emep

European Environment Agency

| Category | Title |
|---|---|
| **General guidance** | Methodological choice and Key category analysis |
| **Version** | Guidebook 2019 |

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# Contents

# 1 Overview

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 for which higher tiered methods are required. This chapter draws extensively on guidance issued by the Intergovernmental Panel on Climate Change for estimating emissions of greenhouse gases, and in particular the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 Guidelines) (IPCC 2006) and its 2019 Refinement (IPCC, 2019).

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 1.1.3) 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 in order to make the most efficient use of available resources. It is also important to identify categories that contribute significantly to the national totals to ensure that they are compiled accurately and that the data needed to update their estimates is sufficiently maintained. It is good practice for each country to identify its national key categories in a systematic and objective manner. By identifying these key categories in the national inventory, inventory compilers can prioritise their efforts and improve their overall estimates.

## 1.1 Definitions

### *1.1.1 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)[(1)].

### *1.1.2 Fuels*

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

### *1.1.3 Method tiers*

Emissions can be estimated at different levels of complexity. This Guidebook adopts the same approach as that used in the IPCC Guidelines, that methods 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-

([1]) The LRTAP Convention Reporting Guidelines and annexes are available online from the CEIP website (http://www.ceip.at/)

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.

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| **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 method is the simplest method, has the highest level of uncertainty and should not be used to estimate emissions from key categories (see subsection 1.1.4). |
| **Tier 2:**<br>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. Tier methodologies can be similar to Tier 2 (i.e. activity data x emission factor) but with a greater disaggregation of activity data and emission factors. However they can also be complex, dynamic models in which the processes leading to emissions are undertaken at a very high level of detail.<br>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.<br>• Model error: the extent to which the mathematical representation of the processes underlying the emissions deviate from reality.<br>• Parameter error: the error in the model parameters (e.g. emission factors, coefficients, etc.)<br>• Input error: the error in activity data.<br>• 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.<br>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 |

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| | be able to review the methodology within a reasonable time period and are listed below.<br>• For the inventory construction process to be sufficiently transparent, the model documentation has to be clear, correct, concise, comprehensible, and consistent.<br>• The scientific quality of the model has to have been documented in peer-reviewed publications.<br>• 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.<br>• 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.<br>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. |

#### *1.1.4 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 Section 0).

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. This can be achieved by performing a quantitative analysis of the relationship between the magnitude of emissions in any one year (i.e. level) and the change in emissions year to year (i.e. trend) for each category's emissions compared to the total national emissions. The approach for key category analysis is presented in Section 0.

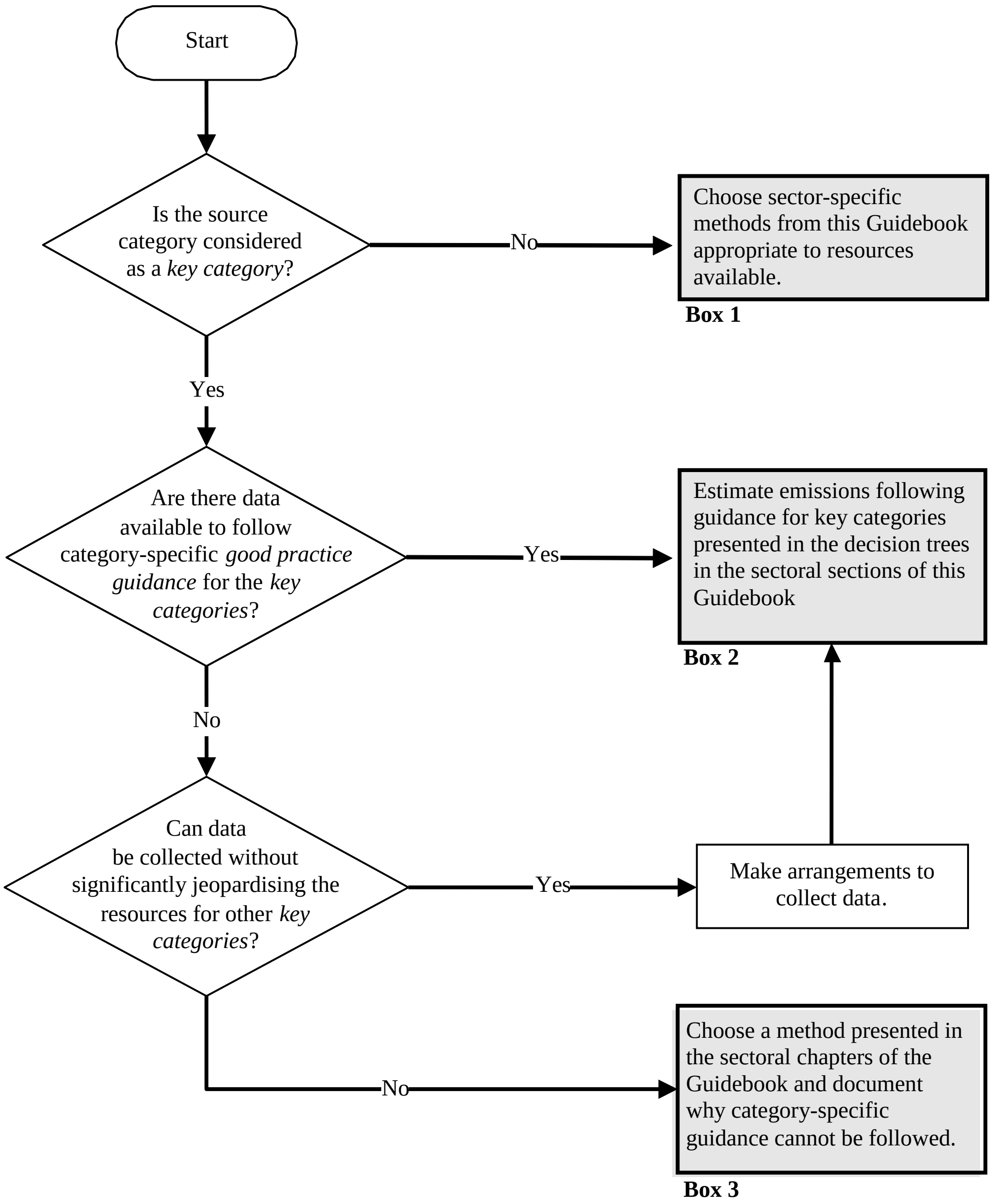
## 1.2 Purpose of key category analysis

A key category analysis helps the identification of the priority categories for which methods, activity data, emission factors and other parameters should be considered for regular update, more rigorously checked and reviewed and, where necessary or possible, improved.

- **Regular update**: Making sure the methods, data flows and country-specific emission factors are kept up to date and available for important regular estimate updates.
- **More focussed checking and review**: Making sure that specific QA/QC activities are implemented for *key categories*. It is *good practice* to give additional attention to *key categories* with respect to quality assurance and quality control (QA/QC) as described in Chapter 6 Inventory management, improvement and QA/QC, and in Part B of this Guidance.
- **Improvement**: Improving accuracy of estimates and reducing overall uncertainty using higher tiered (more accurate) methods. For most sources/sinks, higher tier (Tier 2 and 3) methods are suggested for *key categories*, although this is not always the case. For guidance on the specific application of this principle to *key categories*, it is *good practice* to refer to the decision trees and

sector-specific guidance for the respective category and additional *good practice guidance* in chapters in Part B. 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 1-1. In these cases it should 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.

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



## 1.3 General approach to identify key categories

Key category analysis should be applied in all circumstances of inventory compilation no matter how simple or basic the inventory is. A category can be identified as *key* for different reasons. These include:

- **Level**: the absolute level the source category contributes to the total pollutant emissions for a particular year of interest.
- **Trend**: the change of emissions for the source category across a time series. This is particularly important for categories with increasing or decreasing emissions trends over time.
- **Uncertainty**: if the contribution of a source category's uncertainty to total inventory uncertainty in a particular year, or the trend uncertainty is high, then the category should be identified as key.

In addition to making a quantitative determination of *key categories*, it is *good practice* to consider qualitative criteria for identifying categories that are likely to need prioritised attention (e.g. where significant changes in trends are expected, categories not presently estimated or having a suspected high uncertainty) as described in more detail in Section 3.1.3.

Section 0 presents the detailed methodology for the above cases of *key category* analysis under two approaches. Under approach 1, a *key category* analysis is performed without incorporating uncertainties, whereas under approach 2 information on uncertainties is included. This methodology follows the principles presented in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 1, Chapter 4).

As explained in Section **Error! Reference source not found.** above, the main objective of key category analysis is to identify and prioritise *key categories* within the inventory management system. Therefore, it is helpful to consolidate the different analysis of the level and trend into a single summary list of key categories. This makes engagement with key stakeholders easier and communication of the *key categories* priorities possible. The method for the optional consolidation of key categories is presented in Annex A.

Guidance on reporting and documentation of the *key category* analysis is provided in Section 4. Section 5 gives examples for *key category* identification.

# 2 General rules for identification of key categories

The results of the *key category* analysis help to prioritise data gathering and estimation activities if the analysis is done at a level of aggregation aligned with the national use of methods, data sources and assumptions. Disaggregation to very low levels of subcategories that are all covered by a single method and use of emission factor should be avoided since it will split an important aggregated category into many small subcategories that may be no longer considered as *key*. For example, the combustion of fossil fuels is a large single emission source category but which can be broken down into sub-categories of first, second or third levels, and even to the level of individual plants or boilers.

Table 2-1 lists the recommended source categories and, where relevant, identifies special considerations related to the disaggregation of the analysis. However, countries may adapt the recommended level of analysis in Table 2-1 to their national circumstances. In particular, countries using Approach 2 (subsection 3.1.2) will probably choose the same level of aggregation used for the uncertainty analysis.

The following principles can be followed in designing the analysis and in choosing the level of aggregation or disaggregation for key categories:

- **Categories:** All relevant sectors and categories that contribute to the inventory totals should be included in the key category analysis. For Approach 1, the analysis should be performed at the level of categories or subcategories at which different methods are applied in the inventory. Over time, as estimates are updated/refined and higher tier approaches applied to categories and/or subcategories, the aggregations for key category analysis may change. Countries can consider the disaggregation of categories and subcategories by fuel or other relevant activity differentiators (e.g. livestock/management types etc.) where activity data, assumptions and/or emission factors are from different sources and/or uncertainties are likely to be significantly different. For Approach 2, possible cross-correlations between categories and/or subcategories should be taken into account when considering category aggregation (2). When using Approach 2, the assumptions about such correlations should be the same when assessing uncertainties and identifying key categories (see Chapter A5, Uncertainties). Countries should also consider the relative importance of memo items such as international transportation and biomass burning to ensure that the calculations for these items are adequately addressed when designing improvement activities.
- **Regional disaggregation:** Countries may want to subdivide by region in exceptional cases where regional differences in methods applied are significant. Where this is needed, a regional tag can be added to the category group column of the key category analysis tables for the purposes of transparency.
- **Individual pollutant level:** As it is not possible to combine pollutants using weighting factors (as can be done with greenhouse gases), the key category analysis for each air pollutant should be considered separately. In contrast, a collective analysis of all chemical species of non-methane volatile organic compounds (NMVOCs), where these species can be combined into total NMVOCs, is appropriate.
- **Level of detail:** Countries may choose to perform the quantitative analysis at a more disaggregated level than suggested in Figure 1-1. 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).

The categories included in Table 2-1 below are those for which estimation methods are provided in Part B of this Guidance. 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), 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.

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(2) 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 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.)

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 | These categories should be disaggregated according to methods, data sources, assumptions applied and known or likely differences in uncertainty.<br><br>Estimates compiled from a common set of activity data and emission factors (e.g. energy balances and default or average country specific emission factors) with similar uncertainties can be aggregated.<br><br>Common reasons for disaggregation can include differences in uncertainty for estimates of emissions for different fuels (disaggregation by main fuel type) or the application of Tier 2 or 3 methods for categories or sub-categories.<br><br>Categories where facility/installation reporting is used for part of the estimate and other methods are used to estimate non reporting emission components should be separated as the levels of uncertainty are likely to be different. |
| 1.A.1.b | Petroleum refining | |
| 1.A.1.c | Manufacture of solid fuels and other energy industries | |
| 1.A.2.a | Stationary combustion in manufacturing industries and construction: iron and steel | |
| 1.A.2.b | Stationary combustion in manufacturing industries and construction: non-ferrous metals | |
| 1.A.2.c | Stationary combustion in manufacturing industries and construction: chemicals | |
| 1.A.2.d | Stationary combustion in manufacturing industries and construction: pulp, paper and print | |
| 1.A.2.e | Stationary combustion in manufacturing industries and construction: food processing, beverages and tobacco | |
| 1.A.2.f | Stationary combustion in manufacturing industries and construction: other | |
| 1.A.2.g.viii | Stationary combustion in manufacturing industries and construction: Other | |
| 1.A.2.g.vii | Mobile Combustion in manufacturing industries and construction | See note c |
| 1.A.3.a.i.(i) | Civil aviation (domestic, landing/take-off (LTO)) | Disaggregation could be considered where data for different fuels is sourced from different data providers and different methods are used for small and major airports. |
| 1.A.3.a.ii.(i) | Civil aviation (domestic, cruise) | See note c |
| 1.A.3.b.i | Road transport: passenger cars | Disaggregate by fuel if fuel data is sourced from different data providers and likely to have different levels of accuracy and if |
| 1.A.3.b.ii | Road transport: light-duty vehicles | |

| Source categories to be assessed in key category analysis | | Special considerations |
|---|---|---|
| **Category code** [b] | **Category title** [b] | |
| 1.A.3.b.iii | Road transport: heavy-duty vehicles | emission factors applied are likely to have different levels of accuracy. |
| 1.A.3.b.iv | Road transport: mopeds & motorcycles | |
| 1.A.3.b.v | Road transport: gasoline evaporation | See note c |
| 1.A.3.b.vi | Road transport: automobile tyre and brake wear | See note c |
| 1.A.3.b.vii | Road transport: automobile road abrasion | See note c |
| 1.A.3.c | Railways | See note c |
| 1.A.3.d.i(ii) | International inland waterways | See note c |
| 1.A.3.d.ii | National navigation (shipping) | See note c |
| 1.A.3.e.i | Pipeline compressors | See note c |
| 1.A.3.e.ii | Other Non-road mobile machinery | See note c |
| 1.A.4.a.i | Commercial/institutional: stationary | See note c |
| 1.A.4.a.ii | Commercial/institutional: mobile | See note c |
| 1.A.4.b.i | Residential: stationary plants | See note c |
| 1.A.4.b.ii | Residential: household and gardening (mobile) | See note c |
| 1.A.4.c.i | Agriculture/forestry/fishing: stationary | See note c |
| 1.A.4.c.ii | Agriculture/forestry/fishing: off-road vehicles and other machinery | See note c |
| 1.A.4.c.iii | Agriculture/forestry/fishing: national fishing | See note c |
| 1.A.5.a | Other, stationary (including military) | See note c |
| 1.A.5.b | Other, mobile (including military, land-based and recreational boats) | See note c |
| 1.B.1.a | Fugitive emission from solid fuels: coal mining and handling | See note c |
| 1.B.1.b | Fugitive emission from solid fuels: solid fuel transformation | See note c |
| 1.B.1.c | Other fugitive emissions from solid fuels | See note e |

| Source categories to be assessed in key category analysis | | Special considerations |
|---|---|---|
| Category code [b] | Category title [b] | |
| 1.B.2.a.i | Fugitive emissions oil: Exploration, production, transport | See note c |
| 1.B.2.a.iv | Fugitive emissions oil: Refining / storage | See note c |
| 1.B.2.a.v | Distribution of oil products | See note c |
| 1.B.2.b | Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) | See note c |
| 1.B.2.c | Venting and flaring (oil, gas, combined oil and gas) | See note c |
| 1.B.2.d | Other fugitive emissions from energy production | See note e |
| 2A1 | Cement production | See note d |
| 2A2 | Lime production | See note d |
| 2A3 | Glass production | See note d |
| 2A5a | Quarrying and mining of minerals other than coal | See note d |
| 2A5b | Construction and demolition | See note d |
| 2A5c | Storage, handling and transport of mineral products | See note d |
| 2A6 | Other mineral products | See note e |
| 2B1 | Ammonia production | See note d |
| 2B2 | Nitric acid production | See note d |
| 2B3 | Adipic acid production | See note d |
| 2B5 | Carbide production | See note d |
| 2B6 | Titanium dioxide production | See note d |
| 2B7 | Soda ash production | See note d |
| 2B10a | Chemical industry: Other | See note e |
| 2B10b | Storage, handling and transport of chemical products | See note d |
| 2C1 | Iron and steel production | See note d |

| Source categories to be assessed in key category analysis | | Special considerations |
|---|---|---|
| Category code [b] | Category title [b] | |
| 2C2 | Ferroalloys production | See note d |
| 2C3 | Aluminium production | See note d |
| 2C4 | Magnesium production | See note d |
| 2C5 | Lead production | See note d |
| 2C6 | Zinc production | See note d |
| 2C7a | Copper production | See note d |
| 2C7b | Nickel production | See note d |
| 2C7c | Other metal production | See note e |
| 2C7d | Storage, handling and transport of metal products | See note d |
| 2D3a | Domestic solvent use including fungicides | |
| 2D3b | Road paving with asphalt | |
| 2D3c | Asphalt roofing | |
| 2D3d | Coating applications | |
| 2D3e | Degreasing | |
| 2D3f | Dry cleaning | |
| 2D3g | Chemical products | See note d |
| 2D3h | Printing | |
| 2D3i | Other solvent use | See note e |
| 2G | Other product use | See note e |
| 2H1 | Pulp and paper industry | See note d |
| 2H2 | Food and beverages industry | See note d |
| 2H3 | Other industrial processes | See note e |
| 2I | Wood processing | See note d |

| Source categories to be assessed in key category analysis | | Special considerations |
|---|---|---|
| **Category code [b]** | **Category title [b]** | |
| 2J | Production of POPs | See note d |
| 2K | Consumption of POPs and heavy metals (e.g. electrical and scientific equipment) | See note e |
| 2L | Other production, consumption, storage, transportation or handling of bulk products | See note e |
| 3B1a | Manure management - Dairy cattle | If there are differences in the data sources, assumptions applied and uncertainties for the different animal types and or management/feed practices or if a sub-category accounts for more than 25% of the emissions of the category then these should also be disaggregated. |
| 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 management - Laying hens | |
| 3B4gii | Manure management - Broilers | |
| 3B4giii | Manure management - Turkeys | |
| 3B4giv | Manure management - Other poultry | |
| 3B4h | Manure management - Other animals | See note e |
| 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) | See note e |
| 3Da3 | Urine and dung deposited by grazing animals | |

| Source categories to be assessed in key category analysis | | Special considerations |
|---|---|---|
| **Category code** [b] | **Category title** [b] | |
| 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 | See note e |
| 3Dd | Off-farm storage, handling and transport of bulk agricultural products | See note e |
| 3De | Cultivated crops | |
| 3Df | Use of pesticides | |
| 3F | Field burning of agricultural residues | |
| 3I | Agriculture other | See note e |
| 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 | See note d |
| 5C1bi | Industrial waste incineration | See note d |
| 5C1bii | Hazardous waste incineration | See note d |
| 5C1biii | Clinical waste incineration | See note d |
| 5C1biv | Sewage sludge incineration | See note d |
| 5C1bv | Cremation | See note d |
| 5C1bvi | Other waste incineration | See note e |
| 5C2 | Open burning of waste | |
| 5D1 | Domestic wastewater handling | |

| Source categories to be assessed in key category analysis | | Special considerations |
|---|---|---|
| **Category code** [b] | **Category title** [b] | |
| 5D2 | Industrial wastewater handling | |
| 5D3 | Other wastewater handling | |
| 5E | Other waste (please specify in IIR) | See note e |
| 6A | Other (included in national total for entire territory) | See note e |

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.
c Disaggregation could be considered where data (e.g. on fuels or activities) is sourced from different data providers and different methods are used for different sub-categories.
d Categories where facility/installation reporting is used for part of the estimate and other methods are used to estimate non reporting emission components should be separated as the levels of uncertainty are likely to be different.
e If this is a key category then the inventory compiler should determine if there are subcategories with different methods and assumptions that should be split out.

# 3 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 ([3]).
- 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.

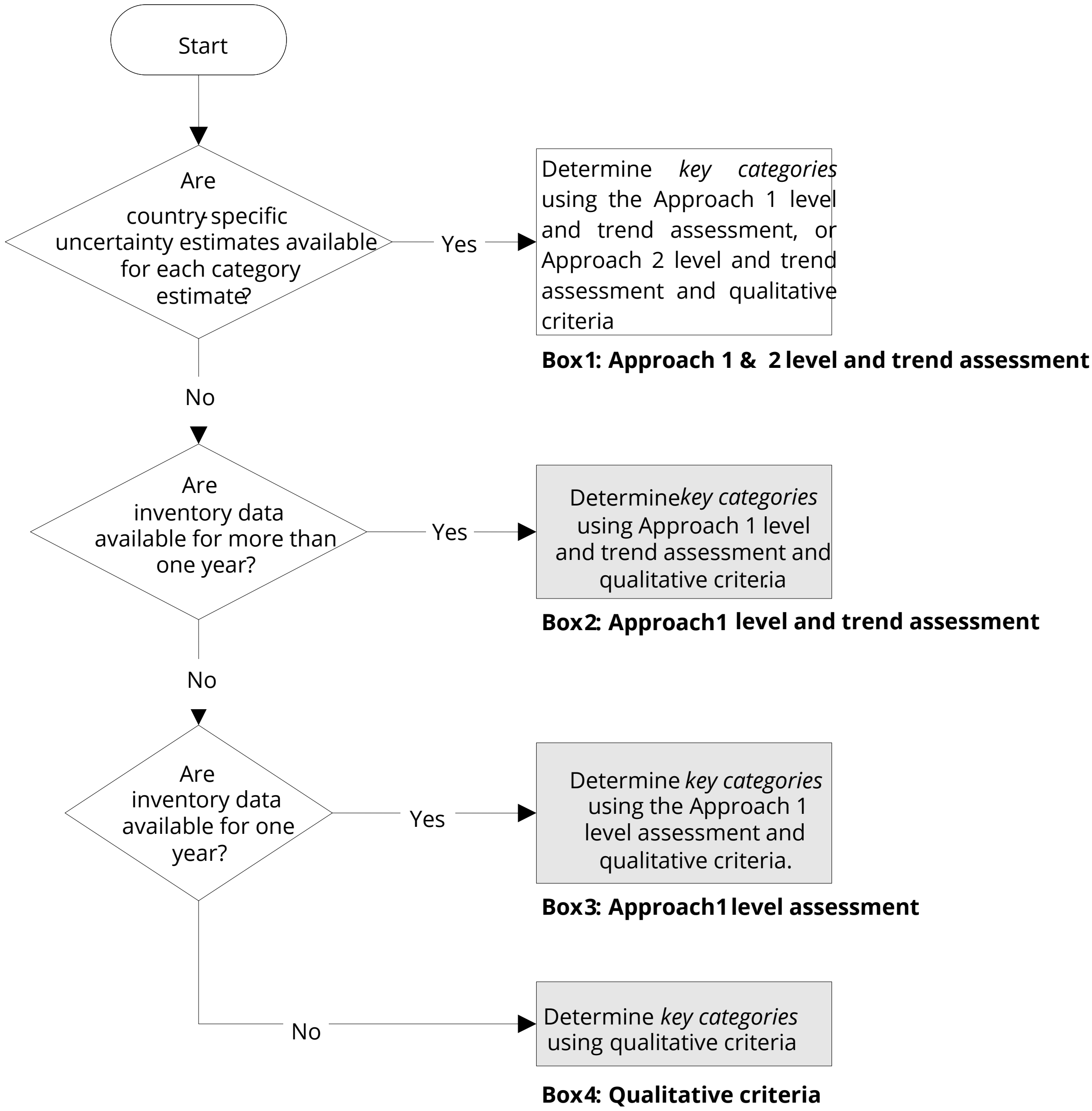
An additional step (see Annex A) can be used for countries wanting to aggregate their pollutant-specific key category analysis to a single list based on weightings.

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 3.1.3).

Figure 3-1 illustrates how inventory compilers can determine which approach to use for the identification of key categories.

([3]) 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 (but uses a different threshold value to that used by IPCC for greenhouse gases key category analysis).

**Figure 3-1 Decision tree to identify key categories**




### *3.1.1 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 (level) and Table ([4]) (trend) illustrate the format of the analysis. Separate calculation sheets ([5]) 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

$$L_{x,t} = \frac{E_{x,t}}{\sum_i E_{i,t}} \qquad (1)$$

Where:

| | | |
|---|---|---|
| $L_{x,t}$ | = | level assessment for source category *x* in latest inventory year (year *t*) |
| $E_{x,t}$ | = | value of emission estimate of source category *x* in year *t* |
| $\sum_i E_{i,t}$ | = | total contribution, which is the sum of the emissions from all *n* source categories (*i* = 1, …*x, n*) 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 $L_{x,t}$. Table presents a format that can be used for the level assessment.

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

| A[6] | B[6] | C[6] | 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** |
| | | | | | |
| | | | | | |
| | | | | | |
| **Total** | | | $\sum_i E_{i,t}$ | 1 | |

Where:

column A: code of NFR categories

([4]) 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.

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

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 contributes significantly to 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.

$$T_{x,t} = \left| \frac{E_{x,t} - E_{x,0}}{\sum_i E_{i,t} - \sum_i E_{i,0}} \right| \tag{2}$$

Where:

$T_{x,t}$ = trend assessment of source category *x* in year *t* as compared to the base year (year 0) or starting year of the inventory

$E_{x,t}$ and $E_{x,0}$ = values of estimates of source category *x* in year *t* and 0 respectively

$\sum_i E_{i,t}$ and $\sum_i E_{i,0}$ = sum of emissions across all *n* source categories (*i* = 1, …*x*, *n*) (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 as an absolute value for the source category *x* by subtracting value of 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 overall difference between the target year (year t) and the base year (year 0) total inventories (the inventory trend). The percentage contribution from category *x* for year *t* to the trend is then calculated by dividing $T_{x,t}$ by the sum of the trend assessment of all categories of the inventory.

The trend assessment then sorts categories by magnitude (highest to lowest) of their contribution to the trend, regardless of whether category trend is increasing or decreasing. Categories whose cumulative percentage contribution is greater than 80% should be identified as *key*.

**Table 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[6] | B[6] | C[6] | 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** | | | $\sum_i E_{i,0}$ | $\sum_i E_{i,t}$ | $\sum_i T_{i,t}$ | 1 | |

Where:

| | | |
|---|---|---|
| column A | : | code of NFR categories (4) |
| column B | : | description of NFR categories (4) |
| column C | : | pollutant (4) |
| 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) |
| column G | : | percentage contribution of the category to the total of trend assessments in last row of column F, i.e. $T_{x,t} / \sum_i T_{i,t}$ |
| 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 , 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 $T_{x,t}$ (which is always positive) 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. An example of Approach 1 analysis for the level and trend is given in Section 5.

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 as *key* in the trend assessment, which show declining trends due to the introduction of abatement measures or other emission reduction measures, should be prioritised because 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.

### *3.1.2 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 (3) describes the Approach 2 level assessment including uncertainty. This equation should be used to modify the equation in column E of Table  to add in the uncertainty component.

$$LU_{x,t} = \frac{L_{x,t} \cdot U_{x,t}}{\sum_i \left(L_{i,t} \cdot U_{i,t}\right)} \quad (3)$$

Where:

| | | |
|---|---|---|
| $LU_{x,t}$ | = | level assessment for category *x* in latest inventory year (year *t*) with uncertainty |
| $L_{x,t}$ | = | computed as in equation (1) |
| $U_{x,t}$ | = | 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 $LU_{x,t}$. 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 (4) 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  to add in the uncertainty component.

$$TU_{x,t} = T_{x,t} \cdot U_{x,t} \quad (4)$$

Where:

| | | |
|---|---|---|
| $TU_{x,t}$ | = | trend assessment for category *x* in latest inventory year (year *t*) with uncertainty |
| $T_{x,t}$ | = | trend assessment computed as in equation (2) |
| $U_{x,t}$ | = | 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 (3) and (4). 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.

### *3.1.3 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. Early identification using qualitative criteria could be used until such assessment is available. The following are examples of qualitative criteria that may be considered:

- **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 should be designated as *key* because they are likely to show substantial increase of emissions or decrease of removals 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 resulting 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 3.1.1 and 3.1.2, for each pollutant.

# 4 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.

Key category analysis is designed to inform the functions of the National Inventory Arrangements and various stakeholders on the priorities for regular update and improvement of the inventory. Therefore, the detailed analysis can be aggregated into a single informative list of the categories identified as key and why. In addition, inventory compilers could consider a means of prioritisation using category rankings across the different analyses and pollutants, highlighting those categories are key across a range of pollutants. Ideally, this summary should also highlight the methodological tier at which the estimates are estimated to give an indication of the scope for further improvement.

Annex A provides a worked example showing one option for combining the results of the Approach 1 level assessment across different pollutants to create a single ranking. The choice of method used to combine results of the level and trend assessments and different pollutants is left to the discretion of inventory compilers, but a range of options are described in Annex A.

# 5 Examples of key category analysis

Examples of the application of Approach 1 are shown in Table 2-1 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 2-1 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 Annex A). In addition, the examples below present the 80 % threshold suggested for key category analysis for air quality pollutants.

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

| A[4] | B[4] | C[4] | 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 |
| 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 |

| A[4] | B[4] | C[4] | 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.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** | **$NO_x$** | **105.58** | **28.12** | **0.56** | **0.55** | **0.55** |
| **1.A.3.b.iii** | **Road transport: heavy-duty vehicles** | **$NO_x$** | **58.78** | **44.87** | **0.10** | **0.10** | **0.65** |
| **1.A.2.f** | **Other (specify in a covering note)** | **$NO_x$** | **34.04** | **21.29** | **0.09** | **0.09** | **0.74** |
| **1.A.4.c.ii** | **Off-road vehicles and other machinery** | **$NO_x$** | **16.32** | **10.19** | **0.04** | **0.04** | **0.78** |
| **1.A.4.b.i** | **Residential plants** | **$NO_x$** | **9.22** | **3.98** | **0.04** | **0.04** | **0.82** |
| 1.A.3.b.ii | Road transport: light-duty vehicles | $NO_x$ | 9.74 | 5.9 | 0.03 | 0.03 | 0.84 |
| 1.A.2.d | Pulp, paper and print | $NO_x$ | 9.37 | 5.91 | 0.02 | 0.02 | 0.87 |
| 1.A.5.b | Other, mobile (including military) | $NO_x$ | 4.63 | 1.24 | 0.02 | 0.02 | 0.89 |
| 1.A.4.a | Commercial/institutional | $NO_x$ | 3.32 | 0.42 | 0.02 | 0.02 | 0.91 |
| 1.A.3.d.ii | National navigation | $NO_x$ | 7.89 | 5.96 | 0.01 | 0.01 | 0.93 |
| 1.A.1.a | Public electricity and heat production | $NO_x$ | 14.44 | 12.84 | 0.01 | 0.01 | 0.94 |

| 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.e | Food processing, beverages and tobacco | $NO_x$ | 1.58 | 0.62 | 0.01 | 0.01 | 0.94 |
| 2.B.2 | Nitric acid production | $NO_x$ | 1.15 | 0.24 | 0.01 | 0.01 | 0.95 |
| 2.C.1 | Iron and steel production | $NO_x$ | 1.72 | 0.95 | 0.01 | 0.01 | 0.96 |
| 1.A.3.c | Railways | $NO_x$ | 2.09 | 1.36 | 0.01 | 0.01 | 0.96 |
| 1.A.1.b | Petroleum refining | $NO_x$ | 2.16 | 1.44 | 0.01 | 0.01 | 0.97 |
| 1.A.2.a | Iron and steel | $NO_x$ | 1.74 | 1.09 | 0.00 | 0.00 | 0.97 |
| 1.A.4.b.ii | Household and gardening (mobile) | $NO_x$ | 2.33 | 1.78 | 0.00 | 0.00 | 0.98 |
| 2.B.10.a | Chemical industry: other | $NO_x$ | 1.58 | 1.05 | 0.00 | 0.00 | 0.98 |
| 2.D.1 | Pulp and paper | $NO_x$ | 10.46 | 10.98 | 0.00 | 0.00 | 0.98 |
| 1.A.4.c.i | Stationary | $NO_x$ | 0.79 | 0.35 | 0.00 | 0.00 | 0.99 |
| 1.A.2.c | Chemicals | $NO_x$ | 1.99 | 2.28 | 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.A.1.c | Manufacture of solid fuels and other energy industries | $NO_x$ | 0.43 | 0.16 | 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.3.a.ii. (i) | Civil aviation (domestic, LTO) | $NO_x$ | 0.68 | 0.45 | 0.00 | 0.00 | 1.00 |
| 1.A.3.e.ii | Other mobile sources and machinery | $NO_x$ | 3.33 | 3.19 | 0.00 | 0.00 | 1.00 |
| 1.A.3.b.iv | Road transport: mopeds & motorcycles | $NO_x$ | 0.09 | 0.22 | 0.00 | 0.00 | 1.00 |
| 1.A.2.b | Non-ferrous metals | $NO_x$ | 0.2 | 0.09 | 0.00 | 0.00 | 1.00 |
| 1.B.2.c | Venting and flaring | $NO_x$ | 0.09 | 0.16 | 0.00 | 0.00 | 1.00 |
| 5.C | Waste incineration | $NO_x$ | 0.02 | 0.09 | 0.00 | 0.00 | 1.00 |
| 2.A.7 | Other including non-fuel mining & construction | $NO_x$ | 0.73 | 0.68 | 0.00 | 0.00 | 1.00 |
| 1.A.3.a.ii.(ii) | Civil aviation (domestic, cruise) | $NO_x$ | 2.04 | 2.08 | 0.00 | 0.00 | 1.00 |
| 1.A.4.c.iii | National fishing | $NO_x$ | 4.51 | 4.53 | 0.00 | 0.00 | 1.00 |
| 1.B.2.a.vi | Other | $NO_x$ | 0.02 | 0 | 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.i | Road transport: passenger cars | $NO_x$ | L1,T1 | |
| 1.A.2.f | Other (specify in a covering note) | $NO_x$ | L1,T1 | |
| 1.A.4.c.ii | Off-road vehicles and other machinery | $NO_x$ | L1, T1 | |
| 1.A.1.a | Public electricity and heat production | $NO_x$ | L1 | |
| 2.D.1 | Pulp and paper | $NO_x$ | L1 | |
| 1.A.3.d.ii | National navigation | $NO_x$ | L1 | |
| 1.A.2.d | Pulp, paper and print | $NO_X$ | L1 | |
| 1.A.4.b.i | Residential plants | NOx | T1 | |
| [a] Approach 1 used only for $NO_x$. | | | | |

# 6 References

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# 7 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.

# Annex 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 should be done for the level and the trend assessments using Approach 2, if uncertainty data are available, and Approach 1 if not. Results for different pollutants and from the level and trend assessments can be combined by scoring each key category according to its position in the ranked pollutant key category list. A possible approach is to sum the percentage contributions across all pollutants to generate a single combined ranked list for each category, as illustrated for the level assessment in the worked example below (Tables A-1 and A-2). However, the scoring applied can be tailored to national circumstances (e.g. by increasing the weighting of some pollutants relative to others). The level and trend assessments may be combined by averaging the rankings from the level and trend assessments, by summing percentage contributions across both the level and trend assessments simultaneously, or by applying a customised scoring system. The method to be followed is left to the discretion of the inventory compilers.

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 NOx**

| NFR 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.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 production | CO | 67651.24 | 67651.24 | 2 | 90 | |
| 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 | |

| NFR 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 |
|---|---|---|---|---|---|---|---|
| 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 | |
| 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 |

| NFR 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.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 industries and construction | $NO_x$ | 242722.7 | 242722.7 | 15 | 70 | KC |
| 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 | |
| 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 | |

| NFR 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.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.**

| NFR category code | NFR category | % 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 production | | | 8 | | | | | 8 | 16 |
| 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 |

| NFR category code | NFR category | % 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.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 |