removal technologies, carbon capture, utilization and storage. In order to achieve the overall aim, the new Methodology report will:

- provide new methodological guidance for carbon dioxide removal technologies, carbon capture utilization only where currently there are gaps in the existing guidelines or where new removal technologies have emerged that could provide scientifically sound and empirically robust methods, activity data, removal factors and other parameters;
- provide, where needed, updated guidance and information of the existing guidance in the *2006 IPCC Guidelines* in relation to carbon dioxide removal technologies, carbon capture and storage.

6. This work will not revise the *2006 IPCC Guidelines*, but will update and provide new guidance for 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*.

7. Generally, national inventories should include greenhouse gas emissions and removals taking place within national territory and offshore areas over which the country has jurisdiction (2006 IPCC Guidelines, Volume I, Chapter 8.2.1).

Approach

8. The result of this work will be an IPCC Methodology Report "2027 IPCC Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture, Utilization and Storage (Supplement to the 2006 IPCC Guidelines)".

9. The authors will follow Annex 3 "Instructions to Experts and Authors" to ensure a consistent and coherent approach across all the volumes or chapters, including the use of common terminology.

10. Annex 4 provides the timetable for this task. Literature will be considered up to a cut-off date at the start of the Government/Expert Review.

2027 IPCC Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture, Utilization and Storage (Supplement to the 2006 IPCC Guidelines)

Introductory Note

2027 IPCC Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture, Utilization and Storage (Supplement to the 2006 IPCC Guidelines) will be a single Methodology Report comprising an Overview Chapter and seven 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
Volume 6: Carbon Dioxide Capture, Transport, Utilization and Storage
Volume 7: Direct Removal of CO_2 from Waterbodies. Alkalinity Enhancement of Waterbodies

The structure of the Methodology Report 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 where update or new guidance is expected, a description is provided below. Also, authors should develop modifications for Chapters, if deemed necessary to ensure consistency with the updates or new guidance made in the other Chapters.

In addition, authors should develop updates or produce new Worksheets, where necessary.

Overview Chapter

Glossary

Volume 1: General Guidance and Reporting (Update)

- **Chapter 1 of the 2019 Refinement to the 2006 IPCC Guidelines – Introduction (Update)**Consequential updates based on the new/updated guidance

Chapter 4 of the 2019 Refinement to the 2006 IPCC Guidelines – Methodological Choice and Identification of Key Categories (Update)

- Consequential updates based on the new/updated guidance

Chapter 8 of the 2019 Refinement to the 2006 IPCC Guidelines – Reporting Guidance and Tables (Update)

- Update in relation to categorization of new source/sink categories or recategorization of existing (e.g. 1.C). Update of all reporting tables, clarifying that the CO_2 emissions are

adjusted by CO_2 capture (negative quantities) to derive net CO_2, explanations to reporting tables: fugitive emissions during international CO_2 transport; CO_2 from biomass fuels in international transport, CO_2 from CCU-products/e-fuels I international transport, CO_2 captured during international transport, CO_2 from biomass in IPCC sectors 1B & 2, 3A and 4, how to report carbon capture in all sectors, differentiating fossil/CCU; biomass & atmospheric origins

Volume 2: Energy (Update)

Chapter 2 and Chapter 3 of the 2006 IPCC Guidelines – Stationary Combustion and Mobile Combustion (Update)

- Placeholder: Depending on the decisions made in relation to CCU, there might be a need for additional guidance in these chapters, e.g. in relation to new emission factors for combustion of fuels based on captured CO_2.

Chapter 4 Volume 2 of the 2019 Refinement to the 2006 IPCC Guidelines – Fugitive Emissions

- Clarification in relation to the emissions from transport, injection and sequestering of CO_2 in relation to enhanced oil, gas, and coal-bed methane recovery
- Placeholder: Depending on the decisions made in relation to CCU, there might be a need for additional guidance in this chapter, e.g. in relation to new emission factors for the production of fuels based on captured CO_2

Volume 3: Industrial Processes and Product Use (New and Update)

Chapter 3 of the 2019 Refinement of the 2006 IPCC Guidelines – Chemical Industry (Update)

- Guidance in relation to the production of products containing or derived from captured CO_2.

Chapter 9 of the 2006 IPCC Guidelines – Consumption and Use of CO2 containing products (New)

- Placeholder: Depending on the decisions made in relation to CCU (in volume 6), there might be a need for additional guidance on emissions arising from the consumption and use of CO_2 containing products

Chapter 10 of the 2006 IPCC Guidelines - Carbonation of cement and lime-based structures (New)

Covering all life stages. Excluding enforced carbonation (covered in Volume 6)

Volume 4: Agriculture, Forestry and Other Land Use (Update and New)

Chapters 2, 4 ,5, 6, 7, 8 and 9 of the 2019 Refinement to the 2006 IPCC Guidelines - Generic Methodologies Applicable to Multiple Land-Use Categories, Forest Land, Cropland, Grassland, Wetlands, Settlements, Other Land

(Update)

- Enhancing soil carbon sinks in croplands and grasslands for CDR: Update in relation to reference stocks and default factors for soil organic carbon estimates.
- Enhancing soil carbon sinks on managed land for CDR: Update to add enhanced weathering into the Tier 3 soil inorganic carbon and relationship to soil organic carbon; update biochar application in soils to develop a Tier 1 method and update of the Tier 2 & 3 methods.

Chapter 4 of the 2019 Refinement to the 2006 IPCC Guidelines – Cropland [Rice Cultivation] (Update)

- Enhancement of soil carbon for biochar amendments: Update Tier 1 default factors to estimate impact of biochar amendments on methane emissions from rice cultivation, and provide guidance for Tier 2 and Tier 3.

Chapter 11 of the 2019 Refinement to the 2006 IPCC Guidelines – N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application (Update)

- Enhancement of soil carbon for biochar amendments: Update Tier 1 default factors to estimate impact of biochar amendments on soil N2O emissions from N inputs in managed soils, and provide guidance for Tier 2 and Tier 3.

Chapters 2, 3, 4 of the Wetlands Supplement (New)

- Enhancement of carbon stocks in organic soils for CDR: new guidance on carbon export from organic soils.

Chapter 4 of the Wetlands Supplement – Coastal Wetlands (Update and New)

- Enhancement of carbon sinks for CDR: Update factors in relation to mangroves, tidal marshes and seagrass in coastal waters.
- New guidance on other coastal wetland types not in previous IPCC Guidelines.

Chapter 12 of the 2019 Refinement to the 2006 IPCC Guidelines – HWP and other durable biomass products (New and Update)

- Update in relation to other durable biomass products for CDR: Develop factors for other durable products (e.g., biochar products) and guidance for higher tier methods, and transfers from other pools.

Volume 5: Waste (Update)

Chapter 5 of the 2006 IPCC Guidelines - Incineration and Open Burning of Waste (Update)

- Placeholder: Depending on the decisions made in relation to CCU (in volume 6), there might be a need for additional guidance on emissions arising from incineration of CO_2 containing products

Volume 6 Carbon Dioxide Capture, Transport, Utilization and Storage (IPCC Sector 5) (New and Update)

Chapter 1. Introduction (New)

- The basic concepts and terms and definitions related to CCUS should be addressed inter alia: technology, removal, short- and long-term storage, “negative” emissions.

Chapter 2 Carbon Dioxide Capture from process gases (Update)

Chapter 3 Direct Air Capture (New)

Chapter 4. Carbon Dioxide Utilization (New)

- Possible ways of CO_2 utilization, e.g. enforced carbonation of industrial and mining wastes, critical mineral extraction, mineralisation (surface), synthetic fuels
- Tracking of captured CO_2, national carbon dioxide balance matrix (sources of captured CO_2 vs. final use and short- and long-term storage).

Chapter 5. Carbon Dioxide Transport (Update)

- Update in relation to all sub-categories (CO_2 transport (ship/rail/pipeline/truck) and cross-border transfers)

Chapter 6. Carbon Dioxide Injection and Geological Storage (Update)

- Update in relation to all sub-categories (injection, long term storage, other)
- Mineralisation (subsurface)

Volume 7. Direct Removal of CO2 from Waterbodies. Alkalinity Enhancement of Waterbodies (IPCC Sector 6) (New)

Chapter 1. Introduction

Chapter 2. Direct Removal of CO2 from Waterbodies

- New guidance on enhancing carbon sinks by capture of CO2 from water with durable storage or other utilization.

Chapter 3. Alkalinity Enhancement of Waterbodies

- New guidance on enhancing carbon sinks by increasing alkalinity in waterbodies.

2027 IPCC Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture, Utilization and Storage (Supplement to the 2006 IPCC Guidelines)

1. Work on a Methodology Report 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[3]). 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), technical support unit (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[4] 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 TSU. 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.
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 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 TSU annually of any changes in the information provided in their previously submitted COI Form. The TFB will evaluate the revised information.

[3] https://www.ipcc.ch/site/assets/uploads/2018/09/ipcc-principles-appendix-a-final.pdf
[4] https://www.ipcc.ch/site/assets/uploads/2018/09/ipcc-conflict-of-interest-2016.pdf

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 as well as providing an electronic copy. 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 and referencing 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:
    a. 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.
    b. Lead authors must consider relevant scientific developments and national methods used by countries in their inventories.

c. 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 with categories where the science is considered to be robust enough to provide guidance for a Tier 1 methodological approach and have a relative[5] contribution to the global/regional emissions of the species, using the significance and prioritization criteria as shown below.

Significance and prioritization criteria

• Significance of the category and the species within the sector on a global/regional scale. Categories significant only for a limited number of particular countries, currently or in the foreseeable future, may not meet this criterion.
• Sufficient data availability and maturity of scientific advances to provide a basis for methodological development, including:
  o Ability to develop default emission and removal factors and parameters
  o Feasibility of obtaining the necessary data to implement the methods
• Relevant for IPCC emissions scenarios and pathways to net zero emissions

22. 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".
23. The general structure should include the following elements: Methodological issues (Choice of method, Choice of emission factors, Choice of activity data), Completeness, Developing a consistent time series and Recalculations, Uncertainty assessment, Quality Assurance/Quality Control (QA/QC) and Reporting and Documentation, Worksheets.
24. Only Chapters identified in the draft Table of Contents are to be updated or new guidance should be provided, as proposed. However, authors should develop modifications for those Chapters, if deemed necessary to ensure consistency with updates or new guidance made in the other Chapters.

Definitions

25. 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.
26. 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 categories, although in some cases Tier 3 will be preferred.
27. Tier 1 approaches are simple methods that can be applied by all countries in all circumstances. Default values for the emission and removal factors and any other parameters needed must be supplied (see below for documentation needed).
28. Tier 2 methods should in principle follow the same methodological approach as Tier 1 but allow for higher resolution country specific emission and removal 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 and removal factors are needed and possibly more parameters will also be needed.

[5] i.e. not insignificant

29. 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.
30. 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 and removal factors for higher tiers need not be specified because it is a function of higher tier methods to find data reflecting national circumstances. 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.
31. Decision Trees. A decision tree is a graphical tool to assist countries in selecting from the IPCC methods.
32. Key categories are inventory categories which individually, or as a group of categories (for which a common method, emission and removal factors and activity data are applied) are prioritised within the national inventory system because their estimates have a significant influence on a country's total inventory in terms of the absolute level, the trend, or the level of uncertainty in emissions. Key category analysis should be performed species by species. The appropriate threshold to define key categories should be considered by authors.
33. Sector refers to the sectors of the guidelines, these are divided into categories and subcategories.
    a. Sector 1
    b. Category 1.A
    c. Sub-category 1st order 1.A.1
    d. Sub-category 2nd order 1.A.1.a
    e. Sub-category 3rd order, 1.A.1.a.i
34. 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.
35. 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.
36. Usage:
    a. "Good Practice" is defined in the 2019 Refinement as follows: "a key concept for inventory compilers to follow in preparing national greenhouse gas inventories. The key concept does not change in the 2019 Refinement. The term "good practice" has been defined, since 2000 when this concept was introduced, 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 practicable". This definition has gained general acceptance amongst countries as the basis for inventory development and its centrality has been retained for the 2019 Refinement. Certain terms in the definition have been updated based on feedback from the statistics community, such that this definition can be also understood 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 they are precise so far as practicable" in the context of refinement of Chapter 3 of Volume 1". The concept mentioned above should be applied to all species dealt with in this report.
    b. Good Practice covers choice of estimation methods appropriate to national circumstances, quality assurance and quality control at the national level, quantification of uncertainties and data archiving and reporting to promote transparency.

c. “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.
d. "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.
e. “Recommend” should not be used. In the GPG2000, the word “recommend” was avoided and “Suggested” was used instead.
f. “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,

Reporting Tables and worksheets

37. 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 and Removal factors and methods

38. Authors should provide default emission or removal factors and parameters. In doing this work, they should draw on the widest possible range of available literature, scientific articles and country reports. Where default values for emission and removal factors or ancillary parameters cannot be provided for a robust methodology set to be a Tier 1 method, authors may decide to add the methodology as a higher tier method rather than Tier 1 setting the good practice for inventory compiler to use their own data.
39. All data reported in the guidance as IPCC default values shall be justified by authors by providing TSU with all background data used, and the source of those data, as well as all information on the method applied to derive the default values from the background data, as needed to replicate the calculation, in a timely manner as drafts are being developed. Background data should be compiled in the attached form (Appendix 1) to facilitate the upload in the Emission Factor Database (EFDB). 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[6].
40. 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 Annexes in Chapter 10, Volume 4, of the 2019 Refinement), with a view to enhancing the transparency and applicability of default values presented in the new Methodology Report.
41. Single IPCC default emission and removal factors might not be ideal for any one country, but they can be recommended provided that regional factors are unavailable, and the defaults are representative of typical conditions as far as can be determined. It may be necessary or appropriate to provide a range of default emission and removal factors along with clear guidance about how countries should select from within the range. Lead authors may also provide multiple default emission and removal factors, disaggregated by region, technology (including abatement and removal technologies), or another relevant classification scheme.
42. It is important to provide more default emission and removal factors that reflect the unique conditions of developing countries. In general, default emission and removal factors for Tier 1 should represent emissions without category-specific mitigation measures, as well as relevant abatement technologies for which data are available.
43. Users of the guidelines should be encouraged to develop and use country specific data. Emission and removal factors for higher tiers need not be specified in the Methodology Report. 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

[6] EFDB evaluation criteria: https://www.ipcc-nggip.iges.or.jp/EFDB/documents/EFDB_criteria.pdf

preferred because the default assumptions and data may not always be appropriate for specific national contexts.

44. 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.
45. Authors should consider consistency in treatment by the exporting and the importing country on reporting of national total net emission when imported biomass is used in BECCS, biochar and other biomass products taking into consideration avoidance of double counting and completeness
46. Authors should exclude natural background when estimating GHG emissions/removals that are not carbon stock changes in C pools listed in Table 1.1 (Volume 4, AFOLU) and in the HWP pool.
47. Methods and emission factors for direct CO2 removal and alkalinity enhancement will need to specify waterbodies, such as rivers, lakes, oceans, and others.
48. Alkalinity enhancement may consider wastewater effluent and brine from desalinization processes.
49. Methods and emission factors for direct CO2 removal from water bodies, increased alkalinity and enhanced weathering should consider downstream storage of inorganic carbon.
50. Examples of coastal wetland systems that have not yet been considered in previous IPCC Guidelines are Tidal flats; tidal marsh-coastal sabkhas, seaweeds (macro-algae), subtidal sediments, and clarify definitions with consideration of Ramsar classes.
51. Coastal and inland wetlands guidance may consider management for CDR including restoration and other activities.
52. Enhanced weathering may include adding rock, mine tailings and other alkaline materials to land.
53. Consider including carbonate lime additions in soils in the updated guidance on enhanced weathering for soil inorganic carbon.

Boxes

54. Consistent with the 2006 IPCC Guidelines, the new Methodology Report may contain Boxes, which should not be used to provide methodological guidance, but for information purposes or providing examples.

Decision trees

55. Consistent with the format and structure of 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 category[7].
56. 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 and removal 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 from a key category.
    d. If data are not available for the method referred to in c, 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 category 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.

[7] 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.

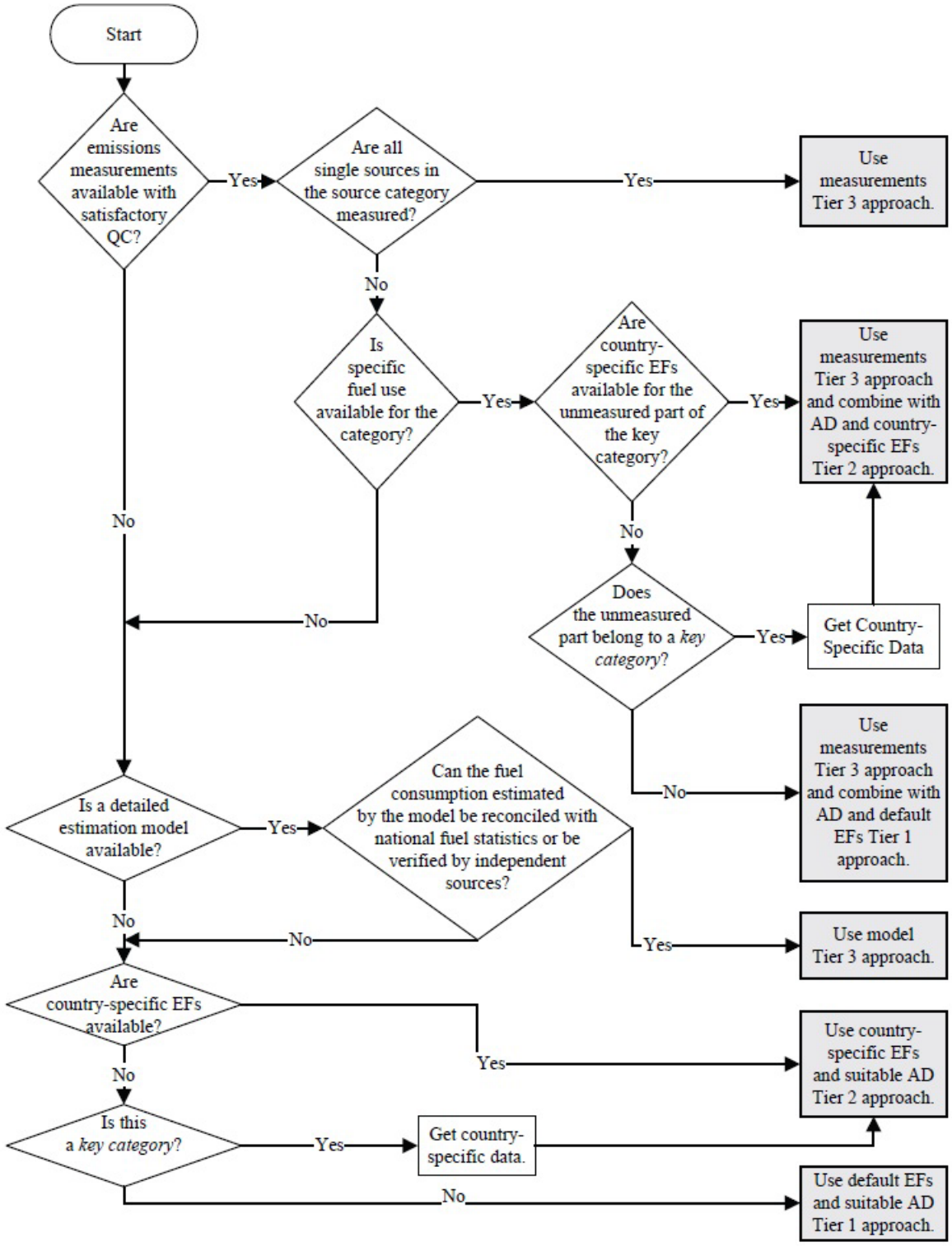
f. Lead authors may develop separate decision trees for different sub-categories. Alternatively, they may include decision tree options for selecting different tiers for different sub-categories. This second option is appropriate if it is advantageous to recommend a higher tier method only for significant sub-categories rather than for the entire category. Decision trees that use the 'significance' criterion must include the "25-30% rule"[8], as reassessed by authors.

57. Additional Formatting Guidelines (see example):
    a. Decision trees should be drafted in separate 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 centered within the boxes.

[8] As defined in the 2019 Refinement (i.e., a significant sub-category is one that makes up more than 25-30% of emissions from a category).

Example. Decision tree for estimating emissions from fuel combustion

Figure 1.2 Generalised decision tree for estimating emissions from fuel combustion



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

Units

58. 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 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_2O from N_2). Where input data available may not be in SI units conversions should be provided.
59. Standard abbreviations for units and chemical compounds are given in Appendix 2.

Appendix 1. Emission and Removal Factors and Parameters Documentation

This form should be used to document all emission and removal factors and parameters used in the new Methodology Report. This gives the minimum information that should be considered by the authors.

Author (the author is the CLA/LA/CA who writes the relevant section and proposes the data)	
IPCC Category	
Name of Emission and Removal Factor / Parameters	
Activity	
Species:	
Value:	
Unit:	
Uncertainty (as +/- % or 2.5 and 97.5 percentiles)	
Applicability (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 (attach the elicitation protocol)
Method of derivation of the value (e.g., arithmetic mean, weighted mean, adjustment of a literature data by expert judgment etc.	
Reference	
URL	
Abstract in English (if the abstract is in another language)	

Appendix 2 Units and Abbreviations

Abbreviations of, and how to spell, Species

CH_4	Methane
N_2O	Nitrous oxide[9]
CO_2	Carbon dioxide
CO	Carbon monoxide
NO_X	Nitrogen oxides
NMVOCs	Non-methane volatile organic compounds
NH_3	Ammonia
CFCs	Chlorofluorocarbons
HFCs	Hydrofluorocarbons
PFCs	Perfluorocarbons
SF_6	Sulphur hexafluoride
CCl_4	Carbon tetrachloride
C_2F_6	Hexafluoroethane
CF_4	Tetrafluoromethane
S	Sulphur
SO_2	Sulphur Dioxide
BC	Black Carbon
OC	Organic Carbon
PMx	Particulate Matter (x – microns)
H_2	Hydrogen
EC	Elemental Carbon

Units and abbreviations

cubic metre	m^3
hectare	Ha
gram	g
gigagram	Gg
tonne	T
gigatonne	Gt
joule	J
degree Celsius	℃
calorie	Cal
year	Yr
capita	Cap
gallon	Gal
dry matter	Dm
atmosphere	atm

Prefixes and multiplication factors

Multiplication Factor	Abbreviation	Prefix	Symbol
1 000 000 000 000 000	1015	peta	P
1 000 000 000 000	1012	tera	T
1 000 000 000	109	giga	G
1 000 000	106	mega	M
1 000	103	kilo	k
100	102	hecto	h
10	101	deca	da
0.1	10-1	deci	d
0.01	10-2	centi	c
0.001	10-3	milli	m
0.000 001	10-6	micro	m

[9] In the IUPAC N_2O 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.

Standard equivalents

1 tonne of oil equivalent (toe)	1 x 1010 calories
10^3 toe	41.868 TJ
1 short ton	0.9072 tonne
1 tonne	1.1023 short tons
1 tonne	1 megagram
1 kilotonne	1 gigagram
1 megatonne	1 teragram
1 gigatonne	1 petagram
1 kilogram	2.2046 lbs
1 hectare	104 m^2
1 calorie^{IT}	4.1868 joule
1 atmosphere	101.325 kPa

2027 IPCC Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture, Utilization and Storage (Supplement to the 2006 IPCC Guidelines)

Date	Action	Comments
October 2024	Scoping Meeting	Prepare ToR, ToC, Workplan and Guidance to authors
October 2024	TFB36 Meeting	Adoption of Outcomes of the Scoping Meeting and Submission to IPCC
1st half 2025	IPCC-62	IPCC Plenary approves ToR, ToC, Workplan and Guidance to authors
1st half 2025	Call for Nomination of Authors and Review Editors	IPCC invites nominations from governments and international organizations
1st half 2025	Establishment of the Steering Committee	TFB select members to join TFI Co-Chairs in the Steering Group *(to ensure consistency across all the volumes and continuity with the earlier IPCC inventory reports)*
1st half 2025	Selection of Coordinating Lead Authors, Lead Authors and Review Editors	Selection by TFB considering expertise and geographical and gender balance
2nd half 2025	1st Lead Author Meetings	LAM1 to develop zero order draft (ZOD)
2nd half of 2025	Science Meeting	A small meeting of CLAs and some LAs to discuss specific issues that require intensive discussion to reinforce the writing process
2nd half 2025	2nd Lead Author Meeting	To develop first order draft (FOD) for review
1st half 2026 (8 weeks)	Expert Review	8 weeks review by experts
1st half2026	3rd Lead Author Meeting	To consider comments and produce second order draft (SOD) for review
2nd half2026	Literature cut-off date (one week before SOD Review)	Peer-reviewed papers accepted by the cut-off date (even if not yet published) will be considered. Non-peer-reviewed documents which are made publicly available by the cut-off date.
2nd half 2026 (8 weeks)	Government & Expert Review	8 weeks review by governments and experts
2nd half 2026	4th Lead Author Meeting	To consider comments and produce final draft (FD)
1st half 2027	Government Review	Distribute to governments for their consideration prior to approval (at least 4 weeks prior to the Panel)
2nd half2027	Adoption/acceptance by IPCC	Final draft submitted to IPCC Panel for adoption/acceptance
2nd half 2027	Publication	Electronic means

2027 IPCC Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture, Utilization and Storage (Supplement to the 2006 IPCC Guidelines)

(CHF)

	2025			2026			2027		
	DC/EIT support	Other	Total	DC/EIT support	Other	Total	DC/EIT support	Other	Total
LAM1	*280,000 70 journeys*	*47,600*	*327,600*						
LAM2	*280,000 70 journeys*	*47,600*	*327,600*						
LAM3				*308,000 77 journeys*	*52,360*	*360,360*			
LAM4				*308,000 77 journeys*	*52,360*	*360,360*			
Science Meeting	*60,000 15 journeys*	*10,200*	*70,200*						
Preparatory Meeting							*60,000 15 journeys*	--	*60,000*