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Manual for SMED:s Quality System in the Swedish Air Pollutant and Greenhouse Gas Emission Inventories

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SMED (Swedish Environmental Emissions Data), is a collaboration between IVL Swedish Environmental Research Institute, Statistics Sweden (SCB), Swedish University of Agricultural Sciences (SLU) and the Swedish Meteorological and Hydrological Institute (SMHI). The collaboration commenced in 2001 with the long-term aim of gathering and developing the competence in Sweden within emission statistics. SMED is, on behalf of the Swedish Environmental Protection Agency and the Swedish Agency for Marine and Water Management, heavily involved in the work related to Sweden's international reporting obligations on emissions within six subject areas (air, water, waste and hazardous substances). Environmental statistics is also produced for national and regional needs, where SMED compiles data for both milestone targets and environmental quality objectives. SMED also develops new methods and produces statistics for follow-up of Sweden's National Waste Plan and Waste Prevention Program. For more information, visit the SMED website www.smed.se (in Swedish).

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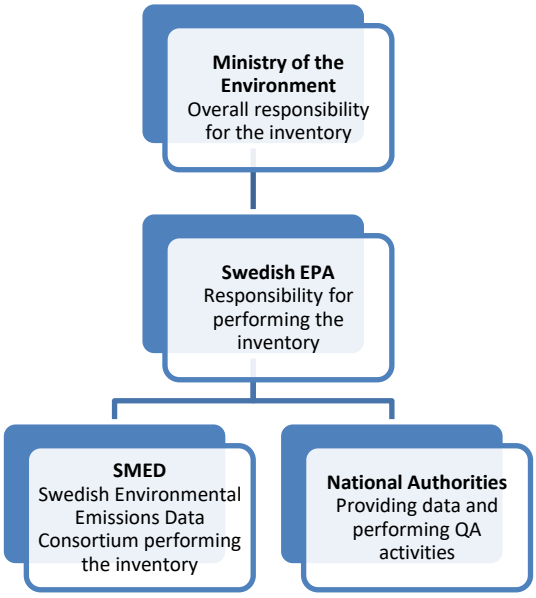
1 Introduction

This manual describes the QA/QC procedures applied in the work with the preparation of the Swedish air pollutant and greenhouse gas emission inventories (hereinafter referred to as emission inventories) annually submitted to the UNFCCC, to the Paris agreement, to the EU Monitoring Mechanism Regulation, to the EU NEC directive and to the CLRTAP. The emission inventories cover historical data from 1990 as well as emission projections to 2050.

The manual is part of the Swedish National System[1], and is in accordance with the quality manual for the Swedish national inventory arrangements for inventory and reporting according to the Paris Agreement and decisions within the EU[2], and with SMED´s overall quality system[3]. This manual is updated regularly to reflect changes in international reporting requirements and reporting guidelines.

The current Swedish inventory system is presented in Figure 1. The Swedish Ministry of the Environment has the overall responsibility and submits the inventory to the European Commission, to the UNFCCC secretariat and to the UNECE secretariat. The Swedish Environmental Protection Agency is coordinating the necessary activities to develop the inventory, and is also responsible for the final quality control and quality assurance of the data before it is submitted. As part of the national system, the Ordinance (2014:1434 ,updated in 2021:1292) Concerning Climate Reporting regulates national authorities to provide data as input to the emission inventory and to perform independent reviews.



[1] Beskrivning av Sveriges nationella system för rapportering av växthusgasinventering, scenarier och styrmedel, Naturvårdsverket 2016.
[2] Naturvårdsverkets kvalitetsdokument för arbete enligt klimatrapporterings-förordningen – rapportering av växthusgasinventering, scenarier och styrmedel Naturvårdsverket, 2016-04-14
[3] SMED´s övergripande kvalitetssystem.

Figure 1. Current national inventory system.

This document covers the activities performed by SMED (Swedish Environmental Emissions Data) and the collaboration between SMED and the Swedish Environmental Protection Agency (EPA). It briefly touches the QA performed within the Swedish national system for greenhouse gas inventories.

The Swedish EPA is, in consultation with SMED, responsible for the compliance of this document with the UNFCCC reporting guidelines and other related guidelines.

2 Definitions

Important concepts and short definitions according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) are listed below.

Good Practice (Glossary, IPCC 2006[4]) Good Practice is a set of procedures intended to ensure that greenhouse gas inventories are accurate in the sense that they are systematically neither over- nor underestimated as far as can be judged, and that uncertainties are reduced as far as possible.

Key Categories (Glossary, IPCC 2006) A key source or key category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level, the trend, or the uncertainty in emissions and removals.

National inventory arrangements (Decision 24/CP.19) The national inventory arrangements include all institutional, legal and procedural arrangements within an Annex I Party made for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information.

QA/QC plan (Chapter 6.5, IPCC 2006) The Quality Assurance and Quality Control (QA/QC) plan is an internal document to organise, plan and implement QA/QC activities. The plan should in general outline QA/QC activities that will be implemented and include a scheduled time frame that follows inventory preparation from its initial development through to final reporting.

QA/QC system (Chapter 6.3, IPCC 2006) The major elements of a QA/QC system are:

- an inventory agency responsible for coordinating QA/QC activities, verification activities and definition of roles/responsibilities within the inventory,
- a QC/QA plan,
- general QC procedures (Tier1),
- source category-specific QC procedures (Tier 2),
- QA and review procedures,
- QA/QC system interaction with uncertainty analyses,
- verification activities,
- reporting, documentation and archiving procedures.

[4] IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000)

Tier 1 QC procedures (General QC procedures) (Chapter 6.6, IPCC 2006) Tier 1 General Inventory Level QC procedures are checks that the inventory agency should use routinely throughout the preparation of the annual inventory. The focus of general QC techniques is on the processing, handling, documenting, archiving and reporting procedures that are common to all the inventory source categories.[5]

Tier 2 QC procedures (Source category-specific QC procedures) (Chapter 6.7, IPCC 2006) Source category-specific QC procedures (Tier 2), are directed at specific types of data used in the methods for individual source categories. The source category-specific QC measures are focusing on key source categories and on source categories where significant methodological and data revisions have taken place. Tier 2 QC activities are in addition to the general QC conducted as part of Tier 1.[6]

Quality assurance (Chapter 6.1, 6.8, IPCC 2006). Quality assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process to verify that data quality objectives were met, ensure that the inventory represents the best possible estimate of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the quality control (QC) programme. QA activities include audits and expert peer reviews.

Quality control (Chapter 6.1, IPCC 2006). Quality control (QC) is a system of routine technical activities, to measure and control the quality of the inventory as it is being developed. The QC system is designed to:

- Provide routine and consistent checks to ensure data integrity, correctness, and completeness;
- Identify and address errors and omissions;
- Document and archive inventory material and record all QC activities.

Quality Objectives (Chapter 6.1, IPCC 2006). The objectives of QA/QC activities on national greenhouse gas inventories are to improve transparency, consistency, comparability, completeness, accuracy, confidence and timeliness[7].

- **Transparency** means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information.

[5] Table 8.1 of the IPCC 2000 GPG lists the general QC procedures.
[6] More specific information is provided in the sector specific chapters of the IPCC GPG.
[7] The objective of timeliness and confidence is introduced in the EC QA/QC programme and not part of the IPCC GPG.

- **Consistency** means that an inventory should be internally consistent in all its elements over a period of years. An inventory is consistent if the same methodologies are used for the base year and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks.
- **Comparability** means that estimates of emissions and removals reported by Parties in inventories should be comparable among Parties.
- **Completeness** means that an inventory covers all sources and sinks as well as all substances required.
- **Accuracy** is a relative measure of the exactness of an emission or removal estimate. Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals, as far as can be judged, and that uncertainties are reduced as far as practicable.
- **Confidence** is used to represent trust in a measurement or estimate. Having confidence in inventory estimates does not make those estimates more accurate or precise; however, it will eventually help to establish a consensus regarding whether the data can be applied to solve a problem. This usage of confidence differs substantially from the statistical usage in the term confidence interval.
- **Timeliness** means submission of a complete inventory on time.

Verification (Chapter 6.1, IPCC 2006). Verification refers to activities and procedures conducted during any of the inventory stages that can help to establish its reliability for the intended applications of the inventory.

Definitions of terms used in this manual:

- *Project specification* is a description of a suggested project, submitted by SMED for review and approval by the Swedish EPA.
- *Project agreement*. A signed agreement between Swedish EPA and SMED to carry out a project according to the project specification.
- *Activity plan*. A detailed internal SMED document with a time schedule for the project, developed based on the project specification.
- *Development project*. A project concentrating on an issue aimed at improving the inventory.
- *TPS*. Technical Production System. A web-based interactive platform developed for the National system, used for data storage, data transfer and data archiving.

3 SMED

Swedish Environmental Emissions Data (SMED) is a consortium constituting of Statistics Sweden (SCB), the Swedish Meteorological and Hydrological Institute (SMHI), the Swedish Environmental Research Institute (IVL) and the Swedish University of Agricultural Sciences (SLU).

SMED is organised as presented in Figure 2. A steering group with one member from each organisation in the consortium has the concluding responsibility versus the Swedish EPA. There is also a program coordinating group, consisting of one member from each organization. The group consist of the different program co-ordinators, one for air and climate, one for water, one combined for waste and hazardous substances, and one from the SLU without responsibility for a specific program area. Each co-ordinator is responsible for coordinating all projects and activities within each program, and for the final quality control and the final approval of all deliverables before delivery to the Swedish EPA.

Within the consortium SMED there is an overall quality system, with an independent quality organisation. The responsibility of the Independent Quality Organisation (SICO) is to audit and review that the QA/QC work within SMED is conducted according to the SMED overall quality manual and to this specific manual. SICO constitutes of one member from each organization not involved in the emission inventory.

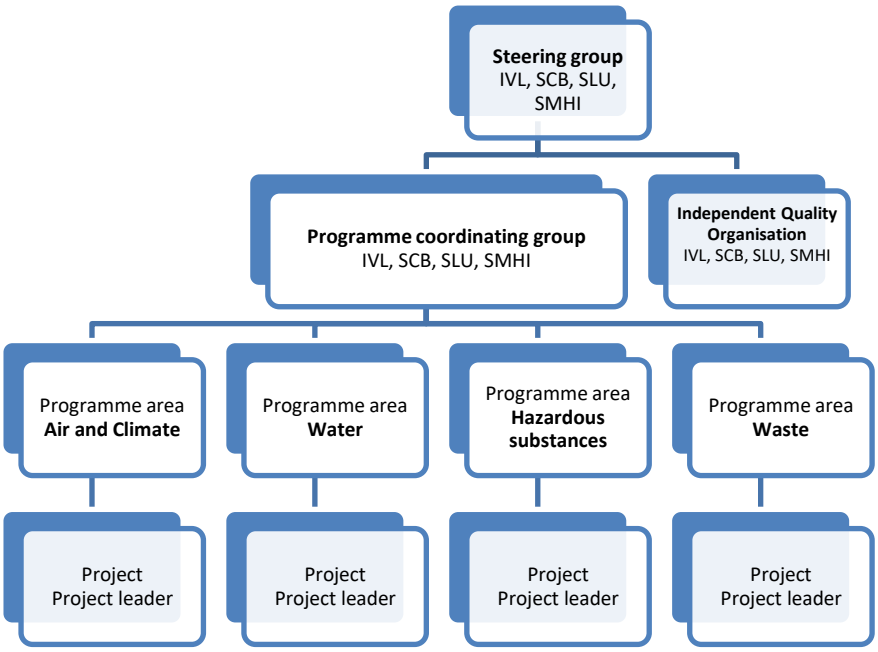


Figure 2. The SMED organisation.

The SMED programme area “Air and Climate” is working with the collection of data and calculations of emissions and removals for the sectors Energy, Industrial Processes and Product Use (IPPU), Agriculture, Land Use Land Use Change and Forestry (LULUCF), and Waste in the Swedish emission inventories. SMED also compiles the major parts of the official inventory documents. SCB performs most of the work in the sectors Energy, Agriculture and Waste, IVL performs the work in the IPPU-sector and SLU performs all of the work within the LULUCF-sector. The major role of the SMHI is to carry out calculations for geographical distribution.

In the work with the emission inventories, SMED is using data from a number of Swedish authorities associated to the National System (Figure 3).

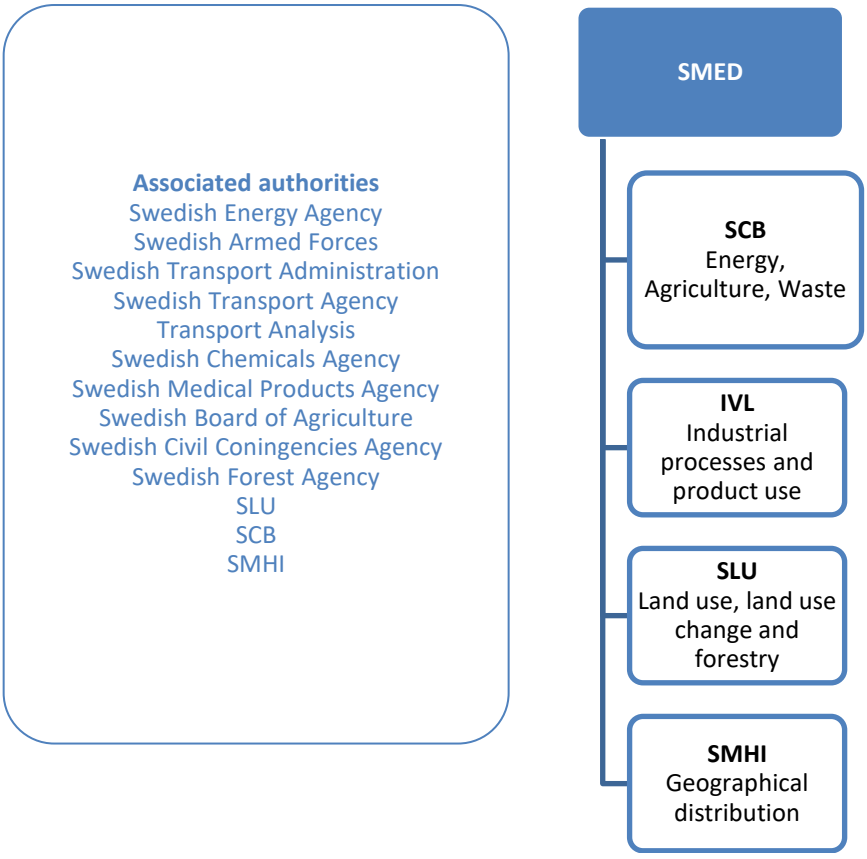


Figure 3. Current organisation of SMED programme area air and climate, main responsibilities in the emission inventories and authorities included in the National System. To ensure independency in data, other divisions of SMHI, SCB and SLU than those working in SMED are involved as data providers.

In the emission inventory, SMED has contacts with the above-mentioned authorities in their role as data providers, which is regulated in the National System[8]. The authorities also provide additional background information in discussions with inventory experts in SMED when needed. SMED also uses information and input data from other contacts, such as trade associations, individual industrial facilities and other experts in the field of interest.

[8]https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/klimatrapporteringsforordning-20141434_sfs-2014-1434
https://svenskforfattningssamling.se/sites/default/files/sfs/2021-12/SFS2021-1292.pdf

4 The SMED Quality System for Emission Inventories

4.1 Aim, structure and content of the Quality System

The overall aim of the quality system is to maintain and improve the quality in all stages of inventory work, in accordance with decision 24/CP.19 and corresponding decisions within EU. This manual describes the structure of the work in all aspects of inventory management and inventory preparation within SMED. It also describes communication with external parties and the role of SMED in the national inventory system.

This manual is a part of the SMED overall quality system that includes all programs for environmental reporting (air and climate, water, waste and hazardous substances).

The quality system described in this manual is designed according to the PDCA-cycle (Plan, Do, Check, Act) presented in Figure 4, which is a generally accepted model for pursuing a systematic quality work according to international standards, in order to ensure the maintenance and development of the quality system. This structure is in accordance with structures described in decision 20/CP.7 and in the 2006 IPCC guidelines. In volume 1, chapter 6, Quality Assurance/Quality Control and verification, the guidelines refer to ISO systems which are built upon the PDCA- cycle. The Quality system in the National system in Sweden is based on the same structure.

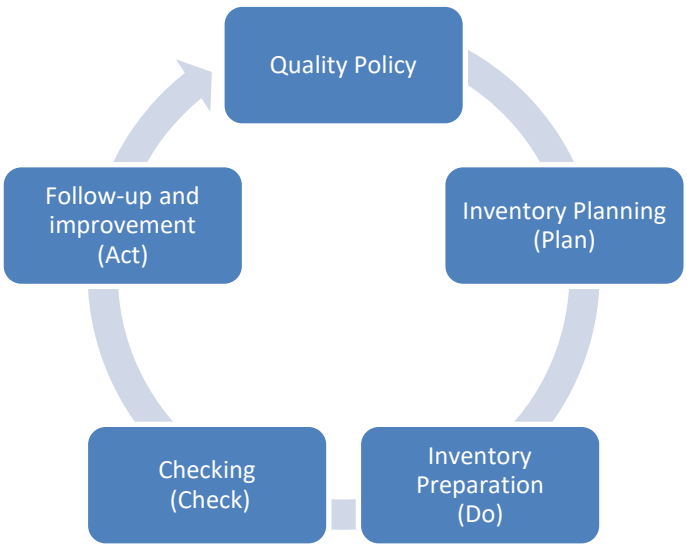


Figure 4. The PDCA cycle.

In the following chapters the procedures in the different stages of the PDCA-cycle, applied by SMED for the Swedish emission inventories, are described. In each chapter there are references to relevant documentation in order to make the quality system transparent for independent reviewers and other interested parties.

5 Quality policy

The policy within SMED, as described below, is in agreement with the quality objectives of the Swedish EPA, and the overall quality policy and principles for quality and environmental work in SMED´s overall quality system (see chapter4.1). The quality policy is:

- To fulfil the quality objectives and requirements as laid down in the guidelines for inventory and reporting, both nationally and internationally.
- To ensure transparent, consistent, comparable, complete and accurate reporting through this quality system.
- That the quality system shall include procedures to ensure that the quality requirements concerning development/research and investigational projects are met.
- To maintain a high standard regarding timely deliverables for Sweden's international reporting obligations.
- To contribute and cooperate actively with the Swedish EPA in order to prevent and minimize the risk of any deviation from defined quality requirements.
- To ensure sufficient resources with adequate competence that meets the requirements set by the Swedish EPA with regard to fulfilling Sweden's international reporting obligations.
- To pursue a continuous development and improvement in inventory management and inventory preparation by actively developing internal quality procedures and competence.

6 Inventory planning (Plan)

6.1 Requirements, decisions and guidelines

This document is the main guidance document for the emission inventory work within SMED, covering the inventory itself as well as development projects for inventory improvement.

It is the responsibility of the Swedish EPA to provide information to SMED regarding any changes in the reporting requirements. Such information is distributed to all persons concerned within SMED through the SMED emission inventory project management team.

In all documents included in the work documentation (appendix 4) there are detailed references to appropriate individual chapters in guidance documents, governing the inventory work, for all sources and sinks.

Some of the most important guidelines and decisions governing the planning of the inventory are:

- UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention (decision 24/CP.19)
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories[9]
- IPCC 2014. 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands
- Guidelines for the technical review of information reported under the Convention related to greenhouse gas inventories, biennial reports and national communications by Parties included in Annex I to the Convention (decision 13/CP.20)
- The Paris Agreement, which is a legally binding international treaty on climate change, was adopted by 196 Parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015. It entered into force on 4 November 2016 (decision 1/CP.21).
- Monitoring procedures under the Paris Agreement are based on existing reporting and review procedures under the Convention (decisions 24/CP.19 and 13/CP.20).

[9] No decision by COP yet.

- The Paris Agreement (article 13.) includes a robust framework for monitoring and reporting called the Enhanced Transparency Framework (ETF). This framework ensures that all participating countries provide transparent and comparable data on their climate actions and support.
- Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU.
- Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013.
- Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council
- Commission implementing regulation (EU) 2020/1208 of 7 August 2020 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) 2018/1999 of the European Parliament and of the Council and repealing Commission Implementing Regulation (EU) No 749/2014
- Regulation (EU) 2023/839 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/841 as regards the scope, simplifying the reporting and compliance rules, and setting out the targets of the Member States for 2030, and Regulation (EU) 2018/1999 as regards improvement in monitoring, reporting, tracking of progress and review
- Guidelines for Reporting Emission Data under the Convention on Long-Range Transboundary Air Pollution (ECE/EB.AIR.125)
- EMEP/EEA air pollutant emission inventory guidebook

6.2 Quality objectives and quality program

The main quality objectives for SMED relating to the Swedish emission inventories are to ensure that:

- the objectives in the project agreements are met and that the Swedish EPA is satisfied with the delivered results,
- deadlines are met, and that
- the work is conducted as efficiently as possible.

The quality program to meet these objectives is based on follow-up and improvement as discussed in chapter 9. Procedures for handling of non-conformity, corrective and proactive actions are described in chapter 8.9.

Customer satisfaction is evaluated by the amount and nature of comments on delivered results. If comments are received that indicate that the customer is not so pleased with some aspects of the delivered results, measures are taken to correct possible errors and prevent similar errors in the future (by reorganising the work and/or adjustments in future project specifications).

Deadlines should be met as specified in project specification. Economical fees for not meeting a deadline are specified in project specifications. If there are problems with meeting a deadline, the customer should be informed as soon as possible, including reasons for the delay and suggestions on revised deadline. If the delay causes troubles for the customer, SMED should do what is possible to minimize those troubles.

The **efficiency of work performed** is evaluated at the follow-up meeting after each completed inventory (see chapter 6.3). Each organisation within SMED also evaluates the economical outcome of each project.

Evaluation of these three quality criteria and additional proposals from follow-up meetings and/or in the planning document (appendix 8) are combined and then considered in the planning of work for the next year (see chapter 6.3).

6.3 Project planning procedure

In the annual planning procedure, suggestions and issues for further consideration are derived from the work with the last inventory, the final project evaluation meeting each year and issues brought up in internal and external audits and reviews. All issues are documented in an annual

planning document (appendix 8), archived at www.projektplace.com (see also chapter 8). From the annual planning document and other relevant priorities, the Swedish EPA assigns SMED to perform the necessary work to improve the inventory according to the Swedish EPA routines.

In the end of each year a planning meeting with SMED and the Swedish EPA is held to plan the next year's work. Before this meeting, a preliminary version of the planning document (appendix 8) is compiled, taking into account comments from national and international reviews, including also new suggestions from inventory staff discussed at project meetings. Prioritising of projects to be performed during the year is based on the urgency due to different criteria and available personal and financial resources.

The planning of individual projects starts by developing a project specification, including a background, a detailed description of the planned work, a plan for follow-up of project progress by Swedish EPA and SMED, a plan for delivery of results and a budget for the project. The project specification is written by the project leader within SMED, audited by the program co-ordinator and approved by the steering group before it is submitted to the Swedish EPA in its final version. For all projects, a project agreement is signed by the Swedish EPA and SMED.

At the best project specifications are developed already at the end of the year, for the work to be performed during the next year but due to the fact that available resources vary over time this is normally done in three phases making it possible to initialize and start up projects all over the year.

Generally, development projects are performed during the first part of the year, with the aim to be included in the inventory submission delivered to the Swedish EPA later the same year. Results from development projects are only included in the inventory if approved by the Swedish EPA. Time plans are developed individually for each project.

The activity plan for the annually performed inventory preparation and quality control is presented in appendix 1.

7 Inventory preparation (Do)

7.1 Organisation and responsibilities

The organisation of SMED, relating to emission inventories, is presented in Figure 5.

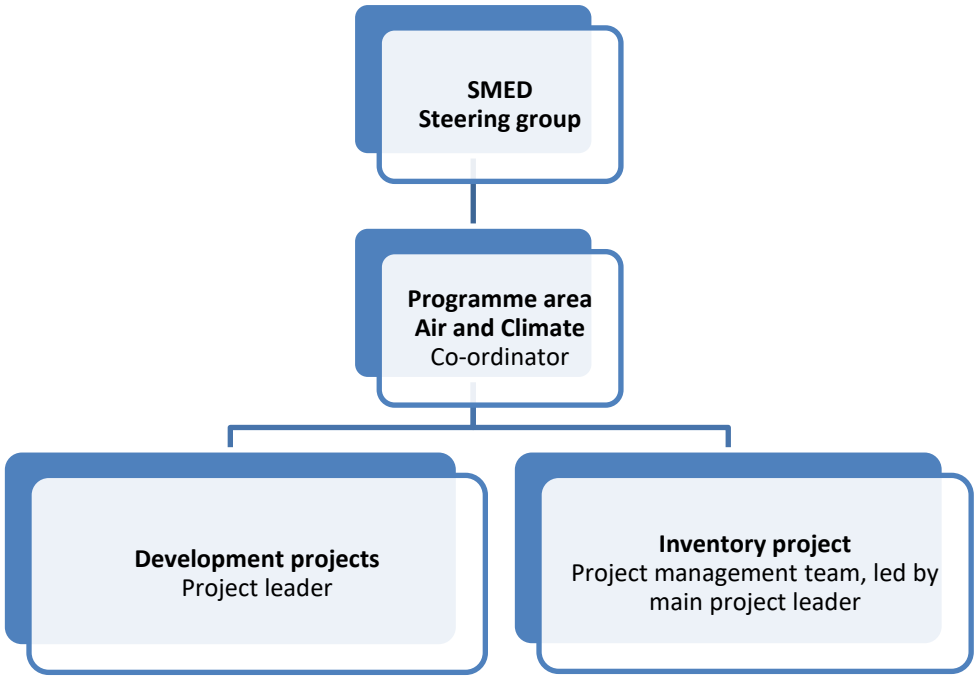


Figure 5. Organisation relating to emission inventories in SMED.

SCB, IVL, SLU and SMHI share the work with the inventory within SMED. Final data are produced mainly by SCB, IVL and SLU. The inventory is led by a team of four members, one from each organisation. One of them is the main project leader. The project management team is responsible for distributing tasks among the inventory staff, managing the inventory work during the year and to organise the annual internal review of data and documentation before submission to the Swedish EPA. The quality control is performed by the inventory staff.

Within SMED a co-ordinator for the air and climate programme area co-ordinates all projects and relevant activities within the program. The co-ordinator is responsible for the final review and approval, before the results are submitted to the Swedish EPA.

Roles and responsibilities are described in appendix 2, which is updated annually.

7.2 Education, awareness and competence

Within SMED, the steering group is responsible for maintaining an adequate staff of experts with suitable education and competence to perform the Swedish emission inventories according to quality requirements.

Maintaining competence and awareness in the inventory work is achieved by ensuring that more than one person is sufficiently familiar with a specific area of work to be able to perform the work in accordance with quality requirements. All work is also described in detail in work documentation (appendix 4). In order to ensure high competence regarding all reporting categories, work with specific categories is exchanged between inventory staff members when appropriate regarding the need for ensuring competence. The work can be performed under supervision and support from a more experienced staff member when needed, to fulfil this objective.

7.3 Internal and external communication

A general guidance on communication for the SMED inventory staff, and between SMED and the Swedish EPA, is described in appendix 9 (in Swedish).

7.3.1 Internal communication

The program co-ordinator has an overview of all projects within the programme area and is the key point for internal communication in SMED as an organisation. The co-ordinator has close communication with the steering group and with the project leaders in all emission inventory related projects and participates when necessary in project and planning meetings.

The project leaders handle communication with the co-ordinator and the inventory staff. Within the project management team for the annual inventory project frequent contact is maintained by telephone, e-mail and video conferences to manage the inventory project.

For each annual inventory cycle there is a start-up meeting in the spring for the inventory project, an intermediate meeting in the fall and a final meeting in the beginning of the next calendar year. At this final meeting the project is normally evaluated regarding project organisation, efficiency and quality.

Common project meetings for all inventory staff members are held regularly during the more intense part of the inventory preparation, i.e. from August to December. The project management team have regular meetings every month and when there are specific needs.

The EPA participates in the start-up meeting, the fall meeting and in the final meeting. At these meetings, the inventory staff and the EPA normally meet in person at one location.

The project management team meeting and project meetings are most of the time held as video- or telephone conferences since the inventory organisations are located in different parts of the country.

All meetings are documented in protocols stored at www.projectplace.com.

The internal communication and frequency of project meetings regarding development projects is, apart from communication with the co-ordinator, dependent on duration of the project and the number of persons involved in the project.

Distribution of information and documents within SMED is handled using email and via www.projectplace.com.

7.3.2 External communication

Monthly follow up meetings are held between the co-ordinator, project management team and the Swedish EPA to track the progress of the inventory preparation and development projects and to share relevant information (e.g. from different national and international meetings and working groups).

Formal communication between SMED, represented by the co-ordinator and a steering group representative, and contact persons at the Swedish EPA is maintained by regular meetings, 2 times a year. These meetings are documented by signed protocols stored at www.projectplace.com. In matters directly relating to the actual project, the project leader or project management team communicates with the contact persons at the Swedish EPA.

Finally, the SMED steering group and programme coordinating group has formal follow-up meetings with the Swedish EPA twice a year.

Communication between SMED and the Swedish EPA is regulated by the SMED overall quality system.

Communication with other authorities in their role as data providers is regulated in the National System.

Regular external communication is also maintained with providers of data and information, other than authorities concerned in the National System. These external contacts include trade associations, individual industrial facilities and national experts.

External communication with contacts abroad include inventory experts in the Nordic countries by participation in joint projects and informal exchange of information, different review programs (e.g. UNFCCC-ERT[10], EU-ESR[11] and EU-NECD Inventory Review), and the UNECE Task Force on Emission Inventories and Projections (TFEIP).

7.4 Documents and documents control

7.4.1 Documents and documents control in the inventory

The documentation relating to the national emission inventory is comprehensive. In Table 1 the most important documents are listed. These documents are normally updated annually. Version and date of the update is given, as well as information on if the document is a draft or a final version. When the annual inventory has been approved externally, e.g. when the review reports have been published, the main project leader makes the archiving of documents and tables at www.projectplace.com. Archives are kept for each submission.

Table 1. Documentation in the emission inventories.

Document	Written by	Reviewed by	Approved by	Updating
Planning document	Inventory staff, co-ordinator	Co-ordinator, SEPA		Annually
Project specification for inventory project	Project leaders and inventory staff	Co-ordinator and steering group	SEPA	Annually
Project specification for development projects	Project leaders and inventory staff	Co-ordinator and steering group	SEPA	Each project
Activity plan	Project management team			Annually
Manual for quality system	Project management team	Co-ordinator	SEPA	Annually
Roles and responsibilities	Project management team			Annually
Documentation of databases and models	Inventory staff	Co-ordinator		When needed (seldom)
Work documentation	Inventory staff			Annually
QC checklists	Inventory staff			Annually
Official inventory reports (NIR/IIR)	Inventory staff (some parts are written by SEPA)	Co-ordinator	SEPA	Annually

[10] Expert Review Team
[11] Effort Sharing Regulation

Document	Written by	Reviewed by	Approved by	Updating
Reporting databases (TPS/CRT reporter)	Inventory staff member responsible for reporting databases	Co-ordinator	SEPA	Annually
Uncertainty estimates	Inventory staff member responsible for uncertainties	Co-ordinator	SEPA	Annually
Key Category analysis	Inventory staff member responsible for key categories	Co-ordinator	SEPA	Annually
External review response documents	Inventory staff	Project management team	SEPA	Each external review
Protocols from internal and external meetings	Inventory staff	All participants		Each meeting
Protocols from external meetings	Inventory staff	All participants		Each meeting
Project reports from development projects	Project leader	Co-ordinator	SEPA	Each project

7.4.2 Documents and documents control in development projects

All development projects aim at improving the annual inventory in all or some of the aspects relating to accuracy, comparability, completeness, transparency and consistency. The objectives of development project may also be to e.g. increase efficiency in the inventory work.

If approved by the Swedish EPA, the results of development projects are implemented in the annual work with the inventory and documented in the regular documenting and QC system (Table 1). Additionally, a project report is in most cases compiled, reviewed and approved by the co-ordinator, and then submitted to the Swedish EPA for final review and approval. The project reports are archived at www.projectplace.com.

7.5 Quality plan (Plan for inventory preparation and quality control)

Figure 6 gives a general overview of the annual inventory process, after a project agreement has been signed and the initial project planning procedures have been performed, according to the description in chapter 6.3. For each step in the process a number of QA or QC procedures are performed. From April, when the collection of data starts, and during the calculation and compilation phases until October, appropriate Tier 1 QC[12],

[12] Table 6.1. in 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

and for some categories Tier 2 QC, are performed and documented, as described in chapters 8.1to 8.7. During September-November, the procedures for internal SMED review take place before final delivery of tables and reports to the Swedish EPA (chapter 8.8.1).

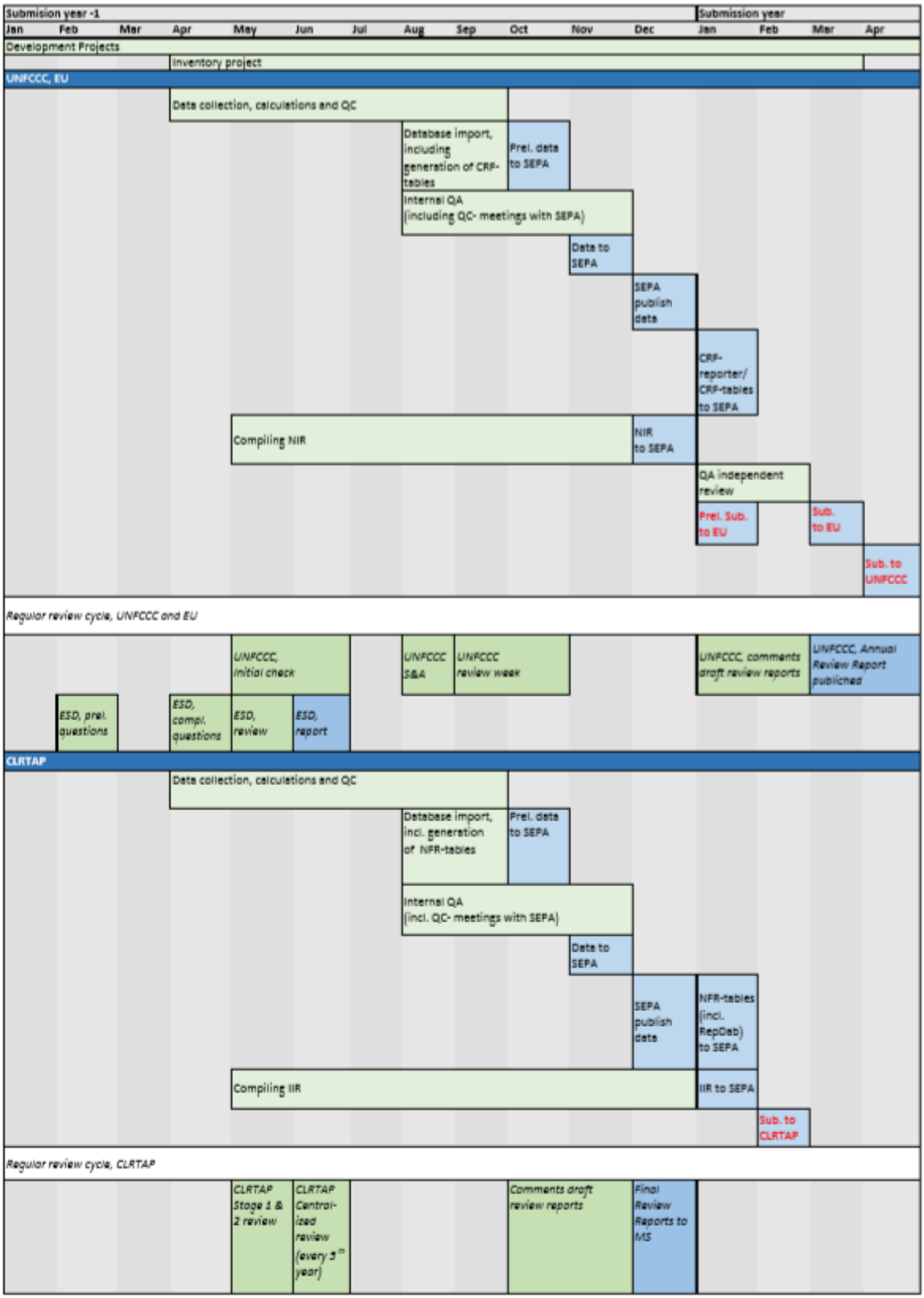


Figure 6. General overview of the inventory process.

The annual inventory cycle and QA/QC is governed by an activity plan (appendix 1). The activity plan is derived from the project agreement with the Swedish EPA and specifies when all activities (QA/QC and other activities) must take place in order to maintain timeliness and high quality in delivered data and reports.

All inventory preparation is described in detail in the work documentation (appendix 4).

7.5.1 Plan for development projects

Development projects are approved by the Swedish EPA, based on a project specification. The specification includes a time schedule for the different project steps, for contacts with the Swedish EPA and for final delivery of results.

8 Checking (Check)

The objective of the quality control and quality assurance steps and procedures outlined in this and the following chapters is to ensure that the inventory is as comparable, consistent, complete, transparent and accurate as possible, given the resources and expertise available.

This chapter describes the routines for quality control and quality assurance that shall be performed during the inventory process by the inventory staff when gathering data and calculating and compiling the emission inventory. The process involves all steps from initial gathering of underlying data until the CRT Database and NFR reporting tables are completed. It also involves the compilation of inventory documentation, from internal work documentation to the official inventory reports (National Inventory Report to UNFCCC and the Informative Inventory Report to CLRTAP).

8.1 Data quality control procedures

8.1.1 Data quality control, General procedures, Tier 1

The general IPCC tier 1 QC-procedures (Table 6.1 in IPCC, 2006) are to be performed regardless of reporting sector or type of data:

Most QC procedures are performed during the inventory process, and those performed by the inventory staff during the inventory process can be summarised to include the following checks.

- Transcription errors in data input
- Calculations are made correctly
- Units and conversion factors are correct
- Integrity of database files
- Consistency in data between source or sink categories
- Correct movement of inventory data between processing steps
- Recalculations, checked and documented
- Completeness check
- Comparison of last submission's estimates to previous estimates
- Documentation of changes that may influence uncertainty estimates

Tier 1 checks are documented in code- or source/sink specific QC-checklists (appendix 5). The remaining Tier 1 checks are described in chapters 8.4 and 8.5.

8.1.2 Data quality control, Specific procedures, Tier 2

For some sources there are requirements on Source Category-specific QC Procedures, Tier 2, according to IPCC (IPCC, 2006). These are included, specified and described, for the codes and sources concerned, in the QC-checklists (appendix 5) and in the work documentation (appendix 4).

Tier 2 Quality Control procedures are introduced into the annual work plan only after approval by the Swedish EPA.

8.2 QC-procedures for development projects

QC procedures during a development project may vary according to the nature of the project. In all cases when results from development projects are included in the inventory, they undergo the same procedures regarding QC, internal audits, documentation, archiving and QA as described for inventory data. The co-ordinator reviews and approves all deliveries to the Swedish EPA.

The aim of development projects is to improve the inventory by providing data and methodology that are in accordance with *good practice* and that reflect national circumstances. In the development projects a thorough analysis of data are made, including verification where possible, in order to ensure that the best input data and methodology practicable are included in the annual inventory, given scientific knowledge, national circumstances and resources available.

8.3 QC-procedures for data gathering and emission calculations in the inventory

In the Swedish inventory system, the responsibilities for performing and documenting the QC procedures during the inventory process rest upon the inventory staff, as given in Appendix 2.

8.3.1 QC-checklists

Throughout the working process, the inventory staff uses QC checklist (appendix 5) as support to the QC procedures. Matters that need further attention or action can also be documented in the QC-checklist.

There is one QC-checklist for each source/sink, category or set of categories depending on the type of underlying data, and how the inventory work is shared between the organisations in SMED. The aim is to achieve the most rational and unambiguous division according to the actual inventory procedures. In the QC-checklist there is a general list of checks to be performed (Tier 1), and specifications are added where necessary. Source or sink category-specific checks, Tier 2, are included and specified in the list for categories concerned, see also chapter 8.1.2. Checks that are not applicable for a specific category do not need to be filled in. They are shaded or removed. The checklists are under continuous development to make them as rational as possible. This implies that the layout will evolve between submissions, however keeping the main functions intact.

In the QC-checklists, besides documenting QC procedures performed, there is also space available to note matters that need further action. This includes:

- changes or corrections to perform before submission of present inventory
- changes or corrections that must be documented elsewhere e.g. NIR and work documentation
- changes that may influence the uncertainty estimates (to be considered and evaluated in the annual uncertainty assessment)

When all matters that have been noted to need further action are performed, these are signed in the list. The QC-checklists are thus the basis for keeping track of changes and the flow of information in the inventory work.

8.3.2 Work documentation

Documentation of the inventory is made in a separate work documentation (appendix 4), either by reporting category or other relevant sub-divisions according to the underlying data or calculation methods. The work documentation are internal documents within each of the SMED organisations to maintain consistency in the annual preparation of the GHG inventory. The inventory staff is responsible for working in accordance with, and also for updating the work documentation as needed.

The documentation is often separated according to the same system as the QC-checklists (sector, category, group of categories etc). The work documentation and the QC checklist are complementary to each other. The work documentation is intended as a manual and working material for the inventory staff, in order to ensure consistency, but is also used as a basis for

inventory improvement and is available for external review. The work documentation is in Swedish. There is currently no specified common format for the work documentation but most of them follows the structure described below.

Chapter 1 and 2 consists of procedures. The first chapter in the work documentation is an overview of the category, national circumstances, and references to relevant guidelines, general information on choice of methods, emission factors and activity data, information on completeness, consistency, uncertainties and QA/QC. Chapter 2 gives the procedures for the inventory staff. Chapter 2 includes references to underlying data and necessary files, how to collect data, how to perform calculations, and any specific QC-procedures. Chapter 1 and 2 are only updated when needed.

Chapter 3 is for suggestions on improvements from SMED. Chapter 4 is for suggestions on improvements from reviews. Chapter 5 covers any comments or notes concerning the inventory work and chapter 6 covers records on recalculations. Chapter 3-6 are records and updated annually.

8.4 Checking inventory estimates

After data collection and calculations are completed, data are imported into the TPS database, and from there exported to the CRT-reporter web-based software provided by the UNFCCC-secretariat and to the NFR tables. The inventory staff performs checks on the time-series trends and effects of recalculations of the UNFCCC-inventory based on graphs generated using TPS exported data and general SAS-routines or for NFR-data by special trend graphs. Any other deviations from previously reported data are also checked. Any corrections that can be done immediately are made, and a new set of corrected input data tables is imported into the TPS database. In the case of the need of more extensive corrections that cannot be dealt with in time to be included in the present submission, they are documented in the appropriate working document to be included in the planning of the following inventory (planning document, appendix 8).

8.5 Checking reporting database and tables

8.5.1 UNFCCC CRT Reporter database

Additional checks to the inventory estimates described above concern sectoral background data and other supporting information in the CRT

reporting system. The checks are “Consistency checks in time series”, “Recalculation check” and “Completeness check” and these checks are made to ensure that all required information is correctly completed. The responsibility for checking the CRT database lies with the person responsible for the reporting databases, who in turn will delegate the task to the inventory staff (see appendix 2).

8.5.2 UNECE/CLRTAP Nomenclature For Reporting (NFR)

In addition to the check of inventory estimates as described above, the format of NFR reporting tables are checked. Before submission of NFR data to the Swedish EPA, the RepDab-tool[13] provided by the EMEP Centre on Emission Inventories and Projections is used by the inventory staff. The RepDab-tool provides a table formats check, checks for internal consistency and completeness. The responsibility for the NFR table checks lies with the inventory staff (according to Appendix 2).

8.6 QC procedures for uncertainty estimates

The general QC-procedures (Table 6.1 in IPCC, 2006) are to be performed regardless of reporting sector or type of data. Those applicable for uncertainty assessment and analysis can be summarised to include the following checks:

- Review of new information in internal documentation (uncertainty parts in QC checklist and work documentation)
- Changes that may influence uncertainty estimates
- Uncertainties estimated
- Correct movement of data between processing steps
- Uncertainty estimates calculated correctly
- Internal review of uncertainty documents (Expert protocols for uncertainty estimates)
- Comparison of estimates to previous submission's estimates

[13] https://www.ceip.at/repdab

Emission data for the uncertainty estimates are taken from the TPS database to ensure complete and accurate compilation. The overall uncertainties are calculated using the SAS software.

General procedures for the Swedish quantitative greenhouse gas uncertainty assessment are described briefly in the work documentation for Uncertainties.

8.6.1 Annual quality control for uncertainty analysis

During the inventory process, the inventory staff documents changes that may influence uncertainty assessment in the appropriate QC-checklist and work documentation. If needed, the uncertainty estimates are also updated before the annual uncertainty assessment is performed.

8.7 QC procedures for Key Source/Key Category analysis

The category specific QC-procedures (IPCC, 2006) are to be performed for Key categories regardless of reporting sector or type of data. Annex A.1 in IPCC 2006 GL, Volume 1 chapter 6 (IPCC, 2006) specifies the category specific level QC procedures. Those applicable for key source/key category analysis can be summarised to include the following checks:

- Transcription errors in data input
- Calculations are made correctly
- Units and conversion factors are correct
- Correct movement of inventory data between processing steps
- Completeness check
- Comparison of last submission's estimates to previous estimates

General procedures for the Swedish key source/key category analysis are described in the work documentation for Key Source Analysis (appendix 4), where also documentation of the annual key source/key category analysis is made.

8.7.1 Annual quality control for Key Source/Key Category analysis

After the SMED internal QA is completed, emission data are extracted from the TPS database and fed into the SAS software to perform the complete Tier 1 and Tier 2 key category/source analyses. This minimizes the risk for transcription errors and ensures complete and accurate repetitive compilation. The SAS software programmed QC procedures for key source/key category analyses focus on to ensure that all relevant data is

transferred, that appropriate GWP values are used for converting emissions to CO_2-equivalents and that aggregation of sources or sinks are done correctly.

8.8 Quality Assurance (QA)

8.8.1 Internal review

This section describes the procedures for quality control and review that are performed after completion of the inventory compilation. These procedures are undertaken prior to the submission of the annual inventory databases/tables (TPS database, CRT database and NFR tables) and the official inventory documents (NIR and IIR) to the Swedish EPA.

8.8.1.1 Checking inventory estimates

When inventory is compiled by SMED, diagrams and tables showing detailed data on activity data, emissions and implied emissions are produced, together with a comparison with last year's submission. A review of trends and recalculations is then performed by SMED. In addition, sector experts at the Swedish EPA review the diagrams and tables. During annual QC meetings, EPA and SMED hold sector-wise meetings where questions and explanations of data, trends and recalculations are discussed. The review meetings are documented (see appendix 6), including if any revisions to the data are needed. If an error cannot be resolved by the inventory staff immediately, it is reported to the project management team. If an error must be considered in the planning of next year's submission it is noted in the QC-checklists and the work documentation (appendix 4 and 5).

When reviewed and final data from the database have been imported into the CRT tables, the inventory staff checks the final tables.

8.8.1.2 Checking official inventory reports, NIR and IIR

The co-ordinator is responsible for the SMED-internal review of official inventory documents before submission to the Swedish EPA. Specific matters of concern are that:

- All recalculations are accounted for and properly explained
- Coming improvements are properly mentioned
- The required substances are covered in the document
- All out-dated information has been removed
- Tables and figures are updated

8.8.1.3 Checking uncertainties and key source analysis

The co-ordinator is also responsible for an annual review concerning:

- Estimated uncertainties
- Key Source/Key category analysis

8.8.2 QA by independent reviewers

8.8.2.1 National QA by independent reviewer

The national QA is regulated in the National System. The national independent review (NOG) covers the Swedish emission inventories submitted to the UNFCCC and to EU[14] and is performed by national independent reviewers. SMED submits official inventory documents and the TPS database to the Swedish EPA, and the Swedish EPA makes relevant documents and the data available to the national independent reviewers.

The national independent reviewers may comment on and make suggestions for any part of the information including data and documentation.

The Swedish EPA returns any comments or findings from national QA by independent reviewers to the co-ordinator within SMED. The project management team is responsible for necessary corrective actions and the co-ordinator for submission of corrected documents to the Swedish EPA.

The inventory staff is available for questions and comments from the Swedish EPA and other authorities involved during the national QA.

All final comments from NOG are recorded by the EPA. Relevant suggestions from the NOG are included in the Planning document and evaluated when planning projects for the following year (see chapter 9 and 6.3).

8.8.2.2 International reviews

Reviews are (normally) performed annually within the UNFCCC, EU and the CLRTAP reporting frameworks. The SMED inventory staff is available to respond to questions and comments from the review teams during international reviews. Questions from the review teams are received by the Swedish EPA and forwarded to the project management team, which distributes the questions to the inventory staff. The Swedish EPA is responsible for transmitting the answers to the relevant body.

[14] Effort Sharing Regulation" ((EU) 2018/842) or "ESR"

The draft reports of these reviews are received by the Swedish EPA and forwarded to the designated responsible for the sector of concern for internal distribution, comments and compiles the answers and sends them back to the Swedish EPA for further transmission to the relevant body. Responding and transferring of information may be done directly through e-channels, if provided by the responding organisation.

Review reports and the replies to the review reports are archived at www.projectplace.com.

All final comments from reviews are recorded and handled in the same way as described above concerning comments from the national review.

8.8.3 Participation in Swedish EPA audits of the Quality system

SMED participates actively in audits of this quality system when initiated by the Swedish EPA. An audit may cover the entire quality system as described in this manual, or parts of the system. An audit is initiated by a request from Swedish EPA to the SMED co-ordinator. The co-ordinator is responsible for involving relevant experts, depending on the coverage and extent of the audit.

8.9 Nonconformity reporting, corrective and proactive actions

In the Swedish QA/QC system, the aim is to solve any problems at lowest possible level. For problems or mistakes that are discovered by the inventory staff, and which can be corrected immediately, no formal non-conformity reporting is made. Other needs for corrections or other changes are documented in the work documentation by inventory staff. Possible improvements desirable or required changes, not already dealt with and needs funding from the Swedish EPA are then collected to the planning document (Appendix 8) to be taken into consideration in the inventory planning procedure.

In order to fulfil the quality objectives in chapter 6.2, the procedures followed for non-conformity reporting, mechanisms for corrective actions and for proactive actions are as described below.

8.9.1 Nonconformity reporting

Information concerning the need for changes or improvements may arise from four different documented stages of the Swedish inventory process, according to the QC system.

- From issues brought up at project meetings or at follow-up meetings with the Swedish EPA. Documented by meeting minutes at www.projectplace.com.
- From the inventory staff by documented findings in the QC checklist or in the annually updated chapters of the work documentation. All QC checklists and work documents are stored at www.projectplace.com.
- Findings in the different steps of SMED internal reviews. Internal reviews are documented at www.projectplace.com.
- Comments and suggestions from external reviews. External review reports are archived at www.projectplace.com.

8.9.2 Mechanisms for corrective actions

Corrective actions that are documented in the QC-checklists and/or the work documentations are attended to be included in the submission as soon as possible. This may be in the present submission or at the latest in the following submission, depending on in what stage of the inventory process the need for corrections is revealed.

Corrective actions which involve more extensive changes and improvements are noted in the work documentation, and then considered in the annual planning of upcoming inventories (planning document, appendix 8). The collection of suggestions to the planning document is the responsibility of the project management team (according to appendix 2).

Needed or desired improvements and changes noted in the planning document are communicated to the Swedish EPA. Through the regular follow-up meetings with SMED and the Swedish EPA, the Swedish EPA is also informed of, and may also introduce, any issues that may be considered as important for future improvement actions.

8.9.3 Proactive actions

In order to prevent mistakes to be repeated any discovered non-conformity or need for changes of any kind are discussed at all project meetings. A decision on how to proceed with the issue is made, which may be to solve it within SMED according to the procedures described above, or if it needs to be presented to the Swedish EPA for further consideration. If it is a major issue it will be regulated and solved in upcoming project agreements.

Intermittently, a risk analysis (appendix 3) is performed by the project management team and the results are taken into consideration in the planning as appropriate.

9 Follow-up and improvement (Act)

As noted in chapter 6.3, after each submission has been completed the project is evaluated regarding project organisation, efficiency and quality. Besides documentation in minutes, all relevant ideas for improvement of the inventory are noted in the planning document. From the planning document (appendix 8) issues that need to be addressed by the Swedish EPA are presented for further consideration.

Suggestions for changes that are noted in the planning document are discussed with the Swedish EPA at follow-up meetings, documented by meeting minutes stored at www.projectplace.com. Changes that are prioritised by the Swedish EPA after discussion with SMED are included in the work with the next submission, either in the inventory or in development projects.

SMED also pursues regular improvement work in relation to data providers not regulated by the National System. This work is primarily undertaken at the annual regular contacts asking for input data to the inventory. At those instances inventory experts discuss possibilities in improving and providing suitable datasets that are quality controlled and quality assured.

Any needs for organisational changes within SMED are handled by the SMED steering group.

10 Appendices

10.1 Appendix 1 Activity plan (Arbetsplan)

The activity plan is a time schedule for the regular annual inventory preparation within the inventory project. It is used throughout the annual work cycle. The activity plan is located at www.projectplace.com

10.2 Appendix 2 Roles and responsibilities (Roller och ansvar)

A document describing the division of responsibilities within SMED. The document is used during the work with the annual inventory. It is located and annually archived at www.projectplace.com.

10.3 Appendix 3 Risk Analysis (Riskanalys)

An intermittently updated document identifying and addressing all major issues that may affect the work with the annual inventory. The document is used during the work with the annual inventory and when relevant in meetings with the Swedish EPA. It is located at www.projectplace.com.

10.4 Appendix 4 Work documentation (Arbetsdokumentation)

The work documentation consists of a number of annually updated documents (in Swedish) describing the work (data handling and calculations) with the inventory with one document for each source/sink code or group of codes, one document for uncertainty estimates and one document for key source/key category analysis. The documents are used during the work with the annual inventory and are located at www.projectplace.com. The documentations for uncertainties and key source/key category analysis are used in the final stages of the inventory and after inventory submission. When the annual inventory is completed the documentation is archived at www.projectplace.com.

10.5 Appendix 5 QC checklist (QC-checklista)

QC-checklists are in Swedish. There is one checklist for each code/group of codes. The QC-checklists are used during the inventory, at the end of the inventory, and during reviews. They are annually archived at www.projectplace.com.

10.6 Appendix 6 QC activities

10.6.1 QC meetings (QC-möten)

Includes documentation per sector (presentations and protocols) from QC-meetings with the SEPA. They are located and annually updated at www.projectplace.com.

10.6.2 Recalculations (Omräkningar)

Includes documentation of recalculations for each code/group of codes compared to previous submission. They are located and annually updated at www.projectplace.com.

10.6.3 Review graphs (Granskningsgrafer)

Includes review graphs for each code/group of codes compared to previous submission. They are located and annually updated at www.projectplace.com.

10.7 Appendix 7 Documentation of databases and models

Documentation in English on databases and models used in the inventory including references to other specific documentation when such documentation exists. The documentation is used as background information and during reviews. It is located at www.projectplace.com.

10.8 Appendix 8 Planning document (Bruttolista)

The planning document is updated annually and covers all issues where changes or improvements are desired or necessary and need funding for development projects. The document is used as a basis for planning

improvements in inventory work. The document is in Swedish and is located and annually archived at www.projectplace.com.

10.9 Appendix 9 Communication (Kommunikation)

A general guidance on communication for the SMED inventory staff, and between SMED and the Swedish EPA (in Swedish). The aim of the guidance is to ensure that relevant information, between different parts within SMED, and between SMED and the Swedish EPA, is communicated using the adequate procedures.

10.10 Appendix 10 Quality declaration (Kvalitetsdeklaration)

A document describing the quality of emission inventory statistics (in Swedish).