| Category | | Title |
|---|---|---|
| General guidance | | **Key category analysis and methodological choice** |
| | | |
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# Contents

# 1 Introduction

This chapter explains the tiered approach used to define the generic levels of detail and rigour required for inventory compilation and how to identify the key categories ([1]) for which higher tiered methods are required. This chapter has been extensively adapted from the 2006 IPCC (Intergovernmental Panel on Climate Change) Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines) to facilitate estimating transboundary air pollutant emissions.

Methodological choice for individual source categories is important in managing overall inventory quality and minimising uncertainty. Generally, inventory uncertainty is lower when emissions are estimated using the most rigorous, higher tiered, methods (see subsection 1.3 ) provided for each category or subcategory in the sectoral volumes of this Guidebook. However, these methods generally require more extensive resources for data collection and calculation, so it may not be feasible to use most rigorous method for every category of emissions. It is, therefore, good practice to identify and prioritise the effort on those categories which make the greatest contribution to the overall inventory estimates (and where possible, the uncertainty).

## 1.1 Categories

The categories used are those of the Nomenclature for Reporting (NFR) as used for reporting emissions according to the United Nations Economic Commission for Europe (UNECE) Guidelines for Reporting Emission Data under the Convention on Long-Range Transboundary Air Pollution (hereinafter the LRTAP Reporting Guidelines) ([2]).

## 1.2 Fuels

Fuels are those based on the definitions of the International Energy Agency (IEA) and used in the IPCC Guidelines.

## 1.3 Method tiers

Emissions can be estimated at different levels of complexity. Within the IPCC Guidelines and adopted by this Guidebook, these are expressed in three tiers of increasing complexity.

The 'Tier 1' method is a 'simple' method using default emission factors only. To upgrade a Tier 1 to a Tier 2 method, the default emission factors should be replaced by country-specific or technology-specific emission factors. This might also require a further split of the activity data over a range of different technologies, implicitly aggregated in the Tier 1 method. A Tier 3 method could be regarded as a method that uses the latest scientific knowledge in more sophisticated approaches and models; more detailed definitions follow.

Tier 1: A method using readily available statistical data on the intensity of processes (activity rates) and default emission factors. These emission factors assume a linear relation between the intensity of the process and the resulting emissions. The Tier 1 default emission factors also assume an average or typical process description. This

([1]) In Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (GPG2000, IPCC, 2000), the concept was named 'key source categories' and dealt with the inventory excluding the Land Use, Land-Use Change and Forestry (LULUCF) Sector. This definition is elaborated for the purposes of this Guidebook in subsection 1.4.
([2]) The LRTAP Convention Reporting Guidelines and annexes are available online from the CEIP website (www.emep-emissions.at/)

method is the simplest method, has the highest level of uncertainty and should not be used to estimate emissions from key categories (see subsection 1.4).

Tier 2:

More complex method

Tier 2 is similar to Tier 1 but uses more specific emission factors developed on the basis of knowledge of the types of processes and specific process conditions that apply in the country for which the inventory is being developed. Tier 2 methods are more complex, will reduce the level of uncertainty, and are considered adequate for estimating emissions for key categories.

Tier 3:

Tier 3 is defined as any methodology more detailed than Tier 2; hence there is a wide range of Tier 3 methodologies. At one end of the range there are methodologies similar to Tier 2 (i.e. activity data x emission factor) but with a greater disaggregation of activity data and emission factors. At the other end of the range are complex, dynamic models in which the processes leading to emissions are described in great detail.

The key criterion to be met before a Tier 3 methodology can replace a Tier 2 methodology is a more accurate estimation of the relevant emissions, reducing the following common sources of error.

- Model error: the extent to which the mathematical representation of the processes underlying the emissions deviate from reality.
- Parameter error: the error in the model parameters (e.g. emission factors, coefficients, etc.)
- Input error: the error in activity data.
- Process error: error introduced through mistakes in the process of compiling the inventory. For complex models, this includes errors in the software implementation of the model.

For small extensions to Tier 2 methodologies, such as the inclusion of abatement measures or refinements to emission factors, it is sufficient to document the quality assurance/quality control (QA/QC) process by which the revised/additional emission factors and associated activity data were obtained. However, where parties wish to use complex simulation models in inventory construction, the model is quite likely to have been developed by a third party. If the use of such models within a methodology is to be accepted as Tier 3, it is necessary to ensure that QA/QC criteria are met by the complex model, the process of parameterisation, and the input data necessary to run the model. These criteria must acknowledge that reviewers should be able to review the methodology within a reasonable time period and are listed below.

- For the inventory construction process to be sufficiently transparent, the model documentation has to be clear, correct, concise, comprehensible, and consistent.
- The scientific quality of the model has to have been documented in peer-reviewed publications.
- The model has to have been tested successfully in the situations for which it will be used in inventory construction, implying that model parameters are

available for those situations.

- The input data required by the model must be available, and of adequate quality, at the spatial and temporal scales for which the model is to be used.

These criteria are valid for all Tier 3 methodologies. However, they may require further interpretation for sector-specific applications and additional criteria may also be appropriate. For example, where it is appropriate, models intended to be used as Tier 3 methods should demonstrate that they obey the law of conservation of matter.

## 1.4 Key categories

A key category is one that is prioritised within the national inventory system because it is significantly important for one or a number of air pollutants in a country's national inventory of air pollutants in terms of the absolute level, the trend, or the uncertainty in emissions (as defined in subsection 2.4).

It is good practice for each country to use key category analysis systematically and objectively as a basis for choosing methods of emission calculation. Such a process will lead to improved inventory quality as well as greater confidence in the resulting estimates. The approach for key category analysis is presented in Section 2.

# 2 Key category analysis

## 2.1 Purpose of key category analysis

It is good practice for each country to identify its national key categories in a systematic and objective manner. This can be achieved by a quantitative analysis of the relationship between the magnitude of emission in any one year (level) and the change in emission year to year (trend) of each category's emissions compared to the total national emissions.

It is also good practice to focus the available resources for improvement in data and methods on categories identified as *key*. The identification of key categories in national inventories enables the limited resources available for preparing inventories to be prioritised; more detailed, higher tier methods can then be selected for key categories. Inventory compilers should use the category-specific methods presented in sectoral decision trees in the sectoral volumes.

For many sources, higher tier (Tier 2 and 3) methods are usually suggested for key categories. For guidance on the specific application of this principle to key categories, it is good practice to refer to the sector-specific decision trees and guidance for the respective category in the sectoral volumes. In some cases, inventory compilers may be unable to adopt a higher tier method due to lack of resources. This may mean that they are unable to collect the required data for a higher tier or are unable to determine country-specific emission factors and other data needed for Tier 2 and 3 methods. In these cases, although this is not accommodated in the category-specific decision trees, a Tier 1 approach can be used, and this possibility is identified in Figure 2-1. It should, in these cases, be clearly documented why the methodological choice was not in line with the sectoral decision tree. Any key categories where the good practice method cannot be used should have priority for future improvements. It is good practice to pay additional attention to key categories with respect to QA/QC as described in Chapter 6 'Inventory management, improvement and QA/QC', and the separate 'Verification' and 'Inventory QA/QC' sections of each sectoral chapter.

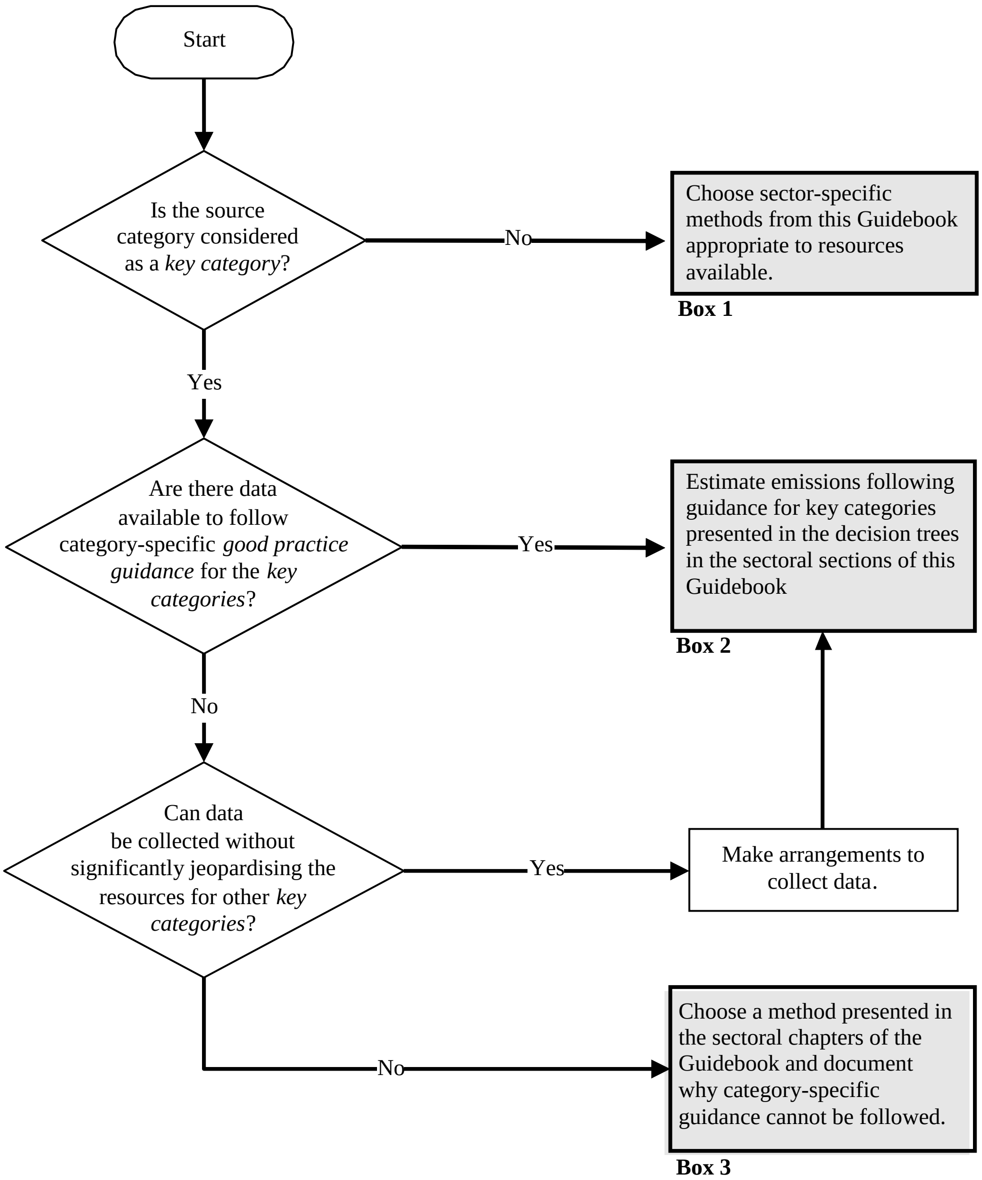


**Figure 2-1 Decision tree to choose a good practice method**

## 2.2 General approach to identify key categories

Any inventory compiler should be able to identify key categories in a basic single-year inventory in terms of their contribution to the absolute level of national emissions. For those inventory compilers who have prepared a time series, the quantitative determination of key categories should also include an evaluation of both the absolute level and the trend of emissions. Some key categories may be identified only when their influence on the trend of the national inventory is taken into account.

Subsection 2.3 sets out general rules for the identification of key categories including the sectoral level into which the categories should be split. The methodology follows the principles developed by the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 1, Chapter 4), described in subsection 2.4, to generate a key category list for each pollutant. However, where a single prioritised list of key categories is needed (e.g. to help in prioritising emission inventory improvements), a further, optional step (Step 2) can be used to consolidate the key categories (Appendix A).

## 2.3 General rules for identification of key categories

The results of the key category identification will be most useful if the analysis is done at the appropriate disaggregation level of categories. Table 2-1 lists the recommended source categories and, where relevant, identifies special considerations related to the disaggregation of the analysis. For example, the combustion of fossil fuels is a large emission source category that can be broken down into subcategories of first, second or third order, and even to the level of individual plants or boilers. Countries may adapt the recommended level of analysis in Table 2-1 to their national circumstances. In particular, countries using Approach 2 (subsection 2.4) will probably choose the same level of aggregation used for the uncertainty analysis. In some cases, disaggregation to very low levels should be avoided since it may split an important aggregated category into many small subcategories that are no longer *key*. The following guidance describes good practice in determining the appropriate level of disaggregation of categories to identify key categories.

- The analysis should be performed at the level of NFR categories or subcategories at which the Guidebook methods and decision trees are provided in the sectoral volumes. Where possible, and as indicated in Table 2-1, some categories should be disaggregated by main fuel types.
- Each air pollutant emitted from each category should be considered separately. For example, carbon monoxide (CO), nitrogen oxides ($NO_x$) and particulate matter ($PM_{10}$) are emitted from each of the detailed road transport classes. The key category analysis for this source should be performed for each of these separately as the methods, emission factors and related uncertainties will be different. In contrast, a collective analysis of all chemical species of non-methane volatile organic compounds (NMVOCs) is appropriate for this category.
- Countries may choose to perform the quantitative analysis at a more disaggregated level than suggested in Figure 2-1 ([3]). In this case, possible cross-correlations between categories and/or subcategories should be taken into account when performing the key category analysis. When using Approach 2, the assumptions about such correlations should be the same as when assessing uncertainties and identifying key categories (see Chapter 5, Uncertainties).

([3]) Most correlations between categories can be avoided by using the aggregation level of this table. Some correlations remain, e.g. in fuel use between stationary combustion and processes. In practice, the effect of

- The categories included in Table 2-1 below are those for which estimation methods are provided in the sectoral volumes. If countries develop estimates for new categories or gases, these should be added to the analysis under Miscellaneous for the appropriate sector.

For each key category (see Table 2-1 below), the inventory compiler should determine if certain subcategories are particularly significant. Usually, for this purpose, the subcategories should be ranked according to their contribution to the aggregate key category. Those subcategories that contribute together more than 60 % to the key category should be treated as particularly significant. It may be appropriate to focus efforts towards methodological improvements of these most significant subcategories.

**Table 2-1 Suggested aggregation level of analysis for Approach 1 [a]**

| Source categories to be assessed in key category analysis | | Special considerations |
|---|---|---|
| **Category code [b]** | **Category title [b]** | |
| 1.A.1.a | Public electricity and heat production | Disaggregate to main fuel types |
| 1.A.1.b | Petroleum refining | Disaggregate to main fuel types |
| 1.A.1.c | Manufacture of solid fuels and other energy industries | Disaggregate to main fuel types |
| 1.A.2.a | Stationary combustion in manufacturing industries and construction: iron and steel | Disaggregate to main fuel types |
| 1.A.2.b | Stationary combustion in manufacturing industries and construction: non-ferrous metals | Disaggregate to main fuel types |
| 1.A.2.c | Stationary combustion in manufacturing industries and construction: chemicals | Disaggregate to main fuel types |
| 1.A.2.d | Stationary combustion in manufacturing industries and construction: pulp, paper and print | Disaggregate to main fuel types |
| 1.A.2.e | Stationary combustion in manufacturing industries and construction: food processing, beverages and tobacco | Disaggregate to main fuel types |
| 1.A.2.f | Stationary combustion in manufacturing industries and construction: other | Disaggregate to main fuel types |
| 1.A.2.g.vii | Mobile Combustion in manufacturing industries and construction | Disaggregate to main fuel types |
| 1.A.2.g.viii | Stationary combustion in manufacturing industries and construction: Other | Disaggregate to main fuel types |
| 1.A.3.a.ii.(i) | Civil aviation (domestic, landing/take-off (LTO)) | |
| 1.A.3.a.ii.(ii) | Civil aviation (domestic, cruise) | |
| 1.A.3.b.i | Road transport: passenger cars | |
| 1.A.3.b.ii | Road transport: light-duty vehicles | |
| 1.A.3.b.iii | Road transport: heavy-duty vehicles | |
| 1.A.3.b.iv | Road transport: mopeds & motorcycles | |
| 1.A.3.b.v | Road transport: gasoline evaporation | |

correlations for key category analysis should be taken into account in the disaggregation level used for the Approach 2 assessment (for more advice on correlations in uncertainty analysis, see Chapter 3, Data Collection.)

| Source categories to be assessed in key category analysis | | Special considerations |
|---|---|---|
| Category code [b] | Category title [b] | |
| 1.A.3.b.vi | Road transport: automobile tyre and brake wear | |
| 1.A.3.b.vii | Road transport: automobile road abrasion | |
| 1.A.3.c | Railways | |
| 1.A.3.d.ii | National navigation (shipping) | Disaggregate to main fuel types |
| 1.A.3.e | Pipeline compressors | Disaggregate to main fuel types |
| 1.A.4.a.i | Commercial/institutional: stationary | Disaggregate to main fuel types |
| 1.A.4.a.ii | Commercial/institutional: mobile | Disaggregate to main fuel types |
| 1.A.4.b.i | Residential: stationary plants | Disaggregate to main fuel types |
| 1.A.4.b.ii | Residential: household and gardening (mobile) | Disaggregate to main fuel types |
| 1.A.4.c.i | Agriculture/forestry/fishing: stationary | Disaggregate to main fuel types |
| 1.A.4.c.ii | Agriculture/forestry/fishing: off-road vehicles and other machinery | Disaggregate to main fuel types |
| 1.A.4.c.iii | Agriculture/forestry/fishing: national fishing | Disaggregate to main fuel types |
| 1.A.5.a | Other, stationary (including military) | |
| 1.A.5.b | Other, mobile (including military, land-based and recreational boats) | |
| 1.B.1.a | Fugitive emission from solid fuels: coal mining and handling | |
| 1.B.1.b | Fugitive emission from solid fuels: solid fuel transformation | |
| 1.B.1.c | Other fugitive emissions from solid fuels | |
| 1.B.2.a.i | Fugitive emissions oil: Exploration, production, transport | |
| 1.B.2.a.iv | Fugitive emissions oil: Refining / storage | |
| 1.B.2.a.v | Distribution of oil products | |
| 1.B.2.b | Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) | |
| 1.B.2.c | Venting and flaring (oil, gas, combined oil and gas) | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 1.B.2.d | Other fugitive emissions from energy production | |
| 2A1 | Cement production | |
| 2A2 | Lime production | |
| 2A3 | Glass production | |
| 2A5a | Quarrying and mining of minerals other than coal | |

| Source categories to be assessed in key category analysis | | Special considerations |
|---|---|---|
| **Category code** [b] | **Category title** [b] | |
| 2A5b | Construction and demolition | |
| 2A5c | Storage, handling and transport of mineral products | |
| 2A6 | Other mineral products | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 2B1 | Ammonia production | |
| 2B2 | Nitric acid production | |
| 2B3 | Adipic acid production | |
| 2B5 | Carbide production | |
| 2B6 | Titanium dioxide production | |
| 2B7 | Soda ash production | |
| 2B10a | Chemical industry: Other | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 2B10b | Storage, handling and transport of chemical products | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 2C1 | Iron and steel production | |
| 2C2 | Ferroalloys production | |
| 2C3 | Aluminium production | |
| 2C4 | Magnesium production | |
| 2C5 | Lead production | |
| 2C6 | Zinc production | |
| 2C7a | Copper production | |
| 2C7b | Nickel production | |
| 2C7c | Other metal production | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 2C7d | Storage, handling and transport of metal products | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 2D3a | Domestic solvent use including fungicides | |
| 2D3b | Road paving with asphalt | |
| 2D3c | Asphalt roofing | |
| 2D3d | Coating applications | |

| Source categories to be assessed in key category analysis | | Special considerations |
|---|---|---|
| **Category code** [b] | **Category title** [b] | |
| 2D3e | Degreasing | |
| 2D3f | Dry cleaning | |
| 2D3g | Chemical products | |
| 2D3h | Printing | |
| 2D3i | Other solvent use | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 2G | Other product use | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 2H1 | Pulp and paper industry | |
| 2H2 | Food and beverages industry | |
| 2H3 | Other industrial processes | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 2I | Wood processing | |
| 2J | Production of POPs | |
| 2K | Consumption of POPs and heavy metals (e.g. electrical and scientific equipment) | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 2L | Other production, consumption, storage, transportation or handling of bulk products | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 3B1a | Manure management - Dairy cattle | |
| 3B1b | Manure management - Non-dairy cattle | |
| 3B2 | Manure management - Sheep | |
| 3B3 | Manure management - Swine | |
| 3B4a | Manure management - Buffalo | |
| 3B4d | Manure management - Goats | |
| 3B4e | Manure management - Horses | |
| 3B4f | Manure management - Mules and asses | |
| 3B4gi | Manure mangement - Laying hens | |
| 3B4gii | Manure mangement - Broilers | |
| 3B4giii | Manure mangement - Turkeys | |
| 3B4giv | Manure management - Other poultry | |

| Source categories to be assessed in key category analysis | | Special considerations |
|---|---|---|
| **Category code** [b] | **Category title** [b] | |
| 3B4h | Manure management - Other animals | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 3Da1 | Inorganic N-fertilizers (includes also urea application) | |
| 3Da2a | Animal manure applied to soils | |
| 3Da2b | Sewage sludge applied to soils | |
| 3Da2c | Other organic fertilisers applied to soils (including compost) | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 3Da3 | Urine and dung deposited by grazing animals | |
| 3Da4 | Crop residues applied to soils | |
| 3Db | Indirect emissions from managed soils | |
| 3Dc | Farm-level agricultural operations including storage, handling and transport of agricultural products | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 3Dd | Off-farm storage, handling and transport of bulk agricultural products | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 3De | Cultivated crops | |
| 3Df | Use of pesticides | |
| 3F | Field burning of agricultural residues | |
| 3I | Agriculture other | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 5A | Biological treatment of waste - Solid waste disposal on land | |
| 5B1 | Biological treatment of waste - Composting | |
| 5B2 | Biological treatment of waste - Anaerobic digestion at biogas facilities | |
| 5C1a | Municipal waste incineration | |
| 5C1bi | Industrial waste incineration | |
| 5C1bii | Hazardous waste incineration | |
| 5C1biii | Clinical waste incineration | |
| 5C1biv | Sewage sludge incineration | |
| 5C1bv | Cremation | |

| **Source categories to be assessed in key category analysis** | | **Special considerations** |
|---|---|---|
| **Category code** [b] | **Category title** [b] | |
| 5C1bvi | Other waste incineration | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 5C2 | Open burning of waste | |
| 5D1 | Domestic wastewater handling | |
| 5D2 | Industrial wastewater handling | |
| 5D3 | Other wastewater handling | |
| 5E | Other waste (please specify in IIR) | If this category is key, the inventory compiler should determine which subcategories are significant. |
| 6A | Other (included in national total for entire territory) | If this category is key, the inventory compiler should determine which subcategories are significant. |

[a] In some cases, inventory compilers may modify this list of categories to reflect particular national circumstances.
[b]The categories should include the respective codes and be consistent with the most recent NFR terminology.

## 2.4 Methodological approaches to identify key categories

The methodology follows the IPCC approach to produce pollutant-specific key categories and covers Approaches 1 and 2 for both level and trend assessments. The two approaches developed by the IPCC, and described below, for performing key category analysis can be used to identify the key categories for each pollutant. Both approaches identify key categories in terms of their contribution to the absolute level of national emissions and to the trend of emissions.

- In Approach 1, key categories are identified using a predetermined cumulative emissions threshold. Key categories are those which, when summed together in descending order of magnitude, cumulatively add up to 80 % of the total level ([4]).
- In Approach 2, key categories can be derived by inventory compilers if category uncertainties or parameter uncertainties are available. Under Approach 2, categories are sorted according to their contribution to uncertainty.

Results of Approach 2 are additional to Approach 1. If Approach 1 and Approach 2 assessments have been performed, it is good practice to report the results of Approach 2 analysis in addition to the results of Approach 1. Results of both Approaches 1 and 2 should be used when setting priorities to inventory preparation.

An additional step (see Appendix A) can be used for countries wanting to aggregate their pollutant-specific key category analysis to a single list based on weightings.

([4]) The predetermined threshold is based on an evaluation of several inventories and is aimed at establishing a general level where a significant percentage of inventory uncertainty will be covered by key categories. The final category that should be defined as *key* is that category for which the cumulative total is exactly equal to, or exceeds the 80 % threshold. This approach is consistent with that recommended by IPCC for the determination of key sources.

In addition to making a quantitative determination of key categories (or where quantitative assessments are not possible), it is good practice to consider qualitative criteria (for more detail, see subsection 2.4.3).

Figure 2-2 illustrates how inventory compilers can determine which approach to use for the identification of key categories.

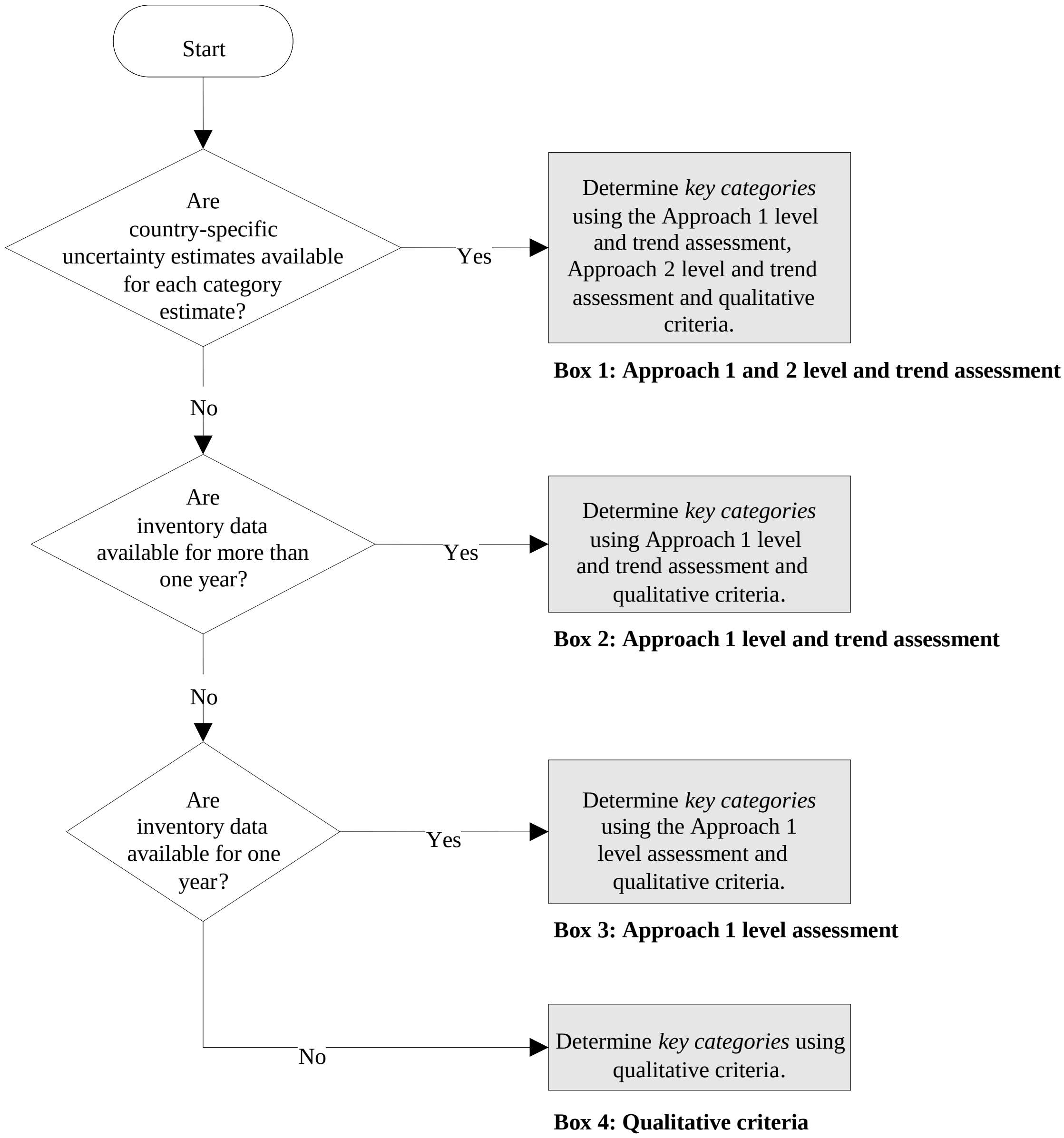


**Figure 2-2 Decision tree to identify key categories**

### 2.4.1 Approach 1 to identify key categories

Approach 1 to identifying key categories assesses the influence of various categories of sources on the *level*, and, possibly, the *trend* of the national inventory. When the inventory estimates are available for several years, it is good practice to assess the contribution of each category to both the level and trend of the national inventory. If only a single year's inventory is available, a level assessment can only be performed.

Approach 1 can readily be accomplished using a spreadsheet analysis. Table 2-2 (level) and Table 2-3 ([5]) (trend) illustrate the format of the analysis. Separate calculation sheets ([6]) are suggested for each pollutant and for the level and trend assessments because it is necessary to sort the results of the analysis for each pollutant. It is more difficult to track the process if the analyses are combined in the same table.

***Level assessment***

The contribution of each source category to the total national inventory level is calculated according to equation (1) (level assessment (Approach 1)):

Key category level assessment = | source category estimate | / total contribution

$$L_{x,t} = E_{x,t} \; / \; \sum E_t \qquad (1)$$

Where:

| | | |
|---|---|---|
| $\boldsymbol{L_{x,t}}$ | = | level assessment for source x in latest inventory year (year *t*) |
| $\boldsymbol{E_{x,t}}$ | = | value of emission estimate of source category *x* in year *t* |
| $\sum \boldsymbol{E_t}$ | = | total contribution, which is the sum of the emissions in year *t*, calculated using the aggregation level chosen by the country for key category analysis |

Key categories according to equation (1) are those that, when summed together in descending order of magnitude, add up to 80 % of the sum of all $\boldsymbol{L_{x,t}}$. Table 2-2 presents a format that can be used for the level assessment.

**Table 2-2 Spreadsheet for the Approach 1 analysis — level assessment**

| A[5] | B[5] | C[5] | D | E | F |
|---|---|---|---|---|---|
| **NFR category code** | **NFR category** | **Pollutant** | **Latest year estimate** $\boldsymbol{E_{x,t}}$ | **Level assessment** $\boldsymbol{L_{x,t}}$ | **Cumulative total of column E** |
| | | | | | |
| | | | | | |
| | | | | | |

([5]) This guidance is copied from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and has been modified to provide column headings relevant for air pollutant emissions.

([6]) The 2006 IPCC Guidelines for National Greenhouse Gas Inventories provides an Excel spreadsheet tool for these calculations.

| | | | | | |
|---|---|---|---|---|---|
| Total | | | $\sum E_t$ | 1 | |

Where:

| | |
|---|---|
| column A: | code of NFR categories |
| column B: | description of NFR categories including fuel type |
| column C: | pollutant |
| column D: | value of emission estimate of category *x* in latest inventory year (year *t*) |
| column E: | level assessment following equation (1) |
| column F: | cumulative total of column F |

Inputs to columns A–D will be available from the inventory. The total of column D presents the emissions. In column E, the level assessment is computed according to equation (1). Once the entries in column E are computed, the categories in the table should be sorted in descending order of magnitude according to column E. After this step, the cumulative total summed in column E can be calculated into column F. Key categories are those that, when summed together in descending order of magnitude, add up to 80 % of the total in column F. Where the method is applied correctly, the sum of entries in column E must be 1. The rationale for the choice of the 80 % threshold for the Approach 1 builds on Rypdal & Flugsrud (2001) and is also presented in the IPCC Guidelines, Chapter 7, subsection 7.2.1.1. This rationale suggests application of some pragmatic reduction to the threshold based on analysis of the relationship of the number of key categories compared to the threshold because of the number of pollutants for which emissions are estimated. Analysis of recent reporting shows that an 80 % cut-off captures a maximum of 75 % of categories for NMVOC reporting where emissions are important for a large number of categories.

The level assessment should be performed for the base year of the inventory (if applicable) and for the latest inventory year (year *t*). If estimates for the base year have changed or been recalculated, the base year analysis should be updated. Key category analysis can also be updated for other recalculated years. In many cases, however, it is sufficient to derive conclusions regarding methodological choice, resource prioritisation or QA/QC procedures without an updated key category analysis for the entire inventory time series. Any category that meets the threshold for the base year or the most recent year should be identified as *key*. However, the interpretation of the results of the key category analysis should take longer time series than the most recent year into account if key category analyses are available. If a category has been *key* for all or most previous years according to either the level or trend assessments or both (the two assessments should be considered separately), they should be identified as *key* in the latest year estimate except in cases where a clear explanation can be provided why a category may no longer be *key* in any future years.

***Trend assessment***

The purpose of the trend assessment is to identify categories that may not be large enough to be identified by the level assessment, but whose trend is significantly different from the trend of the overall inventory, and should therefore receive particular attention. The trend assessment can be calculated according to equation (2) if more than one year of inventory data are available.

$$T_{x,t} = \frac{E_{x,0}}{\sum E_0} \bullet \left( \left[ \frac{(E_{x,t} - E_{x,0})}{E_{x,0}} \right] - \frac{\left( \sum E_t - \sum E_0 \right)}{\sum E_0} \right) \qquad (2)$$

Where:

| | | |
|---|---|---|
| $\boldsymbol{T_{x,t}}$ | = | trend assessment of source category $x$ in year $t$ as compared to the base year (year 0) or starting year of the inventory |
| $\boldsymbol{E_{x,t}}$ and $\boldsymbol{E_{x,0}}$ | = | values of estimates of source category $x$ in year $t$ and 0 respectively |
| $\sum \mathrm{E}_t$ and $\sum \mathrm{E}_0$ | = | total inventory estimates in years $t$ and 0 respectively |

The trend of a category refers to the change in the source category emissions over time; it is computed by subtracting the base year, or the starting year (year 0), estimate for source category $x$ from the latest inventory year (year $t$) estimate and dividing by the value of the base year estimate.

The total trend refers to the change in the total inventory emissions over time, computed by subtracting the year 0 estimate for the total inventory from the latest year (year $t$) estimate and dividing by the value of the year 0 estimate.

In circumstances where the year 0 emissions for a given category are zero, the expression may be reformulated to avoid zero in the denominator (see equation (3)).

$$T_{x,t} = E_{x,t} / \sum E_0 \qquad (3)$$

Where:

| | | |
|---|---|---|
| $\boldsymbol{T_{x,t}}$ | = | trend assessment of source category $x$ in year $t$ as compared to the base year (year 0) or starting year of the inventory |
| $\sum \mathrm{E}_0$ | = | total inventory estimates in years $t$ and 0, respectively |
| $\boldsymbol{E_{x,t}}$ | = | values of estimates of source category $x$ in years $t$ |

The trend assessment identifies categories whose trend is different from the trend of the total inventory, regardless of whether the category trend is increasing or decreasing, or is a sink or source. Categories whose trends diverge most from the total trend should be identified as *key*, when this difference is weighted by the level of emissions of the category in the base year.

Table 2-3 outlines a format that can be used for the Approach 1 trend assessment.

**Table 2-3 Spreadsheet for the Approach 1 analysis — trend assessment**

| A[5] | B[5] | C[5] | D | E | F | G | H |
|---|---|---|---|---|---|---|---|
| **NFR category code** | **NFR category** | **Pollutant** | **Base year estimate** $E_{x,0}$ | **Latest year estimate** $E_{x,t}$ | **Trend assessment** $T_{x,t}$ | **% Contribution to trend** | **Cumulative total of column G** |
| | | | | | | | |
| | | | | | | | |
| **Total** | | | | | $\sum T_t$ | 1 | |

Where:

column A : code of NFR categories ([5])

column B : description of NFR categories ([5])

column C : pollutant ([5])

column D : year 0 estimate of emissions from the national inventory data

column E : latest year estimate of emissions from the most recent national inventory data

column F : trend assessment from equation (2) (from equation (3) for zero base year emissions)

column G : percentage contribution of the category to the total of trend assessments in last row of column F, i.e. $T_{x,t} \ / \sum T_t$

column H : cumulative total of column G, calculated after sorting the entries in descending order of magnitude according to column G

The entries in columns A, B, C and E should be identical to those used in Table 2-2, for the Approach 1 analysis — level assessment. The base year estimate in column D is always entered, while the latest year estimate in column E will depend on the year of analysis. The value of $T_{x,t}$ should be entered in column F for each category of sources, following equation (2), and the sum of all the entries entered in the total line of the table. The percentage contribution of each category to the total of column F should be computed and entered in column G. The categories (i.e. the rows of the table) should be sorted in descending order of magnitude, based on column G. The cumulative total of column G should then be computed in column H. Key categories are those that, when summed together in descending order of magnitude, add up to more than 80 % of the total of column F.

The trend assessment treats increasing and decreasing trends similarly. However, for the prioritisation of resources, there may be specific circumstances where countries may not want to invest additional resources in the estimation of key categories with decreasing trends. Underlying reasons why a category showing strong decreasing trends could include activity decrease, mitigation measures leading to reduced emission factors or abatement measures (e.g. chemical or metals production) changing the production processes.

In particular for a long-term decline of activities (not volatile economic trends) and when the category is not *key* from the level assessment, it is not always necessary to implement higher tier methods or to collect additional country-specific data if appropriate explanations can be provided why a category may not become more relevant again in the future. This could be the case, for example, for emissions of some pollutants (e.g. lead) from road vehicles in countries where switching to lead-free fuel reduced emissions significantly. Regardless of the method chosen or the importance of the category in particular years, countries should endeavour to use the same method for all years in a time series. Therefore, it may be more appropriate to continue using a higher tier method if it had been used in previous years.

Categories, identified using *key* in the trend assessment, which show declining trends, such as the introduction of abatement measures or other emission reduction measures, should be prioritised as appropriate estimation of these emissions will be important. Irrespective of the methodological choice, inventory compilers should clearly and precisely explain and document categories with strongly decreasing trends and should apply appropriate QA/QC procedures.

### *2.4.2 Approach 2 to identify key categories*

Approach 2 is an enhancement on Approach 1 and helps to promote the importance of categories that have a high uncertainty. The approach is based on the results of the uncertainty analysis described in the Chapter 5, Uncertainties, in this Guidebook. Inventory compilers are encouraged to use Approach 2 in addition to Approach 1 because it will provide additional insight into the categories with high uncertainties and will assist in prioritising activities to improve inventory quality and reduce overall uncertainty.

***Application of uncertainty estimates to identify key categories***

Uncertainty estimates based on the uncertainty Approach 1 described in Chapter 5, Uncertainties, are sufficient for this purpose; however, estimates based on the uncertainty Approach 2 should be used when available. The category uncertainties are incorporated by weighting the Approach 1 level and trend assessment results according to the category percentage uncertainty. The key category equations are presented below.

***Level assessment***

Equation (4) describes the Approach 2 level assessment including uncertainty. This equation should be used to modify the equation in column E of Table 2-2 to add in the uncertainty component.

$$LU_{x,t} = \left( L_{x,t} \bullet U_{x,t} \right) / \sum\left[ \left( L_t \bullet U_t \right) \right] \qquad (4)$$

Where:

| | | |
|---|---|---|
| $\boldsymbol{LU_{x,t}}$ | = | level assessment for category $x$ in latest inventory year (year $t$) with uncertainty |
| $\boldsymbol{L_{x,t}}$ | = | computed as in equation (1) |
| $\boldsymbol{U_{x,t}}$ | = | category percentage uncertainty in year $t$ calculated as described in Chapter 5, Uncertainties, and reported in column G of Table 6-1 in the same chapter. If the uncertainty is asymmetrical, the larger uncertainty |

should be used. The relative uncertainty will always have a positive sign.

After computing level assessment with uncertainty, results should be sorted according to decreasing order of magnitude, as in Approach 1. The key categories are those that add up to 80 % of the sum of all $\boldsymbol{LU}_{x,t}$. This 80 % was the basis for the derivation of the threshold used in the Approach 1 analysis. The categories identified by the level assessment with uncertainty that are different from categories identified by Approach 1 should then be highlighted and added to those also to be treated as additional key categories. In addition, the order of key categories identified by Approach 2 may be of use for those who are planning to improve inventories.

***Trend assessment***

Equation (5) shows how the Approach 2 Trend Assessment can be expanded to include uncertainty. This equation should be used to modify the equation in column F of Table 2-3 to add in the uncertainty component.

$$TU_{x,t} = \left( T_{x,t} \bullet U_{x,t} \right) \qquad (5)$$

Where:

| | | |
|---|---|---|
| $\boldsymbol{TU}_{x,t}$ | = | trend assessment for category $x$ in latest inventory year (year $t$) with uncertainty |
| $\boldsymbol{T}_{x,t}$ | = | trend assessment computed as in equation (2) |
| $\boldsymbol{U}_{x,t}$ | = | category percentage uncertainty in year $t$ calculated as described in Chapter 5, Uncertainties. Note that this is the same uncertainty as in the total of column G of Table 6-1 in the same chapter and not the uncertainty assessment for trend. The relative uncertainty will always have a positive sign. |

After computing trend assessment with uncertainty, results should be sorted according to decreasing order of magnitude. The key categories are those that add up to 80 % of the total value of the total $TU_{x,t}$. This 80 % was the basis for the derivation of the threshold used in the Approach 1 analysis. The key categories according to trend assessment with uncertainty should be treated as key categories and should be added to the list of key categories from Approach 1, if they are different from categories identified by Approach 1. In addition, the order of key categories identified by Approach 2 may be of use for those who are planning to improve inventories.

***Incorporating Monte Carlo analysis***

In Chapter 5, Uncertainties, Monte Carlo analysis is presented as the Approach 2 for quantitative uncertainty assessment. Whereas the Approach 1 uncertainty analysis is based on simplified assumptions to develop uncertainties for each category, Monte Carlo types of analysis can handle large uncertainties, complex probability density functions, correlations or complex emission estimation equations. The output of the Approach 2 uncertainty analysis can be used directly in equations (4) and (5). If uncertainties are asymmetrical, the larger percentage difference between the mean and the confidence limit should be used.

Monte Carlo analysis or other statistical tools can also be used to perform a sensitivity analysis to directly identify the principal factors contributing to the overall uncertainty. Thus, a Monte Carlo or similar analysis can be a valuable tool for a key category analysis. Inventory compilers are encouraged to use the method, for example, to analyse more disaggregated subcategories (by modelling correlations), emission factors and activity data separately (to identify key parameters rather than key categories). The use of these methods should be properly documented.

### 2.4.3 Qualitative criteria to identify key categories

In some cases, the results of Approach 1 or Approach 2 analysis of key categories may not identify all categories that should be prioritised in the inventory system. If quantitative key category analysis has not been carried out due to lack of completeness in the inventory, it is good practice to use qualitative criteria to identify key categories. The criteria below address specific circumstances that may not be readily reflected in the quantitative assessment. These criteria should be applied to categories not identified in the quantitative analysis. Those that meet the qualitative criteria should be added to the list of key categories. Although it is important to implement a trend assessment as part of good practice if data are available, it is particularly important to consider these criteria if the trend assessment has not been compiled.

- *Mitigation techniques and technologies*: if emissions from a category have decreased through the use of mitigation techniques, it is good practice to identify such categories as *key*. This will ensure that such categories are prioritised within the inventory and that better quality estimates are prepared to reflect the mitigation effects as closely as possible. It will also ensure that the methods used are transparent with respect to mitigation which is important for assessing inventory quality.
- *Expected growth*: the inventory compiler should assess which categories are likely to show an increase in emissions in the future. The inventory compiler may use expert judgement to make this determination. It is encouraged to identify such categories as *key*.
- *No quantitative assessment of uncertainties performed*: where Approach 2 including uncertainties in the key category analysis is not used, inventory compilers are still encouraged to identify categories that are assumed to contribute most to the overall uncertainty as *key;* the largest reductions in overall inventory uncertainty can be achieved by improving the estimates of categories having higher uncertainties. The qualitative consideration should take into account whether any methodological improvements could reduce uncertainties significantly. This could, for example, be applied to a small net flux results from the subtraction of large emissions, which can imply a very high uncertainty.
- *Completeness*: neither Approach 1 nor Approach 2 gives correct results if the inventory is not complete. The analysis can still be performed, but there may be key categories among those not estimated. In these cases it is good practice to examine qualitatively potential key categories that are not yet estimated quantitatively by applying the qualitative considerations above. The inventory of a country with similar national circumstances can also often give good indications of potential key categories. Chapter 3, Data collection, suggests methods to approximate activity data that can be used to compile preliminary estimates of emissions in a category. This preliminary analysis can thus be used to conclude whether a category potentially is *key* and prioritise data collection in that category.

The qualitative assessment should aim to introduce those categories within the quantitative ranking system, described in subsections 2.4.1 and 2.4.2, for each pollutant.

## 2.5 Reporting and documentation

It is good practice to clearly document the results of the key category analysis in an appropriate inventory report, such as the Informative Inventory Report (IIR), as specified in the UNECE EMEP Reporting Guidelines. Documentation should include a series of tables by pollutant showing the prioritised categories, explaining the choice of method for each category (using Tier 1, 2 or 3 notations) and listing the criteria by which each category was identified as *key* (e.g. Approach 1, Approach 2, level or trend, or qualitative) using the following notations e.g. L1, L2, T1 or T2 where:

- L = key category according to level assessment
- T = key category according to trend assessment
- Q = key category according to qualitative criteria
- 1 = Approach 1 (basic cumulative on magnitude of emission)
- 2 = Approach 2 (applying uncertainty weightings)

Where categories are key and only Tier 1 methods are used a description of the difficulties in estimating using higher tiers should also be described.

## 2.6 Examples of key category analysis

Examples of the application of Approach 1 are shown in Table 2-4 and Table 2-5. Both the level and the trend assessment were conducted using estimates of emissions from the national inventory of Sweden (IVL, 2006). Currently this analysis does not show the recommended level of disaggregation by fuel. Although a qualitative assessment was not conducted in this example, it was not anticipated that additional categories would have been identified.

Examples of the results of the Approach 1 level assessment are shown in Table 2-4 with key categories in bold. Table 2-5 presents an Approach 1 trend key category analysis. Examples of Approach 2 level and trend assessments can be seen in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Chapter 4, Tables 4.9 and 4.10). Table 2-6 finally summarises the results of the key category analysis for $NO_x$ for Sweden.

**NOTE:**

For air quality pollutants there should be a table, or tables, per pollutant as the emissions for different pollutants cannot be added together unless an optional approach for combining results of individual key category analyses is implemented (as specified in Appendix A). In addition, the examples below present the 80 % threshold suggested for key category analysis for air quality pollutants.

**Table 2-4. Example of Approach 1 level assessment (with key categories in bold)**

| A[5] | B[5] | C[5] | D | E | F |
|---|---|---|---|---|---|
| **NFR category code** | **NFR category** | **Pollutant** | **Latest year estimate $E_{x,t}$** | **Level assessment $L_{x,t}$** | **Cumulative total of column E** |
| **1.A.3.b.iii** | **Road transport: heavy-duty vehicles** | **$NO_X$** | **44.87** | **0.26** | **0.26** |
| **1.A.3.b.i** | **Road transport: passenger cars** | **$NO_X$** | **28.12** | **0.16** | **0.42** |
| **1.A.2.f** | **Other (specify in a covering note)** | **$NO_X$** | **21.29** | **0.12** | **0.54** |
| **1.A.1.a** | **Public electricity and heat production** | **$NO_X$** | **12.84** | **0.07** | **0.62** |
| **2.D.1** | **Pulp and paper** | **$NO_X$** | **10.98** | **0.06** | **0.68** |
| **1.A.4.c.ii** | **Off-road vehicles and other machinery** | **$NO_X$** | **10.19** | **0.06** | **0.74** |
| **1.A.3.d.ii** | **National navigation** | **$NO_X$** | **5.96** | **0.03** | **0.77** |
| **1.A.2.d** | **Pulp, paper and print** | **$NO_X$** | **5.91** | **0.03** | **0.81 — see note** |
| 1.A.3.b.ii | Road transport: light-duty vehicles | $NO_x$ | 5.90 | 0.03 | 0.84 |
| 1.A.4.c.iii | National fishing | $NO_x$ | 4.53 | 0.03 | 0.86 |
| 1.A.4.b.i | Residential plants | $NO_x$ | 3.98 | 0.02 | 0.89 |
| 1.A.3.e.ii | Other mobile sources and machinery | $NO_x$ | 3.19 | 0.02 | 0.90 |
| 1.A.2.c | Chemicals | $NO_x$ | 2.28 | 0.01 | 0.92 |
| 1.A.3.a.ii.(ii) | Civil aviation (domestic, cruise) | $NO_x$ | 2.08 | 0.01 | 0.93 |
| 1.A.4.b.ii | Household and gardening (mobile) | $NO_x$ | 1.78 | 0.01 | 0.94 |
| 1.A.1.b | Petroleum refining | $NO_x$ | 1.44 | 0.01 | 0.95 |
| 1.A.3.c | Railways | $NO_x$ | 1.36 | 0.01 | 0.95 |
| 1.A.5.b | Other, mobile (including military) | $NO_x$ | 1.24 | 0.01 | 0.96 |
| 1.A.2.a | Iron and steel | $NO_x$ | 1.09 | 0.01 | 0.97 |
| 2.B.10.a | Other | $NO_x$ | 1.05 | 0.01 | 0.97 |
| 2.C.1 | Iron and steel production | $NO_x$ | 0.95 | 0.01 | 0.98 |
| 2.A.7 | Other including non-fuel mining & construction | $NO_x$ | 0.68 | 0.00 | 0.98 |
| 1.A.2.e | Food processing, beverages and tobacco | $NO_x$ | 0.62 | 0.00 | 0.99 |
| 1.A.3.a.ii.(i) | Civil aviation (domestic, LTO) | $NO_x$ | 0.45 | 0.00 | 0.99 |
| 1.A.4.a | Commercial/institutional | $NO_x$ | 0.42 | 0.00 | 0.99 |
| 1.A.4.c.i | A/F/F Stationary | $NO_x$ | 0.35 | 0.00 | 0.99 |
| 2.B.2 | Nitric acid production | $NO_x$ | 0.24 | 0.00 | 1.00 |

| A[5] | B[5] | C[5] | D | E | F |
|---|---|---|---|---|---|
| **NFR category code** | **NFR category** | **Pollutant** | **Latest year estimate $E_{x,t}$** | **Level assessment $L_{x,t}$** | **Cumulative total of column E** |
| 1.A.3.b.iv | Road transport: mopeds & motorcycles | $NO_x$ | 0.22 | 0.00 | 1.00 |
| 1.B.2.c | Venting and flaring | $NO_x$ | 0.16 | 0.00 | 1.00 |
| 1.A.1.c | Manufacture of solid fuels and other energy industries | $NO_x$ | 0.16 | 0.00 | 1.00 |
| 1.A.2.b | Non-ferrous metals | $NO_x$ | 0.09 | 0.00 | 1.00 |
| 5.C | Waste incineration | $NO_x$ | 0.09 | 0.00 | 1.00 |
| 1.B.1.c | Other (specify in a covering note) | $NO_x$ | 0.08 | 0.00 | 1.00 |
| 1.B.2.a.iv | Refining/storage | $NO_x$ | 0.02 | 0.00 | 1.00 |
| 1.B.1.c | Other (specify in a covering note) | $NO_x$ | 0.08 | 0.00 | 1.00 |
| 1.B.2.a.iv | Refining/storage | $NO_x$ | 0.02 | 0.00 | 1.00 |
| 1.B.2.a.vi | Other | $NO_x$ | 0.00 | 0.00 | 1.00 |

This example is based on the 2006 inventory of Sweden, where fuel type was not separated as recommended in these *Guidelines*. This does not affect categories identified as *key*.

Note: Values in columns E and F are rounded. The final category that should be defined as *key* is that category for which the cumulative total is exactly equal to, or exceeds the 80 % threshold. This approach is consistent with that recommended by the IPCC for the determination of key sources.

**Table 2-5 Example of Approach 1 trend assessment (with key categories in bold)**

| A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|
| **NFR category code** | **NFR category** | **Pollutant** | $E_{x,0}$ **(Gg)** | $E_{x,t}$ **(Gg)** | **Trend assessment** $T_{x,t}$ | **% Contri-bution to trend** | **Cumulative total of column G** |
| **1.A.3.b.i** | **Road transport: passenger cars** | $\mathbf{NO_x}$ | **105.58** | **28.12** | **0.10** | **0.43** | **0.43** |
| **1.A.3.b.iii** | **Road transport: heavy-duty vehicles** | $\mathbf{NO_x}$ | **58.78** | **44.87** | **0.04** | **0.17** | **0.60** |
| **2.D.1** | **Pulp and paper** | $\mathbf{NO_x}$ | **10.46** | **10.98** | **0.02** | **0.07** | **0.67** |
| **1.A.1.a** | **Public electricity and heat production** | $\mathbf{NO_x}$ | **14.44** | **12.84** | **0.02** | **0.07** | **0.74** |
| **1.A.2.f** | **Other (specify in a covering note)** | $\mathbf{NO_x}$ | **34.04** | **21.29** | **0.01** | **0.03** | **0.77** |
| **1.A.4.c.iii** | **National fishing** | $\mathbf{NO_x}$ | **4.51** | **4.53** | **0.01** | **0.03** | **0.80** |
| 1.A.3.d.ii | National navigation | $NO_x$ | 7.89 | 5.96 | 0.00 | 0.02 | 0.82 |
| 1.A.4.a | Commercial/institutional | $NO_x$ | 3.32 | 0.42 | 0.00 | 0.02 | 0.84 |
| 1.A.5.b | Other, mobile (including military) | $NO_x$ | 4.63 | 1.24 | 0.00 | 0.02 | 0.86 |
| 1.A.3.e.ii | Other mobile sources and machinery | $NO_x$ | 3.33 | 3.19 | 0.00 | 0.02 | 0.88 |

| A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|
| NFR category code | NFR category | Pollutant | $E_{x,0}$ (Gg) | $E_{x,t}$ (Gg) | Trend assessment $T_{x,t}$ | % Contri-bution to trend | Cumulative total of column G |
| 1.A.2.c | Chemicals | $NO_x$ | 1.99 | 2.28 | 0.00 | 0.02 | 0.90 |
| 1.A.4.b.i | Residential plants | $NO_x$ | 9.22 | 3.98 | 0.00 | 0.02 | 0.91 |
| 1.A.4.c.ii | Off-road vehicles and other machinery | $NO_x$ | 16.32 | 10.19 | 0.00 | 0.02 | 0.93 |
| 1.A.3.a.ii.(ii) | Civil aviation (domestic, cruise) | $NO_x$ | 2.04 | 2.08 | 0.00 | 0.01 | 0.94 |
| 1.A.2.d | Pulp, paper and print | $NO_x$ | 9.37 | 5.91 | 0.00 | 0.01 | 0.95 |
| 1.A.4.b.ii | Household and gardening (mobile) | $NO_x$ | 2.33 | 1.78 | 0.00 | 0.01 | 0.96 |
| 1.A.3.b.ii | Road transport: light-duty vehicles | $NO_x$ | 9.74 | 5.90 | 0.00 | 0.01 | 0.96 |
| 2.B.2 | Nitric acid production | $NO_x$ | 1.15 | 0.24 | 0.00 | 0.01 | 0.97 |
| 2.A.7 | Other including non-fuel mining & construction | $NO_x$ | 0.73 | 0.68 | 0.00 | 0.00 | 0.97 |
| 1.A.2.e | Food processing, beverages and tobacco | $NO_x$ | 1.58 | 0.62 | 0.00 | 0.00 | 0.98 |
| 1.A.1.b | Petroleum refining | $NO_x$ | 2.16 | 1.44 | 0.00 | 0.00 | 0.98 |
| 1.A.3.c | Railways | $NO_x$ | 2.09 | 1.36 | 0.00 | 0.00 | 0.98 |
| 1.A.3.b.iv | Road transport: mopeds & motorcycles | $NO_x$ | 0.09 | 0.22 | 0.00 | 0.00 | 0.99 |
| 2.B.10.a | Chemical industry: other | $NO_x$ | 1.58 | 1.05 | 0.00 | 0.00 | 0.99 |
| 1.B.2.a.iv | Refining/storage | $NO_x$ | 0.27 | 0.02 | 0.00 | 0.00 | 0.99 |
| 1.A.2.a | Iron and steel | $NO_x$ | 1.74 | 1.09 | 0.00 | 0.00 | 0.99 |
| 1.B.1.c | Other (specify in a covering note) | $NO_x$ | 0.36 | 0.08 | 0.00 | 0.00 | 0.99 |
| 1.B.2.c | Venting and flaring | $NO_x$ | 0.09 | 0.16 | 0.00 | 0.00 | 1.00 |
| 1.A.4.c.i | Stationary | $NO_x$ | 0.79 | 0.35 | 0.00 | 0.00 | 1.00 |
| 5.C | Waste incineration | $NO_x$ | 0.02 | 0.09 | 0.00 | 0.00 | 1.00 |
| 1.A.1.c | Manufacture of solid fuels and other energy industries | $NO_x$ | 0.43 | 0.16 | 0.00 | 0.00 | 1.00 |
| 1.A.3.a.ii. (i) | Civil aviation (domestic, LTO) | $NO_x$ | 0.68 | 0.45 | 0.00 | 0.00 | 1.00 |
| 1.A.2.b | Non-ferrous metals | $NO_x$ | 0.20 | 0.09 | 0.00 | 0.00 | 1.00 |
| 1.B.2.a.vi | Other | $NO_x$ | 0.02 | 0.00 | 0.00 | 0.00 | 1.00 |
| 2.C.1 | Iron ad steel production | $NO_x$ | 1.72 | 0.95 | 0.00 | 0.00 | 1.00 |

[a] This example was based on 2006 inventory of Sweden, where fuel type was not separated as recommended in these *Guidelines*. This does not affect categories identified as *key*.

**Table 2-6 Summary of key category analysis (for $NO_x$)**

**Quantitative method used: Approach 1**

| A | B | C | D | E |
|---|---|---|---|---|
| **NFR Category Code** | **NFR Category** | **Pollutant** | **Identification criteria** | **Comments** [a] |
| 1.A.3.b.iii | Road transport: heavy-duty vehicles | $NO_x$ | L1,T1 | 1.A.3.b.iii |
| 1.A.3.b.i | Road transport: passenger cars | $NO_x$ | L1,T1 | 1.A.3.b.i |
| 1.A.2.f | Other (specify in a covering note) | $NO_x$ | L1,T1 | 1.A.2.f |
| 1.A.1.a | Public electricity and heat production | $NO_x$ | L1,T1 | 1.A.1.a |
| 2.D.1 | Pulp and paper | $NO_x$ | L1,T1 | 2.D.1 |
| 1.A.4.c.ii | Off-road vehicles and other machinery | $NO_x$ | L1 | 1.A.4.c.ii |
| 1.A.3.d.ii | National navigation | $NO_x$ | L1 | 1.A.3.d.ii |
| 1.A.2.d | Pulp, paper and print | $NO_X$ | L1 | 1.A.2.d |
| 1.A.4.c.iii | National fishing | $NO_x$ | T1 | 1.A.4.c.iii |

[a] Approach 1 used only for $NO_X$.

# 3 References

IPCC (2000) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, IPCC National Greenhouse Gas Inventories Programme, Institute for Global Environmental Strategies (IGES), Hayama, Japan (www.ipcc-nggip.iges.or.jp/public/gp/english/).

IPCC (2006) *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, IPCC National Greenhouse Gas Inventories Programme, Global Environmental Strategies (IGES), Hayama, Japan (www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm).

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Rypdal, K. & Flugsrud, K. (2001), 'Sensitivity Analysis as a Tool for Systematic Reductions in GHG Inventory Uncertainties', *Environmental Science and Policy*, Vol. 4 (2–3), pp. 117–135.

Statistics Finland (2005), *Greenhouse gas emissions in Finland 1990–2003,* National Inventory Report to the UNFCCC (United Nations Framework Convention on Climate Change), 27 May 2005.

# 4 Point of enquiry

Enquiries concerning this chapter should be directed to the co-chairs of the task force on emission inventories and projections. Please refer to the TFEIP website (www.tfeip-secretariat.org/) for the contact details of the current co-chairs.

# Appendix A Combining air pollutant specific key categories

Once the trend and level key categories have been identified and ranked for each pollutant they can be combined. This is an optional procedure. This can be done by scoring each key category according to its position in the ranked pollutant key category list. The scoring applied can be tailored to national circumstances. A possible approach is to sum the percentage contributions across all pollutants to generate a single combined ranked list for each category.

This should be done for the level and the trend assessments using Approach 2, if uncertainty data are available, and Approach 1 if not.

Table A-1 shows the components for a simple Approach 1 level assessment example for CO and $NO_x$ prior to aggregation. Similar tables should be compiled for all pollutants for which inclusion in the combined key category analysis is desired.

**Table A-1 Simple example of approach 1 level assessment for CO and $NO_x$**

| NFR09 category code | NFR category | Pollutant | Latest year estimate $E_{x,t}$ | Absolute value of latest year estimate $\lvert E_{x,t} \rvert$ | Level assessment $L_{x,t}$ (%) | Cumulative total of column F (%) | Key category flag |
|---|---|---|---|---|---|---|---|
| 1.A.3.b.i | Road transport: passenger cars | CO | 1171301 | 1171301 | 40 | 40 | KC |
| 1.A.4.b.i | Residential plants | CO | 436585.7 | 436585.7 | 15 | 55 | KC |
| 1.A.2.f | Other, manufacturing industries and Construction | CO | 407963.1 | 407963.1 | 14 | 69 | KC |
| 1.A.2.a | Iron and steel | CO | 233561.2 | 233561.2 | 8 | 77 | KC |
| 2.C | Metal production | CO | 99647.03 | 99647.03 | 3 | 80 | KC |
| 1.A.4.b.ii | Household and gardening (mobile) | CO | 72701.24 | 72701.24 | 2 | 83 | |
| 1.A.3.b.iv | Road transport: mopeds & motorcycles | CO | 71785.3 | 71785.3 | 2 | 85 | |
| 1.A.3.b.ii | Road transport: light-duty vehicles | CO | 69050.87 | 69050.87 | 2 | 87 | |
| 1.A.1.a | Public electricity and heat | CO | 67651.24 | 67651.24 | 2 | 90 | |

| NFR09 category code | NFR category | Pollutant | Latest year estimate $E_{x,t}$ | Absolute value of latest year estimate $\|E_{x,t}\|$ | Level assessment $L_{x,t}$ (%) | Cumulative total of column F (%) | Key category flag |
|---|---|---|---|---|---|---|---|
| | production | | | | | | |
| 1.A.3.b.iii | Road transport: heavy-duty vehicles | CO | 55408.77 | 55408.77 | 2 | 92 | |
| 1.A.3.a.ii. (i) | Civil aviation (domestic, LTO) | CO | 51834.52 | 51834.52 | 2 | 93 | |
| 2.B.5 | Other, chemical industry | CO | 28935.83 | 28935.83 | 1 | 94 | |
| 6.C | Waste incineration | CO | 22526.49 | 22526.49 | 1 | 95 | |
| 1.A.4.c.ii | Off-road vehicles and other machinery (A,F,F) | CO | 21252.68 | 21252.68 | 1 | 96 | |
| 2 A 4 | Soda ash production and use | CO | 20876 | 20876 | 1 | 97 | |
| 1.A.4.c.i | Stationary (A,F,F) | CO | 15564.15 | 15564.15 | 1 | 97 | |
| 1.A.1.c | Manufacture of solid fuels and other energy industries | CO | 11613.7 | 11613.7 | 0 | 98 | |
| 1.B.2.c | Venting and flaring (oil and gas) | CO | 11581.24 | 11581.24 | 0 | 98 | |
| 1.A.3.a.i.(ii) | International aviation (cruise) | CO | 0 | 0 | 0 | 98 | |
| 1.A.3.d.ii | National navigation | CO | 8214.236 | 8214.236 | 0 | 98 | |
| 1.A.3.a.i.(i) | International aviation (LTO) | CO | 0 | 0 | 0 | 98 | |
| 1.A.5.b | Other, mobile (including military) | CO | 7327.805 | 7327.805 | 0 | 98 | |

| NFR09 category code | NFR category | Pollutant | Latest year estimate $E_{x,t}$ | Absolute value of latest year estimate $\|E_{x,t}\|$ | Level assessment $L_{x,t}$ (%) | Cumulative total of column F (%) | Key category flag |
|---|---|---|---|---|---|---|---|
| 5.B | Forest and grassland conversion | CO | 6982.847 | 6982.847 | 0 | 99 | |
| 1.B.1.b | Solid fuel transformation | CO | 6609.735 | 6609.735 | 0 | 99 | |
| 6.D | Other, waste | CO | 6435.548 | 6435.548 | 0 | 99 | |
| 5.E | Other (not included in national total) | CO | 0 | 0 | 0 | 99 | |
| 7 | Other (included in national total) | CO | 5874.342 | 5874.342 | 0 | 99 | |
| 1.A.4.a | Commercial/ institutional | CO | 5408.98 | 5408.98 | 0 | 100 | |
| 1.A.1.b | Petroleum refining | CO | 4726.058 | 4726.058 | 0 | 100 | |
| 1.A.3.c | Railways | CO | 4487.554 | 4487.554 | 0 | 100 | |
| 1.A.3.e ii | Other mobile sources and machinery | CO | 1645.713 | 1645.713 | 0 | 100 | |
| 1.A.3.a.ii. (ii) | Civil aviation (domestic, cruise) | CO | 1359.588 | 1359.588 | 0 | 100 | |
| 1.A.2.b | Non-ferrous metals | CO | 962.006 | 962.006 | 0 | 100 | |
| 1.B.2.a.i | Exploration, production, transport (oil) | CO | 460.3594 | 460.3594 | 0 | 100 | |
| 1.A.1.a | Public electricity and heat production | $NO_x$ | 349625.7 | 349625.7 | 22 | 22 | KC |
| 1.A.3.b.iii | Road transport: heavy-duty vehicles | $NO_x$ | 289605.2 | 289605.2 | 18 | 39 | KC |
| 1.A.3.b.i | Road transport: passenger cars | $NO_x$ | 245229.4 | 245229.4 | 15 | 55 | KC |
| 1.A.2.f | Other, manufacturing | $NO_x$ | 242722.7 | 242722.7 | 15 | 70 | KC |

| NFR09 category code | NFR category | Pollutant | Latest year estimate $E_{x,t}$ | Absolute value of latest year estimate $\|E_{x,t}\|$ | Level assessment $L_{x,t}$ (%) | Cumulative total of column F (%) | Key category flag |
|---|---|---|---|---|---|---|---|
| | industries and construction | | | | | | |
| 1.A.3.a.i.(ii) | International aviation (cruise) | $NO_x$ | 138290.8 | 138290.8 | 0 | 70 | KC |
| 1.A.4.b.i | Residential plants | $NO_x$ | 114788.9 | 114788.9 | 7 | 77 | KC |
| 1.A.1.c | Manufacture of solid fuels and other energy industries | $NO_x$ | 65729.83 | 65729.83 | 4 | 81 | |
| 1.A.3.d.ii | National navigation | $NO_x$ | 63271.82 | 63271.82 | 4 | 85 | |
| 1.A.3.b.ii | Road transport: light-duty vehicles | $NO_x$ | 59155.09 | 59155.09 | 4 | 88 | |
| 1.A.4.c.ii | Off-road vehicles and other machinery (A,F,F) | $NO_x$ | 57548.33 | 57548.33 | 4 | 92 | |
| 1.A.1.b | Petroleum refining | $NO_x$ | 29347.65 | 29347.65 | 2 | 94 | |
| 1.A.2.a | Iron and steel | $NO_x$ | 20324.54 | 20324.54 | 1 | 95 | |
| 1.A.5.b | Other, mobile (including military) | $NO_x$ | 20165.12 | 20165.12 | 1 | 96 | |
| 1.A.3.c | Railways | $NO_x$ | 19231.36 | 19231.36 | 1 | 97 | |
| 1.A.4.a | Commercial/ Institutional | $NO_x$ | 19174.46 | 19174.46 | 1 | 98 | |
| 1.A.3.a.i.(i) | International aviation (LTO) | $NO_x$ | 11131.72 | 11131.72 | 0 | 98 | |
| 1.A.3.a.ii. (ii) | Civil aviation (domestic, cruise) | $NO_x$ | 6168.31 | 6168.31 | 0 | 99 | |
| 1.A.3.e.ii | Other mobile sources and machinery | $NO_x$ | 5625.079 | 5625.079 | 0 | 99 | |

| NFR09 category code | NFR category | Pollutant | Latest year estimate $E_{x,t}$ | Absolute value of latest year estimate $\|E_{x,t}\|$ | Level assessment $L_{x,t}$ (%) | Cumulative total of column F (%) | Key category flag |
|---|---|---|---|---|---|---|---|
| 1.B.2.c | Venting and flaring (oil and gas) | $NO_x$ | 2315.35 | 2315.35 | 0 | 99 | |
| 1.A.3.a.ii. (i) | Civil aviation (domestic, LTO) | $NO_x$ | 2279.565 | 2279.565 | 0 | 99 | |
| 6.C | Waste incineration | $NO_x$ | 1769.171 | 1769.171 | 0 | 100 | |
| 2.C | Metal production | $NO_x$ | 1559.267 | 1559.267 | 0 | 100 | |
| 1.A.3.b.iv | Road transport: mopeds & motorcycles | $NO_x$ | 1180.17 | 1180.17 | 0 | 100 | |
| 1.A.4.b.ii | Household and gardening (mobile) | $NO_x$ | 903.5456 | 903.5456 | 0 | 100 | |
| 2.B.2 | Nitric acid Production | $NO_x$ | 736.3512 | 736.3512 | 0 | 100 | |
| 1.A.4.c.i | Stationary (A,F,F) | $NO_x$ | 725.5066 | 725.5066 | 0 | 100 | |
| 1.B.2.a.i | Exploration, production, transport (oil) | $NO_x$ | 523.5352 | 523.5352 | 0 | 100 | |
| 6.D | Other, waste | $NO_x$ | 421.2438 | 421.2438 | 0 | 100 | |
| 1.B.1.b | Solid fuel transformation | $NO_x$ | 364.7564 | 364.7564 | 0 | 100 | |
| 2.B.5 | Other, chemical industry | $NO_x$ | 360.2754 | 360.2754 | 0 | 100 | |
| 5.E | Other | $NO_x$ | 212.0381 | 212.0381 | 0 | 100 | |
| 5.B | Forest and grassland conversion | $NO_x$ | 198.2986 | 198.2986 | 0 | 100 | |

The individual percentage contribution to totals for each pollutant (L) can be seen in column 6.

A summation of the percentage contributions for each of the identified key categories across the pollutants provides a method for ranking all pollutants considered. Table A-2 shows the simple example combining the CO and $NO_x$ from Table A-1 above with additional pollutants to provide a single ranking across all pollutants.

**Table A-2 Final key category ranking across all pollutants considered in analysis.**

| NFR09 | Sector description | % contributions to pollutant totals for key categories (cumulative 80 %) | | | | | | | Sum of KC % contributions | Rank |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CO | $NH_3$ | NMVOC | $NO_x$ | $PM_{10}$ | $PM_{2.5}$ | $SO_x$ | | |
| 1.A.1.a | Public electricity and heat production | | | | 22 | 6 | 5 | 60 | 92 | 1 |
| 1.A.2.f | Other, manufacturing industries and construction | 14 | | 3 | 15 | 13 | 15 | 17 | 78 | 2 |
| 1.A.3.b.i | Road transport: passenger cars | 40 | | 7 | 15 | 4 | 7 | | 73 | 3 |
| 1.A.4.b.i | Residential plants | 15 | | 4 | 7 | 17 | 15 | | 57 | 4 |
| 1.A.3.b.iii | Road transport: heavy-duty vehicles | | | 2 | 18 | 5 | 7 | | 32 | 5 |
| 4.B.1.a | Dairy | | 25 | | | | | | 25 | 6 |
| 4.B.1.b | Non-dairy | | 23 | | | | | | 23 | 7 |
| 3.D | Other, solvent and other product use (including products containing HMs (heavy metals) and POPs) | | | 22 | | | | | 22 | 8 |
| 1.A.3.b.ii | Road transport: light-duty vehicles | | | | | 7 | 11 | | 18 | 9 |
| 4.B.9 | Poultry | | 11 | | | 6 | | | 18 | 10 |
| 2.A.7 | Other, mineral products (including non-fuel mining & construction) | | | | | 7 | 4 | | 12 | 11 |
| 1.A.3.b.vi | Road transport: automobile tyre and brake wear | | | | | 6 | 5 | | 11 | 12 |
| 4.D.1 | Direct soil emission | | 11 | | | | | | 11 | 13 |
| 1.A.4.c.ii | Off-road vehicles and other machinery (A/F/F) | | | | | 4 | 5 | | 9 | 14 |
| 1.A.2.a | Iron and steel | 8 | | | | | | | 8 | 15 |
| 2.D.2 | Food and drink | | | 8 | | | | | 8 | 16 |

| NFR09 | Sector description | % contributions to pollutant totals for key categories (cumulative 80 %) | | | | | | | Sum of KC % contributions | Rank |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CO | $NH_3$ | NMVOC | $NO_x$ | $PM_{10}$ | $PM_{2.5}$ | $SO_x$ | | |
| | production | | | | | | | | | |
| 4.B.8 | Swine | | 8 | | | | | | 8 | 17 |
| 6.C | Waste incineration | | | | | | 5 | | 5 | 18 |
| 1.B.2.a.i | Exploration, production, transport (oil) | | | 5 | | | | | 5 | 19 |
| 1.A.3.b.v | Road Transport: Gasoline evaporation | | | 3 | | | | | 3 | 20 |
| 1.B.2.a.iv | Refining, storage (oil) | | | 3 | | | | | 3 | 21 |
| 1.B.2.a.v | Distribution of oil products | | | 4 | | | | | 4 | 22 |
| 1.B.2.b | Natural gas | | | 4 | | | | | 4 | 23 |
| 1.B.2.c | Venting and flaring (oil and gas) | | | 3 | | | | | 3 | 24 |
| 2.B.5 | Other, chemical industry | | | 5 | | | | | 5 | 25 |
| 2.C | Metal production | | | | | 4 | | | 4 | 26 |
| 3.B | Degreasing and dry Cleaning | | | 3 | | | | | 3 | 27 |
| 3.C | Chemical products, manufacture and processing | | | 1 | | | | | 1 | 28 |