

1. Stocktaking of existing structures and conditions for GHG inventories. ✓

2. Define necessary structures and conditions for the continuous preparation of GHG inventories. ✓

3. Establish roles and responsibilities for the preparation of GHG inventories. ✓

4. Assemble the technical team to implement the preparation of GHG inventories. ✓

5. Build a quality assurance/quality control system for GHG inventories. ✓

6. Define and implement a continuous improvement plan for GHG inventories. ✓

Guidance for setting up and enhancing national technical teams for GHG inventories in developing countries

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Abbreviations

BMU	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety)
BUR	Biennial Update Report
CGE	Consultative Group of Experts
CGER	Center of Global Environmental Research
CRF	Common Reporting Format
EPA	Environmental Protection Agency
EU	European Union
GEF	Global Environment Facility
GHG	Greenhouse gases
GIO	Greenhouse Gas Inventory Office of Japan
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
ICA	International Consultation and Analysis
IM	Information Matters
IKI	International Climate Initiative
IPCC	Intergovernmental Panel on Climate Change
JNGI	Japan National Greenhouse Gas Inventory
LULUCF	Land use, land-use change and forestry
MoU	Memorandum of Understanding
MRV	Measurement, Reporting and Verification
NAI	Non-Annex I (Parties to the UNFCCC)
NC	National Communication
NDC	Nationally Determined Contributions
NIES	National Institute for Environmental Studies
NIR	National Inventory Report
PDCA	Plan-Do-Check-Act
QA	Quality Assurance
QAWG	Quality Assurance Working Group
QC	Quality Control
SMED	Swedish Environmental Emissions Data
SNICHILE	Chilean National Inventory System
UBA	Umweltbundesamt (German Environment Agency)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme (now UN Environment)
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

1.1 Greenhouse Gas inventories for developing countries under the UNFCCC

Under the United Nations Framework Convention on Climate Change (UNFCCC), all Parties are required to periodically develop and submit national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol. For non-Annex I (NAI) Parties, which are mostly developing countries, the periodicity of inventory reporting is dependent on the requirements for submission of National Communications (NCs) and Biennial Update Reports (BURs).

1.1.1 BURs and NCs

The requirements for reporting by NAI Parties have evolved since the UNFCCC was established. Since 2002, developing countries are reporting their NCs according to the guidelines for the preparation of NCs from NAI Parties (adopted by decision 17/CP.8). The reporting provisions have been further enhanced from 2010 onwards, when the frequency of the submission of NCs from NAI Parties was set to every four years, with an additional requirement to also provide BURs every two years, including updated GHG inventories as well. The first BURs were due in December 2014.

Currently, in accordance with the guidelines for the preparation of NCs from NAI Parties, GHG inventories should, as a minimum, be prepared following the Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories. The guidelines for the preparation of BURs¹ further specify that when providing updates of their GHG inventories, the IPCC Good Practice Guidance (2000) and the Good Practice Guidance for Land Use, Land-Use Change and Forestry (LULUCF) (2003) should also be applied. The new 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereafter: 2006 IPCC Guidelines) show significant improvements over the 1996 IPCC Guidelines and a number of NAI Parties are making efforts to already follow those guidelines. Furthermore, many developing countries are already revising their previous inventories in order to have consistent emission data time series for understanding national GHG trends, which will also provide a basis for improving their planning and decision-making on mitigation actions, including those expressed in their Nationally Determined Contributions (NDCs).

Additionally, with the requirement to submit a BUR, a process of International Consultation and Analysis (ICA)² was introduced. Once a BUR is submitted to the UNFCCC, it will be subject to a technical analysis by an international team of technical experts, followed by a facilitative sharing of views.

A number of developing countries are facing constraints to meet the biennial reporting requirements under the UNFCCC in a continuous manner, both in terms of financial and technical capacities. Many NAI Parties continue to rely on funding from the Global Environment Facility (GEF) as well as other internationally and/or bilaterally funded projects to develop their GHG inventories, BURs³ and NCs. Additionally, in the past, these approaches for support have frequently relied on external technical experts, rather than on building capacities of national personnel. While generally the required products were delivered, no sustainable knowledge and structures for the preparation of GHG inventories were built in the countries, despite trainings and capacity building activities being offered and undertaken. The transition to a permanent approach for ongoing (biennial) inventory preparation implies the need to dedicate budgetary and human resources in a permanent manner within national institutions to manage and carry out core activities of GHG inventory preparation on a regular basis in order to meet the UNFCCC requirements.

1.1.2 The role of GHG inventory technical teams in the context of reporting to the UNFCCC

In the context of an ongoing, two-year cycle of GHG inventory preparation and reporting, there is a need to institutionalise the related processes within a national system for measurement, reporting and verification (MRV), compliant with the reporting requirements for NAI Parties under the UNFCCC. The inventory processes are diverse and largely technical in nature, including information (activity data) gathering from source points (e.g. ministries, national statistics office, the private sector, etc.), data refining, methodological issues (e.g. choice of emission factors, calculation of emissions), quality assurance and reporting. To permit countries to fulfil their international

¹ UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the Convention; see FCCC/CP/2011/9/Add.1, Annex III

² The Information Matters project supports countries participating in the ICA process – see guidance "[Preparing for the ICA process](#)".

³ The Information Matters project supports countries in their efforts to write BURs – see [BUR Template](#) and [BUR Process Guidance Tool](#).

commitments for GHG inventory reporting, in most cases it will be necessary to put in place a national GHG inventory system to manage administrative and technical processes. The core of this national system will be the GHG inventory technical team, who will centralise the inventory-related tasks within the national MRV system and should ideally be placed in a specific department or unit within the country's institution responsible for climate change reporting.

In addition to showing the country's level of GHG emissions for a given year, and, where reported, the trend of emissions over a certain time period, the national GHG inventory report provides a good source of information for other aspects of national climate change reporting such as sectoral GHG inventory trends and progress towards the country's emission reduction targets, including those pledged in the context of the countries' NDCs. As a result, the GHG inventory technical team's role can go beyond the mere preparation of the GHG inventory.

As such, the GHG inventory technical team can be envisioned as the nucleus of connections to focal points for sources of information (such as ministries, etc.) within a process to collect activity data, determine emission factors, and generate calculations in line with principles of inventory quality, as well as timeliness and adherence to the UNFCCC reporting guidelines.

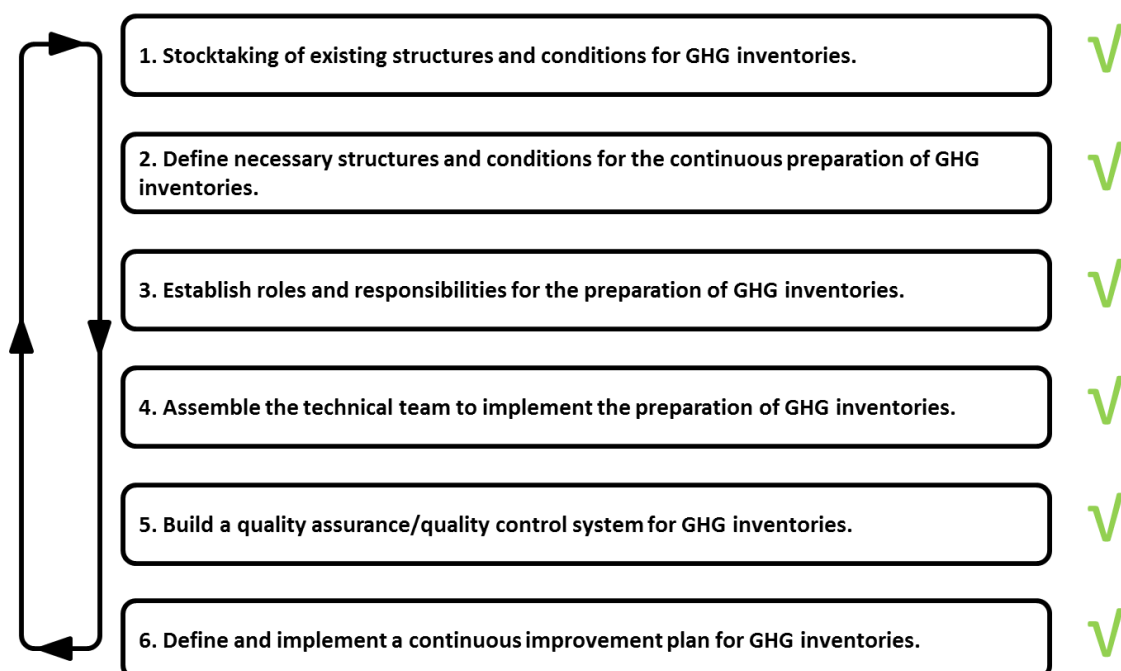
1.2 Scope of this guidance

This guidance aims to assist NAI Parties in meeting a significant part of their reporting requirements to the UNFCCC, i.e. the national GHG inventory, by setting up or enhancing national technical teams for the preparation and reporting of GHG inventories on a regular basis within a national system of GHG inventories. It draws upon experiences from the Information Matters project and lessons learned from developing and developed countries reporting to the UNFCCC over the last decade. Moreover, the guidance assists in highlighting potential capacity needs in establishing and setting up national teams of GHG inventory experts and how these might be addressed.

The document presents examples, many of which are from Annex I Parties, which have longer experience in this process. Lessons learned from the Annex I countries are helpful for NAI Parties, keeping in mind that reporting requirements for Annex I countries are more rigorous (e.g. annual reporting of inventory).

The guidance presented in this paper can be visualised as a step-by-step process that sequentially addresses key actions for setting up or enhancing a national technical team for GHG inventories (Figure 1). The steps included in this process should facilitate the establishment of an operational team, able to comply with current and future UNFCCC reporting requirements.

Figure 1. Six-step approach for setting up and enhancing national technical teams for GHG inventories (Source: NIRAS, 2017)



The first step consists of a stocktaking of existing structures and conditions for GHG inventories. This step gathers information on the current resources dedicated directly and indirectly to the compilation of GHG inventories in a country. The second step defines necessary structures and conditions for the regular preparation of GHG inventories following appropriate standards and existing processes in a country, while ensuring the reliable provision of homogenous activity data from relevant sources. The third step describes how to establish roles and responsibilities for the preparation of GHG inventories, defining the management of the system, responsibilities for data gathering, and supervision of data processing and reporting. The fourth step is dedicated to the set-up of the team, addressing the requirements for a professional team with adequate knowledge of the elements of GHG inventories and related reporting for BURs and NCs. The fifth step provides guidance on developing and managing a quality assurance (QA) and quality control (QC) plan for GHG inventories, throughout the process of preparation and updating. Finally, the sixth step addresses how to implement a continuous improvement plan for GHG inventories.

Following the description of the steps listed above, this paper provides additional guidance on strategies to support the sustainability of technical teams for GHG inventories once they have been established so as to maintain continuity in the reporting process. This approach can be used to set-up a GHG inventory team from scratch, or also may be applied to enhance specific aspects if the team already exists, since each step has its own requirements and recommendations to achieve best practices.

1.3 Information Matters project

The *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) GmbH on behalf of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) of Germany under its International Climate Initiative (IKI) is providing capacity-building and technical support to a number of selected partner countries under the Information Matters (IM) project. The aim of the project is to strengthen in-country capacities for enhanced reporting under the UNFCCC focussing particularly on the preparation of Biennial Update Reports (BURs) and implementation of sustainable MRV systems. During the first phase of the project (2013-2016), support has been provided to the four partner countries Chile, the Dominican Republic, Ghana and the Philippines. During the second project phase (2016-2018), support is provided to four additional countries, namely Colombia, Georgia and Viet Nam, building upon the results, experiences and lessons learned gained in the first phase of the project. In this context, the IM project also generates widely applicable knowledge products based on practical experience, such as this guidance for setting up and enhancing national technical teams for GHG inventories.

2 Step-by-step approach for setting up and enhancing national technical teams for GHG inventories

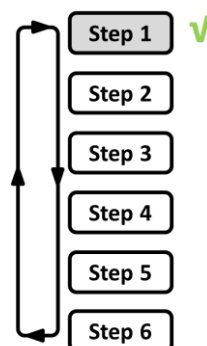
2.1 Step 1: Stocktaking of existing structures and conditions for GHG inventories

The aim of this step is to understand and document the existing system for GHG inventory preparation and reporting within a country. The stocktaking seeks to define the current situation of the team, if any, and the existing base on which a new or enhanced team will be developed.

It should examine the complete picture of the components involved in the GHG inventory process. An important action is to document the involved institutions and functions/posts of staff, their interactions and their tasks for the construction and reporting of GHG inventories, such as provision of activity data and emission factors. In this context, the stocktaking should document any relevant formal or informal agreements between involved institutions.

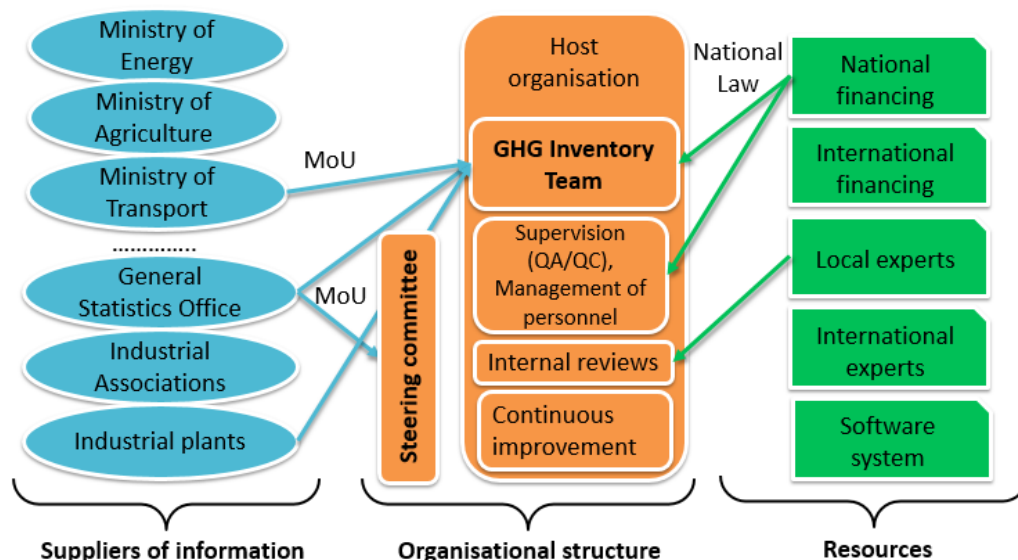
Some useful questions for this step include:

- Is there an entity responsible for the GHG inventory?
- Are there suitable GHG inventory experts in the institutions?
- Is the country making use of GEF funds for the preparation of GHG inventories on a continuous basis?
- Is a certain and permanent budget available (international funding aside) to ensure a sustainable functioning of the system?
- Are there laws, regulations or institutional agreements in place relevant for the preparation of GHG inventories (e.g. for the submission of GHG relevant data)?



Moreover, the stocktaking should examine the resources currently in use to support the GHG inventory process. This includes national policies, laws, regulations or institutional agreements governing the GHG inventory, national and international financing, human resources, and infrastructure resources such as servers and software. The results of the stocktaking will allow the institution charged with setting up or enhancing the technical team to perform a gap analysis of the existing structures and conditions, specific reporting requirements for the inventory, or the goals of the country. Figure 2 shows an example of how relationship mapping may be presented using the information compiled during stocktaking. This approach helps visualising the most important relationships and how key stakeholders related to the GHG Inventory process interact within it, and how resources are connected to the system in order to ensure its functionality and sustainability.

Figure 2. Relationship map example (Source: NIRAS, 2017)



The IM project has produced an analytical tool supporting the process of stocktaking, the *Stock Taking Tool*⁴. While this tool aims to assist in a broader stocktaking of a country's current conditions for BUR-reporting, it also addresses the set-up of national MRV systems and the country's overall mitigation architecture, and hence covers key issues related to GHG inventory preparation. Institutions may consider applying this tool to contribute to the GHG inventory-specific stocktaking addressed here.

Experience in conducting the stocktaking in IM partner countries has shown that countries often encounter similar challenges related to the preparation of their GHG inventories. The most common challenges are summarised in the table below.

Table 1. Common issues identified in stocktaking of GHG inventory arrangements (Source: NIRAS, 2017)

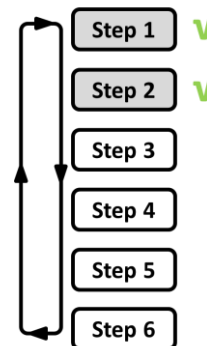
Challenge	Context
GHG inventory team is dependent on external financing from international donors (e.g. GEF funding)	Competing political priorities mean national budget is not made available to the inventory
Suppliers of activity data do not have dedicated resources for data compilation, and activity data are incomplete	Legal requirements or agreements for contributing to the GHG inventory do not exist/or are not sufficient. In addition, lack of financial and human resources on the supplier's side is an important restriction.
Insufficient number and/or experience of professionals to cover all the sectors of the GHG inventory	Absence of stable career opportunities for professionals with experience in GHG inventories
GHG inventory is not a national priority	National commitments such as NDCs are formalised, but government authorities are not aware of their relationship to the inventory
GHG inventory process lacks QA/QC and continuous improvement strategies	Technical capacities are not sufficient to implement a QC plan. Management and/or resources are not available to build a permanent system for third party review (QA).
Scope of the work surpasses the limited resources of the team in charge	Authority charged with inventory preparation is not familiar with the nature of the work or does not have sufficient human resources
Insufficient documentation and archiving of methods and/or data sources of previous inventories	Project-based approach used in previous inventory did not consider regular reporting intervals in the future

The resulting analysis of the stocktaking will serve as the basis for the next step of defining the arrangements for periodic preparation of GHG inventories in the country.

⁴ The *Stock Taking Tool* can be downloaded here: <https://www.transparency-partnership.net/giz-2017-stock-taking-tool>

2.2 Step 2: Define necessary structures and conditions for the continuous preparation of GHG inventories

The second step helps defining necessary actions to enable countries to produce accurate, complete GHG inventories in a timely manner. Currently, developing countries should generate a GHG inventory every two years to comply with the requirements under UNFCCC decision 1/CP.16. Thus, countries should consider a biennial cycle for GHG inventory preparation as a minimum requirement. Taking into account the reporting requirements and underlying methodologies as well as the available resources, the country should determine the characteristics of the inventory that it seeks to generate. Then, the country can define the national structures and conditions to achieve a GHG inventory with these characteristics.



2.2.1 Legal arrangements

It is essential for countries to examine what type of legal basis would be most useful to underpin the inventory preparation process, including the underlying data and information sharing between institutions. This may include a regulation, directive, law, decree, decision or other legal instrument that allows establishing a permanent national entity with responsibility for the GHG inventory and, if necessary, the GHG inventory team. It also covers the legal instrument necessary to formally assign roles and responsibilities to relevant government institutions. In some countries, it could be useful to legally determine the submission of data within a certain time frame to ensure the regular development of a GHG inventory. For example, in Sweden, *the Official Statistics Act (SFS 2001:99) and the related Ordinance 2001:100* obliges companies to contribute to the national GHG inventory reporting. In the case of Chile, the Office of Climate Change of the Ministry of the Environment established its national inventory system in 2012 within the scope of its existing mandate. The appropriate legal basis will depend on the country-specific conditions and norms.

2.2.2 Institutional set-up

Together with the legal framework, it is also recommended to determine the required characteristics of the institution(s) responsible for the GHG inventory and the role and relationship with other contributing institutions. There are two main approaches to institutional set-up. The first is a centralised approach, where one lead agency, department or team maintains a significant degree of control over the inventory preparation. This approach is applicable if there is a legal entity with strong technical expertise, the managerial capacity to run the inventory project, and enough agility to undertake legal agreements with data suppliers and other stakeholders (e.g. a memorandum of understanding, a ministerial decree or official letter defining procedures for supply of activity data). The second option is a more decentralised approach, in which a group of teams and/or institutions undertake parts of the inventory with discretion over methodological issues, organised by a central committee or similar body⁵. This guidance document addresses the steps needed when developing a GHG inventory team as a sustained unit within a national entity for inventories, i.e. a centralised approach.

As an example for a centralised approach, [BOX 1](#) presents the German GHG inventory system. For an additional example of such an approach, see the Finnish institutional arrangements in Annex I.

Irrespective of the approach taken, the institutional set-up needs to take into account other institutions that must be involved in the GHG inventory preparation process. This process may begin by describing the operational workflows of information that will be needed by the inventory team to carry out its mandate. Information relevant for the preparation of a GHG inventory includes, amongst other activity data and emission factors. Activity data refers to the annual, national magnitude of an activity (e.g., tonnes of coal mined nationally in a given year or livestock numbers). Activity data sources may include national databases from government ministries or agencies (e.g. ministries of energy and agriculture, statistics services, environmental protection agencies); standard production statistics from national statistical publications or from industry associations; or even international data sets (data sets from the Food and Agriculture Organization and international industry associations). An emission factor is the mass of GHG emitted per unit of activity (e.g. gram CH₄ per tonne of coal mined). This check should contemplate all the information needs related to the preparation of the GHG inventory and the related information to be reported in the NC and BUR. As

⁵ One other approach is to hire consultants repeatedly to undertake the inventory preparation process. This outsourcing method can be cost-effective if the market offers competitive, competent consultants and research institutes. The UK is an example of a country that applies this approach.

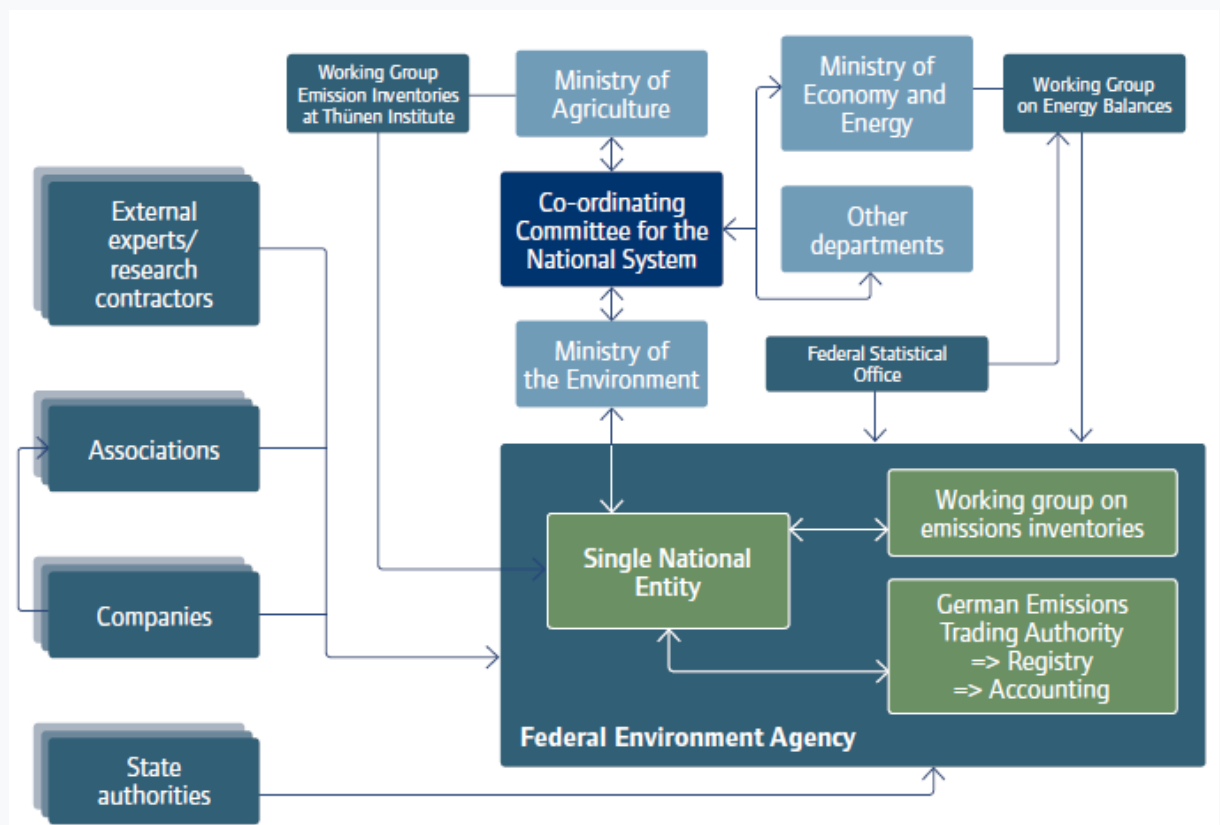
part of this check, it may be useful to prepare a visual map of the connections between the GHG inventory technical team and its sources of data. Generally, there is a group of suppliers of information such as ministries, the general statistics office, industrial associations and specific industries that should, ideally, have an obligation to deliver their activity data in line with quality requirements and according to a defined schedule. This package of information will be received by the GHG inventory team to contribute to the process of building the inventory.

BOX 1: German GHG inventory system

Germany established its national inventory system in 2007 to prepare annual National Inventory Reports to comply with UNFCCC and European Union requirements. The national system was formally set up through an agreement among the state secretaries of relevant ministries, with basic reporting principles and responsibilities laid out in a “Principles Paper for the National System on Emission Inventories”. In this system:

- The **German Environment Agency** (UBA) acts as coordinating entity,
- The ministries participate under the leadership of the **Federal Ministry of Environment, Nature Conservation, Building and Nuclear Safety**, and
- Entities outside the federal government participate, including private entities.

The structure of the system is shown below:



Source: *Good Practice Analysis 2.0: Institutional Arrangements for the GHG Inventory System – 2015, International Partnership on Mitigation and MRV, Low Emissions Capacity Building Programme*

The state secretaries’ agreement also stipulates that the national GHG inventory system should use existing data flows and processes wherever possible. Approximately 80% of data used for GHG emissions reporting is derived from data from the **Federal Statistics Office**. To use this data for GHG emissions reporting purposes, a separate agreement with the Statistics Office was required.

Sources: https://www.transparency-partnership.net/sites/default/files/ws15223_germany_qpa2015_en_fin_web.pdf, www.umweltbundesamt.de/en/topics/climate-energy

Other types of institutions may also have an important relationship with the work of the GHG inventory team. For example, there may be a separate group generating and/or approving the report to the UNFCCC in line with the Party’s commitments that may or may not be located within the same entity as the GHG inventory team. The relationship between each of these entities or resources and the GHG inventory team should be defined by clear rules and procedures, since this will translate into quality activity data, timely provision of data, accurate reporting and fluent operation of the team’s work. A Memorandum of Understanding (MoU) or a ministerial decree may be effective

solutions to establish coordination between the GHG inventory technical team and data sources or suppliers. The entity in charge of the inventory can be responsible for arranging this type of coordination to permit sustainable reporting.

Indonesia provides an example of an institutional set-up through a Multi-Sectoral Policy⁶. The presidential regulation No 71/2011 on the implementation of a national GHG inventory mandates different bodies of the government to produce activity data at national, local and corporate level on an annual basis. The national inventory, which is submitted to the UNFCCC, is coordinated by the Ministry of Environment. In this case, the presidential regulation acts as a coordinating element between the national GHG inventory team and data suppliers, equivalent to MoUs and efficient in time covering not only the ministries but also large enterprises to assure a delivery of information in time and scope.

2.2.3 Human resources

In addition, it is pivotal for countries to anticipate human resources that will be needed to manage and carry out the periodic GHG inventory preparation. The number of team members is subject to the country specific situation, i.e. the availability of national experts, budget and the amount of data to be processed. Considering respective circumstances, a GHG inventory team should, at a minimum, comprise four different positions, namely inventory coordinator (who can also take the role of NC and BUR coordinator), inventory compiler, sector expert(s) and QA/QC coordinator.

The inventory coordinator should be responsible for the overall planning, coordination, management and technical oversight of the inventory development whereas the inventory compiler is in charge of overall data and document management. A sector expert conducts research, data collection, calculations, drafting of sector-specific inputs, QC, archiving, and documentation of the sector-specific information. Moreover, they foster coordination with other sector experts identifying and resolving cross-sectoral challenges. The QA/QC coordinator is predominately concerned with quality assurance/ quality control coordination and can as well be responsible for overall data and document management (more details on QA/QC in 2.5). Multifunctional profiles are also possible and efficient in this type of activity, as for example, a QA/QC coordinator can be also a sectoral expert in waste and cover both tasks simultaneously.

More detailed information about the profiles of those four key roles is included in [Step 4](#) of this document.

2.2.4 Financial resources

Likewise, both available and necessary funding covering the costs of the periodic inventory preparation needs to be explored. In developing the budget, the country should consider the human resources within the GHG inventory team, as defined in the previous sub-section. Furthermore, any budget item associated with other institutions contributing to the inventory process should be considered. Finally, the preparation of the budget should consider the cost of other resources such as external experts, computer systems, software tools, central server and so forth. It is recommended to make use of existing personnel and other resources in the process of building a sustainable GHG inventory preparation process. For example, in a ministry for the environment or in an institute for agricultural studies, employees may be in charge of compiling information relevant to the GHG inventory (such as air quality data, waste management or fertiliser use) but lack sufficient training on GHG inventory preparation. Building capacity of such personnel would be a low cost option instead of hiring new staff or developing a new entity for GHG inventory management.

In most cases, the funding for the preparation of GHG inventories in NAI Parties have come from international sources, such as from GEF, which provides funding for the preparation of NCs and BURs, both directly and through its implementing agencies such as the United Nations Development Programme (UNDP) and UN Environment (UNEP). Nevertheless, while the UNFCCC recognises that NAI Parties require financial and technical assistance and support for the preparation of NCs and BURs, it is also important to consider that GEF and other international funding may not be a long-term solution for fully financing the GHG inventory, in particular if the aim is to institutionalise the inventory into the national structures and build up the necessary capacities. [Chapter 3](#) includes references about the sustainability of this need. Some countries are already preparing their GHG inventory to a certain extent with own national resources, complemented by internationally received funding. Thus, it is also relevant to consider the role that national resources can play in the financing

⁶ See: <http://www.iea.org/policiesandmeasures/pams/indonesia/name-140162-en.php>

of the GHG inventory team and the continuous GHG inventory process. This may include complete coverage of the associated costs or co-financing by an international or bilateral source.

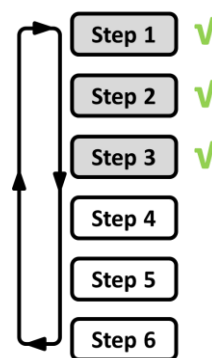
2.2.5 Stakeholder consultation

During the process of defining the characteristics of the target GHG inventory and the legal, institutional, human resource, and funding arrangements necessary to achieve it, an important component should be stakeholder consultation. Two of the main types of stakeholders to inform and consult include: (1) the institutions that will be involved in the inventory preparation, both data providers and possible national entities that could host the GHG inventory technical team, and (2) the potential users of the GHG inventory results.

Consultation with the contributors to the GHG inventory process will permit the country to account for their varying responsibilities, capacities and commitment during the planning process and the selection of the national entity host for the GHG inventory technical team. Furthermore, consultation with users of the GHG inventory results provides feedback as the country defines the characteristics of the GHG inventory such as level of detail required and tiers to apply. It may also help to define appropriate national and international funding sources. Typical users of these results are ministries, energy companies, industrial associations, and non-governmental organisations (NGOs).

2.3 Step 3: Establish roles and responsibilities for the preparation of GHG inventories

Taking into account the requirements defined in the previous step, Step 3 proceeds to provide a thorough definition of roles and responsibilities of the team members for the different activities of inventory preparation. The roles and responsibilities should cover key tasks such as inventory planning and management, provision of high quality activity data in a timely manner, selection of emission factors, inventory calculation, QA/QC and report preparation. Typical roles related to GHG inventory for reporting in the BUR and NC are described in Table 2 below.



Different countries have assigned entities with different expertise to be the lead institution. As noted previously regarding the German system (see [BOX 1](#)), the responsibility lies with the German Environment Agency that acts as lead institution, whereas in Finland it is the national statistics authority Statistics Finland (see [Annex I](#)). As another example, in Chile it is the Department of Climate Change within the Ministry of Environment. In any case, the selection should be enshrined in legal arrangements, as addressed in the previous chapter, and the responsibilities of the lead institution should be defined and delimited. The GHG inventory team should be located ideally within this lead institution and not within multiple ministries.

Table 2, below, provides an overview of the roles, responsibilities and capacities related to a functional GHG inventory system.

Table 2. Roles, responsibilities and capacities for GHG inventories (Source: Mitsubishi UFJ Research and Consulting, 2014)

Role	General responsibilities	Necessary staff capacities
Lead institution	<ul style="list-style-type: none"> Responsible for inventory management, planning and improvement Overall supervision of GHG inventory development Management of contracts and delivery of GHG inventory Coordination with stakeholders Identification of necessary resources to improve the inventory 	<ul style="list-style-type: none"> Technical and administrative expertise, as well as formal government authority Technical knowledge of the UNFCCC reporting requirements and IPCC methodologies Capacity to coordinate and lead the process
National focal point for BUR/NC	<ul style="list-style-type: none"> Submission of the GHG inventory Communication with UNFCCC 	<ul style="list-style-type: none"> Knowledge about UNFCCC procedures and reporting guidelines/requirements
Data providers	<ul style="list-style-type: none"> Timely delivery of data in appropriate format Management of internal data acquisition and processing, QA/QC requirements Communication with lead institution 	<ul style="list-style-type: none"> Technical skills, legal authority to improve and enhance data collection
Independent entity	<ul style="list-style-type: none"> Conduct QA activities 	<ul style="list-style-type: none"> Technical skills to review the GHG inventory
GHG inventory team	<ul style="list-style-type: none"> Coordination with lead entity to prepare the GHG inventory Scheduling of tasks and responsibilities Data acquisition, processing and reporting Review of source data and identification of developments required to improve GHG inventory data quality Documentation and archiving Management of QA/QC plans Delivery of GHG inventory products 	<ul style="list-style-type: none"> Technical skills to carry out estimation and draft inventory report. Technical knowledge of the UNFCCC reporting requirements and IPCC methodologies

The national entity should develop a plan with a clear timeline for the preparation of the GHG inventory. Guidance documents such as the UNDP *Managing the National Greenhouse Gas Inventory Process*⁷ and the United States-Environmental Protection Agency (US-EPA) *Template Workbook*⁸ are useful for this purpose.

Subsequently, the relationship between lead institution and data providers should be defined, and a legal decision, for instance, would facilitate the definition of this relationship. The appropriate agreements defined in the planning stage should be signed or otherwise set-up between the lead institution and each contributing institution. Stakeholder consultation is encouraged at this stage conducted by the national entity responsible for the GHG inventory. The aim in this step is to inform all participants in the inventory and users of the inventory about the responsibility for its preparation and the outline of the preparation plan.

The allocation of roles and responsibilities for GHG inventory development in Sweden is provided as an example in [Annex II](#).

⁷The UNDP *Managing the National Greenhouse Gas Inventory Process* can be found here: http://www.undp.org/content/undp/en/home/librarypage/environment-energy/low_emission_climateresilientdevelopment/managing-the-national-greenhouse-gas-inventory-process.html

⁸ US-EPA *Template Workbook* can be found here: http://ledsgp.org/resource/greenhouse-gas-inventory-system/?loclang=en_gb

2.4 Step 4: Assemble the technical team to implement the preparation of GHG inventories

The fourth step is to assemble the technical team for the preparation of the GHG inventory, or to strengthen the existing team. The first consideration for this step is to define the roles and functions required to develop and prepare the GHG inventory. These functions of the GHG inventory cycle can, for example, be summarised in six stages: plan, collect, estimate, write, improve, and finalise (see Fig. 3, GHG inventory cycle, US-EPA 2011). Using this concept, it is clear that the team entails a variety of functions including management, coordination, data compilation and calculation, and expertise regarding sector emissions.

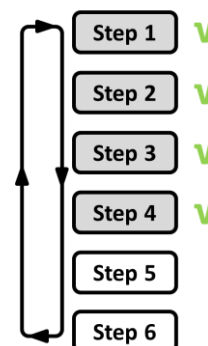
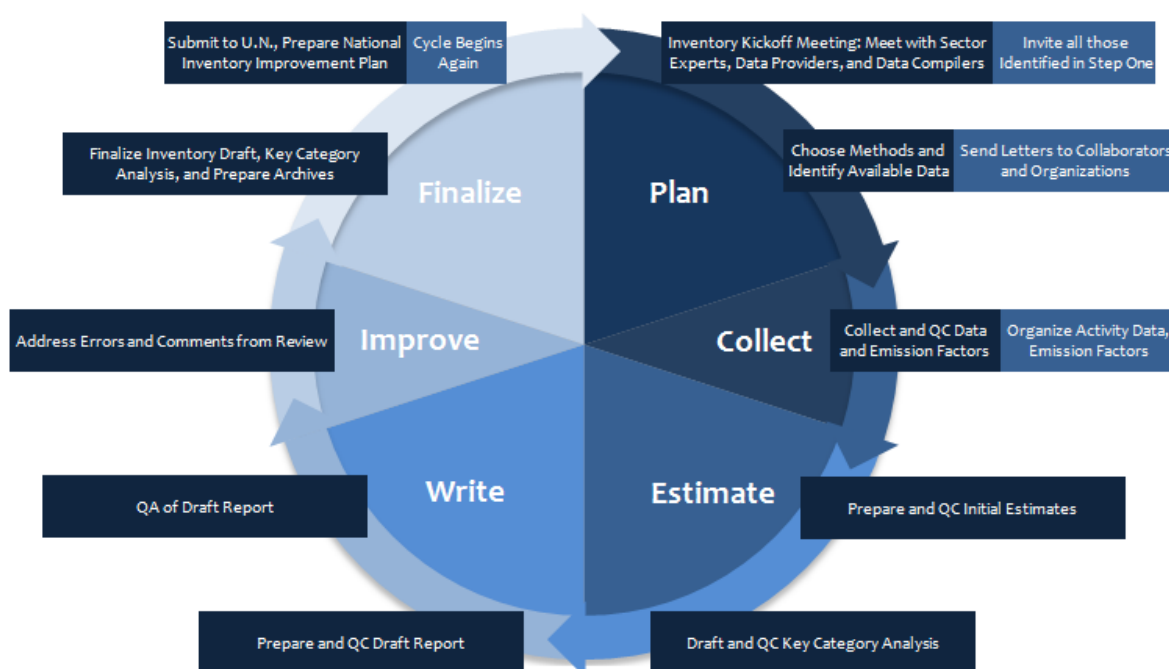


Figure 3. GHG inventory cycle (Source: EPA USA, Template Workbook, 2011)



Under the management of the inventory coordinator, the national entity should define the human resources that will be necessary to manage and implement the periodic GHG inventory preparation. While the GHG inventory technical team may rely on external experts for some of its activities, it nevertheless will require staff with the technical knowledge for the tasks involved. The human resource requirements will depend to some extent on the decisions made about the design of the GHG inventory. For example, if all the inventory categories are calculated using IPCC-Tier 1 methods, the number of technical staff may be smaller and involve staff with general skills. On the other hand, an inventory using Tier 2 or Tier 3 methods will likely require more specialists to manage different sectors, categories and sub-categories addressed in detail by the inventory calculation.

Similarly, a smaller country will be able to rely on fewer people to address the number and types of data sources considered in its inventory. In contrast, a very large country with a wide array of economic activities may require a larger number of individuals to manage the volume and diversity of data to be processed for the inventory calculations.

Taking into account these considerations, the national entity should define the profiles of key staff that will be needed to carry out the inventory tasks. The GHG inventory team should include at least four roles: inventory coordinator, inventory compiler, sector expert and QA/QC coordinator. Table 3 below describes each role and the capacities necessary for each. In small countries with limited human resources, some roles could be merged, for example coordination and compiling. In the absence of country experts with the adequate knowledge, candidates with experience in the compilation and preparation of reports for international organisations should be considered, and knowledge on UNFCCC requirements should be built up through the support of international cooperation or donors. It should be noted that in the establishing of such a team will require certain time and as the team grows the roles and functions of the team members will get more clearly defined.

Table 3. Roles and capacities in a GHG inventory team (Source: Mitsubishi UFJ Research and Consulting, 2014)

Role	General responsibilities	Necessary staff capacities
Inventory coordinator	<ul style="list-style-type: none"> Overall planning, coordination, management and technical oversight of the inventory 	<ul style="list-style-type: none"> Technical and administrative expertise, as well as formal government authority.
Inventory compiler	<ul style="list-style-type: none"> Overall data and document management Combine sector experts' work into a cohesive inventory product Identify and propose ways to resolve cross cutting issues 	<ul style="list-style-type: none"> Technical knowledge of the UNFCCC reporting requirements on NCs and BURs and IPCC Guidelines 1996 and/or 2006. Technical skills to carry out estimation and draft report
Sector experts	<ul style="list-style-type: none"> Undertake research, data collection, calculations, drafting, QC, archiving, and documentation Coordinate with other sector experts to identify and resolve cross-sectoral issues 	<ul style="list-style-type: none"> Knowledge of the sector (Energy, Industrial Production, Agriculture, LULUCF, and Waste) at the country level, including activity data (e.g. energy generated, amounts produced, livestock numbers) and main statistics relevant to the sector and ability to make expert judgements and use assumptions in cases where data may not be accurate or sufficient.
QA/QC coordinator	<ul style="list-style-type: none"> Overall QA/QC coordination and/or overall data and document management 	<ul style="list-style-type: none"> Administrative and technical expertise Technical knowledge of QA/QC techniques for large flows of technical information and reporting. Good understanding of UNFCCC requirements for NCs and BURs, and IPCC guidelines. Understanding of uncertainty calculation.

While these represent minimum requirements, Parties may employ a variety of other roles in their GHG inventory teams. The final number of sector experts to support these positions, as permanent members of the team or external consultants, should be decided according to the country specific situation, e.g. volume of work or available budget. [BOX 2](#) demonstrates an example of GHG inventory team roles and responsibilities from Chile, where the core group includes an inventory process manager, a QA/QC officer, an inventory compiler, and a national inventory report compiler, while additional experts are available upon request based on specific needs.

BOX 2: Roles and responsibilities in the GHG inventory team in Chile

The Chilean National Inventory System (SNICHILE) is organised in a decentralised manner and managed by a single entity that prepares the national GHG inventory through ongoing collaboration with a variety of public agencies. Chile's national GHG inventory team is located within the national entity (Ministry of Environment's climate change office), which coordinates the work of sector teams responsible for preparing their respective sector-specific inventories, and Chilean experts who lend their expertise on national GHG inventory matters across all areas. The national inventory team reports to the BUR/NC national coordinating team, which incorporates the NGHGI into the corresponding report. Lastly, the national coordinating team reports to the Ministerial Council for Sustainability and Climate Change, which approves the corresponding reports.

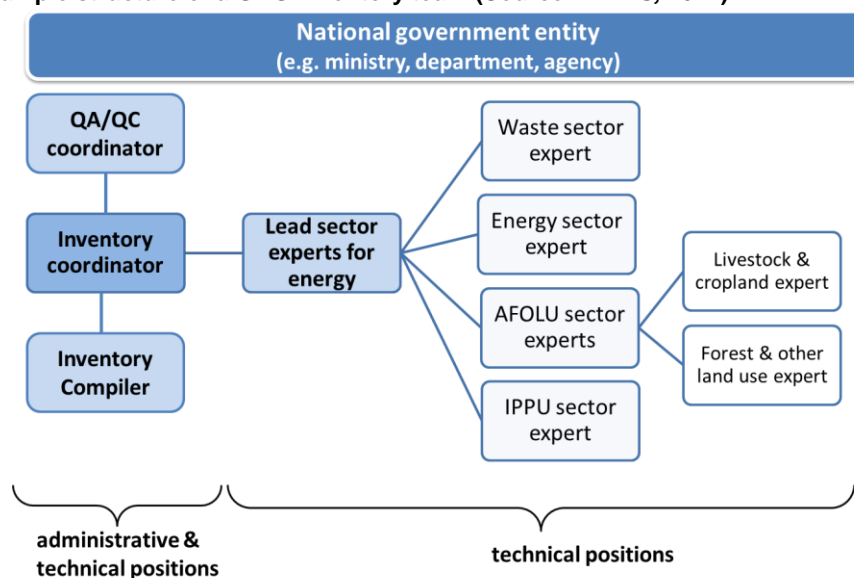
Source: *Chile's national Greenhouse Gas Inventory 1990-2010 – 2014, Climate Change Office, Ministry of the Environment of Chile*

Since 2013, the national entity has been holding meetings of the national GHG inventory team to coordinate and operate SNICHILE. Bilateral meetings are also held regularly with sector teams to address sector-specific issues and support by international experts is sought as part of the GHG inventory improvement plan.

Source: <http://unfccc.int/resource/docs/natc/chlnire.pdf>

Defining a team structure will particularly clarify responsibilities for each role. The objective is to define ownership of each component of the inventory and enable team members to have a clear understanding of their role, position in the team and responsibility. Figure 4 below provides an example of the structure of a GHG inventory team. Note that in some cases, the inventory compiler and the QA/QC coordinator could be the same person, while also covering technical expertise in a sector. These considerations depend on the size of the team necessary to adequately cover the volume of work.

Figure 4. Example structure of a GHG inventory team (Source: NIRAS, 2017)

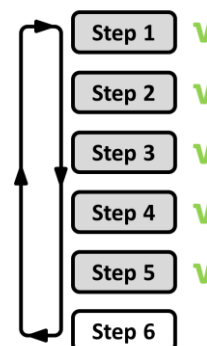


Each role comprises specific knowledge requirements. [Annex III](#) provides an example for these requirements adapted from the US-EPA *Template Workbook for Developing GHG Inventories*, 2011.

As the technical team is assembled, and once it is operational, it will be strengthened by designing and implementing a permanent process of capacity building in GHG inventory preparation and improvement. A list of recommended topics for capacity building, including references to sources for relevant materials and further information can be found in [Annex IV](#).

2.5 Step 5: Build a quality assurance/ quality control system for GHG inventories

This step provides guidance on how to establish a management system that allows adherence with UNFCCC quality requirements expressed as transparency, consistency (internal), comparability (external), completeness and accuracy. The development of the GHG inventory is a process compiling a great amount of information, from different sources, and with different levels of uncertainty. The process of inventory compilation should be repeated periodically and therefore a certain standardisation of the compilation and calculation of emissions is necessary. For these reasons, it is advisable to include a QA/QC system in the scope of the GHG inventory team.



The responsibility of QA/QC should rely on a specialist dedicated fully or partially to this task, reporting to the inventory coordinator and supported by a permanent system with control points and procedures to assure a standard quality in the GHG team office and also for data suppliers. The responsibility has as scope the QC of information from suppliers, QC of the processing of datasets, archiving of correct files, edition of the reports and assuring the references to all the information presented assuring transparency. Also, this position will have responsibility in the continuous improvement process, updating of new knowledge and procedures on GHG inventories calculation or modalities for reporting; creating a channel for external stakeholders with aim to improve the next reporting cycle.

In addition to QA/QC undertaken by the Party, once the inventory is reported in a BUR and submitted to the UNFCCC, it will be subject to the ICA process, including a technical analysis by an international team of technical experts coordinated by the UNFCCC.

The IPCC⁹ defines quality control and quality assurance as follows:

- **Quality Control (QC)** – a system of routine technical activities implemented by the inventory development team to measure and control the quality of the inventory as it is prepared. QC activities include general methods such as accuracy checks on data acquisition and calculations, and the use of approved standardised procedures for emission and removal calculations, measurements, estimating uncertainties, archiving information and reporting. QC activities also include technical reviews of categories, activity data, emission factors, other estimation parameters and methods.
- **Quality Assurance (QA)** – a planned system of review procedures conducted by personnel not involved in the inventory development process. QA is a planned system of review procedures conducted by independent experts and are performed following the implementation of QC procedures.

The staff responsible for coordinating QA/QC activities has been addressed in [Step 4](#) of this guidance. The other components of a national plan involve the definition of procedures to be applied during inventory preparation, review and finalisation to ensure compliance with the UNFCCC¹⁰ quality requirements listed. These procedures may be incorporated in a system that parallels the entire GHG inventory process, providing checks and reviews along the way.

An effective national QA/QC plan contains the following elements:

- Personnel responsible for coordinating QA/QC activities.
- General QC procedures.
- Source-specific QC procedures.
- QA review procedures.
- Schedule for conducting QA/QC activities.
- Reporting, documentation, and archiving procedures.

⁹ See: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_6_Ch6_QA_QC.pdf

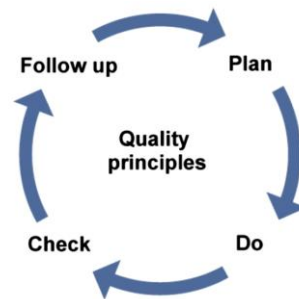
¹⁰ See: http://unfccc.int/national_reports/non-annex_i_natcom/guidelines_and_user_manual/items/2607.php

Specific activities as part of the national QA/QC procedures by the QA/QC coordinator, in collaboration with GHG inventory compiler include:

- Review changes in literature, methods, and assumptions used for the current inventory.
- Review previous years' estimates and methodologies.
- Cross-check the tools, methods and information used for the current inventory with any new developments.
- Review reliability of applied methodology (Tier), i.e. check estimations and statistical procedures; review the quality of the outputs using sensitivity analysis.
- Revise the workflow and methodologies of the data suppliers.
- Undertake internal review of procedures, workflows and performance in time and quality.
- Revise MoUs, if necessary.

Figure 5 shows the Plan-Do-Check-Act cycle (PDCA cycle) developed in Sweden.

Figure 5. Adaptation of PDCA cycle for Sweden QA/QC cycle (Source: Sweden National Inventory Report, 2016)



The Swedish national QA/QC system is designed to ensure the quality of the inventory, i.e. to ensure its transparency, consistency, comparability, completeness and accuracy, in accordance with the reporting guidelines of the UNFCCC and the Kyoto Protocol¹¹. The Swedish quality system is based on the structure described in the UNFCCC guidelines for national systems under the Kyoto Protocol and applies a model aimed to maintain and enhance systematic quality and environmental management according to international standards. The quality system includes procedures such as training of staff, inventory planning and preparation, quality checks, QA, publication, data storage, follow-up and improvements. All QA/QC procedures are documented in a QA/QC plan, which also includes a schedule describing the different stages of the inventory from its initial development to final reporting in the national inventory report. The quality system ensures that the inventory is systematically planned, prepared and followed up in accordance with specified quality requirements so that the inventory is continuously developed and improved. A full example of their QA/QC system is provided in [Annex V](#).

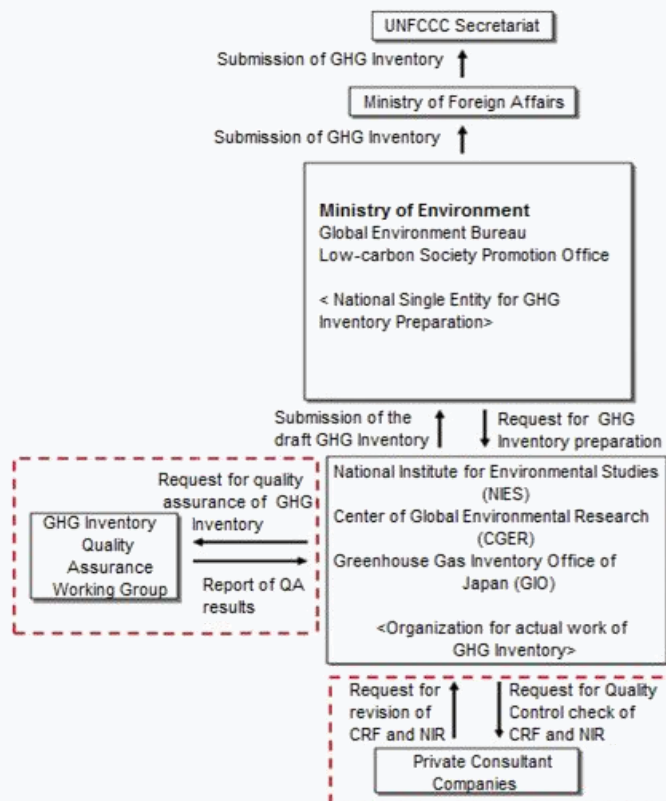
Different methods may be applied depending upon national circumstances. The QA/QC system of the GHG inventory of Japan, for example, relies on a core element called the GHG Inventory Quality Assurance Working Group. This started with a small team in the national environmental agency plus a handful of external consultants, while now it comprises an expert committee with 60 members to improve the inventory continuously ([BOX 3](#)). Many developing countries have organised good practices for QC of their inventories to improve the quality. There are also examples of QA measures occurring within a continuous process with set procedures for specific sectors, encompassing local reviews, training personnel involved in QA/QC standards, assuring a good use of common formats and investing in supporting systems to have reliable information technology (IT) for archiving, documentation sharing and large datasets management. One key issue has been the homogenisation of time series as Parties have moved to higher tier methodological approaches and needed to recalculate their historical data. Thus, it is advisable for all countries to put in place regular QA/QC procedures.

¹¹ See: https://www.naturvardsverket.se/upload/sa-mar-miljon/statistik-a-till-o/vaxthusgaser/2015/national-inventory-report-nir_rapporterad-till-unfccc-160415.pdf

BOX 3: QA/QC practices in Japan

When compiling the inventory in Japan, inventory quality is controlled by performing QC activities (such as checking the correctness of calculations and archiving of documents) at each step in accordance with 2006 IPCC Guidelines. QC activities are conducted by private consulting companies as per requests from the GHG inventory teams. In addition, ministries providing the data to the GHG inventory teams conduct QC activities for the data they are providing to the GHG inventory team. Furthermore, the GHG inventory team within the national GHG inventory office conducts general QC activities.

For QA, there is the GHG Inventory Quality Assurance Working Group (QAWG) using experts who are not directly involved in inventory compilation to avoid conflict of interests. The role of this group is to assure inventory quality and identify specific topics that need improvement. This practice started in 2009 and uses detailed reviews of each emission source and sink as its main tools.



Source: National Greenhouse Gas Inventory Report of Japan – 2016, NIES, CGER and GIO.

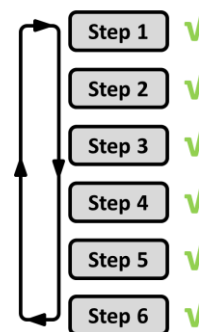
The table below summarises all the QA/QC activities utilised in inventory preparation.

	Implementing entity	Main contents of activity
QC (Quality Control)	Ministry of the Environment (Low-carbon Society Promotion Office, Global Environment Bureau)	<ul style="list-style-type: none"> • Coordinating QA/QC activities for inventory preparation • Establishing, revising, and approving QA/QC plan • Developing, checking, and approving inventory improvement plan
	Greenhouse Gas Inventory Office of Japan, Center for Global Environmental Research, National Institute for Environmental Studies (GIO)	<ul style="list-style-type: none"> • Conducting general QC check • Archiving QA/QC activity records and relevant data and documents • Developing inventory improvement plan • Revising QA/QC plan
	Relevant Ministry and Agencies	<ul style="list-style-type: none"> • Checking data necessary for inventory preparation • Checking JNGI files and inventory prepared by GIO (Category-specific QC)
	Committee for the Greenhouse Gas Emissions Estimation Methods	<ul style="list-style-type: none"> • Discussing and assessing estimation methods, emission factors, and activity data (Category-specific QC)
	Private Consultant Companies	<ul style="list-style-type: none"> • Checking JNGI files and inventory prepared by GIO (Category-specific QC)
QA (Quality Assurance)	Inventory Quality Assurance Working Group (QAWG)	<ul style="list-style-type: none"> • Conducting expert peer review of inventory (QA)

Source: http://www-gio.nies.go.jp/aboutghg/nir/2016/NIR-JPN-2016-v3.0_rev_web.pdf

2.6 Step 6: Define and implement a continuous improvement plan for GHG inventories

The final step, defining and implementing a continuous improvement plan complements the QA/QC process. This step permits the GHG inventory team to take into account all the findings of any GHG inventory reviews (i.e. internal or peer-to-peer reviews) or the capacity building needs identified under the ICA process, with the vision to improve the next GHG inventory preparation process and achieve an improved understanding of the emissions and trends of the country. The activities that should be undertaken for this purpose are:



1. For each GHG inventory cycle, establish a GHG inventory improvement plan taking into account the updating of inventory time series; this should be done by the QA/QC coordinator.
2. Include input from QC and QA activities, both from internal (QC checks, input by inventory team) and external (ICA) activities, into the improvement plan.
3. Establish priorities and a timeline for activities for improvement of the inventory as part of the plan.
4. Undertake activities necessary for implementing the identified priorities, e.g. for developing emission factors or for analysing certain source categories (e.g. waste composition in a specific year); such activities could be the commissioning of a study by the GHG inventory coordinator.
5. Incorporate the improvements into the next inventory preparation cycle, as appropriate.

Specific tasks in this context include:

By the QA/QC coordinator:

- Coordinate regular reviews by an external group of experts outside the GHG inventory team.
- Obtain independent opinion on the inventory.

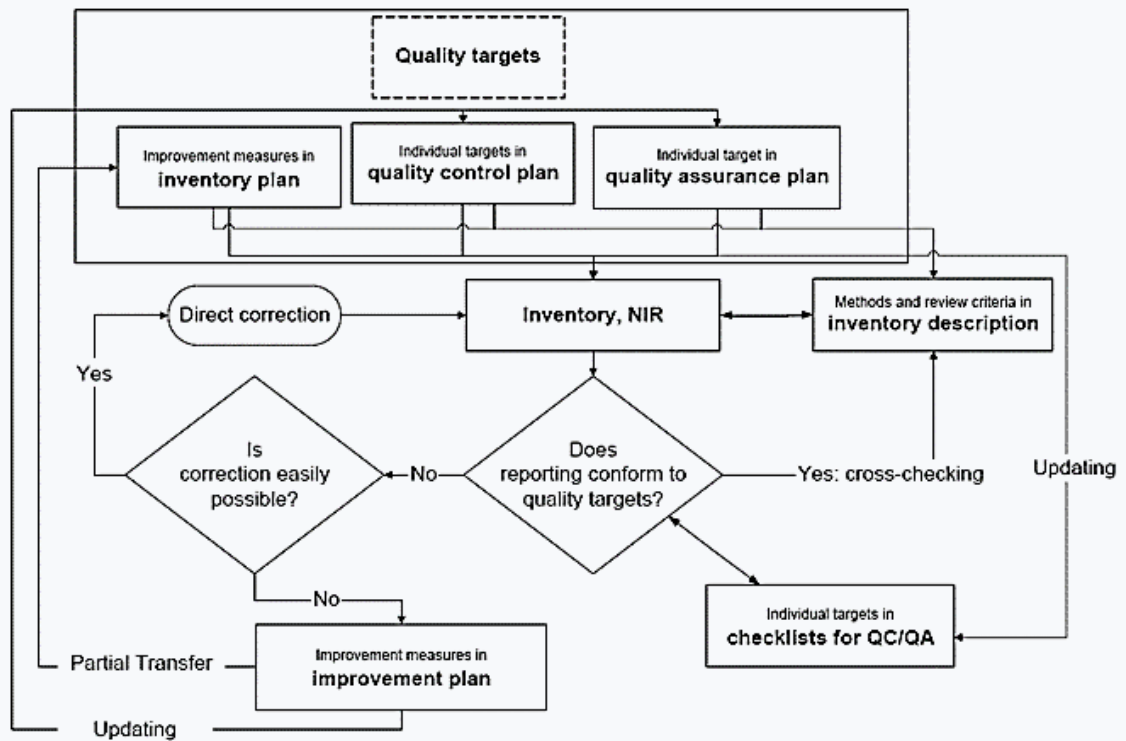
By the GHG inventory coordinator and/or GHG Inventory compiler:

- Coordinate activities that are part of the UNFCCC process and that feed into the GHG inventory improvement plan.
- Include findings from activities carried out under the UNFCCC (for example from the ICA) into the GHG inventory improvement plan.
- Establish and maintain a documentation and archiving system.
- Track and document the improvements made, i.e. on data sources used, updated emission factors or methodologies applied.
- Identify improvements to be implemented as part of the following inventory cycle for those that could not be addressed in the short term.
- Revise MoUs, if necessary.

The impact of the continuous improvement will depend on the effort dedicated by the inventory team and by ownership given by sound institutional arrangements. If this process is applied regularly, and feasible changes are incorporated in the next reporting process, the results will be greater. [BOX 4 and 5](#) show the scheme for continuous improvement in the German GHG inventory system, as well as information on the continuous improvement plan of Chile's GHG inventory.

BOX 4: Continuous improvement in Germany

Germany: The overall system has an improvement plan, which documents all potential improvements identified in the framework of the last completed emissions reporting cycle. It takes into account the findings from internal quality checks, independent inventory reviews and review cycles within the UNFCCC process. In the plan, such improvements and findings are correlated with feasible corrective measures. The UBA categorises the corrective measures, prioritises them and then integrates them completely into the inventory plan. This last step is done in consultation with the relevant responsible experts. The inventory plan is annexed to the published inventory report, and thus is a binding set of specifications for improvements to be carried out in the next reporting year. The interaction of this improvement plan with the QA/QC measures is shown in the figure below.



Source: National Inventory Report, Germany – 2016 German Environment Agency (UBA)

BOX 5: Continuous improvement in Chile

Chile: Since 2015, the GHG Inventory System of Chile has implemented a QA/QC system in line with the IPCC good practices for the preparation of national GHG inventories. The system focuses on quality improvements of the GHG inventory through the establishment and implementation of procedures for quality assurance, quality control and verification. In addition, to identify and prioritise potential improvements of its GHG inventory, Chile has developed and implemented a continuous improvement plan. Within the continuous improvement plan a set of activities and procedures are documented which helps identifying possible areas of improvement, including information on its status of implementation and budget implications. These possible improvements are identified from the findings of external GHG inventory reviews, such as those performed during peer reviews by other countries, or during the ICA of Chile's BUR. These issues are addressed by the National Technical Team during the biennial update of the national GHG inventory, or bilaterally between the Sectoral Technical Teams and the Coordinating Technical Team. An example of the activities included in the continuous improvement plan is given below.

Category	Comment of ICA	Status	Comment of country
Cross-cutting issues	It is recommended to structure the GHG inventory more comprehensively.	Not Implemented	In the next year, the aim is to structure the GHG inventory more comprehensively.
Cross-cutting issues	A list of authors is missing.	Implemented	A list of authors has been included.
Cross-cutting issues	The structure of the translated version differs from the original version of the report.	Not implemented	The consistency of both version will be revised. This step will also be included in the final quality check.
Cross-cutting issues	The cooperation between institutions is still not clear enough (roles, responsibilities, etc.)	Not implemented	... be to ... e roles and responsibilities of the institutions.

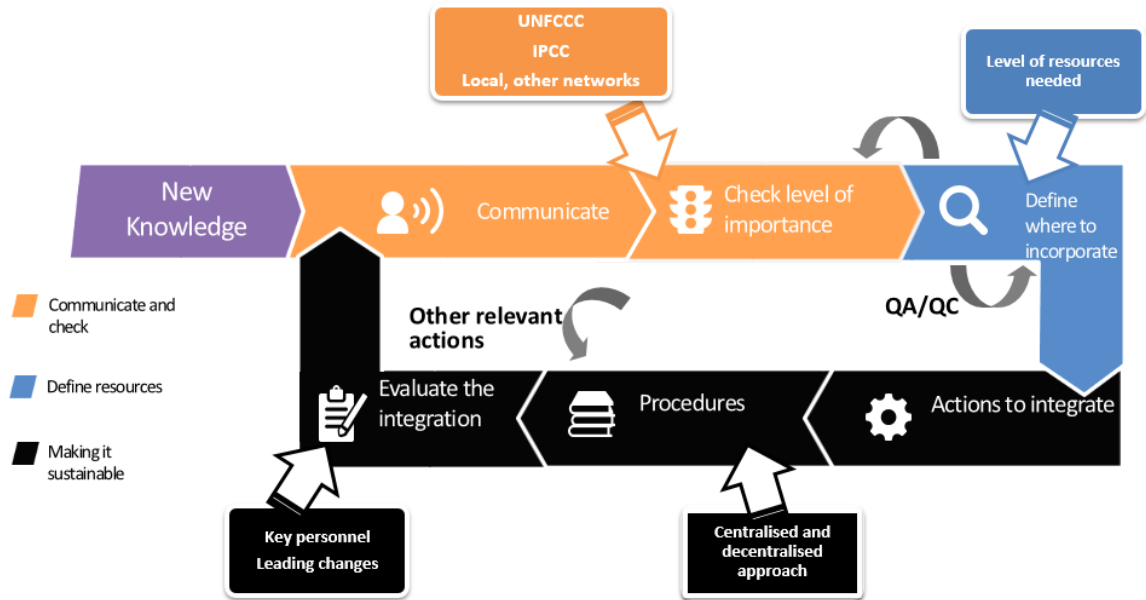
Options:

- Implemented
- Not implemented
- N/A

Source: Adapted from [Chile's Second Biennial Update Report on Climate Change](#), 2016

The GHG inventory improvement plan will also deal with the application of new reporting guidelines (i.e. shifting from 1996 to 2006 IPCC Guidelines) or of additional knowledge on GHG inventory reporting (updates in the guidelines, identification of new emission sources, update of emission factors). Figure 6 below shows the suggested procedure for the GHG inventory team on how to address new knowledge emerging in relation to GHG inventories. Any new knowledge must be communicated correctly within the organisation through formal channels. Then, a process should verify the level of importance of this knowledge and determine how and where it needs to be taken into account, if applicable. Finally, there should be an integration process and development of procedures to ensure that this new knowledge gets systematically incorporated into the inventory process. The workflow for improvement ends with an evaluation of the change to the system to confirm the initial assumptions and benefits. For example, if IPCC officially suggests new default values in a specific sector, this new knowledge should follow a process of internal communication, checking the level of importance, defining where to incorporate it within the inventory, triggering an evaluation of resources needed to have it permanently in the reporting flows and finally integrated through procedures and post evaluation.

Figure 6. Workflow for new knowledge (Source: NIRAS, 2017)



2.7 Ensuring sustainability of the GHG inventory team

Once the technical team for GHG inventories has been set up and/or strengthened, further consideration has to be given on how to ensure its sustainability for ongoing and future reporting cycles. The sustainability of the team is frequently confronted with a number of challenges, which particularly depend on political support and, correspondingly, allocation of financial resources. High-level internal political support is an important factor to ensure the continuous and sustainable operation of a GHG team, especially when it comes to budget allocation and delivery of GHG-relevant data and information from data providers and stakeholders. Lack of such support can decisively affect the sustainability of the budget for inventory preparation as well as the processes of data provision and compilation and the overall quality of the inventory.

The reasons for a lack of support could be low visibility of the outputs produced by the GHG team, which generally are of technical and complex nature, and lack of awareness of the benefits that a robust and high-quality inventory can provide for a country. The challenge to increase the visibility of outputs could be addressed through a targeted communication strategy demonstrating the benefits of the inventory data, as well as related underlying information and data, for various purposes, stakeholders and audiences. For example, priority could be given to the dissemination of results of the GHG inventory with information and key messages tailored to the respective stakeholders, such as policy makers at different governmental levels and sectors as well as the public. To this end, GHG inventory information needs to be summarised and turned into tailor-made outputs using a less technical language. Furthermore, the information contained in BURs, NCs and related reports can have numerous uses in addition to complying with UNFCCC reporting requirements. The information can, for example, help in tracking progress of national goals, such as the NDCs, in assessing the potential of planned or implemented measures (e.g. potential use of carbon taxes in products and services), in identifying sectors that could expand with low carbon footprint, or in considering technological options in specific sectors such as energy generation and waste management. Finally, they can also assist in obtaining information on adaptation needs.

Another challenge frequently faced by GHG inventory teams and affecting its sustainability is a high turnover in staff and the situation that in many developing countries GHG inventory experts are scarce. Retaining human resources requires not only ongoing capacity building and training (including internal trainings and peer-to-peer exchanges), but can also be addressed through building alliances within institutions maintaining the support needed, e.g. by involving non-government actors, such as academia. An example from India ([Annex VI](#)), which has assembled a technical team connected to its Ministry of Environment and Forests shows how strategic alliances and external communication are contributing to the sustainability of the GHG inventory preparation process.

3 In summary

This guidance provides a six-step approach to establish and/ or enhance a national reporting structure based on national teams of experts. This should help to move from the current practice of ad-hoc approaches of GHG inventory preparation to a continuous and dynamic approach that allows incorporating available knowledge and improvements as well as applying good practices in future reporting.

This guidance explains how to set up technical teams of experts to prepare GHG inventories on a regular basis, focusing on necessary requirements to establish such teams while embedding them within a broader institutional system. This in turn will facilitate smooth collaboration between political and technical levels and ensure continuity of processes, such as data and information flows among activity data providers and the national GHG inventory team. Furthermore, the guidance provides examples on how political support could be enhanced and the issue of sufficient human and technical resources could be enhanced.

The approach suggested in this guidance recommends the set-up of a high-level committee (or similar body) to steer the GHG inventory reporting process and to take decisions on the design of the GHG inventory team and on supporting arrangements, to identify needs, and to deal with the availability of local experts and capacity building. Among others, the set-up of a GHG inventory structure also helps in the analysis of available resources and estimation of financial needs.

Lack of national experts and lack of political buy-in are common challenges encountered in a number of developing countries hampering the continuity in the process of GHG inventory preparation. The guidance presented herein aims to help countries in moving to a more permanent reporting process with dedicated professionals. The need for reporting systems at the country level that ensure sustainability of the GHG inventory reporting process and allow integration of upcoming UNFCCC reporting requirements is becoming increasingly important, not only for the NCs and BURs, but in particular also for the future implementation of the Paris Agreement and the monitoring of the NDCs under the Enhanced Transparency Framework.

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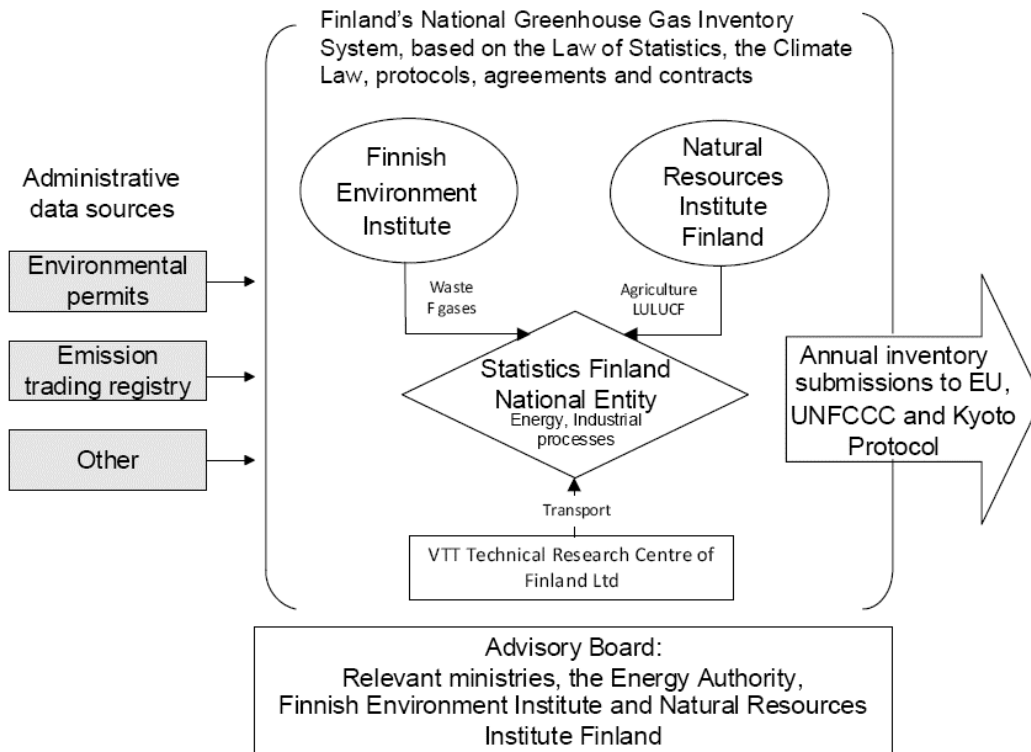
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5 Annexes

5.1 Annex I: Institutional arrangement for GHG inventory in Finland¹²

Statistics Finland, the national authority for official statistics of Finland, was designated by a government resolution in 2003 as in charge of the GHG inventory from 2005 onward. In 2015, the role of Statistics Finland was reinforced through the adoption of the Climate Law (609/2015). The national system is based on agreements between the inventory unit and expert organisations on the production of emission and removal estimates. The following figure describes the institutional set-up.

Figure 7: Institutional arrangement for the GHG inventory in Finland (Source: *Statistics Finland, 2016*)



The advisory board of the GHG inventory ensures collaboration and information exchange in issues related to the reporting of GHG emissions under the UNFCCC and the Kyoto Protocol, and it is charged with reviewing planned and implemented changes in inventory and the inventory quality. Quality requirements are fulfilled by implementing consistently a set of inventory quality management procedures.

In terms of access to data, by law, Statistics Finland has access to relevant data, although access to EU ETS data is also ensured through an agreement between Statistics Finland and the Energy Authority. In addition, agreements between Statistics Finland and the expert organisations define the division of responsibilities (sectors/categories covered) and tasks related to uncertainty and key category analysis, QA/QC and reviews. They also specify the procedures and schedules for the annual inventory process coordinated by Statistics Finland.

The responsibilities to estimate and report emissions/removals from different sectors/categories of the expert organisations are based on established practices for the preparation and compilation of the greenhouse gas emission inventory. All the participating organisations are represented in the advisory board which is set up to support the process of producing annual inventories and the fulfilment of reporting requirements.

¹² Source: Statistics Finland – Greenhouse Gas Emissions in Finland 1990-2014: https://www.stat.fi/static/media/uploads/tup/khkinv/fi_un_nir_2014_20160415.pdf

5.2 Annex II: QA/QC Roles and responsibilities for GHG inventory in Sweden¹³

The **Swedish Ministry of Environment and Energy** has overall responsibility and submits the inventory report to the European Commission and to the UNFCCC secretariat. The **Swedish Environmental Protection Agency** (Swedish EPA) coordinates the activities for developing the inventory report and is also responsible for the final QA/QC of the data before it is submitted. The annual inventory is prepared by collaboration between the Ministry of the Environment and Energy, the Swedish EPA, other government agencies and consultants. The Swedish EPA engages the **SMED consortium** (Swedish Environmental Emissions Data) as consultants with expert skills to conduct the greenhouse gas inventory. SMED is composed of Statistics Sweden, the Swedish Meteorological and Hydrological Institute, the Swedish Environmental Research Institute AB and the Swedish University of Agricultural Sciences. Their contract runs since 2005. The project is run by a project management team with one person from each organisation. The emission statistics are published a number of times each year. An early estimate for the previous year is published on April 15 based on a simplified method. In December, the statistics produced in accordance with the IPCC guidelines for reporting to the European Union (EU) and the UNFCCC are published on the Swedish EPA web site. GHG inventory work is divided according to IPCC sectors, as follows:

Table 4. Division of GHG inventory work in Sweden (Source: *Sweden National Inventory Report, 2015*)

Sector	Data and documentation provided by...	Peer review conducted by...
Energy	Swedish Energy Agency, the Swedish Transport Administration, the Swedish Transport Agency, Transport Analysis, the Swedish Armed Forces	<ul style="list-style-type: none"> Swedish Energy Agency (energy sector excluding transports) Transport Analysis (transports)
Industrial Processes and Product Use	Swedish Chemicals Agency, Medical Products Agency	<ul style="list-style-type: none"> The Swedish EPA (CO₂, CH₄ and N₂O) Swedish Chemicals Agency
Agriculture	Swedish Board of Agriculture, Statistics Sweden	<ul style="list-style-type: none"> The Swedish Board of Agriculture
Land Use, Land-Use Change and Forestry Sector	Swedish University of Agricultural Sciences, Statistics Sweden (SCB), the Swedish Forest Agency, the Swedish Meteorological and Hydrological Institute, the Swedish Board of Agriculture, Swedish Civil Contingencies Agency (MSB), the Geological Survey of Sweden (SGU)	<ul style="list-style-type: none"> Swedish Forest Agency The Swedish Board of Agriculture (agriculture related parts)
Waste	The Swedish EPA	<ul style="list-style-type: none"> The Swedish EPA (a unit other than the one responsible for data)

¹³ Sources: <http://www.swedishepa.se/Environmental-objectives-and-cooperation/Swedish-environmental-work>

https://www.naturvardsverket.se/upload/sa-mar-miljon/statistik-a-till-o/vaxthusgaser/2015/national-inventory-report-nir_rapporterad-till-unfccc-160415.pdf

5.3 Annex III: Profile of main team members of a national GHG inventory team

Profile of the inventory coordinator (similar to inventory compiler)

The inventory coordinator should have a strong scientific, technical and policy background, with experience working both independently and with a variety of members of government, agencies, non-governmental organisations, and research institutions. The inventory coordinator also should have a strong understanding of UNFCCC National GHG Inventory reporting and the IPCC Guidelines for National Greenhouse Gas Inventories. The following list provides examples of the qualifications and knowledge desired for this role.

- Relevant experience in the field of climate change, with a focus on GHG inventories;
- A degree in a subject related to environmental studies/management, engineering, or similar (an advanced degree in specific GHG inventory sectors/categories could be beneficial);
- Demonstrated knowledge and application of the methodologies for preparing GHG inventories and familiarity with the IPCC inventory guidelines (Revised 1996 IPCC Guidelines, Good Practice Guidance and IPCC 2006 Guidelines);
- Experience applying UNFCCC GHG inventory reporting guidelines;
- Familiarity with UNFCCC processes and the content of National Communications;
- Experience managing a budget and a team in accordance with established procedures, employee skill levels and occupational specialisations;
- Experience working with individuals with diverse technical backgrounds and specialties; and
- Evaluating and addressing complex issues associated with quantifying national GHG emissions using UNFCCC and IPCC guidelines.

Responsibilities and activities of the inventory coordinator (similar to inventory compiler)

The following list highlights the main responsibilities and activities of the inventory coordinator:

- Manage and support the National GHG Inventory staff, schedule, and budget in order to develop the inventory in a timely and efficient manner.
 - Prepare a detailed work plan for producing the National GHG Inventory, including interim deliverables and specific outputs, in close consultation with sectoral leads and relevant data providers on a [X] basis (e.g., monthly, biennial, annual etc.).
 - Establish internal processes and schedule to ensure that the national inventory team produces accurate emission estimates.
 - Develop Statement of Work documents and contracts with consultants to support inventory cross-cutting tasks and report compilation.
 - Oversee sector leads/consultants handling the report compilation both at the sector level and compilation from all sectors to ensure incorporation of the inventory in the NC and BUR for submittal to the UNFCCC.
- Identify, assign, and oversee national inventory sector leads.
 - Assist sector leads to prepare and implement sector specific work plans, including interim outputs/deliverables, as well as identify, collect, and organise data for inclusion in the inventory.
 - Assist sector experts with the use of activity data and select and apply appropriate IPCC Good Practice Guidance to improve existing methodologies and emission factors.
- Assign cross-cutting roles and responsibilities, including those for QA/QC, archiving, key category analysis, uncertainty analysis, and compilation of the inventory section of the NC and/or BUR.
 - For all project activities (i.e., QA/QC, uncertainty analysis, archiving, etc.), coordinate with cross-cutting leads to convey responsibilities to sector leads, consultants, national agencies and institutions, and relevant international organisations, such as UNDP country offices, IPCC, UNFCCC, and GEF.
 - Manage QA processes and inventory review periods (if applicable) with support from the QA/QC Coordinator.
- Maintain and implement a national GHG inventory improvement plan. Foster and establish links with related national projects, and other regional, international programmes as appropriate.

Profile of the QA/QC coordinator

The QA/QC coordinator should have a strong scientific and technical background and understanding of UNFCCC National GHG Inventory reporting and the IPCC Guidelines for National Greenhouse Gas Inventories. The following list provides examples of the qualifications and knowledge desired for this role.

- Strong experience with international standards for QA/QC (e.g. ISO);
- Strong expertise with software for workflows and statistical procedures for uncertainty management;
- Proven experience in continuous improvement processes for research activities;
- A degree in a subject related to mathematics/statistics/management, industrial engineering, or similar (an advanced degree such as Masters or Ph.D. could be beneficial);
- Demonstrated knowledge and application of the methodologies for preparing GHG inventories and familiarity with the IPCC Inventory guidelines (Revised 1996 IPCC Guidelines, Good Practice Guidance reports and IPCC 2006 Guidelines);
- Experience applying UNFCCC GHG inventory reporting guidelines;
- Familiarity with UNFCCC processes and the content of National Communications;
- Experience working on a diverse team of individuals with different technical backgrounds and specialties; and
- Evaluating and addressing complex issues associated with quantifying national GHG emissions using UNFCCC and IPCC guidelines.

Responsibilities and activities of the QA/QC coordinator

The following list highlights the main responsibilities and activities of the QA/QC coordinator:

- Manage the QC of all the working groups that build the National GHG Inventory in order to develop the inventory in a timely and efficient manner according to the quality level required by the UNFCCC.
 - Prepare a detailed QC work plan with sectoral leads and relevant data providers on a periodic basis (e.g. monthly, annual, biennial).
 - Establish internal processes and schedule to ensure that the national inventory team produces accurate emission estimates.
 - Review the accuracy of the methods used for estimations in all sectors.
 - Develop Statement of Work documents and contracts with consultants to support inventory cross-cutting tasks in QC.
- Manage the QA process of the sector working groups and the assembled GHG report.
 - Develop an independent review process for all deliverables of the working groups, using external consultants or ministry/agency experts to verify the quality level of the methods and outcomes.
 - Manage an external process open to any stakeholders via web applications or workshops to get further feedback on the WG outcomes
- Manage cross-cutting roles and responsibilities for the improvement process of each reporting cycle.
 - For all project activities (i.e., QA/QC, uncertainty analysis, archiving, etc.), coordinate with cross-cutting leads to convey responsibilities to sector leads, consultants, national agencies and institutions, and relevant international organisations, such as UNDP country offices, IPCC, UNFCCC, and GEF.
- Maintain and implement a national GHG inventory registry.

Profile of the sector expert

The sector expert should have a strong scientific and technical background and understanding of UNFCCC National GHG Inventory reporting and the IPCC Guidelines for National Greenhouse Gas Inventories for the sector in question. The sector expert should have strong experience in the sector in question, with expertise in the sources and sinks relevant to the sector. The following list provides examples of the qualifications and knowledge desired for this role.

- Relevant experience in the sector in question, with a focus on environmental management and GHG inventories;
- A scientific or engineering degree in a subject related to the sector, or similar (an advanced degree such as Masters or Ph.D. could be beneficial);
- Demonstrated knowledge and application of the methodologies for preparing GHG inventories and familiarity with the IPCC Inventory guidelines (Revised 1996 IPCC Guidelines, Good Practice Guidance reports and IPCC 2006 Guidelines);
- Experience applying UNFCCC GHG inventory reporting guidelines;
- Familiarity with UNFCCC processes and the content of National Communications;
- Good command of technical English;
- Professional use of software for editing, scheduling and calculations (Word, PDF, Excel, MS-Project);
- Expertise in at least a general statistic software with modules for time series analysis, seasonal decomposition and advances regression model (e.g. Minitab or SPSS); and
- Understanding of concepts of project management.

Responsibilities and activities of the sector expert

The following list highlights the main responsibilities and activities of the sector expert:

- Follow procedures for inventory preparation
- Adhere to inventory preparation schedule/work plan
- Assess sub-categories and determine priorities
- Set sector-specific preparation schedule
- Determine data availability and quality
- Determine methods and compile data
- Conduct emission calculations and complete text descriptions
- Apply QA/QC procedures
- Sector reporting
- Sector documentation and archiving
- Apply inventory improvement strategy

5.4 Annex IV: Possible themes for capacity-building for a GHG inventory team and available sources

Capacity building topic	Suggested sources	Participants
Preparation of national communications by NAI Parties	CGE Materials (NCs)	<ul style="list-style-type: none"> • Inventory coordinator • Inventory compiler • QA/QC coordinator • Sector experts
UNFCCC guidelines and manuals related to NCs and BUR from NAI Parties	UNFCCC Guidance	<ul style="list-style-type: none"> • Inventory coordinator • Inventory compiler • QA/QC coordinator • Sector experts
Institutional arrangements for BUR	CGE Training Materials (BURs) CGE training materials (NCs)	<ul style="list-style-type: none"> • Inventory coordinator • Inventory compiler
IPCC Guidelines on default methods, data sources, basic QA/QC, uncertainty assessment and reporting procedures	IPCC Guidelines	<ul style="list-style-type: none"> • Inventory compiler • QA/QC coordinator • Sector experts
Managing greenhouse gas inventory processes	UNDP's Managing the National Greenhouse Gas Inventory Process, US-EPA Template Workbook & Capacity Building, Capacity Building Portal	<ul style="list-style-type: none"> • Inventory coordinator • Inventory compiler • QA/QC coordinator
Inventory software	IPCC software , UNFCCC software , ALU software , country-specific software	<ul style="list-style-type: none"> • Inventory compiler • QA/QC coordinator • Sector experts
GEF funding options for GHG inventory	GEF Funding Guidelines & Application Form	<ul style="list-style-type: none"> • Inventory coordinator
Statistical software	Minitab, SPSS	<ul style="list-style-type: none"> • Inventory compiler • QA/QC coordinator • Sector experts
Project management	Project Management Institute practice books	<ul style="list-style-type: none"> • Inventory coordinator • Inventory compiler • QA/QC coordinator • Sector experts

5.5 Annex V: QA/QC system in Sweden¹⁴

The following provides a detailed example of the QA/QC system from the GHG inventory team of Sweden:

Inventory planning (“Plan”)

The responsibility of SMED to maintain and develop an internal quality system is described in the framework contract between the Swedish EPA and the SMED consultants¹⁵.

Planning of the inventory for submission in year x starts in the third quarter of year x-2 when the Swedish EPA gets the preliminary budget for year x-1. General priorities for the coming year are set by the Swedish EPA based on:

- recommendations from international review not yet implemented in the inventory,
- recommendations from national peer review not yet implemented in the inventory,
- key category analysis (focus on major sources/sinks),
- uncertainty analysis (focus on sources/sinks that contributes significantly to the uncertainty of the inventory),
- ideas from SMED and the Swedish EPA on how to improve quality and effectiveness of the inventory, and
- new international and national requirements, decisions and guidelines.

See Figure 8 for an overview of this detailed process.

Inventory preparation (“Do”)

SMED gathers data and information for year x-2 from various government agencies, organisations and companies over the period from April to August of year x-1, with the aim of being able to carry out emission calculations. The calculations are performed in models, statistics programs and calculation programs in April to September. Over the period from September to October, the material is put together in the reporting format. A short description of data collection and processing for each sector is provided below. Preparation of the inventory is documented in detailed work documentation, which serves as instructions for inventory compilers to ensure quality and consistency, and also serves as information in the national peer review process.

Inventory review (“Check”)

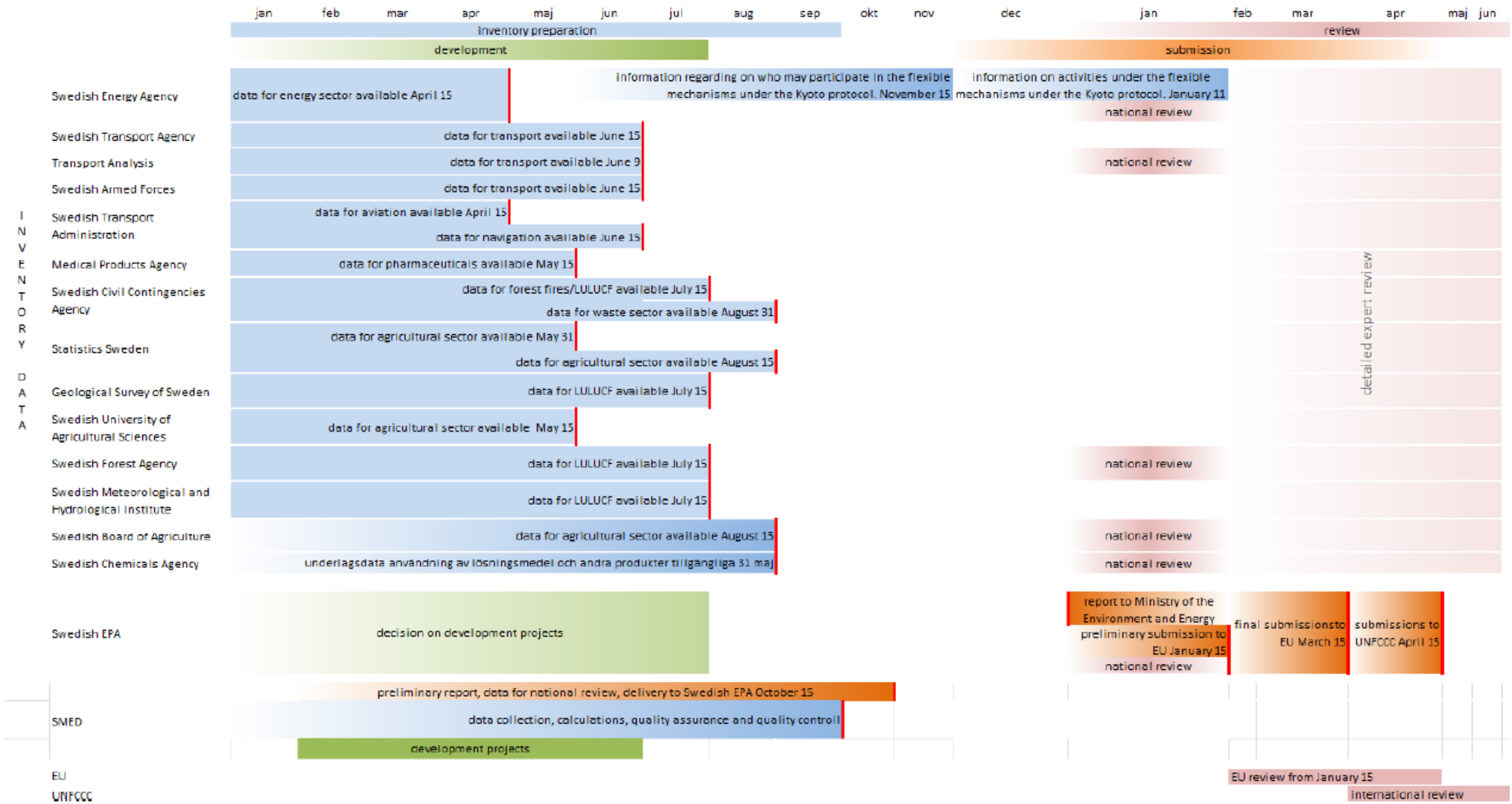
QC is the check that is made during the inventory on different types of data, emission factors and calculations. The QC takes place according to two sets of requirements. First, general requirements are applied to all types of data used as support material for the reporting. Second, specific requirements for QC are applied to certain types of data and/or emission sources. In the Swedish inventory, general QC measures are carried out according to Table 6.1 in 2006 IPCC Guidelines¹⁶

¹⁴ Sources: <http://www.swedishepa.se/Environmental-objectives-and-cooperation/Swedish-environmental-work>
https://www.naturvardsverket.se/upload/sa-mar-miljon/statistik-a-till-o/vaxthusgaser/2015/national-inventory-report-nir_rapporterad-till-unfccc-160415.pdf

¹⁵ See [BOX 3](#) for further details.

¹⁶ <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>

Figure 8. Overview of NIR planning (Source: Sweden National Inventory Report, 2016)



All QC measures performed are documented by SMED in QC checklists for each source category¹⁷. When the reporting tables are completed by SMED, a quality control team (QC-team) performs checks before internal delivery to the SMED quality coordinator. The QC-team consists of one inventory compiler from each of three of the SMED consortium members mentioned in Step 3 of this document, and the review is performed so that each member of the team checks parts of the inventory (data and associated documentation) in which that person was not involved in preparing. In addition, the QC-team performs data checks in terms of the functionality of the software in which the inventory has to be reported (in the case of annex I countries) (i.e. checks of completeness, time-series consistency and recalculation explanations).

Before delivery of the inventory to the Swedish EPA, the SMED quality coordinator performs the final QC. The QC-team and SMED quality coordinator checks serve as QA/QC in accordance with the 2006 IPCC guidelines.

Follow-up and improvement (“Act”)

Each year, all comments received from national and international reviews that are not already addressed, and also ideas from SMED and the Swedish EPA, are compiled into a list of suggested improvements. All suggestions not implemented one year are kept in the list for the following year. Development of Technical Production System (TPS)¹⁸ such as additional functions etc. is organised in a similar way as for the inventory: Ideas are compiled into a list, and from this list issues to be implemented are prioritised. In addition, improvements related to transparency of the NIR are continuously addressed in response to questions raised by national experts during the national peer review, and in response to previous expert review team (ERT) recommendations.

Also, each year, the Swedish EPA follows up on delivered data from responsible agencies to ensure correct and appropriate data will be delivered for the next submission.

Finally, there is a QA process. The Swedish QA/QC system includes several QA activities outside the SMED QA/QC procedures. At the final stages of completion of the inventory, the Swedish EPA performs a peer review for each sector. The national peer review is conducted in two steps: first, an annual national review that checks the robustness of the national system and guarantees that politically independent emissions data is reported. The review is performed by sectorial authorities prior to submission to meet the UNFCCC demands. Second, an in-depth expert peer review of one sector or part of a sector takes place. The choice of sector depends on the outcome of the results from the EU and UNFCCC reviews, and any problems identified by the national review or other needs discovered by SMED inventory experts or Swedish EPA. The aim of the in-depth expert peer review is to improve the inventory data quality. The review is performed by sectorial authorities and other national and international experts.

This example from the GHG inventory of Sweden may be adapted to the biennial reporting process of NAI countries. The salient features are the multiple sources of suggestions for inventory improvements, application of QC measures in line with the 2006 IPCC guidelines, and the parallel QA reviews by independent entities.

¹⁷ Corresponding to a Common Reporting Format code, in the case of the Swedish National Inventory Report.

¹⁸ A system for handling emission data, entitled Technical Production System (TPS), has been developed and was implemented for the first time in submission 2007. It supports data input from text files and Microsoft Excel sheets, and provides different types of quality gateways. For instance, the system makes it possible for multiple users such as the SMED consortium and the national independent reviewers to view data, plot time series and make comparisons between different years and submissions. See: <http://www.naturvardsverket.se/>

5.6 Annex VI: Sustainability of the GHG inventory: Example of India¹⁹

In India, the Ministry of Environment and Forests and Climate Change (MoEFCC) implements all policies and programmes related to the environment, forests, and wildlife, including India's commitments to related international treaties. The MoEFCC created a project management cell (PMC) to coordinate the national communication process, including the GHG inventory, headed by a project director who is a senior-level official in the MoEFCC. Some methods used by this team to ensure sustainability of the GHG inventory team include:

1. **GHG inventory director with technical capacity and political clout:** The project director is a senior-level official within the MoEFCC who is involved in the IPCC and UNFCCC negotiations since their inception. The guidance of the director enables the inventory team to adhere to internationally accepted methodologies and establish the credence of the national communication among government stakeholders.
2. **Strong institutional support:** The PMC secured a network of institutions with relevant experience to support the technical work of GHG inventory preparation. The list of selected institutions is first approved by the National Steering Committee (NSC) at the start of the GHG inventory preparation cycle, after which contracts are issued to them for the work involved.
3. **Knowledge management of GHG data:** The PMC archives all data (inter alia, initial, interim, and final reports), with weekly data backup. Hard and soft copies of reports are also archived in the project director's office in the MoEFCC, along with special publications. Archival of all documents provides a platform for future reference for expert decisions, NSC decisions, and retrieval of activity data, emissions factors, and the methodology used for recalculation.
4. **Communication with partner institutions:** PMC maintains regular communication through e-mails with the project leaders within the institutions that participate in the GHG inventory preparation process. Also, GHG inventory-related information sharing is done through presentations and discussions during review meetings and workshops.
5. **Capacity building across network:** The MoEFCC carries out training workshops for practitioners about new developments in IPCC's GHG inventory preparation methodologies and good practice guidance, including uncertainty management. The trainers in these workshops are experts who have contributed to the development of IPCC methodologies and guidance.

¹⁹ Source: <http://www.wri.org/publication/capacity-needs-greenhouse-gas-measurement-and-performance-tracking>

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