

CHAPTER 7

PRECURSORS AND INDIRECT EMISSIONS

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Contents

| | | |
|-------|--|------|
| 7 | Precursors and Indirect Emissions | |
| 7.1 | Introduction | 7.4 |
| 7.2 | Precursor emissions | 7.4 |
| 7.2.1 | Inventory of precursors | 7.5 |
| 7.2.2 | Link to relevant methodology chapters in the EMEP/CORINAIR Emission Inventory Guidebook | 7.7 |
| 7.3 | Indirect N ₂ O emissions from the atmospheric deposition of nitrogen in NO _x and NH ₃ | 7.15 |
| 7.3.1 | Methodology | 7.15 |
| 7.3.2 | Quality Assurance/Quality Control, Reporting and Documentation | 7.16 |
| | References | 7.16 |

Equations

| | | |
|--------------|---|------|
| Equation 7.1 | N ₂ O emissions from atmospheric deposition of NO _x and NH ₃ | 7.15 |
|--------------|---|------|

Tables

| | | |
|-----------|---|-----|
| Table 7.1 | Link between the IPCC categories and the corresponding methodology chapters in EMEP/CORINAIR Guidebook | 7.7 |
|-----------|---|-----|

Boxes

| | | |
|---------|---|-----|
| Box 7.1 | CLRTAP and Emission Inventory Guidebook | 7.5 |
| Box 7.2 | Calculating CO ₂ inputs to the atmosphere from emissions of carbon-containing compounds | 7.6 |

7 PRECURSORS AND INDIRECT EMISSIONS

7.1 INTRODUCTION

Although they are not included in global warming potential-weighted greenhouse gas emission totals, emissions of carbon monoxide (CO), oxides of nitrogen (NO_x), non-methane volatile organic compounds (NMVOCs), and sulphur dioxide (SO₂) are reported in greenhouse gas inventories. Carbon monoxide (CO), Nitrogen oxides (NO_x) and NMVOC in the presence of sunlight contribute to the formation of the greenhouse gas ozone (O₃) in the troposphere and are therefore often called ‘ozone precursors’. Furthermore, NO_x emission plays an important role in the earth’s nitrogen cycle. Sulphur Dioxide emissions lead to formation of sulphate particles, which also play a role in climate change. Ammonia (NH₃) is an aerosol precursor, but is less important for aerosol formation than SO₂.

Section 7.2 addresses the estimation and reporting of the precursors for national inventories. The methodologies for ambient air quality emission inventories have been elaborated in detail in the EMEP¹/CORINAIR Emission Inventory Guidebook (Guidebook), and these methodologies for CO, NO_x, NMVOCs, and SO₂ emissions are referenced in this chapter rather than to be included in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 Guidelines)*. Exceptions are for sources not well-covered by the Guidebook.

Section 7.3 addresses nitrous oxide (N₂O) emissions that result from the deposition of the nitrogen emitted as NO_x and NH₃. Nitrous oxide is produced in soils through the biological processes of nitrification and denitrification. Simply defined, nitrification is the aerobic microbial oxidation of ammonium to nitrate and denitrification is the anaerobic microbial reduction of nitrate to nitrogen gas (N₂). Nitrous oxide is a gaseous intermediate in the reaction sequence of denitrification and a by-product of nitrification that leaks from microbial cells into the soil atmosphere. One of the main controlling factors in this reaction is the availability of inorganic nitrogen in the soil and therefore deposition of nitrogen resulting from NO_x and ammonia (NH₃) will enhance emissions. N₂O emissions will also be enhanced if nitrogen is deposited in the ocean or in lakes. For this reason the *2006 Guidelines* include guidance for estimating N₂O emissions resulting from nitrogen deposition of all anthropogenic sources of NO_x and NH₃. Only agricultural sources of nitrogen were considered in the *Revised 1996 Guidelines (IPCC, 1997)*.

Guidance is provided in Section 7.3 on estimating N₂O emissions from atmospheric deposition resulting from all categories except agricultural soil management and manure management. Section 7.3 provides information on NO_x emissions. Countries may use national methodologies to estimate emissions of NH₃ not originating from agriculture. NH₃ emissions are also covered in the EMEP/CORINAIR Emission Inventory Guidebook.

7.2 PRECURSOR EMISSIONS

Where the country already has inventories for precursors, the results should be reported in the inventory. In some countries, air pollutant emission inventories are collected via separate procedures than the inventory of direct greenhouse gases, and the methods to produce these inventories can differ from those for greenhouse gases. Also, while the greenhouse gas emissions and sinks inventories are often based on national statistics, air pollutant emission inventories are often developed using plant specific data. Countries should consider whether there is any scope for improving consistency between inventories or cross-checking estimates.

Detailed methodologies for estimating the emissions of precursors are provided in the EMEP/CORINAIR Emission Inventory Guidebook (<http://reports.eea.eu.int/EMEP/CORINAIR4/en>). This guidebook has been developed for emission inventories of substances regulated under the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP) (see Box 7.1) and covers all source sectors and should therefore be considered as primary source of information for estimation of these emissions.

Table 7.1 provides a linkage between the IPCC categories and the corresponding methodology chapters in the EMEP/CORINAIR Guidebook. This table provides information on the specific EMEP/CORINAIR chapters that list methodologies for preparing NO_x, CO, NMVOCs, NH₃ and SO₂² inventories. It also includes information on the availability of methods and the significant precursor emissions from particular categories.

Some of the methodologies and emission factors in the EMEP/CORINAIR Guidebook are technology-specific and are relevant to conditions and categories in both developed and developing countries. However, for some

¹ Cooperative programme for the monitoring and evaluation of the long-range transmission of air pollutants in Europe (EMEP).

² The EMEP/CORINAIR Nomenclature for Reporting (NFR) source categories have been developed to be compatible to the IPCC reporting categories.

sectors, like solvents, small combustion sources (biomass in particular) and open burning, differences between the developed and developing countries may be larger, and the EMEP/CORINAIR Guidebook should be used with great care.

BOX 7.1

CLRTAP AND EMISSION INVENTORY GUIDEBOOK

The Convention on Long-Range Transboundary Air Pollution has been in force since 1979 and includes eight protocols with requirements to reduce emissions and technical annexes on abatement techniques. More detailed information on the Convention is available at <http://www.unece.org/env/lrtap/welcome.html>. As emissions of oxides of nitrogen (NO_x), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs), and sulphur dioxide (SO₂) are reported both to the UNFCCC and UNECE CLRTAP it is important to ensure consistent methodologies and reporting between these two Conventions. (UNECE, 2003)

The EMEP/CORINAIR Guidebook has been prepared by the LRTAP Task Force on Emission Inventories and Projections (TFEIP) and is updated regularly by the Expert Panels under the TFEIP (<http://tfeip-secretariat.org/unece.htm>) to provide comprehensive information and methodologies for estimating emissions. The EMEP/CORINAIR Emission Inventory Guidebook is published by the European Environment Agency (EEA).

7.2.1 Inventory of precursors

An inventory of precursors typically includes oxides of nitrogen, carbon monoxide, non-methane volatile organic compounds, and emissions of sulphur compounds. When estimating emissions of these air pollutants, the use of detailed process or facility-specific data (bottom-up data) gives more accurate estimates than the use of general aggregated emission factors. For all pollutants and source categories it is critical to apply methodologies and emission factors that account for the presence of any emission controls or abatement measures. For large point sources many countries have a registry of individual air quality pollutant emissions reported by the plants. When using data reported by the plants it is good practice to ensure that emissions are not double counted with the top-down inventory data. Data reported by the plants can also be used to check completeness of the inventory.

7.2.1.1 ENERGY

For most countries, road transportation will be a major source of NO_x, CO, and NMVOC emissions. Public electricity and heat production will likely be the major source of SO₂ emissions in countries where coal is used extensively, and also an important source of NO_x emissions. Industrial combustion will also be a source of SO₂, NO_x and CO emissions and residential combustion a source of CO emissions. Oil production will likely be a source of NMVOC, NO_x, and, CO emissions in countries that produce oil and gas.

Most NO_x emissions resulting from fuel combustion are typically 'fuel-NO' that is formed from the conversion of chemically bound nitrogen in the fuel. The content of nitrogen in different fuel varies. Depending on the combustion temperature, thermal-NO_x can also be formed from nitrogen contained in the combustion intake air.

Carbon monoxide and NMVOCs are generated during under-stoichiometric combustion conditions and are dependent on a variety of factors, including fuel type and combustion conditions.

Emissions of sulphur oxides (SO_x) are primarily related to the sulphur content of the fuel, although some sulphur can be retained in the ash. Abatement in stationary combustion can reduce the amount emitted.

7.2.1.2 INDUSTRIAL PROCESSES AND PRODUCT USE

Industrial processes can generate NO_x, CO, NMVOC and SO₂ emissions. Emissions of these gases depend on the type of process, abatement techniques, and other conditions. Industrial process and product use emissions include both channelled emissions (e.g., point sources emissions from a stack) and diffuse emission sources. For example, diffuse emissions from the evaporation of solvents and storage and handling of products are typical primary sources of NMVOC emissions. In some cases, exceptional emissions (e.g., accidental releases) can constitute major emissions from source. Further guidance on estimating total emissions from an industrial site are provided in the EU IPPC (European Union Integrated Pollution Prevention and Control) Reference Document on Monitoring of

Emissions (EC, 2002)³.

7.2.1.3 AGRICULTURE, FORESTRY AND OTHER LAND USE

The burning of crop residues emits NO_x as does the addition of nitrogen to the soils from nitrogen fertilizers and other nutrients. CO and SO₂ are emitted when biomass is burned. The primary sources of the NMVOC emissions are burning of crop residues and other plant wastes, and the anaerobic degradation of livestock feed and animal excreta. Plants, mainly trees and cereals, also contribute to NMVOC concentrations in the atmosphere.

The EMEP/CORINAIR Guidebook does not fully cover emissions from burning of biomass, therefore additional guidance is given in AFOLU Volume, Chapter 4.2.4 for Non-CO₂ emissions from biomass burning from *forest*, Chapter 5.2.4 and 5.3.4 for Non-CO₂ emissions from biomass burning in *Cropland*, and Chapter 6.2.4 and 6.3.4 for Non-CO₂ emissions from biomass burning in *Grassland* (CO, CH₄, N₂O, NO_x). Biomass burning when forest and grasslands are converted to other uses, forest fires, and biomass burning due to forest management practices are discussed in these chapters of Volume 4 for AFOLU sector.

7.2.1.4 WASTE

Emissions of NO_x, CO, and SO₂ are produced by domestic and municipal waste incineration processes as well as the incineration of sledges from wastewater treatment. NMVOC emissions can originate from wastewater treatment plants and solid waste disposal on land.

7.2.1.5 CARBON EMITTED IN GASES OTHER THAN CO₂

The 2006 *Guidelines* estimate carbon emissions in terms of the species which are emitted. Most of the carbon emitted in the form of non-CO₂ species eventually oxidises to CO₂ in the atmosphere and this amount can be estimated from the emissions estimates of the non-CO₂ gases. Box 7.2 provides an approach for making this calculation.

In some cases the emissions of these non-CO₂ gases contain very small amounts of carbon compared to the CO₂ estimate and it may be more accurate to base the CO₂ estimate on the total carbon. Examples are fossil fuel combustion (where the emission factor is derived from the carbon content of the fuel) and a few IPPU categories where the carbon mass balance can be estimated much better than individual gases.

Box 7.2

CALCULATING CO₂ INPUTS TO THE ATMOSPHERE FROM EMISSIONS OF CARBON-CONTAINING COMPOUNDS

Methane, carbon monoxide (CO) or NMVOC emissions will eventually be oxidised to CO₂ in the atmosphere. These CO₂ inputs could be included in national inventories. They can be calculated from emissions of methane, CO and NMVOCs. The basic calculation principles are:

From CH₄: $Inputs_{CO_2} = Emissions_{CH_4} \cdot 44/16$

From CO: $Inputs_{CO_2} = Emissions_{CO} \cdot 44/28$

From NMVOC: $Inputs_{CO_2} = Emissions_{NMVOC} \cdot C \cdot 44/12$

Where C is the fraction carbon in NMVOC by mass (default = 0.6)

The carbon content in NMVOCs will vary depending on the source. Therefore, an inventory based on the speciation of the NMVOC compounds gives more accurate results.

In making these estimates inventory compilers should assess each category to ensure that this carbon is not already covered by the assumptions and approximations made in estimating CO₂ emissions. Relevant examples include carbon from;

- Fugitive emissions from energy use,
- Carbon from Non-CO₂ gases from IPPU,
- AFOLU emissions where non-CO₂ gases have been explicitly deducted.

³ Chapter 3.1 in EU IPPC Reference Document on Monitoring of Emissions, which is available from website <http://eippcb.jrc.es/pages/FActivities.htm>.

7.2.2 Link to relevant methodology chapters in the EMEP/CORINAIR Emission Inventory Guidebook

Table 7.1 provides specific information on methodologies for preparing national emission inventories of NO_x, CO, NMVOCs, and SO₂. The table includes information on the availability of methodologies in the EMEP/CORINAIR Emission Inventory Guidebook and the expected significance of the emissions for each IPCC category under the 2006 Guidelines (see Table 8.2 of Chapter 8 of this Volume) and gas. The Guidebook's codes are equivalents in function to the IPCC reporting categories under the 1996 Guidelines. A mapping between the EMEP/CORINAIR Nomenclature for Reporting (NFR) and the IPCC common reporting framework (CRF) of the 1996 Guidelines with categories under the 2006 Guidelines is also provided in the table.

In case the inventory compiler does not find a corresponding category to a specific IPCC 2006 category in Table 7.1, it is advisable to attempt to find a similar category (e.g., a corresponding boiler size for another industrial branch) in Table 7.1 and apply the corresponding methodology in the EMEP/CORINAIR Emission Inventory Guidebook for this category or to search for other sources of information (see also Chapter 2 of this Volume).

The following codes are used to indicate whether the emissions from the specific source are relevant and covered by the Guidebook:

- A = Emissions of this gas from this category are likely to be emitted and a methodology is provided in the EMEP/CORINAIR Guidebook.
- NI = Emissions of this gas from this category are likely to be emitted, but a methodology is not currently included in the EMEP/CORINAIR Guidebook.
- B = Emissions of this air pollutant from this category are likely to be emitted and the methodology may be included in the EMEP/CORINAIR Guidebook in the future.
- NS = Emissions of this gas from this category not expected to be significant.
- NO = Emissions of this gas from this category do not occur.

| Reporting category | | | Source Sector | EMEP/CORINAIR Inventory Guidebook Chapter | NO _x | CO | NM- VOC | SO _x | |
|---|------|------|---------------|---|--|----|------------|-----------------|---|
| IPCC category | CRF | NFR | | | Relevance of emissions from the category (see codes above the table) | | | | |
| 1 ENERGY | | | | | | | | | |
| 1A1 Energy Industries | 1A1a | 1A1a | 1A1a | Main Activity Electricity and Heat Production | B111 and B112 | A | A | A | A |
| | 1A1b | 1A1b | 1A1b | Petroleum Refining | B132 and B136 | A | A | A | A |
| | 1A1c | 1A1c | 1A1c | Manufacture of Solid Fuels and Other Energy Industries | B142, B146 and B152 | A | A | A | A |
| 1A2 Manufacturing Industries and Construction | 1A2a | 1A2a | 1A2a | Iron and Steel | B111, B112, B323, B324, B325, B331, B332, B333 | A | A | A | A |
| | 1A2b | 1A2b | 1A2b | Non-ferrous Metals | B336, B337, B338, B339, B3310, B3322, B3323 | A | A | A | A |
| | 1A2c | 1A2c | 1A2c | Chemicals | B111 and B112 | A | A | A | A |
| | 1A2d | 1A2d | 1A2d | Pulp, Paper and Print | B3321 | A | A | A | A |
| | 1A2e | 1A2e | 1A2e | Food Processing, Beverages and Tobacco | B111 and B112 | A | A | A | A |
| | 1A2f | 1A2f | 1A2f | Non-Metallic Minerals | B3311, B3312, B3313, B3314, B3318, B3319, B3320, B3323 | A | A | A | A |
| | 1A2g | | | Transport Equipment | B111 and B112 | A | A | A | A |
| | 1A2h | | | Machinery | B111 and B112 | A | A | A | A |
| | 1A2i | | | Mining and Quarrying | B111 and B112 | A | A | A | A |
| | 1A2j | | | Wood and Wood Products | B111 and B112 | A | A | A | A |
| | 1A2k | | | Construction | B111 and B112 | A | A | A | A |
| | 1A2l | | | Textile and Leather | B111 and B112 | A | A | A | A |
| | 1A2m | | | Non-specified Industry | B111 and B112 | A | A | A | A |

| TABLE 7.1 (CONTINUED) | | | | | | | | | |
|---|---------------------------------|-------------|---|--|--|------|--------|-----------------|----|
| LINK BETWEEN THE IPCC CATEGORIES AND THE CORRESPONDING METHODOLOGY CHAPTERS IN EMEP/CORINAIR GUIDEBOOK ¹ | | | | | | | | | |
| Reporting category | | | Source Sector | EMEP/CORINAIR Inventory Guidebook Chapter | NO _x | CO | NM-VOC | SO _x | |
| IPCC category | CRF | NFR | | | Relevance of emissions from the category (see codes above the table) | | | | |
| 1A3 Transport | 1A3a | 1A3a | | Civil Aviation | | | | | |
| | 1A3ai International Aviation | 1A3ai (i) | 1A3ai (i) | International Aviation (LTO) | B851 | A | A | A | A |
| | 1A3aii Domestic Aviation | 1A3aii(ii) | 1A3aii(ii) | International Aviation (Cruise) | B851 | A | A | A | A |
| | | 1A3aii(i) | 1A3aii(i) | Civil Aviation (Domestic, LTO) | B851 | A | A | A | A |
| | | 1A3aii(ii) | 1A3aii(ii) | Civil Aviation (Domestic, Cruise) | B851 | A | A | A | A |
| | 1A3b | 1A3b | 1A3b | Road Transportation | | | | | |
| | 1A3bi | 1A3bi | 1A3bi | R.T., Passenger cars | B710 | A | A | A | A |
| | 1A3bii | 1A3bii | 1A3bii | R.T., Light-duty vehicles | B710 | A | A | A | A |
| | 1A3biii | 1A3biii | 1A3biii | R.T., Heavy duty vehicles | B710 | A | A | A | A |
| | 1A3biv | 1A3biv | 1A3biv | R.T., Mopeds & Motorcycles | B710 | A | A | A | A |
| | 1A3bv | 1A3bv | 1A3bv | R.T., Evaporative Emissions | B760 | NO | NO | A | NO |
| | 1A3c | 1A3c | 1A3c | Railways | B810 | A | A | A | A |
| | 1A3d | 1A3d | 1A3d | Water-borne Navigation | | | | | |
| | 1A3di | 1A3di | 1A3di | International Water-borne Navigation (International bunkers)/International maritime navigation | B842 | A | A | A | A |
| | 1A3dii | 1A3dii | 1A3dii | Domestic Water-borne Navigation//National Navigation | B810 and B842 | A | A | A | A |
| 1A3e | 1A3e | 1A3e | Other Transportation | | | | | | |
| 1A3ei | 1A3ei | 1A3ei | Pipeline Transport/Compressors | B561 and B152 | B | B | A | B | |
| 1A3eii | 1A3eii | 1A3eii | Off-road/Other mobile sources and machinery | B810 | A | A | A | A | |
| 1A4 Other Sectors | 1A4a | 1A4a | 1A4a | Commercial/Institutional | B111, B112, B216 and Small Combustion Installations *) | A | A | A | A |
| | 1A4b | 1A4b | 1A4b | Residential | | | | | |
| | 1A4bi | 1A4bi | 1A4bi | Residential plants | B111, B112 and Small Combustion Installations *) | A | A | A | A |
| | 1A4bii | 1A4bii | 1A4bii | Household and gardening (mobile) | B111, B112 and Small Combustion Installations *) | A | A | A | A |
| | 1A4c | 1A4c | 1A4c | Agriculture/Forestry/Fishing/Fish farms | | | | | |
| | 1A4ci | 1A4ci | 1A4ci | Stationary | B111, B112 and B235 | A | A | A | A |
| | 1A4cii | 1A4cii | 1A4cii | Off-road Vehicles and Other Machinery | B111, B112, B235 and B810 | A | A | A | A |
| 1A4ciii | 1A4ciii | 1A4ciii | National Fishing (mobile combustion) | B111, B112, B235 and B842 | A | A | A | A | |
| 1A5 Non-Specified | 1A5a | 1A5a | 1A5a | Other, Stationary (including military) | B111, B112, B216 and Small Combustion Installations *) | A | A | A | A |
| | 1A5b | 1A5b | 1A5b | Other, Mobile (including military) | B810 | A | A | A | A |
| 1B Fugitive Emissions from Fuels | 1B1 | 1B1 | 1B1 | Solid Fuel | | | | | |
| | 1B1a | 1B1a | 1B1a | Coal Mining and Handling, including Post-mining activities/Solid Fuel Transformation | B511 | NO/A | NO | A | NO |
| | 1B1b | 1B1c | 1B1c | Uncontrolled Combustion and Burning Coal Dumps /Other | | NI | NI | NI | NI |
| | 1B1c | 1B1b | 1B1b | Solid Fuel Transformation | B142 and B424 | NI | NI | A | NI |
| | 1B2 | 1B2 | 1B2 | Oil and Natural Gas | | | | | |
| | 1B2a | 1B2a | 1B2a | Oil | | | | | |
| | 1B2ai | 1B2c | 1B2c | Venting | B521, B923 and B926 | NI | NI | NI | NI |
| 1B2aii | 1B2d | 1B2d | Flaring | B521, B923 and B926 | NI | NI | NI | NI | |

| TABLE 7.1 (CONTINUED) | | | | | | | | | | | |
|---|------------|-------------------|---------------|--|---|------------------|------------------------------|-------------------------------|--|------------------------------|--|
| LINK BETWEEN THE IPCC CATEGORIES AND THE CORRESPONDING METHODOLOGY CHAPTERS IN EMEP/CORINAIR GUIDEBOOK ¹ | | | | | | | | | | | |
| Reporting category | | | Source Sector | EMEP/CORINAIR Inventory Guidebook Chapter | NO _x | CO | NM-VOC | SO _x | Relevance of emissions from the category (see codes above the table) | | |
| IPCC category | CRF | NFR | | | | | | | | | |
| 1B Fugitive Emissions from Fuels | 1B2aiii1 | 1B2ai | 1B2ai | Exploration | B521 and B541 | A | A | A | A | | |
| | 1B2aiii2 | 1B2aii | 1B2aii | Production and Upgrading | B521 and B541 | A | A | A | A | | |
| | 1B2aiii3 | 1B2aiii | 1B2aiii | Transport | B521 and B541 | A | A | A | A | | |
| | 1B2aiii4 | 1B2aiv | 1B2aiv | Refining | B521 and B541 | A | A | A | A | | |
| | 1B2aiii5 | 1B2av | 1B2av | Distribution of Oil Products | B551 | NO | NO | A/B | NO | | |
| | 1B2aiii6 | 1B2avi | 1B2avi | Other | B521 and B541 | NO | NO | NO | NO | | |
| | 1B2b | 1B2b | 1B2b | Natural Gas | B521 and B561 | NO | NO | A | NO | | |
| | 1B2bi | 1B2c | 1B2c | Venting | B521, B923 and B926 | NI | NI | NI | NI | | |
| | 1B2bii | 1B2d | 1B2d | Flaring | B521, B923 and B926 | NI | NI | NI | NI | | |
| | 1B2biii | 1B2e | 1B2e | Other | B521 and B561 | NO | NO | NO | NO | | |
| | 1B3 | 1B3 | 1B3 | Other Emissions from Energy Production | B570 | NI | NI | NI | NI | | |
| 1C CO ₂ Transport, and Storage | 1C | | | Emissions from CO₂ transport injection and storage | | | | | | | |
| 2 INDUSTRIAL PROCESSES AND PRODUCT USE | | | | | | | | | | | |
| 2A Mineral Industry | 2A1 | 2A1 | 2A1 | Cement (decarbonizing) | B3311 | (A = fuel rated) | (A = fuel rated) | (A = fuel rated) | (A = fuel rated, process rated depends on the process) | | |
| | 2A2 | 2A2 | 2A2 | Lime (decarbonizing) | B3312 (fuel rated and diffuse) and B461 | (A = fuel rated) | (A = fuel rated) | (A = fuel rated) | (A = fuel rated) | | |
| | 2A4 | 2A3 | 2A3 | Other uses of carbonites/Limestone and Dolomite Use | B4618 | B | B | B | B | | |
| | 2A4b | 2A4 | 2A4 | Other uses of Soda Ash/Soda Ash Production and use | B4619 | B | B | B | B | | |
| | 2A3 | 2A7 | 2A7 | Other including Non Fuel Mining & Construction | Glass (decarbonizing) | B3314 | (A) depending on the process | (NS) depending on the process | (NS) depending on the process | (A) depending on the process | |
| | 2A5 Other | 2A7 | 2A7 | | Batteries Manufacturing | B461 | NS/B | NS/B | NS/B | NS/B | |
| | | 2A7 | 2A7 | | Extraction of Mineral Ores | B461 | NS/B | NS/B | NS/B | NS/B | |
| | | 2A7 | 2A7 | Other (including asbestos products manufacturing) | B461 | NS | NS | NS | NS | | |
| 2 B CHEMICAL INDUSTRY | 2B1 | 2B1 | 2B1 | Ammonia Production | B443 | NS/B | NS/B | NS/B | NS/B | | |
| | 2B2 | 2B2 | 2B2 | Nitric Acid Production | B442 | A | NS | NS | NO | | |
| | 2B3 | 2B3 | 2B3 | Adipic Acid Production | B4521 | NS/B | NO | NO | NO | | |
| | 2B5 | 2B4 | 2B4 | Carbide Production/Calcium Carbide Production | B443 | NS/B | NS/B | NS/B | NS/B | | |
| | 2B4 | 2B5 | 2B5 | Caprolactam Production | - | NS/B | NS/B | NS/B | NS/B | | |
| | 2B4 | 2B5 | 2B5 | Glyoxylic Acid Production | B453 | NS | NS | B | NS | | |
| | 2B6 | 2B5 | 2B5 | Titanium Dioxide Production | B443 | NS/B | NS/B | NS/B | NS/B | | |
| | 2B7 | 2A4 | 2A4 | Soda Ash Production | B4619 | B | B | B | B | | |
| | 2B8 | Petrochemical and | | Carbon Black Production | | | | | | | |
| | 2B8a | 2B5 | 2B5 | Methanol Production | | NS | NS | A | NS | | |

TABLE 7.1 (CONTINUED)
LINK BETWEEN THE IPCC CATEGORIES AND
THE CORRESPONDING METHODOLOGY CHAPTERS IN EMEP/CORINAIR GUIDEBOOK ¹

| Reporting category | | | Source Sector | EMEP/CORINAIR Inventory Guidebook Chapter | NO _x | CO | NM- VOC | SO _x | |
|--------------------|------|-----|--|--|--|----|------------|-----------------|----|
| IPCC category | CRF | NFR | | | Relevance of emissions from the category (see codes above the table) | | | | |
| 2B10 Other | 2B8b | 2B5 | 2B5 | Ethylene Production | B451 | NS | NS | A | NS |
| | 2B8c | 2B5 | 2B5 | Vinylchloride (except 1,2 dichloroethane+vinylchloride) Production | B454 | NO | NS | NS | NO |
| | 2B8d | 2B5 | 2B5 | Ethylene Oxide Production | B453 | NS | NS | NS | NS |
| | 2B8e | 2B5 | 2B5 | Acrylonitrile Producton | B4520 | NO | NO | A | NO |
| | 2B8f | 2B5 | 2B5 | Carbon Black Producton | B443 | NS | NS | NS | NS |
| | 2B9 | | | Fluorochemical Production | | | | | |
| | | 2B5 | 2B5 | Sulphuric Acid Production | B441 | NS | NS | NS | A |
| | | 2B5 | 2B5 | Ammonium Sulphate Manufacturing | B443 | NS | NS | NS | NS |
| | | 2B5 | 2B5 | Ammonium Nitrate Production | B443 | NS | NS | NS | NS |
| | | 2B5 | 2B5 | Ammonium Phosphate Production | B443 | NS | NS | NS | NS |
| | | 2B5 | 2B5 | NPK fertilizers | B443 | NS | NS | NS | NS |
| | | 2B5 | 2B5 | Urea | B443 | NS | NS | NS | NS |
| | | 2B5 | 2B5 | Graphite | B443 | NS | NS | NS | NS |
| | | 2B5 | 2B5 | Chlorine Production | B443 | NS | NS | NS | NS |
| | | 2B5 | 2B5 | Phosphate Fertilisers Production | B443 | NS | NS | NS | NS |
| | | 2B5 | 2B5 | Storage and Handling of Inorganic Chemical Products | B443 | NS | NS | B | NS |
| | | 2B5 | 2B5 | Other | B443 | NS | NS | NS | NS |
| | | 2B5 | 2B5 | Propylene Production | B452 | NO | NO | A | NO |
| | | 2B5 | 2B5 | 1,2 dichloroethane (except 1,2 dichloroethane+vinylchloride) Production | B453 | NS | NS | NS | NS |
| | | 2B5 | 2B5 | 1,2 dichloroethane + vinylchloride (balanced process) | B455 | NO | NO | A | NO |
| | | 2B5 | 2B5 | Polyethylene (low density) Production | B456 | NO | NO | A | NO |
| | | 2B5 | 2B5 | Polyethylene (high density) Production | B456 | NO | NO | A | NO |
| | | 2B5 | 2B5 | Polyvinylchloride Production | B458 | NO | NO | A | NO |
| | | 2B5 | 2B5 | Polypropylene Production | B459 | NO | NO | A | NO |
| | | 2B5 | 2B5 | Styrene Production | B4510 | NO | NO | A | NO |
| | | 2B5 | 2B5 | Polystyrene Production | B4511 | NO | NO | A | NO |
| | | 2B5 | 2B5 | Styrene Butadiene Production | B4512 | NO | NO | A | NO |
| | | 2B5 | 2B5 | Styrene-butadiene Latex Production | B4512 | NO | NO | A | NO |
| | | 2B5 | 2B5 | Styrene-butadiene Rubber (SBR) Production | B4512 | NO | NO | A | NO |
| | | 2B5 | 2B5 | Acrylonitrile Butadiene Styrene (ABS) Resins Production | B4512 | NO | NO | A | NO |
| | | 2B5 | 2B5 | Formaldehyde Production | B453 | NS | NS | NS | NS |
| | | 2B5 | 2B5 | Ethylbenzene Production | B4518 | NO | NO | NS | NO |
| | | 2B5 | 2B5 | Phtalic Anhydride Production | B4519 | NO | NS | A | NS |
| | 2B5 | 2B5 | Storage & Handling of Organic Chemical Products | B453 | NS | NS | B | NS | |
| | 2B5 | 2B5 | Halogenated Hydrocarbons Production | B453 | NS | NS | B | NS | |
| | 2B5 | 2B5 | Pesticide Production | B453 | NS | NS | B | NS | |
| | 2B5 | 2B5 | Production of Persistent Organic Compounds | B453 | NS | NS | B | NS | |
| | 2B5 | 2B5 | Other (phytosanitary) | B453 | NS | NS | B | NS | |

TABLE 7.1 (CONTINUED)
LINK BETWEEN THE IPCC CATEGORIES AND
THE CORRESPONDING METHODOLOGY CHAPTERS IN EMEP/CORINAIR GUIDEBOOK ¹

| Reporting category | | | Source Sector | EMEP/CORINAIR Inventory Guidebook Chapter | NO _x | CO | NM-VOC | SO _x | |
|---|---|-------------------------|----------------|---|--|----|--------|-----------------|----|
| IPCC category | CRF | NFR | | | Relevance of emissions from the category (see codes above the table) | | | | |
| 2 C METAL INDUSTRY | 2C1 Processes in Iron and Steel Industries and Colliers | | | Blast Furnace Charging | B422 | NS | A | NS | NS |
| | | | | Pig Iron Tapping | B423 | NS | NS | NO | NS |
| | | | | Open Hearth Furnace Steel Plant | B425 | A | NS | NS | NS |
| | | | | Basic Oxygen Furnace Steel Plant | B426 | NS | A | NS | A |
| | | | | Electric Furnace Steel Plant | B427 | A | A | NS | NS |
| | | | | Rolling Mills | B428 | NS | NS | NS | NS |
| | | | | Sinter and Pelletizing Plants (except combustion) | B331 | A | A | A | A |
| | | | | Other | B4210 | NS | NS | NS | NS |
| | 2C2 | 2C2 | 2C2 | Ferroalloys Production | NS | NS | NS | NS | NS |
| | 2C3 | 2C3 | 2C3 | Aluminium Production (electrolysis) | B431 | NS | A | NS | A |
| | 2C6 | 2C5 | 2C5 | Zinc Production | | NO | NO | NO | NI |
| | 2C5 | 2C5 | 2C5 | Lead Production | | NO | NO | NO | NI |
| | 2C4 | 2C5 | 2C5 | Magnesium Production (except combustion) | B432 | NS | NS | NS | NS |
| | 2C7 Other | 2C5 | 2C5 | Silicium Production | B432 | NS | NS | NS | NS |
| | | 2C5 | 2C5 | Nickel Production (except combustion) | B432 | NS | NS | NS | NS |
| | | 2C5 | 2C5 | Allied Metal Manufacturing | B432 | NS | NS | NS | NS |
| | | 2C5 | 2C5 | Galvanising | B432 | NS | NS | NS | NS |
| 2C5 | | 2C5 | Electroplating | B432 | NS | NS | NS | NS | |
| 2C5 | | 2C5 | Other | B432 | NS | NS | NS | NS | |
| 2D NON-ENERGY PRODUCTS FROM FUELS AND SOLVENT USE | 2D1 | 3D | 3D | Lubricant Use | | NO | NO | NI | NO |
| | 2D2 | 3D | 3D | Paraffin Waxes Use | | NO | NO | NI | NO |
| | 2D4 | 2A5 | 2A5 | Asphalt Roofing | B4610 | NS | A | A | NS |
| | | 2A6 | 2A6 | Road Paving with Asphalt | B4611 | A | A | A | A |
| | 2D3 | See "SOLVENT USE" below | | Solvent Use | | | | | |
| 2D3 SOLVENT USE | CRF/NFR 3A PAINT APPLICATION | | | | | | | | |
| | | 3A | 3A | Manufacture of Automobiles | B610 | NO | NS | A/B | NO |
| | | 3A | 3A | Car Repairing | B610 | NO | NO | A/B | NO |
| | | 3A | 3A | Construction and Buildings (except wood painting) | B610 | NO | NO | A/B | NO |
| | | 3A | 3A | Domestic Use (except wood painting) | B610 | NO | NO | A/B | NO |
| | | 3A | 3A | Coil Coating | B610 | NO | NO | A/B | NO |
| | | 3A | 3A | Boat Building | B610 | NO | NO | A/B | NO |
| | | 3A | 3A | Wood Painting/Coating | B610 | NO | NO | A/B | NO |
| | | 3A | 3A | Other Industrial Paint Application | B610 | NO | NO | A/B | NO |
| | | 3A | 3A | Other Non-industrial Paint Application | B610 | NO | NO | A/B | NO |
| | CRF/NFR 3B DEGREASING AND DRY CLEANING | | | | | | | | |
| | | 3B | 3B | Metal Degreasing | B621 | NS | NS | A | NS |
| | | 3B | 3B | Dry Cleaning | B622 | NO | NO | A | NO |
| | | 3B | 3B | Electronic Components Manufacturing | B623 | NS | NS | NS | NS |
| | | 3B | 3B | Other Industrial Cleaning | B623 | NS | NS | NS | NS |

| TABLE 7.1 (CONTINUED) | | | | | | | | |
|---|--------|-----|---|---|--|----|---------------------------------------|-----------------|
| LINK BETWEEN THE IPCC CATEGORIES AND THE CORRESPONDING METHODOLOGY CHAPTERS IN EMEP/CORINAIR GUIDEBOOK ¹ | | | | | | | | |
| Reporting category | | | Source Sector | EMEP/CORINAIR Inventory Guidebook Chapter | NO _x | CO | NM-VOC | SO _x |
| IPCC category | CRF | NFR | | | Relevance of emissions from the category (see codes above the table) | | | |
| CRF/NFR 3 C CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING | | | | | | | | |
| 2D4 OTHER | 3C | 3C | Polyester Processing | B631 | NS | NS | A/B | NS |
| | 3C | 3C | Polyvinylchloride Processing | B631 | NS | NS | A/B | NS |
| | 3C | 3C | Polyurethane Foam Processing | B633 | NS | NS | A | NS |
| | 3C | 3C | Polystyrene Foam Processing | B633 | NS | NS | A | NS |
| | 3C | 3C | Rubber Processing | B631 | NS | NS | A/B | NS |
| | 3C | 3C | Pharmaceutical Products Manufacturing | B631 | NS | NS | A/B | NS |
| | 3C | 3C | Paints Manufacturing | B631 | NS | NS | A/B | NS |
| | 3C | 3C | Inks Manufacturing | B631 | NS | NS | A/B | NS |
| | 3C | 3C | Glues Manufacturing | B631 | NS | NS | A/B | NS |
| | 3C | 3C | Asphalt Blowing | B6310 | NS | A | A | NS |
| | 3C | 3C | Adhesive, Magnetic Tapes, Films & Photographs Manufacturing | B631 | NS | NS | A/B | NS |
| | 3C | 3C | Textile Finishing | B631 | NS | NS | A/B | NS |
| | 3C | 3C | Leather Tanning | B631 | NS | NS | A/B | NS |
| | 3C | 3C | Other | B631 | NS | NS | A/B | NS |
| CRF/NFR 3 D OTHER including products containing HMs and POPs | | | | | | | | |
| 2D4 OTHER | 3D | 3D | Glass Wool Enduction | B641 | NS | NS | B | NS |
| | 3D | 3D | Mineral Wool Enduction | B641 | NS | NS | B | NS |
| | 3D | 3D | Printing Industry | B643 | NO | NO | A/B | NO |
| | 3D | 3D | Fat, Edible and Not Edible Oil Extraction | B644 | NS | NS | A | NS |
| | 3D | 3D | Application of Glues and Adhesives | B641 | NS | NS | B | NS |
| | 3D | 3D | Preservation of Wood | B646 | NO | NO | A | NO |
| | 3D | 3D | Underseal Treatment and Conservation of Vehicles | B647 | NO | NO | IE.3A (car manufacturing & repairing) | NO |
| | 3D | 3D | Domestic Solvent Use (other than paint application) | B648 | NO | NO | A/B | NO |
| | 3D | 3D | Vehicles Dewaxing | B647 | NO | NO | A | NO |
| | 3D | 3D | Domestic Use of Pharmaceutical Products | B641 | NS | NS | B | NS |
| | 3D | 3D | Other (preservation of seeds, etc.) | B641 | NS | NS | B | NS |
| | 3D | 3D | Other (anaesthesia, refrigeration and air conditioning, electrical equipment, etc.) | B651 | NS | NS | B | NS |
| 2 E ELECTRONICS INDUSTRY | 2F | | | | | | | |
| 2 F PRODUCT USES AS SUBSTITUTES FOR OZONE DEPLETING SUBSTANCES | 2F | | | | | | | |
| 2G OTHER PRODUCT USES | 2F, 3D | 3D | See for relevant subcategories under NFR 3D | - | NS | NS | NS | NS |

TABLE 7.1 (CONTINUED)
LINK BETWEEN THE IPCC CATEGORIES AND
THE CORRESPONDING METHODOLOGY CHAPTERS IN EMEP/CORINAIR GUIDEBOOK ¹

| Reporting category | | | | Source Sector | EMEP/CORINAIR Inventory Guidebook Chapter | NO _x | CO | NM-VOC | SO _x | |
|--------------------|--|--|--|---|---|-----------------------|----|---------------------------------------|-----------------|----|
| IPCC category | CRF | NFR | Relevance of emissions from the category (see codes above the table) | | | | | | | |
| 2 H OTHER | 2H1 | 2D1 | 2D1 | Pulp and Paper | | | | | | |
| | | 2D1 | 2D1 | Processes in wood, paper pulp, food, drink and other industries | Pulp and Paper - Chipboard | B461 | NS | NS | NS | NS |
| | | 2D1 | 2D1 | | Pulp and Paper - Paper pulp (kraft process) | B462 | A | NS | A | A |
| | | 2D1 | 2D1 | | Pulp and Paper - Paper pulp (acid sulphite process) | B463 | A | NO | A | A |
| | | 2D1 | 2D1 | | Pulp and Paper - Paper pulp (neutral sulphite semi-chemical process.) | B464 | A | NO | A | A |
| | 2H2 | 2D2 | 2D2 | Food and Drink | | | | | | |
| | | 2D2 | 2D2 | Processes in wood, paper pulp, food, drink and other industries | Food and Drink - Bread | B465 | NS | NS | A | NS |
| | | 2D2 | 2D2 | | Food and Drink - Wine | B466 | NS | NS | A | NS |
| | | 2D2 | 2D2 | | Food and Drink - Beer | B466 | NS | NS | A | NS |
| | | 2D2 | 2D2 | | Food and Drink - Spirits | B466 | NS | NS | A | NS |
| | 2H3 | | | Other | | | | | | |
| | 3D | 3D | 3D | Mineral Wool Enduction | | | | | | |
| | | 3D | 3D | Printing Industry | | | | | | |
| | | 3D | 3D | Fat, Edible and Not Edible Oil Extraction | | | | | | |
| | | 3D | 3D | Application of Glues and Adhesives | | | | | | |
| | | 3D | 3D | Preservation of Wood | | | | | | |
| | | 3D | 3D | Underseal Treatment and Conservation of Vehicles | B647 | NO | NO | IE 3A (car manufacturing & repairing) | NO | |
| | | 3D | 3D | Domestic Solvent Use (other than paint application) | B648 | NO | NO | A/B | NO | |
| | | 3D | 3D | Vehicles Dewaxing | B647 | NO | NO | A | NO | |
| | | 3D | 3D | Domestic Use of Pharmaceutical Products | B641 | NS | NS | B | NS | |
| | | 3D | 3D | Other (preservation of seeds,...) | B641 | NS | NS | B | NS | |
| | | 3D | 3D | Other (anaesthesia, refrigeration and air conditioning, electrical equipment, etc.) | B651 | NS | NS | B | NS | |
| | 3 AGRICULTURE, FORESTRY, AND OTHER LAND USE (AFOLU) | | | | | | | | | |
| | 3A Livestock | 3A1 | 4A | 4A | Enteric Fermentation | B1040 | NO | NO | NO | NO |
| | | 3A2 | 4B | 4B | Manure Management | B1050, B100511, N1090 | NO | NO | B | NO |
| | 3B Land | 3B1 Forest Land | 5A | 5A | Changes in Forest and Other Woody Biomass Stocks | B112100 | B | B | A | B |
| | | | 5B | 5B | Forest and Grassland Conversion (tropical, temperate, boreal forests, grassland, other) | B112200 | A | B | NS | B |
| | | | 5C | 5C | Abandonment of Managed Land (tropical, temperate, boreal forests, grassland, other) | B112300 | A | B | NS | B |
| 5E | | | 5E | Managed Forests (broadleaf and coniferous) | B1101, B110117 | NI | NI | A | NI | |
| | | Non-managed Forests (broadleaf and coniferous) | | B1101, B110117 | NI | NI | A | NI | | |
| | | Other | | B112500 | NS | NS | NS | NS | | |
| 3B2 Cropland | | | | | | NS | NS | NS | NS | |

TABLE 7.1 (CONTINUED)
LINK BETWEEN THE IPCC CATEGORIES AND
THE CORRESPONDING METHODOLOGY CHAPTERS IN EMEP/CORINAIR GUIDEBOOK ¹

| Reporting category | | | | Source Sector | EMEP/CORINAIR Inventory Guidebook Chapter | NO _x | CO | NM-VOC | SO _x |
|---|--|-----|--|---|--|-----------------|----|--------|-----------------|
| IPCC category | CRF | NFR | Relevance of emissions from the category (see codes above the table) | | | | | | |
| 3B Land | 3B3 Grassland | 4D | 4D | Natural Grassland and Other Vegetation (grassland, tundra, other low vegetation, other vegetation (Mediterranean, scrub...)), Soils | B1104 B110117 | A | NI | A | NI |
| | 3B4 Wetland | 4D | 4D | Wetlands (marshes - swamps) | B1105 | NI | NI | NI | A |
| | 3B5 Settlements | 4G | 4G | Other | B1060 | NO | NO | NO | NO |
| 3B6 Other land | | | | | | | | | |
| 3C AGGREGATED SOURCES AND NON-CO ₂ EMISSION SOURCES ON LAND | 3C1a | 5B | 5B | Forest and vegetation fires (man-induced, other) | B1103 | A | A | A | A |
| | 3C1b | 4F | 4F | Field burning of agricultural wastes | B1030 | A | A | A | A |
| | 3C1c | 4D | 4D | Prescribed burning of savannas | | B | B | B | B |
| | 3C4 | 4D | 4D1 | Agricultural soils, direct soil emissions | B1010, B1020 and B1105 | A | NO | A | NO |
| | 3C7 | 4C | 4C | Rice Cultivation | B1010, B1020 | A | NO | A | NO |
| 3D OTHER | 3D1 | NA | NA | Harvested Wood Products | | NO | NO | B | NO |
| | 3D2 | NA | NA | Volcanoes | B1108 | NO | NO | NO | A |
| | | NA | NA | Gas Seeps | B110900 | NO | NO | NO | NO |
| | | NA | NA | Lightning | B111000 | A | NO | NO | NO |
| | | NA | NA | Wildlife animals | B1107 | NO | NO | NS | NO |
| | | 4D | 4D | Waters | B1106 | NO | NO | B | B |
| 4 WASTE | | | | | | | | | |
| 4D WASTE | 4A and 4B | 6A | 6A | Solid Waste Treatment and Disposal and Biological treatment of solid waste | B940 | NO | NO | A/B | NO |
| | 4C | 6C | 6C | Incineration and Open Burning of Waste/Waste Incineration | B921, B922, B924, B925, B927, B970, B991, B992 | A | A | NI/B | A |
| | 4D | 6B | 6B | Wastewater Treatment and Discharge/Wastewater Handling | B9101 and B9107 | NO | NO | A | NO |
| | 4E | 6D | 6D | Other waste | B9101, B9203, B9105, B9106 | A | A | A | NO |
| 5 OTHER | 5A Indirect N ₂ O emissions | | | | | | | | |
| | 5B Other | 7 | 7 | Geothermal energy extraction | B570 | NO | NO | NI | NO/B |
| *) Chapter Small Combustion Installations is available from website http://tfeip-secretariat.org/unece.htm > Expert Panels > Expert Panel on Combustion and Industry | | | | | | | | | |
| ¹ Current references are to the version of the EMEP/CORINAIR Guidebook available when these guidelines are published. | | | | | | | | | |

7.3 INDIRECT N₂O EMISSIONS FROM THE ATMOSPHERIC DEPOSITION OF NITROGEN IN NO_x AND NH₃

In this Guidance, direct nitrous oxide emissions are estimated on the basis of human-induced net nitrogen input to managed soils (e.g., synthetic or organic fertilizers, deposited manure, crop residues, sewage sludge), or of other changes in inorganic nitrogen in the soil as a result of interventions by management practices in nitrogen cycling, e.g., mineralization of nitrogen in soil organic matter, following drainage/management of organic soils, or cultivation/land use change on mineral soils.

In addition to these direct emissions of N₂O, indirect emissions also take place as a result of two different nitrogen loss pathways. These pathways are (1) the volatilization/emission of nitrogen as NH₃ and NO_x and the subsequent deposition of these forms of nitrogen as ammonium (NH₄⁺) and oxidised nitrogen (NO_x) on soils and waters, and (2) the leaching and runoff of nitrogen from synthetic and organic nitrogen fertilizer inputs, crop residues, mineralization of nitrogen through land use change or management practices, and urine and dung deposition from grazing animals, into groundwater, riparian areas and wetlands, rivers and eventually the coastal ocean.

The volatilization of nitrogen as NH₃ and NO_x results both from agricultural fertilizer applied to land and from manure management, as well as from fossil fuel and biomass combustion, and industrial processes. Before being redeposited, NO_x and NH₃ are typically transformed to other nitrogen containing compounds. Oxides of nitrogen are commonly hydrolysed in the atmosphere or upon deposition to form nitric acid (HNO₃), while NH₃ gas generally combines with atmospheric nitric acid or sulphuric acid (H₂SO₄) to form ammonium nitrate and ammonium sulphate aerosols, which are then transformed to a particulate ammonium (NH₄⁺) form. The deposition of these reactive nitrogen compounds from non-agricultural sources onto soils and waters causes N₂O emissions in an exactly analogous way to those resulting from their deposition from agricultural sources. Therefore the indirect N₂O emissions resulting from these various sources are included in these Guidelines using the assumption that same emission factor applies to soil and water deposition.

7.3.1 Methodology

All anthropogenic NH₃ or NO_x emissions are potential sources of N₂O emissions⁴. Specific guidance on estimating N₂O emissions from that portion of nitrogen compounds associated with the volatilisation of NO_x and NH₃ from (1) manure management systems and applied sewage sludge and (2) synthetic and organic nitrogen input to managed soils, and urine and dung nitrogen deposited by grazing animals, are provided in Section 10.5 of Chapter 10, Emissions from livestock and manure management, and Section 11.2.2 of Chapter 11, N₂O and CO₂ emissions from soil amendment, of Volume 4 of AFOLU.

This section provides guidance on estimating N₂O emissions from the atmospheric deposition of nitrogen compounds from all other sources of NO_x and NH₃ emissions, such as fuel combustion, industrial processes, and burning of crop residues and agricultural wastes. The method needs only to be applied where data on NO_x and NH₃ emissions from these sources are available, e.g., from the inventories identified Section 7.2.

Equation 7.1 and EF₄ from Equation 11.9 in Section 11.2.2.1 of Volume 4 can be used to estimate N₂O emissions from the atmospheric deposition of nitrogen resulting from NO_x and NH₃.

EQUATION 7.1
N₂O EMISSIONS FROM ATMOSPHERIC DEPOSITION OF NO_x AND NH₃

$$N_2O_{(i)} = \left[\left(NO_x - N_{(i)} \right) + \left(NH_3 - N_{(i)} \right) \right] \bullet EF_4 \bullet 44 / 28$$

⁴ In addition to being redeposited on soils and surface waters, NH₃ can also lead to the formation of N₂O from atmospheric chemical reactions. However, there is currently no method available for estimating conversion of NH₃ to N₂O in the atmosphere.

Where:

- $N_2O_{(i)}$ = N_2O produced from atmospheric deposition of N from NO_x and NH_3 emissions from source i , in Gg
- $NO_x-N_{(i)}$ = Nitrogen content of NO_x emissions from source i assuming that NO_x is reported in NO_2 equivalents (Gg NO_x-N or Gg $NO_2 \cdot 14/46$)
- $NH_3-N_{(i)}$ = Nitrogen content of NH_3 emissions from source i (Gg NH_3-N or Gg $NH_3 \cdot 14/17$)
- EF_4 = Emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces (kg N_2O-N/kg NH_3-N or NO_x-N emitted).

The activity data $NO_x-N_{(i)}$ and $NH_3-N_{(i)}$ are taken from the inventories as identified in Section 7.2, if available.

This method assumes that N_2O emissions from atmospheric deposition are reported by the country that produced the original NO_x and NH_3 emissions. In reality the ultimate formation of N_2O may occur in another country due to atmospheric transport of emissions. The method also does not account for the probable lag time between NO_x and NH_3 emissions and subsequent production of N_2O in soils and surface waters. This time lag is expected to be small relative to an annual reporting cycle.

7.3.2 Quality Assurance/Quality Control, Reporting and Documentation

It is *good practice* to estimate and report N_2O emissions from atmospheric deposition of NO_x and NH_3 where a country already has an inventory of these gases. For the purposes of calculation, it is assumed that N_2O is emitted in the same year that the original NO_x and NH_3 were emitted.

It is *good practice* to estimate emissions ensuring consistency with the emissions estimated for agriculture sources and avoiding double-counting. Because N_2O emissions may occur outside the country emitting NH_3 or NO_x , use of country- or region-specific emission factors should be thoroughly documented.

N_2O emissions from atmospheric deposition of NH_3 and NO_x are reported in Table 5A of reporting tables in Annex 8A.2 for all sectors, and the AFOLU Sector is also reported in Table 3.8 in Annex 8A.2.

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