CHAPTER 1

INTRODUCTION TO THE 2019 REFINEMENT

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1 INTRODUCTION TO THE 2019 REFINEMENT[1]

UPDATE OF CHAPTER 1 IN VOLUME 1 OF THE 2006 IPCC GUIDELINES AND NEW GUIDANCE IN THE 2019 REFINEMENT.

The *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 Guidelines)* were produced at the invitation of the United Nations Framework Convention on Climate Change (UNFCCC) to update the *Revised 1996 Guidelines and associated good practice guidance*[2] which provide internationally agreed[3] methodologies intended for use by countries to estimate greenhouse gas inventories to report to the UNFCCC.

It is important to recognize that the *2019 Refinement* provide only guidance for reporting which refers to the presentation of emission inventory estimates in the tables or other formats used to transmit inventory information but do not provide guidance for accounting which refers to the way the reported information is used to assess compliance with commitments.

This chapter provides an introduction to the *2019 Refinement* for a broad range of users, including countries and inventory compilers setting out to prepare inventory estimates for the first time. Sections 1.1 to 1.3 describe the overarching framework of these *Guidelines*, focusing on scope, approach, and structure. Sections 1.4 through 1.5 present step-by-step guidance on how to use the *2019 Refinement* for compiling a greenhouse gas inventory.

1.1 CONCEPTS

Update of Section 1.1 of the *2006 IPCC Guidelines*.

Inventories rely on a few key concepts for which there is a common understanding. This helps ensure that inventories are comparable between countries, do not contain double counting or omissions, and that the time series reflect actual changes in emissions.

The *2019 Refinement* provides supplementary *good practice* guidance for estimating and reporting anthropogenic greenhouse gas (GHG) emissions and removals resulting from land use, land-use change and forestry (LULUCF) activities in chapter 2 volume 4 intended to reduce the impacts of natural disturbances on trends capturing the impacts of human activities, building on chapter 2.3.5 of the *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol* (*KP Supplement*).

Anthropogenic emissions and removals

Anthropogenic emissions and removals means that greenhouse gas emissions and removals included in national inventories are a result of human activities. The distinction between natural and anthropogenic emissions and removals follows straightforwardly from the data used to quantify human activity. In the Agriculture, Forestry and Other Land Use (AFOLU) Sector, emissions and removals on managed land are taken as a proxy for anthropogenic emissions and removals, and inter-annual variations in natural background emissions and removals, though these can be significant, are assumed to average out over time.

National territory

National inventories include greenhouse gas emissions and removals taking place within national territory and offshore areas over which the country has jurisdiction. There are some special issues that are described in Section 8.2.1 of Volume 1. For example, emissions from fuel use in road transport is included in the emissions of the

[1] Note: Sections 1.1-1.4 and 1.6 will be updated in the second-order draft (SOD) to reflect refinements in other chapters.

[2] The Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (*1996 Guidelines*, IPCC, 1997), The Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (*GPG2000*, IPCC, 2000), and The Good Practice Guidance for Land Use, Land-use Change and Forestry (*GPG-LULUCF*, IPCC, 2003).

[3] See the Report of the Fourth Session of the Subsidiary Body for Scientific and Technological Advice (FCCC/SBSTA/1996/20), paragraph 30; decisions 2/CP.3 and 3/CP.5 (UNFCCC reporting guidelines for preparation of national communications by Parties included in Annex I to the Convention, part I: UNFCCC reporting guidelines on annual inventories), decision 18/CP.8, revising the guidelines adopted under decisions 3/CP.5, and 17/CP.8 adopting improved guidelines for the preparation of national communications from Parties not included in Annex I to the Convention, and subsequent decisions 13/CP.9 and decision 15/CP.10.

country where the fuel is sold and not where the vehicle is driven, as fuel sale statistics are widely available and usually much more accurate.

Inventory year and time series

National inventories contain estimates for the calendar year during which the emissions to (or removals from) the atmosphere occur. Where suitable data to follow this principle are missing, emissions/removals may be estimated using data from other years applying appropriate methods such as averaging, interpolation and extrapolation. A sequence of annual greenhouse gas inventory estimates (e.g., each year from 1990 to 2000) is called a time series. Because of the importance of tracking emissions trends over time, countries should ensure that a time series of estimates is as consistent as possible.

Inventory reporting

A greenhouse gas inventory report includes a set of standard reporting tables covering all relevant gases, categories and years, and a written report that documents the methodologies and data used to prepare the estimates. The *2006 Guidelines* provide standardised reporting tables, but the actual nature and content of the tables and written report may vary according to, for example, a country's obligations as a Party to the UNFCCC. The *2006 Guidelines* provide worksheets to assist with the transparent application of the most basic (or Tier 1) estimation methodology.

Greenhouse gases

The following greenhouse gases are covered in the *2006 Guidelines*[4]:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulphur hexafluoride (SF_6)
- nitrogen trifluoride (NF_3)
- trifluoromethyl sulphur pentafluoride (SF_5CF_3)
- halogenated ethers (e.g., $C_4F_9OC_2H_5$, $CHF_2OCF_2OC_2F_4OCHF_2$, $CHF_2OCF_2OCHF_2$)
- and other halocarbons not covered by the Montreal Protocol including CF_3I, CH_2Br_2 $CHCl_3$, CH_3Cl, CH_2Cl_2 [5]

The gases listed above have global warming potentials (GWPs) identified by the IPCC prior to finalisation of the *2006 Guidelines*. A GWP compares the radiative forcing of a tonne of a greenhouse gas over a given time period (e.g., 100 years) to a tonne of CO_2. The *2006 Guidelines* also provide methods for gases for which GWP values were not available prior to finalisation, i.e., $C_3F_7C(O)C_2F_5$, C_7F_{16}, C_4F_6, C_5F_8 and c-C_4F_8O.

These gases are sometimes used as substitutes for gases that are included in the inventory and countries are encouraged to provide estimates for them.

Other gases

The *2006 Guidelines* also provide information for the reporting of the following precursors: nitrogen oxides (NO_x), ammonia (NH_3), non-methane volatile organic compounds (NMVOC), carbon monoxide (CO) and sulphur dioxide (SO_2) although methods for estimating emissions of these gases are not given here.

Sectors and Categories

Greenhouse gas emission and removal estimates are divided into main sectors, which are groupings of related processes, sources and sinks:

- Energy
- Industrial Processes and Product Use (IPPU)

[4] The halogenated gases are typically emitted in smaller amounts than CO_2, CH_4 and N_2O, but may have long atmospheric lifetimes and strong radiative forcing effects.

[5] For these gases, emissions could be estimated following the methods described in Section 3.10.2 of Volume 3 if necessary data are available, and then could be reported under sub-category 2B10 'Other'.

- Agriculture, Forestry and Other Land Use (AFOLU)
- Waste
- Other (e.g., indirect emissions from nitrogen deposition from non-agriculture sources[6])

Each sector comprises individual categories (e.g., transport) and sub-categories (e.g., cars). Ultimately, countries will construct an inventory from the sub-category level because this is how IPCC methodologies are set out, and total emissions calculated by summation. A national total is calculated by summing up emissions and removals for each gas. An exception is emissions from fuel use in ships and aircraft engaged in international transport which is not included in national totals, but is reported separately.

In order to calculate a national total it is necessary to choose an approach to include harvested wood products (HWP). Countries can select any of the approaches reflected in Chapter 12 of Volume 4 for the AFOLU Sector to do this.

Reporting is generally organised according to the sector actually generating emissions or removals. There are some exceptions to this practice, such as CO_2 emissions from biomass combustion for energy, which are reported in AFOLU Sector as part of net changes in carbon stocks. Where CO_2 emissions are captured from industrial processes or large combustion sources, emissions should be allocated to the sector generating the CO_2 unless it can be shown that the CO_2 is stored in properly monitored geological storage sites as set out in Chapter 5 of Volume 2.

1.2 ESTIMATION METHODS

As with the *1996 Guidelines* and *IPCC Good Practice Guidance* the most common simple methodological approach is to combine information on the extent to which a human activity takes place (called *activity data* or *AD*) with coefficients which quantify the emissions or removals per unit activity. These are called *emission factors (EF)*. The basic equation is therefore:

$$Emissions = AD \bullet EF$$

For example, in the energy sector fuel consumption would constitute activity data, and mass of carbon dioxide emitted per unit of fuel consumed would be an emission factor. The basic equation can in some circumstances be modified to include other estimation parameters than emission factors. Where time lags are involved, due for example to the time it takes for material to decompose in a landfill or leakage of refrigerants from cooling devices, other methods are provided, for example first order decay methods. The *2006 Guidelines* also allow for more complex modelling approaches, particularly at higher tiers.

Though this simple equation is widely used, the *2006 Guidelines* also contain mass balance methods, for example the stock change methods used in the AFOLU sector which estimates CO_2 emissions from changes over time in carbon content of living biomass and dead organic matter pools.

Carbon dioxide from the combustion or decay of short-lived biogenic material removed from where it was grown is reported as zero in the Energy, IPPU and Waste Sectors (for example CO_2 emissions from biofuels[7,8], and CO_2 emissions from biogenic material in Solid Waste Disposal Sites (SWDS)). In the AFOLU Sector, when using Tier 1 methods for short lived products, it is assumed that the emission is balanced by carbon uptake prior to harvest, within the uncertainties of the estimates, so the net emission is zero. Where higher Tier estimation shows that this emission is not balanced by a carbon removal from the atmosphere, this net emission or removal should be included in the emission and removal estimates for AFOLU Sector through carbon stock change estimates. Material with long lifetime is dealt with in the HWP section.

IPCC methods use the following concepts:

Good Practice: In order to promote the development of high quality national greenhouse gas inventories a collection of methodological principals, actions and procedures were defined in the previous guidelines and collectively referred to as *good practice*. The *2006 Guidelines* retain the concept of *good practice* including the definition introduced with *GPG2000*. This has achieved general acceptance amongst countries as the basis for

[6] Estimates include N_2O emissions from deposition of anthropogenic nitrogen (N) from NO_x/NH_3 wherever deposited and from whatever source (but not allocated to specific sectors). The reason for this is that emission factors for nitrogen deposited are of the same magnitude for agricultural sources as for other nitrogen sources, even when the N is deposited in the ocean.

[7] CO_2 emissions from the use of biofuels should be reported as an information item for QA/QC purposes.

[8] In these guidelines peat is assumed *not* to be a biofuel.

inventory development and says that inventories consistent with *good practice* are those which *contain neither over- nor under-estimates so far as can be judged, and in which uncertainties are reduced as far as practicable.*

Tiers: A *tier* represents a level of methodological complexity. Usually three tiers are provided. Tier 1 is the basic method, Tier 2 intermediate and Tier 3 most demanding in terms of complexity and data requirements. Tiers 2 and 3 are sometimes referred to as *higher tier* methods and are generally considered to be more accurate.

Default data: Tier 1 methods for all categories are designed to use readily available national or international statistics in combination with the provided default emission factors and additional parameters that are provided, and therefore should be feasible for all countries.

Key Categories: The concept of *key category*[9] is used to identify the categories that have a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions and removals, the trend in emissions and removals, or uncertainty in emissions and removals. *Key Categories* should be the priority for countries during inventory resource allocation for data collection, compilation, quality assurance/quality control and reporting.

Decision Trees: Decision trees for each category help the inventory compiler navigate through the guidance and select the appropriate tiered methodology for their circumstances based on their assessment of *key categories.* In general, it is *good practice* to use higher tier methods for *key categories*, unless the resource requirements to do so are prohibitive.

1.3 STRUCTURE OF THE GUIDELINES

Volumes: The *2006 IPCC Guidelines* contain 5 volumes, one for each sector (Volumes 2-5) and one for general guidance applicable to all sectors (Volume 1).

- Volume 1: General Guidance and Reporting
- Volume 2: Energy
- Volume 3: Industrial Processes and Product Use (IPPU)
- Volume 4: Agriculture, Forestry and Other Land Use (AFOLU)
- Volume 5: Waste

This five-volume structure means the cross referencing will be required between two volumes at most: Volume 1 (General Guidance and Reporting), and the relevant sectoral volume.

Chapters: Volume 1 contains chapters that provide detailed cross-cutting guidance by topic as described in more detail in Section 1.5. Volumes 2-5 contain chapters that provide methodological guidance for specific emission and removal categories, along with specific recommendations for uncertainty, QA/QC, time series consistency, and reporting. The volume and chapter structure is presented in Table 1 in the Overview of the *2006 Guidelines*.

Annexes: Annexes are intended to include additional often detailed information beyond what is necessary for a Tier 1 estimate, for example extended data tables.

Appendices: The *2006 IPCC Guidelines* present some technical material in appendices, where emissions or removals are poorly understood and where there is insufficient information available to develop reliable, globally applicable, default methods for a particular source or sink. Countries may use appendices as a basis for further methodological development, but a national inventory can be considered complete without the inclusion of estimates for these sources.

Worksheets: Worksheets are tools designed to provide easy calculation of Tier 1 methodologies. Worksheets are not provided for higher tiers, although they can also be used where the higher tier method is similar to Tier 1 (e.g., where national data is used instead of default data). Some more complex approaches are provided in spreadsheets in the attached CD.

Reporting Tables: The reporting tables are intended to give sufficient detail required for transparent reporting of national greenhouse gas inventories and follow a disaggregated category list. They include summary tables, sectoral tables, background tables and trend tables. The background tables include summary activity data for increased transparency and to facilitate comparison of data across countries. Reporting tables also include results

[9] Chapter 4 of Volume 1 provides more details of *key categories* and approaches to identifying *key categories* for national inventories.

of a *key category* analysis and uncertainty assessment. Reporting also includes memo items (emissions to be reported but not included in national totals) and information items for increased transparency.

1.4 INVENTORY QUALITY

These *guidelines* provide guidance on ensuring quality on all steps of the inventory compilation – from data collection to reporting. They also provide tools to focus resources on the areas where they will most benefit the overall inventory and encourage continuous improvement. Experience has demonstrated that using a *good practice* approach is a pragmatic means of building inventories that are consistent, comparable, complete, accurate and transparent – and maintaining them in a manner that improves inventory quality over time. Indicators of inventory quality are:

Transparency: There is sufficient and clear documentation such that individuals or groups other than the inventory compilers can understand how the inventory was compiled and can assure themselves it meets the *good practice* requirements for national greenhouse gas emissions inventories. Documentation and reporting guidance is provided in Chapter 8, Reporting Guidance and Tables, of Volume 1 and in the respective chapters of Volume 2-6 (see also Volume 1, Chapter 6, QA/QC and Verification).

Completeness: Estimates are reported for all relevant categories of sources and sinks, and gases. Geographic areas within the scope of the national greenhouse gas inventory are recommended in these *Guidelines*. Where elements are missing their absence should be clearly documented together with a justification for exclusion (see Volumes 2-5).

Consistency: Estimates for different inventory years, gases and categories are made in such a way that differences in the results between years and categories reflect real differences in emissions. Inventory annual trends, as far as possible, should be calculated using the same method and data sources in all years and should aim to reflect the real annual fluctuations in emissions or removals and not be subject to changes resulting from methodological differences. (See Chapter 2: Approaches to Data Collection, Chapter 4: Methodological Choice and Identification of Key Categories, and Chapter5: Time Series Consistency in Volume 1.)

Comparability: The national greenhouse gas inventory is reported in a way that allows it to be compared with national greenhouse gas inventories for other countries. This comparability should be reflected in appropriate choice of key categories (see Volume 1, Chapter 4), and in the use of the reporting guidance and tables and use of the classification and definition of categories of emissions and removals presented in Table 8.2 of Chapter 8, and Volumes 2-5.

Accuracy: The national greenhouse gas inventory contains neither over- nor under-estimates so far as can be judged. This means making all endeavours to remove bias from the inventory estimates (see especially Chapter 2, Approaches to Data Collection, and Chapter 3, Uncertainties, in Volume 1 and Volumes 2-5).

Uncertainty assessment (details provided in Chapter 3 of Volume 1) is an important component of *good practice* in national greenhouse gas inventory development. The uncertainty analysis characterises the range and likelihood of possible values for the national inventory as a whole as well as for its components. Awareness of the uncertainty of parameters and results provides inventory compilers with insight when evaluating suitable data for the inventory during the data collection and compilation phases. Uncertainty assessment also helps identify the categories that contribute most to the overall uncertainty, which helps the inventory compiler prioritise future inventory improvements.

The *2006 Guidelines* encourage continuous improvement and rigor through QA/QC and verification activities. A number of concepts and tools in Chapter 6 in Volume 1 are provided to support efficient inventory management, checking and continuous improvement. These activities will ensure that the best use of limited resources can be made and a quality consistent with *good practice* is achieved for each inventory.

Regular communication and consultation with providers of data is recommended throughout the inventory activities (from data collection to final reporting). This communication will build working relationships between data supplier and inventory compilers that will benefit the inventory both in terms of efficiency and quality. This activity will also help to keep the inventory compilers informed of the development of new datasets and even provide opportunities to influence the planning and specifications of data provider's data collection activities.

1.5 NATIONAL INVENTORY MANAGEMENT SYSTEMS

New guidance in section 1.5 of the *2019 Refinement*. It provides guidance on the development, improvement and maintenance of national GHG inventory management systems and highlights the importance of such institutional systems in the inventory compilation process.

This guidance is not intended to be prescriptive. It instead provides examples which illustrate the typical components of a management system and practical guidance on tools and approaches.

It is *good practice* for the national GHG inventory compilation process to be managed through a recognised, supported, and sustainable institutional system.[10] Such a GHG inventory management system includes the processes and expertise involved in the compilation inventory data and reports. It is a tool with which a country can track trends in emissions/removals and understand the performance of mitigation measures.

A national inventory management system can support:

- **Efficient inventory updates** (e.g. annual or biennial updates);
- **Increased quality**[11] **and availability of data and reporting**, including the detail needed by national decision makers and stakeholders engaged in mitigation measures.

1.5.1 Institutional Arrangements

This Section introduces the concept of institutional arrangements and its typical components with respect to national GHG inventories. It provides guidance on identifying appropriate components in keeping with the inventory's intended uses. This section also provides examples of typical types of stakeholders and their roles and responsibilities.

Institutional arrangements includes the interactions between organisations that oversee and contribute to GHG inventory outputs. Institutional arrangements are country-specific and tailored to the competencies and capacities within governments (e.g. environment, energy, agricultural, and statistical ministries), academic/research institutions, and private organisations and consultants.

1.5.1.1 SCOPE AND MANDATE

The scope and mandate of a country's institutional arrangements for national GHG inventories describes what is included in a country's GHG inventory, why the GHG inventory is needed and timeframes for the inventory compilation process. More specifically:

> **Scope**: Summarizes what sectors, gases, and data need to be included in the GHG inventory and the updating frequency. The scope should define the time-series duration, gases, sectors, and categories to be included as well as schedule for GHG inventory compilation, preparation, approval, and release.
>
> **Mandate**: Summarizes the reasons for compiling the GHG inventory (e.g. UNFCCC reporting commitments, national policy making, stakeholder engagement, and/or mitigation performance tracking). The mandate should justify the chosen scope of the inventory.

A simple scope and mandate table can compliment more detailed descriptions. A suggested table for capturing and sharing scope and mandate information is presented in Table 1.1. An illustrative example constructed around the United Kingdom's GHG inventory scope and mandate is presented in Table 1.2.

[10] Formally and legally *recognised* by the national government as the official reference for national GHG emissions and removal data. *Supported* with sufficient resources to complete the work of preparing GHG inventories to meet the country's chosen needs and agreements. The institutional arrangements for preparing inventories are *sustainably* organized so that the work of preparing GHG inventories can be performed in a continuous manner into the future.

[11] Transparency, accuracy, completeness, consistency and comparability.

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TABLE 1.1 A SUGGESTED TABLE FOR CAPTURING AND SHARING INFORMATION ON THE SCOPE AND MANDATE				
Scope	**Mandates a-n (Country specific requirements for compilation and reporting)**			
	Mandate A	**Mandate B**	**Mandate C**	**Mandate D**
Gases/Pollutants				
CO_2, CH_4, N_2O				
F-gases				
Other gases				
Sectors				
Energy, IPPU, Agriculture, Waste, LULUCF				
Other sectors				
Time series				
Time steps				
Start and end year				
Reporting/update				
Frequency				
Formats				

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TABLE 1.2
ILLUSTRATIVE SCOPE AND MANDATE TABLE FOR UK REPORTING AND MRV REQUIREMENTS ASSOCIATED WITH ITS GHG INVENTORY

Scope	**Mandates**					
	UNFCCC: Annual Reporting[12]	**UNFCCC: National Communication and Biennial Report**	**UNFCCC: Nationally Determined Contributions**[13]	**EU Monitoring Mechanism Regulation**[14]	**National Carbon Budgets**[15]	**National Statistics Environmental Accounts**[16]
Gases/Pollutants						
CO_2, CH_4, N_2O	Yes	Yes	Yes	Yes	Yes	Yes
F-gases	Yes	Yes	Yes	Yes	Yes	Yes
Precursors (SO_2, NO_x, CO, NMVOC)	Yes	Yes	No	Yes	No	Yes
Sectors						
Energy, IPPU, Agriculture, Waste	Yes	Yes	Yes	Yes	Yes	Yes
LULUCF	Yes	Yes	No	Yes	Yes	Yes
Time series						
Yearly values 1990 to latest year -2	Yes	Yes	Yes	Yes	Yes	Yes
Projections: 5 yearly steps, latest inventory year to 2040	No	No	Yes	Yes	Yes	No
Reporting						
Frequency	Annual	Biennial	5 Years	Annual	Annual	Annual
Formats	CRF17	CRF: Summary table 2	CRF: Summary table 2	CRF	Carbon Budget	Environmental Accounts[18]

290 Note: Many well-established GHG inventories are compiled in tandem with national air pollutant inventories. This integration can provide
291 efficiencies as a large proportion of the activity data is the same for both. It may also improve linkages (through consistent use of data)
292 between climate mitigation and air quality policies and measures and help inform decision makers of co-benefits and potential conflicts. It
293 may be worth considering pooling resources, management systems for both GHG and air pollutant inventories.

[12] http://unfccc.int/documentation/documents/advanced_search/items/6911.php?priref=600007789#beg.

[13] Article 4(9) of the Paris Agreement http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf (UK is currently part of the EU Burden Sharing Agreement).

[14] UK reporting commitments to the EU: https://ec.europa.eu/clima/policies/strategies/progress/monitoring_en.

[15] https://www.gov.uk/guidance/carbon-budgets.

[16] https://www.ons.gov.uk/economy/environmentalaccounts.

[17] http://unfccc.int/national_reports/annex_i_ghg_inventories/reporting_requirements/items/2759.php.

[18] https://www.ons.gov.uk/economy/environmentalaccounts.

1.5.1.2 THE SINGLE NATIONAL ENTITY

The term "single national entity" (SNE) is often used to refer to the lead organisation with the responsibility for reporting official national GHG estimates. It is often aligned with the national focal point or international point of contact on GHG emissions and removals reporting. The role of SNE is usually taken on by a government ministry with mandate to manage the country's GHG inventory reporting. The role of SNE is sometimes delegated via nationally appropriate mandates/terms of reference to a relevant environmental or statistical agency with the powers to prepare official national reports.

1.5.1.3 THE INVENTORY AGENCY

The technical co-ordination of the GHG inventory data needs to be undertaken by a competent team. Some examples for engaging these technical competencies include:

- **A government ministry SNE acts as the inventory agency**. The role of the inventory agency can be implemented by a government ministry SNE if it has the appropriate coordination and technical capacity.
- **A national agency/statistical office acts as the inventory agency.** The coordination and technical compilation is delegated to a competent agency (e.g. statistics, meteorological, or environmental science). Such an agency is typically focused on providing technical support and analysis to government officials for decision making and reporting. It will often have expertise on certain sectors and access to some of the datasets needed for the compilation and will then outsource other data gathering and compilation for other sectors (e.g. forestry and LULUCF to forest agencies or institutions).
- **A private company, university or other non-government organisation acts as the inventory agency**. The coordination and technical compilation is contractually delegated to an organisation outside of government, such as a university, research institute, or a consultancy/private company. This organisation is selected for its technical competency and capacity to provide or assemble the team for the compilation and reporting of the inventory. Contracts are typically set-up with well-defined deliverables and quality objectives [19] and commitments to engage the organisation over a suitable period of time (e.g. 3 to 5 years) to promote the sustained development and maintenance of the GHG inventory. Provisions should be in place for the potential transfer of systems, tools, and knowledge from the contracted organisation to the SNE or new contracting organisation at the end of the contract period.

1.5.1.4 NATIONAL GHG INVENTORY TECHNICAL STEERING COMMITTEE

To support national processes for approving GHG inventory estimates and documentation, countries may establish a national GHG inventory technical steering committee. This body can be also convened in support of prioritisation and implementation of sectoral improvements of the inventory.

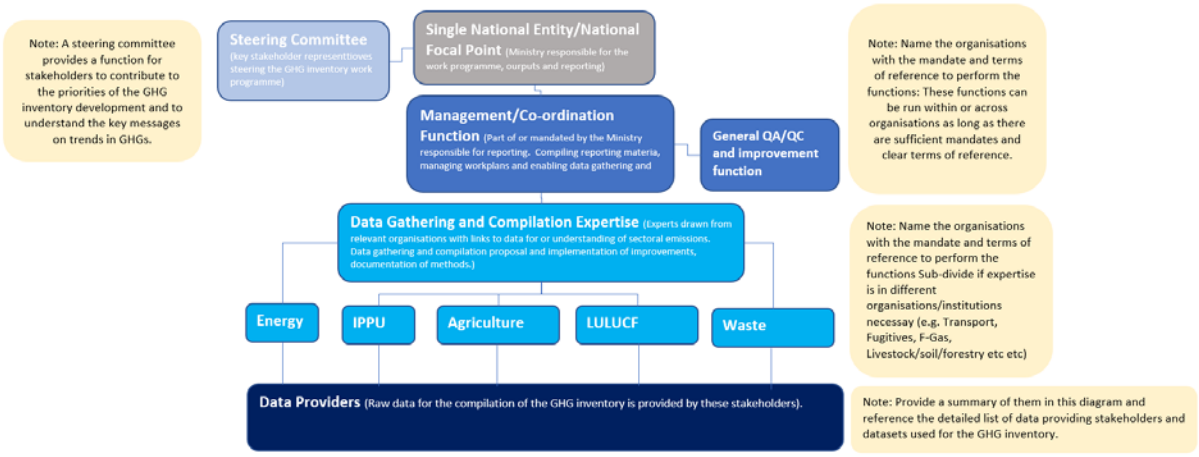
This committee can consist of stakeholders representing users of and data providers to the national inventory (research agencies, national statistical organisations, environmental agencies, education academic institutions, industrial trade associations, and consultancies). It can provide a forum for the SNE to gather these stakeholders to coordinate and inform GHG inventory activities and to secure data provision and independent analysis.

1.5.1.5 ORGANIZATIONAL STRUCTURE

A defined organisational structure helps formalise and communicate the functional roles of organisations and groups of organisations in the national inventory compilation process. A defined organisational structure provides stakeholders with an overview of organisational roles and responsibilities to elaborate terms of reference and guide the allocation of resources to preform inventory work. A generic organisational structure is illustrated in Figure 1.1.

[19] Linked to the quality principals (TCCCA referred to in Volume 1).

Figure 1.1 Illustrative GHG inventory organizational structure



This structure could be elaborated with organisation names.

Each organizational contributor to the inventory management system may have some form of terms of reference that specifies its functional role and responsibilities (e.g. inventory compilation, expert input, tool development and use, and/or data collection) and the schedule for conducting this work. Existing terms of reference for duties such as environmental data gathering or industrial reporting may be revised to address GHG inventory responsibilities.

Countries may consider the need for new or modified laws or directives establishing requirements for GHG data collection, reporting, and quality management to formalize mandates for national GHG inventory processes.

A detailed overview of stakeholder roles and responsibilities for data gathering, compilation, QA/QC, reporting and improvement functions and the identification of critical tools and services are elaborated below.

1.5.1.6 STAKEHOLDER ROLES AND RESPONSIBILITIES

There are a large number of stakeholders involved with and/or interested in GHG inventory outputs. Typical types of stakeholders are presented in Table 1.3. Managing the interests, contributions and involvement of these stakeholders is critical for a long term functional national inventory management system.

TABLE 1.3
LIST OF STAKEHOLDER TYPES WITH THEIR GENERAL ROLES AND CAPABILITIES NEEDED TO FUNCTION

STAKEHOLDER Type	TYPICAL ROLES	NECESSARY Capabilities
Single National Entity (SNE) /National Focal Point	Acquisition and allocation of resources Long-term strategy for support to national decision makers, negotiations, climate action and reporting to stakeholders and UNFCCC Arranging contacts and agreements with collaborating entities that contribute data, research studies, estimate emissions or provide expert reviews, etc. Formal Submission of GHG inventory for National Communications (NC), Biennial Update Reports (BUR), Nationally Determined Contributions (NDCs)	Technical and administrative expertise, as well as formal government authority Understanding of the UNFCCC reporting requirements and IPCC good practice concepts Capacity to coordinate and lead the process Authority to engage other government departments and non-government organisations
Steering Committee: Note: A steering committee provides a function for a wide range of stakeholders to contribute to the	Provide input to overall planning, coordination, management and technical facilitation of inputs and outputs in the process, advisors to the National Focal Point	Sectoral, dataset and/or government policy involvement/awareness and authorities Involved with policy and decision making and negotiations (e.g. on target setting and

priorities of the GHG inventory development and to understand and disseminate the key messages on trends in GHGs	Advice on choice of methods with regard to data availability and decision making needs	mitigation implementation) that uses the GHG inventory data
Management/Coordination & General QA/QC	Management of contracts and delivery of workplans Coordination with all stakeholders Management of experts Management of data supply and data supply agreements Identification of resources necessary to improve data flows Coordination of reviews and responses to independent review/analysis and tracking of recommendations Technical Submission of GHG inventory for National Communications (NC), Biennial Update Reports (BUR), Nationally Determined Contributions (NDCs)	Project Management & team management QA/QC Technical knowledge of the UNFCCC reporting requirements, UNFCCC review processes and IPCC methodologies Some technical awareness of tools and systems for gathering and reviewing data
Compilation (Sector) Experts • Energy • IPPU • Agriculture • LULUCF • Waste	Overall data gathering, compilation and document management Identify and propose ways to resolve cross cutting issues Undertake research, data collection, calculations, drafting, quality control, archiving, and documentation Coordinate with other sector experts to identify and resolve cross sectoral issues Specialist in a sector or group of categories	Technical knowledge of the UNFCCC reporting requirements and IPCC methodologies Technical skills to carry out the work required for the GHG inventory calculation (data analysis, QA/QC, calculations, documentation) Specific national sectoral or sub-sectoral knowledge of practices and technologies employed, data sources, trade associations, networks, policies and key assumptions
Data Providers	Timely delivery of input data in appropriate format Management of data acquisition, processing and reporting systems, QA/QC requirements Communication with SNE	Technical skills/knowledge of, legal authority to improve and enhance data collection
Other contributors and users	General interest in the work with provision of expertise, independent review or use of the data for other purposes	Any
Policy users	GHG inventory data users that inform policies and feed into climate action analysis	Any

The process of stakeholder management is country-specific. However, there two useful steps for the coordination and management of stakeholders.

- **List of Stakeholders**: The first is to maintain a list of all relevant stakeholders with their contact details, roles and responsibilities, and mandate. This list will complement the definition of an organizational structure. The list could include details on:

1. stakeholders name;
2. organization affiliation;
3. contact details;
4. mandate/terms of reference to contribute to the GHG inventory (if any);

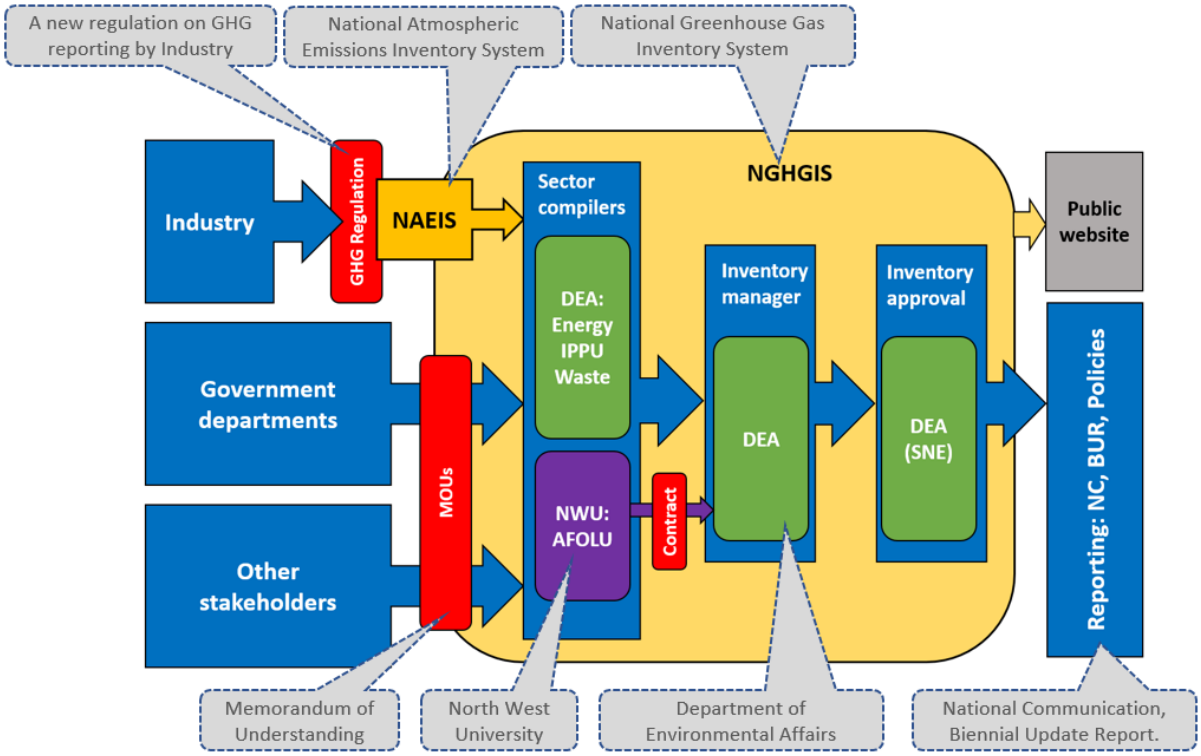
5. engagements to date;
6. sectors/categories involved with;
7. type of involvement (e.g. as a data provider, data user, compilation expert etc).

This listing of stakeholders and their relationship with GHG inventory activities contributes to an institutional memory for national GHG inventory management system. Inventory activities can include steering committee meetings, training sessions, sectoral workshops, compilation and reporting activities, consultations and reviews, etc.

1.5.2 Datasets and data flows

There are numerous datasets needed for GHG inventory compilation and many stakeholders who provide them. Approaches for data collection are provided in Chapter 2. Mapping the "flow" of data, in the form of a diagram, from data collection to final reporting further documents the inventory complication process. And illustrative example of such a diagram is provided in Figure 1.2.

Figure 1.2 Illustrative data flow overview diagram example for South Africa



More detailed data flows for specific datasets, sectors, or categories can also help document the process and build institutional memory.

1.5.2.1 List of datasets

A centralised list of datasets, contributed to by sector experts and managed by the GHG inventory coordinator, can also build institutional memory and support compiling regular updates. A list of datasets will typically include:

- unique name;
- status (received or pending receipt);
- description;
- reference to a relevant data supply agreement;
- location of the data;
- stakeholder supplying (from list of stakeholders above);
- sectors/categories of relevance;
- update frequency.

1.5.2.2 DATA SUPPLY AGREEMENTS (DSA'S)

Chapter 2 on data collection refers to the establishment of agreements formalising data supply. A data supply agreement (DSA) is a document that defines what data, from whom, to whom, and when it will be supplied for GHG inventory compilation. Ideally, a DSA is agreed between the GHG inventory SNE and the data supplier stakeholder.

There are many potential DSA formats. Where there are national laws for data supply, these can be referenced. Where data supply is less formal, DSAs act as an informal specification. Suitable examples of DSAs can be found in many of the countries that are Annex I Parties to the Kyoto Protocol.

DSAs will typically address the following elements:

- **background** on the needs/mandate for the GHG inventory compilation;
- **reference** to laws/terms of reference and any co-operation the data supplier and the GHG inventory activity;
- **objectives** of the agreement with reference to an annex specifying the details;
- **confidentiality** commitments;
- **signatures** of GHG inventory representative and data supplier, if appropriate;
- **technical Annex** containing details of the data to be supplied including:
  - (i) unique Title of the dataset (so there is no confusion with other datasets);
  - (ii) confidentiality flags;
  - (iii) description including format (electronic format) and scope (time-series, detail, nomenclature, categories, geographies);
  - (iv) supplying department/service;
  - (v) deadlines for supply;
  - (vi) details of QA/QC applied to the data prior to supply;
  - (vii) uncertainties in the data.

A generic template for the development of a DSA in the form of a memorandum of understanding with a data supplier can be found in the National Greenhouse Gas Inventory System Templates developed by the United States Environmental Protection Agency and United States Agency for International Development hosted by the LEDs group[20].

1.5.3 Compilation experts

A national inventory management system is supported by a committed team of inventory compilation experts. These experts will understand the requirements for inventory quality (as defined in Chapter 1.4), IPCC methods, national emission/removal related processes/practices, and national datasets. Where possible, it is advantageous for experts to have a good understanding of international reporting and review processes, which can be developed through participation in international or regional peer review activities.

1.5.3.1 ROLES AND RESPONSIBILITIES

A number of roles and responsibilities for core compilation functions of the GHG inventory team are outlined in templates prepared by the US EPA in the Greenhouse Gas Inventory Toolkit[21]. These are not the only examples but provide a useful starting point for specifying terms of reference. The skills and experience of candidates are specific to the sector/categories (as indicated in the toolkit) and include time spent with the relevant datasets and working with emissions and removals categories.

[20] http://ledsgp.org/resource/greenhouse-gas-inventory-system/?loclang=en_gb.

[21] http://ledsgp.org/resource/greenhouse-gas-inventory-system/?loclang=en_gb#ghg-toolkit.

1.5.3.2 TRAINING

Suitably trained and/or experienced GHG inventory experts support a national inventory management system to efficiently produce high quality outputs. Training and experience development is often focussed in three key areas:

Training in the methods in the updated *2006 IPCC Guidelines* available from a number of training services and the UNFCCC/IPCC.

Training in the specific implementation of the updated *2006 IPCC guidelines* for the country. This training may include country-specific material.

Participation in the UNFCCC review/ICA process, which can provide experts with broader experience with GHG inventories undertaken by other countries.

1.5.4 GHG inventory management tools

Workplans, data management systems, QA/QC systems, and documentation procedures facilitate the delivery of inventory outputs.

1.5.4.1 WORKPLANS

GHG inventories are often compiled on a cyclic basis annually, biennially or other periods with common steps across cycles. A national inventory workplan documents and communicate to stakeholders the schedule of steps in a cycle. An illustrative example workplan (based on an annual compilation timeframe) is presented in Table 1.4.

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TABLE 1.4
ILLUSTRATIVE WORKPLAN FOR THE PREPARATION OF GHG INVENTORY INCLUDING AN INDICATIVE TIMELINE FOR A WORK PROGRAMME OF 52 WEEKS (1 YEAR)

Example Activity	Indicative Deadlines	Example Lead Stakeholder
Agreement on the scope of work (including any identified improvements and updates to the time-series) and timeframes with stakeholders/steering committee.	Week 1	SNE/inventory agency & steering committee engaged for prioritising improvements
Appointing/engaging the team of experts to deliver the scope of work needed (data collection, compilation, QA/QC, documentation and reporting) establishing/revising Terms of Reference: • Roles and responsibilities. • Timelines. • Deliverables. • Time (budgets) allocation.	Week 2-6	SNE/ inventory agency
Sectoral estimation (e.g. Energy, IPPU, Agriculture, LULUCF and Waste), including: • Collecting data (engaging with data suppliers) and checking data supplied; • Agreeing any new methodologies and/or continuation of existing methodologies; • Calculation of estimates; • QC (checking of all estimates); • QA (peer review of new estimates); • Documentation; • Finalisation of reporting formats.	Week 3-30	Compilation experts
Collation of sectoral estimates into draft final datasets and national totals and trends (master summary files or database); compilation of uncertainty and *key category* analysis	Week 30-34	Inventory agency Compilation experts where needed for follow-up.
QC of draft final estimates and documentation of changes and trends	Week 32-36	
Drafting (collation of the sectoral documentation on methods, data sources and assumptions, *key category* and uncertainty analysis) into the National Inventory Report	Week 34-40	
Consultation with stakeholders on draft final estimates and National Inventory Report and documented changes and trend features.	Week 40-46	(SNE and steering committee engaged for stakeholder review/consultation on outputs)
Finalisation of estimates and the National Inventory Report.	Week 46-50	
Reporting and other deliverables to stakeholders and national decision-making processes.	Week 50-52	

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447 1.5.4.2 DATA MANAGEMENT SYSTEM

448 The GHG inventory production process involves a large number of datasets compiled using an array of
449 assumptions and expert judgement. No GHG inventory has a fully automated process for gathering data and
450 producing outputs. Sectors and categories will use different data, data formats, data manipulations, and tools.

451 There are many different data management systems used by countries. Some use sophisticated database tools
452 connected to the internet and available for users upload data and to operate from remote locations. However, many
453 currently operate using a collection of spreadsheets for calculating GHG estimates.

454 **Calculating GHG Estimates:** Sector compilation experts need flexibility to compile estimates using tools
455 appropriate to the complexity of their data and methods. Specialised models or spreadsheets may be appropriate.

Spreadsheets are accessible to a range of experts. Complex methods will be undertaken in specialised models or databases to facilitate complex calculations or the handling of large datasets. Common practices for documentation in all calculation files may address:

- using standard classification and nomenclatures for compilation of estimates (this nomenclature can be based on country-specific or IPCC categories);
- maintaining a master list of the calculation files, their types, authors, and versions;
- using a standard file naming convention across categories and inventory cycles;
- documenting in tools evidence for implementation of QA/QC procedures;
- colour coding or other visual formatting to differentiate between areas of data input, calculations, QA/QC checks, explanations, and outputs;
- documenting where historical data or methods have been revised;
- documentation of complex models (see chapter 6);
- standard output format for all reported data.

Collation, Aggregation and Reporting: Inventory data needs to be collated into a coherent set of tables that can be aggregated to produce detailed reporting formats, national totals, and summary tables. This collation enables general QA/QC to be applied more easily using tools to identify anomalies in trends and missing categories. The minimal information in a standardised data structure for time-series data include:

- year (the year of the value in the time-series);
- native nomenclature (if relevant the nomenclature used nationally and linked to the statistics, national definitions and/or source data. Allowing reports for national use in a nomenclature familiar to national stakeholders);
- reporting nomenclature (e.g. IPCC categories and fuels/activities);
- geography (identifying which part of the national geographical area is represented);
- gas/pollutant;
- type of variable (e.g. emission/removal, activity data, implied emission factor);
- the variable value;
- variable units;
- notation key (if relevant);
- reference/description of updates since previous compilation;
- reference for the source of the value (calculation file).

1.5.4.3 MANAGEMENT OF QA/QC & DOCUMENTATION MATERIAL

Extensive guidance on QA/QC and documentation is presented in Chapter 6. A GHG inventory management system may include the following QA/QC, documentation, and archiving elements:

- **QA/QC Plan** (see section 6.5 of the QA/QC chapter), including general and category-specific QC procedures (see sections 6.6 and 6.7).
- A **log of implemented QA and verification activities** with reference to associated documentation and findings (see section 6.8 and 6.10 of the QA/QC chapter).
- An **inventory improvement plan** containing potential, planned and implemented improvements. This plan may include:
  - (i) improvement description;
  - (ii) the categories/sector/GHG inventory activity (QA/QC, stakeholder engagement, data management etc) it relates to;
  - (iii) the origin of the improvement (e.g. recommendation or expert suggestion);

(iv) the status (e.g. suggested, proposed, planned, work in progress, implemented) of the improvement;

(v) priority (informed by the *key category* analysis);

(vi) the owning stakeholder.

- An **inventory archive** (see section 6.11 of the QA/QC chapter) that documents and stores data on the latest and previous GHG inventory estimates, reports, methodology documents, and calculation files.
- **Country-specific training material** addressing country-specific methods and data management tools.

1.5.5 Education, awareness raising and public access to information

The GHG inventory is an asset to national decision makers and supporting analysts. The GHG inventory can provide evidence (e.g. increasing or decreasing trends and sectoral contributions) to support stakeholder engagement and decisions.

Wider use and awareness of the GHG inventory can better engage stakeholders to improve data quality and accessibility, as well as better justify resource allocations for GHG inventory preparation and improvements.

There are activities that can be useful in promoting the GHG inventory work and outputs. These activities also support action by Parties in meeting any international agreements on education, awareness raising and public access to information[22] including:

- Organizing GHG inventory orientated **workshops with stakeholders.**
- **Publication of the GHG inventory data in user-friendly forms** using visual tools such as infographics to engage with wider stakeholders, students, the press and policy makers.
- **Development of overview and sector specific indicators and factsheets** highlighting key stories on the trends and progress to targets**.**
- **Active engagement with and support the BUR, NC, NDC and policies and measures** activities with relevant data and insights. Development of the GHG inventory as a tool to support projections and the quantitative analysis of GHG savings in policies and measures**.**

1.6 COMPILING AN INVENTORY

Compiling a greenhouse gas inventory is a step-by-step process. This section provides guidance on these steps for the *inventory compiler*, i.e., the person, persons or institutions who put together or compose the inventory from materials gathered from several sources. Compilation includes the collection of data, estimation of emissions and removals, checking and verification, uncertainty assessment and reporting.

Before undertaking estimates of emissions and removals from specific categories an inventory compiler should become familiar with the material in Volume 1 *General Guidance and Reporting*. This Volume provides *good practice guidance* on issues that are common to all the estimation methods covered by the sector-specific guidance provided in Volumes 2 to 5 and reporting instructions.

Summary of Volume 1:

- **Data collection:** Collection of data is a fundamental part of inventory preparation. Chapter 2 of Volume 1 provides guidance on initiating and maintaining a data collection program. It covers evaluating existing sources of data, and planning new emission measurements and surveys, extensive reference is made to guidance provided by other organisations. The chapter links the data collection process to the other general issues.
- **Uncertainty assessment:** Estimates of uncertainty are needed for all relevant source and sink categories, greenhouse gases, inventory totals as a whole, and their trends. Chapter 3, Uncertainties, provides practical guidance for estimating and combining uncertainties, along with a discussion of the conceptual underpinnings of inventory uncertainty. Uncertainty issues related to specific category of emissions and removals are addressed in Volumes 2-5.

[22] The Paris Agreement Article 12 for example.

- **Key category analysis:** *Good practice guidance* on how to identify *key categories* of emissions and removals is provided in Chapter 4, Methodological Choice and Identification of Key Categories. The *key category* concept is used, together with the decision trees in Volumes 2-5, to guide users in their methodological choice for each category. These decision trees are the critical link between methodological choice in the sector-specific volumes and the identification of *key categories* in Volume 1.

- **Time series consistency:** Ensuring the time series consistency of inventory estimates is essential for establishing confidence in reported inventory trends. Chapter 5, Time Series Consistency, provides methods for ensuring time-series consistency in cases where it is not possible to use the same method and/or data over the entire period. This chapter also provides *good practice guidance* on when to recalculate estimates for previous years and methods for accounting for changes in emissions and removals over time.

- **Quality Assurance (QA) and Quality Control (QC):** A QA/QC system is an important part of inventory development. Chapter 6, QA/QC and Verification, describes the general QA/QC aspects to consider when compiling an inventory of emissions and removals. *Good practice guidance* on sector specific quality control checks are addressed in Volumes 2-5. Chapter 6 also describes techniques for verifying inventories using external data.

- **Precursors and indirect N_2O emissions:** Volume 1 also includes cross-sectoral guidance on dealing with precursors and indirect emissions of N_2O from deposition of nitrogen compounds (resulting from NO_x and NH_3 emissions) in Chapter 7, Precursors and Indirect Emissions.

- **Reporting:** Chapter 8, Reporting Guidance and Tables, specifically addresses issues related to reporting, including definitions of national territory, gases and reporting categories. Notation keys are introduced to account for completeness and transparency in reporting. The definitions of categories of sources and sinks take into account the structure of the sector guidance in Volume 2-5. The sectoral and summary reporting tables to be applied for reporting emissions and removals of each category are included in Chapter 8. Reporting tables on uncertainties, *key category* analysis, and emission trends have also been developed and are included in Chapter 8.

Volumes 1 and Volumes 2 to 5 are complementary. After the compilers tasked with preparing estimates for specific emission and removal categories have familiarised themselves with the general guidance in Volume 1 they should use the specific sectoral volume(s) appropriate to their categories so that they can apply the requirements in a manner appropriate to their national circumstances. Figure 1.3 illustrates the steps of a typical inventory cycle. Quality control measures should be implemented at each step and should be documented according to the requirements of QA/QC and documentation given in Chapter 6 of Volume 1.

1. The first step for a revised or new greenhouse gas inventory is to identify the *key categories* for the inventory so that resources can be prioritised. Where an inventory already exists, the *key categories* can be identified quantitatively from the previous estimates (see Volume 1 Chapter 4). For a new inventory the compiler will have to make a preliminary assessment based on local knowledge and expertise about large emission sources and inventories in countries with similar national circumstances or, if possible, make preliminary Tier 1 estimates to assist in identifying *key categories*. Assessing the *key categories* helps the inventory compiler to focus effort and resources on the sectors that contribute most to the overall inventory or inventory uncertainty and so helps to ensure that the best possible inventory is compiled for the available resources.

2. Once the *key categories* have been identified, the inventory compiler should identify the appropriate method for estimation for each category in the particular country circumstances. The sector-specific decision trees in Volumes 2-5 and the generalised decision tree in Chapter 4 of Volume 1 provide guidance on selecting appropriate methods. The selection of methods will be determined by the classification of a category as *key* or not *key*, and by both the data and the resources available. Guidance on data collection is provided in Chapter 2 of Volume 1.

3. Data collection should follow the selection of the appropriate methods. (See Chapter 2, 5 and 7 in Volume 1). Data collection activities should consider time series consistency and establish and maintain good verification, documentation and checking procedures (QA/QC) to minimise errors and inconsistencies in the inventory estimates. Data on uncertainties should if possible be collected at the same time. Guidance on the collection of new data in a cost effective way and on uncertainties is provided in Chapter 2 and Chapter 3 of Volume 1 respectively. QA/QC activities should continue throughout this process to minimise errors and document data sources, methods and assumptions. The results of the data collection may lead to refinement of the methods chosen.

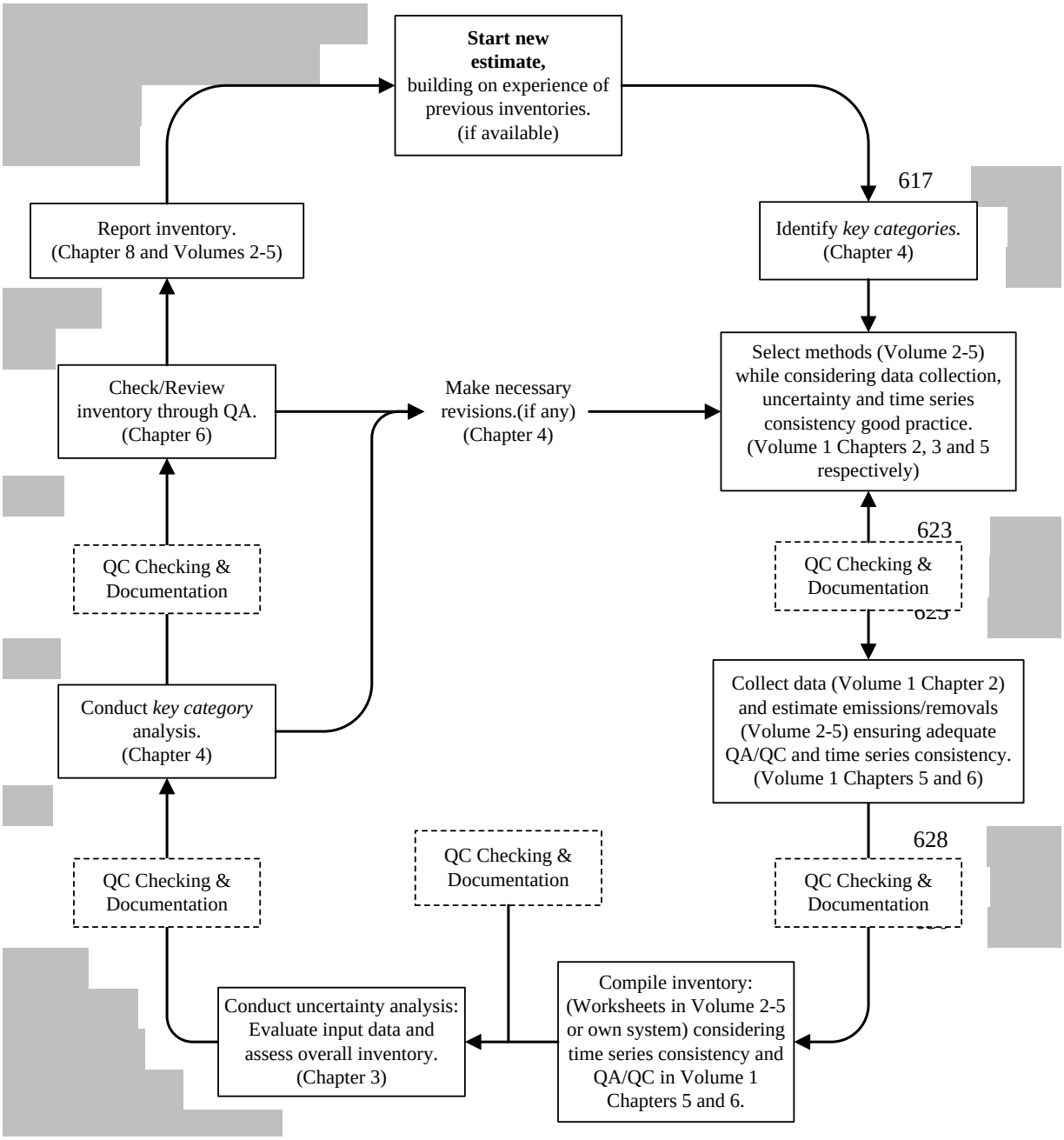
4. Emissions and removals are estimated following the methodological choice and data collection. Care should be taken to follow the general guidance in Chapter 5, Time Series Consistency in Volume 1 especially if the data are incomplete for some years.

5. Once the inventory estimates are complete, the next step is to perform an uncertainty analysis and *key category* analysis (see Chapters 3 and 4 in Volume 1). These analyses may identify categories for which a higher tier should be used and additional data collected.

6. Following the completion of the final quality assurance (QA) checks, the final step in the inventory process is to report the inventory (See Chapter 8 in Volume 1). The aim here is to present the inventory in an as concise and clear way as possible to enable users to understand the data, methods and assumptions used in the inventory. Provision of concise relevant background information and explanations in the reports helps to ensure the inventory (including the report) is transparent.

The inventory compiler should base future inventory revisions on previous inventories. Thus an iterative process builds on and improves the inventory each time a new inventory is compiled as illustrated in Figure 1.3. When a revised inventory is compiled, all years estimates should be reviewed for consistency and updated integrating any feasible improvements where necessary. Chapter 5 in Volume 1 gives advice on compiling consistent time series and provides *good practice* approaches for achieving time series consistency.

Figure 1.3 Inventory development cycle



636 Box 1.1 provides an example on using the *2006 Guidelines* throughout the inventory cycle when estimating
637 emissions from enteric fermentation.

BOX 1.1
USING THE FLOW DIAGRAM (FIGURE 1.3) AND THE 2006 GUIDELINES – LIVESTOCK EXAMPLE

Inventory compilers tasked with preparing estimates for specific emission and removal categories need to familiarise themselves with guidance in two Volumes: the relevant guidance in a sectoral volume (e.g., Volume 4, Agriculture, Forestry and Other Land Use), and the general guidance in Volume 1. Along with the diagram (see Figure 1.3) this box describes how the guidance in the two Volumes is used for estimating methane emissions from Enteric Fermentation:

Start with your previous inventory where available and prioritise categories for estimation.

- The inventory compiler can begin with the overall results of the previous national inventory, particularly the *key category* assessment, as a preliminary step to selecting methods and data (Chapter 4 of Volume 1).

Familiarise yourself with general and sector specific QA/QC requirements.

- Prior to collecting all the data and estimating emissions, the inventory compiler should consult the general guidance in implementing Quality Control (QC) procedures in Chapter 6 of Volume 1 (QA/QC and Verification) along with the specific QC procedures for enteric fermentation described in Chapter 10 of Volume 4. QC procedures should be implemented at every step of the inventory cycle. This will include regular checking and clear documentation of data sources methods and assumptions.

Choose appropriate methods based on category importance and data availability.

- The inventory compiler should consult the decision tree and methodological guidance in Chapter 10 of Volume 4 to select an appropriate method. In this example, enteric fermentation is a *key category*, which indicates that normally Tier 2 or 3 should be selected.

- The general guidance in Chapter 2 (Approaches to Data Collection) of Volume 1 and Chapter 10 of Volume 4 will guide the inventory compiler in choosing appropriate emission factor, activity data and other estimation parameters. This may include identifying or choosing from existing data or collection and classification of new data.

Collect the data necessary for the latest year and a consistent time series and uncertainty estimation.

- The next step involves collection of the needed data for all years. The availability of data may sometimes restrict use of higher tier methods for *key categories*.

- Chapter 5 (Time Series Consistency) of Volume 1 should be used if preparing estimates for more than one year. This guidance is particularly relevant if the selected method is different from the one used in previous inventories or the sources of data or their classification have changed. This can imply the need for recalculations of previous estimates or splicing of data series. Chapter 10 of Volume 4 should be consulted for source-specific guidance on time-series consistency.

- In estimating uncertainties, inventory compilers should also refer to the general guidance on uncertainty in Chapter 3 of Volume 1 - paying particular attention to guidance on concepts and methods – and the uncertainty section of the enteric fermentation livestock chapter for source-specific information (for example default uncertainties). Ideally, the inventory compiler should collect activity data, emission factors, and uncertainty information at the same time because this is the most efficient strategy.

Estimate emissions/removals consistent with the guidance.

- The next step is to estimate methane emissions from enteric fermentation for all relevant years. Relevant guidance for this step includes the specific guidance for enteric fermentation in Volume 4, Chapter 10 relating to completeness, reporting and documentation, and time series consistency sections.

- The enteric fermentation emissions and uncertainty data are used subsequently as input into the compilation of the overall inventory, the estimation of category-specific and overall uncertainty, and the *key category* assessment. The results of these steps may require changes or revisions to the original estimate of emissions of enteric fermentation.

BOX 1.1 (CONTINUED)

Check and review the estimates.

- Following the Quality Assurance (QA) guidance in Volume 1, the inventory compiler should arrange for review of the estimate and documentation by technical experts not involved in the preparation of the inventory. External reviewers may suggest improvements or identify errors that would require a recalculation of the enteric fermentation estimate.

Report the estimates.

- The *IPCC Guidelines* provide guidance on reporting information on enteric fermentation in two places: the enteric fermentation chapter of Volume 4, and the reporting tables in Chapter 8 of Volume 1. The inventory compiler should consult both chapters for a complete description of reporting guidance.

Note: In the case of an initial inventory effort, with no previous *key category* analysis, a qualitative assessment of enteric fermentation could be used. See Chapter 2 and Chapter 4 of Volume 1. In this example, it can be concluded that methane from enteric fermentation is key in most inventories and should therefore be considered initially key.

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