CHAPTER 1

AN INTRODUCTION TO NATIONAL GHG INVENTORIES

[Parts shaded in grey – the unchanged text from the 2006 IPCC Guidelines]

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Contents

Tables

Figures

Boxes

1 INTRODUCTION TO GHG INVENTORIES

No refinement.

1.1 CONCEPTS

No refinement.

1.2 ESTIMATION METHODS

No refinement.

1.3 STRUCTURE OF THE GUIDELINES

No refinement regarding the structure of the *2006 IPCC Guidelines*. Regarding the structure of the *2019 Refinement*, see the Overview Chapter.

1.4 INVENTORY QUALITY

No refinement.

1.5 NATIONAL GHG INVENTORY ARRANGEMENTS

[New guidance in the *2019 Refinement*].

This section provides guidance on establishing GHG inventory arrangements that can support the development, improvement and maintenance of national GHG inventories.

This guidance should not be prescriptive. It instead, it provides approaches and examples of national GHG inventory arrangements that could be useful.

It is considered *good practice* that the transparency, accuracy, completeness, comparability and consistency of national GHG inventories improves over time to a state that they can fully inform national and international stakeholders on the national trends (and the reasons for them) and meet reporting requirements. It is therefore beneficial for compilation teams to consider some of the different approaches, tools and templates that can help to ensure the smooth running of repeated GHG inventory compilation activities. Establishment of organised national GHG inventory arrangements can help to improve **quality**[1]**, timeliness and efficient use of resources**.

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

BOX 1.1
BROADER BENEFITS/APPLICATIONS AND LINKAGES OF GHG INVENTORY ACTIVITIES WITH OTHER RELATED DATA COLLECTION AND REPORTING NEEDS

The following linkages can be beneficial and could be managed as a wider programme under GHG inventory arrangements.

Subnational GHG inventory compilation (e.g. Cities) can bring benefit to and gain from engagement with more structured and coordinated national GHG inventory arrangements. This benefit can result from interest in and contribution to combined efforts to gather/collate/use geographically resolved data on large industrial installations and regulated sites (including waste disposal and recycling/treatment sites), and diffuse traffic and transport, agriculture and forestry data. Use of common guidelines (such as these), approaches and assumptions (e.g. emission factors) between national and subnational estimation activities will also help to improve the efficiency and credibility of GHG estimates and decision-making processes associated with them.

GHG and Air Pollutant inventory compilation synergies: Many well-established GHG inventories are compiled in tandem with national air pollutant inventories. This integration can provide efficiencies, as a large proportion of the activity data (energy, agriculture, transport statistics) are the same for both. It may also improve linkages (through consistent use of data) between climate mitigation and air quality measures and help decision makers track co-benefits and potential conflicts. Countries that apply this integrated approach, manage to pool resources and management systems for both GHGs and air pollutant inventories and operate more efficiently.

1.5.1 Institutional Arrangements (Governance)

This section introduces the concept of institutional arrangements. There is a wide diversity in the different approaches used by countries to monitor, report and respond to review of its GHG estimates. Recognising this, this section provides some examples common concepts and tools that could be used when setting up or strengthening GHG inventory arrangements.

Institutional arrangements include the interactions between organisations that are involved with the GHG inventory inputs, compilation processes, and outputs. This could include environment, energy, agricultural, and statistical ministries and/or agencies), academic/research institutions, private organisations and career experts and consultants.

Countries may also consider the need for new or modified laws or directives establishing requirements for data collection, archiving, reporting, and quality management to formalize institutional arrangements for national GHG inventory compilation.

1.5.1.1 COMMITMENTS

A useful concept to introduce, and use to coordinate and prioritise GHG inventory activities around are the countries monitoring and reporting commitments and other decision making needs for the GHG inventory data. This analysis will help define and prioritise the data and expert needs and therefore, the institutional arrangements for the national GHG inventory. Such an analysis could provide useful detail on why the GHG inventory is needed, the tasks involved, who is responsible for each task, the scope (e.g. sectors, gases, geographies, time-series duration), and timeframes (e.g. schedule and updating frequency) for the inventory compilation, reporting, and review processes. An example of a simplified commitments analysis is presented in Table 1.1. Such a summary table can complement more detailed descriptions. An illustrative example summary constructed around the United Kingdom's GHG inventory scope and mandate is presented in Table 1.1.

TABLE 1.1
A SUGGESTED TABLE FOR CAPTURING AND SHARING INFORMATION ON THE COMMITMENTS SUPPORTED BY THE NATIONAL GHG INVENTORY

Commitments[1]	Gases[2]	Sectors & categories[3]	Geographical resolution	Temporal resolution of estimates[4]	Start and end year and time steps[5]	Reporting Frequency[6]	Reporting Formats[7]

1. List the commitments that the national GHG inventory supports.
2. Add gases included e.g. CO_2, CH_4, N_2O, Fluorinated GHGs, Other Gases.
3. Add sectors included Energy, IPPU, Agriculture, FOLU, Waste, Other sectors.
4. The temporal resolution is usually annual estimates however, some GHG inventories have larger time steps for earlier years.
5. Indicate the time resolution needed. This is usually annual estimates but can be different.
6. Indicate the start and end year of the time series. In addition, indicate the time steps required. These could be annual time steps for data estimated for every year of the time series of bigger time steps e.g. every 5 years.
7. How often are the data reported?
8. Highlight any specific reporting formats (e.g. table structures, schemas, variables needed for specific reporting).

123

TABLE 1.2
ILLUSTRATIVE COMMITMENTS TABLE CONSTRUCTED AROUND UK REPORTING AND MRV COMMITMENTS

Commitments	Gases	Sectors & categories	Geographical resolution	Temporal resolution of estimates	Start and end year and time steps	Reporting Frequency	Reporting Formats
UNFCCC: Annual Reporting[a]	CO_2, CH_4, N_2O, Fluorinated gases, Precursors (SO_2, NOx, CO, NMVOC)	Energy, IPPU, Agriculture, FOLU, Waste	UK + Over seas territories	Annual estimates	Yearly values 1990 to latest year -2. Annual time steps	Annual	CRF[f]
National Statistics Environmental Accounts[e]							Environmental Accounts[e]
EU Monitoring Mechanism Regulation[c]			Mainland UK				CRF
National Carbon Budgets[d]			UK				Carbon Budget
UNFCCC: National Communication and Biennial Report	CO_2, CH_4, N_2O, Fluorinated gases		UK + Over seas territories			Biennial	CRF: Summary table 2
UNFCCC: Nationally Determined Contributions[b]						5 Years	CRF: Summary table 2

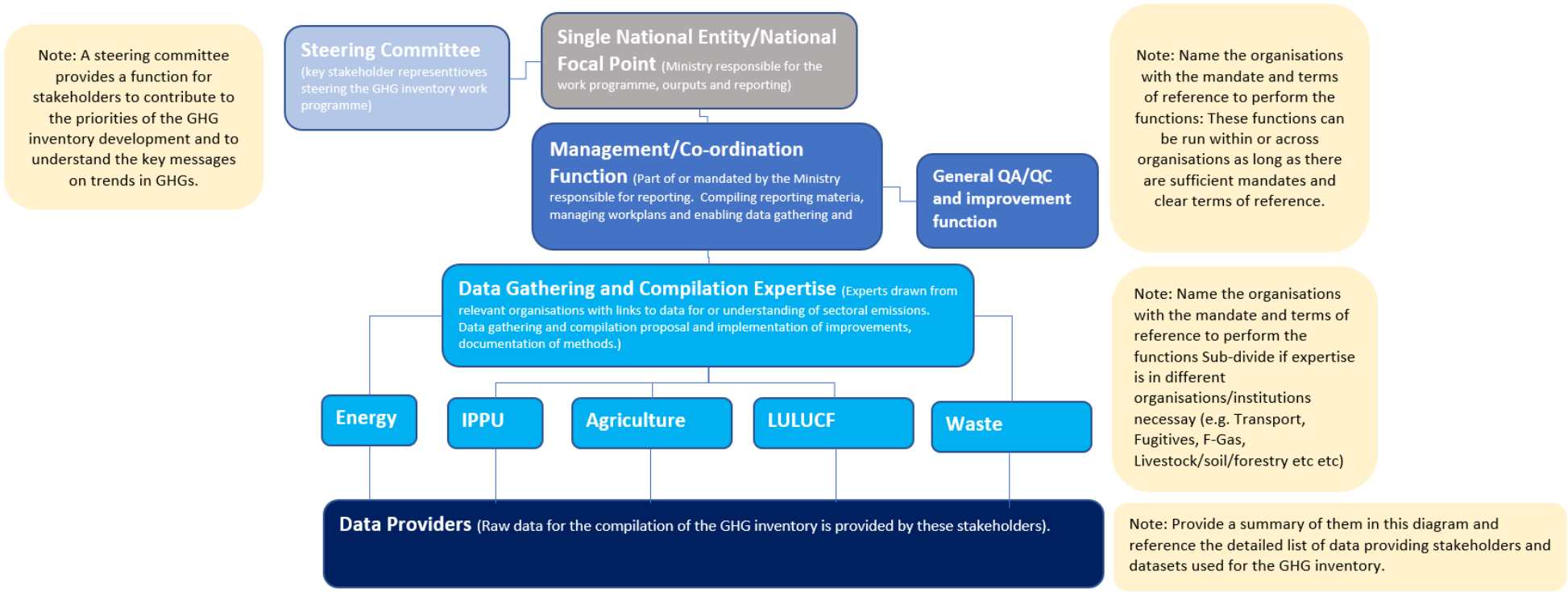
124 [a] http://unfccc.int/documentation/documents/advanced_search/items/6911.php?priref=600007789#beg.
125 [b] Article 4(9) of the Paris Agreement http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf (UK is currently part of the EU Burden Sharing Agreement).
126 [c] UK reporting commitments to the EU: https://ec.europa.eu/clima/policies/strategies/progress/monitoring_en.
127 [d] https://www.gov.uk/guidance/carbon-budgets.
128 [e] https://www.ons.gov.uk/economy/environmentalaccounts.
129 [f] http://unfccc.int/national_reports/annex_i_ghg_inventories/reporting_requirements/items/2759.php.

1.5.1.2 ORGANIZATIONAL STRUCTURE

Clarifying organisational structure can help formalise and communicate the functional roles of organisations in the national inventory compilation process. A defined organisational structure provides stakeholders with an overview of the roles and responsibilities for the functioning system. A generic organisational structure is illustrated in Figure 1.1. A complete and informative structure diagram could also include organisation names.

A detailed overview of the types of stakeholder roles and responsibilities is elaborated in the following section.

136 **Figure 1.1 Illustrative GHG inventory organizational structure**



137

1.5.1.3 STAKEHOLDER ROLES AND RESPONSIBILITIES

There are a large number of stakeholders involved with and/or interested in GHG inventory inputs, processes, and outputs. Typical stakeholder types are presented in Table 1.3. Managing the interests, contributions and involvement of these stakeholders is critical for a long-term functional national GHG inventory 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 (see 1.5.1.4 below)	Acquisition and allocation of resources; Development of long-term strategy for support to national decision makers, negotiations, climate action and reporting; Arranging contacts and agreements with collaborating entities that contribute data, research studies, estimate emissions or provide expert reviews, etc; Responsible for submission of GHG inventory;	Technical and administrative expertise, as well as formal government authority Understanding of reporting requirements and IPCC *good practice* concepts Capacity to coordinate and lead the process Authority to engage other government departments and non-government organisations
A steering committee or working group for stakeholders that contribute to GHG inventory development and to disseminate key messages on trends in GHGs	Provide input to the planning, coordination, management and technical facilitation of inputs and outputs in the process, advisors to the National Focal Point Advice on choice of methods with regard to data availability and decision-making needs.	Sectoral, dataset and/or government policy involvement, knowledge, and authority over data collection, research and national strategies. Involved with policy and decision making and negotiations (e.g. on target setting and mitigation implementation) that uses national GHG inventory data
Management/Coordination & General QA/QC (i.e. "Inventory Agency")	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 reporting of GHG inventory data and reports.	Project Management & team management QA/QC Technical knowledge of the reporting requirements, review processes and IPCC methodologies Technical awareness of tools and systems for gathering and reviewing data
Compilation (Sector) Experts and researchers • Energy • IPPU • Agriculture • FOLU • Waste	Overall development of methods, data sources, 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. Specialist in a sector or group of categories	Technical knowledge of the 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	Technical skills/knowledge of, legal authority to improve and enhance data collection

	Management of data acquisition, processing and reporting systems, QA/QC requirements Communication with SNE, the Inventory Agency and sector experts, as needed.	
Other contributors and users	General interest in the work with provision of expertise, independent review, research or use of the data for other purposes.	Any
Policy advisor	GHG inventory data users that inform policies and feed into climate action analysis.	Any

Each organization contributing to the national GHG inventory may have, or need, some form of terms of reference (ToR). This ToR can help to specify functional roles and responsibilities (e.g. inventory compilation, expert input, tool development and use, and/or data collection and storage) and the schedule for conducting this work. Existing terms of reference for duties such as environmental data gathering or industrial reporting may also be revised to address GHG inventory responsibilities.

The process of stakeholder coordination is likely to be different in different countries. However, the development and maintenance of a list of stakeholders, their roles, responsibilities and interests are quite common. Table 1.4 provides suggested metadata that can complement the definition of an organizational structure in subsection 1.5.1.2 above.

TABLE 1.4
SUGGESTED METADATA FOR TRACKING GHG INVENTORY STAKEHOLDERS.

1.Name	2.Organisation	3.Contact	4.Mandate	5.Engagement Activities	6.Sector	7.Role

1. **Name**: stakeholders name;
2. **Organisation**: organisation affiliation;
3. **Contact**: contact details;
4. **Mandate**: mandate/terms of reference to contribute to the GHG inventory (if any);
5. **Engagement activities** (Activities that the stakeholder has been regularly involved with e.g. training, workshops, regular meetings attended, data provision etc.);
6. **Sector**: sectors/categories involved with (any particular sector or category involvement);
7. **Role**: type of involvement (e.g. as a data provider, data user, compilation expert, coordinators, data gathering, QA/QC, review, steering committee meetings, training, sectoral workshops, compilation and reporting activities, consultations, and reviews.

1.5.1.4 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 and representing the countries GHG inventory interests internationally. It is often aligned with the national focal point or international point of contact on climate reporting. The role of SNE is usually taken on by a government ministry with mandate to manage the country’s GHG inventory reporting and response to climate change. A key role within the SNE is that of overseeing the GHG inventory activities. A designated focal point coordinates the activities needed to ensure that outputs are prepared of sufficient quality to meet the country’s commitments. The role of SNE is sometimes delegated, via mandates/terms of reference, to a climate change, environmental, or statistical agency with the technical capacity to prepare national reports. This can be the Inventory Agency with a mandate to report the GHG inventory data to the ministry or on behalf of the ministry internationally.

1.5.1.5 THE INVENTORY AGENCY

The technical co-ordination of the GHG inventory data needs to be undertaken by a competent team. Countries employ a variety of different organisational structures to compile inventories. Some examples for engaging these technical competencies include:

- **A government ministry acts as the inventory agency**. The role of the inventory agency can be implemented by a government ministry that also serves as the SNE, in which case it should have the appropriate coordination and technical capacity.
- **A national institution acts as the inventory agency.** The coordination and technical compilation is delegated to a competent institution (e.g. statistical, meteorological, or environmental). Such an institution 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 Other Land Use 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 [2] and commitments to engage the organisation preferably over a suitable period (e.g. 3 to 5 years) to promote the sustained development and maintenance of the GHG inventory. Provisions should be in place for the full transfer of data, documents, calculation and reporting tools and knowledge of the national GHG inventory from the contracted organisation to the SNE or new contracting organisation at the end of the contract period.

Steps should be taken to ensure retention of institutional knowledge and capability to ensure that the inventory can continue to be delivered and achieve quality standards in the future. Whether the inventory is managed within the national government or by external organisations, provisions should be in place for the potential transfer of data, documents, calculation and reporting tools and knowledge of the national GHG inventory to a new inventory team, including consideration of adequate training investment.

1.5.1.6 NATIONAL GHG INVENTORY TECHNICAL STEERING COMMITTEE OR WORKING GROUP

To support national processes for approving GHG inventory estimates and documentation, countries may establish a working group or committee of relevant stakeholders.

This group or committee can consist of stakeholders representing users of (e.g. policy makers) and data providers to the national GHG inventory (e.g. research agencies, national statistical organisations, environment agencies, academic institutions, industrial trade associations, and consultancies). It can provide a forum for the SNE to coordinate and communicate on GHG inventory activities and to secure data provision and independent analysis.

This group of stakeholders can be also convened in support of prioritisation and implementation of inventory improvements.

[2] Linked to the quality principles (TCCCA referred to in Volume 1).

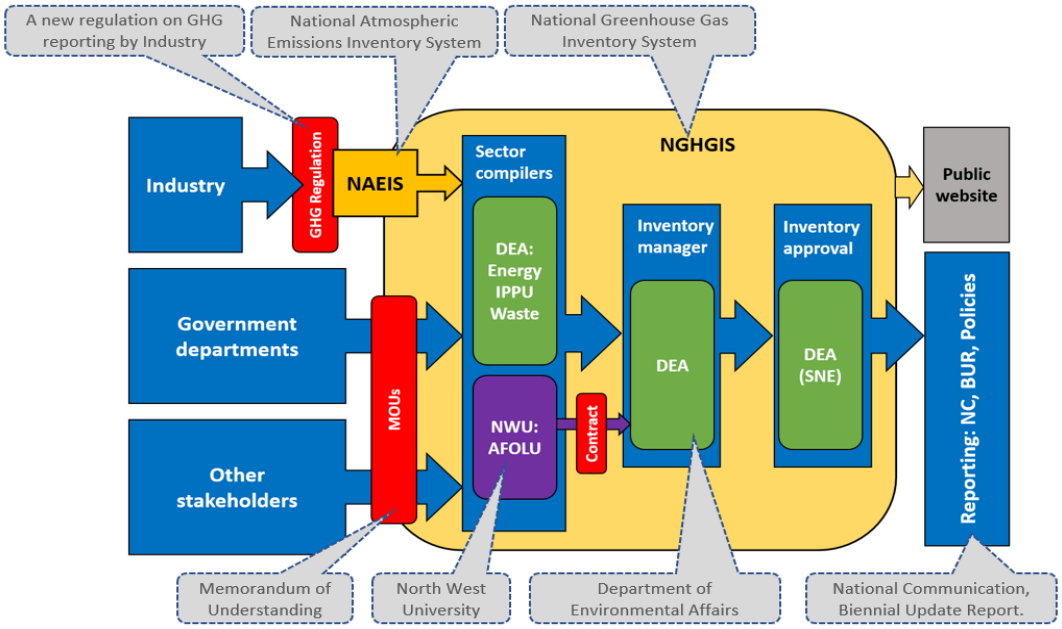
1.5.2 Datasets and data flows

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 initial data collection to final reporting, further documents the inventory compilation process. An illustrative example of the components of such a diagram is provided in Box 1.2.

BOX 1.2

ILLUSTRATIVE DATA FLOW OVERVIEW DIAGRAM EXAMPLE FOR SOUTH AFRICA

The diagram below presents a simplified view of the key data flows for South Africa's GHG inventory. This data flow diagram is underpinned by a list of all datasets used in the GHG inventory (see above in 1.5.1.2) which links to/references the relevant stakeholders (see Table 1.1c) held in a related list in South Africa's "National System for GHG Estimation and Reporting".



The diagram illustrates the data flows from industrial reporting, government departments and other stakeholders. Industrial reported data are made available to the GHG inventory via the National Atmospheric Emissions Inventory Systems (NAEIS). Reporting industries are mandated to report certain GHG relevant information into the NAEIS by the GHG Regulation that was established in 2016-2017. A number of government departments provide statistical data such as the energy balance, mineral resources and traffic statistics. Other organisations provide data such as that used for country-specific emission factors, certain agriculture statistics and forestry data.

More detailed data flows for specific datasets, sectors, or categories can help document the process, improve transparency 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 coordinator, can help build and maintain institutional memory and support efficient compilation of regular updates. A suggested outline for a list of datasets is presented in Table 1.5 below.

TABLE 1.5
SUGGESTED TABLE FOR LISTING DATASETS USED IN THE GHG INVENTORY

1.Name	2.Status	3.Description	4.Reference	5.Location	6.Supplier	7.Sector/ category	8.Update

1. **Name**: This should be a unique name for the dataset;
2. **Status**: Provide a status to indicate if the dataset is received or pending receipt, outdated etc;
3. **Description**: A description of the dataset;
4. **Reference**: A reference or link to a relevant data supply agreement if it exists (see following section);
5. **Location**: Where the received data are stored within the GHG Inventory archive;
6. **Supplier**: The stakeholder supplying (from list of stakeholders above);
7. **Sector/category**: The sectors/categories of relevance to the dataset;
8. **Update**: The regularity that the dataset is updated.

1.5.2.2 DATA SUPPLY AGREEMENTS (DSAS)

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. This can be useful for managing a regularly updated GHG inventory. 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 UNFCCC. Suggested contents that could form part of an agreement document exchanged between the GHG Inventory SNE and the data supplier stakeholder are provided below:

- background on the needs/mandate for the GHG inventory compilation;
- reference to laws/terms of reference and co-operation between the data supplier and the GHG inventory representatives;
- objectives of the agreement with reference to an annex specifying the details;
- confidentiality provisions and commitments;
- feedback provisions that enable the receiving party provide feedback to the supplier to promote continuous improvement of data collection;
- 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 (to avoid 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 Templates developed by the United States

Environmental Protection Agency and United States Agency for International Development hosted by the LEDs group[3].

1.5.3 Compilation experts

A national GHG inventory system is supported by a committed team of inventory compilation experts. These experts 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

Section 6.4 of Chapter 6 of the *2006 IPCC Guidelines* provides some detail on roles and responsibilities for QA/QC related activities. Table 1.1c above provides an outline of the typical roles for compilation experts. Roles and responsibilities for core compilation functions of the GHG inventory team are also outlined in a comprehensive templates prepared by the US EPA in the Greenhouse Gas Inventory Toolkit[4]. These are not the only examples, but they provide a useful starting point for specifying a 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.

1.5.3.2 TRAINING

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

- Training in the methods in the latest *IPCC Guidelines* available from a number of training services and the UNFCCC/IPCC.
- Training in the specific implementation of relevant *IPCC guidelines* for the country. This training may include country-specific material.
- Participation in international review processes (e.g. UNFCCC process), which can provide experts with broader experience with GHG inventories undertaken by other countries.

Training should also build national training capacity to promote a sustainable national GHG inventory. A roster of trainers may be maintained by the Single National Entity or inventory agency.

1.5.4 GHG inventory management tools

The development of GHG inventory management tools will help to ensure efficiency and transparency in the GHG inventory compilation activities. Tools include workplans, improvement plans, data management systems, quality systems, and documentation procedures.

1.5.4.1 WORKPLANS

GHG inventories are often compiled on a cyclic basis (e.g. annually, biennially, or other periods) with repeating steps across cycles. A national inventory workplan clarifies the schedule of steps in a cycle for generation GHG inventory outputs to relevant stakeholders. An illustrative example workplan (based on an annual compilation timeframe) is presented in Table 1.6. Workplans should be reviewed and where necessary revised prior to the start of a new inventory compilation cycle. Workplans should be revised to accommodate improvement activities and new data collection/analysis or review tasks. The inventory agency or GHG inventory coordinator should maintain these workplan and formalise them with GHG inventory compilation contributors through formal or informal communication of the workplan.

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

TABLE 1.6
ILLUSTRATIVE WORKPLAN FOR THE PREPARATION OF GHG INVENTORY INCLUDING AN INDICATIVE TIMELINE FOR A WORK PROGRAMME OF 52 WEEKS (1 YEAR)

Example Activity	Illustrative 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, FOLU 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	

1.5.4.2 DATA MANAGEMENT SYSTEM

The process of GHG inventory preparation involves numerous datasets compiled using an array of assumptions and expert judgement. Sectors and categories will use different data, data formats, data manipulations, and tools for their compilation.

There are many different data management systems used by countries. Some use sophisticated database tools connected to the internet and available for users to upload data and to operate from remote locations. However, many countries currently operate using a collection of spreadsheets, databases and bespoke software systems for calculating GHG estimates. Some key points around the differences between data management systems needed for calculating estimates and for aggregating and reporting GHG inventory data are provided below:

Calculating of GHG Estimates: Sector compilation experts need flexibility to compile estimates using tools appropriate to national circumstances, including the complexity of their data and methods. Specialised models or

spreadsheets may be appropriate. Spreadsheets are often used when starting out and for developing methods, as they are accessible to a range of experts. More complex methods will often entail use of specialised models or databases to facilitate complex calculations and/or the handling of large datasets. Whatever tools are used applying a common practices for documentation within calculation tools including the following points should be considered:

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

Collation, Aggregation and Reporting: For analysis 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 also enables general QA/QC to be applied more easily using tools to identify anomalies in trends and missing categories. The suggested information in a standardised data structure for collating time-series data is presented in the Table 1.7 below:

TABLE 1.7
SUGGESTED INFORMATION IN A STANDARDISED DATA STRUCTURE FOR COLLATING TIME-SERIES DATA

1.Year	2.National Nomenclature	3.Reporting Nomenclature	4.Geography	5.Gas	6.Type of variable	7.Value	8.Units	9.Notation Keys	10.Reference

1. Year (the year of the value in the time-series);
2. 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);
3. Reporting nomenclature (e.g. IPCC categories and fuels/activities);
4. Geography (identifying which part of the national geographical area is represented);
5. Gas/pollutant;
6. Type of variable (e.g. emission/removal, activity data, implied emission factor);
7. The variable value;
8. Variable units;
9. Notation key (if relevant);
10. Reference/description of updates since previous compilation; and 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. The following components could be considered as part of QA/QC management and documentation of the GHG inventory:

- **QA/QC Plan** (see section 6.5 of the QA/QC chapter of the *2006 IPCC Guidelines*), 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 a simple or more complex table as illustrated below:

TABLE 1.8
SUGGESTED DESCRIPTION OF POTENTIAL, PLANNED AND IMPLEMENTED IMPROVEMENTS IN INVENTORY IMPROVEMENT PLAN

1.Name	2.Description	3.Categories	4.Origin	5.Status	6.Priority	7.Owner

1. A short unique **name;**
2. Improvement **description** including information on timeframes and technicalities for development;
3. The **categories**/sector/GHG inventory activity (QA/QC, stakeholder engagement, data management etc.) it relates to;
4. The **origin** of the improvement (e.g. recommendation or expert suggestion or international review process);
5. The **status** (e.g. suggested, proposed, planned, work in progress, implemented) of the improvement;
6. **The priority** of the improvement (informed by the *key category* analysis); and
7. The owning stakeholder.

- An **inventory archive** (see section 6.11 of the QA/QC chapter) that structures 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.

1.5.4.4 EDUCATION, AWARENESS RAISING AND PUBLIC ACCESS TO THE INFORMATION

The GHG inventory is an asset to national decision makers and supporting analysts. The GHG inventory can provide information (e.g. increasing or decreasing trends and sectoral contributions) to support stakeholder decision making. Education-related activities aimed at those in relevant government ministries, departments and agencies can help develop technical capacity, enhance cooperation, and improve knowledge about how the inventory outputs may be utilized in analysis and decision-making.

There are activities that can be useful in promoting the GHG inventory processes and outputs. These activities support action by countries in meeting any international agreements on education, awareness raising and public access to information[5] . Some examples of such activities include:

- Organizing GHG inventory orientated **workshops with stakeholders.** These can range from technical workshops focused on overall inventory results or on specific sectors to awareness raising events for mass media
- **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 to national projections, policies and measures and international reporting processes**.

[5] The Paris Agreement Article 12 for example.

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