

# U.S. EPA Toolkit for Building National GHG Inventory Systems

4. QA/QC Procedures

|  |  |
| --- | --- |
|  | 1. Inventory Planning |
|  | 2. Institutional Arrangements |
|  | 3. Methods and Data Documentation |
|  | **4. QA/QC Procedures** |
|  | 5. Key Category Analysis |
|  | 6. Archiving System |
|  | 7. National Inventory Improvement Plan |

Staff Member Responsible for Populating the Template: Contact Information

|  |  |  |  |
| --- | --- | --- | --- |
| Name: |  | Organization name: |  |
| Title/Position: |  | Organization postal address: |  |
| Phone number: |  | Organization web address: |  |
| Email: |  | Organization phone number: |  |

Template 4. QA/QC Procedures Overview

|  |  |
| --- | --- |
| Introduction to Template 4. QA/QC Procedures | |
| Instructions | |
| Overview of Steps | |
| STEP 1 | Assign QA/QC roles and responsibilities in Table 4-1. |
| STEP 2 | Document existing QA/QC activities and other data quality procedures in Table 4-2. |
| STEP 3 | Complete Table 4-3 to establish general QC procedures for Sector/Category Leads to follow. |
| STEP 4 | Complete Table 4-4 to establish sector/category-specific QC procedures for Sector/Category Leads to Follow. |
| STEP 5 | Establish QA activities for external expert reviewers and document. |
| STEP 6 | Use Table 4-6 to finalize, distribute, and implement the QA/QC plan. |
| STEP 7 | Propose inventory improvements as a result of QA/QC activities in Table 4-7. |
| **Appendices** | |
| Appendix 1 | QA/QC Checklists |
| Appendix 2 | Expert Review Elicitation Template |
| Revision History | |

Abbreviations

CBI confidential business information

CMA Conference of the Parties serving as the meeting of the Parties to the Paris Agreement

CO2 carbon dioxide

CO2 Eq. carbon dioxide equivalents

CRT common reporting table

ETF enhanced transparency framework (under the Paris Agreement)

GHG greenhouse gas

GWP global warming potential

IPCC Intergovernmental Panel on Climate Change

IPPU industrial processes and products use

ISO International Organization for Standardization

MMT million metric tonnes

MPGs modalities, procedures, and guidelines

“N” no

N2O nitrous oxide

NID national inventory document

QA quality assurance

QA/QC quality assurance and quality control

QC quality control

TACCC transparency, accuracy, completeness, comparability, consistency

UK United Kingdom

UNFCCC United Nations Framework Convention on Climate Change

URL uniform resource identifier

“Y” yes

## Introduction to Template 4. QA/QC Procedures

The EPA has developed the *Toolkit for Building National Greenhouse Gas Inventory Systems* (‘Toolkit’) to help developing countries build their institutional capacity to establish, maintain, and improve sustainable inventory management systems, which facilitate and support preparing complete, high-quality greenhouse gas (GHG) inventories using the [*2006 Intergovernmental Panel on Climate Change Guidelines*](https://www.ipcc-nggip.iges.or.jp/public/2006gl/) (*2006 IPCC Guidelines*) and the [*2019 Refinement of the 2006 IPCC Guidelines*](https://www.ipcc.ch/site/assets/uploads/2019/12/19R_V0_01_Overview.pdf)(*2019 Refinement*) on a biennial basis.[[1]](#footnote-2)

In EPA’s Toolkit, this is Template 4. Its purpose is to build confidence in national GHG inventories by helping countries to develop and implement a quality assurance and quality control (QA/QC) plan. This template addresses the key elements of a QA/QC plan, including data quality objectives that improve the transparency, accuracy, consistency, comparability, and completeness (TACCC) of the inventory over time. The data quality objectives and the other key elements of the QA/QC plan facilitate inventory review and coordination of the review across the inventory. This template includes a series of checklists (formatted as tables) to build a QA/QC plan that you may refine and customize to record country-specific information. It also includes three QA/QC checklists that can be customized to track the progress of the QA/QC work done, as well as an expert review elicitation template.

The guidance in this template is consistent with the current reporting requirements under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement Enhanced Transparency Framework[[2]](#footnote-3) (ETF) for National GHG Inventories (i.e., Biennial Transparency Reports). Under the ETF, in accordance with the *2006 IPCC Guidelines*, countries are required to prepare a QA/QC plan, implement general and sector/category-specific QA/QC activities, and implement a basic expert peer review of their inventories. The *2006 IPCC Guidelines* and the *2019 Refinement* provide more detailed information on developing and implementing a QA/QC plan.

Note: If you are using the IPCC Inventory Software, certain quality control (QC) procedures are built into the software itself. QC in the IPCC Inventory Software only covers the estimates. Additional QC is needed for factors outside the software’s control (i.e., using data from the correct sources, checking data entry, checking documentation, or any checks related to proper documentation in the National Inventory Document (NID)). Quality assurance (QA) is not covered by the software, as this involves an external third party reviewing the inventory. This QA/QC template includes other necessary QC steps that should be covered in addition to using the QC checks in the IPCC Inventory Software.

**Quality Assurance/Quality Control (QA/QC) Activities**

It is important to define and understand the application of QA, QC, and verification before developing and implementing a QA/QC plan for your GHG inventory. **It is advised to retain the background section, below, to provide context to those who read or use the QA/QC Plan**.

**Background**

The IPCC defines QC, QA (including audits) and verification as follows:

* **Quality Control (QC)** – A system of routine technical activities implemented by the inventory compilers to measure and control the quality of the inventory as it is prepared.
* **Quality Assurance (QA)** – A planned system of review activities, including a basic peer review,[[3]](#footnote-4) conducted by personnel not involved in the inventory development process. QA activities are preferably performed by independent third parties after QC procedures are performed on a completed inventory.Audits are a type of QA toevaluate how effectively the inventory compilers implement the QC procedures noted in the QC plan, based on the available documentation. Audits can ensure your inventory is meeting data quality objectives by confirming QC and recordkeeping procedures have been implemented and documented. Audits may be held had varying intervals (e.g., 3-5 years) depending on resources and national circumstances.
* **Verification** – The activities conducted during the planning and development, or after completion of an inventory that can help to establish its reliability for the intended applications of the inventory. For inventories, verification specifically refers to comparison with methods that are external to the inventory and apply independent data, including estimates made by other bodies or through alternative methods (e.g., Table 4-4, quality control procedure #A1.b or #C1.a).

In short, QC is part of the inventory compiler’s day-to-day work. QA is performed by external experts who are not directly involved in compiling the inventory, as an additional quality check. Verification activities may be constituents of both QA and QC, depending on the methods used and the stage at which independent information is used (e.g., comparisons of draft estimates with independent data sets).

QC is further divided into general procedures and QC procedures specific to a sector/category. General QC procedures include quality checks for calculations in addition to data handling, processing, and documentation. General checks are completed annually for each sector/category, providing a record of checks performed and corrective actions taken. Sector/category-specific QC procedures complement general QC procedures and focus on the data and methodology used for an individual category. These procedures require knowledge of the specific sector/category, the types of data available, and the parameters associated with estimating emissions or removals. These procedures are performed in addition to the general QC checks; however, the specificity and frequency of these checks will vary across sectors/categories — you may not have to complete these checks every year. The *2006 IPCC Guidelines* (Volume 1, Chapter 6, Section 6.2)[[4]](#footnote-5) provide questions to consider when balancing available resources and sufficient QA/QC.

Both QA and QC are critical components of an inventory management system. When QA/QC activities are implemented effectively, they improve inventory quality and guide inventory improvements. A fundamental element of the inventory management system is maintaining a well-documented QA/QC plan. An effective QA/QC plan includes the following elements:

* A timeline for updating and distributing the QA/QC plan.
* Personnel responsible for coordinating QA/QC activities.
* General QC procedures that apply to all inventory sectors/categories.
* Sector/category-specific category QC procedures.
* QA review activities.
* Interactions between QA/QC and uncertainty activities.
* Verification activities.
* Reporting, documentation, and archiving procedures.
* A list of QA/QC improvements by priority, which should be reviewed regularly and used to guide inventory improvements.

## Instructions

The tables in this template may be customized by adding, removing, or modifying columns or rows to better reflect your country’s particular needs or circumstances.

|  |  |
| --- | --- |
| Complete the cells that are shaded this color: |  |

Enter new information about your inventory in black text.

The blue text throughout each template provides detailed instructions and example responses to help you complete the tables. Once the tables are complete, delete all the blue text throughout the template (with the exception of the QA/QC activities background information). The remaining text or tables in black text may be used for reporting or to contribute to a National GHG Inventory System Manual.

### Suggested Roles and Responsibilities

Suggested roles and responsibilities of the National Inventory Coordinator (NIC), QA/QC Coordinator, and Sector/Category Leads (see roles documented in Template 2. Institutional Arrangements) for completing this template are defined below. Sector/Category Leads, depending on national circumstances, will provide support to the NIC and QA/QC Coordinator, as required.

Role: National Inventory Coordinator

Responsibilities:

Complete Tables 4-1 and 4-6 with the QA/QC Coordinator

Support the QA/QC Coordinator and Sector/Category Leads in completing Tables 4-3 and 4-4

Role: QA/QC Coordinator

Responsibilities:

Complete Tables 4-1 and 4-6 with National Inventory Coordinator

Complete Table 4-2

Complete Table 4-3 and 4-4 with the Sector/Category Leads and National Inventory Coordinator

Complete Table 4-5

Distribute Table 4-7 to Sector/Category Leads and collect templates once completed

Role: Sector/Category Leads

Responsibilities:

Complete Table 4-3 and 4-4 with the QA/QC Coordinator and National Inventory Coordinator

Support the QA/QC Coordinator in completing Table 4-5

Complete Table 4-7

To complete this template, the National Inventory Coordinator and QA/QC Coordinator will carry out the steps defined below and following the guidance above each table in this template.

### Overview of Steps

|  |  |
| --- | --- |
| **Steps** | **Purpose** |
| 1. Assign QA/QC roles and responsibilities. | It is important to assign roles and responsibilities, so people understand the procedures they are responsible for implementing. For countries with small inventory teams, people may have multiple roles. Ensure these roles are documented in Template 2. Institutional Arrangements. |
| 1. Document existing QA/QC activities and other data quality procedures. | Inventory teams are likely already conducting basic QC procedures and/or have QA processes in place. It is important to document these as part of the QA/QC plan. In addition, the entity responsible for the GHG inventory development may have additional QA/QC or data quality procedures in place which should be documented. |
| 1. Establish general QC procedures. | There are general procedures that should be applied to every source and sink category, aiming to provide confidence in the inventory and improve quality of the GHG inventory over time. |
| 1. Establish sector/category-specific QC procedures. | There are sector/category-specific QC procedures that focus on improving quality for specific categories, starting with key categories (see Template 5. Key Category Analysis). |
| 1. Establish QA activities for external expert reviewers and document comments. | QA activities are carried out by experts who are not part of the inventory compilation team but who have relevant inventory expertise. Document QA activities and any comments that reviewers provide during the QA process to help improve the quality of the inventory. |
| 1. Finalize, communicate, and implement the QA/QC plan. | Establish a timeline of communication and implementation of the QA/QC plan. Inventory team members and QA reviewers should receive a copy of the QA/QC plan. |
| 1. Propose inventory improvements as a result of QA/QC activities. | Create a list of areas of improvements, add priority and regularly review list to guide inventory improvements over time. The areas of inventory improvement that are identified throughout the implementation of QA/QC activities should be added to the overall inventory improvement plan. |
| 1. Appendix 1: QA/QC Checklists | These checklists can help the QA/QC Coordinator monitor QA/QC activities during the inventory compilation cycle. |
| 1. Appendix 2: Expert Review Elicitation Template | Example text can be used to instruct external experts to ensure a focused review. |

### STEP 1: Assign QA/QC roles and responsibilities in Table 4-1

* In Table 4-1**,** identify key QA/QC personnel and any additional country-specific QA/QC responsibilities.[[5]](#footnote-6)
  + The **Role column** is prefilled with typical QA/QC roles. You may keep them or modify them according to your national circumstances. For example, you may combine roles, add roles, or remove roles.
    - Identify the QA/QC Coordinator – the main person responsible for developing, maintaining, and overseeing implementation of the QA/QC plan. A detailed list of QA/QC Coordinator responsibilities can be found in the QA/QC Coordinator Checklist in Appendix 1 of this template. The QA/QC Coordinator will work with the *National Inventory Coordinator* and Sector/Category Leads to understand the implications of ensuring quality across the inventory.
    - Note: If the inventory team is small, it is common for one or more people to have multiple roles in inventory compilation. A large QA/QC team is not a necessity – the key is to ensure that the QA/QC system is efficient and effective and helps to advance inventory improvements.
  + The **QA/QC Responsibility column** includes suggested responsibilities for each of the roles. You may modify them as needed to reflect national circumstances and inventory needs.
  + If using the IPCC Inventory Software, identify QA/QC personnel who are familiar with or able to learn about QC within the software. QC procedures are built into the IPCC Inventory Software (i.e., alerting the user about missed data, values out of sequence, etc.), but additional measures are required to check factors outside the software’s control, such as checking data sources. The software does not perform QA, which must be done by external expert reviewers.
  + Ensure that the role of the external expert reviewer is well defined and agreed upon. The expert can be from within the country or an international expert, but as noted above, the expert should not be directly involved in compiling the inventory. See Step 5 for more information on external experts.
* Note: While QA/QC activities should be applied to the whole Inventory, it is important that efforts be prioritized for key categories as well as categories where significant changes in methods or data have been made. See Template 5. Key Category Analysis for more information on how to identify key categories.

Table 4-1. Inventory Compilation Team Members Responsible for QA/QC Activities

| Role | QA/QC responsibility | Name | Organization | Contact information |
| --- | --- | --- | --- | --- |
| National Inventory Coordinator | * Coordinate with the QA/QC Coordinator on QA/QC plan implementation * Focus on cross-cutting QA/QC activities | [Enter text] |  |  |
| QA/QC Coordinator | * Develop and implement the overall QA/QC plan |  |  |  |
| Sector/Category Lead(s) | * Develop and implement general, sector/category-specific (as appropriate) QA/QC procedures listed in Tables 4-3 and 4-4 below. * Focus on key categories |  |  |  |

### STEP 2: Document existing QA/QC activities and other data quality procedures in Table 4-2

* In **Table 4-2**, describe any activities and procedures implemented in previous inventory compilation cycles that meet the suggested checks in the *2006 IPCC Guidelines* (Volume 1, Chapter 6, Table 6.1) and those listed in Table 4-2. The QA/QC Coordinator should work with the Sector Leads to assess the QA/QC activities already occurring.
  + The **QA/QC** **Documentation Questions column** includes guiding questions that will help the QA/QC Coordinator document existing QA/QC activities and procedures. Add rows to the table as necessary.
    - Using these questions, the QA/QC Coordinator should review the inventory team’s QA/QC protocols, data quality procedures or any other guidance for conducting QA/QC activities.
* This information will provide a useful basis for further developing QA/QC activities in subsequent steps.

Table 4-2. Documentation of Existing QA/QC Activities

| QA/QC documentation questions | Sector/category | Procedure | Supporting documents |
| --- | --- | --- | --- |
| Are there existing QC procedures from previous compilation cycles? | [Enter text] |  |  |
| Are there existing QA activities from previous compilation cycles? |  |  |  |
| Are QA/QC findings from previous reviews logged into an overall inventory improvement plan? |  |  |  |
| Are there additional QA/QC activities and procedures that are documented elsewhere? |  |  |  |
| Does the entity responsible for GHG inventory development have any data quality or quality assurance procedures that must be followed? |  |  |  |
| Have data providers (e.g., government agencies, industry) undertaken data quality procedures before providing data for GHG inventory development? |  |  |  |

### STEP 3. Complete Table 4-3 to establish general QC procedures for Sector/Category Leads to follow

General QC procedures include quality checks related to calculations in addition to data handling, processing, and documentation. These checks are applicable to all inventory sectors/categories.

According to the *2006 IPCC Guidelines*, general QC procedures are designed to be implemented routinely for all categories, although it may not be necessary or possible to check all aspects of inventory input data, parameters, or calculations every year. Checks may be performed on selected sets of data and processes. A representative sample of general QC procedures may be implemented each year for all categories, according to national circumstances, to check the quality of the inventory. In establishing criteria for selecting sample data sets and processes, it is good practice for the QA/QC Coordinator, in collaboration with the *National Inventory Coordinator* and Sector/Category Leads, to ensure all parts of the inventory have undergone QC over an appropriate period as determined in the QA/QC plan (i.e., smaller sources that have limited changes could be subject to priority checks and only undergo all checks periodically whereas key categories and categories with changes in methods/data or activity data trend changes should be subject to the full suggested general checklist in addition to other checks discussed in Step 4, etc.).

* Table 4-3 includes a list of QC procedures that should be performed at the category or subcategory level by the appropriate Sector/Category Leads. The sectors/categories included in this process will vary based on national circumstances. The QA/QC Coordinator and National Inventory Coordinator will provide support in completing these QC checks.
  + The **QC Activity** column has been prepopulated with general QC activities listed in Table 6.1[[6]](#footnote-7) of the *2006 IPCC Guidelines* and from other best practices for GHG inventories, with modifications for clarity.
  + The **Procedures** column includes a description of procedures that could be completed as part of each QC activity. This column also draws from Table 6.1 from the *2006 IPCC Guidelines*, with modifications for clarity. It may not be necessary or possible to complete all of these procedures every year, but you are encouraged to complete as many QC checks as possible.
  + For each procedure, record the name or initials of the person responsible for completing the activity and the date of completion in the column Procedure Completed.[[7]](#footnote-8)
    - Indicate “Y” under Error (Y/N) if errors are discovered while completing a QC procedure and indicate “N” when no errors are found.
  + If the general QC activity identifies an issue, document action was taken to correct the issue in the Corrective Action column.
  + In the Supporting Documents/Other Notes column, list any additional files that help to document the completion of general QC procedures, or notes needed to provide context to the actions taken, if not otherwise documented.
    - For example, separate documentation which explains corrective actions taken.
* Modify these activities and their associated procedures as needed and add more rows as necessary. To help the QA/QC Coordinator track the completion of procedures, it may be useful to list each discrete procedure in a separate row of the table.

Table 4-3 provides example text in *blue* to demonstrate how documentation of corrective actions or QC procedures may be referenced or presented. The example text uses notations (i.e., numbers and letters) to reference an **Error! Reference source not found.**, which summarizes the documents referenced within the table. Customize this approach or table to best suit your national circumstances.

For ease of reference the *Supporting Documentation List* is directly below, but for the flow of your inventory documentation you may want to include this list after Table 4-3.

*[Example] Supporting Documentation List:*

*NS = No specific supporting documentation other than that within the inventory worksheets.*

1. *Compilation of new production data (Excel File: Production Data\_30June2024.xlsx)*
2. *Hand calculations for a sample of data (Excel File: Hand Calcs\_28June2024.xlsx)*

Table 4-3. General QC Procedures

| Item | Procedure completed | | Corrective action (If applicable) | | | Supporting documents/other notes |
| --- | --- | --- | --- | --- | --- | --- |
| Date | Name  (first initial, last name) | Errors (Y/N) | Date | Name  (first initial, last name) |
| 1. **DATA GATHERING, INPUT, AND HANDLING ACTIVITIES** | | | | | | |
| 1. Check a sample of input data for transcription errors.   *Use electronic data where possible to minimize transcription errors from manual data entry.* | | | | | | |
| 1. Check a sample of the input data from each category (e.g., activity data, emission factors, uncertainty inputs) for transcription errors. | *June 30 2024* | *A. Smith* | *Y* | *July 2 2024* | *B. Johnson* | *1* |
| 1. Ensure that all activity data and conversion factors are entered with the appropriate number of significant figures or to the exact value. | *June 30 2024* | *A. Smith* | *N* | *July 2 2024* | *B. Johnson* | *NS* |
| 1. Check the integrity of database files. | | | | | | |
| 1. Confirm that the data processing steps are correctly represented in the database. | [Enter text] |  |  |  |  |  |
| 1. Confirm that data relationships are correctly represented in the database (e.g., if activity data are dependent on both geographical location and animal type, ensure the data relationship joins both of those parameters. Otherwise, duplicate or otherwise incorrect calculations could occur.) |  |  |  |  |  |  |
| 1. Ensure that data fields are properly labeled. |  |  |  |  |  |  |
| 1. Ensure that adequate and current documentation of database and model structure and operation are archived and accessible (see *Template 6. Archiving System*). |  |  |  |  |  |  |
| 1. Check that spreadsheet best practices are used to minimize user or data entry error, if using a spreadsheet for calculations.[[8]](#footnote-9) | | | | | | |
| 1. Confirm that the appropriate data processing steps are correctly represented in the spreadsheet. |  |  |  |  |  |  |
| 1. Check that common values/conversions/global warming potentials (GWPs) used in calculations are not hardcoded into cell formulas or code but rely on look up tables. |  |  |  |  |  |  |
| 1. Ensure each spreadsheet has clear instructions for how to update it and a description of how the spreadsheet works, such as inclusion of a table of contents. |  |  |  |  |  |  |
| 1. Ensure spreadsheets include a record of how they have been updated with the latest year(s) and QC checked. |  |  |  |  |  |  |
| 1. Perform a random check of cell formulas to ensure they are correct in each source sheet. |  |  |  |  |  |  |
| 1. Identify spreadsheet modifications that could provide additional controls or checks on quality. | | | | | | |
| 1. Review and ensure that any automatic checks and/or quality checks within the spreadsheets are clear (i.e. spreadsheets may include automated checks, such as computational checks to verify calculations, range checks for input data, mass balance checks, and internal consistency checks within and between spreadsheets). These procedures are transferrable to data compilations processes based on excel. If using R, Python or other tools, you may find ways to also automate and incorporate comparable quality checks. |  |  |  |  |  |  |
| 1. Ensure a consistent approach is used to identify cells with hardwired data, new or updated data, or draft data. |  |  |  |  |  |  |
| 1. Ensure that all data are clearly labeled, especially when not located in a table. |  |  |  |  |  |  |
| 1. Check that Confidential Data are appropriately protected. | | | | | | |
| 1. Check that only the inventory compilation team members who need access can access confidential data. |  |  |  |  |  |  |
| 1. Check that such data are reported in compliance with the agreed terms of the data provider (if applicable). |  |  |  |  |  |  |
| 1. **CHECKING CALCULATIONS** | | | | | | |
| 1. Check that emissions/removals are calculated correctly. | | | | | | |
| 1. Reproduce a representative sample of emissions/removals calculations and compare to reported values. | *June 28 2024* | *A. Smith* | *Y* | *July 4 2024* | *B. Johnson* | *2* |
| 1. Check whether emission units, parameters, and conversion factors are correct and appropriately hardwired. | | | | | | |
| 1. Check that units are properly labeled and correctly carried through from beginning to end in the calculation sheets and the completed Template 3. Methods and Data Documentation. |  |  |  |  |  |  |
| 1. Check that temporal and spatial adjustment factors are used correctly and documented. |  |  |  |  |  |  |
| 1. Check methodological and data changes that have occurred since the previous inventory cycle. | | | | | | |
| 1. Ensure any difference can be explained by the new data and/or methodology (if not consider confirming checks B.1-2 in this table were performed) |  |  |  |  |  |  |
| 1. Check for consistency in data between categories. | | | | | | |
| 1. Check those parameters (e.g., activity data, constants) common to multiple categories are identified clearly, including source files, and confirm that there is consistency in the values for these parameters in the emission/removal calculations. |  |  |  |  |  |  |
| 1. Check consistency of data when moving the data from one processing step to the next. | | | | | | |
| 1. Check that emissions/removals data are correctly aggregated from lower reporting levels (e.g., subcategory, category) to higher reporting levels (e.g., sector, inventory) when preparing summaries. |  |  |  |  |  |  |
| 1. Check that emissions/removals data are consistently transcribed between different intermediate products (i.e., drafts and the final report). If not, it could be a version control issue (i.e., reverting to a previous iteration) if values should not change between the inventory stages. |  |  |  |  |  |  |
| 1. Check that uncertainties in the data are calculated correctly and documented, including uncertainty inputs. | | | | | | |
| 1. Check that uncertainty estimates are complete and calculated correctly. |  |  |  |  |  |  |
| * 1. Duplicate uncertainty calculations on a small sample, if appropriate. |  |  |  |  |  |  |
| 1. Check time series consistency. | | | | | | |
| 1. Check for temporal consistency in time series input data for each category and the algorithm or method used for calculations throughout the time series. |  |  |  |  |  |  |
| 1. Check methodological and data changes resulting in recalculations, checking that the impact of recalculations is reported in NID. |  |  |  |  |  |  |
| 1. Check that the effects of mitigation activities, if occurring, have been appropriately reflected in time series calculations. |  |  |  |  |  |  |
| 1. Check data for completeness. | | | | | | |
| 1. Check that estimates are reported for all categories, depending on national circumstances, and for all years from the base year to the period of the current inventory. |  |  |  |  |  |  |
| 1. Check that definitions of any “Other” or country-specific categories are clear. |  |  |  |  |  |  |
| 1. Confirm NID includes a summary of completeness of inventory. |  |  |  |  |  |  |
| 1. If a category/subcategory is not estimated, check that documentation is provided in NID and Common Reporting (CRT) Table 9 to explain or clarify the omission, consistent with MPG paragraphs 30, 31 and 45. |  |  |  |  |  |  |
| 1. Check that explanation includes a quantitative evaluation of significance in relation to total net emissions has been performed and documented for subcategories or categories not estimated (or “NE”) consistent with MPGs paragraph 32. |  |  |  |  |  |  |
| 1. Check trends for consistency. | | | | | | |
| 1. For each category, compare current inventory emissions estimates to previous estimates at the most disaggregated level, if available (e.g., archived Template 3. Methods and Data Documentation). |  |  |  |  |  |  |
| * 1. If there are significant changes or departures from expected trends, and reasons for the differences are not documented, re-check estimates again and document any trend changes over the time series. Significant changes to trends may indicate possible input or calculation errors. |  |  |  |  |  |  |
| * 1. If the reason for differences is documented, confirm reasonableness and clarity. |
| 1. Check values of implied emission factors (aggregate emissions/removals divided by activity data) across time series and document changes. |  |  |  |  |  |  |
| 1. Check for any unusual or unexplained trends in activity data or other parameters across the time series. |  |  |  |  |  |  |
| 1. Check category level and/or gas emissions trends to ensure that calculations (as a whole and for the subcategories) are trending as expected. If they do not, consider check 7a above. If data is updated within a cycle recheck trends after implementing any data updates. . |  |  |  |  |  |  |
| 1. **DATA DOCUMENTATION** | | | | | | |
| 1. Confirm data sources are well-documented. | | | | | | |
| 1. Check that data references are properly cited in the NID (i.e., review citations for methodologies, activity data, and emissions data; see Template 3. Methods and Data Documentation). | [Enter text] |  |  |  |  |  |
| 1. Check that every data element has a reference for the source of the data (via cell comments or another system of notation). |  |  |  |  |  |  |
| 1. Check that all appropriate citations are complete (i.e., include all relevant information and full documentation to locate the reference). |  |  |  |  |  |  |
| * 1. Randomly check citations for transcription errors. |  |  |  |  |  |  |
| * 1. Randomly check citations for outdated URLs. |  |  |  |  |  |  |
| 1. Review internal documentation and archiving. | | | | | | |
| 1. Check that there is detailed internal documentation to support the estimates and enable duplication of calculations (see Template 3. Methods and Data Documentation). |  |  |  |  |  |  |
| 1. Check the archive for completeness, ensuring that all inventory data, supporting data, and inventory records (including draft and final inventory reports, CRTs) are archived and stored to facilitate detailed review (see Template 6. Archiving System). |  |  |  |  |  |  |
| * 1. Check that the archived data is securely retained. |  |  |  |  |  |  |
| * 1. Check if there are back-up records (e.g., in the cloud) and if they are stored in an accessible manner. |  |  |  |  |  |  |
| 1. Check the integrity of any data archiving arrangements of outside organizations involved in inventory preparation. |  |  |  |  |  |  |
| 1. Check that changes in data or methodology are documented. |  |  |  |  |  |  |
| 1. Check that any assumptions, expert judgement, and criteria for the selection of activity data, emission factors and other estimation parameters are documented and archived. | | | | | | |
| 1. Ensure descriptions of activity data and emission factors with information on categories and methodologies align with the *2006 IPCC Guidelines*. Ensure that these are properly documented within both the NID and CRTs, where applicable, and archived. |  |  |  |  |  |  |
| 1. Check that any assumptions applied are clearly stated as assumptions. Ensure that the rationale for the assumption includes the origin of the assumption (citation in NID, but inventory data documentation should record contact information (e.g., name, email, phone number, etc.)). |  |  |  |  |  |  |
| 1. For categories with multiple sources of activity data, check that selection of data is documented and that the reasons for any differences across datasets are noted (e.g. coverage, etc.). |  |  |  |  |  |  |
| 1. Confirm that the QA/QC and Verification discussion in the inventory report summarizes implementation of these procedures. | | | | | | |
| 1. In the NID, describe the type of checks that were completed. |  |  |  |  |  |  |
| 1. Ensure discussion of procedures implemented is consistent with the *2006 IPCC Guidelines*, including findings and corrective actions. |  |  |  |  |  |  |

### STEP 4: Complete Table 4-4 to establish sector/category-specific QC procedures for Sector/Category Leads to follow

Sector and category-specific QC procedures complement general inventory QC procedures and focus on the data and methodology used for an individual source and sink category. Completing these procedures requires sector/category-specific knowledge, including knowledge of the types of data available and the parameters associated with emissions or removals from a particular source.

Note: Countries should apply sector/category-specific QC procedures each year for key categories (see Template 5. Key Category Analysis) and for those individual categories in which significant methodological changes and/or data revisions have occurred in accordance with the *2006 IPCC Guidelines* and in accordance with national circumstances.

* Table 4-4 lists the sector/category-specific QC procedures that should be performed by inventory compilers. The procedures listed in this table are consistent with the *2006 IPCC Guidelines* Table 6.1[[9]](#footnote-10) and have been modified for clarity.
  + The **Procedures** column includes a description of procedures that could be completed as part of each QC activity. It may not be necessary to complete all of these procedures, but you are encouraged to complete as many QC checks as possible.
  + For each procedure, record the name or initials of the person responsible for completing the activity and the date of completion in the column **Procedure Completed**.[[10]](#footnote-11) Indicate “Y” under **Error (Y/N)** if errors are discovered while completing a QC procedure, and indicate “N” when no errors are found.
  + If the general QC procedure identifies an issue, document action was taken to correct the issue in the **Corrective** **Action** column.
  + In the Supporting Documents/Other Notes column, list any additional files that help to document the completion of general QC procedures, or notes needed to provide context to the actions taken, if not otherwise documented.
    - For example, separate documentation which explains corrective actions taken.
* Modify these activities and their associated procedures as needed and add more rows as necessary.
* Duplicate the table for as many categories as appropriate. More information about the types of sector/category-specific QC procedures that should be conducted can be found in the *2006 IPCC Guidelines* and the *2019 Refinement*.

Table 4-4 provides example text in *blue* to demonstrate how documentation of corrective actions or QC procedures may be referenced or presented. The example text uses notations (i.e., numbers and letters) to reference an *[Example] Sector-Specific Supporting Documentation List*, which summarizes the documents referenced within the table. Customize this approach or table to best suit your national circumstances.

For ease of reference the *[Example] Sector-Specific Supporting Documentation List* is below, but for the flow of your inventory documentation you may want to include this list after Table 4-4.

*[Example] Sector-Specific Supporting Documentation List:*

*NS = No specific supporting documentation other than that within the inventory worksheets.*

1. *Compare historical data (Excel File: Cars Workbook\_15Aug2024.xlsx, “Historical compare” worksheet)*
2. *Compare against published regional data using regional-method (Excel File: Compare Method update\_16Aug2024.xlsx)*

Table 4-4. Sector/Category-specific QC Procedures

| **Category code and name**: **[Insert sector, IPCC category/subcategory code, and category/subcategory name, E.g., “Energy: 1A3Bi Cars”]** | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Key category in the previous GHG inventory:  Record “Yes” if the **category** was a key category in the previous inventory, otherwise record “No”. | [Enter text] | | | | | | | |
| **Item** | **Procedure completed** | | **Corrective action (If applicable)** | | | | | **Supporting documents/other notes** |
| **Date** | **Name**  **(first initial, last name)** | **Errors (Y/N)** | | **Date** | **Name**  **(first initial, last name)** | |
| 1. **EMISSION DATA QUALITY CHECKS** | | | | | | | | |
| 1. Check emission comparisons: Historical data for categories and key subcategories. | | | | | | | | |
| 1. Compare emission estimates to results from previous inventories and review any unusual increases or decreases. Compare national-level estimates as well as category and subcategory estimates. | *August 15 2024* | *A. Smith* | *Y* | *August 21 2024* | | | *B. Johnson* | *1* |
| 1. Check trends against independent estimates of emissions and/or removals based on alternative methods to ensure changes since the previous inventory are reasonable. | *August 16 2024* | *A. Smith* | *Y* | *August 24 2024* | | | *B. Johnson* | 2 |
| 1. Check for completeness (if not implemented as general QC procedure, see checks B.8a-e in Table 4-3). |  |  |  |  | | |  |  |
| 1. **EMISSION FACTOR QUALITY CHECKS** | | | | | | | | |
| 1. Assess the representativeness of IPCC default emission factors, given national circumstances | | | | | | | | |
| 1. Evaluate the national conditions compared to the context of the studies upon which the IPCC default factors were based. | [Enter text] |  |  |  | | |  |  |
| 1. Check how emission factors compare to alternative factors (e.g., IPCC default, from/between other countries, literature, site- or plant-specific factors). Conduct research to determine whether there are more accurate/ representative emission factors in existence. Document results of this assessment. |  |  |  |  | | |  |  |
| 1. Review country-specific emission factors for robustness. | | | | | | | | |
| 1. Check the background data used to develop country-specific emission factors to assess adequacy of the emission factors and the QA/QC performed during their development. |  |  |  |  | | |  |  |
| 1. Assess whether secondary studies used to develop country-specific factors used at least general QC procedures. |  |  |  |  | | |  |  |
| 1. Conduct reference calculations that use stoichiometric ratios and conservation of mass and land. |  |  |  |  | | |  |  |
| 1. **EMISSION ESTIMATE AND MEASUREMENT CHECKS** | | | | | | | | |
| 1. Review emission estimates for robustness. | | | | | | | | |
| 1. Compare GHG estimates to other existing estimates (e.g., independently compiled national estimates), as available. | [Enter text] |  |  |  | | |  |  |
| 1. If using higher-tier methods or models, selectively reproduce model calculations with abbreviated calculations to judge relative accuracy. This could be done by applying lower-tier methods (e.g., energy sector comparison of reference and sectoral approach) and comparing the resulting estimates. |  |  |  |  | | |  |  |
| 1. Compare intensity indicators between countries for this category. |  |  |  |  | | |  |  |
| 1. Document verification findings and any further actions (e.g., additional QC, improvement plans in Table 4-7). |  |  |  |  | | |  |  |
| 1. Review emission measurements for robustness. | | | | | | | | |
| 1. Identify which variables rely on direct emission measurement. Ensure consistent units are used throughout calculations. |  |  |  |  | | |  |  |
| 1. Determine if national or international (e.g., ISO) standards were used in measurements. |  |  |  |  | | |  |  |
| 1. Check procedures used to measure emissions, including sampling procedures and maintenance. Ensure measurement equipment is calibrated and maintained properly. |  |  |  |  | | |  |  |
| 1. Confirm that uncertainties have been estimated and documented (if not implemented as general QC procedure, see checks B.6a in Table 4-3). |  |  |  |  | | |  |  |
| 1. **ACTIVITY DATA QUALITY CHECKS** | | | | | | | | |
| 1. Review national-level activity data for robustness. | | | | | | | | |
| 1. Perform comparisons between the activity data from the source currently in use and other existing sources of activity data (e.g., other independently compiled data). | [Enter text] |  |  |  | | |  |  |
| 1. Check applicability of data. Ensure that the activity data being used is the best available source of data. |  |  |  |  | | |  |  |
| 1. Determine the level of QC performed by the data provider. Adjust the relevant uncertainty accordingly and document findings. |  |  |  |  | | |  |  |
| 1. Check data supplier’s methodology for filling in time series for data that are not available annually. Check to make sure that the interpolation and extrapolation methods are consistent across sources, as appropriate. See Volume 1, Chapter 5 of 2006 IPCC GLs. |  |  |  |  | | |  |  |
| 1. Review trends in national activity data for consistency. | | | | | | | | |
| 1. Check historical trends. |  |  |  |  | | |  |  |
| 1. If activity data for any year diverges significantly from the historical trend, check for errors and document findings. If no errors are detected, document the reasoning for the deviation in trend. |  |  |  |  | | |  |  |
| 1. Review site-specific activity data for consistency. | | | | | | | | |
| 1. Check for inconsistencies across sites, as applicable. Review other sources of activity data to ensure that site-specific data is being reported accurately. |  |  |  |  | | |  |  |
| 1. Determine if national or international (e.g., ISO) standards were used in collecting or generating data. |  |  |  |  | | |  |  |
| 1. Compare aggregated site-specific data (e.g., production) to national statistics. |  |  |  |  | | |  |  |
| 1. Compare top-down and bottom-up estimates for similar orders of magnitude. |  |  |  |  | | |  |  |

### STEP 5: Establish QA activities for external expert reviewers and document comments in Table 4-5

Quality assurance (QA) involves review by experts not involved in preparing the inventory (i.e., external to inventory compilation) to provide an unbiased technical review of the inventory. QA activities complement QC activities and may vary based on national circumstances. A“basic expert peer review” involves an independent review of the calculations, methods, data, and assumptions by experts in the relevant technical fields who are not closely connected with the national inventory compilation process. Per the 2006 IPCC Guidelines and the MPGs (para. 35), countries should implement a basic expert peer review of all categories before finalizing the inventory, to the extent possible, so potential problems can be identified and addressed prior to submitting. Expert review offers the opportunity to uncover technical issues related to the application of methodologies, selection of activity data, and development and choice of emission factors.

The inventory agency may have procedures in place for implementing peer reviews of technical reports and data. If feasible as part of your inventory’s QA activities, the charge to reviewers should include broad questions (e.g., related to clarity and transparency) that invite detailed expert opinion, versus one-word answers, and should also include category-specific questions related to changes in methods and data incorporated since the previous inventory.

While experts are ideally independent of the inventory agency, they should be affiliated with other national agencies, research facilities, international organizations, or other organizations with relevant expertise in GHG emission estimation methodologies, activity data, or other parameters. If external experts or third-party reviewers are unavailable, staff from the inventory agency can fulfill this role and review portions of the inventory that they are not directly involved in compiling. In smaller countries, where there may not be external expertise in all technical areas, the inventory compiler could consider contacting inventory compilers from other countries as part of an external review.

To identify experts, Sector/Category Leads should provide recommendations for individual experts to review the inventory. Sector/Category Leads should also reach out to data-supplying agencies/organizations, national educational institutions, and research and trade associations for additional nominations.

The QA/QC Coordinator should work with the *National Inventory Coordinator* and Sector/Category Leads to develop a list of external reviewers that will participate in the QA process. The QA/QC Coordinator should update the list at the beginning of each inventory cycle.[[11]](#footnote-12)

* Resources that will aid in organizing an expert review can be found in the appendices. The QA/QC Coordinator Checklist (**Appendix 1**) includes steps for organizing and implementing a basic expert peer review. The Expert Review Elicitation Template (**Appendix 2**) is a template for communicating instructions to external experts to facilitate and focus their review. In Table 4-5, the QA/QC Coordinator should document comments from expert reviewers during the QA process.
  + For each row, include the external reviewer’s name, organization, area(s) of expertise and contact information.
  + In the **Comment** **Summary** column, summarize the experts’ recommendations regarding specific improvements that could be made to the inventory.
  + In the **Response Summary** column, summarize the Sector/Category Lead’s responses to the experts’ recommendations.
    - Reviewers’ comments should be reviewed and addressed by Sector/Category Leads, as appropriate, prior to the completion of the inventory. Comments and responses should be documented and archived to ensure transparency and for reference of future compilation teams.
* Key categories should be given priority for QA review (see *Template 5. Key Category Analysis* for more information on how to identify key categories), as well as categories where significant changes in methodology or data have been made.

Table 4-5. Comments from External Reviewers

| Name | Organization | Area of expertise | Sector/  category | contact information | Date comments received | Comment summary | Response summary |
| --- | --- | --- | --- | --- | --- | --- | --- |
| [Enter text] |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

### STEP 6: Use Table 4-6 to finalize, communicate, and implement the QA/QC plan

It is essential to communicate the contents of the QA/QC plan to inventory team members and external experts involved in the QA process for the GHG inventory so that the QA/QC activities and procedures can be effectively implemented. To maximize engagement, all stakeholders need to understand the importance of the QA/QC plan and how it relates to the inventory improvement plan (see *Template 7. National Inventory Improvement Plan*).

* In Table 4-6, the QA/QC Coordinator should develop a timeline for creating/updating and communicating the QA/QC plan. Modify the table and add rows as needed to accommodate additional activities, including interim steps needed to create, update, and distribute the QA/QC plan.
  + In the **Timeline** column, indicate the timeline for when the QA/QC activity will occur.
  + Use the **Outcome** and **Potential Improvements** columns to reflect on the implementation of the QA/QC activity and improve the communication of the QA/QC plan.

Table 4-6 provides example text in blue with a suggested timeline for communication and implementation of the QA/QC plan. The QA/QC Coordinator can refer to the following recommendations (as showcased in the example text) while developing and implementing the QA/QC plan.

* At the beginning of the inventory compilation cycle (i.e., during the inventory inception meeting with the entire inventory compilation team), introduce the current QA/QC plan and timeline to all team members and distribute QC checklists.
* The QA/QC Coordinator should regularly review the plan and modify it to reflect new processes, implement recommended improvements, and support the objectives of the inventory improvement plan (see *Template 7. National Inventory Improvement Plan).*
* Ensure that members of the inventory compilation team understand the purpose and outcomes of the QA/QC plan and update the plan as needed. Conduct an in-depth review of QA/QC responsibilities at the start of each cycle and provide reminders to team members at critical milestones (e.g. before first draft is due, during the review phase, etc.).

Table 4-6. Timeline of Communication and Implementation of the QA/QC Plan

| Activity | Timeline  (when the activity will occur) | Outcome  (description of the results of the activity) | Potential improvements  (how the activity may be modified to produce a better outcome) |
| --- | --- | --- | --- |
| Create or update the QA/QC plan | *Week 1-2 of Inventory Compilation* | *Updated, but difficult to retrace suggestions from the last inventory cycle.* | *Document suggested updates from the inception meeting in Template 7. National Inventory Improvement Plan immediately.* |
| Distribute the plan (including timeline) to each inventory compilation team member or external expert | *Week 4 of Inventory Compilation, coinciding with the inception meeting* | *Two inventory team members were unable to attend the meeting and did not receive the handout.* | *Consider if there is a standard, accessible web platform for all team members to access and reference as needed at any point of the inventory cycle.* |
| Engage with members of the inventory team and external experts to ensure procedures and purpose of the QA/QC plan is clear | *Week 4 of the Inventory Compilation* | *Inventory team members requested reminders about the critical milestones for the inventory cycle to stay on top of upcoming tasks.* | *Provide updates at every critical milestone. For next inventory cycle,*   * *Update at Week 12 (first draft due date)* * *Update at Week 20 (second draft due date)* * *Update at Week 26 (prior to final revisions)* |
| Perform QC Procedures | *Week 5 through Week 40* | *Compilers indicated it was difficult to find their email communications concerning the status of QC efforts between team members.* | *Encourage compilers to summarize QC documentation for different stages (e.g., activity data/date gathering, transcription, calculations, etc.) when they occur and, in a standard, accessible format for the team, rather than rely on email communications at the end of the inventory cycle.* |
| Carry Out QA Activities | *Week 20 during external expert review* | *External experts requested a reminder that the inventory cycle was beginning again.* | *At Week 4, send email outlining the steps and dates external experts can expect.* |

### STEP 7: Propose inventory improvements as a result of QA/QC activities in Table 4-7

An important part of QA/QC activities is to use the results of these activities to identify how to improve the quality of the inventory. The QA/QC Coordinator should keep a record of all corrective actions taken and how improvements have been implemented. The impacts of the improvements implemented to date should also be documented.

In **Table 4-7**, describe all corrective actions taken and improvements to the inventory that have resulted from QA/QC activities (Steps 3 through 5). The Sector/Category Leads should update this table as the inventory team completes tables 4-1 through 4-6. By completing this table while completing the rest of this template, you are less likely to have to revisit the template to reconstruct improvement ideas later.

* For the **Topic** column, identify a topic to categorize the potential improvement (e.g., institutional arrangements, methodology, activity data, QA/QC, communication, etc.). Add rows as necessary to include all potential improvements.
  + If the topic is related to a specific sector/category, record Energy, IPPU, Agriculture, LULUCF, or Waste followed by the **category code and** **name** (ex: 1A3Bi Cars); if it does not fall under a specific sector/category, record “Not applicable” or “N/A” in the category code and name column.
* The **Issue** column is where you should describe or justify why an improvement is needed.
* In the **Improvement Option** column, describe the action to be taken, and how it should resolve the issue.
* In the **Relevant Inventory Quality Principles column**, record which GHG inventory principle(s) that the improvement would address: transparency, accuracy, consistency, comparability, or completeness (i.e., TACCC).

When this table is complete, copy its contents into Template 7. National Inventory Improvement Plan.

Table 4-7. Potential Improvements to the GHG Inventory

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Topic | Category code and name | Issue | Improvement option | Relevant inventory quality principles |
| [Enter Text] |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

## Appendix 1: QA/QC Checklists

This section includes three checklists that may help the *National Inventory Coordinator* and QA/QC Coordinator track progress of the development of the overall QA/QC plan and implementation of QA/QC activities. Modify the checklists to suit national circumstances and inventory needs.

The checklists are:

1. QA/QC Coordinator Checklist
2. National Inventory Coordinator Checklist: Cross-Cutting Checks for Overall Inventory Quality
3. National Inventory Coordinator Checklist: Detailed Checklist for National Inventory Document (NID)
4. **QA/QC Coordinator Checklist**

The responsibilities of the QA/QC Coordinator include:

* Clarifying and communicating QA/QC responsibilities to GHG inventory members, ensuring that all QA/QC activities are covered.
* Developing, periodically reviewing, and updating the QA/QC plan.
* Developing a timeline for all QA/QC activities, deciding when external expert review will occur, and ensuring the timely and accurate completion of QA/QC checklists and related activities, such as a basic expert peer review.
* Coordinating external expert reviews of the GHG inventory and ensuring that recommendations are incorporated into the inventory, as appropriate.
* Ensuring that potential improvements to the inventory identified during the QA/QC process are implemented in the inventory improvement plan (see Template 7. National Inventory Improvement Plan).
* Managing and delivering documentation of QA/QC activities to the NIC and Archiving Coordinator (see Template 2. Institutional Arrangements and Template 6. Archiving System).

| Activities | Procedure Completed | |
| --- | --- | --- |
| Name | Date |
| 1. Communicate and clarify QA/QC responsibilities to inventory team members. | [Enter text] |  |
| 1. Develop QA/QC checklists appropriate to roles on the inventory team. (See Table 4-3 and Table 4-4 in this template for examples) |  |  |
| 1. Distribute QA/QC checklist to appropriate inventory team members. Set deadline(s) for completion. |  |  |
| 1. Ensure the timely and accurate completion of QA/QC checklists and related activities by checking in with team members at appropriate times in the inventory compilation cycle. |  |  |
| 1. Collect completed QA/QC checklists. |  |  |
| 1. Review completed QA/QC checklists for completeness and accuracy. |  |  |
| 1. Deliver documentation of QA/QC activities to the NIC and Archiving Coordinator. |  |  |
| 1. Coordinate the external expert review(s) of the GHG inventory and ensure that recommendations are incorporated into the inventory, as appropriate. Steps to coordinate external expert reviewers and inventory compilation team include:    1. Identify external expert reviewers (i.e., through category leads).    2. Set QA review schedule. Communicate schedule to inventory team.    3. Establish QA review format (i.e., digital mark-up in Word, enter comments in a spreadsheet).    4. Inform expert reviewers of the QA review schedule and expectations.    5. Work with NIC to distribute draft GHG inventory for review.    6. Collect and compile comments from expert reviewers.    7. Deliver compiled comments to NIC and Sector/Category Leads to address, as appropriate.    8. Incorporate comments into inventory improvement plan, as appropriate.    9. Deliver compiled comments and responses to Archiving Coordinator to retain in the GHG inventory archive. |  |  |

**2. National Inventory Coordinator Checklist: Cross-cutting Checks for Overall Inventory Quality**

| Activities | Procedure Completed | |
| --- | --- | --- |
| Name | Date |
| **Net Emission Calculations Across GHG Emission and Removal Categories** | | |
| 1. Identify parameters that are common across categories (e.g., conversion factors, carbon content coefficients) and check for consistency | [Enter text] |  |
| 1. Check that calculations using same data inputs (e.g., animal population data) report comparable values and units (e.g., analogous in magnitude) |  |  |
| 1. Check across categories that the same electronic data is used for common data (e.g., domestic population data, animal population data used for both enteric fermentation and manure management calculations, ensure nitrogen in manure applied to pasture, range, and paddock matches between manure management and agricultural soil management) |  |  |
| 1. Check that the number of significant digits or decimal places for common parameters, conversion factors, emission factors, or activity data is consistent across categories |  |  |
| 1. Check that net and gross total emissions are reported consistently (in terms of significant digits or decimal places) across categories |  |  |
| 1. Check that emission and removal data are correctly aggregated from lower reporting levels to higher reporting levels (e.g., including comparison with totals in CRTs and manual spot checks) |  |  |
| 1. Check that CO2-equivalent emissions for non-CO2 emissions are calculated using the correct 100-year GWPs (according to MPG para. 37, these GWPs are sourced from IPCC’s Fifth Assessment Report, excludes fossil methane). |  |  |
| 1. Check if there are significant changes or departures from expected trends. Ensure trends are clearly explained |  |  |
| 1. Other (specify): |  |  |
| **Documentation** | | |
| 1. Check for consistent internal documentation practices across categories |  |  |
| 1. Other (specify): |  |  |
| **CRT Alignment** | | |
| 1. Check that background data sheets estimates in CRTs align with NID |  |  |
| 1. Check that key category analysis aligns with NID, if using a country specific approach to disaggregating the analysis |  |  |
| 1. Check that impacts of recalculations are consistent with NID |  |  |
| 1. Check that method and emission factor notations are consistent with input files |  |  |
| **Completeness** | | |
| 1. Check that data gaps completeness issues across is are identified and reported as required for all categories over the time series, i.e., using appropriate notation keys |  |  |
| 1. Compare current national GHG inventory estimates with the estimates from previous inventory cycles |  |  |
| 1. Other (specify): |  |  |
| **Maintaining Master Inventory Files and Inventory Document** | | |
| 1. Check that file version control procedures were implemented (e.g., file naming conventions, etc.) |  |  |
| 1. Other (specify): |  |  |

**3. National Inventory Coordinator Checklist: Detailed Checklist for National Inventory Document (NID)**

| NID QC Checklist | Procedure Completed | |
| --- | --- | --- |
| Name | Date |
| **Front Section** | | |
| 1. Check that cover page has correct date, title, and contact information | [Enter text] |  |
| 1. Check that tables of contents, tables, and figures are accurate (i.e., titles match document, page numbers match; numbers run consecutively and have correct punctuation, document links are correct, etc.) |  |  |
| 1. Check that NID Executive Summary and Introduction Chapters are updated with appropriate years and discussion of trends |  |  |
| 1. Other (specify): |  |  |
| **Tables and Figures** | | |
| 1. Check that all tables and figures are updated with new data and show appropriate years |  |  |
| 1. Check that all values in tables match values in underlying data tools (e.g., spreadsheets, IPCC Inventory Software data base, etc.) |  |  |
| 1. Check that all tables have correct number of significant digits |  |  |
| 1. Check alignment in columns and labels |  |  |
| 1. Check that table formatting is consistent across NID |  |  |
| 1. Check that all figures are referenced in the text |  |  |
| 1. Check table and figure titles for accuracy and consistency with content |  |  |
| 1. Other (specify): |  |  |
| **Equations** | | |
| 1. Check for consistency in formatting of equations, where presented |  |  |
| 1. Check that variables used in equations are defined following the equation |  |  |
| 1. Other (specify): |  |  |
| **References** | | |
| 1. Check consistency of references, and that citations in text and references match |  |  |
| 1. Other (specify): |  |  |
| **General Format** | | |
| 1. Check that all acronyms are spelled out first time and not subsequent times throughout each chapter |  |  |
| 1. Check that all fonts in text, headings, titles, and subheadings are consistent |  |  |
| 1. Check that all highlights, editor notes, and comments are removed from document |  |  |
| 1. Check that size, style, and indenting of bullets are consistent |  |  |
| 1. Perform spelling and grammar check |  |  |
| 1. Other (specify): |  |  |
| **Other Issues** | | |
| 1. Check that each section is updated with current year (or most recent year that GHG inventory report includes) |  |  |
| 1. Other (specify): |  |  |

## Appendix 2: Expert Review Elicitation Template

This section includes suggested text for expert review elicitation. Modify the language to suit national circumstances and inventory needs. The text below can be used to instruct external experts to ensure a focused review, targeting both key categories and areas where methodological refinements have been implemented. To encourage clarity, you can duplicate this elicitation for each sector, tailoring the sector-specific questions, and send out to only those applicable sector experts. This complements guidance in *2006 IPCC Guidelines*, Volume 1, Chapter 2: Data Collection. As with other steps in Template 4. QA/QC procedures, customize, delete, or replace the blue text with your information to complete this template.

DATE: [insert]

TO: [insert]

FROM: [insert]

SUBJECT: Expert Review Process for [insert starting year of time series] – [insert last year of time series] Draft Inventory of [insert the name of your country]’s Greenhouse Gas Emissions and Removals

**Introduction**

Thank you for your interest in providing input during the expert review of the [insert starting year of time series] – [insert last year of time series] Draft Inventory of [insert the name of your country]’s Greenhouse Gas Emissions and Removals. You have been identified as an expert who may wish to submit comments on [insert sectors/categories to be reviewed]. Please note that the deadline for submitting comments is [insert the deadline by which review comments should be submitted].

Charge questions are included below to facilitate your review and indicate where input would be helpful. While these charge questions are designed to assist both reviewers and the inventory team in conducting a more focused expert review, we welcome comments outside the scope of the charge questions.

**Categories to be reviewed**

[Insert and clarify which sectors/categories are to be reviewed, ideally in the form of a bulleted list or table. In some cases, not all sectors/categories to be included in the inventory will be ready for review during the expert review period but ideally key categories and/or categories with changes should be included.]

**Relevant Updates**

[List the categories where methodological updates have been applied to be review, and summarize the updates in the following recommended format:

* Category Code – Category Name – Describe the update (e.g., new category included, moved to Tier 2 approach for activity data)
* Example: 3.A.3 – Enteric Fermentation – Moved swine subcategory to a Tier 2 approach (emissions from this category previously ranged from 2.3 to 3.1 MMT CO2 Eq. across the time-series and updated to 2.9 to 3.8 MMT CO2 Eq.)]

**Request for Expert Feedback for the [insert starting year of time series] – [insert last year of time series] [insert the sector to be reviewed] Chapter**

***General Questions***

1. Please provide your overall impressions of the transparency of [insert relevant sectors/categories].

2. Please provide any recommendations that [insert national GHG inventory agency] can consider to improve the completeness and/or accuracy of [insert relevant sectors/categories].

3. For the categories included in the expert review, are the national circumstances for [insert relevant sectors/categories] current and accurately described? Are there technologies, practices, or trends that [insert national GHG inventory agency] should consider?

***Sector Category-Specific Questions***

[List category specific questions. Examples are below*.*

1. With the inclusion of updated feed intake data, we request feedback on the overall chapter text, assumptions, and information on the state of the industry for the following category:

* Enteric Fermentation

2. Please provide input on:

* Data sources and industry information on number of head and type of swine (i.e., growing, finishing, breeding), preferably by subnational regions.
* Data on the current and historical diet composition (e.g., percent of crude protein, dry matter intake) for swine, preferably specific to growth stage and subnational region.
* Data or literature available measuring methane yield from swine.

3. We seek comments on assumptions applied to determine the split for subnational population data based on information published by the national statistical offices. Are other options or data sources available to distinguish more disaggregated population data?]

**Submitting Feedback**

We look forward to receiving your feedback. Please send comments and feedback to [insert staff member and/or email-address] by [insert due date based on national inventory compilation schedule to allow for consideration of feedback prior to submission, e.g. 30-90 days].

Please do not submit by email any information that may be confidential business information (CBI), proprietary information, or information that may otherwise be protected. If you wish to provide this type of information, please contact [insert staff member name and email-address] prior to providing protected information.

Please note that [insert national GHG inventory agency] may post submitted expert review comments without change and make expert reviewer names and credentials available online; however, individuals’ names will not be attributed to their comments.

## Revision History

January 2025: Updated template for consistency with ETF reporting guidelines, including updates to reflect *2006 IPCC Guidelines* and its *2019 Refinement* framework for implementing this analysis.

1. The EPA Toolkit for Building National GHG Inventory Systems is available at <https://www.epa.gov/ghgemissions/toolkit-building-national-ghg-inventory-systems>. [↑](#footnote-ref-2)
2. See 18/CMA.1, Modalities, Procedures and Guidelines (MPGs), Annex Chapter II, Section A. Definitions, Section C.6 Methods, and Section E.1 Reporting guidance for National Greenhouse Gas Inventory Report, available at <https://unfccc.int/sites/default/files/resource/CMA2018_03a02E.pdf>. If you have capacity constraints related to developing a QA/QC plan, this template may help address constraints and facilitate steps towards preparing a QA/QC plan consistent with future reporting requirements and the *2006 IPCC Guidelines*. [↑](#footnote-ref-3)
3. As noted in MPGs under the ETF (Decision 18/CMA.1), a basic peer review should be conducted to ensure adherence to the IPCC guidelines. [↑](#footnote-ref-4)
4. *2006 IPCC Guidelines* on QA/QC, available here: <https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_6_Ch6_QA_QC.pdf>. [↑](#footnote-ref-5)
5. Ensure these staff are familiar with the *2006 IPCC Guidelines* on QA/QC, available here: <https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_6_Ch6_QA_QC.pdf>. The *2019 Refinement to the 2006 IPCC Guidelines* has additional guidance that may be helpful, available here: <https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/1_Volume1/19R_V1_Ch06_QA_QC.pdf>. [↑](#footnote-ref-6)
6. See <https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_6_Ch6_QA_QC.pdf> [↑](#footnote-ref-7)
7. The United Kingdom government has issued a series of tools and guidance to help people improve the quality assurance of analytical models. The UK GHG inventory team uses elements of these. Other countries might like to consider if they could use these tools and guidance. They are available at <https://www.gov.uk/government/collections/quality-assurance-tools-and-guidance-in-decc>. [↑](#footnote-ref-8)
8. The guidance at <https://www.gov.uk/government/collections/quality-assurance-tools-and-guidance-in-decc> may prove useful. [↑](#footnote-ref-9)
9. See <https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_6_Ch6_QA_QC.pdf> [↑](#footnote-ref-10)
10. The UK government has issued a series of tools and guidance to help people improve the quality assurance of analytical models. The UK GHG inventory team uses elements of these. Other countries might like to consider if they could use these tools and guidance. They are available at <https://www.gov.uk/government/collections/quality-assurance-tools-and-guidance-in-decc>. [↑](#footnote-ref-11)
11. How this list is organized or updated can vary, but it is recommended to at least have the expert name (first and last, if appropriate), the agency/organization they are associated with, as well as an email address in three separate columns. You could also include a column that indicates the last time the contact information was verified. [↑](#footnote-ref-12)