National Environmental Research Institute
Ministry of the Environment · Denmark

Quality manual for the greenhouse gas inventory

Version 1

Research Notes from NERI No. 224

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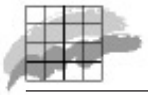

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Data sheet

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Abstract:	A plan for the quality work has to be made for the Kyoto Protocol greenhouse gas emission inventory. This report outlines the quality work in the Danish inventory. The content is fulfilling the objectives as given by the international community and suggests a general paradigm that secures a measurable quality system

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Contents

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Preface

This research notes report outlines the work in the emission inventory group at the Department of Policy Analysis at the National Environmental Research Institute (NERI). The content is a status for development and implementation of a Quality Control and Assurance system for greenhouse gas inventories.

Summary

This report is a manual for the Quality Control and Quality Assurance of greenhouse gas emission inventories performed by the Danish National Environmental Research Institute (NERI). This version 1 will be tested during 2005 and 2006. Major changes in the procedure may prove necessary for the next version after the testing period. The manual is in accordance with the guidelines provided by the UNFCCC and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC) with some extensions. The ISO 9000 standards are also used as important input for the structure of the manual. The work with quality is sub divided into the following elements:

1. Quality Management, that co-ordinates activity to direct and control with regard to quality.
2. Quality Planning, in where quality objectives are defined including specification of necessary operational processes and resources to fulfil the quality objectives.
3. Quality Control, that secures fulfilling of quality requirements.
4. Quality Assurance that provides confidence for fulfilment of quality requirements.
5. Quality Improvement that increases the ability to fulfil quality requirements.

In the ISO 9000, the term quality relates to the fulfilment of requirements, where the requirements are generated from need or expectations as stated by either organizations, customers or interested parties. The organizations can be seen as the international community. The requirements from the international community are assumed to be reflected in the UNFCCC and The Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC).

A solid and clear definition of when the quality is sufficient is an essential platform for the Quality Management. However, such a definition is missing in the UNFCCC guidelines. The standard of the inventory result is defined as being composed of the accuracy and regulatory usefulness. The goal is to maximise the standard of the inventory and the following statement defines the quality objective:

The quality objective is only inadequately fulfilled if it is possible to make an inventory of higher standard without exceeding the frame of resources.

This statement does not secure that the inventory provides results of a sufficient standard for the end-user. If the standard is judged to be unsatisfactory by the end-user on one hand while the Quality Assurance shows the quality to be sufficient on the other hand, then a demand for additional resources for inventory work exists. If this is the case the resource responsible authorities should to be consulted.

The Quality Planning is based on the data flow in the inventory. The flow of data has to take place in a transparent way by making the

transformation of data detectable. It is important that it is easy to find the original data background for any calculation and easy to trace the sequence of calculations from the raw data to the final emission result.

The objectives for the Quality Management, as formulated by *IPCC Good Practise* and the *UNFCCC* guideline, are to improve elements of transparency, consistency, comparability, completeness and accuracy. Two other factors are included in this manual as important: (1) Robustness of the inventory in relation to change in conditions like staff and external data availability. (2) Correctness of the data handling by elimination of miscalculation.

The means for the Quality Planning have to be detailed measurable checkpoints imbedded through out all activities in the inventory and they are denoted Point of Measurements (*PM*). A first version of a *PM* listing is reported in this manual. A database for *PM*'s is under construction. The database will test, where specific data and reporting is stored and visualised on line during the progress of the inventory work.

It may be meaningful to combine inventory reporting and the quality documentation reporting in one single report every year. It is, however, still open how the Quality reporting will be performed. One idea is to develop a database that yields output in report format every year or as a written reporting. The database solution may be an attractive way to minimise the additional work associated with the quality reporting.

The IPCC Guidelines recommend using higher Tier Quality Control for key sources in particular. Thus the key source identification is crucial for the planning of quality work.

Sammenfatning

Denne rapport er en manual for kvalitetssikring og kontrol ved den årlige danske rapportering af emissionen af drivhusgasser. Rapporten er udarbejdet af Danmarks Miljøundersøgelser (DMU). Dette er version 1, som repræsenterer en test-periode. Derfor kan større eller mindre ændringer i procedurer og fremgangsmåder forekomme frem til den næste version. Denne manual er i overensstemmelse med UNFCCC og Good Practice Guidance, samt Uncertainty Management i National Greenhouse Gas Inventories (IPCC) med nogle tilføjelser. Strukturen i manualen er bygget op som foreslået i ISO 9000-standarderne. Arbejdet med kvalitetsdelen er bygget op af følgende dele:

(1) kvalitetsstyring (Quality Management), der koordinerer aktiviteter i forhold til kvalitet.

(2) Kvalitetsplanlægning (Quality Planning) hvor kvalitetsmål er defineret, inklusiv en specifikation af nødvendige tiltag og nødvendige ressourcer for at opfylde målsætningen.

(3) Kvalitetskontrol (Quality Control), der skal sikre, at de tiltag, som planlægningen lægger op til, også udføres i praksis.

(4) Kvalitetssikring (Quality Assurance) der kan dokumentere af den ønskede kvalitet faktisk er tilstede.

(5) Kvalitetsforbedring (Quality Improvement) der skal give mulighed for bevidst at forbedre kvaliteten.

I ISO 9000 er kvalitet baseret på krav, der er fremsat som forventninger fra virksomheder, kunder eller interessenter. Virksomheden kan ses som det internationale samfund, der ønsker en udredning af emissioner. Kravene fra det internationale samfund er forudsat reflekteret i FN og The Good Practice Guidance og Uncertainty Management i National Greenhouse Gas Inventories (IPCC).

En klar definition af hvornår en kvalitet er tilstrækkelig er essentiel for kvalitetsstyring. En sådan definition mangler dog i FN og i The Good Practice Guidance og Uncertainty Management i National Greenhouse Gas Inventories (IPCC). Standarden af opgørelsen er defineret til at bestå af nøjagtighed og brugbarhed. Formålet med kvalitetsstyring er således at optimere standarden, hvilket munder ud i følgende definition for tilstrækkelig kvalitet:

Kvalitetsmålet er kun utilstrækkeligt opfyldt, hvis det er muligt at lave en opgørelse af højere standard uden brug af ekstra ressourcer

Denne definition sikrer ikke, at opgørelsen opfylder behovet for brugerne af resultatet. Hvis en standard er vurderet til at være utilstrækkelig på den ene side og kvaliteten, som formuleret overfor, er opfyldt, så hersker der et behov for flere ressourcer. I et sådan tilfælde skal de bevilgende myndigheder kontaktes.

Kvalitetsplanlægningen er baseret på dataflowet i arbejdsgangen bagved opgørelsen. Dette dataflow skal foregå på en transparent måde, hvor alle beregningsresultater let kan spores fra de originale baggrundsdata og frem til det endelige resultat. Det skal være let at finde frem til de originale data og forstå deres baggrund.

Formålet med kvalitetsstyring er, som formuleret af *IPCC Good Practise* og *UNFCCC* guideline, at forbedre elementer som transparens, konsistens, sammenlignelighed, fuldkommenhed og præcision. Derudover er der inkluderet to andre faktorer i denne manual: (1) Robusthed af opgørelsen i forhold til ændringer i forudsætningerne bag opgørelsen, såsom personale og tilgængelige datakilder. (2) Korrekthed af databearbejdning og således ingen fejlberegninger.

Midlerne til kvalitetsplanlægning skal være detaljerede kontrolpunkter, der dækker alle aktiviteter. Disse kontrolpunkter er benævnet Point of Measurements (*PM*). I denne manual ses en første version af en liste af *PM*'er og en database er under udarbejdelse. Databasen vil kunne teste, hvor afrapportering og behandling af *PM*'er er gemt og visualiseret.

Det kan vise sig meningsfyldt at kombinere afrapportering med kvalitetsdokumentation i den samme rapport, hvert år. Men det er dog stadigt åbent hvordan den konkrete samlede afrapportering af kvalitetssikringen vil foregå.

1 Introduction

This report is a quality manual for the Quality Control (QC) and Quality Assurance (QA) for greenhouse gas emission inventories performed by the Danish National Environmental Research Institute. The quality procedure will be improved as a continuous process. The quality manual is thus periodically updated. This is version 1 representing a testing period during 2005 and 2006. Major changes in the procedure may prove to be necessary for the next version based on the practice of the inventory work.

The manual is in accordance with the guidelines provided by the UNFCCC and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC) with some extensions. The ISO 9000 standards are also used as important input for the structure of the manual. The QA/QC activities - as described in this manual - governs work that only use external data and the persons who are directly involved in this work are denoted *inventory staff*. This manual sets up guidelines for the work by *inventory staff*. The *inventory staff* is located in the Department of Policy Analysis, NERI, Denmark.

First the concept of quality is defined using conventional terminology and the interaction between different elements is briefly outlined. The quality goal is defined and from that, a listing of basic factors to take into account is made. This forms the platform for concrete tasks to be done in order to fulfil the quality goal. Finally a reporting structure is outlined in which every task is addressed.

2 Concepts of quality work

Quality is in ISO 9000 defined as the degree to which a set of inherent characteristics fulfils requirements. Requirements are the need or expectation that is stated, generally implied of obligatory. The quality planning is based on the following definitions as lined out by both ISO 9000 standards and it covers the activities lined out by the UNFCCC and the Good Practice Guidance:

- Quality management (*QM*) co-ordinate activity to direct and control with regard to quality
- Quality Planning (*QP*) defines quality objectives including specification of necessary operational processes and resources to fulfil the quality objectives
- Quality Control (*QC*) fulfils quality requirements
- Quality Assurance (*QA*) provides confidence that quality requirements will be fulfilled
- Quality Improvement (*QI*) increases the ability to fulfil quality requirements

The activities are considered inter-related in this work as shown in Figure 1.

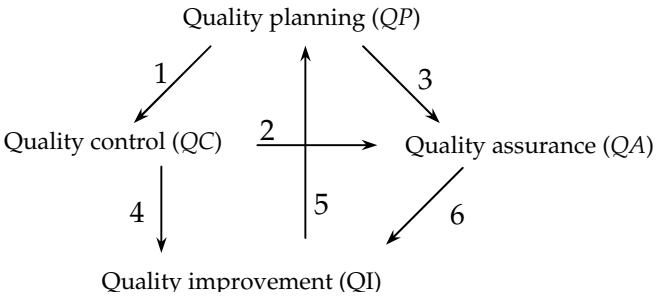

Figure 1. The Inter-relation between the activities with regard to quality. The arrows are explained in the text below this figure.

1: The *QP* sets up the objectives and from these measurable properties valid for the *QC*.

2: The *QC* investigates the measurable properties that are communicated to the *AC* for assessment in order to ensure sufficient quality.

3. The *QP* identifies and defines measurable indicators for the fulfilment of the quality objectives. They form the basis for the *QA* and have to be supported by the input coming from the *QC*.

4: The result from *QC* will highlight the degree of fulfilment for every quality objective. It will thus be a good basis for suggestions of improvements of the inventory to meet the quality objective.

5: Suggested improvements in the quality may induce changes in the quality objectives and their measurability.

6: The evaluation done by external authorities is important input when improvements in quality are considered.

3 Definition of sufficient quality

A solid definition of when the quality is sufficient is essential. Without this, the fulfilment of the objectives will never be clear and the process of quality control and assurance can easily turn out to be a fuzzy and unpleasant experience for the people involved. Contrary, in case of a solid definition and thus a clear goal, it will be possible to make a valid statement of "good quality" and thus form constructive conditions and motivate the inventory work positively. A clear definition of sufficient quality has not been given in the UNFCCCC guidelines. In the Good Practice Guidance Chapter 8.2, however, it is mentioned that:

"Quality control requirements, improved accuracy and reduced uncertainty need to be balanced against requirements for timeliness and cost effectiveness".

However, the statement of balancing requirements and costs is not a solid basis for QC as long as this balancing is not well defined.

In the ISO 9000, the quality is based on the fulfilment of requirements, where the requirements are generated from needs or expectations as stated by either organizations, customers or interested parties. The organizations can be seen as the international community that requires the results from the inventory. The requirements from the international community are assumed to be reflected in the UNFCCC and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC).

The standard of the inventory result is defined as being composed of the accuracy and regulatory usefulness. The goal is to maximise the standard of the inventory and the following statement defines the quality objective:

The quality objective is only inadequately fulfilled if it is possible to make an inventory of higher standard without exceeding the frame of resources.

This statement does not secure that the inventory provides results of a sufficient standard for the end-user. The problem is that the end-user does not explicitly communicate explicit standards that have to be fulfilled. This makes it impossible to develop a quality system that with certainty can ensure the results of the standard required by the end-user. However, the QA/QC results are useful for assessing the standard of the inventory. If the standard is judged to be unsatisfactory by the end-user while the *QM* shows the quality to be sufficient then a demand for additional resources for the inventory work exists. In this case the resource responsible authorities have to be consulted.

4 Process oriented QC/QA

The strategy is based on a process-oriented principle (ISO 9000 series) and the first step is thus to set up a system for the process of the inventory work. The product specification for the inventory is a data set of emission figures and the process is thus identical with the data flow in the preparation of the inventory.

The data flow needs to support the QC/QA in order to facilitate a cost-effective procedure. The flow of data has to take place in a transparent way by making the transformation of data detectable. It needs to be easy to find the original data background for any calculation and to trace the sequence of calculations from the raw data to the final emission result. Computer programming for automated calculations and checking will enhance the accuracy and minimise the number of miscalculations and flaw in input value settings. Especially manual typing of numbers needs to be minimised. This assumes, however, that the quality of the programming has been verified to ensure the correctness of the automated calculations. Automated value control is also one of the important means to secure accuracy. Realistic uncertainty estimates are necessary for securing accuracy, but they can be difficult to make, due to the uncertainty of the uncertainty estimates itself. It is therefore important to include the uncertainty calculation procedures into the data structure as much as possible. The QC/QA needs to be supported to as wide an extent as possible by the data structures, otherwise the procedure can easily become troublesome and subject for frustration.

Both data processing and data storage forms the data structure. The data processing is done using mathematical operations or models. It may be complicated models for human activity or simple summations of lower aggregated data. The data storage includes databases and file systems of data that are either calculated using the data processing at the lower level or using input to new processing steps or even both output and input in the data structure. The measure for quality is basically different for processing and storage so this needs to be kept separate in a well-design quality manual.

The data storage takes place for the following types of data:

External Data: a single numerical value of a parameter coming from an external source. This is thus basic input, as the *inventory staff* does not measure any new data. These data govern the calculation of *Activity-Release Data*.

Activity-Release Data: Data for input to the final emission calculation in terms of data for release source strength and activity. The data is directly applicable for use in the standardised forms for calculation. These data are calculated using external data or represent a direct use of *External Data* when they are directly applicable for *Emission Calculations*.

Emission Data: Estimated emissions based on the *Activity Release* Data.

Emission Reporting: Reporting of emission data in requested formats and aggregation level.

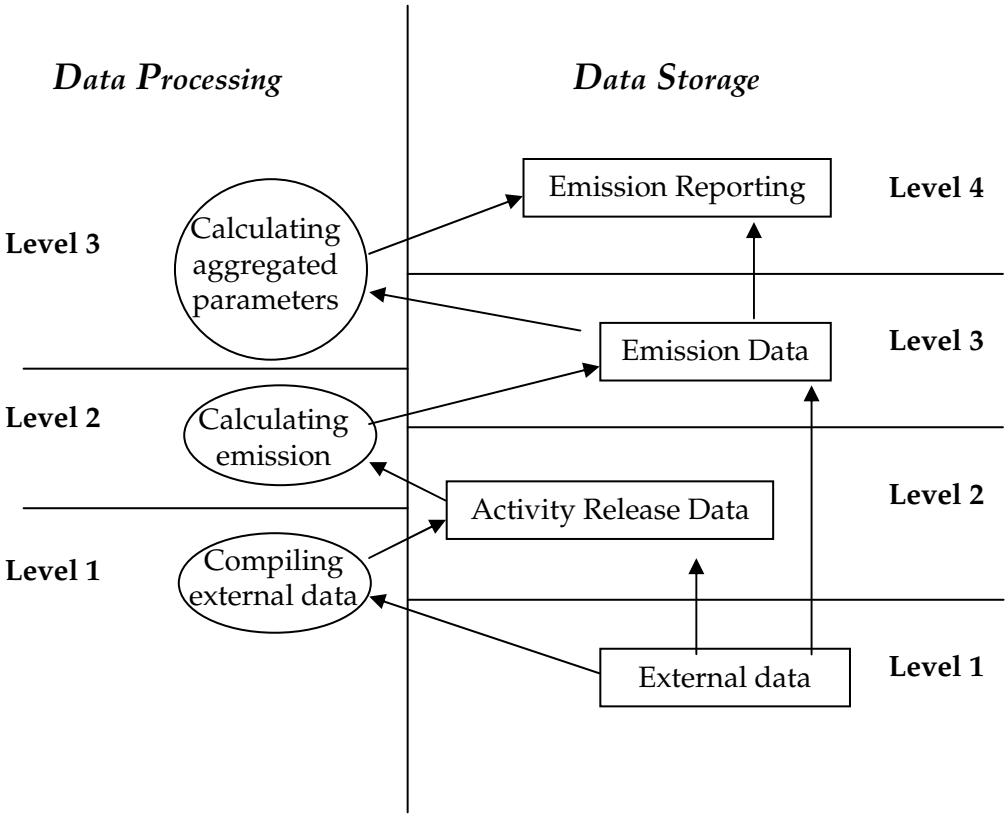

Figure 2. The general data structure for the emission inventory.

Key levels are defined in the data structure as:

Data storage Level 1, External data
Collection of external data sources from different sectors and statistical surveys typically reported on a yearly basis. The data consist of raw data, having identical format as the data received and gathered from external sources. Level 1 data acts as a base set, on which al subsequent calculations are based. If alterations in calculation procedures are made they are based on the same data set. When new data are introduced they can be implemented in accordance with the QA/QC structure of the inventory.

Data storage Level 2, Data directly usable for the inventory
This Level represents data that have been prepared and compiled in a form that is directly applicable for calculation of emissions. The compiled data are structured in a database for internal use as a link between more or less raw data and data that are ready for reporting. The data are compiled in a way that elucidates the different approaches in emission assessment: (1) Directly on measured emission rates especially for larger point sources. (2) Based on activities and emission factors, where the value setting of these factors are stored at this level.

Data storage Level 3, Emission data
The emission calculations are reported by the most detailed figures and divided in sectors. The unit at this level is typically mass per year for the country. For sources included in the SNAP system the SNAP level 3 is relevant. Internal reporting is performed at this level to feed the external communication of results.

Data storage Level 4, Final reports for all subcategories
The complete emission inventory is reported to UNFCCC at this level by summing up the results from every subcategory.

Data processing Level 1 compilation of external data
Preparation of input data for the emission inventory based on the external data sources. Some external data may be used directly as input to the data processing at level 2, while others need to be interpreted using more or less complicated models, which takes place at this level. The interpretation of activity data is to be seen in connection to availability of emission factors. These models are compiled and processed as an integrated part of the inventory work.

Data processing Level 2 Calculation of inventory figures
The emission for every subcategory is calculated, including the uncertainty for all sectors and activities. The summation of all contributions from subsources makes up the inventory.

Data processing Level 3 Calculation of aggregated parameters
Some aggregated parameters need to be reported as part of the final reporting. This will not be complicated calculations but important figures, e.g. implied emission factors at a higher aggregated level to be compared in time-series and with other countries.

5 Critical Control Points (*CCP*)

A Critical Control Point (*CCP*), in this manual, is an element or an action, which needs to be taken into account in order to fulfil the quality objective. The list of *CCP*s will form the condition for assessing the performance in relation to the quality objective.

The objectives for the *QM* as formulated by *IPCC Good Practise* are to improve elements of transparency, consistency, comparability, completeness and confidence. In the UNFCCC guideline the element "confidence" is replaced by "accuracy" and in this manual "accuracy" is used. The objectives given by these guidelines are, in this manual, defined to be a list of *CCP* for fulfilling the real objective as defined in Chapter 3 above. The following explanation is given by UNFCCC guidelines for each *CCP*:

Accuracy is a relative measure of the exactness of an emission or removal estimate. Emission figures shall not systematically neither overestimate nor underestimate the true emissions, as far as it can be judged, and uncertainties have to be reduced as far as practicable. Appropriate methodologies should be used in accordance with the *IPCC good practice guidance*, to promote accuracy in inventories.

Comparability means that estimates of emission and removals reported by Annex I Parties in inventories should be comparable among Annex I Parties. For this purpose, Annex I Parties should use the methodologies and formats agreed upon by the COP for estimating and reporting inventories. The allocation of different source/sink categories should follow the split of *Revised 1996 IPCC Guidelines for national Greenhouse Gas Inventories* at the level of its summary and sectoral tables.

Completeness means that an inventory covers all sources and sinks as well as all gases included in the *IPCC* Guidelines, as well as other existing relevant source/sink categories, which are specific to individual Annex I Parties and, therefore, may not be included in the *IPCC* Guidelines. Completeness also means full geographic coverage of sources and sinks of an Annex I Party.

Consistency means that an inventory should be internally consistent in all its elements with inventories of other years. An inventory is consistent if the same methodologies are used for the base and subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks. Under certain circumstances an inventory using different methodologies for different years can be considered to be consistent if it has been recalculated in a transparent manner in accordance with the Intergovernmental Panel on Climate Change (IPCC).

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. The

transparency of the inventories is fundamental to the success of the process for the communication and consideration.

The five *CCP*'s listed above is stated in the guidelines. However, in this manual they are not considered to be a complete set in order to fully secure the quality objectives in Chapter 3. The robustness against unexpected disturbance of the inventory work has to be high in order to secure high quality, which is not covered by the *CCP*s above.

Robustness implies arrangement of inventory work as regards e.g. inventory experts and data sources in order to minimise the consequences of any unexpected disturbance due to external and internal conditions. A change in an external condition could be interruption of access to an external data source and an internal change could be a sudden reduction in qualified staff, where a skilled person suddenly leaves the inventory work.

The correctness is not stated in the guideline explicitly, as it may be considered part of the accuracy. However, the definition of accuracy in the guidelines is solely pointing at the task of minimising uncertainty and factors as miscalculations are not covered by an uncertainty analysis. Thus, the term correctness is defined as an independent *CCP*. This is done because the correctness of the inventory is a condition for all other objectives to be effective. A large part of the Tier 1 procedure given by the Good Praxis Guideline is actually checks for miscalculations and thus a support of an objective of correctness.

Correctness has to be secured in order to avoid uncontrollable occurrence of uncertainty directly due to errors in the calculations. Correct data transmission from one level of the inventory to the next level is an important part of the correctness.

The different *CCP*'s are not independent and represent different degrees of generality. E.g. deviation from *comparability* may be accepted if a high degree of *transparency* is applied. Furthermore, there may even be a conflict between the different *CCP´s*. E.g. new knowledge may suggest improvements in calculation methods for better *completeness,* but the same improvements may partly violate the *consistency* and *comparability* with regard to former year's inventories and the reporting from other nations. It is therefore a multi-criteria problem of optimisation to apply the set of *CCP*s in the activity for good quality.

6 Point of Measurements (*PM*)

The *CCP*'s have to be based on clear measurable factors, otherwise the *QP* will end up being a loose declaration of intent. Thus in Table 1 below a series of *Point for Measuring* (*PM*) is identified as building blocks for a solid *QM*. The Table 8.1 in the Good Praxis Guidance is a listing of such *PM*'s. However, this listing is a first version and a more complete listing may be needed in order to secure support for all the *CCP*'s. The *PM*s will be routinely checked in the QC reporting and when external reviews take place the reviewers will be asked to assess the fulfilment of the *PM*s using a check listing system.

A database that can collect all data from the inventory regarding every *PM'* are under construction and testing. The listing in Table 1 is a first version that will be modified during the first period of implementation of the quality work.

Table 1. A list of the PM's including a short description

Level	CCP	Id	Description
Data Storage level 1	1. Accuracy	DS.1.1.1	Documentation showing that all possible national data sources are included by setting up the reasoning for the selection of data sets
		DS.1.1.2	General level of uncertainty for every data set including the reasoning for the specific values
		DS.1.1.3	Quantification of the uncertainty level of every single data value including the reasoning for the specific values.
		DS.1.1.4	Comparability of the data values with similar data from other countries, which are comparable with Denmark and evaluation of the discrepancy.
	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included by setting up the reasoning for the selection of data sets
	4.Consistency	DS.1.2.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PM's)
	5.Correctness	DS.1.5.1	Shows one to one correctness between external data sources and the databases in house, which are linked to higher levels in the data structure
	6.Robustness	DS.1.6.1	Explicit agreements between the external institution of data delivery and NERI about the condition of delivery
		DS.1.6.2	At least two employees must have a detailed insight into the gathering of every external data set.
	7.Transparency	DS.1.7.1	Summary of each data set including the reasoning for selecting the specific data set
		DS.1.7.2	The archiving of data sets needs to be easy accessible for any person in the emission inventory
		DS.1.7.3	References for citation for any external data set have to be available for any single number in any data set.
		DS.1.7.4	Listing of external contacts to every data set
		DS.1.7.5	The data Id at level 1 has to be linked directly to the Ids used in higher level data sets.
Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to type of variability (Distribution as: normal, log normal or other type of variability)

		DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals)
		DP.1.1.3	Evaluation of the methodological approach using international guidelines
	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCC and IPCC.
	3.Completeness	DP.1.3.1	Assessment of the most important missing knowledge about the mathematical relationships
		DP.1.3.2	Assessment of the most important missing accessibility to critical data sources
	4.Consistency	DP.1.4.1	In order to keep consistency at a higher level an explicit description of the activities needs to accompany any change in the calculation procedure
		DP.1.4.2	Identification of parameters (e.g. activity data, constants) that are common to multiple source categories and confirmation that there is consistency in the values used for these parameters in the emission calculations
	5.Correctness	DP.1.5.1	Shows at least once by independent calculation the correctness of every data manipulation
		DP.1.5.2	Verification of calculation results using guideline values
		DP.1.5.3	Verification of calculation results using time-series
		DP.1.5.4	Verification of calculation results using other measures
	6.Robustness	DP.1.6.1	Any calculation must be anchored to two responsible persons that can replace each other in the technical issue of performing the calculations.
	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described
		DP.1.7.2	The theoretical reasoning for mathematical methods must be described
		DP.1.7.3	Explicit listing of assumptions behind the methods
		DP.1.7.4	Clear reference to data set at Data Storage level 1
		DP.1.7.5	A manual log table in the emission databases to collect information about recalculations
Data Storage level 1	2.Comparability	DS.2.2.1	Comparison with other countries that are closely related to Denmark and explanation of the largest discrepancies
	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data type at level 3 to data at level 1
	6.Robustness	DS.2.6.1	All persons in the inventory work must be able to handle and understand all data at level 3.
	7.Transparency	DS.2.7.1	The time trend for every single parameter must be graphically available and easy to map
		DS.2.7.2	A clear Id must be given in the data set having reference to level 1.
Data Processing level 2	1. Accuracy	DP.2.1.1	Documentation of the methodological approach for the uncertainty analysis
		DP.2.1.2	Quantification of uncertainty
	2.Comparability	DP.2.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCC and IPCC
	5.Correctness	DP.2.5.1	Comparison to inventory of the previous years on the level of the categories of the CRF as well as on SNAP source categories. Any major changes are checked, verified, etc.
		DP.2.5.2	Total emissions when aggregated to CRF source categories are compared to totals based on SNAP source categories (control of data transfer)
		DP.2.5.3	Check of time-series of the CRF and SNAP source categories as they are found in the Corinair databases. Considerable trends and changes are checked and explained

		DP.2.5.4	Check of time-series of previous inventories
	6.Robustness	DP.2.6.1	Any calculation at level 4 must be anchored to two responsible persons that can replace each other in the technical issue of performing the calculations.
	7.Transparency	DP.2.7.1	The reasoning for the choice of methodology for uncertainty analysis needs to written explicitly
		DP.2.7.2	There must be clear Id to Data Storage level 2 data in the calculation sheets
Data Storage level 3	1. Accuracy	DS.3.1.1	Quantification of uncertainty
	5.Correctness	DS.3.5.1	Documentation of a correct connection between all data types at DS3 to data at level DS2
	7.Transparency	DS.3.7.1	Reporting of the calculation principle and equations used
		DS.3.7.2	Reporting of the theoretical reasoning for mathematical methods
		DS.3.7.3	Reporting of assumptions behind the methods
		DS.3.7.4	Clear reference to data set at level 1
Data Processing level 3	7.Transparency	DP.3.7.1	In the calculation sheets there must be clear Id to Data Storage level 3 data
Data Storage level 4	1. Accuracy	DS.4.1.1	Questionnaire to external experts: The performance of the PM's that relates to accuracy
	2.Comparability	DS.4.2.1	Description of similarities and differences in relation to other country inventories for the methodological approach
	3.Completeness	DS.4.3.1	Questionnaire to external experts: The performance of the PM's that relates to completeness
		DS.4.3.2	National and international verification including explanation of the discrepancies.
	4.Consistency	DS.4.4.1	The inventory reporting must follow the international guidelines suggested by UNFCC and IPCC.
	7.Transparency	DS.4.7.1	External review for evaluation of the communication performance

7 Structure of reporting

The final inventory report sums up the emission from a series of sub-categories of human activity, such as large point sources, agriculture, etc. Each sub-category needs to have an individual reporting in order to include all necessary details adding up into complete inventory reports. The structure of reporting is shown in Figure 3 and will be explained in the following paragraphs.

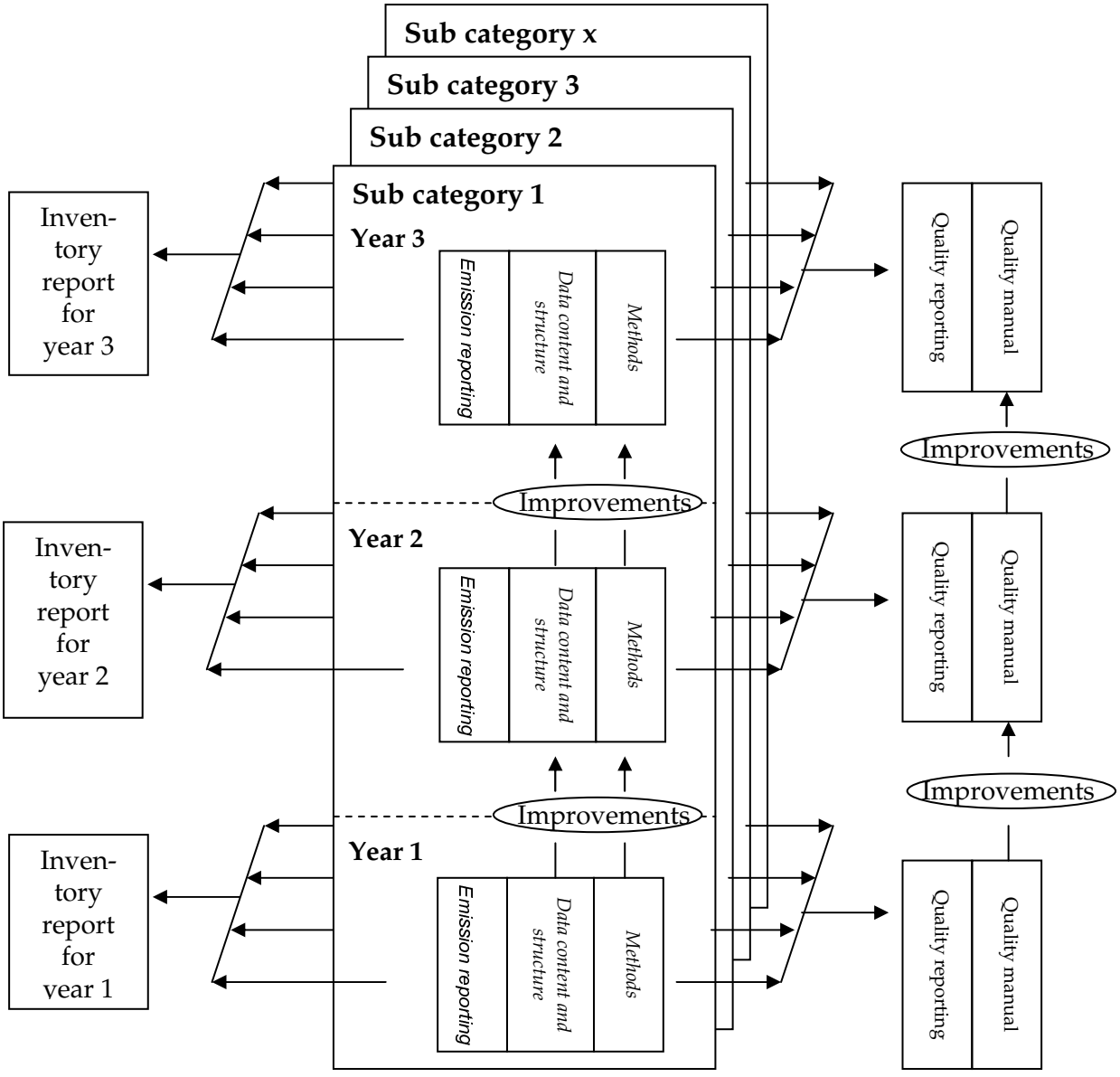

Figure 3. The general structure of reporting.

Four types of reporting activities are undertaken: (1) National state of year Inventories Reporting (NIR), (2) Data content and Structure (DCS), (3) Methodological Description (MD), (4) Quality Reporting (QAR) and (5) Quality Manual (QM). The reporting of NIR and QAR present specific data sets and must thus be done every year, while the other reportings DCS, MD and QM are process oriented and thus

linked to changes in methods and procedures, which are not necessary changes from one year to another.

It may be meaningful to combine NIR and QR in one single result-oriented report every year. The other reporting types must be done in separate reports in order to optimise transparency. It is, however, still open how the quality reporting is going to be done. It could be done as either a database that yields output in report format every year or as a written reporting. The database solution may be an attractive way to minimise the additional work associated with the quality reporting.

8 Plan for the quality work

The IPCC uses the concept of a tiered approach, i.e. a stepwise approach where complexity, advancement and comprehensiveness increase. Generally, more detailed and advanced methods are recommended in order to give guidance to countries which have more detailed data sets and more capacity, as well as to countries with less data and manpower available. The tiered approach helps focussing on areas of the inventories that are relatively weak instead of investing effort on irrelevant subjects. Furthermore, the IPCC Guidelines recommends using higher Tier methods for key sources in particular. Thus the key source identification is crucial for the planning of quality work. However, several topics for making priority sources listing exist, e.g. (1) The contribution to the total emission figure (key source listing); (2) The contribution to the total uncertainty; (3) Most critical sources in relation to implementation of new methodologies and thus highest risk for miscalculations. Every one of these listings are needed for different aspects of the quality work.

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National Environmental Research Institute

The National Environmental Research Institute, NERI, is a research institute of the Ministry of the Environment. In Danish, NERI is called *Danmarks Miljøundersøgelser (DMU)*.
NERI's tasks are primarily to conduct research, collect data, and give advice on problems related to the environment and nature.

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