SMED Report No 38 2010

Swedish Environmental Emissions Data

Consequences for the Swedish Greenhouse Gas Inventory from using the 2006 IPCC Guidelines

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2009-08-25

Contract No 309 0808

On behalf of the Swedish Environmental Protection Agency

Published at: www.smed.se
Publisher: Swedish Meteorological and Hydrological Institute
Address: SE-601 76 Norrköping, Sweden
Start year: 2006
ISSN: 1653-8102

SMED is short for Swedish Environmental Emissions Data, which is a collaboration between IVL Swedish Environmental Research Institute, SCB Statistics Sweden, SLU Swedish University of Agricultural Sciences, and SMHI Swedish Meteorological and Hydrological Institute. The work co-operation within SMED commenced during 2001 with the long-term aim of acquiring and developing expertise within emission statistics. Through a long-term contract for the Swedish Environmental Protection Agency extending until 2014, SMED is heavily involved in all work related to Sweden's international reporting obligations on emissions to air and water, waste and hazardous substances. A central objective of the SMED collaboration is to develop and operate national emission databases and offer related services to clients such as national, regional and local governmental authorities, air and water quality management districts, as well as industry. For more information visit SMED's website www.smed.se.

Preface

This study was initiated by the Swedish Environmental Protection Agency with the aim to gain experience on the use of 2006 IPCC Guidelines. It was conducted by the inventory experts within the consortium SMED who annually compile the Swedish Greenhouse Gas Inventory on commission from the Swedish EPA. This report is a compilation and synthesis of the experts' views on the implications and assessment of consequences for the Swedish Greenhouse Gas Inventory system from a possible future use of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

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Background

About a year ago IPCC published the new *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 GL),* which were prepared by the IPCC in response to an invitation by SBSTA. At SBSTA 26 in spring 2007 the 2006 GL were welcomed and discussed (INF/SBSTA/2007/L.5). The conclusions state the need to consider the 2006 GL in context of the revision of the new reporting guidelines, and encouraged Parties, in position to do so, to gain experience and submit information on their experience. The start of the process to revise the reporting guidelines is expected to start in the fall of 2009.

The Swedish National System entails distributed responsibilities between several authorities. The Swedish EPA, which is responsible for the final compilation of the inventory and coordination of the National System, has initiated this study in order to gain experiences and to assess consequences for the Swedish inventory system from a possible future use of the new IPCC Guidelines. The Swedish EPA intends to have a dialogue with national authorities, the Ministry of Environment and other EU member states about the results.

Overall objective

The overall objective of this study was to increase the knowledge about the 2006 IPCC Guidelines and estimate impacts on the Swedish GHG inventory if applied.

Detailed objectives

1. Assess, identify and document if and for which areas and source categories changes or adjustments in the Swedish inventory work will be necessary if the IPCC 2006 Guidelines become mandatory.
2. Assess if possible changes in methodology in order to be in line with the 2006 Guidelines may result in quantitative changes in the emission estimates compared to the present Swedish methods.
3. Assess and identify if the 2006 Guidelines imply any changes for the national authorities concerned as part of the National System.
4. Indicative cost estimates for introducing new methodologies according to the 2006 IPCC Guidelines, where relevant.
5. Identify and describe changes in the revised reporting format.
6. Evaluate positive or negative consequences for the inventory and the quality of reported emissions as a result of the revised reporting format.

Structure of this report

The structure of this report follows the structure of the IPCC 2006 Guidelines. First a general chapter gives an overview of the IPCC 2006 Guidelines, and points out some of the major changes compared to the 1996 Guidelines, including changes in the reporting format. Changes in the 2006 Guidelines are identified in relation to present Swedish practices, and implications for the Swedish inventory are pointed out for each separate issue according to the headings below.

The major changes and implications are summarised in the chapter "General findings and implications". This chapter is followed by one chapter for each of the five volumes, in which an overview of identified changes and implications are presented. The detailed results of the survey are for each volume presented in Annexes 1 to 5.

WHAT NEEDS TO BE DONE?

Describe what changes or developments are needed to comply with the IPCC 2006 Guidelines.

IMPLEMENTATION REQUIRED?

Is a change or development required according to the text in the IPCC Guidelines?

CHANGES FOR AUTHORITIES

Will the issues identified imply any need for change for the national authorities concerned as part of the National System (as data providers)?

IMPLICATIONS ON QUALITY

Are there any positive or negative consequences for the inventory and the quality of reported emissions as a result of the revised reporting format and of revised reporting requirements?

IMPLICATIONS ON QUANTITY

Will changes in methodology in order to be in line with the 2006 Guidelines result in quantitative changes in the emission estimates compared to the present?

COST FOR CHANGE

Indicative estimates of costs ***- Low****,* ***Medium*** *or* ***High -*** *for introducing new methodologies according to the 2006 IPCC Guidelines (costs only for inventory work performed by SMED, not including e.g. new scientific investigations, statistical surveys or work related to the responsibility of authorities in the National System),*

TIME PLAN FOR IMPLEMENTATION

Indicative estimate of time needed for implementation of change, if relevant: ***1)*** *extensive preparatory work needed,* ***2)*** *reorganisation of existing material or less extensive preparation needed, or* ***3)*** *less than one year in advance of the introduction of change in any given submission.*

The 2006 IPCC Guidelines

The 2006 IPCC Guidelines is an update and revision of the 1996 IPCC Guidelines. The 2006 IPCC Guidelines for National Greenhouse Gas Inventories can be found on the web, http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm, and contain, besides the five methodology volumes also of pdf-files with Cover, Foreword and Preface, an Overview, a Glossary and a List of contributors. The five methodology volumes are as below:

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

Structural and principal changes compared to the 1996 IPCC Guidelines

In the Overview section in the 2006 IPCC Guidelines, Chapter 5, Specific Developments in the 2006 IPCC Guidelines, the major developments are pointed out (http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm).

The *2006 IPCC Guidelines* are based on a thorough scientific review and a structural enhancement of the IPCC's inventory methodology across all categories, including the following specific developments:

***Volume 1* (*General Guidance and Reporting*)**
• *Introductory advice:* A new section has been included, providing an overview of greenhouse gas inventories and the steps needed to prepare an inventory for the first time.
• *Extended advice on data collection:* The *2006 IPCC Guidelines* introduce systematic cross-cutting advice on data collection from existing sources and by new activities, including design of measurement programmes.
• *Key category analysis:* General principles and guidance are provided. In the *2006 IPCC Guidelines,* the integration of Agriculture and LULUCF into the AFOLU volume has been addressed, and key category analysis is better integrated across emission and removal categories.

***Volume 2* (*Energy*)**
• *Treatment of* CO_2 *capture and storage*: These emissions are covered comprehensively, including fugitive losses from CO_2 capture and transport stages (which are estimated using conventional inventory approaches) plus any losses from carbon dioxide stored underground (estimated by a combination of modelling and measurement techniques, given the amounts injected - which would also be monitored for management purposes). The inventory methods reflect the estimated ac-

tual emissions in the year in which they occur. The inventory methods for geological CO_2 capture, transport and storage (CCS) provided in Volume 2 are consistent with the IPCC Special Report on Carbon Dioxide Capture and Storage (2005). Amounts of CO_2 captured from combustion of biofuel, and subsequently injected into underground storage are included in the inventory as a negative emission. No distinction is made between any subsequent leakage of this CO_2 and that of CO_2 from fossil sources.

• *Methane from abandoned coal mines*: A methodology for estimating these emissions is included in the *2006 IPCC Guidelines* for the first time.

***Volume 3* (*Industrial Processes and Product Use*)**

• *New categories and new gases*: The *2006 IPCC Guidelines* have been expanded to include more manufacturing sectors and product uses identified as sources of greenhouse gases. These include production of lead, zinc, titanium dioxide, petrochemicals, and liquid crystal display (LCD) manufacturing. Additional greenhouse gases identified in the IPCC Third Assessment Report are also included where anthropogenic sources have been identified. These gases include nitrogen trifluoride (NF_3), trifluoromethyl sulphur pentafluoride (SF_5CF_3), and halogenated ethers.

• *Non-energy use of fossil fuels*: Guidance on demarcation with the energy sector has been improved, and emissions from non-energy uses of fossil fuels are now reported under Industrial Processes and Product Use, rather than in Energy. A method has been introduced for checking the completeness of carbon dioxide emission estimates from the non-energy uses.

• *Actual emissions of fluorinated compounds*: The potential emissions approach used as a tier 1 method in the *1996 IPCC Guidelines* is no longer considered appropriate, as it does not provide estimates of true emissions, and is not compatible with higher tiers. The Tier 1 methods proposed in this volume are therefore actual emission estimation methods, although these are often based on default activity data when better data are not available. Simplified mass balance approaches have also been proposed in appropriate sectors, such as refrigeration.

***Volume 4* (*Agriculture, Forestry and Other Land Use*)**

• *Integration between agriculture and land use, land-use change and forestry*: This integration removes the somewhat arbitrary distinction between these categories in the previous guidance, and promotes consistent use of data between them, especially for more detailed methods.

• *Managed land is used in these guidelines as a proxy for identifying anthropogenic emissions by sources and removals by sinks*. In most AFOLU sectors anthropogenic GHG emissions by source and removals by sinks are defined as those occurring on *managed land*. The use of managed land as a proxy for anthropogenic effects was adopted in the *GPG-LULUCF*. The preponderance of anthropogenic effects occurs on managed lands and, from a practical standpoint, the information needed for inventory estimation is largely confined to managed lands.

• *Consolidation of previously optional categories*: Emissions by sources and removals by sinks associated with all fires on managed land are now estimated, removing the previous optional distinction between wildfires and prescribed burning. This is consistent with the concept of managed land as a proxy for identifying anthropogenic emissions by sources and removals by sinks, as discussed above. Wildfires and other disturbances on unmanaged land cannot, in general, be associated to an anthropogenic or natural cause, and hence are not included in the *2006 IPCC Guidelines*, unless the disturbance is followed by a land-use change. In this case, the land affected by disturbance is considered to be managed, and all the greenhouse gas emissions by sources and removals by sinks associated to the fire and other events are now estimated, irrespective of whether of a natural origin or not. Carbon dioxide emissions and removals associated with terrestrial carbon stocks in settlements and managed wetlands, which were previously optional, have been incorporated into the main guidance.
• *Harvested wood products (HWP)*: The *2006 IPCC Guidelines* provide detailed methods that can be used to include HWP in greenhouse gas inventories using any of the approaches that are currently under discussion within the UNFCCC process.
• *Emissions from managed wetlands*: The *2006 IPCC Guidelines* now contain methods to estimate CO_2 and N_2O emissions from managed wetlands. However, due to limited availability of scientific information, methods for CH_4 emissions are contained in an Appendix – Basis for future methodological development.
• *Settlements*: A field visit of sample plots on urban areas might be needed.

***Volume 5* (*Waste*)**
• *Revised methodology for methane from landfills*: The previous Tier 1 method, based on the maximum potential release of methane in the year of placement, has been replaced by a simple first order decay model that provides the option to use data available from the UN and other sources. This approach includes regional and country-specific defaults on waste generation, composition and management, and provides a consistent basis for estimating greenhouse gas emissions across all tiers. This gives a more accurate time series for estimated emissions and should avoid the situation in which usage of landfill gas apparently exceeds the amount generated in a particular year.
• *Carbon accumulation in landfills*: This is provided as an output from the decay models, and can be relevant for the estimation of HWP in AFOLU.
• *Biological treatment and open burning of waste*: Guidance on estimation of emissions from composting and biogas facilities has been included to ensure a more complete coverage of sources.

Relevant to all volumes
• *CO_2 resulting from the emissions of other gases*: The *2006 IPCC Guidelines* estimate carbon emissions in terms of the species which are emitted. Most of the carbon emitted as these non-CO_2 species eventually oxidises to CO_2 in the atmosphere; and this amount can be estimated from the emissions estimates of the non-CO_2 gases. In some cases the emissions of these non-CO_2 gases contain very small

amounts of carbon compared to the CO_2 estimate, and it may be more accurate to base the CO_2 estimate on the total carbon. See Volume 1 Section 7.2.1.5 for an approach to estimating these inputs of CO_2 to the atmosphere. Examples are fossil fuel combustion (where the emission factor is derived from the carbon content of the fuel) and a few IPPU sectors where the carbon mass balance can be estimated much better than individual gases.

• *Treatment of nitrogen (N) deposition*: The *GPG 2000* lists sources of anthropogenic nitrogen deposition that subsequently give rise to anthropogenic emissions of nitrous oxide (N_2O), but provides estimation methods only for a subset of these, associated with agricultural sources of ammonia (NH_3) and nitrogen oxides (NO_X). The *2006 IPCC Guidelines* extend this approach to all significant sources of N deposition, including agriculture, industrial and combustion sources, with the ultimate N_2O emission attributed to the country responsible for the nitrogen originally emitted.

General findings and implications

In this chapter a summary and overview of the major findings are presented. In the sector specific chapters below an overview for each volume is presented, and in the Annexes 1 to 5 more detailed findings and implications are presented for each volume of the 2006 Guidelines.

Major issues

Major issues are here defined as those judged to being required if reporting according to the 2006 Guidelines is adopted, and where it is anticipated that quite extensive preparatory work is needed if these issues are to be fully implemented.

New reporting format

The changes in the reporting format are of different kinds. One type of change is a more detailed reporting as more sub-categories have been added compared to the present reporting system. The consequences of this for the Swedish inventory work depend on what kind of information is already available in the Swedish inventory. For some splits data are already available on the required level, while for others new disaggregated time series need to be developed (if possible).

Another type of change is a reorganisation and reallocation of emissions in the reporting system. For example regarding limestone and dolomite use in the industrial processes sector, which at present is reported in one code, while in the new system emissions are to be allocated to the industrial process where the emissions occur. There is also a reorganisation of the reporting of non-energy use of fuels, from the present energy sector to the new IPPU-sector, where the reporting of non-energy use of fuels is combined with the reporting of emissions from solvent use in the new code Non-energy Products from Fuels and Solvent Use.

In the new reporting system there are some new sources introduced of varying importance. There are also new gases introduced e.g. a number of fluorinated gases and indirect emissions of N_2O from NH_3 and NO_X.

The preparatory work needed includes to make an overview of which required information is already available (in suitable disaggregated format) in the Swedish inventory and where a possible development of new disaggregated time series or time series for new sources and/or gases are needed. If new time series are to be developed for new or disaggregated sub-categories, an assessment to identify the needs and the level of ambition should be made in due time before implementation.

A re-coding, re-organisation and re-allocation of background information and data files to comply with the new code system is necessary, and as a result of this also an adjustment of the Swedish Technical Support System TPS (database and applications).

Positive consequences: The new reporting system will probably result in a more transparent reporting due to the increased number of sub-category splits, and to better accuracy and transparency due to the reorganisation within the system leading to a lowered risk of double counting or omissions of emissions.

Negative consequences: Work and resources needed to go into the adjustment to the new reporting system.

Higher requirements for QA/QC

We interpret that in the 2006 GL there are higher requirements for QA/QC. No changes in methodology are introduced, but generally there is a wording of "should" instead of "encouraged". This applies not only to the inventory work within SMED, but also to the authorities in their role as data providers in the National System.

New fuel groups and fuel types

The present five fuel groups (liquid, solid, gaseous, biomass and other) are revised into six groups in the 2006 GL: liquid, solid, gas, other fossil fuels, peat and biomass. There are also some revisions regarding fuels identified within these groups. The present fuel types “municipal solid waste” (MSW) and “industrial waste” are split into Municipal Waste (non-biomass fraction), Industrial waste, Waste oils and Municipal Waste (biomass fraction).

The work needed includes comparing fuel types, to reprogram calculation files, develop time series for biogenic/fossil fractions of MSW, and develop emission factors and thermal values for new fuel types, as well as recalculation of time series.

Activity data on municipal waste is currently not divided into biomass/non-biomass. Activity data has to be improved with this division of biomass/non-biomass. The responsibility of activity data for the division of biomass/non-biomass fractions is not defined within the present National System.

New sources and sink categories

An overview and assessment of new sources/sinks in the inventory need to be made in time before implementation, in order to define relevance, possibilities, level of ambition and work plans for developing data for these new sources/sinks.

Implications for authorities within the National System

In several instances, if reporting according to the 2006 Guidelines is adopted, new data and/or methodologies are required. For several of those listed below, the responsibilities are at present not defined within the National System.

New data and/or methodologies required

The Swedish Environmental Protection Agency needs to consider:

- an adjustment of TPS to meet the needs of the new reporting format

Within the Energy sector:

- the requirements for a division of MSW into a biomass and a non-biomass fraction to be used as activity data in the Energy sector.
- emission factors for NO_X and NH_3 to be used as a basis for calculating indirect emissions of N_2O.
- data relating to Carbon capture and storage, when introduced.
- increased requirements on QA/QC.
- activity data on AdBlue for calculation of emissions from road transport.
- possibly additional activity data regarding Non-energy Products for Fuels and Solvent Use

Within the IPPU sector:

- activity data for the new fluorinated gases

Within the AFOLU sector:

- there are a number of new methodologies which need to be developed.

Within the Waste sector:

- there are several issues within the waste sector where additional information and data are required to meet good practice according to the 2006 GL.

Implications on estimated quantities

Estimated *increases* in emissions may arise from changes regarding the reporting of:

- indirect emissions of N_2O from NOx and NH_3
- CO_2 resulting from the emissions of other gases
- new fluorinated gases
- new sources described, emissions will increase if sources exist

- improved and/or revised methodology descriptions for sub-categories in the IPPU sector, e.g. chemical industry, metal industry
- new default EFs for GHGs previously not reported
- changed methodology for iron and steel.
- revised slope factors for PFC from primary aluminium production.
- GHGs from open burning of waste.
- new source categories in the AFOLU sector.

Estimated *decreases* in emissions may arise from changes regarding the reporting of:

- biogenic fraction of MSW reported as biomass
- urea-based catalysts for road transport
- future reporting of CCS
- new sink categories in the AFOLU-sector, e.g. HWP, harvested wood products
- changed emission factors and other parameters for estimating emissions from manure management and from agricultural soils

For many of these identified changes giving rise to either an increase or a decrease of emissions, the individual impacts on the quantity of emissions are probably quite small. A non-exhaustive estimate of quantified changes is presented in Table 1. All changes are estimated using the current global warming potentials (GWPs) and any influence from updated GWPs according to the IPCC 4th Assessment Report are not taken into consideration in Table 1.

For several of the other changes identified there are no implications for any changes of the quantity of emissions. For quite many other cases of identified changes the expected impact on the quantity of emissions is difficult to judge, or likely to be small.

Table 1 Indicative quantitative estimates for some identified changes.

Source/sink	Present CRF	Implications for quantities of emissions	Change	Fraction of National total in 2006, excl. LULUCF
Indirect emissions of N_2O from NOx and NH_3	NA	"New" emissions calculated	increase	0.4%
CO_2 resulting from the emissions of other gases	NA	"New" emissions calculated	increase	?
Fuel groups and fuel types	1A	Biogenic fraction of MSW reported as biomass	decrease	0.9%
Mobile combustion, urea based catalysts	1A3	Slight decrease	decrease	0.2%
Iron and steel methodology	2C1	Increased emissions of CO2 and CH4	increase	0.2%
Ferroalloys	2C2	Emissions of CH4	increase	<0.001%
Aluminium production	2C3	Increase of PFCs if new slope factors are used	increase	0.1%
New F-gases	2F	If new F-gases are used emissions will increase	increase	?
Indirect N_2O from composting	NA	Slight increase	increase	?
Non-CO_2 from biomass burning (AFOLU)	4, 5	More gases included. A small increase	increase	0.005%
Emissions from managed soils	4	More areas and sources included	increase	?
Emissions from manure management	4B	Changes in some emission factors and MCFs	decrease	0.5%
Agricultural soils	4D	Changed emission factors and other parameters	decrease	1.1%
Harvested wood products (HWP)	NA	Important pool. The size depends on method.	sink	1-25%
Solid waste disposal	6A	Probably very small increase	increase	?
Biological treatment of solid waste	6D	New sources, probably small increases	increase	?
Waste incineration	6C	Probably small changes	incr./decrease	?
Wastewater treatment, new methods	6B	Probably small increase	increase	?

Implications on quality

Generally, many of the identified changes in the 2006 Guidelines will probably lead to improved quality if implemented, especially regarding transparency and completeness. For some new or revised methodology descriptions it seems that the proposed methodologies might be unnecessarily complicated and resource demanding in relation to expected quality improvements in results, as far as can be judged.

Cost for implementation of identified changes

Within this project, the costs for implementing the identified changes have been roughly estimated. The costs are however dependant on in what detail the "change" has been identified. Possibly some major issues which comprise several detailed changes can be performed step by step after further study and prioritisation, while others, at present presented as small changes with low costs could benefit from being treated together and consequently, as an "aggregated" issue be regarded as more costly. This type of analysis has not been thoroughly performed within this work.

With the present level of knowledge, higher costs are expected for:

- Implementing the total reorganisation and reallocation of the reporting code system, including development of new time series for sub-categories where relevant.
- A total implementation of the new fuel groups and fuel types in the reporting system, including development of time series, emission factors and recalculations
- Implementing higher requirements for QA/QC.
- Developing calculations for Soil Management.
- Development of methodology and calculations for Harvested Wood Products.
- Development of methodology and calculations for non-CO_2 emissions from biomass burning.
- Regarding the waste sector, if all new requirements for data are to be fulfilled quite substantial investigations are needed.

Areas where further work is needed

New sources / sinks and sub-category splits, an assessment of relevance and work needed to develop methodology and data, and as a result, a prioritisation of further work.

The new reporting format, a more thorough analysis and assessment of what changes are needed, e.g. re-organisation and re-allocation of present data, etc. After this analysis and assessment, produce a stepwise work plan for implementation.

To make a better estimate of *the total impact on the quantity of emissions* from all identified changes, a study to roughly estimate changes in emissions is needed.

An assessment of what identified changes within the waste sector to prioritise, given the availability of data (or possibility to develop data) at a reasonable costs.

Further studies of the proposed changes in the AFOLU sector in relation to the reporting according to the Kyoto protocol may be relevant.

Identified individual changes where it is anticipated that an implementation may require extensive preparatory work

This includes the issues presented below and which are marked with a 1 in the column "Time plan for implementation" in the tables "Overview of identified changes and implications from Volume X" in the respective chapters below.

General

- As a consequence of the more disaggregated reporting system, new time series may have to be developed to ensure time series consistency. An assessment of needs and a planning of the work is a necessary first step.

Energy

- As a consequence of new definitions of fuel group and fuel types in the 2006 GL work needs to be done to compare fuel types, reprogramming, develop time series for biogenic/fossil fractions of MSW, emission factors and thermal values for new fuel types, recalculations of time series.
- Higher requirements for QA/QC in the Energy sector may need an early preparation, and also to include the Energy agency in the work.

AFOLU

- Considering a system for matching emissions from terrestrial fires to land use
- Develop calculations for emissions from managed soils.

- Development of methodology and calculations for Harvested Wood Products.
- Develop methods for calculating emissions from drained land.
- Revised methodology for Settlements

Waste

- Carbon stored in SWDS (Solid Waste Disposal Sites) should be reported as an information item in the waste sector. It is related to Chapter 12, Harvested Wood Products in the AFOLU Volume.
- Emissions from biological treatment of solid waste should be reported. Methodologies need to be developed for a) CH_4 and N_2O from composting facilities and b) CH_4 from anaerobic digestion of organic waste (unintentional leakages).
- Development of methodology for estimating CH_4 and N_2O from waste water treatment. Presently the reporting is not complete regarding the treatment phase. Furthermore it is unclear if the Swedish methodology for other phases than the actual treatment of wastewater is Good Practice according to the 2006 GL.

Summary of identified changes and implications in each volume

Volume 1, General Guidance and reporting

Volume 1 of the 2006 IPCC Guidelines gives general "Good Practice Guidance" within six areas of inventory work. The content of Volume 1 builds on earlier guidance from the 1996 IPCC Guidelines, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000) and Good Practice Guidance for LULUCF (2003).

Volume 1 contains eight chapters and two Annexes:

1. Introduction
2. Approaches to Data Collection
3. Uncertainties
4. Methodological Choice and Identification of Key Categories
5. Time Series Consistency
6. Quality Assurance/Quality Control and Verification
7. Ozone Precursors, SO_2 and Indirect Emissions
8. Reporting Guidance and Tables
    - Annex 8A.1: Prefixes, Units and abbreviations. Standard equivalents
    - Annex 8A.2: Reporting Tables

Changes in relation to the present Swedish practices have been identified regarding the methodology for Key Category analysis (Chapter 4), the introduction of calculations of indirect emissions (Chapter 7) and the new reporting tables (Chapter 8, Annex 8A.2)

Table 2 presents and overview of the identified changes and implications for the Swedish inventory for Volume 1, General Guidance and Reporting. Further details are presented in Annex 1.

Table 2 Overview of identified changes and implications from Volume 1, General Guidance and Reporting

Chapter	Identified change	Present CRF	New CRF	What needs to be done	Implementation required	Change for authorities	Implications on quality	Implications for quantity of emissions	Cost for change	Time plan for implementation
4	Develop Key Category analysis	NA	NA	Expand current analysis, integration of AFOLU, disaggregation, emissions and removals separately, uncertainties	It is Good Practice	No	Better on Key Category Analysis	No	medium	2
5	Time series consistency	NA	NA	As a consequence of the more disaggregated reporting system, new time series may have to be developed	Yes	Maybe, if relevant for new sources.	Increased transparency	None, if data already exists in an aggregated format, if new sources/sinks there will be implications on quantity	?	1 (assessment and planning)
7	Indirect emissions of N_2O from NO_X and NH_3	NA	5	Develop calculations of indirect emissions of N_2O for other than agricultural sources. To be reported in the new CRF 5A	Where a NOx and/or NH3 inventory exists it is good practice to estimate indirect N_2O (vol3, ch1.2.4)	Emission factors for NOx and NH_3?	Better completeness	Increased emissions, "new" emissions calculated	Probably quite low if only already existing emission estimates of NOx and NH_3 are to be utilised	3
8, annex 8A2	Reporting format, reorganisation,new sub-categories, new background/validation/completeness tables	all	all	An overview of which required information is already available (in suitable disaggregated format) in the Swedish inventory, possible development of new specific time series. Reallocation of background data files to comply with the new code system.	Yes	Adjustment of TPS database system	Increased transparency, accuracy	None, if data already exists, if new sources/sinks there will be implications on quantity	high	1

Volume 2, Energy

Volume 2, Energy consists of the chapters:

Chapter 1, Introduction
Chapter 2, Stationary Combustion
Chapter 3, Mobile Combustion
Chapter 4, Fugitive Emissions
Chapter 5, Carbon Dioxide Transport, Injection and Geological Storage
Chapter 6, Reference Approach
Annex 1 Worksheets

Changes in relation to the present Swedish practices have been identified regarding the requirements for QA/QC, which are higher in the 2006 GL where instances of the wording "are encouraged" from the 1996 GL have generally been changed into the stronger wording "should" in the 2006 GL. Furthermore, new fuel groups and fuel types are defined in the 2006 GL. Changes in the reporting format for the Energy sector primarily consist of further disaggregation of present sources. The volume also includes extensive descriptions on managing calculations regarding future Carbon Capture and Storage (CCS).

Table 3 presents and overview of the identified changes and implications for the Swedish inventory for Volume 2, Energy. Further details are presented in Annex 2.

Table 3 Overview of identified changes and implications from Volume 2, the Energy sector

Chapter	Identified change	Present CRF	New CRF	What needs to be done	Implementation required	Change for authorities	Implications on quality	Implications for quantity of emissions	Cost for change	Time plan for implementation
2	Non-energy use of fuels re-allocated	1Ad	2D	Re-allocation, no methodological change	Yes	No	Possibly less risk of doublecounting/omitting emissions	No	low	2-3
2, Annex 1	Carbon bound in products			worksheet in Annex 1 of the Energy Volume where a compilation of all CO2 bound in products is to be made	Yes	No	?	No	low	3
2	Former CRF 1A2f is split into CRF 1A2f – 1A2m	1A2f	1A2f-m	Reprogramming, data exist, possible problems with confidentiality	Yes	STEM, confidentiality	Increased transparency	No	low	3
2	Fuel groups and fuel types	1A	1A	Compare fuel types, reprogramming, develop time series for biogenic/fossil fractions of MSW, EFs and thermal values for new fuel types, recalculation of time series	Yes	Biomass fraction of MSW	Increased transparency	Decrease if biogenic fraction of MSW is reported as biomass	medium-high	1
2	Carbon capture	1A		When Carbon Capture is introduced this has to be included in the calculations	Yes, future	Activity etc, who?				
2	Oxidation factors	1A		Transparent documentation in the NIR	Yes	No	Increased transparency	No	low	3
2	Higher requirements for QA/QC, pages 2.43 – 2.44 in the 2006 IPCC Guidelines	1	1	No changes in methodology, but generally a wording of "should" instead of "encouraged"	Yes	Increased QA/QC for STEM	better quality	No	high	1
3	Mobile combustion, urea based catalysts included	1A3	1A3	Collect data, calculate emissions	Yes	Activity data on AdBlue?	better	Slight decrease?	low-medium	3

Chap-ter	Identified change	Present CRF	New CRF	What needs to be done	Implementation required	Change for authorities	Implications on quality	Implications for quantity of emis-sions	Cost for change	Time plan for implementation
4	Fugitive emis-sions/re-allocation	1B	1B	Re-allocating in the report system	Yes	No	tranparency	No	low	3
4	Fugitive emissions, QA/QC	1B	1B	Active involvement in QA/QC from industry	No, it is impor-tant	No	Hopefully	No	low-medium	3
5	Carbon dioxide transport, injection and geological storage	NA	1C	When/if CCS is practiced, methods for calculations have to be developed	Yes	Activity, who?	better	If CO2 is stored, emissions will decrease	?	When CCS is introduced
6	Reference appro-ach			No big change in methodology	Yes	No	better	No	low	3

Volume 3, IPPU

Volume 3, IPPU, consists of the chapters:

1. Introduction
- Table 1.3 Verification of Completeness of Reported CO_2 from Non-Energy Use of Fossil Fuels
- Table 1.5 Feedstock Balance Check
2. Mineral Industry Emissions
3. Chemical Industry Emissions
4. Metal Industry Emissions
5. Non-energy Products from Fuels and Solvent Use
6. Electronics Industry Emissions
7. Emissions of Fluorinated Substitutes for Ozone Depleting Substances
8. Other Product Manufacture and Use

Annex 1 Worksheets (examples for F-gases)
Annex 2, Potential emissions (Formerly Tier 1 for consumption of HFCs, PFCs and SF_6)
Annex 3, Improvements since 1996
Annex 4, Glossary for Industrial processes and Product Use Sector

General changes in the IPPU sector

From IPCC 2006 GL:

> This volume contains major changes and improvements to the section covering 'Industrial Processes' and 'Solvent and Other Product Use' in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (*1996 IPCC Guidelines*). First, these *Guidelines* (*2006 IPCC Guidelines*) introduce practical guidance on allocation of carbon dioxide (CO_2) emissions released from combustion of fuel in the Energy Sector and Industrial Processes Sector, which was not clear in the *1996 IPCC Guidelines*. Second, these *Guidelines* are based on the principle that emissions should be reported in the industries where these emissions occur. Accordingly, there has been a shift in the categories in which some emissions are reported, particular those from the use of limestone, dolomite and other carbonates.

This sector is a combination of the present sector 2, Industrial Processes and present sector 3, Product and Solvent Use.

The reporting code system is substantially reorganised and extended with new categories and sub-category splits.

A new chapter in the IPPU sector (Volume 3, Chapter 5) deals with Non-energy Products from Fuels and Solvent use. This also means that the linkages have become stronger with the Energy sector. More guidance and tables are provided for verification of balances and checking of completeness for fuels used for other purposes than energy. These are Table 1-3 in Chapter 1 of Volume 3: Verification of

Completeness of Reported CO_2 from Non-Energy Use of Fossil Fuels, and Tables 1-5, Feedstock Balance Check.

New fluorinated gases have been included, but the reporting of potential emissions of fluorinated gases has been removed and only methodologies for estimating actual emissions are included.

Capture and Abatement is a new issue in the 2006 GL. This is extensively discussed in the Energy volume of the 2006 GL. In the IPPU-volume CCS is described only for processes where CCS might be relevant.

Table 4 presents an overview of the identified changes and implications for the Swedish inventory for Volume 3, IPPU. Further details are presented in Annex 3.

Table 4 Overview of identified changes and implications from Volume 3, the IPPU sector

Chap-ter	Identified change	Present CRF	New CRF	What needs to be done	Implementa-tion required	Change for authorities	Implications on quality	Implications for quantity of emissions	Cost for change	Time plan for imple-mentation
2	Lime production, higher Tier methodology	2A2	2A2	If lime production is a key category, a change to Tier 2 is required from present Tier 1	Yes, if key category	No	better	probably small or none	low	2
2	Tier 3 methdology added for most sources in the Mineral Industry chapter	2A	2A	Tier 2 is still sufficient, could move to Tier 3	No	No				
2	Emissions should be reported in the industries where these emis-sions occur. Accordingly, there has been a shift in the categories in which some emissions are reported, particular those from the use of limestone, dolomite and other carbonates	2A3	Several in CRF 2	CO2 emissions today reported under CRF 2A3 would need to be reported under different categories within CRF 2	Yes, reallocation of CO2 emissions in the reporting system. No change of methodology	No	better transparen-cy	No	medium-low	3
2	Disaggregation of specified sources	2A7	Several 2A	Study new/extended methodology description, disaggregate on new codes	Yes	No	better	probably small or none	low	3
3	Titanium dioxide production	NA	2B6	Investigate if titanium dioxide produc-tion occurs in Sweden, if so emis-sions should be estimated	Yes	No	better	If procudtion occurrs, emission will be added	low	3
3	Other chemical industry, sub-categories added	2B5	2B8a-f	Disaggregation of present 2B5, investigate new sources, estimate CO2 and consider CH4	Yes	No	better	Better com-pleteness if sources/gase s presently not covered are included	low-medium	2
4	Iron and steel, methodology, allocation	2C1	2C1	Check allocation of emissions en-ergy/process. Use of carbonates to be reported here. Method according to 2006 GL is proposed in recently concluded SMED-project	Yes	No	better	increase of reported emissions of CO2 and CH4	low-medium	3

Chap-ter	Identified change	Present CRF	New CRF	What needs to be done	Implementa-tion required	Change for authorities	Implications on quality	Implications for quantity of emissions	Cost for change	Time plan for imple-mentation
4	Ferroalloys	2C2	2C2	Estimate CH4 by default EFs, pres-ently not estimated	Yes	No	better complete-ness	Increased, "new" emis-sions calcu-lated (CH4)	low	3
4	Aluminium production	2C3	2C3	Check CO2 calculations from the facility. Assess if new default slope factors should be used	Yes	No	Accuracy	Increased PFCs if new slope factors are used	low	3
4	Other metal production, sub-categories added	2C5	2C5-2C7	Investigate how to split present 2C5 on Zinc, Lead and Other production	Yes	No	No	No	low	2
5	Non-energy products from fuels and solvent use	1Ad	2	The handling of information and split between the Energy and the IPPU sectors need to be investigated and clarified. Development of methodol-ogy and estimates, as well as time series in this new reorganized format and for new sources	Yes	No	Probably less risk of double counting	No	medium	2-3
1, table 1.3	Verification of completeness of CO2 from non-energy use of fossil fuels	NA	2	Complete table	?	No	Increased quality	No	low	3
1, table 1.5	Feedstock consumption for feedstock/reductants	NA	2	Complete table	?	No	Increased quality	No	low	3
6	Electronics industry emissions, new chapter.	2F	2E	Investigate the occurrence and use of fluorinated gases at PV manufactur-ing in Sweden.	Yes	Activity data?	better complen-tess	If sources exist, emis-sion will increase	low	2
7	Product use as substitutes for ozone depleting substances. New F-gases	2F	2F	New F-gases included, general refinements of methodologies (see details in Annex)	Yes	Activity data?	better	If new F-gases, emis-sions will increase	medium, depends on ac-tions	2

Chap-ter	Identified change	Present CRF	New CRF	What needs to be done	Implementa-tion required	Change for authorities	Implications on quality	Implications for quantity of emissions	Cost for change	Time plan for imple-mentation
7.4	Foam blowing	2F2	2F2	Investigate other foams than XPS, investigate end-of-life emissions from XPS	yes	No	better accuracy (XPS) and complete-ness (other foams)	probably small	low (XPS) - low medium (other foams)	3 (XPS), 2 (other fo-ams)
7.5	Refrigeration and air conditioning	2F1	2F1a+2 F1b	Containers, service practices, end-of-life emissions, split stationary and mobile emissions	probably	No, if confidenti-ality cannot be solved	transpar-ency, probably complete-ness and accuracy	probably small	medium	2
7.6	Fire protection	2F3	2F3	Keep track of possible new gases, service and end-of-life could be better investigated.	No					
8.2	Electrical equipment	2F8	2G1+su bcate-gories	Better data on different steps of life cycle needed	yes (already from present GL)	No, if confidenti-ality cannot be solved	accuracy, transparen-cy	?	low	1 (since it is already good practice)
8.3	Other uses of SF6 and PFC	2F9	2G2+su b catego-ries	Additional possible sources. Include gas distributors as an annual source of information	yes	No, if confidenti-ality cannot be solved	complete-ness	Might increas if new sources exist	low-medium	2

Volume 4, AFOLU

Volume 4 consists of the chapters:

1. Introduction
2. Generic Methodologies Applicable to Multiple Land-Use Categories
3. Consistent Representations of Land
4. Forest Land
5. Cropland
6. Grassland
7. Wetlands
8. Settlements
9. Other Land
10. Emissions from Livestock and Manure Management
11. N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application
12. Harvested Wood products

Annex 1 Worksheets
Annex 2 Summary of Equations

General changes in the AFOLU sector

The reporting from the agricultural sector and LULUCF has been combined into one. However, the reporting of the different emissions is not substantially changed.

A new aspect in the inventory is the incorporation of key category analysis for land-use categories, C pools, and CO_2 and non-CO_2 greenhouse gas emissions for AFOLU. A key source/sink category is defined as "one that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions and removals, the trend in emissions and removals, or uncertainty in emissions and removals." In Sweden the AFOLU sector has several large sources (cattle, organic soils etc.) that may qualify as key categories. It is difficult to clearly see the practical consequences of this. However, the aggregation level of emissions/ removals is revised in the suggested new key category analysis and new key-categories will probably be identified. The Tier level hierarchy is stricter and if an emission/ removal is identified as key, a higher Tier-methodology has to be applied. Therefore, methodologies for currently reported emissions/ removals might have to be revised.

Identified need for changes and the implications for the Swedish inventory are summarised in the table below and further elaborated in Annex 4.

Table 5 Overview of identified changes and implications for Volume 4, the AFOLU sector

.LAND-USE CATEGORIES, CARBON POOLS AND NON-CO_2 GASES TO BE ESTIMATED, THEIR RELEVANCE TO AFOLU SECTIONS, AND THE REFERENCE TO *1996 IPCC GUIDELINES* (grey shaded) and consequences for the Swedish inventory (in white cells).												
Information from Table 1.2 in the IPCC 2006 Guidelines							**Estimated consequences for the Swedish inventory**					
Land-use category/ Chapter	**Subcategory**	**C pool & non-CO_2 gases**	**Methods Section**	**Chapter 2 Method**	**Linkage to *1996 IPCC GL***	**Tier 1 Method**	**Changes necessary**	**Source/ sink change**	**Change for Authorities**	**Costs**	**Changes in reporting format**	**Positive/ negative cons-equences**
Forest Land (Chapter 4)	Forest Land Remaining Forest Land (FF)	Above-ground_biomass	4.2.1	2.3.1.1	5A	·	No	-	No	No	Minor	-
		Below-ground_biomass	4.2.1	2.3.1.1	NE	·	No	-	No	No	Minor	-
		Dead organic matter	4.2.2	2.3.2.1	NE	0	Below-ground	Sink	New metho-dologies required	Medi-um	Minor	Principles might be used also for HWP
		Soil carbon	4.2.3	2.3.3.1	5D	·	No	-	No	No or small changes	Minor	
		Non-CO2 from biomass burning	4.2.4	2.4.1	NE	·	Yes	Source	New metho-dologies required	Medi-um	Depends on Tier level	-

.LAND-USE CATEGORIES, CARBON POOLS AND NON-CO_2 GASES TO BE ESTIMATED, THEIR RELEVANCE TO AFOLU SECTIONS, AND THE REFERENCE TO *1996 IPCC GUIDELINES* (grey shaded) and consequences for the Swedish inventory (in white cells).

Information from Table 1.2 in the IPCC 2006 Guidelines							Estimated consequences for the Swedish inventory					
	Land Converted to Forest Land (LF)	Above-ground_biomass	4.3.1	2.3.1.2	5A,5C	·	No	-	No	No	Minor	-
		Below-ground_biomass	4.3.1	2.3.1.2	NE	·	No	-	No	No	Minor	-
		Dead organic matter	4.3.2	2.3.2.2	NE	·	Below-ground	Sink	New methodologies required	Medium	Minor	Principles might be used also for HWP
		Soil carbon	4.3.3	2.3.3.1	5D	·	No	Sink	No	No		
		Non-CO2 from biomass burning	4.3.4	2.4.1	4E, 4F	·	Yes	Source	New methodologies required	Medium	Depends on Tier level	-
Cropland (Chapter 5)	Cropland Remaining Cropland (CC)	Above-ground_biomass	5.2.1	2.3.1.1	5A	·	No	-	No	No	No	
		Dead organic matter	5.2.2	2.3.2.1	NE	0	No	-	No	No	No	
		Soil carbon	5.2.3	2.3.3.1	5D	·	No	Source	No	No	No	
		Non-CO2 from crop residue burning	5.2.4	2.4.1	4F	·	Maybe	Small Source	New data/ methodologies required	Low	Maybe	

.LAND-USE CATEGORIES, CARBON POOLS AND NON-CO_2 GASES TO BE ESTIMATED, THEIR RELEVANCE TO AFOLU SECTIONS, AND THE REFERENCE TO *1996 IPCC GUIDELINES* (grey shaded) and consequences for the Swedish inventory (in white cells).

Information from Table 1.2 in the IPCC 2006 Guidelines							Estimated consequences for the Swedish inventory					
		Methane emissions from rice	5.5	-	4C	·	-	-	-	-	-	-
	Land Converted to Cropland (LC)	Above-ground_biomass	5.3.1	2.3.1.2	5B	·	No	-	No	No	No	
		Dead organic matter	5.3.2	2.3.2.2	NE	·	No	-	No	No	No	
		Soil carbon	5.3.3	2.3.3.1	5D	·	No	Source	No	No	No	
		Non-CO2 from biomass (crop residue) burning	5.3.4	2.4	4E, 5B	·	Maybe	Small source	New data/ methodologies required	Low	Maybe	
Grassland (Chapter 6)	Grassland Remaining Grassland (GG)	Above-ground_biomass	6.2.1	2.3.1.1	5A	0	No	-	No	No	No	
		Dead organic matter	6.2.2	2.3.2.1	NE	0	No	-	No	No	No	
		Soil carbon	6.2.3	2.3.3.1	5D	·	No	Source	No	No	No	
		Non-CO2 from biomass burning	6.2.4	2.4	4E	·	Yes	Small Source	New data/ methodologies required	Low-Medium	New	
	Land Converted	Above-ground_biomass	6.3.1	2.3.1.2	5B	·	No	-	No	No	No	

.LAND-USE CATEGORIES, CARBON POOLS AND NON-CO_2 GASES TO BE ESTIMATED, THEIR RELEVANCE TO AFOLU SECTIONS, AND THE REFERENCE TO *1996 IPCC GUIDELINES* (grey shaded) and consequences for the Swedish inventory (in white cells).												
Information from Table 1.2 in the IPCC 2006 Guidelines							**Estimated consequences for the Swedish inventory**					
	to Grassland (LG)	Dead organic matter	6.3.2	2.3.2.2	NE	·	No	-	No	No	No	
		Soil carbon	6.3.3	2.3.3.1	5D	·	No	Source	No	No	No	
		Non-CO2 from biomass burning	6.3.4	2.4	4F, 5B	·	Yes	Small Source	New data/ methodologi-es required	Low-Medi-um	New	
Wetlands (Chapter 7)	Peatlands Remaining Peatlands	CO2 emissions	7.2.1.1	-	NE	·	No, assumed unmana-ged					
		Non-CO2 emis-sions	7.2.1.2	-	NE	·	No, assumed unmana-ged					
	Land Being Converted for Peat Extrac-tion	CO2 emissions	7.2.2.1	–	NE	NA	Yes	Source	New metho-dologies required	Medi-um	New	-
		Non-CO2 emis-sions	7.2.2.2	-	NE	·	Yes	Source	New metho-dologies required	Medi-um	New	-

.LAND-USE CATEGORIES, CARBON POOLS AND NON-CO_2 GASES TO BE ESTIMATED, THEIR RELEVANCE TO AFOLU SECTIONS, AND THE REFERENCE TO *1996 IPCC GUIDELINES* (grey shaded) and consequences for the Swedish inventory (in white cells).												
Information from Table 1.2 in the IPCC 2006 Guidelines							**Estimated consequences for the Swedish inventory**					
	Flooded Land Remaining Flooded Land	CO2 emissions	NG	-	NE	.	Probably not relevant for Sweden					
		Non-CO2 emissions	Appendix3	-	.		Probably not relevant for Sweden					
	Land Converted to Flooded Land	CO2 emissions	7.3.2	Appendix2	-	NE	Probably not relevant for Sweden					
		Non-CO2 emissions	Appendix 3	-	.		Probably not relevant for Sweden					
Settlements (Chapter 8)	Settlements Remaining Settlements	Above-ground_biomass	8.2.1	2.3.1.1	5A	0	Yes	-	SLU	Medium to high	Maybe	-

.LAND-USE CATEGORIES, CARBON POOLS AND NON-CO_2 GASES TO BE ESTIMATED, THEIR RELEVANCE TO AFOLU SECTIONS, AND THE REFERENCE TO *1996 IPCC GUIDELINES* (grey shaded) and consequences for the Swedish inventory (in white cells).

Information from Table 1.2 in the IPCC 2006 Guidelines							Estimated consequences for the Swedish inventory					
	(SS)	Dead organic matter	8.2.2	2.3.2.1	NE	0	Yes	-	SLU	Medi-um to high	Maybe	
		Soil carbon	8.2.3	2.3.3.1	NE	· 1						
	Land Con-verted to Settle-ments (LS)	Above-ground_biomass	8.3.1	2.3.1.2	5B	·	Yes	-	SLU	Medi-um to high	Maybe	
		Dead Organic Matter	8.3.2	2.3.2.2	NE	·	Yes	-	SLU	Medi-um to high	Maybe	
		Soil carbon	8.3.3	2.3.3.1	NE	·	Yes	Source	New metho-dologies required	Medi-um	New	-
Other Land (Chapter 9)	Land Con-verted to Other Land (LO)	Above-ground_biomass	9.3.1	2.3.1.2	5B	·	Probably not requi-red					-
		Dead Organic Matter	9.3.2	2.3.2.2	NE	NA	Probably not requi-red					-

.LAND-USE CATEGORIES, CARBON POOLS AND NON-CO_2 GASES TO BE ESTIMATED, THEIR RELEVANCE TO AFOLU SECTIONS, AND THE REFERENCE TO *1996 IPCC GUIDELINES* (grey shaded) and consequences for the Swedish inventory (in white cells).												
Information from Table 1.2 in the IPCC 2006 Guidelines							**Estimated consequences for the Swedish inventory**					
		Soil carbon	9.3.3	2.3.3.1	NE	·	Probably not required					-
Livestock (Chapter 10)	Enteric Fermentation	CH4 emissions	10.3	-	4A	·	?	?	Might be (revise EF)	Low/ Medium	No	
	Manure Management	CH4 emissions	10.4	-	4B	·	?	?	No (update EF)	Low	No	
		N2O emissions	10.5	-	4B	·	?	?	No (update EF)	Low	No	
Managed soils (Chapter 11)	Soil Management	N2O emissions	11.2	-	4D	·	Yes		Yes all mananged soils included instead of only agricultural soils	High	Yes?	
	Liming	CO2 emissions	11.3	-	_	·	No major	-	No	No	No	-
	Urea Fertilization	CO2 emissions	11.4	-	NE	·	Merged for all land?	-	No	No	Yes	-

.LAND-USE CATEGORIES, CARBON POOLS AND NON-CO_2 GASES TO BE ESTIMATED, THEIR RELEVANCE TO AFOLU SECTIONS, AND THE REFERENCE TO *1996 IPCC GUIDELINES* (grey shaded) and consequences for the Swedish inventory (in white cells).												
Information from Table 1.2 in the IPCC 2006 Guidelines							**Estimated consequences for the Swedish inventory**					
Harvested wood products (Chapter 12)	Wood Pro-ducts	Wood Products C stock changes	Chapter 12	-	NE	.	Yes	Sink	Completely new system	High	New	Important pool

Volume 5, Waste

Volume 5 consists of the chapters:

1. Introduction
2. Waste Generation, Composition and Management Data
3. Solid Waste Disposal
4. Biological treatment of Solid Waste
5. Incineration and Open Burning of Waste
6. Wastewater Treatment and Discharge

    Annex 1 Worksheets

The new reporting format for the Waste sector primarily consists of an addition of some new sub-category splits and no fundamental reorganisation.

Primary changes are revised methodology for methane from landfills, carbon accumulation in landfills, biological treatment and open burning of waste

Identified changes and the implications for the Swedish inventory in the Waste sector are summarised in
Table **6**. Further details are presented in Annex 5.

Table 6 Overview of identified changes and implications from Volume 5, the Waste sector

Chap-ter	Identified change	Present CRF	New CRF	What needs to be done	Implementation required	Change for authorities	Implications on quality	Implications for quantity of emis-sions	Cost for change	Time plan for imple-menta-tion
1	Indirect N2O from compos-ting	NA	5	Estimate indirect N2O when estimates of NH3 from composting are available	Good practice when data on NH3 emissions from composting are available	Need for additional data?	improvement	Slight increase	low if data on NH3 are available	1
3	Solid waste disposal	6A	4A	1. Calculate carbon stored in SWDS. 2. Check and if necessary adjust the current delay time for production of CH4. 3. Check if there are any emissions from residues from mechanical-biological treatment plants. 4. The distribution of waste to managed and unmanaged sites for the purpose of MCF estimation documented 5. An inventory of recovery facilities for CH4 is desirable. Flaring and energy recovery should be documented sepa-rately from each other	1. Reported as an information item in the Waste sector, related to Chapter 12, Harvested Wood Products, of the AFOLU. 2. It is good practice to choose and use delay time between zero and six months. Values outside the range should be supported by evidence. 3. Countries should provide their own estimates of the fractions of this type disposed in SWDS, incinerated or recycled. 4. In Sweden we believe that all Swedish sites are managed. Are there any documentation avail-able to support it? This must be supported in some do-cumentation. 5. ”is desirable” and ”should”.	Expertise and data	improvement	No or small implications on quantitative estimates	medium-low for each issue	1, 2 or 3 depen-ding on issue
4	Biological treatment of solid waste	6D	4B	Not reported at present. Needs to be developed	Yes	Yes	improvement	probably small		1

Chapter	Identified change	Present CRF	New CRF	What needs to be done	Implementation required	Change for authorities	Implications on quality	Implications for quantity of emissions	Cost for change	Time plan for implementation
5	Waste incineration	6C	4C	• Estimate greenhouse gases from open burning of waste (accidental land-fill fires etc). • Investigate if better input data are available for separating biogenic from fossil fraction of waste for CO2 calculations. • Investigate/apply emission factors for MSW for CH4 and N2O. • Emissions are to be reallocated and reported in the new CRF-codes 4C1, Waste Incineration, and 4C2, Open Burning of Waste	• Greenhouse gases from open burning of waste should be estimated. • N2O and CH4 should be reported from waste incineration.	Maybe, need for aditional data, who?	improvement	Emissions will increase (open burning of waste and if N2O and CH4 from waste incineration are included). Not possible to judge influence from refined calculations biogenic/fossil fractions	low-medium	3, if data are available
6	Waste-water treatment	6B	4D	1. To complete the coverage of the Swedish reporting of CH4. This can be done by mapping the existing data gaps or by using the method in 2006 IPCC Guidelines. 2. To complete the coverage of the Swedish reporting of N2O. This can be done by mapping the existing data gaps in combination with the present method in Sweden or using the approach in 2006 IPCC Guidelines	Yes, good practice	Probably	Probably slightly improved by mapping the emissions of CH4 and N2O in the treatment processes, but it will probably not improve by using the method in 2006 IPCC Guidelines.	probably small		1

References

2006 IPCC Guidelines for National Greenhouse Gas Inventories.
http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm

IPCC (2000). Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.
http://www.ipcc-nggip.iges.or.jp/public/gp/english/gpgaum_en.htm

IPCC (2003). Good Practice Guidance for Land Use, Land-Use Change and Forestry. http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm

Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.
http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm

Annexes

Annex 1: Volume 1, General Guidance and Reporting
Annex 2: Volume 2, Energy
Annex 3: Volume 3, IPPU
Annex 4: Volume 4, AFOLU
Annex 5: Volume 5, Waste

Annex 1

Volume 1, General Guidance and reporting

Table of content

Volume 1, General Guidance and Reporting

Volume 1 of the 2006 IPCC Guidelines gives general "Good Practice Guidance" within six areas of inventory work. The content of Volume 1 builds on earlier guidance from 1996 IPCC Guidelines, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000) and Good Practice Guidance for LULUCF (2003).

Volume 1 contains 8 chapters and two Annexes:

1. Introduction
2. Approaches to Data Collection
3. Uncertainties
4. Methodological Choice and Identification of Key Categories
5. Time Series Consistency
6. Quality Assurance/Quality Control and Verification
7. Ozone Precursors, SO_2 and Indirect Emissions
8. Reporting Guidance and Tables
    - Annex 8A.1: Prefixes, Units and abbreviations. Standard equivalents
    - Annex 8A.2: Reporting Tables

Chapter 1, Introduction

Chapter 1 introduces the new guidelines, points out some changes relative to the earlier guidance and describes inventory preparation practices in general terms.

Implications for changes in the Swedish inventory

None

Chapter 2, Approaches to Data Collection

Chapter 2 contains general advice and guidance on how and where to collect data. The guidance is well in line with present practices in the Swedish inventory. For Swedish conditions the annex 2A.1 presenting a protocol for documentation of expert elicitation could be of value.

Implications for changes in the Swedish inventory

Further develop documentation of expert estimates could be an improvement.

Chapter 3, Uncertainties

The chapter on uncertainties is a development from Good Practice Guidance where the basis is the same, only with more extensive guidance and explanations regarding the theory and methods for uncertainty analysis.

Implications for changes in the Swedish inventory

None as a direct result of the new Guidelines. The Swedish work could however move on to a more elaborated uncertainty analysis, but this is already a possibility with the present Good Practice Guidance.

Noted: The instructions in chapter 3.7.3 could be improved. According to expertise at Statistics Sweden it is in fact possible to compute an exact correction term for uncertainties.

Chapter 4, Methodological Choice and Identification of Key Categories

In Good Practice Guidance (2000) both Key sources and recalculations are handled in the same chapter. In the 2006 IPCC Guidelines these are separated in two chapters (4 and 5), which contain more elaborated and extensive descriptions, explanations and guidance. The former Key Source analysis is replaced by Key Category analysis and the 2006 IPCC Guidelines present two approaches for identifying national key categories. The first approach is identical to the method currently used to perform the Key Category analysis in the Swedish inventory. The second approach includes an additional step by involving uncertainty estimates in the analysis. The guidelines recommend parties that have produced uncertainty estimates to apply the second approach in their Key Category analysis. The guidelines also states that it is good practice to perform the Key Category analysis on a disaggregated level that correspond to the level of IPCC categories at which IPCC methods and decision trees are generally provided in the sectoral volumes. Today, Sweden's Key Category analysis is in principle performed on a level that corresponds to the current common reporting format.

WHAT NEEDS TO BE DONE

The 2006 IPCC Guidelines provide more extensive methodology descriptions than the current guidelines. This implies that Sweden would need to expand the current analysis to include more disaggregated source categories. The new guidelines also state that the analysis should be performed for emissions and removals separately, which would require further adjustments of the current Key Category analysis. To follow the recommendations from the new guidelines, Sweden would also need to expand the current Key Category analysis by including uncertainty estimates in the analysis.

IMPLEMENTATION REQUIRED?

Yes – if Sweden are to adhere to good practice.

CHANGES FOR AUTHORITIES

The changes do not affect any authorities.

IMPLICATIONS ON QUALITY

Following good practice and expanding the level of detail of the Key Category analysis would increase the quality of the Key Category analysis.

IMPLICATIONS ON QUANTITY

None.

COST FOR CHANGE

The cost for implementation would be medium.

TIME PLAN FOR IMPLEMENTATION

The time plan for implementing a new Key Category analysis following the 2006 Guideline requirements is estimated to need some preparation which need to begin at the latest the year preceding the year of implementation (category 2).

Chapter 5, Time Series Consistency

The chapter on time series consistency contains basically the same guidance on recalculations and time series as before, but is extended with more descriptions, explanations and guidance. No changes are required in the Swedish approach. However, in the chapter it is pointed out that recalculations may be necessary due to some new categories and sub-categories which are introduced in the 2006 GL and where estimates for the entire time series are required if these categories are relevant to include in the reporting.

Implications for changes in the Swedish inventory

None, except for possible recalculations of time series due to reporting of new categories or sub-categories introduced in the 2006 GL.

Chapter 6, Quality Assurance/Quality Control and Verification

Extended chapter compared to Good Practice Guidance, but basically the same requirements.

Implications for changes in the Swedish inventory

None.

Chapter 7, Precursors and Indirect Emissions

This is a new chapter compared to earlier guidance. It is stated that in principle the 2006 GL do not contain any guidance regarding precursor emissions (NO_X, CO, NMVOC and SO_2). The EMEP/CORINAIR Guidebook is referred to as guidance for estimating these substances, unless insufficient information exists in the EMEP/CORINAIR Guidebook.

This chapter also contains methodology descriptions for calculation of indirect emissions of N_2O, which arise from the nitrogen emitted and deposited as NH_3 and NO_X. The 2006 Guidelines include guidance for estimating N_2O emissions resulting from nitrogen deposition of all anthropogenic sources of NO_X and NH_3. Only agricultural sources of nitrogen were considered in the Revised 1996 Guidelines (IPCC, 1997). Sources covered in this section are sources such as fuel combustion, industrial processes, and burning of crop residues and agricultural wastes. The method needs only to be applied where data on NO_X and NH_3 emissions from these sources are available.

Implications for changes in the Swedish inventory

WHAT NEEDS TO BE DONE

Develop calculations of indirect emissions of N_2O for other than agricultural sources. To be reported in the new CRF 5A.

IMPLEMENTATION REQUIRED?

The 2006 GL explicitly says that the method needs only to be applied where data on NO_X and NH_3 emissions from these sources (=sources not covered in the AFOLU volume) are available. We interpret this such that for indirect emissions from the sources with specified methodology descriptions in the AFOLU sector it is required.

CHANGES FOR AUTHORITIES

If calculations of indirect emissions are to be made for other sources than AFOLU, the emission factors for NOx and NH_3 will be included in the National System, which means that the responsibilities among the authorities for these EFs need to be defined.

IMPLICATIONS ON QUALITY

Better completeness.

IMPLICATIONS ON QUANTITY

If indirect emissions are calculated, emission estimates will be higher since this is a "new" source included in the inventory.

COST FOR CHANGE

Probably quite low if only already existing emission estimates of NOx and NH_3 are to be utilised for calculations of indirect emissions of N_2O.

TIME PLAN FOR IMPLEMENTATION

Relatively easily done at a later stage if only existing data on NOx and NH_3 are to be used.

Chapter 8, Reporting Guidance and Tables

In a number of cases extensions with new "sub-categories" or" sub-category splits" have been added in the reporting system. This is done in order to increase the transparency or as a result of increased knowledge or improved methodologies available. The code system has also in some sectors been changed and quite a lot of reallocations have been made, especially for the IPPU sector and to some extent for the AFOLU sector.

In the **Energy sector**, the changes in format primarily consist of extensions and new sub-categories or sub-category splits. A number of new categories for Carbon dioxide transport and storage have been added.

In the **IPPU sector** extensions have been introduced and a substantial reorganisation of CRF codes has been made. The reorganisation is partly a result of a new way of looking at solvents and non-energy use of fuels, and addition of CRF codes for several sources covered in the 2006 GL which previously were not well covered, or which have shown to be, or have become, more important than previously known. This includes e.g. processes in the chemical industry and in the electronics industry. A fundamental re-thinking regarding allocation of carbonate use in processes has also been implemented in the reporting format.

One additional change is the introduction of a background table in the IPPU sector for reporting the allocation of all "non-energy use of fuels", both from the IPPU sector and from the Energy sector.

In the **AFOLU-sector** new sources and sinks have been introduced, and the present separate sectors Agriculture and LULUCF have been combined into one, which has implications for the reporting system.

Changes in reporting format in the **Waste** sector are minor compared to the other sectors. Some extensions into sub-category splits have been included.

Table 5A is a new cross-sectoral table for reporting calculated indirect emissions of N_2O from emissions of NH_3 and NO_X from all sectors.

These changes in the reporting format imply that the inventory has to be adjusted to meet the new requirements, including:

- More detailed information required in the sectoral and background reporting tables. In some cases the information is already available in the Swedish inventory on the more disaggregated level, but in some cases not.
- Recalculation of time series for the new sub-categories or sub-category splits.

- The database system, TPS, and all other national data-handling systems and data files need to be translated into the extended and partially reorganised code system.
- Introduction of NH_3 emissions in the GHG inventory (for calculation of indirect emissions of N_2O).

Annex 2

Volume 2, Energy

Table of Content

Volume 2, Energy

Volume 2, Energy consists of the chapters:

Chapter 1, Introduction
Chapter 2, Stationary Combustion
Chapter 3, Mobile Combustion
Chapter 4, Fugitive Emissions
Chapter 5, Carbon Dioxide Transport, Injection and Geological Storage
Chapter 6, Reference Approach
Annex 1 Worksheets

General changes in the Energy Sector

The requirements for QA/QC are higher in the 2006 GL. Furthermore, instances of the wording "are encouraged" from the 1996 GL have generally been changed into the stronger wording "should" in the 2006 GL.

Chapter 1, Introduction

The introduction chapter for energy includes detailed descriptions of methodological approaches, data collection issues, uncertainty in inventory estimates, QA/QC and completeness. None of this information is however new and does not imply the need for any general change in the inventory with regard to emissions from the energy sector, apart from those mentioned in the following chapters.

Chapter 2, Stationary Combustion

Identified changes in present CRF 1Ad, Non energy Use of Fuels

Non-energy use of fuels should be reported under IPPU and not under 1Ad as present. Data are to be calculated according to the same methodology as present. There is an auxiliary worksheet in Annex 1 of the Energy Volume where a compilation of all CO_2 bound in products is to be made.

IMPLEMENTATION REQUIRED?

Yes.

WHAT NEEDS TO BE DONE

Different allocation of reported emissions.

IMPLICATIONS ON QUALITY

None.

IMPLICATIONS ON QUANTITY

None.

CHANGES FOR AUTHORITIES

None.

COST FOR CHANGE

Low.

TIME PLAN FOR IMPLEMENTATION

Can be implemented during the year before introduction of change.

Identified changes in present CRF 1A1a, Public Electricity and Heat Production and CRF 1Af, Other manufacturing industries

Former 1A1a is split into 1A1ai-iii and former CRF 1A2f is split into CRF 1A2f – 1A2m.

IMPLEMENTATION REQUIRED?

Yes.

WHAT NEEDS TO BE DONE

This can easily be done. We have got all the data needed already as our activity data for CRF 1A2f is on plant level for each ISIC class (five digit level). Activity data for CRF 1A1a is already split into electricity-, heat- or a combination of electricity/heat production. Some minor extra programming needs to be done.[1] Recalculations from 1990 and onwards could be done easily too, if time series should be kept from 1990.

The detailed split increases the risk for problems with confidentiality, if activity data are considered confidential on plant level at the time for the change. However, in chapter 2.5.1, pages 2.41-2.42, the IPCC 2006 GL state:

> Most energy statistics are not considered confidential. If inventory compilers do not report disaggregated data due to confidentiality concerns, it is good practice to explain the reasons for these concerns, and to report the data in a more aggregated form.

In other words, if confidentiality problems occur, we report more aggregated data and explain the reason.

[1] When doing this programming, one has to keep in mind that the Swedish version of ISIC, SNI, has changed in 2008. Thus the programming has to be different for the years 1990-2007 and 2008 and onwards. This is however an issue that has to be dealt with in Sweden even if the 2006 IPCC Guidelines should not be ratified.

IMPLICATIONS ON QUALITY

The transparency of the inventory will increase. It will be easier to analyse emission trends in the different industries concerned.

IMPLICATIONS ON QUANTITY

None.

CHANGES FOR AUTHORITIES

Possible problems with confidentiality has to be addressed together with the Energy Agency, see section on "What Needs to be Done" above.

COST FOR CHANGE

Low.

TIME PLAN FOR IMPLEMENTATION

Can be implemented during the year before introduction of change.

Identified changes in present CRF 1A, Stationary combustion: fuel groups and fuel types

- Former five fuel groups (liquid, solid, gaseous, biomass and other) is revised into six groups: liquid, solid, gas, other fossil fuels, peat and biomass.
- Fuels identified within these groups are sometimes also revised.
- Former fuel types “municipal solid waste” and “industrial waste” are split into Municipal Waste (non-biomass fraction), Industrial waste, Waste oils and Municipal Waste (biomass fraction).

IMPLEMENTATION REQUIRED?

Yes.

WHAT NEEDS TO BE DONE

- Careful comparison of all fuel types in the 2006 IPCC Guidelines and fuel types in the Swedish energy statistics
- Reprogramming of fuel groups and fuel types according to the new system
- Activity data on municipal waste is currently not divided into biomass/non-biomass. Activity data has to be improved. There are two alternatives:
    - Collecting activity data on municipal waste so that both biomass fraction and the non-biomass fraction are reported. This alternative is most likely time consuming and costly. The Swedish Energy Agency has to be involved since the energy statistics in Sweden has to be changed. We do not know how well fractions on biomass/non-biomass – waste are known at the plants that report combustion of waste.

    - Estimating the general proportion of biomass/non-biomass fraction of municipal wastes from literature studies and/or development projects, and apply these percentages on available data on municipal waste. As the waste collection system in Sweden is improved, the share of biomass will change (decrease), so this must be done for several years.
- Thermal values and emission factors have to be developed/revised for any fuel types that are changed.
- Recalculations back to 1990 are possible and quite easy for all fuel types with the exception of municipal waste. If municipal waste is to be recalculated for earlier years, it will have to be done with some type of estimation (estimated share biomass waste) that could be rough for the earlier years.

IMPLICATIONS ON QUALITY

The quality of the inventory will increase since the new fuel groups and fuel types are more relevant. If data on biomass fraction of municipal waste is of low quality, the uncertainty of this data will of course be high. It will anyway be an improvement compared to today, when all waste is reported as fossil.

IMPLICATIONS ON QUANTITY

Emission levels will decrease when the biomass fraction of municipal waste is reported as biomass.

CHANGES FOR AUTHORITIES

The Swedish Energy Agency has to be involved if activity data on municipal waste is to be collected in a different way (see section on "What needs to be done" above).

COST FOR CHANGE

Medium - high.

TIME PLAN FOR IMPLEMENTATION

If activity data on municipal waste is to be collected so that the biomass/non-biomass fraction is reported, extensive preparatory work is needed.

Identified changes in present CRF 1A, stationary combustion: CO_2 capture

If/when CCS is introduced in Sweden, reported CO_2 emissions from plants with CO_2 capture should be equal to estimated emissions for each plant (assuming no capture) minus the amount of captured CO_2 for each plant.

IMPLEMENTATION REQUIRED?

Yes.

WHAT NEEDS TO BE DONE

Currently nothing, as CCS is not occurring in Sweden. If CCS is introduced in Sweden, data on the amount of CO_2 captured for each plant has to be collected. As stated in page 2.36 of the 2006 GL, plants, with capture and storage will most probably meter the amount of gas removed by the gas stream and transferred to geological storage, so this will probably not be so difficult.

IMPLICATIONS ON QUALITY

Currently none, as CCS is not occurring in Sweden. If CCS is introduced in Sweden, this change is needed in order to maintain the quality of the Swedish inventory.

IMPLICATIONS ON QUANTITY

If CCS is introduced in Sweden and reported according to the 2006 IPCC Guidelines, emission levels will decrease.

CHANGES FOR AUTHORITIES

If/when CCS is introduced in Sweden input data will be needed. The future responsibility for this is presently not defined within the National System.

COST FOR CHANGE

The cost for reporting CCS if/when it is introduced in Sweden is very hard to estimate. Under the assumptions given above under the section on “What needs to be done”, we estimate the extra work within the GHG Inventory to be low-medium, given that necessary data will be provided.

TIME PLAN FOR IMPLEMENTATION

Preparation for implementation of CCS in the GHG Inventory should start at the same timepoint as CCS is introduced in Sweden.

Identified changes in present CRF 1A, Stationary combustion: oxidation factors

For country specific CO_2 emission factors, it is good practice to provide the sources of the calorific values, carbon content and *oxidation factors* (whether the default factor of 100 percent is used or a different value depending on circumstances).
In Sweden, the default factor of 100 percent is used, however this is not clearly reported in the NIR.

IMPLEMENTATION REQUIRED?

Yes.

WHAT NEEDS TO BE DONE

Explicit documentation in NIR, appendix with emission factors.

IMPLICATIONS ON QUALITY

The transparency will improve and thus the quality will improve.

IMPLICATIONS ON QUANTITY

None.

CHANGES FOR AUTHORITIES

None.

COST FOR CHANGE

Very low.

TIME PLAN FOR IMPLEMENTATION

Can be implemented during the last year before introduction of change.

Identified changes in present CRF 1A, Stationary combustion: QA/QC

Required QA/QC procedures for stationary sources are extensive in the 2006 IPCC Guidelines. For all procedures, the word used is "should", however sometimes with "if possible" added. The amount of work that is needed for this could be significant. All procedures are listed in pages 2.43 – 2.44.

IMPLEMENTATION REQUIRED?

Yes if possible.

WHAT NEEDS TO BE DONE

All procedures need to be addressed together with the Swedish Energy Agency. We will have to find a reasonable level and prioritise among proposed procedures.

IMPLICATIONS ON QUALITY

The quality will improve.

IMPLICATIONS ON QUANTITY

Probably none, unless errors are detected because of the QA/QC procedures.

CHANGES FOR AUTHORITIES

Many of the procedures could require a lot of work for the Swedish Energy Agency. See above under What needs to be done and in the guidelines pages 2.43 – 2.44.

COST FOR CHANGE

Depends on priorities, could be high.

TIME PLAN FOR IMPLEMENTATION

It is possible that extensive preparatory work is needed.

Also noted (no changes)

In those circumstances where double counting could occur, it is good practice to make sure that emission estimates have been correctly allocated to stationary combustion in the Energy sector or to mobile combustion or other sectors. This should also be clearly stated in the NIR.

Page 2.37: The same activity data *should* be used for all emissions. Does this imply that it is not possible to, for example, use data on CO_2 from ETS and use other data (energy statistics) for estimating other emissions?

Page 2.37: Calorific values *should* be consistent with calorific values used in energy statistics.

Chapter 3, Mobile Combustion

Identified changes in present CRF 1A3b, Road transportation

2006 IPCC Guidelines include a new category for emissions from urea-based catalysts, which should be reported under 1A3b iv. Emissions from urea-based catalysts are not addressed in 1996 IPCC Guidelines and are not included in the Swedish national inventory.

WHAT NEEDS TO BE DONE

According to 2006 IPCC Guidelines it is considered good practice to estimate CO_2 emissions from urea-based catalytic converters using equation 3.2.2 in the guidelines.

To estimate CO_2 emissions from urea-based catalytic converters Swedish inventory compilers need to collect data on the amount of urea-based additive consumed as well as the purity of the additive. Country specific data on purity level might quite easily be gathered through contacts with providers of the additive. IPCC provide a default purity value if country specific data is unavailable. Hence, to follow good practice it is sufficient to gather data on the urea consumption. The urea-based additive is marketed under the name AdBlue.

The consumption of AdBlue would need to be estimated using data from AdBlue providers. This would require an identification of these providers. If AdBlue are exclusively provided by suppliers of petroleum products it might be possible to gather data on AdBlue consumption together with data on the consumption of other petroleum fuels, within the current survey format. If AdBlue is provided by others than the suppliers of petroleum fuels (e.g. the chemical industry), there might be a

need for an alternative survey or some other initiative to estimate the total amount of AdBlue consumed.

IMPLEMENTATION REQUIRED?

Yes

IMPLICATIONS ON QUALITY

Including emissions from urea-based catalysts will increase the quality of the Swedish inventory.

IMPLICATIONS ON QUANTITY

Current information from Swedish providers of AdBlue state that it decreases diesel consumption by about the same volume as the AdBlue added. Given that the carbon content of AdBlue is lower than that of diesel it would imply a slight decrease in the quantity of CO_2 emissions.

CHANGES FOR AUTHORITIES

If data on AdBlue consumption are to be gathered through the current monthly survey on supply and delivery of petroleum products (EN401) it would require that the Swedish Energy Agency revise the survey and update their databases etc. accordingly.

COST FOR CHANGE

The cost for including the category CRF 1A3b vi in the Swedish inventory is estimated to be low to medium.

TIME PLAN FOR IMPLEMENTATION

The inclusion of category CRF 1A3b vi in the Swedish inventory can be made during the year before introduction of change.

Chapter 4, Fugitive Emissions

Identified changes in present CRF 1B, Fugitive emissions

1. The allocation of emissions on CRF-codes within CRF 1B has changed.
2. Demand for active industry involvement in the QA/QC for CRF 1B.

IMPLEMENTATION REQUIRED?

1. Yes.
2. No. The guidelines only say "…it is important to…"

WHAT NEEDS TO BE DONE

1. Reallocate emissions according to new CRF codes. This is done by reprogramming, and is quite easy.

2. Extra contacts with relevant industries and extra verification of reported data. However, most data in this sector is already today obtained by contacts with industries involved, so the change will not be big.

IMPLICATIONS ON QUALITY

1. The quality of emissions estimates in the inventory will not be affected, however with the new CRF codes it will be easier to read and understand reported emissions.
2. More extensive QA/QC will improve the quality of the inventory. Most likely the changes will not be that big.

IMPLICATIONS ON QUANTITY

None.

CHANGES FOR AUTHORITIES

None.

COST FOR CHANGE

1. Low.
2. Low – medium depending on how this is done.

TIME PLAN FOR IMPLEMENTATION

1. Can be introduced during the last year before implementation.
2. Can be introduced during the last year before implementation.

Chapter 5, Carbon Dioxide Transport, Injection and Geological Storage

Identified changes

Emissions from CCS are not included in the 1996 IPCC Guidelines, so this is a new reporting item. CCS is a new technology currently not occurring in Sweden.

IMPLEMENTATION REQUIRED?

Yes.

WHAT NEEDS TO BE DONE

As long as no CCS takes place in Sweden, we just report ”NO”. If/when CCS is introduced in Sweden, it has to be reported. For this sector, no Tier 1 or Tier 2 methods exist. Emissions have to be reported according to Tier 3, which is with data from each site. The guidelines identify the following steps that have to be performed (section 5.7.1, choice of method):

1. Identify and document all geological storage operations in the jurisdiction.

2. Determine whether an adequate geological site characterization report has been produced for each storage site.
3. Determine whether the operator has assessed the potential for leakage at the storage site.
4. Determine whether each site has a suitable monitoring plan.
5. Collect and verify annual emissions from each site.

It is very hard to estimate the amount of work needed to accomplish this. Most likely, CCS will only exist in a few places in Sweden. We can assume that some control system will exist. Therefore it will probably be possible to collect data of reasonably good quality from each site.

IMPLICATIONS ON QUALITY

Currently none, as CCS is not occurring in Sweden. If CCS is introduced in Sweden, it must be reported to maintain the quality of the Swedish inventory.

IMPLICATIONS ON QUANTITY

If CCS is introduced in Sweden and reported according to the 2006 IPCC Guidelines, emission levels will decrease.

CHANGES FOR AUTHORITIES

If/when CCS is introduced in Sweden a responsible authority should be defined.

COST FOR CHANGE

The cost for reporting CCS if/when it is introduced in Sweden is very hard to estimate. Under the assumptions given above under “What needs to be done”, we estimate the extra work within the GHG Inventory to be low to medium, given that necessary data are provided to the inventory compilers.

TIME PLAN FOR IMPLEMENTATION

Preparation for implementation of CCS in the GHG Inventory should start at the same time that CCS is introduced in Sweden, if it occurs.

Chapter 6, Reference Approach

Identified changes in present Reference Approach

The method is simple, straightforward and well explained. Issues that cause problems today are addressed and guidance/solutions are provided. The accepted difference when comparing to the sectoral approach is 5%, an increase as only 2% difference is accepted today. Apparently the IPCC has concluded that 2% was too harsh.

Possible explanations to differences are provided, as a help in the GHG inventory work.

IMPLEMENTATION REQUIRED?

Yes. You can not do the Sectoral Approach according to the new guidelines and Reference Approach according to the old guidelines.

WHAT NEEDS TO BE DONE

No special preparations are needed as all required data are already available. The first time the Reference Approach is done according to the new guidelines we just have to be extra careful so that no omissions or mistakes are made.

IMPLICATIONS ON QUALITY

The quality will improve. The Reference Approach is important for the QA/QC for CRF 1, and as the Reference Approach is improved so will the QA/QC for all sources within CRF 1.

IMPLICATIONS ON QUANTITY

None.

CHANGES FOR AUTHORITIES

None.

COST FOR CHANGE

Low.

TIME PLAN FOR IMPLEMENTATION

Can be introduced during the year preceding the year of implementation.

Annex 3

Volume 3, IPPU

Table of Contents

Volume 3, Industrial Processes and Product Use (IPPU)

Volume 3, IPPU, consists of the chapters:

1. Introduction
- Table 1.3 Verification of Completeness of Reported CO_2 from Non-Energy Use of Fossil Fuels
- Table 1.5 Feedstock Balance Check
2. Mineral Industry Emissions
3. Chemical Industry Emissions
4. Metal Industry Emissions
5. Non-energy Products from Fuels and Solvent Use
6. Electronics Industry Emissions
7. Emissions of Fluorinated Substitutes for Ozone Depleting Substances
8. Other Product Manufacture and Use

Annex 1 Worksheets (examples for F-gases)
Annex 2, Potential emissions (Formerly Tier 1 for consumption of HFCs, PFCs and SF_6)
Annex 3, Improvements since 1996
Annex 4, Glossary for Industrial processes and Product Use Sector

General changes in the IPPU sector

From IPCC 2006 GL:

> This volume contains major changes and improvements to the section covering 'Industrial Processes' and 'Solvent and Other Product Use' in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (*1996 IPCC Guidelines*). First, these *Guidelines* (*2006 IPCC Guidelines*) introduce practical guidance on allocation of carbon dioxide (CO_2) emissions released from combustion of fuel in the Energy Sector and Industrial Processes Sector, which was not clear in the *1996 IPCC Guidelines*. Second, these *Guidelines* are based on the principle that emissions should be reported in the industries where these emissions occur. Accordingly, there has been a shift in the categories in which some emissions are reported, particular those from the use of limestone, dolomite and other carbonates.

This sector is a combination of the present sector 2, Industrial processes and present sector 3, Product and Solvent Use.

A new chapter in the IPPU sector (Volume 3, Chapter 5) deals with Non-energy Products from Fuels and Solvent use. This also means that the linkages have become stronger with the Energy sector. More guidance and tables are provided for verification of balances and checking of completeness for fuels used for other purposes than energy. These are Table 1-3 in chapter 1 of Volume 3: Verification of Completeness of Reported CO_2 from Non-Energy Use of Fossil Fuels, and Tables 1-5, Feedstock Balance Check.

The reporting code system is substantially reorganised and extended with many new sub-category splits.

Capture and Abatement is a new issue in the 2006 GL. These issues are extensively discussed in the Energy volume of the 2006 GL. In the IPPU-volume CCS is described only for processes where CCS might be relevant.

Chapter 1 Introduction

Chapter 1 includes definition and structure for the treatment of industrial processes and product use. The definition of industrial processes and fuel combustion emissions is described in box 1.1 in the 2006 GL and is as follows (more explanatory text in the chapter):

> Combustion emissions from fuels obtained directly or indirectly from the feedstock for an IPPU process will normally be allocated to the part of the source category in which the process occurs. These source categories are normally 2B and 2C. However, if the derived fuels are transferred for combustion in another source category, the emissions should be reported in the appropriate part of Energy Sector source categories (normally 1A1 or 1A2).

The chapter also presents the enlarged and reorganised code system for the IPPU-sector. There are also parts covering the nature of non-energy uses of fuels as well as the accounting for feedstocks and reductant uses of fossil fuels. One part of the chapter deals with QC of completeness and allocation of CO_2 from non-energy use of fuels:

> Two Quality Control (QC) approaches – a CO_2 *completeness check* and a *feedstock balance check* – have been introduced for checking the completeness of accounting CO_2 emissions from feedstock/reductant use of fossil fuels. Guidance is provided to facilitate the organisation and completion of this task: (a) checking that total reported bottom-up calculated CO_2 emissions from non-energy use sources (including uses as feedstock and reductant) at different subcategory levels are complete and consistent; and b) checking that feedstock/reductant requirements of processes included in the inventory are in balance with the non-energy use/feedstock supply as recorded in national energy statistics. Moreover, guidance is provided on documenting and reporting how these emissions are *allocated* in the inventory and how the completeness was checked (Section 1.4).

Section 1.3 provides an explanation of the principles which have guided the estimation and reporting of CO_2 emissions from the non-energy uses of fossil fuels, and describes the data issues related to the estimation methods.

Identified major changes in the IPPU-sector

- New extended code system, new categories and sub-categories
- Handling and reporting of non-energy use of fuels, including completeness check and feedstock balance tables

- New fluorinated gases
- There is no longer a requirement to report potential emissions of fluorinated gases.

WHAT NEEDS TO BE DONE

Code system: An overview of which required information is already available (in suitable disaggregated format) in the Swedish inventory, possible development of new specific time series. Reallocation of background data files to comply with the new code system. Adjustment of TPS.

Non-energy use of fuels: The handling of information and split between the Energy and the IPPU sectors need to be investigated and clarified. Development of methodology and estimates, as well as time series in this new reorganized format might be needed.

New fluorinated gases: An inventory has to be made.

IMPLEMENTATION REQUIRED?

Yes

CHANGES FOR AUTHORITIES

Extended need for data regarding the new fluorinated gases.

IMPLICATIONS ON QUALITY

Transparency will increase as a result of the new code system and of the reorganized handling and reporting of non-energy use of fuels. The accuracy and completeness may also improve.

IMPLICATIONS ON QUANTITY

If new fluorinated gases are included, this will increase the emissions estimates.

COST FOR CHANGE

Difficult to judge but probably rather high (except for the new F-gases, where a rather low cost is expected since information at present seem to be difficult to obtain).

TIME PLAN FOR IMPLEMENTATION

The work concerning non-energy use of fuels should start well in advance of implementation, since it is not possible at this point to clearly foresee the consequences. If new time series are to be developed for new or disaggregated subcategories, an assessment to identify the needs and the level of ambition should be made.

Chapter 2, Mineral Industry Emissions

Improvements since the 1996 GL:

There are three key changes to the Mineral Chapter in the *2006 IPCC Guidelines*, as compared to the earlier guidance documents. Firstly, a new input-based method has been introduced for all source categories that estimates emissions based on the quantity, type and composition of carbonate inputs to the production processes. For example, in addition to the Tier 2 method based on clinker output during cement production, an alternate method is elaborated based on estimating emissions from the carbonate input to the kiln.

Secondly, clear guidance has been developed to specify where emissions from the use of limestone, dolomite and other carbonates should be reported. As noted above, these *Guidelines* are based on the principle that emissions should be reported in the industries where they occur. For example, where limestone is used as a flux for iron and steel production, emissions from the use of the limestone should be reported under Iron and Steel Production. Only emissions from limestone and dolomite used in the mineral industry should be reported in the Mineral Industry Chapter. Inventory compilers are encouraged to assess carefully how this change may impact, in particular, emission estimates for the Mineral Industry, the Chemical Industry, and Metal Production.

In addition while earlier guidance highlighted only limestone and dolomite use, these *Guidelines* also outline methods for estimating emissions from use of other carbonates, including magnesia and sodium carbonate. These *Guidelines* also establish three approaches for estimating emissions from glass production. Acid-induced release of CO_2 from acidification of carbonate-containing materials (e.g., phosphate ores) is also considered, although specific estimation methods are not provided.

Identified changes in present CRF 2A1, Cement Production

2006 IPCC Guidelines include a new Tier 3 methodology for estimating emissions from cement production. The 1996 IPCC Guidelines include only a Tier 1 and a Tier 2 methodology.

WHAT NEEDS TO BE DONE

To estimate CO_2 emissions from cement production according to the new Tier 3 methodology SMED would need to acquire plant-specific activity data on carbonates consumed (their chemical composition and calcinations achieved) and relevant plant specific emission factors. It is unclear whether or not this is practical or even possible is Sweden.

IMPLEMENTATION REQUIRED?

Calculating CO_2 emissions from cement production following the new Tier 3 methodology is not a requirement. It is considered good practice to calculate emissions using the Tier 2 methodology currently applied in the Swedish inventory.

CHANGES FOR AUTHORITIES

The choice of methodology does not affect any authorities.

IMPLICATIONS ON QUALITY

Estimating CO_2 emissions according to the new Tier 3 methodology would increase the quality of the Swedish inventory given that good quality plant-specific activity data and emission factors are available.

IMPLICATIONS ON QUANTITY

Estimating CO_2 emissions according to the new Tier 3 methodology would probably have a marginal effect on the quantity of the emissions. Whether this would be a marginal increase or decrease would depend on the type of carbonates consumed.

COST FOR CHANGE

The cost for implementing would be low provided that activity data and emission factors are available.

TIME PLAN FOR IMPLEMENTATION

Some preparatory work is needed, to start earlier than the year preceding the year of implementation.

Identified changes in present CRF 2A2, Lime Production

2006 IPCC Guidelines include a more detailed methodology for how to estimate CO_2 emissions from lime production than the 1996 IPCC Guidelines. Three different methodologies are presented (Tier 1 – Tier 3) requiring different levels of detail in the activity data and emission factors applied.

WHAT NEEDS TO BE DONE

To estimate CO_2 emissions from lime production following any of the higher Tier methodologies, SMED would need to acquire plant-specific activity data on more detailed level than what is used at present. A Tier 2 method would require country-specific information on the proportion of hydrated lime produced as well as plant-level ratios of lime product to LKD (lime-kiln dust) production. A Tier 3 method would require data on carbonates consumed as well as their specific emission factors. It is unclear whether or not this is practical or even possible to meet any of these requirements in Sweden.

IMPLEMENTATION REQUIRED?

Calculating CO_2 emissions from lime production according to any of the higher Tier methodologies is not a requirement as long as lime production is not a key source. However, lime production is most likely a key source in the Swedish inventory since it represents a considerable part of the emissions within the key source 2A Mineral products. Consequently, to follow good practice Sweden would need to adopt at least the Tier 2 methodology.

CHANGES FOR AUTHORITIES

The choice of methodology does not affect any authorities.

IMPLICATIONS ON QUALITY

Estimating CO_2 emissions according to the new Tier 2 or 3 methodology would increase the quality of the Swedish inventory given that the specific inputs needed are available and of good quality.

IMPLICATIONS ON QUANTITY

Estimating CO_2 emissions according to the new Tier 2 or 3 methodologies would probably have a marginal effect on the quantity of the emissions.

COST FOR CHANGE

The cost for implementing would be low provided that the specific inputs needed are available

TIME PLAN FOR IMPLEMENTATION

Some preparatory work is needed, to start earlier than the year before implementation.

Identified changes in present CRF 2A3, Limestone and Dolomite use

The source category CRF 2A3 are split into a number of sub-categories in the 2006 IPCC Guidelines. Emissions reported under CRF 2A3 in the current Swedish inventory should according to the new guidelines be reported under CRF 2A3 Glass production and CRF 2A4 Other Process Uses of Carbonates.

The 2006 IPCC Guidelines include detailed methodologies for estimating CO_2 emissions from Glass Production and Other Process Uses of Carbonates. Three different methodologies (Tier 1 – Tier 3) are presented for each category, requiring different levels of detail in the activity data and emission factors applied. The Tier 3 methodology for glass production is based on accounting for the carbonate input to the glass melting furnaces. The Tier 2 methodology for other process use of carbonates is based on the quantity of limestone and dolomite consumed.

WHAT NEEDS TO BE DONE

The Swedish inventory includes activity data on carbonates consumed by the major glass producers, corresponding to the requirement for a Tier 3 methodology. However, activity data on carbonate inputs and the corresponding emissions are today reported partly in CRF 2A3 and partly in CRF 2A7. Consequently it would be possible to adapt to the 2006 IPCC Guidelines by a simple adjustment of the files used for estimating CO_2 emissions from glass production.

Additional CO_2 emissions today reported under CRF 2A3 would also need to be reported under different categories within CRF 2A4 according to the new Guidelines. This would not require any additional activity data to correspond to the Tier 2 methodology, but an adjustment of the files used for estimating CO_2 emissions.

To follow the Tier 3 methodology additional data on carbonate inputs would need to be reported by the industries.

An additional correction that needs to be made is to relocate the CO_2 emissions associated with the use of limestone and dolomite within the production of iron pellets from the present CRF 2A3 to CRF 2C1. According to the 2006 Guidelines emissions from the use of limestone and dolomite should be included in the industrial source category where they are emitted.

IMPLEMENTATION REQUIRED?

To be able to respond to the new CRF reporting tables it is necessary to adjust the estimation procedures and implement the methodologies prescribed by the 2006 IPCC Guidelines.

CHANGES FOR AUTHORITIES

The changes do not affect any authorities.

IMPLICATIONS ON QUALITY

Estimating CO_2 emissions according to the new Tier 2 and 3 methodologies would have no effect on the quality of the Swedish inventory.

IMPLICATIONS ON QUANTITY

Estimating CO_2 emissions according to the new Tier 2 and 3 methodologies would have no effect on the quantity of the emissions.

COST FOR CHANGE

The cost for implementation would be low for each adjustment but medium if all adjustment needed to correspond to the new reporting format are to be made.

TIME PLAN FOR IMPLEMENTATION

Adjustments can be made during the year preceding the year of implementation.

Identified changes in present CRF 2A7, Other mineral products

The source category CRF 2A7 does not exist as such in the 2006 IPCC Guidelines. Emissions of CO_2 reported under CRF 2A7 in the current Swedish inventory should, according to the new guidelines, be reported under CRF 2A3 Glass production (glass mineral wool), CRF 2A4 Other Process Uses of Carbonates (LECA) and CRF 2A5 Other (rock wool).

The 2006 IPCC Guidelines include detailed methodologies for estimating CO_2 emissions from Glass production and from Other Process Uses of Carbonates. Three different methodologies are presented (Tier 1 – Tier 3) requiring different levels of detail in the activity data and emission factors applied.

There is also a table 2-7 for information and possible use for checking of allocation and completeness, listing emissive and non-emissive uses of carbonates.

WHAT NEEDS TO BE DONE

CO_2 emissions today reported under 2A7 include emissions from production of mineral wool and emissions from LECA production. The methodology used for estimating emissions from LECA production are in general in accordance with the new Tier 3 methodology since it is based on CO_2 emissions from ETS data, which are facility specific estimates based on carbonate inputs. The methodologies used for estimating emissions from mineral wool production are not in correspondence with any of the new Tier 1-3 methodologies presented in 2006 IPCC Guidelines. To follow the new Guidelines data on carbonates consumed would need to be acquired from the relevant industries and emissions calculated and reported under each new source category.

IMPLEMENTATION REQUIRED?

To be able to adhere to the new CRF reporting tables it is necessary to adjust the estimation procedures and implement the methodologies prescribed by the 2006 IPCC Guidelines.

CHANGES FOR AUTHORITIES

The changes do not affect any authorities.

IMPLICATIONS ON QUALITY

Estimating CO_2 emissions according to any of the new methodologies would increase the quality of the Swedish inventory.

IMPLICATIONS ON QUANTITY

We do not foresee any implications on the quantity of the emissions.

COST FOR CHANGE

The cost for implementation would be low, given that data on carbonates consumed are available.

TIME PLAN FOR IMPLEMENTATION

Given that data are available, the change can be introduced during the year preceding the year of implementation.

Chapter 3, Chemical Industry Emissions

Improvements since 1996 GL:

New sources of emissions have been introduced: nitrous oxide (N_2O) emissions from Production of Caprolactam, Glyoxal, and Glyoxylic acid, and CO_2 emissions from Titanium Dioxide Production. Soda Ash production was reallocated from Mineral Industry to

Chemical Industry. In the Soda Ash Production section the methodology for synthetic (Solvay) soda ash production process, which was lacking in the *1996 IPCC Guidelines* and the *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (*GPG2000*), has been introduced.

CO_2 emission factors have been added for Petrochemical Production processes, including emission factors for methanol, ethylene, ethylene dichloride/vinyl chloride, ethylene oxide, acrylonitrile, and carbon black production. Methane emission factors have been updated for these petrochemical production processes. Styrene production is no longer included in the guidance document. A systematic description of Tier 1, 2 and 3 methodologies for all source categories is provided in the text.

The descriptions of emission-related processes have been enlarged giving more information about their chemistry and technology aspects.

More systematic guidance is also given to avoid double counting fuel products used as a feedstock or reductant (cross-cutting issue with Energy Sector). This issue is discussed in regard to ammonia production, carbide production, and titanium dioxide, and petrochemical production (Sections 3.2, 3.6, 3.7, and 3.9).

A discussion of utilisation of CO_2 in Urea Production is included in the section on Ammonia Production. Emissions from urea use that were previously accounted for in the Industrial Processes Sector have been reallocated according to the sectors where urea is used (Energy Sector and Agriculture, Forestry and Other Land Use (AFOLU) Sector) to take proper account of exports urea produced in ammonia plants. Emissions from other chemical products manufactured using CO_2 recovered in the ammonia production process are accounted together with emissions from ammonia production, as before.

The methodology for calculation of HFC-23 emissions from HCFC-22 production has incorporated the principal methods used within the industry, including continuous direct, proxy and in-process measurements in Tier 3 and efficiency-based material balance methods in Tier 2. In addition, explicit guidance has been added on fugitive and by-product emissions from the production of other fluorinated compounds including hydrofluorocarbons (HFCs), sulphur hexafluoride (SF6) and uranium hexafluoride (UF6).

Identified changes in the present CRF 2B2, Nitric acid production

The guidelines include description of three Tiers, of which the Swedish inventory is approximately a Tier 2. Tier 1 is a default method based on production, Tier 2 takes production and abatement technologies into account in combination with technology- and abatement-specific emission factors, and Tier 3 is based on plant specific continuous measurements.

SMED uses plant specific data from the single nitric acid production facility still in operation. There are continuous measurements of N_2O at one of the local production plants at this site, while calculations are made for the other. In the NIR we state that the Swedish method is a Tier 2 method.

NSCR and SCR systems designed to abate N_2O can give rise to additional emissions of CO, CO_2 and hydrocarbons (CH_4 and NMVOCs). These emissions will depend on the hydrocarbon reducing agent that is used (methane (CH_4), propane (C_3H_8), propene

(C_3H_6), LPG). Emissions can be estimated based on the quantity of reducing agent used and the completeness of combustion. Plant-level information will be required to enable emissions estimation. Over time default values could be developed as more information becomes available, however, at present there are no default values. Methods for estimating these emissions are not included in these *Guidelines*, however, inventory compilers are encouraged to investigate these emission sources and to develop appropriate methodologies.

WHAT NEEDS TO BE DONE

No changes are required.

Identified changes in present CRF 2B4, Carbide production

Emissions reported under CRF 2B4 in the current Swedish inventory should according to the new guidelines be reported under CRF 2B5.

The 2006 IPCC Guidelines include detailed methodologies for estimating CO_2 emissions from Carbide production. Three different methodologies are presented (Tier 1 – Tier 3) requiring different levels of detail in the activity data and emission factors applied.

WHAT NEEDS TO BE DONE

The current estimations of CO_2 from Carbide production in the Swedish inventory are based on production data and correspond to the Tier 1 methodology presented in the 2006 IPCC Guidelines. To calculate emissions according to any of the higher Tier methodologies Swedish inventory compilers would, in addition to production data, need to acquire plant specific data on the amount of C contained in the product (Tier 2) or plant specific data on the petroleum coke input, carbon content factors and carbon oxidations factors (Tier 3). Since Carbide production is not a key source for CO_2 emissions, estimating emissions following any higher Tier methodologies is not required. To adjust to the new source category code requires only very minor adjustments.

IMPLEMENTATION REQUIRED?

It is a requirement to report emissions under CRF2B5.

CHANGES FOR AUTHORITIES

The changes do not affect any authorities.

IMPLICATIONS ON QUALITY

The changes do not affect the quality of the emissions calculations unless Sweden chooses to use a higher Tier methodology which would increase the quality.

IMPLICATIONS ON QUANTITY

The changes of reporting code only does not affect the quantity of the emissions.

COST FOR CHANGE

The cost for implementation will be low.

TIME PLAN FOR IMPLEMENTATION

Adjustment to the new reporting system can be made at time of implementation.

Titanium dioxide production

It is unclear if titanium dioxide production occurs in Sweden. Titanium dioxide is one of the most common white pigments.

WHAT NEEDS TO BE DONE

It has to be investigated if titanium dioxide production occurs in Sweden, if so emissions should be estimated.

IMPLEMENTATION REQUIRED?

It is a requirement to report emissions under CRF2B6.

CHANGES FOR AUTHORITIES

The changes do not affect any authorities.

IMPLICATIONS ON QUALITY

If the source exists, the quality will be better.

IMPLICATIONS ON QUANTITY

If the source exists, the quantity of emissions will increase.

COST FOR CHANGE

The cost for implementation would be low.

TIME PLAN FOR IMPLEMENTATION

This probably does not require much time.

Soda Ash production

Soda ash production does not occur in Sweden, at present it is reported as NO.

Identified changes in the present CRF 2B5, Other Chemical Industry

This guidance is much more elaborated and developed compared to earlier guidance. Several sub-categories have been introduced with extensive guidance, e.g. methanol, ethylene, acrylonitrile, VCM production). If the type of production described in the guidelines exists in Sweden (which at least some of it does), emissions are at present reported and aggregated in the present CRF code 2B5, Chemical industry, other.

In the inventory for petrochemical processes feedstocks and the allocation of fuels to Energy/Industrial processes need to be clear. At present SMED does not estimate CO_2 from chemical industry processes (NA), but in the 2006 GL there are tables with default emission factors for CO_2 for several types of processes. There is detailed guidance covering three Tiers. Tier 1 is based on default emissions factors for production, Tier 2 is based on feedstock and Tier 3 is based on plant specific data.

WHAT NEEDS TO BE DONE

Presently in principal all data reported from chemical industry in CRF 2B5 originate from environmental reports from individual facilities. No calculations are made based on activity data and emission factors.

A thorough survey of the production of petrochemicals would be needed to assess completeness in reporting. There are a number of possible sources from where activity data might be gathered, as for example production statistics, energy statistics and environmental reports. Emissions could then be estimated using any of the Tier 1-3 methodologies presented, depending on what kind of activity data that are available.

An assessment need to be made of whether facilities presently included in the inventory in 2B5 should be allocated specifically in one of the new sub-categories, and if so, the estimation methodologies need to be revised. Estimates of CO_2, and maybe additional CH_4 sources need to be checked in order to determine whether sources are missing and whether default emission factors could be used.

IMPLEMENTATION REQUIRED?

Yes

CHANGES FOR AUTHORITIES

No changes for authorities are foreseen.

IMPLICATIONS ON QUALITY

The quality will be better, as regards transparency and most probably also accuracy and completeness.

IMPLICATIONS ON QUANTITY

Estimated emissions might increase due to changes of methodology/introduction of CO_2 from "new" processes into the inventory. It is however not totally clear if these CO_2-emissions are already partly or totally accounted for in the energy sector.

COST FOR CHANGE

The cost would probably be low to medium.

TIME PLAN FOR IMPLEMENTATION

This work should be started in due time before implementation, and in combination with the work on non-energy-use of fuels. To clarify the allocation of feedstock is probably the larger problem; reallocation of emissions in the reporting system is a minor problem.

Chapter 4, Metal Industry Emissions

Improvements since 1996 GL:

The Metal Industry Section of *2006 IPCC Guidelines* incorporates a number of changes. Where carbon and carbon-containing materials, including carbonate containing minerals, are used in the metal production process for purposes other than the direct production of energy within the process, the CO_2 emissions are now counted within the metals guidance. For example, the CO_2 emissions from carbon-based electrodes for aluminium production are now included within the guidance for aluminium, and the CO_2 emissions from the use of limestone and dolomite used in iron and steel making are included within the guidance for iron and steel production.

The Metal Industry Section now includes guidance for estimating emissions of CO_2 and CH_4 from metallurgical (coal) coke production; however the CO_2 and CH_4 emissions from metallurgical coke production are to be reported under Energy Sector, not Industrial Processes and Product Use (IPPU) Sector. Emission factors for production of direct reduced iron (DRI), pellets, and sinter from iron ore and other iron-containing raw materials are now included under iron and steel production. Separate CO_2 emission factors are provided for blast furnace iron making and for steel making using the basic oxygen furnace (BOF), electric arc furnace (EAF) and open hearth furnace (OHF) processes.

CO_2 emissions from primary magnesium production based on dolomite and magnesite raw materials are also included in this section. In addition, new guidance has been developed and is available for calculation of CO_2 emissions resulting from production of zinc and lead. Separate CO_2 emission factors are provided for primary and secondary lead and zinc production processes. More comprehensive guidance is also included for ferroalloys production processes. Revised guidance is offered in the *2006 IPCC Guidelines* for magnesium for new gases reflecting efforts to replace sulphur hexafluoride as a cover gas. Finally, calculation factors have been updated to reflect the most recent experience for measured emission factors, typical compositions of process materials impacting calculations, and, in some instances new equations are included.

Identified changes in present CRF 2C1, Iron and Steel production

The 2006 IPCC Guidelines include three different methodologies (Tier 1 – Tier 3) for estimating CO_2 and CH_4 emissions from Iron and Steel production, requiring different levels of detail in the activity data and emission factors applied.

The Tier 1 method, for both CO_2 and CH_4, is based on national production data and default emission factors.

The Tier 2 method, only for CO_2, is based on national data on the use of process input materials (mass-balance approach) together with default or plant-specific data on carbon content of input materials.

The Tier 3 method, for both CO_2 and CH_4, is based on plant-specific emissions measurements or plant-specific data on process input materials (mass-balance approach) together with plant-specific data on emission factors and carbon content.

WHAT NEEDS TO BE DONE

The revised guidelines state that all carbon used in blast furnaces, direct reduced iron (DRI) basic oxygen furnaces (BOF) and electric arc furnaces (EAF) should be considered as process-related (i.e. reporting code 2C1). The revised guidelines also state that all carbon used in the coke oven should be reported as energy (i.e. reporting cod 1A1c). These rules for allocation are those which are suggested in the recently concluded development project "*Fortsättning av riktad kvalitetskontrollstudie av utsläpp från industrin i Sveriges internationella rapportering*".

The current CO_2 emissions from Iron and Steel production in the Swedish inventory are, for most plants, estimated using the recommended Tier 3 methodology. For most plants reported emissions, by the facilities, to the EU emission trading system (ETS) are used. Reporting according to the ETS requires a mass balance approach. For secondary iron and steel production no major changes are required to be in line with the 2006 Guidelines.

For two primary plants (SSAB) Sweden uses a country specific methodology where emissions are estimated based on the consumption of blast-furnace gas, used as fuel in the blast furnace, when calculating process emissions. The revised guidelines states that all consumption of coke oven-, blast furnace- and basic oxygen furnaces gas used in the blast furnace and basic oxygen furnace should be allocated as process emissions and that all carbon used in the coke oven should be allocated as energy. In order to be in line with the revised guidelines reported emissions of CO_2, CH_4 and N_2O need to be reallocated and calculated for SSAB.

IMPLEMENTATION REQUIRED?

It is a requirement to report emissions of CO_2 and CH_4 under CRF 2C1. No methodologies are provided for N_2O emissions. These emissions are likely to be small, but countries can make estimates provided they develop country-specific methods based on researched data.

CHANGES FOR AUTHORITIES

The changes do not affect any authorities.

IMPLICATIONS ON QUALITY

The changes for SSAB will lead to better transparency and increased quality in the reported emissions.

IMPLICATIONS ON QUANTITY

The changes will increase the reported emissions of CO_2 and CH_4 for SSAB.

COST FOR CHANGE

The cost for implementation would be low to medium.

TIME PLAN FOR IMPLEMENTATION

Most of the preparatory work has already been performed in the recently concluded SMED project "*Fortsättning av riktad kvalitetskontrollstudie av utsläpp från industrin i Sveriges internationella rapportering*". An implementation into the inventory does therefore not require any extensive preparations.

Identified changes in present CRF 2C2, Ferroalloys production

In the 2006 IPCC guidelines three methodologies for estimating CO_2-emissions and CH_4-emissions are described (Tier 1 - Tier 3). These methodologies ask for activity data of different levels of detail (see table below). In 1996 Revised IPCC Guidelines only two different Tier methodologies for calculating CO_2-emissions (Tier 1a corresponding to Tier 2 and Tier 1b corresponding to Tier 1 in 2006 IPCC Guidelines) and no methods for CH_4-estimations, were included.

Tier 1 - Tier 3 from 2006 IPPC guidelines for estimating CO_2- and CH_4-emissions from Ferroalloy production

Tier	CO_2	CH_4
1	Calculate emissions using default emission factors and national production data.	Multiply data by default emission factors.
2	Calculate emissions using reducing agent specific emission factors.	Calculate emissions using operation-specific emission factors.
3	Calculate emissions using plant specific data.	Aggregate facility specific measured emissions data as basis for the Tier 3 method.

In the Swedish reporting of greenhouse gases to UNFCCC the reported CO_2-emissions are collected from the company's environmental reports. Their methodology most likely corresponds to the Tier 3 methodology described in the 2006 IPCC guidelines. No estimates of CH_4-and N_2O-emissions from ferroalloy production are done and these gases are reported as NE and NA, respectively.

WHAT NEEDS TO BE DONE

The default emission factors presented in the 2006 IPCC Guidelines makes it possible to also estimate the emissions of CH_4 from the Swedish ferroalloy production. Concerning N_2O-emissions from ferroalloy production the 2006 IPCC Guidelines state that "The errors associated with estimates or measurements of N_2O emissions

from the ferroalloys industry are very large and thus, a methodology is not provided."

IMPLEMENTATION REQUIRED?

It is a requirement to report emissions of CO_2 and CH_4 under CRF 2C2.

CHANGES FOR AUTHORITIES

The changes do not affect any authorities.

IMPLICATIONS ON QUALITY

Estimating CH_4 emissions according to the new Tier 2 or 3 methodology would increase the quality of the Swedish inventory given that the specific inputs needed are available and of good quality.

IMPLICATIONS ON QUANTITY

CH_4 estimates from ferroalloy production will increase the reported CH_4-emissions in sector 2 by between approximately 1 and 10% depending on Tier used and type of ferroalloy production.

COST FOR CHANGE

The cost for implementation would be low.

TIME PLAN FOR IMPLEMENTATION

Can be included into the inventory work during the year preceding the year of implementation.

Identified changes in present CRF 2C3, Aluminium production

In the 2006 IPCC guidelines three methodologies for estimating CO_2-emissions and PFC-emissions are described (Tier 1 - Tier 3). These methodologies ask for activity data of different levels of detail. In 1996 Revised IPCC Guidelines only two different Tier methodologies for calculating CO_2-emissions were included. The Tier 1 methodology in 2006 IPCC Guidelines corresponds to the Tier 1b methodology in 1996 IPCC Guidelines with the distinction that CO_2 emissions from consumption of pitch volatiles and packing coke from baking anodes are included in the default emission factors for the Prebake process. The 1996 Tier 1a match with the Tier 2 in 2006 IPCC Guidelines. In 2006 IPCC Guidelines also a Tier 3 method is included. For this methodology facility specific information on sulphur and ash content in baked anodes and packing coke as well as hydrogen content in green anodes and collected amount of waste tar, is needed.

For calculations of PFC emissions from primary aluminium production the 1996 IPCC Guidelines describes three Tier methodologies, Tier 1a, Tier 1b and Tier 1c. These methodologies correspond in 2006 IPCC Guidelines to Tier 3, Tier 2 and Tier 1, respectively, but with slightly different emission factors/slope coefficients.

In the Swedish reporting of greenhouse gases to UNFCCC the reported CO_2-emissions are collected from the company's environmental reports. Their methodology for the estimating CO_2-emission corresponds to either the Tier 2 or the Tier 3 methodology described in the 2006 IPCC guidelines.

The reported emissions of PFC from primary aluminium production are calculated using the 1996 Tier 1b methodology, which corresponds to the 2006 GL Tier 2.

WHAT NEEDS TO BE DONE

To be sure to estimate CO_2-emission according to the Tier 3 methodology presented in the 2006 IPCC guidelines we need to find out weather or not the CO_2 estimates provided by the company are based on typical industry values for impurities or actual concentration of impurities.

Tier 2 slope coefficients for calculation of PFC emissions from primary aluminium production are slightly different compared to Tier 1b in 1996 IPCC Guidelines. To fulfil the Tier 2 methodology the currently used slope factors have to be replaced with the ones presented in 2006 IPCC Guidelines.

IMPLEMENTATION REQUIRED?

It is a requirement to report emissions of CO_2 and PFCs under CRF 2C2. For PFC the slope factors would have to be changed or justified.

CHANGES FOR AUTHORITIES

The changes do not affect any authorities.

IMPLICATIONS ON QUALITY

The changes do not affect the quality of the CO_2 estimates.

IMPLICATIONS ON QUANTITY

Calculation of CF_4 and C_2F_6 from primary aluminium production with 2006 GL Tier 2 slope factors, results in increased CF_4 emissions around 35% and decreased C_2F_6 emissions around 15%. Expressed in CO_2 equivalents, the total reported PFC emissions will increase about 25% when using the 2006 Tier 2 slope factors in comparison to the 1996 Tier 1a methodology.

COST FOR CHANGE

The cost for implementation would be low.

TIME PLAN FOR IMPLEMENTATION

Can be introduced during the last year before implementation.

Identified changes in present CRF 2C5, Other

The current source category CRF 2C5 is split into three categories in the 2006 IPCC Guidelines. Emissions reported under CRF 2C5 in the current Swedish inventory should according to the new guidelines be reported under CRF 2C5 Lead production, CRF 2C6 Zinc production and CRF 2C7 Other.

The 2006 IPCC Guidelines include three different methodologies (Tier 1 – Tier 3) for estimating CO_2 emissions from lead as well as zinc production, requiring different levels of detail in the activity data and emission factors applied.

WHAT NEEDS TO BE DONE

The current CO_2 emissions from lead production are estimated based on data from one facility with primary production and one facility with secondary production. The methods used for both the primary and secondary production correspond to the Tier 2 methodology presented in the in the 2006 IPCC Guidelines. To correspond to the Tier 3 methodology presented in the 2006 IPCC Guidelines actual measured CO_2 emissions would need to be provided by the individual plants.

However, data on reducing agents provided by the plant with primary lead production also include reducing agents used for zinc produced at the same facility. The amount of input materials reported is not specified according to whether it is used for lead or zinc production. To achieve a separation between CO_2 emissions from lead and zinc production the plant would need to be able to provide data on input materials accordingly. It is not known whether or not this is possible (or desirable). If not, Sweden will have to report emissions from CRF 2C6 Zinc production as IE in CRF 2C5 Lead production.

IMPLEMENTATION REQUIRED?

It is a requirement to report emissions according to the new CRF categories but emissions can be reported as IE.

CHANGES FOR AUTHORITIES

The changes do not affect any authorities.

IMPLICATIONS ON QUALITY

The changes do not affect the quality of the emissions.

IMPLICATIONS ON QUANTITY

The changes do not affect the quantity of the emissions.

COST FOR CHANGE

The cost for reporting emissions from zinc production separately would be low.

TIME PLAN FOR IMPLEMENTATION

Some preparatoy work would be needed to implement the changes.

Chapter 5, Non-energy Products from Fuels and Solvent Use

Improvements since 1996 GL:

> Almost this entire source category, which is described in Chapter 5, is new within the IPPU Sector. The *1996 IPCC Guidelines* did cover emissions from asphalt and road paving, but in much less detail. The products covered here comprise: lubricants, paraffin waxes, bitumen/asphalt, and solvents.
>
> Emissions from lubricants were previously covered under fuel combustion without any discrimination between emissions arising during lubricants use and any emissions from waste lubricants used for heat raising. The same is true for paraffin waxes. Asphalt emissions refer to production and use of asphalt for road paving, asphalt roofing and other applications. Asphalt emissions also include emissions from asphalt blowing. The subcategory '2D3 Solvent Use' refers to the subcategories 3A and 3B in the *1996 IPCC Guidelines*. Although asphalt and solvents are not significant sources of direct greenhouse gas emissions, they are included in this chapter to provide a description of them since they are sources of ozone precursors (non-methane volatile organic compounds (NMVOC), and in the case of asphalt also carbon monoxide (CO)). In particular, solvent use is a very substantial source of NMVOC.

All sources described in this chapter (5) are to be included in the verification of completeness of fossil CO_2 from non-energy.

Chapter 5.2, Lubricant use

According to this chapter the fraction of lubricant (lubricants, greases, waxes) from primary use, e.g. lubrication or for coating, is to be reported as carbon released to the atmosphere. The secondary fate, as waste combusted for energy recovery purposes, should be reported in the energy sector, while if disposed in landfill or incinerated as waste, to be reported in the waste sector.

The 2006 IPCC guidelines present two methods (Tier 1 and 2) for estimating CO_2 emissions from lubricant use. The Tier 2 equation requires data on the total consumption of different kinds of lubricants (in TJ, conversion from physical units may be necessary), the carbon content and type specific fraction of lubricant oxidised during use (ODU). The Tier 1 equation requires data on total consumption of lubricants together with default values on carbon content and ODU.

In Sweden there are data on the total lubricant consumption and the carbon content, but no data on ODU. According to the 2006 GL the Tier 1 method can be applied if this is not a key category, which is highly unlikely.

WHAT NEEDS TO BE DONE

Assess if present activity data on consumption and carbon content are suitable/enough to cover all lubricants. Perform calculations according to the default method.

IMPLEMENTATION REQUIRED?

Yes.

IMPLICATIONS ON QUALITY

Better transparency.

IMPLICATIONS ON QUANTITY

Unknown.

CHANGES FOR AUTHORITIES

Present providers of information are the Swedish Energy Agency. Additional work by them may be needed.

COST FOR CHANGE

Low.

TIME PLAN FOR IMPLEMENTATION

The introduction of the Tier 1 methodology in the Swedish inventory could be made during the year preceding the year of implementation in the Swedish submission.

Chapter 5.3 Paraffin wax use

The category includes such products as petroleum jelly, paraffin waxes and other waxes. Paraffin waxes are separated from crude oil during the production of light (distillate) lubrication oils.

Paraffin waxes are used in a number of different applications; candles, corrugated boxes, paper coating, board sizing, food production, wax polishes, surfactants, and others.

Emissions occur primarily when the waxes are combusted during use, like when burning candles, or for most of the applications, when discarded and incinerated for energy recovery purposes (energy sector) or combusted as waste (waste sector).

WHAT NEEDS TO BE DONE

Investigate where and how to find activity data. Perform calculations according to the default method, since this is not expected to be a key category.

IMPLEMENTATION REQUIRED?

Yes.

IMPLICATIONS ON QUALITY

Better transparency.

IMPLICATIONS ON QUANTITY

Unknown.

CHANGES FOR AUTHORITIES

We do not know where to find appropriate activity data, this has to be investigated. Authorities may be involved.

COST FOR CHANGE

Low.

TIME PLAN FOR IMPLEMENTATION

Probably no need for extensive preparations.

Chapter 5.4 Asphalt production and use

The present guidance for CRF 2A5, Asphalt roofing and CRF 2A6, Road paving with asphalt have been combined into one guidance. It comprises the non-combustion emissions from the production of asphalt in asphalt plants other than refineries and its applications (road, roof) and subsequent releases from the surfaces. Reporting is to be done under the new CRF code 2D4, Non-Energy Products from Fuels and Solvent Use, Other. No direct GHG emissions are expected, only NMVOC, CO, SO_2 and particulate matter.

No changes are identified other than reallocation according to the new CRF-code system.

Chapter 5.5 Solvent use

Guidance refers to large parts to the EMEP/CORINAR Guidebook. No changes are required for the Swedish inventory.

Chapter 6, Electronics Industry Emissions

Improvements since 1996 GL:

> The *1996 IPCC Guidelines* and the *GPG2000*, described methods for estimating emissions from semiconductor manufacturing alone for seven fluorinated carbon compounds: CF_4, C_2F_6, CHF_3, C_3F_8, c-C_4F_8, NF_3 and SF_6. The *2006 IPCC Guidelines* expands that scope to include additional manufacturing sectors and more gases, updates the Tier 1 methodology and emission factors, and provides explicit estimates of uncer-

tainties for emissions factors and activity data. The *2006 IPCC Guidelines* incorporates emissions from liquid crystal display (LCD) manufacturing, photovoltaic (PV) cell manufacturing and the use of heat transfer fluids in semiconductor manufacturing. In addition, the number of greenhouse gases in the *2006 IPCC Guidelines* has been expanded to include difluoromethane (CH_2F_2), octofluorocyclopentene (C_5F_8), hexafluorbutadiene (C_4F_6) and octafluorotetrahydrofuran (C_4F_8O); F_2 and COF_2 have also been added because, even though they are not greenhouse gases, CF_4 may be formed during their use. A new Tier 1 methodology is adopted that includes new default emissions factors and activity data for all sectors.

The electronics industry is small or non-existent in Sweden. Previously there was one commercial semi-conductor manufacturer, which now has closed down. Expected emissions are various fluorinated gases. The inventory of fluorinated gases is partly based on data from the Product Register. Up until now no other commercial production has been identified. Small-scale activities may exist in research and development in industry or at universities. In the 2006 GL there is a table of production capacities for PV where Sweden is included. The production does however not have to include the use of fluorinated gases. This possible production of PV has to be investigated further.

WHAT NEEDS TO BE DONE

Investigate the occurrence and use of fluorinated gases at PV manufacturing in Sweden.

IMPLEMENTATION REQUIRED?

Yes

IMPLICATIONS ON QUALITY

Improved completeness

IMPLICATIONS ON QUANTITY

Might increase, depending on if this is found to be a source.

CHANGES FOR AUTHORITIES

If possible, higher involvement from KemI, but confidentiality may be a problem.

COST FOR CHANGE

Probably low

TIME PLAN FOR IMPLEMENTATION

Some preparation and investigations are necessary.

Chapter 7, Emissions of Fluorinated Substitutes for Ozone Depleting Substances

Improvements since 1996 GL:

The emissions in a number of the source categories (applications) covered by this chapter have been the subject of considerable study since the *1996 IPCC Guidelines* were written. This has been particularly the case for sectors with delayed emissions (e.g. refrigeration, foam and fire protection) where the earlier emission factor estimates proposed by Gamlen and others have been further developed to reflect the varying emission rates from a variety of sub-applications. Much of this was included in the *GPG2000*.

One of the consequences of this improved understanding has been recognition that the potential emissions approach used as Tier 1 in the *1996 IPCC Guidelines* is no longer appropriate. The potential emissions approach is still described in Annex 1 of this volume as a verification tool for completeness of sources and as a QC check of the sum of activity data per compound, which should be equal to the sum of apparent domestic consumption as calculated in the potential emissions approach. The Tier 1 approaches now proposed in these *Guidelines* are therefore actual emission estimation methods, although often based on default emission factors and with the potential to use global/regional activity databases where better information is not available. Chapter 7 of this volume contains examples of these new Tier 1 approaches and guidance on how to implement them. Simplified mass balance approaches have also been maintained in appropriate sectors, most typically where pressurised equipment is used and serviced (refrigeration & fire protection). Attention has also been addressed to the treatment of solvents contained in aerosols. Now emissions from all aerosol based products, irrespective of their purpose, will be reported within the aerosol application.

Activity information continues to be the biggest challenge in the ODS substitutes area, particularly at country level, for two reasons. The first is that trade in products containing HFCs and/or perfluorocarbons (PFCs) can not easily be monitored and the second is that confidentiality of activity data for specific chemicals may need to be protected. Global/regional activity data from reputable sources may therefore provide significant help to some reporting countries and it is proposed that the IPCC Emission Factor Database (EFDB) act as the focal point for such data. However, while inclusion in the EFDB will provide a level of assurance that due process has been followed inventory compilers will remain responsible for assessing the appropriateness of such data for their purposes.

This chapter contains methodological descriptions for
-Solvents
-Aerosols
-Foam blowing
-Refrigeration and air conditioning
-Fire protection
-Other applications

The present Tier 1, Potential emissions, is only included as verification and for QA/QC purposes and are not to be reported. In the 2006 GL both Tier1 and Tier 2

are estimates of actual emissions where Tier 1 are estimates aggregated on the application level (e.g. refrigeration total). Tier 2 includes a disaggregating on sub-application level (e.g. household refrigeration, transport refrigeration etc). According to this definition, the Swedish inventory is made according to a Tier 2 methodology.

Two different approaches are described, the emission factor approach (A) and a mass-balance approach (B), suitable only for some applications. In reality the inventory often relies on a combination of both.

Quite substantial references are made to regional or global databases for production, consumption and trade of fluorinated gases. These do not exist yet apart from the IPCC EFDB (emission factor database (http://www.ipcc-nggip.iges.or.jp/EFDB/main.php). These databases are foreseen to be used as a help in the inventory directly, or as quality control, cross-checks and assessment of the levels of calculated national data.

Identified changes for present CRF 2F5, Solvents

Solvents are not included in the Swedish inventory. No evidence has been found that they are used.

Identified changes for present CRF 2F4, Aerosols/Metered dose inhalers

No changes are identified in methodology.

Identified changes for present CRF 2F2, Foam blowing

No real changes are identified, but a development towards better completeness, as well as better estimates regarding end-of-life emissions should be performed.

WHAT NEEDS TO BE DONE

There is quite substantial and extended guidance on a multitude of foams, open-cell foams and closed cell foams, which are not included in the Swedish inventory, and which it is usually quite difficult to find activity data for if they are not manufactured in the country. This is acknowledged in the new guidelines, and they refer to these coming regional databases (and the present www.afeas.org) for information or assumptions on foams imported in products.

For closed cell foams, of which XPS is one (included in the Swedish inventory), new information on expected emissions is included in the Guidelines. In short, less than 50% of the HFC-134a is expected to be released from the foam during the whole life cycle. Information on a maximum potential end-of-life loss is given to be 37.5%. Large emphasis is put on the estimates of end-of-life treatment of foams in the chapter.

IMPLEMENTATION REQUIRED?

Investigation and documentation of end-of-life emissions for XPS. Investigate if open cell foams are an emission source for fluorinated gases.

IMPLICATIONS ON QUALITY

Better accuracy (XPS) and possibly completeness (open cell foams).

IMPLICATIONS ON QUANTITY

Difficult to judge.

CHANGES FOR AUTHORITIES

No

COST FOR CHANGE

Only for the development regarding XPS the cost would be low. For investigating possible emissions from open cell foams, the cost would be low to medium depending on if emission sources in Sweden are identified (until now no emissions from open cell foams are included in the inventory).

TIME PLAN FOR IMPLEMENTATION

For XPS, the work can be performed at a later stage.
For open cell foams, some preparatory work is probably needed.

Identified changes for present CRF 2F1, Refrigeration and air conditioning (stationary and mobile)

In principle the Swedish inventory follows the descriptions in the 2006 GL. There is however an increased level of detail given as good practice both in the different steps of the lifecycle of equipment, the collection of activity data, in the calculations and in the documentation.

The new reporting format requires a split reporting of emissions into stationary and mobile sources.

WHAT NEEDS TO BE DONE

Further refine into more detailed calculations, collect additional activity data, and focus the documentation. Additional information is especially needed concerning the handling of containers, what happens at maintenance and servicing of equipment and at end-of-life of equipment.
Emissions from stationary and from mobile sources are already split in the present Swedish calculations and no additional work is needed.

IMPLEMENTATION REQUIRED?

Yes, improvements and refinements are needed to correctly adhere to good practice.

IMPLICATIONS ON QUALITY

Better transparency, possibly also completeness.

IMPLICATIONS ON QUANTITY

Difficult to judge. Calculations using some of the additional activity data e.g. concerning emissions at detailed stages like servicing may increase emissions, but these emissions may also already be included in the present emission factors.

CHANGES FOR AUTHORITIES

Probably no change for the present provider of some of the activity data (KemI), unless confidentiality problem can be solved. (see Table 7.10 in the GL for documentation and suggestions on information sources)

COST FOR CHANGE

Medium

TIME PLAN FOR IMPLEMENTATION

If the use of additional data are to be implemented, some preparatory work concerning sources of information is certainly needed.

Identified changes for present CRF 2F3, Fire extinguishers

No principal changes are identified. However, new fluorinated gases may be introduced and the practices at service and at end-of-life could be better investigated and documented. In the 2006 GL higher default emission factors are given than those used in the Swedish inventory.

WHAT NEEDS TO BE DONE

Keep track of possible new gases. Investigate practices at service and end-of-life.

IMPLEMENTATION REQUIRED?

No.

Identified changes for present CRF 2F6, Other applications using ODS substitutes

This is presently reported as NO in the Swedish inventory. No changes foreseen.

Chapter 8, Other Product Manufacture and Use

Improvements since 1996 GL:

The *1996 IPCC Guidelines* contained just two methods for estimating emissions of SF_6 from electrical equipment: (1) a potential approach that equated emissions to chemical consumption, and (2) a simple emission factor- based approach that applied country-specific or global default emission factors to the quantities of SF_6 in operating and retiring equipment respectively. The *GPG2000* introduced three Tier 3 mass-balance methods and a more detailed Tier 2 emission-factor based approach that provided emission factors for each life cycle stage. In addition, the *GPG2000* provided regional default emission factors for the latter.

The *2006 IPCC Guidelines* simplify the *GPG2000* by (1) replacing two of the Tier 3 mass-balance methods with a single, flexible Tier 3 method that contains both mass-balance and emission-factor-based components. (2) moving the country-level mass-balance method to the QA/QC section, (3) moving the method for estimating potential emissions from the Methodological Choice discussion and into a separate section where it can be used for QA/QC, and (4) replacing the potential emissions approach with the default emission-factor-based approach, which has been moved from Tier 2 to Tier 1. These changes leave one Tier 3 method, one Tier 2 method, and one Tier 1 method. These *Guidelines* also update the regional emission factors provided in the *GPG2000*, providing values for additional types of equipment and for additional regions. Finally, these *Guidelines* incorporate new guidance on selecting and using alternative activity data when the preferred data are not available for all facilities. These updates incorporate the experience acquired over the past several years of reporting.

Specific methods for estimating emissions from research and industrial accelerators and from radar reconnaissance planes (e.g., AWACS) have been added to the 'Use of SF_6 and PFCs in Other Products' section. An indicative list of potential additional sources of SF_6 and PFCs has been added to guide the inventory preparer.

Also, Guidance on N_2O emissions from product use such as medical application has been improved.

This chapter includes guidance on:
-emissions of SF_6 and PFCs from electrical equipment
-the use of SF_6 and PFCs in other products
-N_2O emissions from product uses.

Identified changes in present CRF 2F8, Electrical equipment

Extended chapter with more descriptions and details as well as increased detailed guidance on documentation.

At present we do not have very good knowledge on the total installed amounts. Some data are available from Svensk Energi, but these do not cover all uses, why an assumed amount is added. The knowledge about practices at filling new equipment in the field, servicing, recycling and destruction is not well known, which they should be in order to be able to make more accurate calculations. A closer

cooperation with industry, trade associations (Svensk Energi, others?) and experts in recycling/destruction would improve estimates.

Additionally, in the Swedish inventory there is a problem with surplus SF_6 reported from the Product Register at KemI as imported into the country each year. It is not known with any certainty where this SF_6 ends up (possibly within the area of electrical equipment). A further investigation of this is however in practice already necessary from the present Guidelines.

No principal changes in methodology are identified. Presently a combination of Tier 1 for installed amounts of SF_6 and a Tier 2 for manufacturing emissions is used. This is not a key source and Tier 1 is sufficient.

WHAT NEEDS TO BE DONE

Track down the surplus SF_6.

Increase the accuracy on installed banks of SF_6, nameplate capacity of new equipment, nameplate capacity of existing equipment and nameplate capacity of retiring equipment (to be documented according to good practice).

Increase the knowledge of practices at filling in the field, servicing, recycling and destruction.

IMPLEMENTATION REQUIRED?

Yes, already from the present Guidelines.

IMPLICATIONS ON QUALITY

Better accuracy, transparency

IMPLICATIONS ON QUANTITY

Unknown

CHANGES FOR AUTHORITIES

Better data from KemI possible?

COST FOR CHANGE

Low

TIME PLAN FOR IMPLEMENTATION

Since these changes are already necessary in order to adhere to good practice, efforts should be made in the near future.

Chapter 8.3 Use of SF_6 and PFCs in other applications

The chapter mentions the use of SF_6 or PFCs in the following areas

- SF_6 and PFC´s used in military applications, particularly SF_6 used in airborne radar systems, e.g. AWACS (Airborne Warning and Control Systems), and PFCs used as heat transfer fluids in high-powered electronic applications.
- SF_6 used in equipment in university and research particle accelerators
- SF_6 used in equipment in industrial and medical particle accelerators
- "Adiabatic" applications utilising the low permeability through rubber of SF_6 and some PFCs, e.g. car tires and sport shoe soles.
- SF_6 used in sound-proof windows
- PFCs used as heat transfer fluids in commercial and consumer applications
- PFCs used in cosmetics and in medical applications
- Other uses, e.g. gas-air tracers in research and leak detectors.

In the Swedish inventory emissions of SF_6 from sound-proof windows and from jogging shoes are included.

Identified changes in the present CRF 2F9, Other

Additional sources are specified in the 2006 GL. It will be necessary to investigate if they occur in Sweden.

No methodological changes are identified for the sources already covered in the Swedish inventory.

It is declared that it is good practice to contact all gas producers/distributors to identify SF_6 and PFC users and to investigate the gas consumption of all source categories, also other than those mentioned in the chapter.

WHAT NEEDS TO BE DONE

Investigate additional possible sources for use and emissions of SF_6 and PFC. Include gas distributors as an annual source of information.

IMPLEMENTATION REQUIRED?

Yes

IMPLICATIONS ON QUALITY

Better completeness

IMPLICATIONS ON QUANTITY

Unknown

CHANGES FOR AUTHORITIES

If possible, more detailed data from teh product register at KemI

COST FOR CHANGE

Low to medium, depending on if additional sources are found to exist.

TIME PLAN FOR IMPLEMENTATION

Some preparatory work is needed.

N_2O from product uses, identified changes in the present CRF 3D, Use of N_2O

No changes are identified.

Annex 4

Volume 4, AFOLU

Table of Contents

Volume 4, AFOLU

Volume 4 consists of the chapters:

1. Introduction
2. Generic Methodologies Applicable to Multiple Land-Use Categories
3. Consistent Representations of Land
4. Forest land
5. Cropland
6. Grassland
7. Wetlands
8. Settlements
9. Other land
10. Emissions from Livestock and Manure Management
11. N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application
12. Harvested Wood products

    Annex 1 Worksheets

    Annex 2 Summary of Equations

General changes in the AFOLU sector

The reporting from the agricultural sector and LULUCF has been combined into one. However, the reporting of the different source/sink categories is not substantially changed.

A new aspect in the inventory is the incorporation of key category analysis for land-use categories, C pools, and CO_2 and non-CO_2 greenhouse gas emissions for AFOLU. A key source/sink category is defined as "one that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions and removals, the trend in emissions and removals, or uncertainty in emissions and removals." In Sweden the AFOLU sector has several large sources (cattle, organic soils etc.) that may qualify as key categories. It is difficult to clearly see the practical consequences of this. However, the aggregation level of emissions/ removals is revised in the suggested new key category analysis and new key-categories will probably be identified. The Tier level hierarchy is stricter and if an emission/ removal is identified as key, a higher Tier-methodology has to be applied. Therefore, methodologies for currently reported emissions/ removals might have to be revised.

Identified need for changes and the implications for the Swedish inventory are summarised in the chapter on AFOLU in the main report.

Chapter 2, Generic Methodologies Applicable to Multiple Land-Use Categories

Emissions of "new" gases as CO, NMVOC and NO_x from biomass burning might have to be reported for different land use categories.

Default emission factors have been improved, but Sweden will probably only use these emission factors for verification.

Greater emphasis is made on the differentiation between mineral soils and organic soils. We are already able to differentiate between those for the major land-uses.

Equation 2.3 indicates that "harvested wood products" is suggested to be regarded as a carbon pool. This will influence on the total reported removals from the sector compared to today's reporting of LULUCF.

There is a Tier 1 option to assume that the dead organic matter carbon pool is in a steady state (It is not quite clear if this option refer to all land use categories.). If this option is adopted and thereby a zero stock change is reported, this pool will never become a key category – even if the pool becomes a large source. If the possibility to us this option is adopted, there is a risk of cherry-picking.

For the stock change method, carbon stock changes should be calculated between times t_1 and t_2. Consequently a trend will be reported and it is up to each country to decide the length of the period. However, IPCC states that this period could be "longer" in boreal forest, where the growth rate of biomass is quite low.

For some emissions, e.g. biomass burning, a quite strict matching of emission to different land use categories is required. On the other hand, for some emissions it is enough to report on national level without matching to land use, e.g. liming. This is different from the current guidelines.

A new source/sink taken up in the 2006 guidelines is changes in inorganic carbon pools. The estimations require an advanced methodology (only Tier 3). IPCC writes: "Where data and knowledge are sufficient and activities that significantly change soil inorganic C stocks are prevalent, it is good practice for countries to do a comprehensive hydro-geochemical analysis that includes all important land-use and management activities to estimate their effect on soil inorganic C stocks."

There are definitely emissions from inorganic pools of soil carbon in areas with lime-stone in the parent material in Sweden. However, we believe that we do not have enough process knowledge and background data to do such estimations with a Tier 3 approach.

The Tier 3 approach, adapted for predictions by the stock change method for carbon pools is very similar to the current Swedish approach.

Chapter 3. Consistent representation of lands

IPCCs six broad land use classes are still valid but it might be possible to merge all "from" land use conversions to one class. E.g. land use conversions GF, CF, WF, SF and OF can be reported as LF. On the other hand, on a voluntary basis land use might be stratified into more classes: climate, soil, biomass and management practices. Our current system seems still to be the Tier 3 choice.

The current land use system is based on data from the Swedish NFI that covers all land and fresh water areas. According to this system the Cropland area is estimated to about 3 M ha. However, current data from the agriculture sector uses another data source that slightly deviates from the Cropland area of 3 M ha. It has been decided to use the NFI system and agriculture data have to be area weighted by the NFI estimates. To avoid inconsistencies in reporting this should be made immediately in the current reporting.

A general new principle seems to be to match emissions/removals to as many land-use classes as possible (3.18). This is probably, to increase accuracy of estimates by applying separate emissions factors per class. However, the division into several strata/ classes is mainly valid for a Tier 1 approach and usually not relevant for Sweden.

IPCC argues, that over time it is likely that the total area of managed land increases and argues that a country should not be credited for the new introduced carbon stocks (3.9). Therefore IPCC recommends a recalculation to consider such issues. Sweden has interpreted that managed land, e.g. Forest land, gradually can degrade to unmanaged land, e.g. Wetlands, or be converted from unmanaged land to managed land. So both types of conversions occur and it's not evident that the area of managed land will increase. If unmanaged land is transferred into managed land, or vice versa, carbon stock changes are considered. This is not made from zero to actual stock, instead after conversion the change in stock is calculated as the actual difference in stock and the calculation is possible since Sweden use permanent sample plots that cover all relevant land. We think that this methodology is sound and in line with the intentions.

Chapter 4. Forest land

The stock-change method that Sweden uses is still a Tier 3 method and the estimations of living biomass seem to be acceptable and considered *good practice*. IPCC is more clear on that dead wood below-ground shall be reported which will demand a certain amount of development.

A land-use change in connection to fire is taken up in the new guidelines, but forest fires are rare in Sweden so we do not expect any new advanced methods to be developed. Fire will be reported with Tier 1 or 2 since Tier 3 demands improved emission factors and geographically identified fires. Except for carbon pools, emissions from forest fires seem to be the only emission that has to be matched to land use for Forest land. For conversion to Forest land, it is *good practice* to include all carbon pools and non-carbon pools. “Non carbon pools” probably refers to emissions from forest fires and emissions from drained organic soils. Consequently, emissions from forest fertilization has not to be matched to land use (forest remaining forest or different conversions to forest).

We believe that IPCC puts more emphasis on documentation of: i) emission factors, ii) activity data, iii) validation of model simulations, and iv) a more thorough analysis of emissions than in the present guidelines.

WHAT NEEDS TO BE DONE?

Develop a Tier 1 or 2 system for matching emissions from forest fires to land use.

IMPLEMENTATION REQUIRED?

Required by the IPCC.

CHANGES FOR AUTHORITIES

Cooperate with the Swedish Rescue Service Agency

IMPLICATIONS ON QUALITY

Will be improved

IMPLICATIONS ON QUANTITY

No additional

COST FOR CHANGE

Medium

TIME PLAN FOR IMPLEMENTATION

Less than one year

Chapter 5. Cropland

No major changes for Swedish conditions. The present system is a combination of Tier 3 and Tier 2 (organic soils). If any improvements are going to be made it should be for the organic soils. It seems to be optional to report non-CO_2 emissions from burning of agricultural residues (see Chapter Forest land).

Chapter 6. Grassland

No major changes. Following the text on Tier definitions our present system is Tier 2 for biomass since "Tier 3 approaches consist of using a combination of dynamic models and inventory measurements of biomass stock changes." Sweden does report carbon stock changes of trees but not for shrubs. It might be necessary to match emission from fires to Grassland and to conversions to Grassland (See Forest land).

Chapter 7. Wetlands

Good Practice Guidance for reporting emissions associated to drained peat lands. The reporting covers emissions of CO_2 and N_2O (CH_4.should probably not be reported). The suggestion to make reporting of N_2O mandatory is new and methodologies for reporting have to be developed or adapted to at least Tier 1. Flooded land is assumed to be uncommon in Sweden.

WHAT NEEDS TO BE DONE?

A system for monitoring N_2O and, for some areas, also CO_2, from drained land.

IMPLEMENTATION REQUIRED?

Required by the IPCC

CHANGES FOR AUTHORITIES

No identified

IMPLICATIONS ON QUALITY

Will be improved

IMPLICATIONS ON QUANTITY

A new emission

COST FOR CHANGE

Medium

TIME PLAN FOR IMPLEMENTATION

Less than one year

Chapter 8. Settlements

We do report changes in living biomass and dead wood on Settlements, however, now the reporting requirements seem mandatory. Since it is likely that emission from soils, especially when soils are converted to Settlements may be large it can possibly become a key category. Thus it may be necessary to develop a Tier 2 methodology for this land-use class, particularly for the land-conversion issue. The category “Settlements” is defined as roads, railways, hiking paths, gravel pits, power lines, urban area, etc, however, the National Forest Inventory inventory does not inventory urban areas. A field inventory/ visit of urban land (national land use category 13) should be considered (Finland has already started).

WHAT NEEDS TO BE DONE?

A field visit on NFI-sample plots in urban areas

IMPLEMENTATION REQUIRED?

Required by the IPCC.

CHANGES FOR AUTHORITIES

For SLU

IMPLICATIONS ON QUALITY

Will be improved

IMPLICATIONS ON QUANTITY

Depends on actions

COST FOR CHANGE

Medium to high

TIME PLAN FOR IMPLEMENTATION

Less than one year

Chapter 9. Other land

Only some minor changes are foreseen.

Chapter 10, Emissions from Livestock and Manure Management

The chapter on emissions of methane from enteric fermentation in livestock and methane and nitrous oxide emissions from manure management contains basically the same methodology as the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (GPG 2000).

There are new emission factors and refined temperature climate classification.

Identified changes in present CRF 4A, Methane emissions from enteric fermentation

The enteric fermentation emission factors for Cattle are updated. Also the conversion factors (Y_m) are changed. A new emission factor for deer is introduced which confirms the emission factor used in Sweden for reindeer (source: Finland Statistics).

WHAT NEEDS TO BE DONE

Sweden uses national data for cattle. If differences are large between the updated factors in 2006 GL and the national data a crosscheck regarding the enteric fermentation emission factors and conversion factors could be made. Step 1: make comparison according to underlying Excel sheet in connection with the Swedish calculations. Step 2: If there is a big difference an assignment to Jan Bertilsson at SLU would be necessary (the person concerned according to present work practices).

IMPLEMENTATION REQUIRED?

Unclear.

CHANGES FOR AUTHORITIES

If an update is considered necessary, new underlying data has to be ordered.

IMPLICATIONS ON QUALITY

The quality will increase if updated emission factors and conversion factors are considered to be more appropriate.

IMPLICATIONS ON QUANTITY

Updated emission factors and conversion factors might increase the emissions.

COST FOR CHANGE

Step 1:Low.
Step 2: Medium.

TIME PLAN FOR IMPLEMENTATION

In due time before implementation, some preparatory work is needed.

Identified changes in present CRF 4B, Methane emissions from manure management

The temperature classification for manure management methane emission factors for cattle is more detailed in the 2006 GL than in the 1996 GL. The earlier defined climate region "cool" (1996 GLG) where Sweden fits is now subdivided into five categories ($\leq$ 10, 11, 12, 13, 14 °C) with one default emission factor for each. This however only applies if Tier 1 is used, which is not the case in Sweden.

The emission factors for Western Europe have changed significantly for the livestock species, dairy cows and swine, but also for other cattle, buffalo, goats and horses. Swine is now divided into market and breeding swine with different emission factors. Even the category poultry is refined and is subdivided into layers (dry), layers (wet), broilers, turkeys and ducks with different methane emission factors.

The difference in temperature classification refers to methane conversion factors (MCF) as well. The manure management system liquid/ slurry is refined and divided by cover and temperature with new MCFs. The MCF for deep bedding (cattle, swine) has decreased significantly. An MCF is introduced for poultry manure with litter.

WHAT NEEDS TO BE DONE

The above mentioned emission factors and methane conversion factors have to be analysed and the Swedish calculations have thereafter to be updated. The new values have to be verified based on the study carried out by Andrew Dustin (JTI 2002). The new factors for slurry, methane lies in line with Sweden's values. A smaller investigation on if more detailed data than presently available regarding type of coverage (Crust/roof) is needed.

CHANGES FOR AUTHORITIES

None.

IMPLICATIONS ON QUALITY

The quality will increase with more precise emission factors and methane conversion factors.

IMPLICATIONS ON QUANTITY

Decreased emissions.

COST FOR CHANGE

Low.

TIME PLAN FOR IMPLEMENTATION

In due time before implementation, some preparatory work is needed.

Identified changes in present CRF 4B, N_2O emissions from manure management

The **default emission factors for direct N_2O emissions from manure management** are changed for solid storage, liquid/slurry and deep bedding.

WHAT NEEDS TO BE DONE

Emission factors have to be revised and checked with the report from JTI (Dustin 2002) and updated if necessary.

IMPLEMENTATION REQUIRED?

Unclear.

CHANGES FOR AUTHORITIES

None.

IMPLICATIONS ON QUALITY

The quality will increase.

IMPLICATIONS ON QUANTITY

Emissions will decrease if emission factors are changed..

COST FOR CHANGE

Low.

TIME PLAN FOR IMPLEMENTATION

In due time before implementation, some preparatory work is needed.

Chapter 11, N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application

Different NO_2-emissions in this chapter are reported together. Tracing of land use to emission is not required, but for a few emissions land use can be used to improve estimates. No major changes are identified for liming. Urea fertilization is very limited in Sweden and will not be a large source.

N_2O Emissions from Managed Soils

Estimations for N_2O emissions have earlier only been calculated for agricultural soils but is now suggested to be calculated for all managed land, which are all managed soils on land, including Forest land.

Emissions of nitrous oxide can take place directly from the soils to which N is applied (direct emissions) and also through two indirect pathways (indirect emissions). One pathway is the volatilisation of N as NH_3 and oxides of N (NO_x) and deposition of these and their products (NH_4^+ and NO_3^-) onto soils and water surfaces. The sources of NH_3 and NO_x are agricultural fertilisers and manures, fossil fuel combustion, biomass burning, and processes in the chemical industry

The other pathway is leaching and runoff from land of N from inputs of fertiliser, crop residues, mineralisation of N associated with loss of soil C in mineral and drained/managed organic soils through land-use change or management practices, and urine and dung deposition from grazing animals. In comparison with the previous guidance documents, the 2006 IPPC Guidelines now include crop residues as an N input into the leaching and runoff component.

Identified changes in present CRF 4D, Agricultural soils

N_2O Emissions from Managed Soils

In the 2006 IPCC Guidelines estimations for N_2O emissions are covering all managed soils instead of solely agricultural soils. **Forest land** is now included which implies major additions/ changes.

For N_2O, the basic Tier 3 approach is the same as used in the IPCC Good Practice Guidance for Land Use, Land-use Change and Forestry (GPG-LULUCF) for Grassland and Cropland, and in the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (GPG 2000) for agricultural soils while relevant parts of the GPG-LULUCF methodology have been included for Forest land.

The 2006 IPCC Guidelines provides **full sectoral coverage** of indirect N_2O emissions, which includes agricultural fertilisers and manure, fossil fuel combustion, biomass burning, and processes in the chemical industry. The Revised 1996 Guidelines and Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (GPG 2000) only include agricultural fertilisers and manure. However the indirect N_2O missions from the atmospheric deposition of nitrogen as NOx and NH_3 arising from other than agriculture will be reported in table CRF5A (Volume 1, chapter 7)

The **default emission factor** to estimate direct N_2O emissions from managed soils are changed for N additions from fertilisers, organic amendments and crop residues, and N mineralised from mineral soils has been lowered from 1,25% to 1%.

The emission factor for animals has been disaggregated for different animal types based on urine and dung depositions. Sheep and "other animals" have been given a separate, lower emission factor.

Choice of activity data

Applied **mineral or organic nitrogen fertilisers** are no longer adjusted for the amounts of NH_3 and NOx in the Tier 1 approach in 2006 IPCC Guidelines. This is due to that the emission factors are determined from fertiliser induced $N_2O - N$ emitted/total amount of N applied. The N_2O emissions have earlier been underestimated.

The equation for estimating the amount of **N in crop residues**, including N-fixing crops and from forage/pasture renewal (F_{CR}).has been modified in the 2006 IPCC Guidelines. The contribution of below-ground N in crop residues and also N from forage or pasture renewal are now accounted for.

There is a close relation between Soil C and N in soil organic matter (SOM). Loss of soil C is accompanied with mineralisation of N. This **mineralised N** is regarded as a source of N available to be transformed to N_2O . Therefore the 2006 IPCC Guidelines includes mineralised N resulting from loss of soil organic C stocks in mineral soils through land-use change or management practices (F_{SOM}) which is an addition compared to the previous guidelines. The same emission factor as for applied fertilisers etc. is used.

Biological nitrogen fixation has been omitted as a direct source of N_2O because of the lack of evidence of significant emissions arising from the fixation process itself.

The 2006 IPCC Guidelines provides advice on estimating CO_2 emissions associated with the use of urea as a fertiliser.

The **uncertainty range** for the emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces has been widened. **Emission factors** for nitrous oxide from agricultural soils are revised based on an extensive literature review. The overall emission factor for leached N, composed by emission factors for ground water and surface drainage, rivers and estuaries, has been lowered (from 0,025 to 0,0075 kg N_2O/kg N).

Release of N by mineralisation of soil organic matter as a result of **change of land use or management** is now included as an additional source. These are significant adjustments to the methodology previously described in the 1996 IPCC Guidelines.

A three-Tier approach is provided in the 2006 IPCC Guidelines instead of the two-Tier approach in 1996 IPCC Guidelines.

WHAT NEEDS TO BE DONE

N_2O Emissions from Managed Soils

Estimations for N_2O emissions from Forest land is now included. To estimate N_2O emissions from Forest land would require annual area of managed organic soils on Forest land. The default value for the emission factors for nutrient rich forest soils (EF2F, Temp, Org, R for temperate and boreal organic nutrient rich forest soils (kg N_2O–N ha-1)) nutrient poor forest soils and (EF2F, Temp, Org, P for temperate and boreal organic nutrient poor forest soils (kg N_2O–N ha-1)) need to be justified alternatively replaced by national values. Further, on Forest land areas among other things should be stratified by soil fertility. Data on the amount of fertilisers, deposition and all other inputs on Forest land need to be collected.

Various default emission factors are introduced/ modified (see Identified changes in present CRF 4D, Agricultural soils, above) in 2006 Guidelines compared to earlier guidance. These default emission factors have to be examined and modified in the Swedish calculations.

Applied **mineral or organic nitrogen fertilisers and grazing manure** shall no longer be adjusted for the amounts of NH_3 and NOx .

The amount of **N in crop residues** (F_{CR}) needs to be adjusted for below-ground N in crop residues and also N from forage or pasture renewal.

The amount of **mineralised N** resulting from loss of soil organic C stocks in mineral soils **through land-use change or management practices** (F_{SOM}) is to be added.

Remove **nitrogen fixation** as a direct source of N_2O.

IMPLEMENTATION REQUIRED?

N_2O Emissions from Managed Soils

- Forest land: Yes.
- Default emission factors: ?
- Applied **mineral or organic nitrogen fertilisers and grazing manure** no longer adjusted for the amounts of NH_3 and NOx : Yes(?).
- Removing nitrogen fixation: Yes (?).
- The amount of **N in crop residues** (F_{CR}) needs to be adjusted for below-ground N in crop residues and also N from forage or pasture renewal: Yes (?).
- The amount of mineralised N resulting from loss of soil organic C stocks in mineral soils through land-use change or management practices (F_{SOM}) is to be added: Yes (?).

CHANGES FOR AUTHORITIES

N_2O Emissions from Managed Soils

- Forest land: Yes. More data e.g. on deposition needed. Within the present National System there is no defined responsible authority for this kind of data.
- Default emission factors: No.
- Applied **mineral or organic nitrogen fertilisers and grazing manure** no longer adjusted for the amounts of NH_3 and NOx : No.
- The amount of **N in crop residues** (F_{CR}) needs to be adjusted for below-ground N in crop residues and also N from forage or pasture renewal: Yes (?).
- The amount of **mineralised N** resulting from loss of soil organic C stocks in mineral soils **through land-use change or management practices** (F_{SOM}) is to be added: No, because the average annual loss of soil C is already calculated in Equation 2.25 in chapter 2 (?).
- Nitrogen fixation is no longer needed to be provided from Statistics Sweden.

IMPLICATIONS ON QUALITY

N_2O Emissions from Managed Soils

- Forest land: Since N_2O emissions from Forest land will be included the emission estimates for N_2O will be more comprehensive.
- Default emission factors: The emissions will be more precise.
- Applied **mineral or organic nitrogen fertilisers and grazing manure** no longer adjusted for the amounts of NH_3 and NOx : The emissions will be more precise.
- The amount of **N in crop residues** (F_{CR}) needs to be adjusted for below-ground N in crop residues and also N from forage or pasture renewal: The emission will be more precise (?).
- The amount of **mineralised N** resulting from loss of soil organic C stocks in mineral soils **through land-use change or management practices** (F_{SOM}) is to be added: Yes (?).

IMPLICATIONS ON QUANTITY

N_2O Emissions from Managed Soils

- Forest land: Adding the Forest land will increase the national emissions.
- Default emission factors: If the default values are chosen the emissions will be lowered.
- Using applied **mineral or organic nitrogen fertilisers and grazing manure** no longer adjusted for the amounts of NH_3 and NOx will increase the national emissions.
- The national emissions will increase by adding amount below-ground N in crop residues and also N from forage or pasture renewal **in crop residues** (F_{CR}).

- The amount of **mineralised N** resulting from loss of soil organic C stocks in mineral soils **through land-use change or management practices** (F_{SOM}) will increase the national emissions (?).
- Removing **nitrogen fixation** as a direct source of N_2O will lower the national emissions.

COST FOR CHANGE

N_2O Emissions from Managed Soils

- Forest land: Medium to high (?).
- **Default emission factors**: Low (investigation of emission factors and SAS programming).
- Applied **mineral or organic nitrogen fertilisers** no longer adjusted for the amounts of NH_3 and NOx : Low (SAS programming).
- The amount of **N in crop residues** (F_{CR}) adjusted for below-ground N in crop residues and N from forage or pasture renewal: Low (SAS programming).
- The amount of **mineralised N** resulting from loss of soil organic C stocks in mineral soils **through land-use change or management practices** (F_{SOM}) is to be added: Low (SAS programming).
-

TIME PLAN FOR IMPLEMENTATION

N_2O Emissions from Managed Soils

- Forest land: ?
- Default emission factors: A few years before implementation. Less extensive preparation needed.
- Applied **mineral or organic nitrogen fertilisers** no longer adjusted for the amounts of NH_3 and NOx : A few years before implementation. Less extensive preparation needed.
- The amount of **N in crop residues** (F_{CR}) needs to be adjusted for below-ground N in crop residues and also N from forage or pasture renewal: A few years before implementation. Less extensive preparation needed.
- The amount of **mineralised N** resulting from loss of soil organic C stocks in mineral soils **through land-use change or management practices** (F_{SOM}) is to be added: A few years before implementation. Less extensive preparation needed.
- Removing **nitrogen fixation** as a direct source of N_2O can relatively easily be implemented during the year before the change has to be introduced.

Chapter 12. Harvested Wood Products

Harvested Wood Products (HWP) is a new category in the reporting. It implies that wood-products that have left the forest should be considered in the reporting. This may be followed in different ways, but one intuitive way is to regard forest prod-

ucts as a carbon pool that is filled by the manufacturing of forest products and emptied when they are combusted or mineralized. Finland is a country that already has tested to report HWP.

IPCC suggests some tentative methods where either change of HWP as change in stock is measured, or through measurement of 'flows'. A problem is to determine in which country HWP should be reported since there are large import/export flows. All countries need to use the same method if the global estimates should be correct and un-biased.

There is a need of a considerable effort to develop the methodology and data capture to be able to report the HWP category.

WHAT NEEDS TO BE DONE?

Wait until approach is decided, meanwhile, examine probably data sources

IMPLEMENTATION REQUIRED?

Yes, likely

CHANGES FOR AUTHORITIES

No yet identified

IMPLICATIONS ON QUALITY

Will be improved

IMPLICATIONS ON QUANTITY

Large

COST FOR CHANGE

High

TIME PLAN FOR IMPLEMENTATION

One year

Annex 5

Volume 5, Waste

Table of Contents

Volume 5, Waste

Volume 5 consists of the chapters

1. Introduction
2. Waste Generation, Composition and Management Data
3. Solid Waste Disposal
4. Biological treatment of Solid Waste
5. Incineration and Open Burning of Waste
6. Wastewater Treatment and Discharge

Annex 1 Worksheets

Chapter 1, Introduction

WHAT NEEDS TO BE DONE

To estimate indirect N_2O when estimates of NH_3 from composting are available.

IMPLEMENTATION REQUIRED?

Yes, it is good practice when data on NH_3 emissions from composting are available.

CHANGES FOR AUTHORITIES

This may lead to needs of new data.

IMPLICATIONS ON QUALITY

The quality on the reported data will improve since mapping of this field needs to be done.

IMPLICATIONS ON QUANTITY

The quantity of N_2O emissions will probably increase slightly if any.

COST FOR CHANGE

Low if data on NH_3 are available.
The total costs will probably be high since investigations needs to be done in this new field.

TIME PLAN FOR IMPLEMENTATION

Extensive preparatory work is needed if new investigations need to be made.

Chapter 2, Waste Generation, Composition and Management Data

No changes that will require implementation has been identified.

Chapter 3, Solid Waste Disposal

Identified changes in present CRF 6A, Solid waste disposal on land

WHAT NEEDS TO BE DONE

1. To calculate carbon stored in SWDS.
2. To check and if necessary adjust the delay time for production of CH_4 that Sweden is currently using.
3. To check if there are any emissions from residues from mechanical-biological treatment plants.
4. The distribution of waste to managed and unmanaged sites for the purpose of MCF estimation should be documented with supporting information.
5. An inventory of recovery facilities for CH_4 is desirable. Flaring and energy recovery should be documented separately from each other.

IMPLEMENTATION REQUIRED?

1. It is reported as an information item in the Waste sector and related to Chapter 12, Harvested Wood Products, of the AFOLU Volume.
2. It is good practice to choose and use delay time between zero and six months. Values outside the range should be supported by evidence.
3. Countries *should* provide their own estimates of the fractions of this type disposed in SWDS, incinerated or recycled.
4. We consider that all sites in Sweden are managed. Are there any documentation available to support it? This must be supported by some documentation.
5. ”is desirable” and ”should”.

CHANGES FOR AUTHORITIES

1. This will lead to needs of national expertise and maybe also new data.
2. This will lead to needs of national expertise.
3. This will lead to needs of new data.
4. This will lead to needs of new documentation.
5. This will lead to needs of new documentation.

IMPLICATIONS ON QUALITY

1. The quality will improve when the mapping has been done.
2. The quality on the reported data will improve from controlling this factor.
3. The quality will improve when the mapping has been done.
4. The quality will improve when the mapping and documentation has been done.
5. The quality will improve when the mapping and documentation has been done.

IMPLICATIONS ON QUANTITY

1. There will be no implication on quantity in the reported data for the waste sector.
2. There will be insignificant implication on quantity in the reported data.
3. There will probably be a very small implication on quantity in the reported data.
4. There will probably be no implication on quantity in the reported.
5. There will be no implication on quantity in the reported data.

TOTAL COST FOR CHANGE

1. The costs will probably be medium because some investigations need to be carried out in this new field.
2. The costs will probably be low because we expect that only some minor investigations needs to be carried out.
3. The costs will probably be medium because some investigations need to be carried out in this new field.
4. The costs will probably be low because we expect that only some minor investigations needs to be carried out.
5. The costs will probably be medium because some investigations needs to be carried out in this new field.

TIME PLAN FOR IMPLEMENTATION

1. Extensive preparatory work is needed before implementation.
2. Can relatively easily be implemented during the year preceding the year the change has to be introduced.
3. Less extensive preparation needed, a few years before implementation.
4. Less extensive preparation needed, a few years before implementation.
5. Less extensive preparation needed, a few years before implementation.

Chapter 4, Biological treatment of Solid Waste

Identified changes in present CRF 6D, Other

No estimations on emission are reported for biological treatment of solid waste. Therefore the inclusion of these kinds of activities will need some mapping on the present situation in Sweden and data sources available.

WHAT NEEDS TO BE DONE

1. To estimate and report emissions of CH_4 and N_2O from centralized composting facilities and home composting.
2. To estimate and report emissions of CH_4 from anaerobic digestion of organic waste (unintentional leakages).

IMPLEMENTATION REQUIRED?

1. Yes, it is included to ensure more complete coverage of sources.

2. Yes, it is included to ensure more complete coverage of sources.

CHANGES FOR AUTHORITIES

1. This will lead to needs of new data.
2. This will lead to needs of new data.

IMPLICATIONS ON QUALITY

1. The quality will improve when the mapping has been done.
2. The quality will improve when the mapping has been done.

IMPLICATIONS ON QUANTITY

1. There will probably be a very small implication on quantity in the reported data.
2. There will probably be a very small implication on quantity in the reported data.

TOTAL COST FOR CHANGE

1. The costs will probably be high since a lot of investigations need to be carried out in this new field.
2. The costs will probably be high since a lot of investigations need to be carried out in this new field.

TIME PLAN FOR IMPLEMENTATION

1. Extensive preparatory work is needed before implementation due to new investigations.
2. Extensive preparatory work is needed before implementation due to new investigations.

Chapter 5, Incineration and open burning of waste

Identified changes in present CRF 6C and 6D, Waste incineration, and Other Waste

Sweden reports incineration of waste from only one facility, SAKAB, where hazardous waste as well as MSW are incinerated. Data reported are from the environmental report, but calculations on biogenic and fossil fractions are made by SMED. CO_2 is estimated whereas CH_4 and N_2O are reported as NE. According to the 2006 IPCC GL emission factors for MSW should be used on the MSW fraction of the waste. Probably no emission factors are available for the hazardous waste fraction.

Emissions from accidental landfill fires, as well as from open burning of waste (assumed to be garden waste) occur, but greenhouse gases are not estimated.

WHAT NEEDS TO BE DONE

- Estimate greenhouse gas emissions from open burning of waste (accidental landfill fires etc).
- Investigate if better input data are available for separating biogenic from fossil fraction of waste for CO_2 calculations.
- Investigate/apply emission factors for MSW for CH_4 and N_2O.
- Emissions are to be reallocated and reported in the new CRF-codes 4C1, Waste Incineration, and 4C2, Open Burning of Waste.

IMPLEMENTATION REQUIRED?

- Greenhouse gas emissions from open burning of waste should be estimated.
- N_2O and CH_4 emissions from waste incineration should be reported.

CHANGES FOR AUTHORITIES

New authorities and/or redefined responsibilities for authorities already part of the National System. (This applies to responsibilities regarding activity data on the occurrence of fires and on the biogenic/fossil fractions of waste).

IMPLICATIONS ON QUALITY

The quality will be improved if greenhouse gases from open burning of waste are included, if more accurate calculations on the biogenic/fossil fractions from incineration of waste can be made, and if N_2O and CH_4 emissions from waste incineration are estimated.

IMPLICATIONS ON QUANTITY

Greenhouse gas emissions will increase if emissions from open burning of waste and if N_2O and CH_4 emissions from waste incineration are included. At present it is not possible to judge how good the present calculations of biogenic/fossil fractions are, and if refined calculations (if possible) will result in an increase or decrease of fossil CO_2 emissions.

COST FOR CHANGE

Low

TIME PLAN FOR IMPLEMENTATION

Can relatively easily be done, if data are available.

Chapter 6, Wastewater Treatment and Discharge

Identified changes in present CRF 6B, Wastewater handling

Sweden reports emissions of CH_4 from landfilled sludge from wastewater treatment. This is reported in 6A (Solid waste disposal on land) and 2006 IPCC Guidelines supports this allocation. The emissions of CH_4 *in the treatment processes* have so far not been reported because of the lack of knowledge in this field. The 1996 and 2006 IPCC Guidelines estimates CH_4 emissions by using total organics in the wastewater together with other factors, which is a different approach from the one used in Sweden. So far the Swedish approach has been approved, but at present Sweden does not follow the steps for good practice that is presented in the 2006 IPCC Guidelines. Therefore it has to be further investigated if the Swedish approach can be approved according to 2006 IPCC Guidelines or if Sweden must change method.

Sweden reports emissions of N_2O from wastewater treatment plants after discharging the treated wastewater. The emissions of N_2O *in the treatment processes* have not been reported because of the lack of knowledge in this field. At present Sweden is using the method according to the 1996 IPCC Guidelines with a national adjustment. The method in the 2006 IPCC Guideline seems to be slightly different and it needs to be analysed in more detail before describing the consequences for the Swedish inventory.

WHAT NEEDS TO BE DONE

1. To complete the coverage of the Swedish reporting of CH_4. This can be done by mapping the existing data gaps or by using the method in the 2006 IPCC Guidelines.
2. To complete the coverage of the Swedish reporting of N_2O. This can be done by mapping the existing data gaps in combination with the present method in Sweden or using the approach in the 2006 IPCC Guidelines.

IMPLEMENTATION REQUIRED?

1. The methods in the 2006 IPCC Guidelines are good practice.
2. The methods in the 2006 IPCC Guidelines are good practice.

CHANGES FOR AUTHORITIES

1. This will probably lead to needs of new data.
2. This will probably lead to needs of new data.

IMPLICATIONS ON QUALITY

1. The quality will probably be slightly improved by mapping the emissions of CH_4 in the treatment processes, but it will probably not improve by using the method in the 2006 IPCC Guidelines.

2. The quality will probably be slightly improved by mapping the emissions of N_2O in the treatment processes, but it will probably not improve by using the method in the 2006 IPCC Guidelines.

IMPLICATIONS ON QUANTITY

1. Mapping the emissions of CH_4 in the treatment processes will probably have a very small implication on quantity in the reported data. It is difficult to assess the implications of the method in the 2006 IPCC Guidelines.
2. Mapping the emissions of N_2O in the treatment processes will probably have a very small implication on quantity in the reported data. It is difficult to assess the implications of the method in the 2006 IPCC Guidelines.

COST FOR CHANGE

3. The costs will probably be high since a lot of investigations needs to be done in this new field.
4. The costs will probably be high since a lot of investigations needs to be done in this new field.

TIME PLAN FOR IMPLEMENTATION

3. Extensive preparatory work is needed due to the need for new data.
4. Extensive preparatory work is needed due to the need for new data.