# REPUBLIC OF CROATIA 2018

# INFORMATIVE INVENTORY REPORT

# (1990 – 2016)

March 2018

CROATIAN AGENCY FOR ENVIRONMENT AND NATURE

MINISTRY OF ENVIRONMENT AND ENERGY

CROATIAN AGENCY FOR ENVIRONMENT AND NATURE

# REPUBLIC OF CROATIA 2018

# INFORMATIVE INVENTORY REPORT

# (1990 – 2016)

**under the Convention on Long-range Transboundary Air Pollution (CLRTAP) and National Emission Ceilings Directive (NECD 2016/2284/EU)**

**EKONERG – Energy and Environmental Protection Institute**

Koranska 5, Zagreb, Croatia

Ordered by: Croatian Agency for Environment and Nature

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Title:

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***Submission to the Convention on Long-range Transboundary Air Pollution and National Emission Ceilings Directive (NECD 2016/2284/EU)***

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Zagreb, March 2018

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LIST OF ABBREVIATIONS

| | |
|---|---|
| CAEN | - Croatian Agency for Environment and Nature |
| CLRTAP | - Convention on Long-Range Transboundary Air Pollution |
| CollectER | - Collect Emission Register |
| COPERT | - Computer Programme to Calculate Emissions from Road Transport |
| CORINAIR | - Core Inventory of Air Emissions in Europe |
| CRF | - Common Reporting Format (UNFCCC) |
| EEA | - European Environmental Agency |
| EMEP | - Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe |
| ETC/ACC | - European Topic Centre on Air and Climate Change |
| GHG | - Greenhouse gas |
| IPCC | - Intergovernmental Panel on Climate Change |
| MPMEP | - Multi-Polluant Multi-Effect Protocol |
| NFR | - Nomenclature for Reporting |
| OG-IT | - Official Gazette – International Treaties |
| AE-DEM | - Air Emission – Data Exchange Mode |
| Report*ER* | - AE-DEM module for reporting |
| SNAP | - Selected Nomenclature for Air Pollution |
| UNECE | - United Nations Economic Commission for Europe |
| UNFCCC | - United Nations Framework Convention on Climate Change |
| EPR | - Environmental Pollution Register |
| IIR | - Informative Inventory Report (CLRTAP) |
| NEC Directive | - National Emission Ceiling Directive |
| LULUCF | - Land Use, Land-Use Change and Forestry |
| CBS | - Croatian Bureau of Statistics |
| St.Y. | - Statistical Yearbook |
| MI | - Ministry of Interior |
| MEE | - Ministry of Environment and Energy |

| | |
|---|---|
| MA | - Ministry of Agriculture |
| EIHP | - Energy Institute Hrvoje Požar |
| $SO_2$ | - Sulphur oxides reported as $SO_2$ |
| NOx | - Nitrogen oxides reported as $NO_2$ |
| $NH_3$ | - Ammonia |
| NMVOC | - Non-methane volatile organic compounds |
| VOC | - Volatile organic compounds |
| CO | - Carbon monoxide |
| TSP | - Total suspended particulate matter |
| $PM_{10}$ | - Particulate matter with diameter less than 10 μm |
| $PM_{2.5}$ | - Particulate matter with diameter less than 2.5 μm |
| As | - Arsenic |
| Cd | - Cadmium |
| Cr | - Chromium |
| Cu | - Copper |
| Hg | - Mercury |
| Ni | - Nickel |
| Pb | - Lead |
| Se | - Selenium |
| Zn | - Zinc |
| HCH | - Hexachlorocyclohexane |
| PAH | - Polyaromatic hydrocarbons |
| PCDD/PCDF | - Dioxins and furans |
| DE | - Direct emission – emission from stationary sources submitted in EPR |
| GDP | - gross domestic product |
| I-TEQ | - International Toxic Equivalent; The older International Toxic Equivalent (I-TEQ) scheme by the North Atlantic Treaty Organisation (NATO) initially set up in 1989 and later extended and updated |
| DIY | - do-it-yourself |
| GO | - Gas oil |

| | |
|---|---|
| HFO | - Heavy fuel oil |
| KER | - Kerosene |
| LPG | - Liquefied petroleum gas |
| LF | - Liquid fuel |
| NG | - Natural gas |
| SHB | - Single house boiler |

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# EXECUTIVE SUMMARY

## ES1 INTRODUCTION

The Republic of Croatia 2018 Informative Inventory Report (1990 – 2016) provides a detail description of the methodologies used for the compilation of the Croatian air emission inventory submission under the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe (UNECE/CLRTAP) and Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC (OJ L 344, 17/12/2016, hereinafter new NEC Directive).

As a party to the UNECE/LRTAP Convention, and the EU MS, Croatia is obligated to annually report data on emissions of air pollutants covered in the LRTAP Convention, its seven Protocols and new NEC Directive. These are: main pollutants ($SO_2$, NOx, CO, NMVOC and $NH_3$), particles (TSP, $PM_{10}$ and $PM_{2.5}$), black carbon (BC), heavy metals (Cd, Pb, Hg, As, Cr, Cu, Ni, Se and Zn) and persistent organic compounds (PCDD/PCDF, PAHs, HCB and PCBs).

The Croatian Agency for Environment and Nature[1] (CAEN) is competent authority for Informative Inventory Report with the Ministry of Environment and Energy[2] (MEE) supervision.

Executive institution with care of preparing the air pollution emission inventory, NFR formats, and IIR, including maintenance of databases (CollectER and COPERT) is EKONERG Ltd. from Zagreb.

Data on air pollution emissions, presented in this report are prepared on the standard methods and procedures according to the *EMEP/EEA Air Pollutant Emission Inventory Guidebook "Technical*

[1] The Croatian Environment Agency (CEA) in 2015 changed the name into the Croatian Agency for Environment and Nature (CAEN)

[2] The Ministry of Environment and Nature Protection (MENP) in 2016 changed the name into the The Ministry of Environment and Energy (MEE) in accordance to Law on the Organisation and Scope of Ministries and other central state administration bodies (Official Gazette, no. 93/16 and 104/16)

*Guidance to Prepare National Emission Inventories" (2013 and 2016),* the *EMEP/CORINAIR Good Practice Guidance, Good practice for CLRTAP emission inventories* and other available technical guidance.

This report follows recommended structure for the Informative Inventory Report (IIR) set in Annex II of the 2014 Reporting Guidelines for Estimating and Reporting Emission Data under LRTAP Convention. Reported emissions and projections follow latest version of the template "NFR14[3]".

The Croatian IIR 2018 covers all year in the period from 1990 to 2016. The complete set of tables in the NFR format, are submitted separately in digital form only, and the NFR for 2016 is presented in the Appendix 4 of this report.

The key information on the activities required to create the Croatian inventory are national energy balance, statistical yearbooks and annual statistical reports, the national database for road vehicles, the Environmental Pollution Registry (EPR) database, the Database on Volatile Organic Compound (VOC) emissions and the data of individual plants of large polluters of the environment, EUROSTAT database and EUROCONTROL datasets. For large point sources emissions are taken from EPR base at CAEN.

A key category analysis is carried out for the year 2016 showing the relevant sources for air pollution in Croatia along with the overview of large point sources emissions in 2016 (Chapter 2).

With the purpose of inventory, a schedule of activities for data quality control and quality assurance that covers the basic procedures and steps in preparing the inventory and IIR is prepared and presented in Appendix 1.

The report provides an assessment of the uncertainty of the pollutant emission calculations using Tier 1 EMEP / EEA methodology. Emission uncertainty evaluation for 2016 and uncertainty of the emission trend 1990-2016 per pollutant are provided in Chapter 1.7 and Annex 7.

Details on projections are presented in Chapter 6.

In section ES2, the trends of all pollutants in the scope for 1990-2016 are presented along with emission projections for 2020. Section ES3 gives an overview of sectoral emissions in 2016. Overview of performed recalculations and other changes is given in section ES4, improvements in ES5 and planned improvements in ES6.

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[3] the Nomenclature for Reporting (NFR) format which should ensure the transparency of the inventories among Parties

## ES2 EMISSION TRENDS 1990–2016 AND PROJECTIONS FOR 2020

Emissions of almost all relevant air pollutants show a general downward trend in the period from 1990 to 2016. The NOx emissions were reduced by 50.5%, $SO_2$ by 91.4%, $NH_3$ by 34.7%, NMVOC by 60.1%, CO by 63.7%, $PM_{2.5}$ by 51.5%, $PM_{10}$ by 45.9%, TSP by 33.2%, BC by 45.7%, heavy metals: Pb by 98.5%, Cd by 28.5%, Hg by 57.1%, As by 95.3%, Cr by 61.5%, Cu by 6.2%, Ni by 70.1%, Se by 23% and Zn by 11.4%. The PCDD/PCDF emission was reduced by 57.7%, PCBs by 12.6% and PAHs by 70.6% (Table 1.1-5). The HCB emission increased by 8.9% since 1990 (details in Chapter IV).

Emission of three main pollutants $SO_2$, NOx and NMVOC show that emissions in 2016 are below the emission ceilings laid down in the Gothenburg Protocol and new NEC Directive (Table 1.1-2). Details on projections are presented in Chapter 6. Following figure shows trends of the relative emissions for main pollutants along with their projections in the "with measures scenario," (figure ES2-1) and corresponding target value laid down in the Gothenburg Protocol and new NEC Directive.

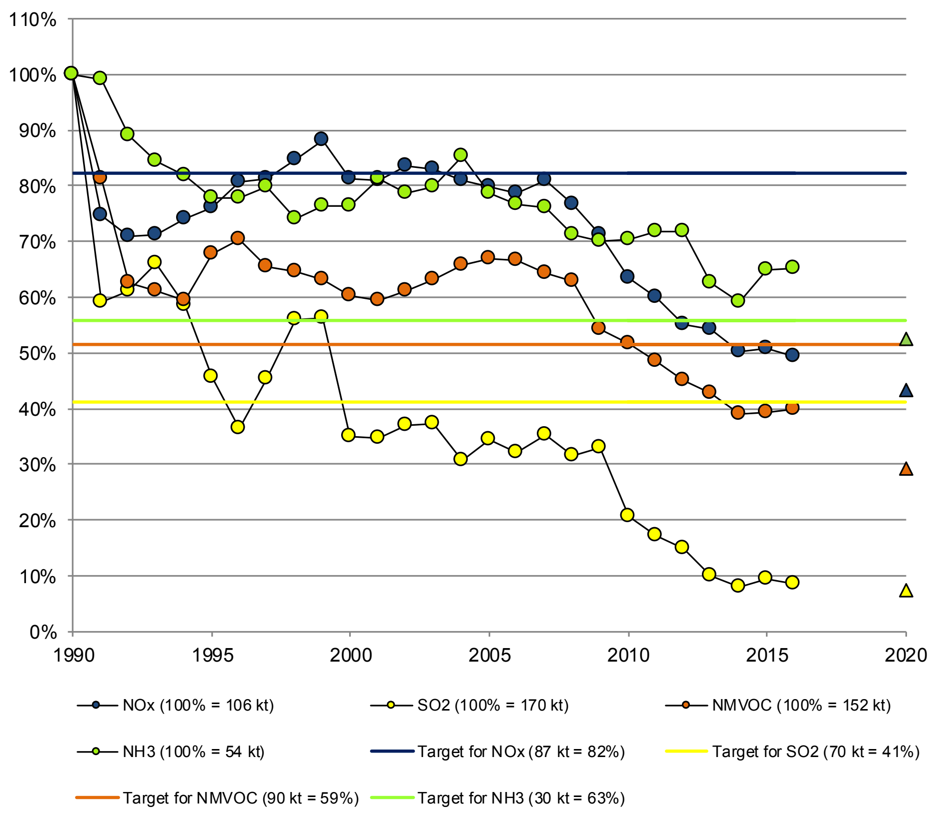


**Figure ES2-1 Relative total emission for main pollutants in the Republic of Croatia for 1990 - 2016 and projections for with measures scenario for 2020**

## ES3 SECTORAL EMISSIONS IN 2016

- **Energy** (fuel combustion and fugitive emissions) is the main source of air pollution in Croatia. The energy sector contributes the most to the following substances: to the total $SO_2$ emission with 98.6%, NOx with 93.3%, NMVOC with 41.2%, $NH_3$ with 8.2%, TSP with 50.6%, $PM_{2,5}$ with 89.4%, $PM_{10}$ with 68.7%, BC with 95.6%, CO with 99.8%, Pb with 80.7%, Cd with 89.6%, Hg with 84.4%, As with 86.1%, Cr with 95.7%, Cu with 92.6%, Ni with 98,6%, Se with 44.4%, Zn with 99.6%, PCDD / PCDF with 81.4%, PAU with 99.8% i HCB with 97.9%.

- **Industrial processes and product use**: mineral industry, chemical industry, metal industries, other industries and other solvent use are the main sources of PCBs, NMVOC, Pb, Cd, Hg, TSP, $PM_{10}$, $PM_{2.5}$, As and Se emissions. To the total PCBs emissions industrial processes and product use contributes with 98.9%, to NMVOC emission with 43.9%, TSP with 38.9%, $PM_{10}$ with 19.1%, Pb with 19.3%, Cd with 10.2%, Hg with 13.4%, Se with 55.6%, Pb with 11.1%, $PM_{2,5}$ with 7.5% As with 13.5%, Cu with 7.3%, $NH_3$ with 6.2% i BC with 4.4%.

- **Agriculture** is the main source of emissions of $NH_3$ (83.8%), NMVOC (12%), TSP (10.1%), $PM_{10}$ (11.6%) and NOx (4.9%). Manure management contributes with 60.1% and use of mineral N-fertilizers with 23.7% to $NH_3$ emission.

- **Waste**: the main source of PCDD/PCDF (18.3%), NMVOC (2.9%), $NH_3$ (1.7%), HCB (2.1%) and Hg (2.2%) emissions.

- **Natural emissions**; the emissions originating from forest fires is reported and they are not included in national total emissions. They are therefore observing under memo items.

Tables from ES3-1 to ES3-4 present total national emissions by source of discharges, and total (specific) emissions expressed in dependence of population, area and gross domestic product of Croatia in 2016. The share of each SNAP sector in total national emissions of certain pollutants is also representing in tables. Table ES3-1 shows an overview of national emissions of pollutants that cause acidification, eutrophication and photochemical pollution ($SO_2$, NOx, NMVOC, CO and $NH_3$). Table ES3-2 shows particulate matter emissions (TSP, $PM_{10}$, $PM_{2.5}$ and BC), table ES3-3 shows heavy metal emissions (Pb, Cd, Hg, As, Cr, Cu, Ni, Se and Zn). Table ES3-4 shows emission of persistent organic pollutants (PAHs, PCDD / PCDF, PCBs and HCB) for Croatia in 2016.

**Table ES3-1 Emissions of the substances which cause acidification, eutrophication and photochemical pollution in the Republic of Croatia, 2016**

| **Emissions 2016, t/yr** | **$SO_2$** | **NOx** | **NMVOC** | **CO** | **$NH_3$** |
|---|---|---|---|---|---|
| Combustion in energy transformation industry | 6.348.5 | 6.932.0 | 355.5 | 1.250.1 | 10.9 |
| Non-industrial combustion plants | 1.058.5 | 7.199.2 | 16.397.4 | 124.064.8 | 2.241.1 |
| Combustion in manufacturing industry | 2.910.4 | 5.107.3 | 957.8 | 8.247.9 | 30.4 |
| Production processes | 3.974.4 | 1.049.3 | 6.418.0 | 20.499.0 | 2.229.3 |
| Extraction and distribution of fossil fuels and geothermal energy | 0 | 0 | 2.514.9 | 0 | 0 |
| Solvent and other product use | 4 | 15 | 25.240.6 | 458.9 | 34 |
| Road transport | 66.6 | 22.331.4 | 6.261.0 | 34.849.6 | 509.0 |
| Other mobile source and machinery | 59.8 | 7.117.1 | 1.277.0 | 12.770.5 | 2.6 |
| Waste treatment and disposal | 291.8 | 60.0 | 2.081.2 | 293.9 | 607.4 |
| Agriculture | 0 | 2.560.5 | 8.367 | 0 | 29.349.2 |
| **TOTAL** | **14.713.7** | **52.371.7** | **69.870.7** | **202.434.6** | **35.013.9** |
| Other source and sinks (not included in national total) | 405.6 | 2.215.2 | 2.077.3 | 20.341.0 | 134.7 |
| Emissions in relation to population, kg/citizen | 3.5 | 12.5 | 16.7 | 48.5 | 8.4 |
| Emissions in relation to area, $kg/km^2$ | 0.3 | 0.9 | 1.2 | 3.6 | 0.6 |
| Emissions in relation to GDP, g/EUR | 0.3 | 1.1 | 1.5 | 4.4 | 0.8 |
| **Share, %** | **SO2** | **NOx** | **NMVOC** | **CO** | **NH3** |
| Combustion in energy transformation industry | 43.1 | 13.2 | 0.5 | 0.6 | 3.1E-02 |
| Non-industrial combustion plants | 7.2 | 13.7 | 23.5 | 61.3 | 6.4 |
| Combustion in manufacturing industry | 19.8 | 9.8 | 1.4 | 4.1 | 0.1 |
| Production processes | 27.0 | 2.0 | 9.2 | 10.1 | 6.4 |
| Extraction and distribution of fossil fuels and geothermal energy | 0 | 0 | 3.6 | 0 | 0 |
| Solvent and other product use | 0 | 2.9E-02 | 36.1 | 2.3E-01 | 0 |
| Road transport | 0.5 | 42.6 | 9.0 | 17.2 | 1.5 |
| Other mobile source and machinery | 0.4 | 13.6 | 1.8 | 6.3 | 7.6E-03 |
| Waste treatment and disposal | 2.0E+00 | 1.1E-01 | 3.0 | 1.45E-01 | 1.7 |
| Agriculture | 0 | 4.9 | 12 | 0 | 83.8 |
| **TOTAL** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** |
| Other source and sinks (not included in national total) | 2.8 | 4.2 | 3.0 | 10.0 | 0.4 |

**Table ES3-2 Particulate matter emissions in the Republic of Croatia, 2016**

| **Emissions 2016, t/yr** | **TSP** | **$PM_{2.5}$** | **$PM_{10}$** | **BC** |
|---|---|---|---|---|
| Combustion in energy transformation industry | 1.141.5 | 661.5 | 870.0 | 26.5 |
| Non-industrial combustion plants | 14.441.8 | 13.419.7 | 13.748.5 | 1.906.6 |
| Combustion in manufacturing industry | 387.6 | 307.7 | 341.4 | 51.9 |
| Production processes | 14.647.7 | 1.216.0 | 4.842.5 | 32.8 |
| Extraction and distribution of fossil fuels and geothermal energy | 0 | 0 | 0 | 0 |
| Solvent and other product use | 412.6 | 315.1 | 390.5 | 99.2 |
| Road transport | 2.085.7 | 1.467.0 | 1.842.0 | 708.5 |
| Other mobile source and machinery | 428.7 | 425.9 | 427.3 | 132.8 |
| Waste treatment and disposal | 176.2 | 174.7 | 174.9 | 5.6 |
| Agriculture | 3.778.9 | 423.9 | 2.967.0 | 0.0 |
| **TOTAL** | **37.500.8** | **18.411.4** | **25.604.2** | **2.963.9** |
| Other source and sinks (not included in national total) | 25.1 | 24.8 | 25.1 | 10.1 |
| Emissions in relation to population, kg/citizen | 9.0 | 4.4 | 6.1 | 0.7 |
| Emissions in relation to area, $kg/km^2$ | 0.7 | 0.3 | 0.5 | 0.1 |
| Emissions in relation to GDP, g/EUR | 0.8 | 0.4 | 0.6 | 0.1 |
| **Share, %** | **TSP** | **$PM_{2.5}$** | **$PM_{10}$** | **BC** |
| Combustion in energy transformation industry | 3.0 | 3.6 | 3.4 | 0.9 |
| Non-industrial combustion plants | 38.5 | 72.9 | 53.7 | 64.3 |
| Combustion in manufacturing industry | 1.0 | 1.7 | 1.3 | 1.8 |
| Production processes | 39.1 | 6.6 | 18.9 | 1.1 |
| Extraction and distribution of fossil fuels and geothermal energy | 0 | 0 | 0 | 0 |
| Solvent and other product use | 1.1 | 1.7 | 1.5 | 3.3 |
| Road transport | 5.6 | 8.0 | 7.2 | 23.9 |
| Other mobile source and machinery | 1.1 | 2.3 | 1.7 | 4.5 |
| Waste treatment and disposal | 0.470 | 0.949 | 0.683 | 0.190 |
| Agriculture | 10.1 | 2.3 | 11.6 | 0.0 |
| **TOTAL** | **100.0** | **100.0** | **100.0** | **100.0** |
| Other source and sinks (not included in national total) | 0.1 | 0.1 | 0.1 | 0.3 |

**Table ES3-3 Heavy metals emissions in the Republic of Croatia, 2016**

| **Emissions 2016, t/yr** | **Pb** | **Hg** | **Cd** | **As** | **Cr** | **Cu** | **Ni** | **Se** | **Zn** |
|---|---|---|---|---|---|---|---|---|---|
| Combustion in energy transformation industry | 339.4 | 204.3 | 35.3 | 123.9 | 205.1 | 274.2 | 6.925.9 | 28.0 | 1.418.9 |
| Non-industrial combustion plants | 1.294.7 | 47.7 | 633.3 | 13.0 | 1.092.7 | 287.9 | 96.4 | 25.0 | 24.372.6 |
| Combustion in manufacturing industry | 319.6 | 118.0 | 30.5 | 66.0 | 129.0 | 169.6 | 127.9 | 57.7 | 1.677.3 |
| Production processes | 702.3 | 40.5 | 73.7 | 196.7 | 238.8 | 76.7 | 507.0 | 230.6 | 253.1 |
| Extraction and distribution of fossil fuels and geothermal energy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solvent and other product use | 1002 | 65.2 | 46.0 | 1.69974 | 19.9368 | 611.5 | 60.4 | 0 | 354.3 |
| Road transport | 4.106.4 | 11.329 | 21.2 | 0.3 | 340.4 | 6.471.1 | 65.0 | 6.2 | 5.898.4 |
| Other mobile source and machinery | 185.6 | 1.5 | 3.3 | 1.7 | 16.7 | 527.7 | 59.5 | 6.9 | 365.9 |
| Waste treatment and disposal | 6.8 | 11.1 | 2.5 | 1.9 | 5.5 | 11.3 | 5.9 | 0.1 | 40.2 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **7.956.7** | **499.7** | **845.7** | **405.1** | **2.048.3** | **8.429.9** | **7.847.9** | **354.5** | **34.380.8** |
| Other source and sinks (not included in national total) | 0.72 | 0.64 | 0.05 | 0.25 | 1.06 | 3.39 | 2.74 | 0.78 | 137.43 |
| Emissions in relation to population, kg/citizen | 1.9 | 0.1 | 0.2 | 0.1 | 0.5 | 2.0 | 1.9 | 0.1 | 8.2 |
| Emissions in relation to area, $kg/km^2$ | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.6 |
| Emissions in relation to GDP, g/EUR | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.0 | 0.7 |
| **Share, %** | **Pb** | **Hg** | **Cd** | **As** | **Cr** | **Cu** | **Ni** | **Se** | **Zn** |
| Combustion in energy transformation industry | 4.3 | 40.9 | 4.2 | 30.6 | 10.0 | 3.3 | 88.3 | 7.9 | 4.1 |
| Non-industrial combustion plants | 16.3 | 9.5 | 74.9 | 3.2 | 53.3 | 3.4 | 1.2 | 7.0 | 70.9 |
| Combustion in manufacturing industry | 4.0 | 23.6 | 3.6 | 16.3 | 6.3 | 2.0 | 1.6 | 16.3 | 4.9 |
| Production processes | 8.8 | 8.1 | 8.7 | 48.6 | 11.7 | 0.9 | 6.5 | 65.0 | 0.7 |
| Extraction and distribution of fossil fuels and geothermal energy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solvent and other product use | 12.593 | 13.0 | 5.4 | 0.41963 | 0.97334 | 7.3 | 0.8 | 0 | 1.0 |
| Road transport | 51.6 | 2.2672 | 2.5 | 0.07027 | 16.6 | 76.8 | 0.8 | 1.8 | 17.2 |
| Other mobile source and machinery | 2.3 | 0.3 | 0.4 | 0.42727 | 0.8 | 6.3 | 0.8 | 2.0 | 1.1 |
| Waste treatment and disposal | 0.1 | 2.2 | 0.3 | 0.47 | 0.27 | 0.13 | 0.08 | 0.03 | 0.12 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** |
| Other source and sinks (not included in national total) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table ES3-4 Persistent organic pollutants emissions in the Republic of Croatia, 2016**

| **Emissions 2016, kg/yr for PAH, HCB, PCB; g I-TEQ/yr for PCDD/PCDF** | **PAH** | **PCDD/ PCDF** | **HCB** | **PCB** |
|---|---|---|---|---|
| Combustion in energy transformation industry | 5.1 | 0.5 | 3.4E-02 | 4.1 |
| Non-industrial combustion plants | 6359.3 | 14.4 | 0.24 | 0.0 |
| Combustion in manufacturing industry | 370.8 | 0.5 | 1.5E-02 | 0.6 |
| Production processes | 13.092225 | 0.1 | 0 | 0.1 |
| Extraction and distribution of fossil fuels and geothermal energy | 0 | 0 | 0 | 0 |
| Solvent and other product use | 2.8 | 0.001 | 0 | 417.4 |
| Road transport | 149.2 | 1.0 | NA | NE |
| Other mobile source and machinery | 42.6 | 0.3 | 0.003 | 0.002 |
| Waste treatment and disposal | 0.0043 | 3.7 | 0.0063372 | 0.003 |
| Agriculture | 0 | 0 | 0 | 0 |
| **TOTAL** | **6942.9** | **20.5** | **0.30** | **422.3** |
| Other source and sinks (not included in national total) | 93.2 | 0.0068 | 0.0002156 | 0.0001026 |
| Emissions in relation to population, kg/citizen | 1.7 | 0.005 | 7.077E-05 | 0.1 |
| Emissions in relation to area, kg/km$^2$ | 0.1 | 0.0004 | 5.219E-06 | 0.007 |
| Emissions in relation to GDP, g/EUR | 0.1 | 0.000 | 6.379E-06 | 0.009 |
| **Share, %** | **PAH** | **PCDD/ PCDF** | **HCB** | **PCB** |
| Combustion in energy transformation industry | 7.3E-02 | 2.2 | 11.4 | 1.0 |
| Non-industrial combustion plants | 91.6 | 70.4 | 80.3 | 0.0 |
| Combustion in manufacturing industry | 5.3 | 2.2 | 5.1 | 0.2 |
| Production processes | 0.2 | 0.4 | 0.0 | 0.0 |
| Extraction and distribution of fossil fuels and geothermal energy | 0 | 0 | 0 | 0 |
| Solvent and other product use | 0.0 | 0.004 | 0 | 98.9 |
| Road transport | 2.1 | 4.8 | - | - |
| Other mobile source and machinery | 0.6 | 1.7 | 1.1 | 0.001 |
| Waste treatment and disposal | 0 | 18.3 | 2 | 0.001 |
| Agriculture | 0 | 0 | 0 | 0 |
| **TOTAL** | **100.0** | **100.0** | **100.0** | **100.0** |
| Other source and sinks (not included in national total) | 1.3 | 0.03 | 0 | 0 |

# ES4 RECALCULATIONS AND OTHER CHANGES

The recalculations had to be carried out due to the availability of new information, improvements in sectors, implementation of higher tier (e.g. Tier 2), changing methodology, due to identification of time series inconsistency, increase the accuracy of the estimates and reduce the uncertainty.

The emissions of almost all pollutants were recalculated for the full time series 1990–2015, for the present submission. In Appendix 8. The influence of emission recalculations made 1990 - 2015 in respect to each of pollutant and by SNAP97 sector are presented. In addition, the overview of changes between total pollutants emissions for 2015 submitted in 2017 and in this year submission, along with comparison with total pollutants emissions for 2016 and explanations for changes are present in table ES4-1.

**Table ES4-1 Recalculations and explanations for changes between submitted total pollutants emissions for year 2015 in IIR 2017 and in IIR 2018**

| Pollutant | 2017 sub-mission | 2018 submission | | Unit | Explanations for changes between the 2017 and 2018 submissions |
|---|---|---|---|---|---|
| | IIR 2017 | IIR 2018 | | | |
| | 2015 | 2015 | 2016 | | |
| NOx | 52.9 | 51.9 | 52.6 | kt | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from |

| Pollutant | 2017 submission | 2018 submission | | Unit | Explanations for changes between the 2017 and 2018 submissions |
|---|---|---|---|---|---|
| | IIR 2017 | IIR 2018 | | | |
| | 2015 | 2015 | 2016 | | |
| | | | | | Eurocontrol<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation.<br>– 3.B Manure management: Emissions were recalculated for the entire 1990-2015 period due to correction of activity data in order to ensure consistent AD between CRF and NFR tables. This resulted in a change of emission for NFR 3.B.1.a Cattle dairy, 3.B.3 Fattening pigs and 3.B.4.g Poultry. Another review issue was detected with NOx emissions - emissions were missing for certain animal categories in the NRF tables. NOx estimates for categories 3.B.1.b, 3.B.2, 3.B.4.a, 3.B.4.d, 3.B.4.e, 3.B.4.f, 3.B.4.g.i, 3.B.4.g.ii, 3.B.4.g.iii and 3.B.4.g.iv have been recalculated for the entire 1990-2015 time period.<br>– 3.D.a.2.b Sewage sludge applied to soil: Starting with this Report, as a part of the improvement programme and TERT recommendation, NOx emissions from this source are now being reported. |
| NMVOC | 59.4 | 61.3 | 62.6 | kt | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation |

<table>
<tr><th rowspan="3">Pollutant</th><th>2017 sub-mission</th><th colspan="2">2018 submission</th><th rowspan="3">Unit</th><th rowspan="3">Explanations for changes between the 2017 and 2018 submissions</th></tr>
<tr><th>IIR 2017</th><th colspan="2">IIR 2018</th></tr>
<tr><th>2015</th><th>2015</th><th>2016</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.a.v Fugitive emission from distribution of oil products: changes due to the correction of the insignificant manual error in the calculation<br>– 1.B.2.b.ii Natural gas - Exploration, production, transport: Small changes due to the correction of calculation for the period 2013. – 2015.<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.D.3.a Domestic solvent use including fungicides: including Tier 2 EF according to GB2016<br>– 2.D.3.d Coating applications: Use of new methodology that include a more extensive set of activity data.<br>– 2.D.3.e Degreasing: Use of new methodology that include a more extensive set of activity data.<br>– 2.D.3.f Dry cleaning: Use of new methodology that include a more extensive set of activity data.<br>– 2.D.3.g Chemical products: including of new activities in sector.<br>– 2.D.3.h Printing: Use of new methodology that include a more extensive set of activity data.<br>– 2.H.2 Food and beverages industry: correction of error in calculation<br>– 5.D.1 Domestic wastewater handling: correction of unit for emission factor<br>– 5.D.2 Industrial wastewater handling: correction of unit for emission factor<br>– 3.B Emissions were recalculated for the entire 1990-2015 period due to correction of activity data in order to ensure consistent AD between CRF and NFR tables. This resulted in a change of emission for NFR 3.B.1.a Cattle dairy, 3.B.3 Fattening pigs and 3.B.4.g Poultry.</td></tr>
</table>

| Pollutant | 2017 sub-mission | 2018 submission | | Unit | Explanations for changes between the 2017 and 2018 submissions |
|---|---|---|---|---|---|
| | IIR 2017 | IIR 2018 | | | |
| | 2015 | 2015 | 2016 | | |
| $SO_2$ | 14.0 | 14.9 | 13.3 | kt | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occured<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.d.ii National navigation (shipping): Small changes due to the correction of calculation for the SO2 for the period 2013. – 2015.<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation. |
| $NH_3$ | 26.8 | 34.9 | 35.2 | kt | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred |

<table>
<tr><th rowspan="3">Pollutant</th><th>2017 sub-mission</th><th colspan="2">2018 submission</th><th rowspan="3">Unit</th><th rowspan="3">Explanations for changes between the 2017 and 2018 submissions</th></tr>
<tr><th>IIR 2017</th><th colspan="2">IIR 2018</th></tr>
<tr><th>2015</th><th>2015</th><th>2016</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years.<br>– 3.B Emissions were recalculated for the entire 1990-2015 period due to correction of activity data in order to ensure consistent AD between CRF and NFR tables. This resulted in a change of emission for NFR 3.B.1.a Cattle dairy, 3.B.3 Fattening pigs and 3.B.4.g Poultry.<br>– 3.D.1.a Inorganic N-fertilizers (includes urea): Emissions for the entire time period 1990-2015 were recalculated using the GB2016 EFs instead of GB2013 and GB2009 methodologies which were used until this report.<br>– 3.D.a.2.b Sewage sludge applied to soil: Starting with this Report, as a part of the improvement programme and TERT recommendation, emissions from this source are now being reported.<br>– 3.D.a.3 Urine and dung deposited by grazing animals: Starting with this report, as a part of the improvement programme and TERT recommendation, NH3 emissions from the from urine and dung deposited by grazing animals (3.B.1.a Dairy cows, 3.B.1.b Other cattle, 3.B.2 Sheep, 3.B.4.d Goats, 3.b.4.e Horses and 3.4.b.f Mules and asses) has been moved and reported in the correct category) instead of being included in 3.B source category.<br>– 5.B.1 Biological treatment of waste - Composting: category has been included in the IIR 2018 for the first time<br>– 5.D.3 Other wastewater handling: correction of value for emission factor</td></tr>
<tr><td>$PM_{2.5}$</td><td>19.3</td><td>20.5</td><td>20.5</td><td>kt</td><td>Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015</td></tr>
</table>

| **Pollutant** | **2017 submission** | **2018 submission** | | **Unit** | **Explanations for changes between the 2017 and 2018 submissions** |
|---|---|---|---|---|---|
| | **IIR 2017** | **IIR 2018** | | | |
| | **2015** | **2015** | **2016** | | |
| | | | | | – 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.A.1 Cement production: harmonization of activity data with NIR2018.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation.<br>– 3.B During the 2017 ESD revision of the NIR 2016, issue was detected with the activity data of certain animal categories in the CRF tables due to NAPA to AAP (2006 IPCC guidelines) conversion. Emissions were recalculated for the entire 1990-2015 period due to correction of activity data in order to ensure consistent AD between CRF and NFR tables. This resulted in a change of emission for NFR 3.B.1.a Cattle dairy, 3.B.3 Fattening pigs and 3.B.4.g Poultry.<br>– 5.E Other waste: harmonization of emission factor with GB2016 |

<table>
<tr><th rowspan="3">Pollutant</th><th>2017 submission</th><th colspan="2">2018 submission</th><th rowspan="3">Unit</th><th rowspan="3">Explanations for changes between the 2017 and 2018 submissions</th></tr>
<tr><th>IIR 2017</th><th colspan="2">IIR 2018</th></tr>
<tr><th>2015</th><th>2015</th><th>2016</th></tr>
<tr><td>PM10</td><td>25.8</td><td>27.8</td><td>27.8</td><td>kt</td><td>Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.A.1 Cement production: harmonization of activity data with NIR2018.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation.<br>– 3.B During the 2017 ESD revision of the NIR 2016, issue was detected with the activity data of certain animal categories in the CRF tables due to NAPA to AAP (2006 IPCC guidelines) conversion. Emissions were recalculated for the entire 1990-2015 period due to correction of activity data in order to ensure consistent AD between CRF and NFR tables. This resulted in a change of emission for NFR 3.B.1.a Cattle dairy, 3.B.3 Fattening pigs and 3.B.4.g Poultry.</td></tr>
</table>

| Pollutant | 2017 submission | 2018 submission | | Unit | Explanations for changes between the 2017 and 2018 submissions |
|---|---|---|---|---|---|
| | IIR 2017 | IIR 2018 | | | |
| | 2015 | 2015 | 2016 | | |
| | | | | | – 5.E Other waste: harmonization of emission factor with GB2016 |
| TSP | 37.7 | 40.3 | 39.7 | kt | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.A.1 Cement production: harmonization of activity data with NIR2018.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation.<br>– 5.C.1.b.iii Clinical waste incineration: correction of unit for emission factor<br>– 3.B During the 2017 ESD revision of the NIR 2016, issue was detected with the activity data of certain animal categories in the CRF tables due to NAPA to AAP (2006 IPCC guidelines) conversion. Emissions were recalculated for the entire 1990-2015 period due to correction of |

<table>
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<tr><th>IIR 2017</th><th colspan="2">IIR 2018</th></tr>
<tr><th>2015</th><th>2015</th><th>2016</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>activity data in order to ensure consistent AD between CRF and NFR tables. This resulted in a change of emission for NFR 3.B.1.a Cattle dairy, 3.B.3 Fattening pigs and 3.B.4.g Poultry.<br>– 5.E Other waste: harmonization of emission factor with GB2016</td></tr>
<tr><td>BC</td><td>3.1</td><td>3.3</td><td>3.4</td><td>kt</td><td>Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.A.3 Glass production: correction of EF for mineral wool production.<br>– 5.C.1.b.iii Clinical waste incineration: correction of unit for emission factor<br>– 5.E Other waste: harmonization of emission factor with GB2016</td></tr>
</table>

| Pollutant | 2017 sub-mission | 2018 submission | | Unit | Explanations for changes between the 2017 and 2018 submissions |
|---|---|---|---|---|---|
| | IIR 2017 | IIR 2018 | | | |
| | 2015 | 2015 | 2016 | | |
| CO | 202.2 | 215.8 | 212.9 | kt | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation |
| Pb | 7.1 | 7.9 | 8.2 | t | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii |

| Pollutant | 2017 submission | 2018 submission | | Unit | Explanations for changes between the 2017 and 2018 submissions |
|---|---|---|---|---|---|
| | IIR 2017 | IIR 2018 | | | |
| | 2015 | 2015 | 2016 | | |
| | | | | | (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation<br>– 5.E Other waste: harmonization of emission factor with GB2016 |
| Cd | 0.8 | 0.9 | 0.9 | t | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty |

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<tr><th>IIR 2017</th><th colspan="2">IIR 2018</th></tr>
<tr><th>2015</th><th>2015</th><th>2016</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.5.E Other waste: harmonization of emission factor with GB2016<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation<br>– 5.E Other waste: harmonization of emission factor with GB2016</td></tr>
<tr><td>Hg</td><td>0.5</td><td>0.5</td><td>0.5</td><td>t</td><td>Small changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation<br>– 5.E Other waste: harmonization of emission factor with GB2016</td></tr>
<tr><td>As</td><td>0.3</td><td>0.5</td><td>0.4</td><td>t</td><td>Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption</td></tr>
</table>

| Pollutant | 2017 submission | 2018 submission | | Unit | Explanations for changes between the 2017 and 2018 submissions |
|---|---|---|---|---|---|
| | IIR 2017 | IIR 2018 | | | |
| | 2015 | 2015 | 2016 | | |
| | | | | | calculation occurred<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation<br>– 5.E Other waste: harmonization of emission factor with GB2016 |
| Cr | 2.0 | 2.1 | 2.1 | t | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii |

<table>
<tr><th rowspan="3">Pollutant</th><th>2017 sub-mission</th><th colspan="2">2018 submission</th><th rowspan="3">Unit</th><th rowspan="3">Explanations for changes between the 2017 and 2018 submissions</th></tr>
<tr><th>IIR 2017</th><th colspan="2">IIR 2018</th></tr>
<tr><th>2015</th><th>2015</th><th>2016</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation<br>– 5.E Other waste: harmonization of emission factor with GB2016</td></tr>
<tr><td>Cu</td><td>7.2</td><td>7.9</td><td>8.5</td><td>t</td><td>Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil), 1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation<br>– 5.E Other waste: harmonization of emission factor with</td></tr>
</table>

| Pollutant | 2017 sub-mission | 2018 submission | | Unit | Explanations for changes between the 2017 and 2018 submissions |
|---|---|---|---|---|---|
| | IIR 2017 | IIR 2018 | | | |
| | 2015 | 2015 | 2016 | | |
| | | | | | GB2016 |
| Ni | 6.6 | 6.3 | 6.0 | t | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c. in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f. in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation |
| Se | 0.4 | 0.3 | 0.4 | t | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation |

| Pollutant | 2017 submission | 2018 submission | | Unit | Explanations for changes between the 2017 and 2018 submissions |
|---|---|---|---|---|---|
| | IIR 2017 | IIR 2018 | | | |
| | 2015 | 2015 | 2016 | | |
| | | | | | LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015. |
| Zn | 31.6 | 35.2 | 35.5 | t | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii |

<table>
<tr><th rowspan="3">Pollutant</th><th>2017 sub-mission</th><th colspan="2">2018 submission</th><th rowspan="3">Unit</th><th rowspan="3">Explanations for changes between the 2017 and 2018 submissions</th></tr>
<tr><th>IIR 2017</th><th colspan="2">IIR 2018</th></tr>
<tr><th>2015</th><th>2015</th><th>2016</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.<br>– 2.D.3.i, 2.G Other solvent and product use: including new activity in calculation</td></tr>
<tr><td>PCDD / PCDF</td><td>20.9</td><td>23.1</td><td>23.1</td><td>g I-Teq</td><td>Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– 5.E Other waste: harmonization of emission factor with GB2016</td></tr>
<tr><td>Total 4 PAHs</td><td>8.0</td><td>8.2</td><td>8.2</td><td>t</td><td>Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil),</td></tr>
</table>

<table>
<tr><th rowspan="3">Pollutant</th><th>2017 submission</th><th colspan="2">2018 submission</th><th rowspan="3">Unit</th><th rowspan="3">Explanations for changes between the 2017 and 2018 submissions</th></tr>
<tr><th>IIR 2017</th><th colspan="2">IIR 2018</th></tr>
<tr><th>2015</th><th>2015</th><th>2016</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.</td></tr>
<tr><td>benzo (a) pyrene</td><td>2.7</td><td>2.7</td><td>2.7</td><td>t</td><td>Small changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.</td></tr>
</table>

<table>
<tr><th rowspan="3">Pollutant</th><th>2017 sub-mission</th><th colspan="2">2018 submission</th><th rowspan="3">Unit</th><th rowspan="3">Explanations for changes between the 2017 and 2018 submissions</th></tr>
<tr><th>IIR 2017</th><th colspan="2">IIR 2018</th></tr>
<tr><th>2015</th><th>2015</th><th>2016</th></tr>
<tr><td>benzo (b) fluoranth ene</td><td>2.7</td><td>2.8</td><td>2.8</td><td>t</td><td>Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015.</td></tr>
<tr><td>benzo (k) fluoranth ene</td><td>1.0</td><td>1.0</td><td>1.1</td><td>t</td><td>Small changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy</td></tr>
</table>

| Pollutant | 2017 submission | 2018 submission | | Unit | Explanations for changes between the 2017 and 2018 submissions |
|---|---|---|---|---|---|
| | IIR 2017 | IIR 2018 | | | |
| | 2015 | 2015 | 2016 | | |
| | | | | | balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015. |
| indeno (1, 2, 3-cd) pyrene | 1.5 | 1.5 | 1.5 | t | Small changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred<br>– 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol<br>– 1.A.3.b Road transportation:<br>o data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br>o data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles<br>– Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with |

| **Pollutant** | **2017 sub-mission** | **2018 submission** | | **Unit** | **Explanations for changes between the 2017 and 2018 submissions** |
|---|---|---|---|---|---|
| | **IIR 2017** | **IIR 2018** | | | |
| | **2015** | **2015** | **2016** | | |
| | | | | | the GB2016 methodology and FE for the past years<br>– 1.B.2.c Venting and flaring: Small changes due to the correction of calculation for the period 2014. – 2015. |
| HCB | 0.284 | 0.295 | 0.296 | kg | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occured |
| PCBs | 428.7 | 425.0 | 422.5 | kg | Changes stems from methodology improvement in sectors:<br>– 1.A.1.a consumption of biomass was added for the period from 2010-2015<br>– 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred |

## ES5 IMPROVEMENTS AND OTHER ACTIVITY

The Croatian IIR 2018 includes improvements and other activity that will lead to future improvements of inventory are present in table ES5-1.

**Table ES5-1 Improvements and other activity made in IIR 2018**

| **NFR sector, Name** | **NFR sub-sector, Name** | **Description of improvements and other activity made** |
|---|---|---|
| 1 A Energy – fuel combustion | 1.A.1 Energy industries | 1.A.1.a For the period 2010-2015 data on biomass consumption were included<br><br>1.A.1.b in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3<br><br>1.A.1.c in 2014 and 2015 wrong NCV was used for natural gas consumption 34.00 instead of 34.60 MJ/m3 |
| 1 A Energy – fuel combustion | 1.A.2 Manufacturing industry | 1.A.2.f in 2014 and 2015 error in liquid fuel consumption calculation occurred |
| 1.A Energy – fuel combustion | 1.A.3.b Road transport | Data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars<br><br>Data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles |

| NFR sector, Name | NFR sub-sector, Name | Description of improvements and other activity made |
|---|---|---|
| 1.A Energy – fuel combustion | 1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil) | Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol |
| 1.A Energy – fuel combustion | 1.A.3.d.ii National navigation (shipping) | Small changes due to the correction of calculation for the SO2 for the period 2013. – 2015. |
| 1.A Energy – fuel combustion | Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture /Forestry/Fishing: Off-road vehicles and other machinery: Small changes due to the harmonization with the GB2016 methodology and FE for the past years | Small changes due to the harmonization with the GB2016 methodology and FE for the past years |
| 1.B Fugitive emissions | 1.B.2.a.v Fugitive emission from distribution of oil products: | Small changes due to the correction of calculation in past years |
| 1.B Fugitive emissions | 1.B.2.b.ii Natural gas - Exploration, production, transport | Small changes due to the correction of calculation for the period 2013. – 2015. |
| 1.B Fugitive emissions | 1.B.2.c Venting and flaring | Small changes due to the correction of calculation for the period 2014. – 2015. |
| 2 Industrial processes and product use | 2.A.1 Cement production | Recalculation was performed for 2014 and 2015 due to harmonization of activity data with NIR2018. |
| 2 Industrial processes and product use | 2.A.3 Glass production | Recalculation was performed for BC emissions from mineral wool production for the period 2007-2015 due to incorrect EF previously used. |
| 2 Industrial processes and product use | 2.D.3.a Domestic solvent use including fungicides | Recalculation for the trend was performed due to the EF adjustment according to Tier 2 from GB2016 related to the following products: Household products, Car care products and Pesticides. |

| NFR sector, Name | NFR sub-sector, Name | Description of improvements and other activity made |
|---|---|---|
| 2 Industrial processes and product use | 2.D.3.d Coating applications | Recalculation for the trend was performed due to the use of new calculation methodology that includes a more comprehensive set of activity data. |
| 2 Industrial processes and product use | 2.D.3.e Degreasing | Recalculation for the trend was performed taking into account the amount of solvent used (for vapor cleaning), rather than just the number of inhabitants. |
| 2 Industrial processes and product use | 2.D.3.f Dry cleaning | Recalculation for the trend was performed taking into account the amounts of imported/exported/produced perchlorethylene, rather than the number of inhabitants. |
| 2 Industrial processes and product use | 2.D.3.g Chemical products | New activity - Adhesive, magnetic tapes, films and photographs manufacturing (SNAP 060311) was included in this category, thus the recalculation was performed for the entire trend. |
| 2 Industrial processes and product use | 2.D.3.h Printing | Recalculation for the trend was performed due to the use of new calculation methodology that includes a more comprehensive set of activity data. |
| 2 Industrial processes and product use | 2.D.3.i, 2.G Other solvent and product use | New activity – Use of fireworks (SNAP 060601) was included in this category, thus the recalculation was performed for the entire trend.<br><br>Recalculation was also performed for NMVOC emissions for 2015 for the activity – use of adhesives due to the incorrect calculation. |
| 2 Industrial processes and product use | 2.H.2 Food and beverages | Recalculation was performed for NMVOC emissions for 2015 for the activity - production of wine due to the incorrect calculation. |
| 3 Agriculture | 3.B Manure management | During the 2017 ESD revision of the NIR 2016, issue was detected with the activity data of certain animal categories in the CRF tables due to NAPA → AAP (2006 IPCC guidelines) conversion. Emissions were recalculated for the entire 1990-2015 period due to correction of activity data in order to ensure consistent AD between CRF and NFR tables. This resulted in a change of emission for NFR 3.B.1.a Cattle dairy, 3.B.3 Fattening pigs and 3.B.4.g Poultry.<br><br>Up to this Report, NH3 emissions from urine and dung deposited by grazing animals (3.B.1.a Dairy cows, 3.B.1.b Other cattle, 3.B.2 Sheep, 3.B.4.d Goats, 3.b.4.e Horses and 3.4.b.f Mules and asses) were included in 3.B source category. Starting with this report, as a part of the improvement programme and TERT recommendation, emissions from the aforementioned grazing animals has been moved to the correct category (3.D.a.3 Urine and dung deposited by grazing animals). This resulted in a recalulcation change of NH3 emissions from 3.B category. |

| NFR sector, Name | NFR sub-sector, Name | Description of improvements and other activity made |
|---|---|---|
| | | During the 2017 ESD revision of the NIR 2016, issue was detected with NOx emissions – emissions were missing for certain animal categories in the NRF tables. NOx estimates for categories 3.B.1.b, 3.B.2, 3.B.4.a, 3.B.4.d, 3.B.4.e, 3.B.4.f, 3.B.4.g.i, 3.B.4.g.ii, 3.B.4.g.iii and 3.B.4.g.iv have been recalculated for the entire 1990-2015 time period. |
| 3 Agriculture | 3.D.1.a Inorganic N-fertilizers (includes also urea application) | During the revision, The TERT noted that for 3.D.a.1 Inorganic N-fertilizers (includes also urea application) emission calculation GB2013 and GB2009 methodologies were used. Emissions for the entire time period 1990-2015 were recalculated using GB2016 EFs (Table 3.2). Starting with this report, as a part of the improvement programme and TERT recommendation, NH3 emissions from the from urine and dung deposited by grazing animals (3.B.1.a Dairy cows, 3.B.1.b Other cattle, 3.B.2 Sheep, 3.B.4.d Goats, 3.b.4.e Horses and 3.4.b.f Mules and asses) has been moved and reported in the correct category (3.D.a.3 Urine and dung deposited by grazing animals) instead of being included in 3.B source category. |
| 3 Agriculture | 3.D.a.2.b Sewage sludge applied to soil | Starting with this Report, as a part of the improvement programme and TERT recommendation, NH3 emissions from the source 3.D.a.2.b Sewage sludge applied to soil are now being reported, using Tier 1 methodology and EFs are from GB2016. |
| 3 Agriculture | 3.D.a.3 Urine and dung deposited by grazing animals | Up to this Report, NH3 emissions from urine and dung deposited by grazing animals (3.B.1.a Dairy cows, 3.B.1.b Other cattle, 3.B.2 Sheep, 3.B.4.d Goats, 3.b.4.e Horses and 3.4.b.f Mules and asses) were included in 3.B source category. Starting with this report, as a part of the improvement programme and TERT recommendation, emissions from the aforementioned grazing animals has been moved to the correct category (3.D.a.3 Urine and dung deposited by grazing animals). This resulted in a recalculation change of NH3 emissions from 3.B category. |
| 5 Waste | 5.B.1 Biological treatment of waste - Composting | Source category 5.B.1 Biological treatment of waste - Composting (Technologies – Compost production, SNAP 091005) has been included in the IIR 2018 for the first time. Data on different types of waste (dry weight) presented in the GHG emissions report have been used for $NH_3$ emission calculation. Emission factor for $NH_3$ emission calculation from GB2016 has been used. Notation key NE has been used for the period 1990 - 2006 because activity data are not available. Accordingly, recalculation was performed for the period 1990 – 2015. |

| NFR sector, Name | NFR sub-sector, Name | Description of improvements and other activity made |
|---|---|---|
| 5 Waste | 5.C.1.b.iii Clinical waste incineration | Correction of unit for TSP and BC emission factors have been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015. |
| 5 Waste | 5.D Wastewater handling<br>5.D.1 Domestic wastewater handling<br>5.D.2 Industrial wastewater handling<br>5.D.3 Other wastewater handling | For source categories 5.D.1 and 5.D.2 correction of unit for NMVOC emission factor has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015.<br><br>For source category 5.D.3 correction of value for $NH_3$ emission factor has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015. |
| 5 Waste | 5.E Other waste | For categories included into NFR code 5.E harmonization of $PM_{2.5}$, $PM_{10}$, TSP, Pb, Cd, Hg, As, Cr, Cu and PCDD/PCDF emission factors with GB2016 has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015. |

## ES6 PLANNED IMPROVEMENTS

Planned improvements for the next or one of the next inventories are present in table ES6-1.

**Table ES6-1 Improvements planned for the next or one of the next inventory**

| NFR sector, Name | NFR sub-sector, Name | Improvements planned |
|---|---|---|
| 1.A Energy – fuel combustion | 1.A.1.a Public electricity and Heat production | As long term goal Croatia will take certain steps to justify the use of direct emissions for large point sources in the inventory |
| 1.A Energy – fuel combustion | 1.A.2 Stationary combustion in manufacturing industries and construction | On short term basis it is planned to divide total consumption of fuel to appropriate branches for the whole period from 1990 to 2000 |
| 1.A Energy – fuel combustion | 1.A.2 Stationary combustion in Manufacturing industries and construction | For NOx emission calculation Croatia uses methodology disaggregated by fuel types (gas oil, fuel oil, natural gas, etc.) but not disaggregated by technology. As long term goal Croatia will estimate NOx emission by technology type. |

| NFR sector, Name | NFR sub-sector, Name | Improvements planned |
|---|---|---|
| 1.A Energy – fuel combustion | 1.A.3.a Aviation (civil) | For the harmonization of the calculation methodology with the GB2016 for the aviation, it is necessary to estimate the representative aircraft. For that it is necessary to collect more detailed data on aircrafts and their movements in all airports in Croatia. |
| 1.A Energy – fuel combustion | 1.A.3.b Road transport | The application of COPERT 5 software programme is planned for next submission.<br>Also, during the processing of "raw" data (Ministry of interior vehicle data base in text form), it was noted that some vehicles are missing, so clarification of data was requested from the Ministry of Interior. Interior Ministry drew attention to the different categorization of vehicles in 2014. Consequently the model for the processing of "raw" vehicle data was amended and it was found that the model should be applied to the whole historical trend, because some vehicles due to insufficiently described categorization were not counting. The above improvement will be carried out in one of the following submissions.<br><br>In 2014 Croatia reported annual mileage of each vehicle type to Odyssee database. It is planned to incorporate those data in COPERT 5 model |
| 1.A Energy – fuel combustion | 1.A.3.b Road transport | Croatia calculates emissions from all lubricants in the scope of 2.D.3.i Other Solvent Use, 2G. As long term goal Croatia will divide lubricant used for solvent purposes and lubricant used for road transportation purposes according to EMEP / EEA Guidebook and TERT recommendation. |
| 2 Industrial processes and product use | 2.A.5.b Construction and demolition | The plan is to recalculate the trend (entire reporting period) for this category after collecting the required activity data according to Tier 1 EMEP/EEA GB2016 methodology, which would include: Construction of houses, Construction of apartments, Non-residential construction and Road construction. In order to achieve this, efforts will be made to collect these data, if possible for the next submission. |
| 2 Industrial processes and product use | 2.D.3.d Coating applications | The plan is to recalculate the trend (entire reporting period) for this category after further investigation of available data which would enable transition to Tier 2 EMEP/EEA GB2016 methodology. Trend analysis should be carried out so the recalculations will be included in one of the next submissions. |
| 2 Industrial processes and product use | 2.D.3.h Printing | The plan is to recalculate the trend (entire reporting period) for this category after further investigation of available data which would enable transition to Tier 2 EMEP/EEA GB2016 methodology. Trend analysis should be carried out so the recalculations will be included in one of the next submissions. |
| 3 Agriculture | 3.B Manure management | Improving emission calculation of NMVOC by moving from emission calculation Tier 1 to Tier 2 methodology is a planned short-term improvement.<br><br>The plan is also to improve emission calculation of NH3 (Nex and other parameters used in the emission estimates are taken from the |

| NFR sector, Name | NFR sub-sector, Name | Improvements planned |
|---|---|---|
| | | „Improvement of NH3, CH4 i N2O emission calculation from manure management and development of national factors“, developed by the experts from the Faculty of Agriculture, 2015). Factors and parameters in question will undergo a revision during a new project that is planned due to issues raised by the ERT in the NIR reviews in 2016. As a part of this revised project, updated national emission factors and parameters are expected. The above mentioned improvement will be carried out in one of the following submissions. |
| 3 Agriculture | 3.D.c Farm-level agricultural operations including storage, handling and transport of agricultural products | Reporting PM emissions from this source in the appropriate current category (currently 3.D.c is included in 3.D.a.1) and moving from emission calculation Tier 1 to Tier 2 methodology are both planned short-term improvements. |
| 3 Agriculture | 3.F Field burning of agricultural residues | Although the activity of burning of agricultural residues in the open field is forbidden according to Croatian low, according to IIASA statement such activities are carried out on Croatia territory (in possession of satellite images that confirmed the statement). In view of mentioned, it is necessary to carry out national analysis. A plan is to calculate relevant emissions from this source category, when the activity data will be available and confirm. |
| 5 Waste | 5.B.1 Biological treatment of waste - Composting | 5.B.1 Biological treatment of waste - Composting (Technologies – Compost production, SNAP 091005) has been included in the IIR 2018 for the first time. Activity data on types of composted waste (dry weight) presented in the GHG emissions report have been used for $NH_3$ emission calculation for the period 2007 – 2016. Activity data for the previous period are not available.<br><br>Future improvements are related primarily to aggregation of accurate data for $NH_3$ emission calculations for the whole reporting period. |

# I INTRODUCTION

## 1.1 BACKGROUND INFORMATION FOR INVENTORY PREPARATION

The Republic of Croatia became a Party to the 1979 Geneva Convention on Long-range Transboundary Air Pollution (CLRTAP, OG-IT 12/93) and to the Protocol on Long-term Financing of the Cooperative Programme for Monitoring and evaluation of the Long-range Transmission of Air Pollutants in Europe on 8 October 1991 (OG-IT 12/93). The Republic of Croatia has also ratified following protocols under the LRTAP Convention: Protocol on Further Reduction of Sulphur Emissions in 1998 (OG-IT 17/98 and corr. 3/99), Protocol on Heavy Metals (OG-IT 05/07 and 9/07), Protocol on Persistent Organic Pollutants (OG-IT 05/07 and 9/07), Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes (OG-IT 10/07 and 2/08), Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes (OG-IT 10/07 and 2/08), including the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone 1999 ("Gothenburg Protocol") (OG-IT 4/08 and 07/08).

As a Party to the UNECE/LRTAP Convention and its Protocols, Croatia submitted the first national inventory and IIR in the 1998 for emissions in 1996.

Table 1.1-1 shows status of ratification[4] of international treaties under the CLRTAP.

**Table 1.1-1 Status of ratification of international treaties under the CLRTAP**

| Treaty | Signed by the Parties | In force since | Number of Parties | Ratified by Croatia |
|---|---|---|---|---|
| **Convention on Long-range Transboundary Air Pollution** | 1979 | 1983 | 51 | 1992 |
| Protocol on Long-term Financing of the Cooperative Programme for Monitoring and evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) | 1984 | 1988 | 45 | 1992 |
| Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent | 1985 | 1987 | 25 | - |
| Protocol on Further Reduction of Sulphur Emissions | 1994 | 1998 | 28 | 1998 |

[4] Ratification, Acceptance (A), Approval (AA), Accession (a)

| Treaty | Signed by the Parties | In force since | Number of Parties | Ratified by Croatia |
|---|---|---|---|---|
| Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes | 1988 | 1991 | 35 | 2007 |
| Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes | 1991 | 1997 | 24 | 2007 |
| Protocol on Persistent Organic Pollutants/revised in 2009 | 1998 | 2003 | 33 | 2007 |
| Protocol on Heavy Metals/revised in 2012 | 1998 | 2003 | 33 | 2007 |
| Protocol to Abate Acidification, Eutrophication and Ground-level Ozone ("Gothenburg Protocol")/revised 2012 | 1999 | 2005 | 25 | 2008 |

The Gothenburg Protocol sets upper limits for Croatia for the total emissions in 2010 and in years after 2010 for each of four main pollutants. These reduction commitments are equal to emission quotas set in the NEC Directive (Table 1.1-2).

The Revised Gothenburg Protocol (C.N.155.2013.TREATIES-XXVII.1.h) defines the emission reduction commitments for $SO_2$, NOx, $NH_3$, VOC and $PM_{2.5}$ responsible for acidification, eutrophication and ground-level ozone pollution which leads to significant negative impacts on human health and the environment, for 2020 and beyond (Table 1.1-3). These commitments are expressed as a percentage reduction from the 2005 emission level and are equal to those defined in the new NEC Directive for period from 2020 to 2029.

**Table 1.1-2 Emission quotas for certain pollutants for Croatia and deadlines achieving them**

| Emission quotas * | Deadline | $SO_2$ | NOx | $NH_3$ | NMVOC |
|---|---|---|---|---|---|
| **Gothenburg Protocol** | by 2010 | 70 kt | 87 kt | 30 kt | 90 kt |
| **Revised Gothenburg Protocol** | after 2010 up to 2020 | | | | |
| **NEC Directive/Directive 2001/81/EC** | 1. July 2013 | | | | |

The Gothenburg Protocol was implemented in European legislation with the Directive 2001/81/EC of the European Parliament and the Council on National Emission Ceilings for certain pollutants (hereinafter Directive 2001/81/EC). The Directive 2001/81/EC sets upper limits pollutant-specific and legally binding emission ceilings for each of four pollutants responsible for acidification, eutrophication and ground-level ozone pollution (($SO_2$, $NO_2$, NMVOC and $NH_3$) and for each EU MS, which had be attained by 2010 and for Croatia by the date of its accession to the Union, which was on 1 July 2013. The Directive 2001/81/EC was amended accordingly to Directive 2013/17/EU[5].

On 31. December 2016 new NEC Directive entered into force. The new NEC Directive repeals and replaces Directive 2001/81/EC, from the date of its transposition (30. June 2018) ensuring that the emission ceilings for 2010 set in that Directive 2001/81/EC shall apply until 2020.

New NEC Directive, like revised Gothenburg Protocol, sets national reduction commitments for the $SO_2$, NOx, $NH_3$, VOC and $PM_{2.5}$. New NEC Directive also transposes the reduction commitments for 2020 taken by the EU and its Member States under the revised Gothenburg Protocol and sets more ambitious reduction commitments beyond 2030 (Table 1.1-3).

**Table 1.1-3 Emission reduction commitments for $SO_2$, NOx, $NH_3$, NMVOC and $PM_{2.5}$ in accordance to NEC Directive for Croatia**

| Pollutant | Reduction commitments for Croatia compared to 2005 | |
|---|---|---|
| | For any year from 2020 to 2029 | For any year from 2030 |
| $SO_2$ | 55 % | 83 % |
| NOx | 31 % | 57 % |
| $NH_3$ | 1 % | 25 % |
| NMVOC | 34 % | 48 % |
| $PM_{2.5}$ | 18 % | 55 % |

The Protocol on Persistent Organic Pollutants (hereinafter Protocol on POPs) came into force for Croatia on 6 December 2008. In accordance with paragraph 5 (a) of Article 3 (basic obligations), "Each Party shall reduce its total annual emissions of each substance listed in Annex III from the level of the emission in a reference year set in accordance with that Annex by taking effective measure, appropriate in its particular circumstances“. The reference year for the Republic of Croatia on the issue of POPs is 1990. Accordingly, in the Table 1.1-4 is an overview of the level of allowances that is for certain POPs to which it is necessary to reduce emissions if they exceed the current level.

[5] Directive 2013/17/EU of the Council of the European Union of 13 May 2013 adapting certain directives in the field of environment, by reason of the accession of the Republic of Croatia (OJ L 158, 10.6.2013, p. 193).

**Table 1.1-4 Emission levels for certain POPs according to Protocol on POPs**

| Pollutant | Emission level in 1990* |
|---|---|
| Polycyclic aromatic hydrocarbons (PAHs)** | 23.65 t |
| Dioxins and furans (PCDD/PCDF) | 48.4 g I-Teq |
| Hexachlorobenzene (HCB) | 0.27 kg |
| Polychlorinated biphenyls (PCBs) | 483.1 kg |

**according to Annex III, Protocol on POPs*
**"For the purposes of emission inventories, the following four indicator compounds shall be used: Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene i Indeno(1,2,3-cd)pyrene*

In accordance with CLRTAP Executive Body's Decision 2002/10[6], on emission data reporting under the Convention and the Protocols in force, Croatia is obliged to report on air emissions in line with Emission Reporting Guidelines[7] and methodology described in EMEP/CORINAIR Emission Inventory Guidebook 2016. Specifically, the application of annual emissions under the CLRTAP consists of the preparation of NFR formats (emission inventor) and Informative Inventory Report (IIR).

The NFR nomenclature (CLRTAP) is fully consistent with the CRF nomenclature under the UN Framework Convention on Climate Change (UNFCCC), with the overall aim of harmonization reporting formats.

Taking into account the above mentioned, this IIR follows the proposed content; the introductory chapter describes the national inventory background, the institutional and organizational arrangements, and the inventory preparation process, and methodologies and data sources used. It also gives an overview of the key categories, QA/QC procedures, the uncertainty evaluation and the general assessment of completeness. The Chapter 2 provides explanation of key trends by pollutants following NFR nomenclature. The Chapter 3 provides emission trends by pollutant. Chapters 4 to 8 present on source category descriptions, methodologies used for emission estimation, activity statistics, emission factors, main recalculations and planned improvements. The Chapter 9 gives a summary of recalculations (by sector, year and pollutant) and planned

[6] Decision 2002/10 on emission data reporting under the Convention and the Protocols in force, ECE.EB.AIR/77/Add.1, 2002
[7] Emission Reporting Guidelines, ECE/EB.AIR/80, 2003

improvements. In Chapter 10 an overview of Croatia projections for the following pollutants are presented NOx, $SO_2$, NMVOC, $NH_3$ and $PM_{2.5}$.

The national inventory is updated annually in order to reflect the availability of new information, sectoral improvements, implementation of higher Tier (e.g. Tier 2), change in methodology used, identification of time series inconsistency, the accuracy of the estimates, inclusion of technical corrections by teams for revision under the LRTAP Convention and the NEC Directive and the reduction of the uncertainty.

Recalculations are applied retrospectively to earlier years, which accounts for any difference in previously published data. Conducted recalculations are described in detail in Chapters from 4 to 8, and in the Chapter 9 with a summary of them.

The total emissions of Croatian from 1990 to 2016 reported by pollutant are presented in the Table 1.1-5, along with the share of change in periods from 1990 – 2016 and 2015 - 2016 by pollutant.

**Table 1.1-5 Time series of total emissions in the Republic of Croatia by pollutant**

| Pollutant | Unit | 1990 | 1995 | 2000 | 2005 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Share of change from 1990-2016 | Share of change fron 2015-2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NOx** | **kt** | 105.8 | 80.7 | 86.0 | 84.5 | 67.2 | 63.6 | 58.4 | 57.4 | 53.1 | 53.7 | 52.4 | -50.5% | -2.6% |
| **NMVOC** | **kt** | 175.0 | 118.5 | 105.6 | 117.0 | 90.5 | 84.8 | 78.7 | 74.6 | 68.2 | 69.0 | 69.9 | -60.1% | 1.3% |
| **SO2** | **kt** | 170.3 | 77.8 | 59.4 | 58.7 | 35.2 | 29.2 | 25.2 | 16.9 | 13.8 | 15.8 | 14.7 | -91.4% | -6.9% |
| **NH3** | **kt** | 53.7 | 41.7 | 40.9 | 42.2 | 37.8 | 38.5 | 38.5 | 33.6 | 31.7 | 34.9 | 35.0 | -34.7% | 0.4% |
| **PM2.5** | **kt** | 37.9 | 35.6 | 33.2 | 40.8 | 31.0 | 28.2 | 26.1 | 23.9 | 19.8 | 20.7 | 18.4 | -51.5% | -10.9% |
| **PM10** | **kt** | 47.3 | 42.7 | 40.5 | 51.1 | 39.4 | 36.4 | 33.9 | 30.9 | 26.9 | 28.0 | 25.6 | -45.9% | -8.4% |
| **TSP** | **kt** | 56.1 | 50.7 | 50.5 | 70.3 | 54.3 | 51.6 | 47.7 | 42.0 | 39.0 | 40.5 | 37.5 | -33.2% | -7.3% |
| **BC** | **kt** | 5.5 | 5.0 | 4.8 | 5.9 | 4.7 | 4.3 | 4.0 | 3.7 | 3.2 | 3.3 | 3.0 | -45.7% | -9.5% |
| **CO** | **kt** | 557.4 | 444.4 | 451.2 | 418.8 | 300.1 | 272.6 | 254.7 | 232.1 | 202.6 | 216.6 | 202.4 | -63.7% | -6.5% |
| **Pb** | **t** | 539.5 | 329.8 | 277.2 | 55.6 | 8.1 | 7.9 | 7.3 | 8.4 | 7.9 | 8.0 | 8.0 | -98.5% | 0.0% |
| **Cd** | **t** | 1.2 | 0.9 | 0.9 | 1.1 | 1.0 | 0.9 | 0.9 | 0.9 | 0.8 | 0.9 | 0.8 | -28.5% | -4.8% |
| **Hg** | **t** | 1.2 | 0.3 | 0.5 | 0.6 | 0.6 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | -57.1% | 1.6% |
| **As** | **t** | 8.6 | 1.2 | 1.0 | 1.1 | 0.8 | 0.6 | 0.6 | 0.5 | 0.4 | 0.5 | 0.4 | -95.3% | -16.7% |
| **Cr** | **t** | 5.3 | 3.7 | 3.1 | 3.7 | 2.6 | 2.6 | 2.4 | 2.2 | 2.0 | 2.2 | 2.0 | -61.5% | -5.7% |
| **Cu** | **t** | 9.0 | 6.0 | 7.2 | 8.9 | 7.8 | 7.6 | 7.4 | 8.2 | 7.7 | 8.1 | 8.4 | -6.2% | 4.1% |
| **Ni** | **t** | 26.2 | 20.3 | 16.8 | 20.5 | 14.6 | 12.2 | 10.4 | 7.5 | 6.6 | 8.3 | 7.8 | -70.1% | -4.9% |
| **Se** | **t** | 0.5 | 0.3 | 0.3 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.4 | 0.3 | 0.4 | -23.0% | 8.0% |
| **Zn** | **t** | 38.8 | 32.1 | 30.6 | 37.4 | 36.5 | 35.4 | 35.0 | 35.1 | 32.1 | 35.4 | 34.4 | -11.4% | -2.8% |
| **PCDD/ PCDF** | **g I-Teq** | 48.4 | 42.4 | 40.7 | 48.6 | 33.3 | 30.8 | 30.0 | 26.2 | 22.3 | 23.1 | 20.5 | -57.7% | -11.3% |
| **PAHs** | **t** | 23.6 | 16.7 | 14.9 | 18.4 | 13.5 | 12.0 | 11.0 | 10.0 | 8.0 | 8.2 | 6.9 | -70.6% | -14.9% |
| **HCB** | **kg** | 0.27 | 0.26 | 0.26 | 0.31 | 0.30 | 0.29 | 0.30 | 0.29 | 0.26 | 0.30 | 0.30 | 8.9% | -0.2% |
| **PCBs** | **kg** | 483.1 | 468.3 | 441.4 | 435.7 | 433.7 | 433.0 | 430.9 | 430.3 | 428.7 | 425.1 | 422.3 | -12.6% | -0.7% |

## 1.2 INSTITUTIONAL AND ORGANIZATIONAL ARRANGEMENTS FOR INVENTORY PREPARATION

An important pre-condition for efficient data management system and development of the inventory is a clearly defined organization, competences and responsibilities of institutions involved in the process of developing the inventory. Previous includes a number of steps to be taken in the collection and processing of data, calculation, control and verification of emission inventories and documentation and communication to competent international bodies.

In terms of organizational arrangements, a decentralized model was applied in Croatia in which particular tasks of inventory preparation is delegated to domestic public and professional institutions. From institutional point of view, the Ministry of Environment and Energy (MEE) is a National Focal Point for LRTAP Convention, while inventory preparation is under responsibility of the Croatian Agency for Environment and Nature (CAEN).

The Croatian Agency for Environment and Nature selects executive institution for annual inventory preparation according to the requirements of LRTAP Convention by public tendering, EKONERG – Energy Research and Environmental Protection Institute Ltd, Zagreb, has been selected as executive institution for preparation of this IIR.

The main official sources of activity data for the inventory of pollutant emissions are:

- The Ministry of Environment and Energy[8] with assistance of Energy Institute Hrvoje Požar that prepares the national annual energy balance;
- The Central Bureau of Statistics (Business Statistics Sector) that, on the basis of the statistic survey programme, collects data on the amounts of raw materials and products relating to activities defined by the National Classification of Business Activities;
- The Ministry of Interior keeps data on number of registered road vehicles and off-road vehicles.
- The Croatian Agency for Environment and Nature that collects data from emission point sources in the Environmental Pollution Register (EPR) [9])

[8] Since December 2011 Ministry of Economy, since 19 October 2016 Ministry of Environment and Energy

- The Ministry of Agriculture[10]
- The EUROCONTROL data
- The EUROSTAT data.

Activity data provided through questionnaires completed directly by individual emission sources or other specialized institutions are used in the development of the inventory to calculate and check data provided by official publications.

The Figure 1.2-1 shows structure and components of Croatia emission inventory system.

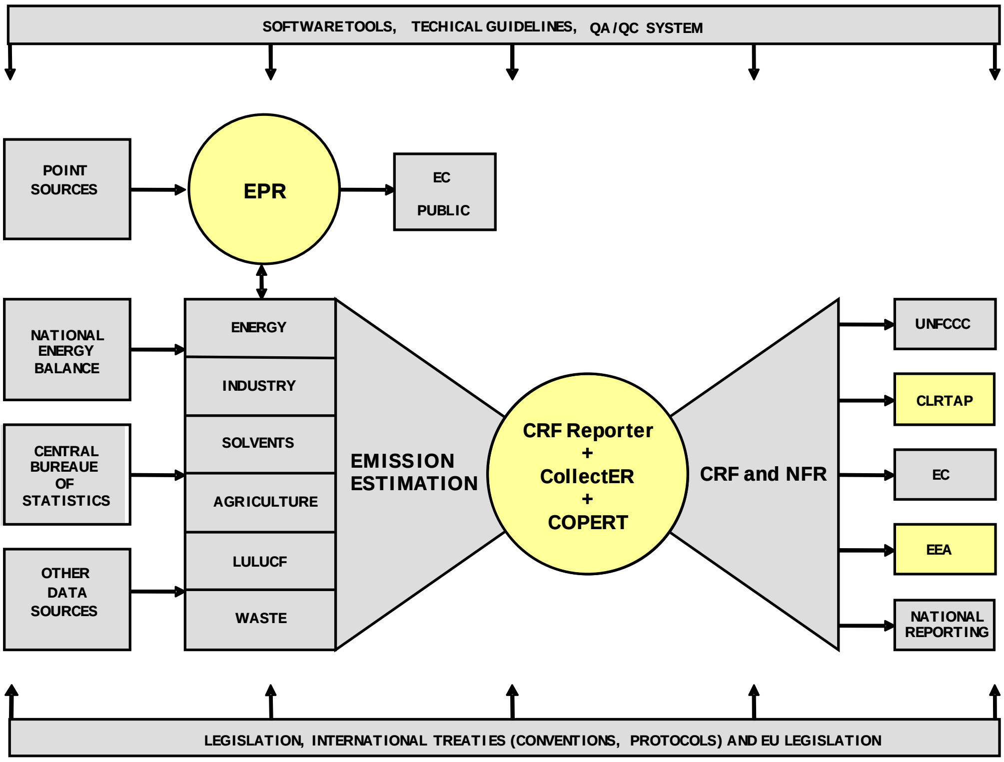



**Figure 1.2-1 National emission inventory system**

[9] EPR – Environmental Pollution Register: a: a set of data of sources, type, amount, manner and place of discharge, transfer and disposal of pollutants and waste into the environment based on the *Ordinance on the Environmental Pollution Register (OG 87/15)*

[10] Ministry of Regional Development, Forestry and Water Management - since December 2011 Ministry of Agriculture

## 1.3 THE PROCESS OF INVENTORY PREPARATION

The process of inventory preparation has three main phases:

1) planning,
2) preparation and
3) reporting and archiving.

### 1) PLANNING

Planning phase includes activities related to organizational and technical aspects of inventory preparation such as: selection of executive institution, preparation of timetable according to EMEP reporting programme, preparation a schedule of activities for data quality control and quality assurance (Schedule of activities, Appendix 1), review of existing/updated reporting guidelines and guidebooks, updating of emission factors and analysis of recommendations for inventory improvement from previous submissions or gave by expert review teams if such exists.

In accordance with ECE/EB.AIR/125, Guidelines for Reporting Emissions and Projections Data under the Convention on Long-range Transboundary Air Pollution, TFEIP, March 2014 reporting guidance covers deadlines for submission of data, as follows:

- *Reporting deadlines*: The deadline for submitting annual emission inventory reports is 15 February. The deadline for submitting four-yearly projection reports is 15 March. The deadline for submitting the IIR is 15 March. Parties are, however, encouraged to submit their IIRs at the same time they submit their emission reports. The deadline for submitting gridded data and LPS data is 1 May. The EU may deliver its emission and projections reports by 30 April, its IIR by 30 May and its gridded data and LPS data by 15 June;
- *Four-yearly reporting*: Parties to the Gothenburg Protocol within the geographical scope of EMEP shall regularly update their projections and report every four years from 2015 onward their updated projections, for the years 2020, 2025 and 2030 and, where available, also for 2040 and 2050.

- *Four-yearly reporting*: Every four years from 2017 onward, Parties shall report for the year x-2 updated aggregated sectoral (GNFR) gridded emissions and LPS emissions. Gridded emissions in a grid of 0.1 x 0.1 degrees shall be reported for all substances referred to in paragraph 7 of these Guidelines. As an alternative, a Party may report gridded emissions in a grid of approximately 50 x 50 $km^2$ until it is technically and economically feasible to switch to a grid of 0.1 x 0.1 degrees.

Detailed and updated information related to deadlines and scope of reporting are available on official EMEP[11] /CEIP[12] web page – www.ceip.at/.

Reporting under the new NEC Directive should be fully consistent with reporting under the LRTAP Convention.

2) INVENTORY PREPARATION

Inventory preparation phase is a central phase in the process, which includes identification and updating of emission sources according to Nomenclature for Reporting, collection and processing of activity data, emission calculation and recalculations if necessary according to EMEP/EEA and EMEP/CORINAIR methodology, filling the database and preparation of report and tables.

3) REPORTING AND ARCHIVING

After inventory preparation phase, activity data and emission factors should be properly archived, emission inventory report and NFR tables should be submitted and QA/QC procedures and activities should be documented. In addition, the Croatian Agency for Environment and Nature

[11] EMEP European Monitoring and Evaluation Programmeis a scientifically based and policy driven programme under the CLRTAP for international co-operation to solve transboundary air pollution problems.

[12] CEIP: The EMEP Centre on Emission Inventories and Projections

(CAEN) should start with initial activities related to inventory review process and facilitate public access to inventory data.

## 1.4 DESCRIPTION OF METHODOLOGIES AND DATA SOURCES USED

### 1.4.1 Official data sources

Activity data needed for emissions calculation are extracted from regular publications and databases of Central Bureau of Statistics and other relevant governmental organizations and ministries. For particular sub-sectors and source categories, data that are more detailed are required then those published in official statistical reports, such as disaggregated energy balance, vehicle fleet etc.). Beside official publications, the CAEN sends questionnaires directly to the Large Point Sources asking for activity data, which they use for emissions calculations in order to check consistency of data provided by different sources (see chapter on quality control). The Table 1.4-2 gives the overview of the official and other activity data sources in relation to the NFR sectors.

**Table 1.4-2 Official and other activity data sources for NFR sectors**

<table>
<tr><th>NFR Sector</th><th>Activity data</th><th>Source</th></tr>
<tr><td rowspan="4">1 Energy<br>1 A 1 Energy Industries</td><td rowspan="3">Fuel sold, fuel consumption and fuel characteristic data for thermal power plants<br>Fuel characteristic in power plants</td><td>Energy balance - The Ministry of Environment and Energy with assistance of Energy Institute Hrvoje Požar (1990 – 2016)</td></tr>
<tr><td>Environmental Pollution Register - the Croatian Agency for Environment and Nature</td></tr>
<tr><td>National electricity producer</td></tr>
<tr><td>Sulphur content in fuel</td><td>Major national fuel producer</td></tr>
<tr><td rowspan="4">1 A 2 Manufacturing Industries and Construction</td><td rowspan="3">Fuel sold<br>Fuel consumption</td><td>Energy balance - The Ministry of Environment and Energy with assistance of Energy Institute Hrvoje Požar (1990 – 2016)<br>Industry analysis balance - Energy Institute Hrvoje Požar (2000 – 2016)</td></tr>
<tr><td>Environmental Pollution Register - the Croatian Agency for Environment and Nature</td></tr>
<tr><td>Major national industry companies</td></tr>
<tr><td>Sulphur content in fuel</td><td>Major national fuel producer</td></tr>
</table>

| NFR Sector | Activity data | Source |
|---|---|---|
| 1 A 3 Transport | Fuel sold | Energy balance - The Ministry of Environment and Energy with assistance of Energy Institute Hrvoje Požar (1990 – 2016) |
| | Number of vehicles | Vehicle data base – the Ministry of Interior |
| | Annual mileage | Statistical yearbook – the Central Bureau of Statistics<br>Odyssee database |
| | Min. and max temperature for big towns | Statistical yearbook – the Central Bureau of Statistics |
| | Sulphur content in fuel | Major national fuel producer |
| | Number of flights and fuel amount by cycle and routes | EUROCONTROL data (2005 – 2016) |
| 1 A 4 Residential – public – commercial sector – agriculture / forestry / fishing | Fuel sold | Energy balance - The Ministry of Environment and Energy with assistance of Energy Institute Hrvoje Požar (1990 – 2016) |
| | Sulphur content in fuel | Major national fuel producer |
| 1 B Fugitive Emissions from fuel | Amount of fuel treated, stored, distributed | Energy balance - The Ministry of Environment and Energy with assistance of Energy Institute Hrvoje Požar (1990 – 2016) |
| | Production and processed data | the Croatian Agency for Environment and Nature (survey request: oil refineries) |
| | Emission data | Environmental Pollution Register - CAEN |
| **2 Industrial Processes and Product Use** | Production data | Annual Report on Industrial Production – PRODCOM - the Central Bureau of Statistics |
| | | Environmental Pollution Register (EPR) - CAEN |
| | | the Croatian Agency for Environment and Nature (survey requests: steel producers, fertilizers producers) |
| | | Database on Volatile Organic Compound emissions (VOC database) – the Croatian Agency for Environment and Nature |
| | Import and export data | EUROSTAT data (2001 – 2016) |
| | Fuel sold for no energy consumption | Energy balance - The Ministry of Environment and Energy with assistance of Energy Institute Hrvoje Požar (1990 – 2016) |
| **3 Agriculture** | Number of animals<br>Amount of N-fertilizers sold | Statistical yearbook - the Central Bureau of Statistics<br>Croatian Agricultural Agency<br>Report on fertilizer production - IFA data bank - the International Fertilizer Association |
| | | the Croatian Agency for Environment and Nature (survey requests: fertilizers producers) |

| NFR Sector | Activity data | Source |
|---|---|---|
| **5 Waste** | Amount of waste | Environmental Pollution Register, Waste Management Information System- Croatian Agency for Environment and Nature |
| | Statistical data related to living conditions in households | Censuses for 1981, 1991, 2001, 2011 - the Central Bureau of Statistics |
| | The amount of treated wastewater | Statistical Reports and Releases - Central Bureau of Statistics |
| | Number of car and house fires | Ministry of Interior |
| **11 Natural sources (11B Forest fires)** | Area of land burned and amount of wood burned | Statistical yearbook - the Central Bureau of Statistics |
| | | Ministry of Agriculture |

### 1.4.2 Methodology

After activity data are collected, they are distributed to NFR and SNAP sectors, sub-sectors and source categories database with corresponding update emission factors entered into central database CollectER. Croatia is using CollectER III (Version 3 of October 2010) for annual inventory preparation. The CollectER III was conducted in accordance with the recommendations TFEIP/EIONET and ETC/ACC European Environment Agency (EEA). Emissions from road transport are calculated by means of program application COPERT 4 (v11.3) that contains activity data on vehicle fleet and procedures for emissions calculation from road transport.

Pollutant emissions are reporting in defined NFR14 format (Excel spreadsheet), which discusses the sources of emissions of the following sectors: Energy (NFR 1); Industrial Processes and product use (NFR 2); Agriculture (NFR 3); Waste (NFR 5); and Natural sources (NFR 11). The NFR format under the CLRTAP is in full compliance with the CRF format under the UNFCCC. In Appendix 2, the distribution of sectors according to SNAP nomenclature with explanations is presented.

In combination with software tools, EMEP/EEA methodology aims to obtain consistency, completeness, comparability and transparency of the emissions estimates utilizing two basic methodological approaches:

- "Bottom-up" where total emissions from defined territory are determined by summing the measured/estimated emissions from all individual sources on defined territory. In case when one or more sources are missed out inventory is incomplete which leads to lower level of emissions.
- "Top-down" where total emissions from defined territory are determined from aggregate statistical data (for instance total fuel consumption or cement production) and average emission factors that give the best estimation of activities (sectors) under consideration.

Due to evident advantages and shortcomings of both approaches inventory agency in practice, utilize both of them with emphasis on achieving a balance between resources available and quality of estimations. For Large point sources emissions calculation, "bottom up" approach is used, and emissions from all other sources by "top down". That combination is reasonable because data for LPS are considered more reliable than other smaller sources.

Emissions are calculated on the base of the standard methods and procedures of:

- *EMEP/EEA[13] Air Pollutant Emission Inventory Guidebook "Technical Guidance to Prepare National Emission Inventories" (2009, 2013, 2016)*
- *EMEP/CORINAIR Atmospheric Emission Inventory Guidebook 2007 (EMEP 2007)*
- *EMEP/CORINAIR Good Practice Guidance. Good practice for CLRTAP emission inventories (Tinus Pulles, John van Aardenne, 24 June 2004)*
- *EMEP/CORINAIR Atmospheric emission inventory guidebook, Second edition (September, 1999)*
- *Emission factor manual PARCOM-ATMOS, Emission factor for air pollution (1992)*
- *Bundesamt für Umwelt, Wald und Landschaft (BUWAL): Emissionsfaktoren für stationäre Quallen – HANDBUCH (1995)*
- *US EPA Compilation of Air Pollutant Emission Factors, Vol. 1: Stationary Point and Area Sources (1995)*
- *Corinair; Technical annexes, Volume 2, Default emission factors handbook (CORINE, 1992)*

[13] Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) of the Convention on Long-range Transboundary Air Pollution provides scientific support to the Convention

Emission factors contained in the CollectER database are largely taken from the sectoral guidelines for determining the emission of pollutants produced in the framework of the project *Reconstruction of the National Inventory System and enforcement of its implementation* (LIFE/TCY/CRO/00086).

The methodology used for calculation of emissions includes product of activity data (e.g. fuel consumption, the production statistics, number of animals, waste treated, etc.) and corresponding emission factor. Emission factors used are default or plant specific emission factors (calculated from direct emissions observed plants reported in Croatian EPR base). The use of country-specific emission factors, if available, is recommended but these cases should be based on well-documented research. A detailed description of the methodology used is shown in sector-specific chapters of IIR in chapters from 4 to 8 and their abstract follows below.

The methods used for the NFR sectors are as follows:

**1 ENERGY**

- 1.A.1.a (Electricity production and Combined heat and power generation), 1.A.1.b, 1.A.2.f.i, 1.B.2.b.i: Tier 2 method. Emission factors: plant specific (DE – direct emissions from EPR) and emission factors from GB2016.
- 1.A.1.a (Heat plants), 1.A.1.c, 1.A.2.a, 1.A.2, 1.A.3.b.vii, 1.A.4.a, 1.A.4.c.i: Tier 1 EMEP/EEA methodology, along with the recommended Tier 1 emission factors from GB2016.
- 1.A.3.a (Aviation (civil)), 1.A.3.a.i (i), 1A.3.a.ii (i), 1.A.3.a.i (ii), 1.A.3.a.ii (ii): Tier 1 EMEP/EEA methodology, along with the recommended Tier 1 emission factors from GB2013.
- 1.A.3.b (Road transport), 1.A.3.b.i 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv, 1.A.3.b.v, 1.A.3.b.vi: COPERT 4 (v11.3) model
- 1.A.3.b.vii Road transport: Road abrasion: Tier 1 EMEP/EEA methodology, along with the recommended Tier 1 emission factors from GB2016.
- 1.A.3.c: Tier 1 EMEP/EEA methodology, along with the recommended Tier 1 emission factors from GB2016
- 1.A.3.d.ii, 1.A.3.d.i(i): Tier 1 EMEP/EEA methodology, along with the recommended Tier 1 emission factors from GB2016

- 1.A.4.b.i, 1.A.2.g.vii, 1.A.4.b.ii, 1.A.4.c.ii: Tier 2 EMEP/EEA methodology, along with the recommended Tier 2 emission factors from GB2016
- 1.B.1.a, 1.B.2.a.i, 1.B.2.a.v, 1.B.2.c: Tier 1 EMEP/EEA methodology, along with the recommended Tier 1 emission factors from GB2016.
- 1.B.2.a.iv, 1.B.2.b: Tier 2 EMEP/EEA methodology, along with the recommended Tier 2 emission factors from GB2016.

**2 INDUSTRIAL PROCESSES AND PRODUCT USE**

- 2.A.1, 2.A.2.: Tier 2 EMEP/EEA methodology, along with abated Tier 2 emission factors from GB2016.
- 2.A.3, 2.D.3.d, 2.D.3.f, 2.D.3.h, 2.K: Tier 1 EMEP/EEA methodology, along with Tier 1 emission factors from GB2016.
- 2.A.5.a, 2.A.5.b, 2.D.3.b, 2.D.3.c, 2.I : Tier 1 EMEP/EEA methodology, along with Tier 1 emission factors from GB2016 (except 2.A.5.b - emission factor from GB2013).
- 2.B.1, 2.B.2, 2.B.10.a (sulphuric acid, NPK fertilizers and urea), 2.D.3.a, 2.D.3.i, 2.G: Tier 2 method. Emission factors: plant specific (DE – direct emissions from EPR), and/or EMEP/EEA emission factors from GB2016.
- 2.C, 2.D.3.g, 2.H: Tier 2 EMEP/EEA methodology, along with Tier 2 emission factors from GB2016.
- 2.D.3.e: Tier 1 method. Emission factors: for vapour cleaning EF from GB2016; for cold cleaning EF derived from an expert estimate made by the VTT Technical Research Centre of Finland (Source: SYKE (2011), Air Pollutant Emissions in Finland 1980-2009, Informative Inventory Report, p 252).

**3 AGRICULTURE**

- 3.B: Tier 2 EMEP/EEA methodology and Tier 2 emission factors from GB2016 with national specifics.
- 3.D.1.a: Tier 1 EMEP/EEA methodology and Tier 1 emission factors from GB2016 for NOx, NMVOC, and PMs emission calculation, and Tier 2 EMEP/EEA methodology, along with Tier 2 emission factors from GB2016 for $NH_3$ emission calculation.

- 3.D.a.2.a: Tier 2 EMEP/EEA methodology and Tier 2 emission factors from GB2016 with national specifics.
- 3.D.a.2.b: Tier 1 EMEP/EEA methodology and Tier 1 emission factors from GB2016
- 3.D.a.3: Tier 2 EMEP/EEA methodology and Tier 2 emission factors from GB2016 with national specifics.

**5 WASTE**

- 5.A, 5.C.1.b.iii, 5.C.1.b.v: Tier 1 EMEP/EEA methodology, along with Tier 1 emission factors from GB2016.
- 5.B.1: Tier 2 EMEP/EEA methodology for $NH_3$ from GB2016.
- 5.C.1.b.i: Tier 1 EMEP/EEA methodology, along with Tier 1 emission factors from GB2016 and GB2009 (for emission factors not estimated in GB2016).
- 5.D.1, 5.D.2: Tier 2 EMEP/EEA methodology for NMVOC from GB2016.
- 5.D.3: Tier 2 EMEP/EEA methodology for $NH_3$ from GB2016.
- 5.E: Tier 2 EMEP/EEA methodology, along with Tier 2 emission factors from GB2016.

**11 NATURAL SOURCES**

- 11.B Forest fires: MEP/EEA methodology, along with Tier 1 emission factors from GB2016.

## 1.5 KEY SOURCE CATEGORIES

**Table 1.5-1 Key source categories in 2016 for the Croatian Emission Inventory**

| Pollutant | Key categories (Sorted from high to low from left to right) | | | | | | | | | | | | Total (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SOx** | 1A1a | 1B2aiv | 1A1b | 1A2f | 1A4bi | | | | | | | | 85.4 |
| | -24.8% | -24.1% | -16.2% | -13.0% | -7.3% | | | | | | | | |
| **NOx** | 1A3bi | 1A3biii | 1A4bi | 1A1a | 1A2f | 1A4cii | 3Da1 | 1A3bii | | | | | 80.2 |
| | -21.6% | -16.9% | -9.9% | -9.5% | -7.7% | -5.3% | -4.6% | -4.6% | | | | | |
| **NH3** | 3B3 | 3Da1 | 3B1a | 3B1b | 1A4bi | 2B10a | | | | | | | 82.1 |
| | -23.1% | -20.3% | -13.1% | -12.9% | -6.9% | -5.9% | | | | | | | |
| **NMVOC** | 1A4bi | 2H2 | 2D3d | 2D3e | 2D3i | 1A3bi | 3B1a | 3B1b | 1B2av | 5A | 2D3a | 1A3biv | 80.2 |
| | -28.0% | -8.6% | -6.9% | -5.7% | -5.5% | -4.3% | -4.3% | -3.7% | -3.5% | -3.4% | -3.4% | -2.9% | |
| **CO** | 1A4bi | 1A3bi | 1B2aiv | | | | | | | | | | 85 |
| | -63.2% | -12.2% | -9.6% | | | | | | | | | | |
| **TSP** | 1A4bi | 2D3b | 2A5a | 3Da1 | 3B3 | | | | | | | | 81.8 |
| | -42.2% | -26.4% | -5.9% | -2.9% | -2.6% | | | | | | | | |
| **PM10** | 1A4bi | 2D3b | 2A5a | 3Da1 | 1A3bi | 1A3bvi | | | | | | | 80.2 |
| | -57.5% | -8.1% | -4.1% | -4.1% | -2.4% | -2.1% | | | | | | | |
| **PM2.5** | 1A4bi | 1A3bi | | | | | | | | | | | 81 |
| | -75.8% | -3.3% | | | | | | | | | | | |
| **Pb** | 1A3bi | 1A4bi | 2G | 1A3bvi | 2A3 | | | | | | | | 81.2 |
| | -37.1% | -16.3% | -12.3% | -9.8% | -5.8% | | | | | | | | |
| **Hg** | 1A1a | 1A2f | 1A4bi | 2K | 1B2aiv | | | | | | | | 85.3 |
| | -39.4% | -21.3% | -8.4% | -8.3% | -7.8% | | | | | | | | |
| **Cd** | 1A4bi | 2G | 2A3 | | | | | | | | | | 80.3 |
| | -71.1% | -5.2% | -4.0% | | | | | | | | | | |
| **PCDD/ PCDF** | 1A4bi | 5C1biii | | | | | | | | | | | 81.7 |
| | -72.8% | -9.0% | | | | | | | | | | | |
| **PAH** | 1A4bi | | | | | | | | | | | | 91.8 |
| | -91.8% | | | | | | | | | | | | |
| **HCB** | 1A4bi | | | | | | | | | | | | 82.1 |
| | -82.1% | | | | | | | | | | | | |

Data source: RepDab Report, http://www.ceip.at/repdab-check-your-inventory/

**Table 1.5-1 (cont.) Key source categories in 2016 for the Croatian Emission Inventory**

| Pollutant | Key categories (Sorted from high to low from left to right) | | | | | | | | | | | | Total (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| As | 1B2aiv | 1A1a | 1A2f | 2A3 | | | | | | | | | 89.1 |
| | 46.0% | 18.1% | 13.2% | 11.8% | | | | | | | | | |
| Cr | 1A4bi | 1A3bvi | 1B2aiv | 1A2f | | | | | | | | | 82.7 |
| | 54.1% | 14.3% | 8.4% | 5.9% | | | | | | | | | |
| Cu | 1A3bvi | 2G | | | | | | | | | | | 83.8 |
| | 76.6% | 7.2% | | | | | | | | | | | |
| Ni | 1A1b | 1B2aiv | | | | | | | | | | | 84.1 |
| | 77.9% | 6.2% | | | | | | | | | | | |
| Se | 2A3 | 1A2f | 1A4bi | | | | | | | | | | 85.7 |
| | 63.1% | 15.5% | 7.0% | | | | | | | | | | |
| Zn | 1A4bi | 1A3bi | 1A3bvi | | | | | | | | | | 83.9 |
| | 70.1% | 7.0% | 6.8% | | | | | | | | | | |
| benzo(a) pyrene | 1A4bi | | | | | | | | | | | | 94.5 |
| | 94.5% | | | | | | | | | | | | |
| benzo(b) fluoranthe | 1A4bi | | | | | | | | | | | | 91.0 |
| | 91.0% | | | | | | | | | | | | |
| benzo(k) fluoranthe | 1A4bi | | | | | | | | | | | | 89.9 |
| | 89.9% | | | | | | | | | | | | |
| Indeno (1,2,3-cd) | 1A4bi | | | | | | | | | | | | 94.3 |
| | 94.3% | | | | | | | | | | | | |
| PCBs | 2K | | | | | | | | | | | | 98.8 |
| | 98.8% | | | | | | | | | | | | |
| BC | 1A4bi | 1A3bi | 1A3bii | | | | | | | | | | 81.3 |
| | 62.4% | 14.7% | 4.3% | | | | | | | | | | |

Data source: EKONERG Ltd, 2017

## 1.6 QA/QC AND VERIFICATION METHODS

Quality assurance and quality control procedures for inventory compilation and reporting are part of defined QA/QC plan. In 2009, EKONERG Ltd. for the CAEN has prepared an internal document (the QA/QC plan) to organise and implement activities across all of the emissions inventory activities including involved stakeholders (e.g. suppliers of data, recipients, inventory compiling institution), data collection, data manipulation, inventory compilation, consolidating the inventory estimates (e.g. into a single national database) and reporting. QA/QC activities performed for this inventory compilation is presented in Appendix 1 and these include checks in: data collection activities, activity data entry into databases, emission calculation, databases items, Emission reporting template - NFR tables for all years from 1990 to 2016 (for 2016 in Appendix I), preparation of IIR (Informative Inventory Report) and archiving.

Before submitting reporting tables, the RepDab tool is run. If needed, data revise. When all tables passed all RepDab tests then tables are submitted.

Following sub-chapters give a clarification of the terms 'quality control' and 'quality assurance' used for the purpose of the inventory management.

### 1.6.1 Quality Control (QC)

Quality Control (QC) is a system of routine technical activities to measure and control the quality of the inventory as it is being developed. The QC system is designed to:

- Provide routine and consistent checks to ensure data integrity, correctness, and completeness;
- Identify and address errors and omissions;
- Document and archive inventory material and record all QC activities.

QC activities include general methods such as accuracy checks on data acquisition and calculations and the use of approved standardized procedures for emission calculations, measurements, estimating uncertainties, archiving information and reporting. Higher tier of QC activities include technical reviews of source categories, activity and emission factor data and methods. For example, control of bottom-up data for industry and energy sector from the Croatia Environmental Pollution Register (EPR) is performed. The EPR is based on the Ordinance on the Environmental Pollution Register (Official Gazette No. 87/15). According to that Ordinance the competent authorities (CA), which are 21 counties, with in cooperation with the competent inspectorate, are responsible to assess the completeness, consistency and credibility of the data submitted by the operators, and they verified forms. Data from EPR (direct pollutants emissions, fuel consumptions and productivity) by each individual plant are checking on consistency, transparency and completeness in the process of inventory preparation. If, by comparing previously reported data, there are significant decreases (dips) or significant increases (peak) in the reported emissions and/or fuel consumption and/or realized productivity, then it is checked whether the plant has introduced a new emission reduction technology (also part of the ROO system), new fuel or incorrect entry of certain data in the database occurred (the most common error is entering the data in another metering unit). In the next step, the inventory compiler informs the person in CAEN responsible for air pollutant emission inventory work, who then informs the person responsible for EPR database. Further, person responsible for EPR database notifies the competent authority in the county, who then informs the responsible person at operator about data inconsistency. The responsible person at operator then corrects or explains the inconsistency. For the energy sector particularly for the sector of electricity and heat production, the total amount of fuel reported in the ROO database is compared with fuel sold amount by fuel type from the National Energy Balance. Last notation is also the part of yearly process of data collection.

### 1.6.2 Quality Assurance (QA) and Verification

Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. Reviews, preferably by independent third parties, should be performed upon a finalized inventory following the implementation of QC procedures. Reviews verify that data quality objectives were met, ensure that the inventory represents the best possible estimates of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the QC programme.

Croatian Agency for Environment and Nature (CAEN) is responsible for inventory preparation and Ministry of Environment and Energy is responsible for final approval according Regulation on emission quotas for certain pollutants in the air in the Republic of Croatia (OG 108/13 and 19/17) and pursuant to the aforesaid, the CAEN responsibility is also to carry out verification and peer reviews of: activity data quality, calculated emissions, and prepared report before the submission to the LRTAP Convention.

In the inventory preparation process, general quality control procedures have been applied (see Appendix 1). In addition, some specific quality control procedures related to check of activity data and emission factors were applied in previous submissions with new or updated emission factors and activity data from other sources (Environmental Pollution Register, direct communication with operators). Application of quality control procedures have resulted in recalculations of emissions which is presented in Chapter 10. For now, the system of quality assurance at the national level has not been established yet i.e. the institutions that will examine the inventory have not yet been determined.

In the framework of the UNECE LRTAP Convention and EU National Emissions Ceilings Directive by the year, 2008 began with a review and check in detail the inventories of each Party (so-called Stage 3 in depth reviews) in accordance with the model established under the UN Framework Convention on Climate Change (UNFCCC). The Republic of Croatia was reviewed in 2011 and in 2014 (Table 1.6-1). The annual review is concentrated on $SO_2$, NOx, NMVOC, $NH_3$, plus $PM_{10}$ and $PM_{2.5}$ for the time series which are reflecting current priorities from EMEP Steering Body and the Task Force on Emission Inventories and Projections (TFEIP). HMs and POPs have reviewed to the extent possible.

Approved plan of Stage 3 (in depth) review in the 2018 -2020 period - of Emission inventories under CLRTAP by Parties to be reviewed is presented in Table 1.6-1.

**Table 1.6-1 Approved plan of Stage 3 (in depth) reviews of Emission inventories under CLRTAP (2018 -2020)**

| | |
|---|---|
| **2018** | Moldova, Armenia, Finland, Belarus, Ukraine, Montenegro and Azerbaijan |
| **2019** | Turkey, Bosnia and Herzegovina, the Former Yugoslav Republic of Macedonia, Russian Federation, Albania and Georgia |
| **2020** | Liechtenstein, Switzerland, Kyrgyzstan, Kazakhstan, Monaco and the European Union |

Data source: http://www.ceip.at/review-of-inventories/in-depth-review-of-ae-inventories

The first comprehensive technical review of National Emission Inventories for EU member states, pursuant to the Directive on the Reduction of National Emissions of Certain Atmospheric Pollutants (Directive (EU) 2016/2284), was first implemented in June 2017. A technical review is conducted on the basis of officially submitted emissions in NFR tables for the period 1990 - 2015 (submission on 15. February 2017) and the Informative Inventory Report (IIR) (submission on 15. March 2017). Comprehensive technical review of NECD inventory was carried out for 2005, 2010 and 2015 and for the following pollutants: NOx, NMVOC, $SO_2$, $NH_3$ and $PM_{2.5}$.

The Comprehensive Technical Review of Member State Inventories aims to ensure accurate, reliable and verified emission inventories, in particular for 2005 and 2015, to ensure that the Commission has accurate, reliable and verified information on annual NECD emissions to determine compliance with the NECD targets. A secondary objective of the review was to strengthen Member States' capacity in managing NECD inventories efficiently and in delivering high quality inventory data and Informative Inventory Reports (IIRs) to the European Commission in due time. The review also sought to harmonise approaches used in monitoring inventories reported under the NECD with reviews undertaken by other organisations that have similar interests such as the reviews under the LRTAP Convention and the EU Greenhouse Gas Monitoring Mechanism (MMR)/United Nations Framework Convention on Climate Change (UNFCCC).

There was set of 58 issues for Croatia as follows: for the Energy sector 23 questions (Fugitive emissions from fuels: 3, Fuel combustion in stationary sources: 10 and Fuel combustion in mobile sources: 10), for Sector Industry and Solvent use 17 questions (Industry: 7 and Use of solvent: 8), for the Agriculture sector 17 questions and for the Waste sector one question. The Croatian team of experts successfully responded to 58 questions asked. For the Sector Industry and Solvent Use, Croatia has received two technical corrections (TC), particularly for source categories: NFR 2.D.3.h Printing and NFR 2.D.3.d Coating application, because of incomplete activity data and subsequently underestimated NMVOC emissions.

## 1.7 GENERAL UNCERTAINTY EVALUATION

Emissions uncertainty analysis are calculated on the basis of the standard methods and procedures of:

- UNECE: Guidelines for Estimating and Reporting Emission Data under the Convention on Long Range Transboundary Air Pollution, Edition 2009 (UNECE 2009)
- EMEP/EEA air pollutant emission inventory guidebook (EMEP/EEA Guidebook).

The uncertainty estimations of total national emissions reporting to the CLRTAP for Croatia are developed to be in accordance with the Tier 1 methodology described in the EMEP/EEA Guidebook. The uncertainty estimates are based on emission data for the base year (1990) and 2016, and on uncertainties for activity rates and emission factors for NFR sectors. Estimated emissions for 1990 and 2016, the uncertainty introduced into the trend 1990-2016, and the uncertainty in total national emissions 2016 for all pollutants are shown in the Table 1.7-1. The uncertainty estimates include all NFR sectors on aggregated level Detail calculation sheets and results of Croatia uncertainty analyses are provided in Appendix 7.

### 1.7.1 Overview of the method

The uncertainty in an emission can be propagated from uncertainties in the activity data and the emission factor through the error propagation equation (Mandel 1984, Bevington and Robinson 1992)[14]. This method is present in the EMEP/EEA Guidebook, where the conditions imposed for use of the method are:

- Input parameters (emission factor, activity data) have Gaussian (normal) distributions. Uncertainty is symmetric with respect to the mean value. The length of the range from mean to upper larger value (97.5% percentile) is equal to the length of the range from mean to lower, smaller value (2.5% percentile).
- The correlation between the input data in model does not exist. That is the main reason why is appropriate aggregation of data needed for the uncertainty analysis.
- Calculation of trend uncertainty using Tier 1 method is based on the essential assumption that the input uncertainty of emission factors and activity data for 1990 and 2016 are equal.

Under these conditions, the uncertainty calculated for the emission rate is appropriate.

The Guidebook recommends that inputs (direct emissions[15], activity data and emission factors) are as far as possible statistically independent, e.g. that emission factors used in several source categories yield one uncertainty estimate on an aggregated level rather than using the same Figure for each source category.

Appropriate aggregation of data for the uncertainty analysis is important to avoid over- or underestimation of uncertainty due to correlations.

[14] http://cxdd.broceliande.kerbabel.fr/?q=node/398/200

[15] In this context direct emissions means emission data based on measurements or expert judgements reported e.g. by plants in EPRT.

**Assumptions used in NFR sectors aggregation are following:**

- Emission factors are considered independent across the different sectors, technologies and fuel.
- Emission estimates of different pollutants are considered to be independent.
- Activity data are considered to be independent.

**Assumptions used in uncertainty calculation are following:**

- Emission factor uncertainties were in lower end of default range for all sources and pollutants (EMEP/EEA Guidebook, Part A - general guidance chapters, 5-Uncertainties, Table 3-2 and 3-3).
- Emission factor uncertainties have Type A sensitivities and activity data uncertainties have Type B sensitivities, as suggested in EMEP/EEA Guidebook.

### 1.7.2 Documentation of uncertainties

The uncertainty estimates for emission factors derive from expert judgments based on information on 95% confidence intervals in the EMEP/EEA Guidebook. The default uncertainties for emission factors are given in letter codes (Table 3-2, General guidance chapter 5 - Uncertainties EMEP/EEA Guidebook) representing an uncertainty range (Table 3-3, General guidance chapter 5 - Uncertainties EMEP/EEA Guidebook). In uncertainty analysis, the lower value of the default uncertainty range for emission factors was used for all sources and pollutants. For some pollutants and source categories, no information on default uncertainty ranges is available in the EMEP/EEA Guidebook and thus the uncertainty ranges from Switzerland´s IIR 2011 are applied when appropriate.

The uncertainty estimates for activity data derive from Croatia's greenhouse gas inventory (Croatian NIR), from expert judgment based on comparisons with available datasets of other countries and from EMEP/EEA Guidebook (Table 3-1, General guidance chapter 5 – Uncertainties) where appropriate (Table 1.7.2-1). For source categories where activity data uncertainty was taken from Croatian NIR, default uncertainty from IPCC guidance was used and average value from range of given uncertainty was set. For source categories, where activity data uncertainty was taken from other countries with available activity data uncertainty sheets, available data was compared and expert judgment was made to choose the most acceptable activity data uncertainty.

**Sources of data used:**

- uncertainty analysis of Croatia's greenhouse gas inventory – NIR (activity data),
- uncertainties from France's, Finland's, Switzerland's and Danish's Informative Inventory Reports (emission factors and activity data),
- default values of EMEP/EEA Guidebook (activity data and emission factors).

**Uncertainty ranges for activity data**

Uncertainty rates for activity data in NFR sectors and used aggregation level are listed in Table 1.7.2-1.

**Table 1.7.2-1 Applied uncertainty levels for activity data and data sources by NFR sector aggregation**

| NFR SECTOR AGGREGATION | % | DATA SOURCE |
|---|---|---|
| 1A1, 1A2, 1A3b | 3 | National data in combination with comparisons with other datasets and other countries |
| 1A3a Aviation | 3 | National data in combination with EUROCONTROL datasets |
| 1A3c i 1A3d | 5 | National data in combination with comparisons with other datasets and other countries |
| 1A4a | 5 | expert judgment in combination with comparisons with other datasets and other countries |
| 1A4b, 1A4c | 3 | National data in combination with Tier 2 methodology from EMEP/EEA 2016 guidebook |
| 1B1, 1B2ai | 10 | expert judgment in combination with comparisons with other datasets and other countries |
| 1B2aiv, 1B2av, 1B2b,1B2c | 3 | Facilities data in combination with Tier 2 methodology from EMEP/EEA 2016 guidebook |
| 2A1, 2A2, 2A3 | 3 | Facilities data in comparison with national statistical data |
| 2A5a, 2A5b | 5 | National data and comparison with other datasets and other countries |
| 2B1, 2B2 | 3 | Facilities data in comparison with national statistical data |
| 2B10a, 2H, 2I | 5 | National data and comparisons with other datasets and other countries |
| 2C | 7.5 | Facilities data in comparison with national statistical data |
| 2D3b, 2D3c, 2D3d, 2D3g, 2D3h | 30 | National statistical data and comparisons with other datasets and other countries |
| 2K | 50 | National population statistical data and comparisons with other |

| NFR SECTOR AGGREGATION | % | DATA SOURCE |
|---|---|---|
| | | datasets and other countries |
| 2D3a, 2D3i, 2G, 2D3d, 2D3e, 2D3f | 10 | National statistical data in combination with Tier 2 methodology from EMEP/EEA 2016 guidebook |
| 3B1, 3B2, 3B4d, 3B4e, 3B4f | 10 | National statistical data in comparisons to National Central Register of Livestock under Croatian Agricultural Agency |
| 3B3, 3B4g | 50 | National statistical data in comparisons to National Central Register of Livestock under Croatian Agricultural Agency |
| 3D1a | 5 | Facilities data in combination with Tier 2 methodology from EMEP/EEA 2016 guidebook |
| 5A, 5B1, 5C | 5 | National data from the Environmental Pollution Register and Waste Management Information System under Croatian Agency for Environment and Nature |
| 5D1, 5D2 | 30 | National statistical data |
| 5D3 | 30 | National statistical data from 1991, 2001 and 2011 Census under Croatian bureau of Statistic in combination with extrapolation method |
| 5E | 5 | National base of accidental fire under Ministry of Interior |

**Uncertainty ranges for emission factors**

The applied uncertainties are for most emission factors, default values referring to EMEP/EEA Guidebook. Guidebook doesn´t propose uncertainty for pollutants TSP, $PM_{10}$, $PM_{2.5}$, BC and $NH_3$ (regard some sectors) so in comparison with datasets of other countries, expert judgment is applied for TSP, $PM_{10}$, $PM_{2.5}$ and BC, or in the case of $NH_3$ the emission factors uncertainty from Danish IIR was applied (Table 1.7.2-3). Furthermore, for 1.A.4 subsectors the TSP, $PM_{10}$ and $PM_{2.5}$ emission factors uncertainty from Switzerland´s IIR 2011 was applied (Table 1.7.2-4). The applied uncertainties for emission factors are listed in Tables from 1.7.2-2 to 1.7.2-4.

**Table 1.7.2-2 Applied uncertainty levels for $SO_2$, $NO_2$, NMVOC, CO, TSP, $PM_{10}$, $PM_{2.5}$, PAH, HCB, PCDD/PCDF emission factors by NFR sectors**

| NFR SECTORS | EMISSION FACTORS UNCERTAINTY RATES, % | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SO_2$ | $NO_2$ | NMVOC | CO | TSP | $PM_{10}$ | $PM_{2.5}$ | BC | PAH | HCB | PCDD /PCDF |
| 1.A.1, 1.A.2 | 10 | 20 | 50 | 20 | 50 | 50 | 50 | 50 | 100 | 100 | 100 |
| 1.A.3.b Road transport | 20 | 20 | 20 | 20 | 100 | 100 | 100 | 100 | 400 | 400 | 400 |
| 1.A.3 Other transport | 20 | 100 | 100 | 100 | 500 | 500 | 500 | 500 | 400 | 400 | 400 |
| 1.A.4 | 20 | 50 | 50 | 50 | x | x | x | x | 400 | 400 | 400 |
| 1.B | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 400 | 400 | 400 |
| 2 | 20 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 400 | 400 | 400 |
| 2.A | 20 | 50 | 20 | 50 | 50 | 50 | 50 | 50 | 400 | 400 | 400 |
| 2.D.3.i | 20 | 31 | 50 | 50 | 50 | 50 | 50 | 50 | 400 | 400 | 400 |

| NFR SECTORS | EMISSION FACTORS UNCERTAINTY RATES, % | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SO_2$ | $NO_2$ | NMVOC | CO | TSP | $PM_{10}$ | $PM_{2.5}$ | BC | PAH | HCB | PCDD /PCDF |
| 3.B | - | 100 | - | - | 100 | 100 | 100 | x | 400 | 400 | 400 |
| 3.D | - | 100 | 100 | - | 50 | 50 | 50 | x | 400 | 400 | 400 |
| 5.A, 5.D | 20 | - | 50 | - | 100 | 100 | 100 | 100 | 400 | 400 | 400 |
| 5.C | 20 | 20 | 50 | 50 | 50 | 50 | 50 | 50 | 100 | 100 | 100 |

Data source: EMEP/EEA guidebook, Part A - general guidance chapters, 5-uncertainties, Table 3-2 and 3-3, with exception for TSP, $PM_{10}$, $PM_{2.5}$ – expert judgment

**Table 1.7.2-3 Applied uncertainty levels for heavy metals, HCH and PCBs emission factors by NFR sectors**

| NFR SECTORS | EMISSION FACTORS UNCERTAINTY RATES, % | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | As | Cd | Cr | Cu | Hg | Ni | Pb | Se | Zn | $NH_3$ | PCBs |
| 1.A.1, 1.A.2 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 1000 | 100 |
| 1.A.3.b Road transport | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 |
| 1.A.3 Other transport | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 1000 | 400 |
| 1.A.4 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 1000 | 400 |
| 1.B | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 1000 | 400 |
| 2 A, 2 B, 2 C, 2 D, 2 F | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 |
| 3.B | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 100 | 400 |
| 3.D | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 100 | 400 |
| 5.D.1 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 |
| 5.D.3 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 1000 | 100 |

Data source: EMEP/EEA guidebook, Part A - general guidance chapters, 5-uncertaintie, Table 3-2 and 3-3,

**Table 1.7.2-4 Applied uncertainty levels for $PM_{2.5}$, $PM_{10}$ and TSP emission factors for NFR 1.A.4**

| NFR SECTORS | EMISSION FACTORS UNCERTAINTY RATES, % | | | |
|---|---|---|---|---|
| | $PM_{2.5}$ | BC | $PM_{10}$ | TSP |
| 1.A.4.a Commercial / institutional | 78.0 | 78.0 | 78.0 | 78.0 |
| 1.A.4.b.i Residential | 76.0 | 76.0 | 76.0 | 76.0 |
| 1.A.4.b.ii Residential: Household and gardening (mobile) | 50.0* | 50.0* | 50.0* | 50.0 |
| 1.A.4.c.i Agriculture/Forestry/Fishing: Stationary | 39.0 | 39.0 | 39.0 | 39.0 |
| 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | 80.0* | 80.0* | 80.0* | 80.0 |

Data source: Switzerland´s IIR 2011 with exception for (*) $PM_{10}$, $PM_{2.5}$, BC– expert judgment

### 1.7.3 Results of Tier 1 uncertainty evaluation

Table 1.7.3-1 shows a summary of the uncertainty evaluation of Croatia total emissions 2016 and the trend uncertainties 1990-2016 by pollutant. Detail calculation sheets and results of Croatia uncertainty analyses are provided in Appendix 7.

**Table 1.7.3-1 The summary of the uncertainty evaluation for Croatia and total emissions by pollutant in 2016**

| Pollutant | Total emission in 2016 | Unit | Emission uncertainty | Trend | Trend uncertainty |
|---|---|---|---|---|---|
| | | | % | % | % |
| **$SO_2$** | 14.71 | kt | 13.87 | -91.36% | 1.10 |
| **NOx** | 52.33 | kt | 14.37 | -50.51% | 2.29 |
| **NMVOC** | 69.87 | kt | 18.56 | -60.07% | 3.66 |
| **CO** | 202.43 | kt | 32.93 | -63.68% | 5.75 |
| **TSP** | 37.54 | kt | 35.23 | -33.09% | 14.76 |
| **$PM_{10}$** | 25.65 | kt | 43.11 | -45.77% | 6.24 |
| **$PM_{2.5}$** | 18.41 | kt | 56.94 | -51.48% | 3.68 |
| **BC** | 2.96 | kt | 55.63 | -45.73% | 8.03 |
| **PAH** | 6.94 | t | 366.97 | -70.64% | 20.25 |
| **HCB** | 0.30 | kg | 320.10 | 8.89% | 15.62 |
| **PCDD/PCDF** | 20.47 | g I-TEQ | 282.18 | -57.69% | 10.27 |
| **$NH_3$** | 35.01 | kt | 87.49 | -34.76% | 18.55 |
| **As** | 0.40 | t | 147.97 | -95.31% | 17.78 |
| **Cd** | 0.84 | t | 294.56 | -28.53% | 92.09 |
| **Cr** | 2.02 | t | 222.69 | -61.84% | 62.98 |
| **Cu** | 8.43 | t | 158.93 | -6.20% | 26.20 |
| **Hg** | 0.50 | t | 76.77 | -57.16% | 105.16 |
| **Ni** | 7.84 | t | 90.73 | -70.09% | 12.27 |
| **Pb** | 6.95 | t | 141.16 | -98.71% | 1.35 |
| **Se** | 0.35 | t | 252.48 | -23.04% | 46.03 |
| **Zn** | 34.34 | t | 286.35 | -11.39% | 50.81 |
| **PCBs** | 422.26 | kg | 398.51 | -12.60% | 61.10 |

The results of uncertainty analysis are interpreted in the manner provided below. For example, in Table 1.7.3-1 row with evaluated $NO_2$ emission uncertainty tells us that with certainty of 95% total $NO_2$ emission for the year 2016 varies between [52.33*(1-p/100), 52.33*(1+p/100)], where "p" is emission uncertainty (14,37%). With the same approach the 95% probability range for trend is between [-50.51%-t, -50.51%+t], where "t" is trend uncertainty (2.29%).

High emission uncertainty for pollutants: PAH, PCDD/PCDF, Cu, Pb, Se, PCBs, Zn, Hg is expected. The main reason is high default uncertainty of emission factors (400%) that is given in Table

3.2 from EMEP/EEA guidebook. These are categories that have been classified at level E, which is an estimate of uncertainty based on assumptions and has unlimited range of uncertainty. For pollutants: $PM_{10}$, $PM_{2.5}$, BC and TSP uncertainty ranges in Table 3.3 from EMEP/EEA guidebook are not defined. For pollutant, $NH_3$ range of uncertainty is classified in category D or E, where estimate of the uncertainty is based on assumption, so the range is not specified. As the total uncertainty would not be overestimated, for $PM_{10}$, $PM_{2.5}$, BC and TSP the source category NFR 1.A.4 is divided into lower subcategories.

## 1.8 GENERAL ASSESSMENT OF COMPLETENESS

According to reporting guidelines, in cases when methodological and data gaps exist in the inventory, parties to the Convention are required to inform and explain in a transparent manner the reason of their appearance, also the emission of certain emission sources from the inventory. To accomplish this, Parties have to use designated notation keys, Explanation of the meaning and the purpose of notation keys are presented in the following sub-chapter.

Notation keys are used in NFR emission tables for sub-sectors, from which emissions has not been quantitatively estimated. In Table 1.8-1 definition for each notation key used in NFR format is presented.

**Table 1.8-1 Definition of Notation keys**

| Notation key | Meaning | Purpose |
|---|---|---|
| NO | Not occurring | For activities or processes which do not exist in Republic of Croatia / for emissions by sources of compounds that do not occur for a particular compound or source category; |
| NE | Not estimated | Where emission occur, but have not been estimated or reported |
| NA | Not applicable | When activity or process exist, but it is assumed that they do not result with emission / Is used for activities which are believed to result in emission which are insignificant to national totals; |
| IE | Included elsewhere | Where emissions for mentioned activity or process are calculated and included in inventory, but did not separately presented for this source category / For emissions of pollutants which are calculated, but included elsewhere from expected source category in the inventory; |
| C | Confidential | For emissions by sources of compounds which could lead to the disclosure of confidential information |

| Notation key | Meaning | Purpose |
|---|---|---|
| NR | Not relevant | According to paragraph 9 in the Emission Guidelines, Emission inventory reporting should cover all years from 1980, Onwards, if data are available, Where emissions are not strictly required by the different Protocols, e.g. for some parties emissions of NMVOC prior to 1988 |

### 1.8.1 Sources reported as "NE"

**Table 1.8.1-1 Explanation to the Notation key NE**

| NFR14 code | Substance(s) | Reason for not estimation |
|---|---|---|
| 1.A.1.b | $NH_3$, PCB, HCB | FEs are not available in EMEP/EEA GB |
| 1.A.1.c | PCB, HCB | FEs are not available in EMEP/EEA GB |
| 1.A.2.g.vii | PCB, HCB, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PCDD/F, Hg, As | FEs are not available in EMEP/EEA GB |
| 1.A.3.b.i | HCB, PCBs | FEs are not available in EMEP/EEA GB neither in COPER 4 model |
| 1.A.3.b.ii | | |
| 1.A.3.b.iii | | |
| 1.A.3.b.iv | | |
| 1.A.3.b.vi | Hg, As, PCDD/F, PAHs, HCB, PCBs | FEs are not available in EMEP/EEA GB |
| 1.A.3.b.vii | BC, PCDD/F, PAHs, HCB, PCBs | FEs are not available in EMEP/EEA GB |
| 1.A.3.d.ii | benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene | FEs are not available in EMEP/EEA GB |
| 1.A.4.b.ii, 1.A.4.c.ii | Hg, As, PCDD/PCDF, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, HCB, PCBs | FEs are not available in EMEP/EEA GB |
| 1.A.4.c.i | HCB, PCBs | FEs are not available in EMEP/EEA GB |
| 1.B.2.a.i | $SO_2$, PCDD/F | FEs are not available in EMEP/EEA GB |
| 1.B.2.c | NH3, PCDD/PCDF | FEs are not available in EMEP/EEA GB |
| 2.B.1 | NMVOC, $SO_2$, $PM_{2.5}$ | FEs are not available in EMEP/EEA GB |
| 2.B.2 | $NH_3$, $PM_{2.5}$ | FEs are not available in EMEP/EEA GB |
| 5.C.1.b.i | $NH_3$ | FEs are not available in EMEP/EEA GB |
| 5.C.1.b.iii | $NH_3$, PMs, Se, Zn | FEs are not available in EMEP/EEA GB |

### 1.8.2 Explanation of the notation key “IE“

**Table 1.8.2-1 Explanation to the Notation key IE**

| NFR14 code | Substance(s) | Included in NFR code | |
|---|---|---|---|
| 1A.2.a | All relevant | 1.A.2.f | (1990 - 2000) |
| 1.A.2.b | All relevant | 1.A.2.f | (1990 - 2000) |
| 1.A.2.c | All relevant | 1.A.2.f | (1990 - 2000) |
| 1.A.2.d | All relevant | 1.A.2.f | (1990 - 2000) |
| 1.A.2.e | All relevant | 1.A.2.f | (1990 - 2000) |
| 1A2gviii | All relevant | 1.A.2.f | (1990 - 2016) |
| 1.A.3.d.i.(ii) | All relevant | 1.A.3.d.i(i) | (1990 - 2016) |
| 1.A.4.a.ii | All relevant | 1.A.4.b.ii and 1.A.4.c.ii | (1990 - 2016) |
| 1.A.4.c.iii | All relevant | 1.A.3.d.ii (based on total amount of exhausted fuel for national navigation, maritime and river traffic) | (1990 - 2016) |
| 1.A.5.a | All relevant | 1.A.4.a.i | (1990 - 2016) |
| 1.A.5.b | All relevant | 1.A.3.a, 1.A.3.b (i-iv), 1.A.3.d | (1990 - 2016) |
| 2.A.1 | All relevant for fuel combustion except for PMs | 1.A.2.f | (1990 - 2016) |
| 2.A.2 | All relevant for fuel combustion except for PMs | 1.A.2.f | (1990 - 2016) |
| 2.A.3 | All relevant for fuel combustion except for PMs | 1.A.2.f | (1990 - 2016) |
| 2.A.5.c | TSP, $PM_{10}$, $PM_{2.5}$ | 2.A.1, 2.A.2, 2.A.3, 2.A.5.a, 2.A.5.b | (1990 - 2016) |
| 2.B.10.b | TSP, $PM_{10}$, $PM_{2.5}$ | 2.B.10.a | (1990 - 2016) |
| 2.C.1 | $NH_3$ | 1.A.2.f | (1990 - 2000) |
| | | 1.A.2.a | (2001 - 2016) |
| 2.C.2 | All relevant for fuel combustion | 1.A.2.b | (1990 - 2003) |
| 2.C.3 | All relevant for fuel combustion | 1.A.2.b | (1990 - 1991) |
| 2.G | All relevant | 2.D.3.a | (1990 - 2016) |
| 3.D.a | NOx, $NH_3$, and other relevant | 3.B source categories | (1990 – 2016) |
| 3.D.b | PMs | 3.D.a.1 | (1990 – 2016) |
| 3.D.c | PMs | 3.B source categories, 3.D.a.1 | (1990 – 2016) |
| 3.D.e | PMs | 3.D.a.1 | (1990 – 2016) |
| 5.C.1.b.i | All relevant | 1.A.2.f | (2009 – 2016) |
| 5.C.1.b.ii | All relevant | 5.C.1.b.i | (1990 – 2008) |

### 1.8.3 An account of sub-sources included in reporting codes "OTHER"

**Table 1.8.3-1 Sub-sources accounted for in reporting codes "Other"**

| NFR14 code | Substance(s) reported | Sub-source description | |
|---|---|---|---|
| 1.A.2.f | All relevant | Stationary combustion in manufacturing industries and construction: Iron and steel (1 A 2 a), Non-ferrous metals (1 A 2 b), Chemicals (1 A 2 c ), Pulp, Paper and Print (1 A 2 d), Food processing, beverages and tobacco (1 A 2 e) | (1990 - 2000) |
| 1.A.5.a | All relevant | (C) - military, (IE) Combustion in commercial and institutional plants (NFR 1 A 4 a and SNAP 020100) | (1990 - 2016) |
| 1.A.5.b | All relevant | (C) - military, (IE) - Combustion in vehicles (sub-sectors 1 A 3 b (i-iv)), other mobile combustion in NFR code 1 A 4 a i | (1990 - 2016) |
| 1.B.1.c | NO | - | (1990 - 2016) |
| 1.B.3 | NO | - | (1990 - 2016) |
| 2.B.10.a | $NO_x$, CO, NMVOC, $SO_2$, $NH_3$, $PM_{10}$, TSP, $PM_{2.5}$ | **Processes in inorganic chemical industry** - production of: sulfuric acid (SNAP 040401), NPK fertilizers (SNAP 040407), urea (SNAP 040408), Ammonium phosphate SNAP 040406), carbon black (SNAP 040409), **and processes in organic chemical industry** - production of: Ethylene (SNAP 040501), Propylene (SNAP 040502), Vinyl chloride (SNAP 040504), Polyethylene LD (SNAP 040506), Polyvinylchloride (SNAP 040508), Styrene (SNAP 040510), Polystyrene (SNAP 040511) and Ethyl benzene (SNAP 040518) | 1990 |
| | | **Processes in inorganic chemical industry** - production of: sulfuric acid (SNAP 040401), NPK fertilizers (SNAP 040407), urea (SNAP 040408), Ammonium phosphate SNAP 040406), carbon black (SNAP 040409), **and processes in organic chemical industry** - production of: Ethylene (SNAP 040501), Propylene (SNAP 040502), Vinyl chloride (SNAP 040504), Polyethylene LD (SNAP 040506), Polyvinylchloride (SNAP 040508), Polystyrene (SNAP 040511) and Ethyl benzene (SNAP 040518) | 1991 |
| | | **Processes in inorganic chemical industry** - production of: sulfuric acid (SNAP 040401), NPK fertilizers (SNAP 040407), urea (SNAP 040408), Ammonium phosphate SNAP 040406), carbon black (SNAP 040409), **and processes in organic chemical industry** - production of: Ethylene (SNAP 040501), Propylene (SNAP 040502), Vinyl chloride (SNAP 040504), Polyethylene LD (SNAP 040506), Polyvinylchloride (SNAP 040508), Polystyrene (SNAP 040511) | 1992 and 1993 |

| NFR14 code | Substance(s) reported | Sub-source description | |
|---|---|---|---|
| | | **Processes in inorganic chemical industry** - production of: sulfuric acid (SNAP 040401), NPK fertilizers (SNAP 040407), urea (SNAP 040408), Ammonium phosphate SNAP 040406), carbon black (SNAP 040409), **and processes in organic chemical industry** - production of: Ethylene (SNAP 040501), Propylene (SNAP 040502), Vinyl chloride (SNAP 040504), Polyethylene LD (SNAP 040506), Polyvinylchloride (SNAP 040508), Polystyrene (SNAP 040511), Formaldehyde (SNAP 040517) and Ethyl benzene (SNAP 040518) | 1995 and 1996 |
| | | **Processes in inorganic chemical industry** - production of: sulfuric acid (SNAP 040401), NPK fertilizers (SNAP 040407), urea (SNAP 040408), Ammonium phosphate SNAP 040406), carbon black (SNAP 040409), **and processes in organic chemical industry** - production of: Ethylene (SNAP 040501), Propylene (SNAP 040502), Vinyl chloride (SNAP 040504), Polyethylene LD (SNAP 040506), Polyvinylchloride (SNAP 040508), Polystyrene (SNAP 040511) and Formaldehyde (SNAP 040517) | 1994 and 1997 - 2000 |
| | | **Processes in inorganic chemical industry** - production of: sulfuric acid (SNAP 040401), NPK fertilizers (SNAP 040407), urea (SNAP 040408), Ammonium phosphate SNAP 040406), carbon black (SNAP 040409), **and processes in organic chemical industry** - production of: Ethylene (SNAP 040501), Propylene (SNAP 040502), Vinyl chloride (SNAP 040504), Polyethylene LD (SNAP 040506), Polystyrene (SNAP 040511) and Formaldehyde (SNAP 040517) | 2001 and 2002 |
| | | **Processes in inorganic chemical industry** - production of: sulfuric acid (SNAP 040401), NPK fertilizers (SNAP 040407), urea (SNAP 040408), Ammonium phosphate SNAP 040406), carbon black (SNAP 040409), **and processes in organic chemical industry** - production of: Ethylene (SNAP 040501), Propylene (SNAP 040502), Polyethylene LD (SNAP 040506), Polystyrene (SNAP 040511) and Formaldehyde (SNAP 040517) | 2003 - 2009 |
| | | **Processes in inorganic chemical industry** - production of: NPK fertilizers (SNAP 040407), urea (SNAP 040408), **and processes in organic chemical industry** - production of: Ethylene (SNAP 040501), Propylene (SNAP 040502), Polyethylene LD (SNAP 040506), Polystyrene (SNAP 040511) and Formaldehyde (SNAP 040517) | 2010 - 2011 |

| NFR14 code | Substance(s) reported | Sub-source description | |
|---|---|---|---|
| | | **Processes in inorganic chemical industry** - production of: sulfuric acid (SNAP 040401), NPK fertilizers (SNAP 040407), urea (SNAP 040408), **and processes in organic chemical industry** - production of: Formaldehyde (SNAP 040517) | 2012<br>2013<br>2014 |
| 2.C.7.c | NO | **-** | (1990 - 2016) |
| 2.D.3.i | VOC, NOx, CO, $SO_2$, $NH_3$, $PM_{2.5}$, $PM_{10}$, TSP, As, Cd, Cr, Cu, Hg, Pb, PCDD/PCDF, Total 4 PAH, benzo(a), benzo(b), benzo(k), Indeno | Fat, edible and non-edible oil extraction (SNAP 060404), Tobacco combustion (SNAP 060602), Preservation of wood with creosote preservative type / organic solvent borne preservative (SNAP 060406), Application of glues and adhesives (SNAP 060405) and conservation of vehicles (SNAP 060407) | (1990 - 2016) |
| 2.H.3 | NO | - | (1990 - 2016) |
| 2.G | NMVOC | Use of pesticide, including fungicide | (1990 – 2016) |
| 3.D.a.2.c | NO | - | (1990 - 2016) |
| 5.C.1.b.vi | NO | - | (1990 - 2016) |
| 5.D.3 | $NH_3$ | Latrines | (1990 - 2016) |
| 5.E | All relevant | Car fire, industrial building fire, apartment building fire, undetached house fire, detached house fire | (1990 - 2016) |

# II ANALYSIS OF KEY TRENDS BY POLLUTANT

This chapter gives an overview of the methodology for the key source analysis by observed pollutants, the results of key sources analysis with an overview of the change in share from 1990 to 2015, then overview of direct emissions of large point sources in Croatia (from EPR base) and in the end overview and analysis of pollutants time series.

## 2.1 THE METHODOLOGY FOR KEY SOURCE ANALYSIS

The methodology used to identify key source categories of individual pollutant follows the quantitative Approach 1 described in the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Sensitivity analysis - a simplified approach, suggested in the assessment of key sources, if uncertainties are not known. 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[16]

## 2.2 KEY SOURCE ANALYSIS

The analysis of key sources in Republic of Croatia includes all pollutants under CLRTAP and associated protocols: pollutants which causes acidification, eutrophication and ground-level ozone ($SO_2$, $NO_X$, CO, NMVOC and $NH_3$), particles (TSP, $PM_{10}$ and $PM_{2.5}$), black carbon (BC), heavy metals (Pb, Cd and Hg), other heavy metals (As, Cr, Cu, Ni, Se and Zn) and persistent organic pollutants:

[16] *Guidebook 2009 (Key category analysis and methodological choice)*: 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.

total 4 PAHs (benzo(a)-pyrene, benzo(b)-fluoranthene, benzo(k)-fluoranthene, Indeno(1,2,3-cd)-pyrene), PCDD/PCDF, HCB and PCBs). National emissions have been disaggregated into the categories according to required reporting format (NFR). A summary of all key and main sources and their contributions to overall pollutant emissions and percentage of emission change ("-"decrease and "+"increase) from 1990 to 2015 is provided in Table 2.2-1 below. As a note, each of pollutant totals in Table 2.2-1 represents pollutant total only for emission of key sources, not a national total.

**Table 2.2-1 Summary of key and main sources and their contributions to overall pollutants emission and percentage of emission change ("-" decrease and "+" increase) from 1990 to 2016**

| Pollutant | NFR Code | Key source during 2016<br>NFR name | Emission in 2016 | % of total emission in 2016 | % change from 1990 to 2016 |
|---|---|---|---|---|---|
| $NO_x$ | 1A3biii | Road transport: Heavy duty vehicles and buses | 8.93 | 17.04% | -11.02% |
| | 1A3bi | Road transport: Passenger cars | 10.85 | 20.71% | -55.57% |
| | 1A1a | Public electricity and heat production | 5.13 | 9.80% | -58.87% |
| | 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | 3.79 | 7.24% | -79.90% |
| | 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | 2.82 | 5.38% | -63.76% |
| | 3Da1 | Inorganic N-fertilizers (includes also urea application) | 2.43 | 4.64% | -12.95% |
| | 1A3bii | Road transport: Light duty vehicles | 2.39 | 4.57% | -10.45% |
| | 1A4bi | Residential: Stationary | 5.21 | 9.95% | 18.74% |
| | 1A4ai | Commercial/institutional: Stationary | 1.63 | 3.12% | -58.16% |
| | | **Total for key sources** | **43.18** | **82.5%** | |
| NMVOC | 1A4bi | Residential: Stationary | 16.07 | 22.99% | -30.06% |
| | 2H2 | Food and beverages industry | 5.38 | 7.70% | -75.93% |
| | 2D3i | Other solvent use | 3.43 | 4.91% | -70.23% |
| | 2D3e | Degreasing | 2.96 | 4.24% | -70.82% |
| | 1A3bi | Road transport: Passenger cars | 2.75 | 3.93% | -88.76% |
| | 2D3d | Coating applications | 12.28 | 17.57% | -43.20% |
| | 1B2av | Distribution of oil products | 2.25 | 3.22% | -37.58% |
| | 3B1a | Manure management - Dairy cattle | 2.69 | 3.85% | -44.92% |
| | 5A | Biological treatment of waste - Solid waste disposal on land | 2.05 | 2.94% | 123.07% |
| | 3B1b | Manure management - Non-dairy cattle | 2.32 | 3.32% | 54.77% |

| Pollutant | NFR Code | Key source during 2016 NFR name | Emission in 2016 | % of total emission in 2016 | % change from 1990 to 2016 |
|---|---|---|---|---|---|
| | 2D3a | Domestic solvent use including fungicides | 2.12 | 3.03% | -80.88% |
| | 2D3h | Printing | 2.35 | 3.36% | -28.03% |
| | | **Total for key sources** | **49.86** | **81.1%** | |
| $SO_2$ | 1A1a | Public electricity and heat production | 3.31 | 22.5% | -95.7% |
| | 1B2aiv | Fugitive emissions oil: Refining / storage | 3.77 | 25.6% | 109.6% |
| | 1A1b | Petroleum refining | 3.04 | 20.7% | -86.5% |
| | 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | 1.79 | 12.1% | -95.0% |
| | | **Total for key sources** | **11.90** | **80.9%** | |
| $NH_3$ | 3B3 | Manure management - Swine | 8.14 | 23.25% | -35.88% |
| | 3Da1 | Inorganic N-fertilizers (includes also urea application) | 7.16 | 20.45% | 16.71% |
| | 3B1a | Manure management - Dairy cattle | 4.60 | 13.13% | -60.74% |
| | 3B1b | Manure management - Non-dairy cattle | 4.53 | 12.95% | -11.21% |
| | 2B10a | Chemical industry: Other | 2.07 | 5.93% | -40.44% |
| | 1A4bi | Residential: Stationary | 2.23 | 6.38% | -26.23% |
| | | **Total for key sources** | **28.74** | **82.1%** | |
| $PM_{2.5}$ | 1A4bi | Residential: Stationary | 13.34 | 72.44% | -53.03% |
| | 1A3bi | Road transport: Passenger cars | 0.63 | 3.43% | 260.10% |
| | 1A1a | Public electricity and heat production | 0.59 | 3.22% | -15.37% |
| | 2B10a | Chemical industry: Other | 0.35 | 1.92% | 28.50% |
| | | **Total for key sources** | **14.92** | **81.0%** | |
| $PM_{10}$ | 1A4bi | Residential: Stationary | 13.67 | 53.37% | -53.07% |
| | 2D3b | Road paving with asphalt | 2.25 | 8.78% | 274.04% |
| | 2A5a | Quarrying and mining of minerals other than coal | 1.15 | 4.49% | -14.90% |
| | 3Da1 | Inorganic N-fertilizers (includes also urea application) | 1.14 | 4.45% | -40.73% |
| | 1A3bi | Road transport: Passenger cars | 0.63 | 2.47% | 260.10% |
| | 1A3bvi | Road transport: Automobile tyre and brake wear | 0.56 | 2.20% | 66.12% |
| | 1A1a | Public electricity and heat production | 0.76 | 2.98% | -35.27% |
| | | **Total for key sources** | **20.16** | **78.8%** | |
| TSP | 1A4bi | Residential: Stationary | 14.36 | 38.29% | -53.18% |
| | 2D3b | Road paving with asphalt | 10.50 | 27.99% | 274.04% |
| | 3Da1 | Inorganic N-fertilizers (includes also urea application) | 1.14 | 3.04% | -40.73% |
| | 3B3 | Manure management - Swine | 1.01 | 2.70% | -25.48% |
| | 2A5a | Quarrying and mining of minerals other than coal | 2.35 | 6.25% | -14.90% |

| Pollutant | NFR Code | Key source during 2016<br>NFR name | Emission in 2016 | % of total emission in 2016 | % change from 1990 to 2016 |
|---|---|---|---|---|---|
| | 1A1a | Public electricity and heat production | 1.00 | 2.67% | -53.05% |
| | | **Total for key sources** | **30.35** | **80.9%** | **-33.2%** |
| CO | 1A4bi | Residential: Stationary | 123.53 | 61.0% | -35.4% |
| | 1A3bi | Road transport: Passenger cars | 26.71 | 13.2% | -87.9% |
| | 1B2aiv | Fugitive emissions oil: Refining / storage | 20.46 | 10.1% | -59.1% |
| | | **Total for key sources** | **170.69** | **84.3%** | |
| Pb | 1A3bi | Road transport: Passenger cars | 3.15 | 39.5% | -99.3% |
| | 1A4bi | Residential: Stationary | 1.29 | 16.2% | -27.8% |
| | 1A3bvi | Road transport: Automobile tyre and brake wear | 0.79 | 9.9% | 62.0% |
| | 2A3 | Glass production | 0.47 | 5.9% | 0.5% |
| | 2G | Other product use | 1.00 | 12.6% | 80.3% |
| | | **Total for key sources** | **6.70** | **84.2%** | |
| Cd | 1A4bi | Residential: Stationary | 0.61 | 72.6% | 9.9% |
| | 2G | Other product use | 0.05 | 5.4% | -30.7% |
| | 2A3 | Glass production | 0.04 | 4.3% | 0.5% |
| | | **Total for key sources** | **0.70** | **82.3%** | |
| Hg | 1A1a | Public electricity and heat production | 0.20 | 39.9% | 234.7% |
| | 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | 0.11 | 21.7% | -10.3% |
| | 2K | Consumption of POPs and heavy metals (e.g. electrical and scientific equipment) | 0.04 | 8.4% | -12.6% |
| | 1B2aiv | Fugitive emissions oil: Refining / storage | 0.04 | 7.7% | -57.1% |
| | 1A4bi | Residential: Stationary | 0.04 | 8.5% | -26.9% |
| | | **Total for key sources** | **0.43** | **86.1%** | |
| PCDD/ PCDF | 1A4bi | Residential: Stationary | 14.4 | 70.3% | -56.5% |
| | 5C1biii | Clinical waste incineration | 2.2 | 10.9% | -60.2% |
| | | **Total for key sources** | **16.6** | **81.1%** | |
| PAH | 1A4bi | Residential: Stationary | 6.35 | 91.5% | -65.2% |
| | | **Total for key sources** | **6.35** | **91.5%** | |
| As | 1B2aiv | Fugitive emissions oil: Refining / storage | 0.14 | 35.5% | 701.2% |
| | 1A1a | Public electricity and heat production | 0.10 | 23.5% | -86.5% |
| | 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | 0.06 | 14.7% | -44.5% |
| | 2A3 | Glass production | 0.05 | 13.0% | 0.5% |
| | | **Total for key sources** | **0.35** | **86.7%** | |
| Cr | 1A4bi | Residential: Stationary | 1.09 | 53.12% | 5.98% |

| Pollutant | NFR Code | Key source during 2016 NFR name | Emission in 2016 | % of total emission in 2016 | % change from 1990 to 2016 |
|---|---|---|---|---|---|
| | 1A3bvi | Road transport: Automobile tyre and brake wear | 0.29 | 14.31% | 61.80% |
| | 1B2aiv | Fugitive emissions oil: Refining / storage | 0.17 | 8.44% | -59.13% |
| | 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | 0.11 | 5.54% | -66.97% |
| | | **Total for key sources** | **1.67** | **81.4%** | |
| Cu | 1A3bvi | Road transport: Automobile tyre and brake wear | 6.42 | 76.2% | 61.7% |
| | 2G | Other product use | 0.61 | 7.3% | 60.9% |
| | | **Total for key sources** | **7.03** | **83.4%** | |
| Ni | 1A1b | Petroleum refining | 6.61 | 84.2% | -59.7% |
| | | **Total for key sources** | **6.61** | **84.2%** | |
| Se | 2A3 | Glass production | 0.22 | 62.5% | 0.5% |
| | 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | 0.05 | 15.4% | -29.4% |
| | 1A4bi | Residential: Stationary | 0.02 | 6.8% | -20.1% |
| | | **Total for key sources** | **0.30** | **84.7%** | |
| Zn | 1A4bi | Residential: Stationary | 24.20 | 70.4% | 6.7% |
| | 1A3bi | Road transport: Passenger cars | 2.44 | 7.1% | 50.2% |
| | 1A3bvi | Road transport: Automobile tyre and brake wear | 2.39 | 6.9% | 67.2% |
| | | **Total for key sources** | **29.03** | **84.4%** | |
| benzo(a) pyrene | 1A4bi | Residential: Stationary | 2.14 | 93.6% | -65.8% |
| | | **Total for key sources** | **2.14** | **93.6%** | |
| benzo(b) fluoranthene | 1A4bi | Residential: Stationary | 2.20 | 90.0% | -64.2% |
| | | **Total for key sources** | **2.20** | **90.0%** | |
| benzo(k) fluoranthene | 1A4bi | Residential: Stationary | 0.81 | 88.6% | 6.2% |
| | | **Total for key sources** | **0.81** | **88.6%** | |
| Indeno (1,2,3-cd) pyrene | 1A4bi | Residential: Stationary | 1.20 | 93.4% | -65.4% |
| | | **Total for key sources** | **1.20** | **93.4%** | |
| PCBs | 2K | Consumption of POPs and heavy metals (e.g. electrical and scientific equipment) | 417.43 | 98.9% | -12.6% |
| | | **Total for key sources** | **417.43** | **98.9%** | |
| HCB | 1A4bi | Residential: Stationary | 0.24 | 80.0% | 10.6% |
| | 1A1a | Public electricity and heat production | 0.03 | 11.4% | 750.1% |
| | | **Total for key sources** | **0.27** | **91.3%** | |
| BC | 1A4bi | Residential: Stationary | 1.87 | 63.14% | -41.65% |
| | 1A3bi | Road transport: Passenger cars | 0.45 | 15.25% | 433.77% |

| Pollutant | NFR Code | Key source during 2016 — NFR name | Emission in 2016 | % of total emission in 2016 | % change from 1990 to 2016 |
|---|---|---|---|---|---|
| | 1A3bii | Road transport: Light duty vehicles | 0.13 | 4.46% | -37.43% |
| | | **Total for key sources** | **2.46** | **82.9%** | |

## 2.3 EMISSIONS OF LARGE POINT SOURCES (LPS) IN 2016

Overview of the total emissions of large point sources (LPSs) is shown in table 2.3-1. Emissions of LPSs reported in the EPR were used. All other pollutant emissions required under the LRTAP Convention were calculated according to EMEP/CORINAIR methodology. Emissions from two refineries in Croatia is presented in a way that the total emissions from both refineries are allocated in 65:35 shares in favour of the refinery with higher emissions in accordance with the EPR. The table also shows total emissions of LCPs, total national emissions and the share of LCPs in total national emissions in 2016.

**Table 2.3-1 Pollutant emissions from large point source (LPS) and LPS share in the Republic of Croatia national total emissions, 2016**

| Pollutant | NOx (as $NO_2$) | NMVOC | SOx (as $SO_2$) | $NH_3$ | $PM_{2.5}$ | $PM_{10}$ | TSP | CO | Pb | Cd | Hg | PCDD/ PCDF (dioxins/ furans) | PAHs | HCB | PCBs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LCP** | **Gg** | **Gg** | **Gg** | **Gg** | **Gg** | **Gg** | **Gg** | **Gg** | **Mg** | **Mg** | **Mg** | **g I-Teq** | **Mg** | **kg** | **kg** |
| HEP, TPP PLOMIN 1 | 2.01 | 0.03 | 2.90 | 0.00 | 0.05 | 0.10 | 0.20 | 0.08 | 0.08 | 2.0E-03 | 7.3E-02 | 9.0E-02 | 2.3E-05 | 5.60E-03 | 1.54 |
| HEP, TPP PLOMIN 2 | 1.55 | 0.05 | 0.24 | 0.00 | 0.03 | 0.06 | 0.13 | 0.07 | 0.14 | 3.4E-03 | 1.2E-01 | 1.5E-01 | 3.8E-05 | 9.33E-03 | 2.56 |
| HEP, TPP RIJEKA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HEP, TPP SISAK | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HEP, CHP ZAGREB (EL-TO) | 0.46 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.03 | 0.00 | 0.0E+00 | 6.3E-04 | 3.0E-03 | 3.2E-04 | 0.00 | 0.00 |
| HEP, CHP ZAGREB (TE-TO) | 0.23 | 0.03 | 0.03 | 0.00 | 0.00 | 0.01 | 0.01 | 0.03 | 0.00 | 0.0E+00 | 1.1E-03 | 4.0E-03 | 2.4E-05 | 0.00 | 0.00 |
| HEP, CHP OSIJEK | 0.14 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.0E-08 | 2.6E-04 | 9.0E-04 | 5.7E-06 | 0.00 | 0.00 |
| HEP, KTPP Jertovec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0E+00 | 2.0E-06 | 6.9E-06 | 4.2E-08 | 0.00 | 0.00 |
| PETROKEMIJA | 1.13 | 0.03 | 0.20 | 2.00 | 0.35 | 0.28 | 0.69 | 0.01 | 0.00 | 0.0E+00 | 2.8E-03 | 1.4E-04 | 0.0E+00 | 0.00 | 0.00 |
| INA D.D. SISAK OIL REFINERY | 0.53 | 0.34 | 1.94 | 0.03 | 0.07 | 0.15 | 0.21 | 7.43 | 0.07 | 1.6E-02 | 1.5E-02 | 8.0E-03 | 7.4E-04 | 0.00 | 0.00 |
| INA D.D. RIJEKA OIL REFINERY | 0.99 | 0.64 | 3.61 | 0.05 | 0.14 | 0.28 | 0.39 | 13.79 | 0.14 | 3.0E-02 | 2.7E-02 | 1.5E-02 | 1.4E-03 | 0.00 | 0.00 |
| NAŠICECEMENT | 0.61 | 0.22 | 0.52 | 0.00 | 0.05 | 0.09 | 0.01 | 1.83 | 0.06 | 4.7E-03 | 2.9E-02 | 2.4E-03 | 2.7E-04 | 2.72E-03 | 6.08E-02 |
| CEMEX HRVATSKA (DALMACIJACEMENT) | 1.56 | 0.02 | 0.05 | 0.00 | 0.08 | 0.15 | 0.02 | 1.91 | 0.09 | 7.7E-03 | 4.7E-02 | 3.9E-03 | 4.5E-04 | 4.43E-03 | 9.91E-02 |
| HOLCIM HRVATSKA Ltd | 0.61 | 0.02 | 0.11 | 0.00 | 0.03 | 0.06 | 0.01 | 0.42 | 0.04 | 3.1E-03 | 1.9E-02 | 1.6E-03 | 1.8E-04 | 1.76E-03 | 3.95E-02 |
| ISTRACEMENT, CALUCEM Group | 0.29 | 0.00 | 0.27 | 0.00 | 0.01 | 0.02 | 0.00 | 1.96 | 0.01 | 9.4E-04 | 5.8E-03 | 4.8E-04 | 5.5E-05 | 5.41E-04 | 1.21E-02 |
| ROCKWOOL ADRIATIC | 0.07 | 0.04 | 0.32 | 0.07 | 0.05 | 0.06 | 0.07 | 0.02 | 0.06 | 8.5E-04 | 3.5E-03 | 8.9E-02 | 0.06 | 2.71E-04 | 7.43E-02 |
| Vetropack Straža d.d. | 0.41 | 0.00 | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SLADORANA D.D. ŽUPANJA | 0.03 | 0.34 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 5.59E-02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SUGAR FACTORY OSIJEK | 0.17 | - | 0.71 | 0.00 | 0.00 | 0.09 | 0.00 | 1.61E-02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **LCP TOTAL** | **10.91** | **1.79** | **11.13** | **2.16** | **0.86** | **1.36** | **1.75** | **27.66** | **0.69** | **0.07** | **0.34** | **0.37** | **0.07** | **0.02** | **4.38** |
| **NATIONAL TOTAL** | **51.90** | **61.34** | **14.91** | **34.87** | **20.54** | **27.82** | **40.30** | **215.79** | **7.94** | **0.88** | **0.49** | **23.06** | **8.16** | **0.30** | **425.04** |
| **SHARE LCP IN NATIONAL TOTAL** | **21.02%** | **2.92%** | **74.64%** | **6.19%** | **4.20%** | **4.90%** | **4.35%** | **12.82%** | **8.71%** | **7.72%** | **70.57%** | **1.61%** | **0.83%** | **8.35%** | **1.03%** |

# III EMISSION TRENDS BY POLLUTANT

This chapter gives a description and graphical overview of pollutant emissions, as well, the overview of emissions by SNAP nomenclature, for the period 1990 - 2016. In addition, the acidification index was considered.

Methodology improvement (move to higher tier), harmonization of so far used EFs with new propose ones in EMEP/EEA guidebook, activity data harmonization with NIR and other activities led to differences in national emission total of pollutants submitted in previous year and those submitted this year, and are aggregated in tables in Appendix 8 and in detail described in chapters from 4 to 9 in the part *Recalculations and other changes* and in the Chapter 10.

## 3.1 SULPHUR DIOXIDE ($SO_2$)

The total sulphur dioxide ($SO_2$) emission in 2016 was amounted to 14.7 kt that is 6.9 % lower than in 2015 (Table 3.1-1). Moreover, the $SO_2$ emission in 2016 was decrease by 91.4 % compared with 1990 (Figure 3.1-1). One-half of (43.1 %) the sulphur dioxide emissions in 2016 derive from the energy sector public electricity and heat production, 19.8% originates from fuel combustion in manufacturing industry and construction, 27.6% from fugitive emissions from activities in the Refining/storage sector, 7.2 % from small combustion (stationary and mobile). The reduction is mainly occurs due to a transfer from fuels with high sulphur content to low-sulphur fuels, for both road transport and stationary combustion. Also, the war for Croatian independence in the period 1991 – 1995 was the reason for the decline in fuel consumption and overall production in almost all sectors and as consequence the decline in emissions. Great decline in $SO_2$ emission trend can be observed in 2000 due to second coal thermal power plant (TPP) entering into operation in Croatia. Second TPP has a technique for reducing $SO_2$ emission ($SO_2$ scrubbing process) with efficiency higher than 95%. The second TPP on coal has approximately double capacity in comparison to first one. Since 2000, first TPP with no technique for the $SO_2$ emission reduction is in operation only when the electricity needs are higher (mainly in the summer).

Since 1990, emissions from the public electricity and heat production sector have declined by 93.6 %, from the manufacturing industry and construction by 92.1 %, from transport sector by 97.8 %, from small combustion by 95.7 %. Sulphur emissions from industrial processes and product use sector, have also decreased, by 82.9 % compared to 1990, due to a stopping of the aluminium production, pulp and paper production (Kraft process) and carbon black production and also due to great reduction in production of sulphuric acid. Increasing trend in $SO_2$ emissions (by 68.3 % since 1990) has sector Refining/storage (NFR 1.B.2.a.iv) due to the installation of sulphur recovery plants, the first one in 1997 and second in 2008 within the refineries.

It can be seen that the $SO_2$ emissions in 2016 was lower than the reduction commitment of 70 kt set under the Gothenburg Protocol and the NEC Directive.

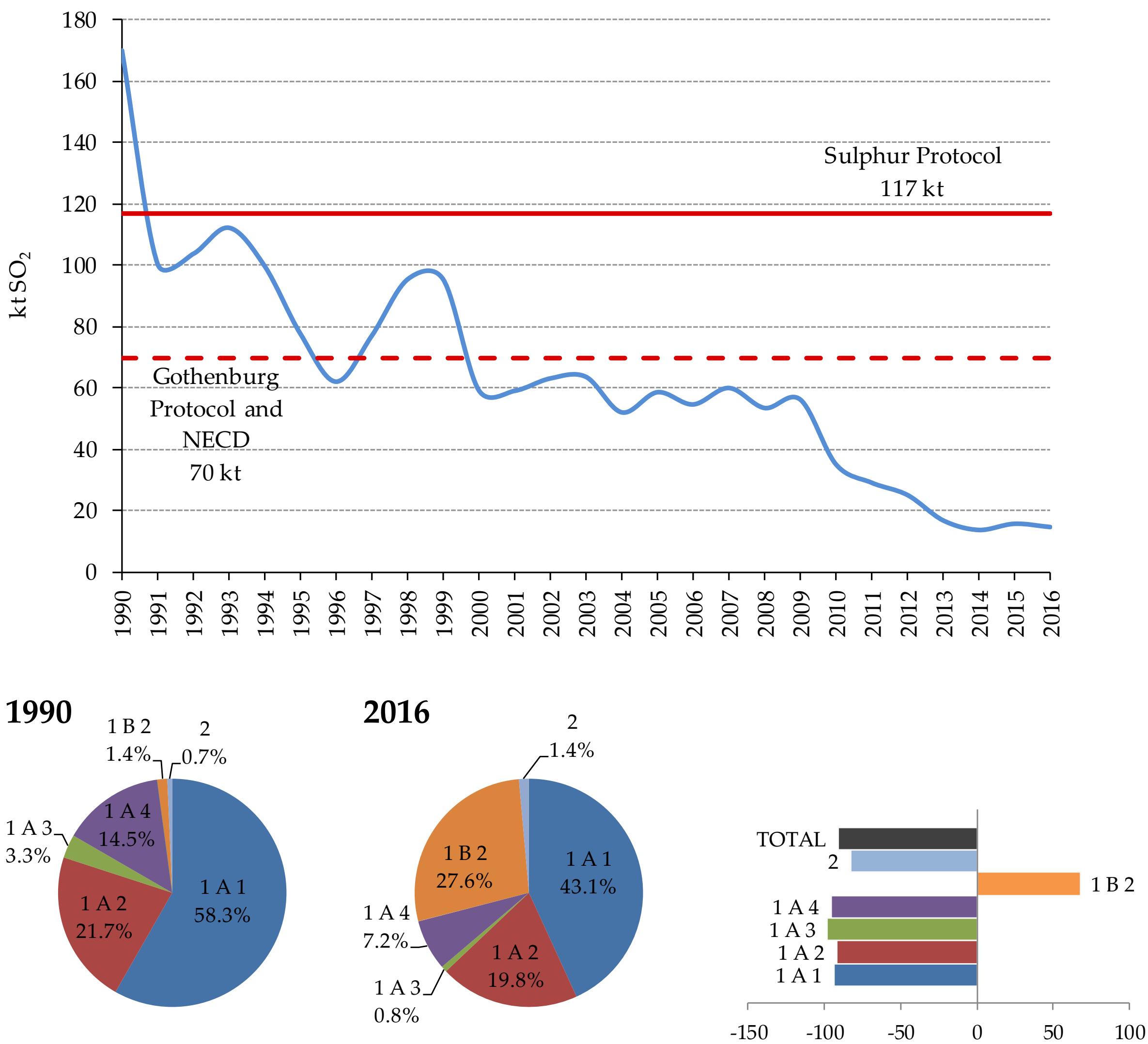



**Figure 3.1-1 The $SO_2$ emissions (kt/yr.) and percentage share by sector and variation in $SO_2$ emissions**

**Table 3.1-1 The $SO_2$ emissions by SNAP nomenclature in the period 1990-2016**

| $SO_2$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1990 | 99.2 | 22.6 | 35.6 | 3.0 | NA | NA | 4.4 | 4.7 | 0.61 | NA | 170.3 |
| 1991 | 59.8 | 13.3 | 18.9 | 2.1 | NA | NA | 3.0 | 3.1 | 0.40 | NA | 100.6 |
| 1992 | 73.3 | 7.7 | 14.4 | 1.6 | NA | NA | 4.4 | 2.1 | 0.35 | NA | 103.9 |
| 1993 | 75.0 | 10.1 | 17.8 | 1.8 | NA | NA | 4.8 | 2.5 | 0.44 | NA | 112.4 |
| 1994 | 66.3 | 7.4 | 18.4 | 1.8 | NA | NA | 3.5 | 2.0 | 0.45 | NA | 99.8 |
| 1995 | 53.2 | 4.6 | 13.1 | 1.9 | NA | NA | 2.9 | 1.6 | 0.48 | NA | 77.8 |
| 1996 | 39.2 | 4.3 | 9.1 | 1.6 | NA | NA | 4.9 | 2.6 | 0.46 | NA | 62.2 |
| 1997 | 52.9 | 6.1 | 10.2 | 1.9 | NA | NA | 4.0 | 1.8 | 0.46 | NA | 77.2 |
| 1998 | 69.2 | 4.9 | 12.9 | 2.5 | NA | NA | 4.2 | 2.0 | 0.45 | NA | 96.2 |
| 1999 | 69.5 | 6.5 | 10.2 | 2.8 | NA | NA | 4.6 | 2.0 | 0.49 | NA | 96.2 |
| 2000 | 32.9 | 6.2 | 9.6 | 3.9 | NA | NA | 5.2 | 2.7 | 0.46 | NA | 60.9 |
| 2001 | 33.6 | 5.2 | 10.5 | 3.4 | NA | NA | 3.9 | 2.2 | 0.43 | NA | 59.2 |
| 2002 | 33.5 | 7.0 | 11.7 | 3.6 | NA | NA | 4.4 | 2.7 | 0.43 | NA | 63.3 |
| 2003 | 35.3 | 6.5 | 9.5 | 3.4 | NA | NA | 5.7 | 2.9 | 0.44 | NA | 63.7 |
| 2004 | 25.3 | 5.9 | 9.0 | 3.8 | NA | NA | 5.2 | 2.6 | 0.46 | NA | 52.2 |
| 2005 | 32.5 | 5.7 | 9.5 | 3.8 | NA | NA | 4.3 | 2.5 | 0.44 | NA | 58.7 |
| 2006 | 29.3 | 4.9 | 9.8 | 3.4 | NA | NA | 4.2 | 2.7 | 0.42 | NA | 54.8 |
| 2007 | 38.3 | 3.7 | 8.5 | 4.0 | NA | NA | 3.1 | 2.0 | 0.46 | NA | 60.1 |
| 2008 | 32.0 | 3.4 | 8.1 | 3.6 | NA | NA | 2.9 | 3.3 | 0.39 | NA | 53.6 |
| 2009 | 36.7 | 3.8 | 6.5 | 3.5 | NA | NA | 2.4 | 3.0 | 0.43 | NA | 56.4 |
| 2010 | 19.7 | 3.6 | 5.6 | 2.3 | NA | NA | 1.9 | 1.7 | 0.38 | NA | 35.2 |
| 2011 | 17.2 | 3.1 | 3.8 | 3.5 | NA | NA | 0.5 | 0.8 | 0.31 | NA | 29.2 |
| 2012 | 14.5 | 2.9 | 3.4 | 3.7 | NA | NA | 0.0 | 0.4 | 0.26 | NA | 25.2 |
| 2013 | 8.9 | 1.5 | 3.0 | 3.0 | NA | NA | 0.0 | 0.2 | 0.27 | NA | 16.9 |
| 2014 | 6.1 | 1.1 | 2.8 | 3.5 | NA | NA | 0.0 | 0.1 | 0.22 | NA | 13.8 |
| 2015 | 8.1 | 1.1 | 3.0 | 3.3 | NA | NA | 0.0 | 0.1 | 0.27 | NA | 15.8 |
| 2016 | 6.3 | 1.1 | 2.9 | 4.0 | NA | NA | 0.1 | 0.1 | 0.29 | NA | 14.7 |
| 2016 vs 1990 | -93.6% | -95.3% | -91.8% | 32.4% | NA | NA | -98.5% | -98.7% | -52.5% | NA | -91.4% |
| 2016 vs 2015 | -21.2% | -7.8% | -2.3% | 22.0% | NA | NA | 129.8% | -3.5% | 8.4% | NA | -6.9% |

## 3.2 NITROGEN OXIDES ($NO_X$)

The nitrogen oxides ($NO_x$) emission encompasses nitrogen monoxide and nitrogen dioxide emissions. The emissions are expressed as equivalents of $NO_2$. The $NO_x$ is a pollutant that causes acidification and eutrophication. Together with volatile organic compounds and other reactive gases in atmosphere, and in presence of solar radiation, the $NO_x$ takes part in ground ozone formation. Nitrogen oxides are formed in all combustion in the energy and transport sectors, and the largest emission sources are road traffic, off-road vehicles and machinery, production of electricity and heating and manufacturing industry and construction.

The NOx emission in 2016 amounted to 52.4 kt, which is a decline by 53.4 % since 1990 and decrease by 2.6 % compare to 2015 (Table 3.2-1). Emissions from the energy sector in 2016 were about 48.8 kt and account for about 93.3 % of the total NOx emission. Transport sector (NFR 1.A.3) was the main contributor in energy sector in 2016, with contribution of 48 % to the total of NOx emission, and with domination of road transport. In relation to the 1990 the NOx emission in transport sector has declined by 38.8%, due to the introduction of catalytic converters in cars and the subsequent successively more strict emission standards. Energy stationary combustion sectors (including off-road mobile sources) also have recorded a great decrease since 1990, mostly due to lower fuel consumption. Also, the war for Croatian independence in the period 1991 – 1995 was the reason for the decline in fuel consumption and overall production in almost all sectors and as consequence the decline in emissions. Since 2007 the trend of NOx emission has recorded decline due to the economic crisis which still exists in Croatia (Figure 3.2-1).

About 19.2 % of the NOx emissions in 2016 derive from small combustion sources (NFR 1.A.4 mobile and stationary), 12.6 % originates from fuel combustion in manufacturing industry and construction (NFR 1.A.2) and 13.2 % from the energy sector public electricity and heat production (NFR 1.A.1). All mentioned sectors have recorded a decline since 1990, the sector 1.A.4 by 40.9 %, 1.A.2 by 72 % and 1.A.1 by 61.5 %. In the period between 2016 and 2015, most of key sectors have recorded decline of emission: 1.A.1 by 2.1 %, 1.A.2 by 4.5 %, 1.A.3 by 2.7 %, 1.A.4 by 2.4 %, while sector 3.D recorded an increase by 6.7 %. The crop production and agricultural soils is also source of NOx emissions in Croatia, with 4.6 % of contribution to national NOx total in 2016. Those NO emissions occurs from soil microbial processes, and has decreased by about 12.9 % between 1990 and

2016 mostly due to decrease in N-fertilizer usage in crop production. The industrial processes and product use sector is not a significant source of NOx emission in Croatia. In 2016 it contributed with 1.8 % and in 1990 with 2.6 % to national NOx total. The emission in the sector has declined by about 64.9 % between 1990 and 2016, mostly due to stopping the production of aluminium, paper and pulp (Kraft process) and carbon black production and also due to decline in productions. Compare to previous year, this sector has recorded a decrease by 11.5 %.

The NOx emission in 2016 was lower than the reduction commitment of 87 kt set under the Gothenburg Protocol and the NEC Directive.

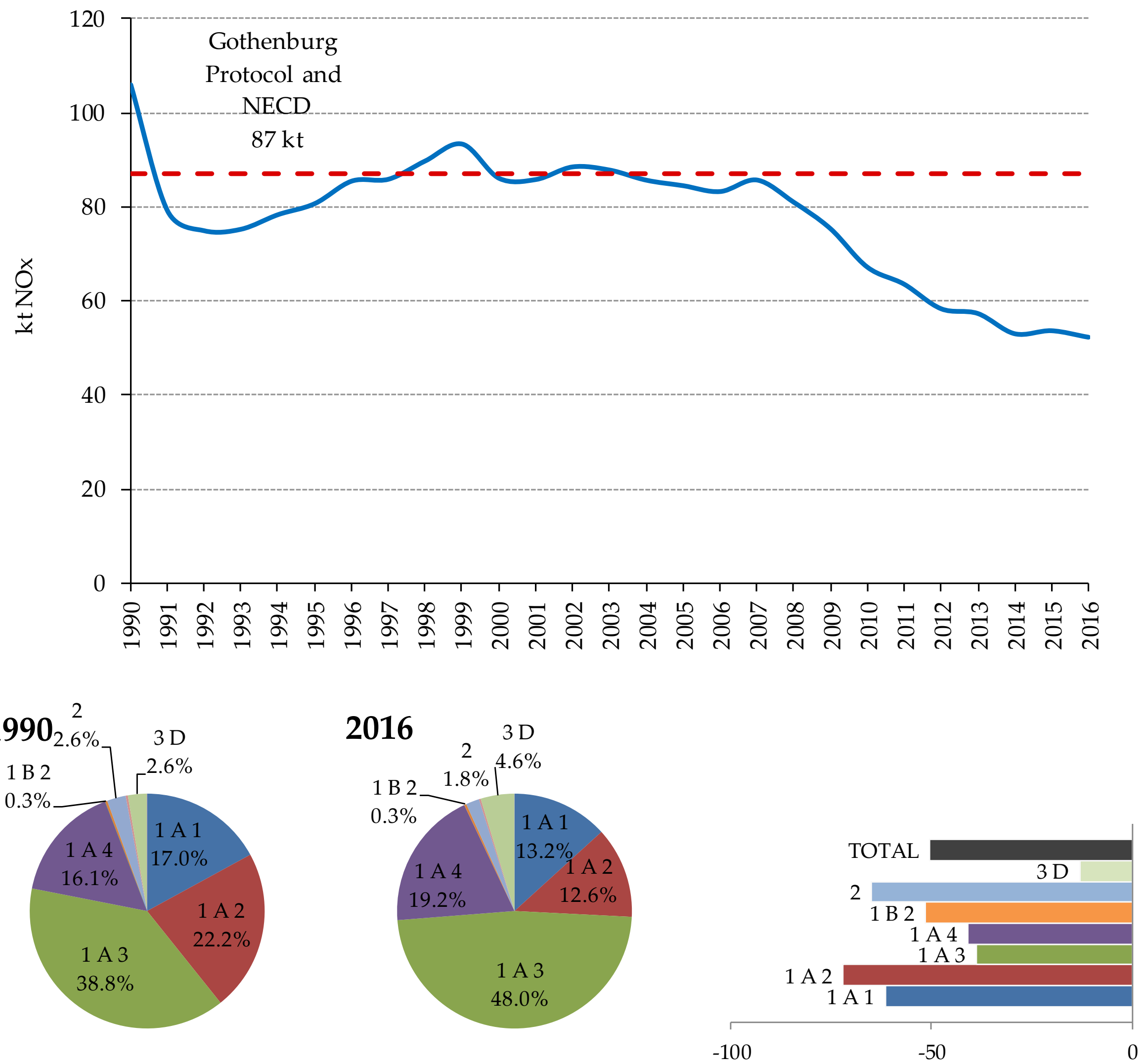



**Figure 3.2-1 The NOx emissions (kt/yr.) and percentage share by sector and variation in NOx emissions**

**Table 3.2-1 The NOx emissions by SNAP nomenclature in the period 1990-2016**

| NOx | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1990 | 18.0 | 9.2 | 18.9 | 3.0 | NA | 2.19E-02 | 37.1 | 16.4 | 7.7E-02 | 3.1 | 105.8 |
| 1991 | 13.5 | 7.8 | 13.1 | 2.6 | NA | 2.04E-02 | 26.6 | 12.4 | 5.9E-02 | 3.1 | 79.1 |
| 1992 | 15.9 | 8.3 | 11.1 | 2.9 | NA | 2.26E-02 | 25.4 | 7.8 | 5.1E-02 | 3.5 | 74.9 |
| 1993 | 16.4 | 8.9 | 11.0 | 2.5 | NA | 2.05E-02 | 26.7 | 7.1 | 6.1E-02 | 2.6 | 75.3 |
| 1994 | 15.5 | 7.6 | 11.5 | 2.6 | NA | 8.93E-03 | 28.6 | 9.7 | 5.7E-02 | 2.7 | 78.3 |
| 1995 | 18.2 | 8.2 | 10.9 | 2.8 | NA | 2.16E-02 | 28.6 | 9.2 | 6.4E-02 | 2.6 | 80.7 |
| 1996 | 17.3 | 10.0 | 11.2 | 2.6 | NA | 2.09E-02 | 30.8 | 10.6 | 5.8E-02 | 2.7 | 85.4 |
| 1997 | 16.2 | 9.6 | 10.9 | 2.7 | NA | 2.06E-02 | 32.9 | 10.0 | 6.0E-02 | 3.4 | 85.8 |
| 1998 | 19.1 | 8.1 | 12.4 | 2.4 | NA | 2.18E-02 | 33.4 | 11.7 | 6.1E-02 | 2.6 | 89.9 |
| 1999 | 20.5 | 9.5 | 11.5 | 2.7 | NA | 2.52E-02 | 34.7 | 11.6 | 6.7E-02 | 2.9 | 93.5 |
| 2000 | 14.1 | 8.4 | 11.3 | 2.9 | NA | 2.45E-02 | 32.6 | 13.7 | 6.6E-02 | 3.2 | 86.3 |
| 2001 | 13.1 | 8.3 | 12.2 | 2.3 | NA | 3.22E-02 | 31.7 | 14.5 | 6.6E-02 | 3.5 | 85.7 |
| 2002 | 14.7 | 8.5 | 12.0 | 2.4 | NA | 3.52E-02 | 33.4 | 14.0 | 6.2E-02 | 3.3 | 88.4 |
| 2003 | 13.7 | 9.3 | 11.1 | 2.6 | NA | 3.73E-02 | 33.5 | 14.4 | 6.3E-02 | 3.1 | 87.8 |
| 2004 | 11.3 | 8.9 | 12.5 | 3.0 | NA | 2.73E-02 | 33.3 | 13.3 | 6.1E-02 | 3.2 | 85.6 |
| 2005 | 11.8 | 8.9 | 12.5 | 2.6 | NA | 2.71E-02 | 31.6 | 13.7 | 6.1E-02 | 3.3 | 84.5 |
| 2006 | 10.8 | 8.1 | 13.1 | 2.5 | NA | 2.65E-02 | 31.6 | 13.9 | 6.4E-02 | 3.1 | 83.2 |
| 2007 | 12.9 | 7.4 | 14.1 | 2.7 | NA | 2.67E-02 | 31.5 | 13.6 | 6.9E-02 | 3.4 | 85.6 |
| 2008 | 10.9 | 7.6 | 13.0 | 2.6 | NA | 2.80E-02 | 28.7 | 14.8 | 6.4E-02 | 3.3 | 81.0 |
| 2009 | 10.7 | 7.7 | 11.8 | 1.6 | NA | 2.05E-02 | 27.9 | 12.6 | 6.6E-02 | 2.9 | 75.3 |
| 2010 | 8.7 | 8.1 | 8.2 | 1.8 | NA | 2.39E-02 | 26.5 | 11.2 | 3.7E-02 | 2.7 | 67.2 |
| 2011 | 9.1 | 7.7 | 6.8 | 1.3 | NA | 2.10E-02 | 25.0 | 10.5 | 4.5E-02 | 3.1 | 63.6 |
| 2012 | 8.0 | 7.3 | 6.9 | 1.2 | NA | 2.01E-02 | 22.7 | 9.3 | 4.6E-02 | 2.9 | 58.4 |
| 2013 | 7.8 | 7.0 | 5.9 | 1.1 | NA | 1.77E-02 | 24.3 | 8.8 | 4.4E-02 | 2.4 | 57.4 |
| 2014 | 7.1 | 6.2 | 5.6 | 1.2 | NA | 1.53E-02 | 22.5 | 8.2 | 5.0E-02 | 2.2 | 53.1 |
| 2015 | 7.1 | 7.2 | 5.2 | 1.2 | NA | 1.49E-02 | 23.1 | 7.5 | 5.4E-02 | 2.4 | 53.7 |
| 2016 | 6.9 | 7.2 | 5.1 | 1.0 | NA | 1.50E-02 | 22.3 | 7.1 | 6.0E-02 | 2.6 | 52.4 |
| 2016 vs 1990 | -61.5% | -21.9% | -72.9% | -64.7% | NA | -31.5% | -39.9% | -56.6% | -22.0% | -17.5% | -50.5% |
| 2016 vs 2015 | -2.1% | 0.5% | -2.3% | -10.6% | NA | 0.5% | -3.4% | -5.1% | 10.1% | 6.0% | -2.6% |

## 3.3 AMMONIA ($NH_3$)

Ammonia contributes to acid deposition and eutrophication. It also reacts rapidly with atmospherically-formed sulphuric and nitric acids to contribute to ambient levels of fine particles. Agriculture represents the largest source of ammonia emissions. Ammonia is a common by-product of animal excreta due to the often inefficient conversion of feed nitrogen into animal product.

The $NH_3$ emission in 2016 amounted to 35 kt. Emission has decrease by 34.7 % since 1990 and increase since year before by 11 % (Table 3.3-1). About 83.8 % of $NH_3$ emissions in Croatia originate from the agriculture sector, in which source category manure management account for about 60.1 % and the rest of the sector´s emissions (23.7 %) originate from mineral N-fertilizers application. Sectors with a smaller share in $NH_3$ emissions in 2016 but also a key sources are the industrial processes sector (about 6.2 %), and small combustion sector (about 6.4 %). Other sectors contribute with less influence like latrines (about 1.7 %), and transport sector (about 1.5 %) in which passenger cars are the dominant source. Sources of ammonia emission in industrial processes sector in Croatia are production of: ammonia, nitric acid and mineral N-fertilizers.

Dairy cattle (category 3.B) is the single major source of emissions from Agriculture in Croatia for year 1990, representing about 25% of total $NH_3$ emission (15% in year 2016). The overall trend of the NH3 emission from livestock is decreasing and dependent on the number of animals (44% reduction from animal sources in 2015 compared to 1990), and with the numbers of most of the animal categories in continuous decline since 1990. Dairy cattle is the single major source of $NH_3$ emission within category 3B (22% in 2016, 31% in 1990), followed by Market swine (28% in 2016, 22% in 1990). The decline in period 1991 - 1995 is a result of the war for Croatian independence, while the reason for decline in the years after 2008 is due to economic recession. $NH_3$ emission from agricultural soils varies in correlation with the total amount of N - mineral fertilizers applied in the period 1990 – 2016 (decrease of ~0.6 % in 2016 compared to 1990). In 2016, major source of emission is mineral fertilizer – urea (category 3D) representing about 25% of emission (13% in 1990). Within the category 3.D – Agricultural soils, major source of $NH_3$ emission is mineral fertilizer urea (62% in 2016, 78% in 1990) followed by NPK fertilizers (9% in 2016, 5% in 1990). The increase in the NH3 emission can be also observed in transport sector with road traffic domination (by about 16 times compared to 1990) due to its formation in vehicles' catalytic converters.

The ammonia emission in 2016 (Figure 3.3-1) was above the value of 30 kt set under the Gothenburg Protocol and the NEC Directive. This was a result of corrections made during the 2017 Comprehensive Technical Review of National Emission Inventories pursuant to the Directive on the Reduction of National Emissions of Certain Atmospheric Pollutants (Directive (EU) 2016/2284).

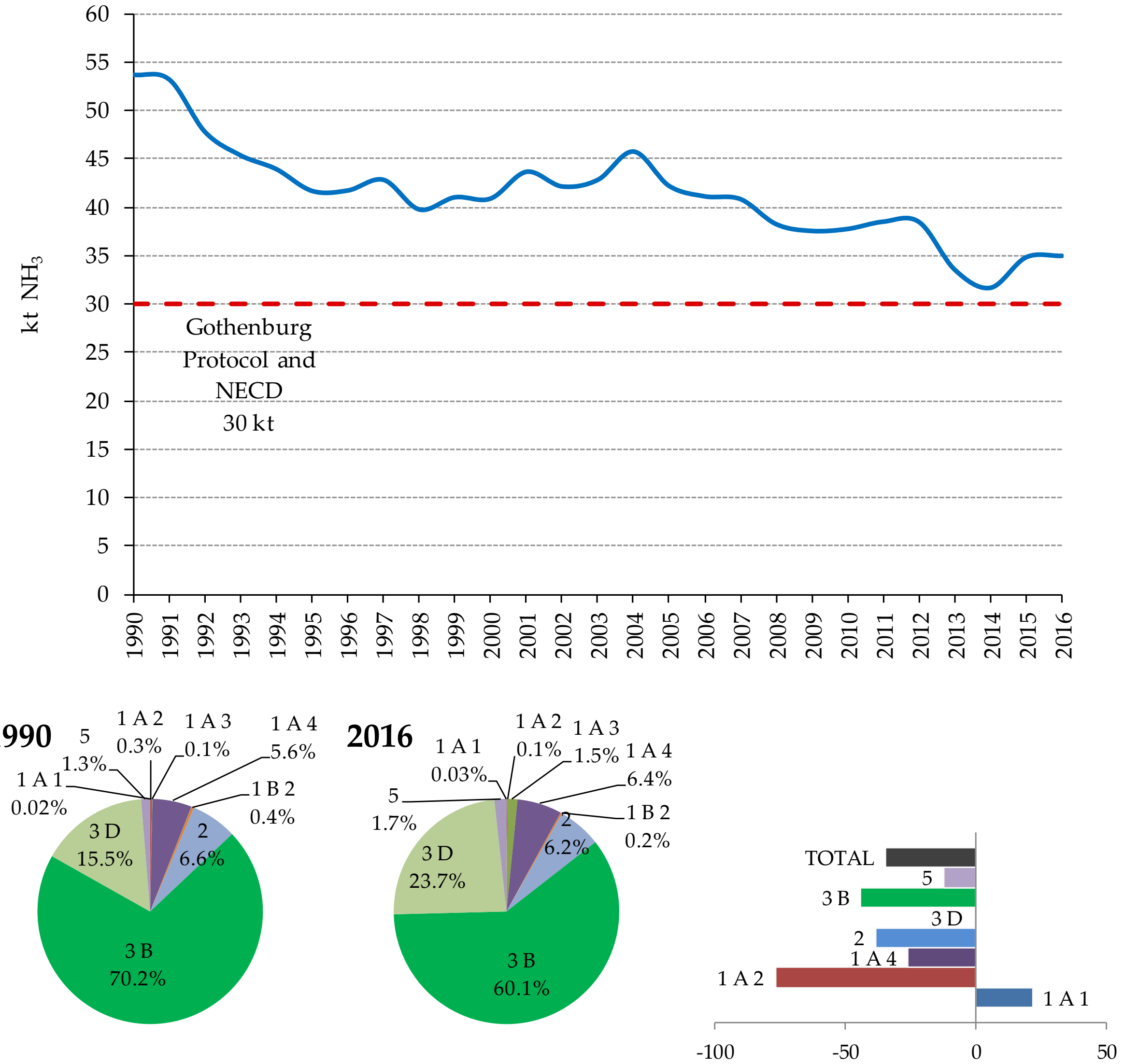



**Figure 3.3-1 The NH3 emissions (kt/yr.) and percentage share by sector and variation in NH3 emissions**

**Table 3.3-1 The NH3 emission by SNAP nomenclature in the period 1990-2016**

| NH3 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1990 | 9.0E-03 | 3.03 | 0.13 | 3.69 | NA | 5.0E-02 | 0.03 | 3.5E-03 | 0.69 | 46.0 | 53.7 |
| 1991 | 5.5E-03 | 3.58 | 0.13 | 3.62 | NA | 4.7E-02 | 0.02 | 2.5E-03 | 0.69 | 45.1 | 53.2 |
| 1992 | 6.3E-03 | 3.13 | 0.11 | 4.59 | NA | 5.2E-02 | 0.02 | 1.4E-03 | 0.69 | 39.2 | 47.8 |
| 1993 | 9.1E-03 | 3.30 | 0.11 | 3.25 | NA | 4.7E-02 | 0.04 | 1.7E-03 | 0.69 | 37.9 | 45.4 |
| 1994 | 5.6E-03 | 2.99 | 0.08 | 3.61 | NA | 2.0E-02 | 0.04 | 1.8E-03 | 0.68 | 36.5 | 43.9 |
| 1995 | 4.2E-03 | 3.16 | 0.09 | 3.67 | NA | 4.9E-02 | 0.06 | 1.7E-03 | 0.68 | 34.0 | 41.7 |

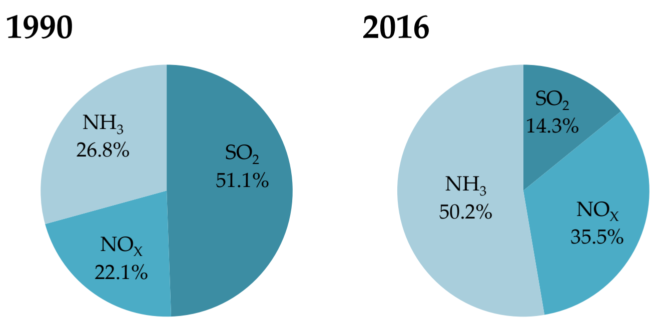
| $NH_3$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1996 | 4.9E-03 | 3.53 | 0.09 | 3.64 | NA | 4.7E-02 | 0.09 | 1.8E-03 | 0.67 | 33.7 | 41.7 |
| 1997 | 7.1E-03 | 3.24 | 0.12 | 3.69 | NA | 4.6E-02 | 0.15 | 1.7E-03 | 0.67 | 34.9 | 42.8 |
| 1998 | 6.7E-03 | 3.25 | 0.11 | 4.15 | NA | 5.0E-02 | 0.23 | 2.0E-03 | 0.66 | 31.3 | 39.8 |
| 1999 | 6.5E-03 | 3.19 | 0.08 | 3.03 | NA | 5.7E-02 | 0.29 | 2.4E-03 | 0.66 | 33.7 | 41.0 |
| 2000 | 1.0E-02 | 2.84 | 0.08 | 3.56 | NA | 5.6E-02 | 0.36 | 2.4E-03 | 0.66 | 33.3 | 40.9 |
| 2001 | 9.4E-03 | 3.13 | 0.07 | 2.75 | NA | 7.3E-02 | 0.34 | 2.6E-03 | 0.65 | 36.6 | 43.7 |
| 2002 | 1.2E-02 | 2.99 | 0.08 | 2.91 | NA | 7.6E-02 | 0.37 | 2.5E-03 | 0.65 | 35.1 | 42.2 |
| 2003 | 1.1E-02 | 3.44 | 0.09 | 3.60 | NA | 7.9E-02 | 0.39 | 3.0E-03 | 0.65 | 34.6 | 42.8 |
| 2004 | 1.1E-02 | 3.36 | 0.10 | 4.58 | NA | 5.9E-02 | 0.39 | 2.9E-03 | 0.64 | 36.6 | 45.8 |
| 2005 | 1.1E-02 | 3.56 | 0.08 | 3.77 | NA | 6.1E-02 | 0.41 | 3.1E-03 | 0.64 | 33.7 | 42.2 |
| 2006 | 1.0E-02 | 3.17 | 0.10 | 2.55 | NA | 6.0E-02 | 0.45 | 3.3E-03 | 0.64 | 34.2 | 41.1 |
| 2007 | 1.2E-02 | 2.97 | 0.09 | 2.72 | NA | 6.1E-02 | 0.63 | 3.4E-03 | 0.64 | 33.7 | 40.9 |
| 2008 | 1.2E-02 | 2.88 | 0.07 | 2.16 | NA | 6.4E-02 | 0.61 | 3.8E-03 | 0.63 | 31.8 | 38.3 |
| 2009 | 9.5E-03 | 2.91 | 0.08 | 1.69 | NA | 4.7E-02 | 0.62 | 3.4E-03 | 0.63 | 31.6 | 37.6 |
| 2010 | 1.2E-02 | 3.02 | 0.09 | 2.61 | NA | 5.5E-02 | 0.58 | 3.1E-03 | 0.62 | 30.8 | 37.8 |
| 2011 | 1.3E-02 | 2.84 | 0.08 | 2.61 | NA | 4.8E-02 | 0.57 | 3.0E-03 | 0.62 | 31.7 | 38.5 |
| 2012 | 1.1E-02 | 2.73 | 0.09 | 2.81 | NA | 4.6E-02 | 0.58 | 2.8E-03 | 0.62 | 31.6 | 38.5 |
| 2013 | 1.1E-02 | 2.61 | 0.08 | 1.90 | NA | 4.0E-02 | 0.56 | 2.7E-03 | 0.62 | 27.8 | 33.6 |
| 2014 | 9.9E-03 | 2.19 | 0.06 | 1.55 | NA | 3.5E-02 | 0.51 | 2.7E-03 | 0.61 | 26.7 | 31.7 |
| 2015 | 9.9E-03 | 2.43 | 0.05 | 2.54 | NA | 3.4E-02 | 0.51 | 2.6E-03 | 0.62 | 28.7 | 34.9 |
| 2016 | 1.1E-02 | 2.24 | 0.03 | 2.23 | NA | 3.4E-02 | 0.51 | 2.6E-03 | 0.61 | 29.3 | 35.0 |
| 2016 vs 1990 | 21.5% | -26.0% | -77.2% | -39.6% | NA | -32.5% | 582.5% | -24.6% | -12.4% | -36.2% | -34.7% |
| 2016 vs 2015 | 10.5% | -7.8% | -35.7% | -12.1% | NA | 0.1% | -0.7% | 0.9% | -1.9% | 2.4% | 0.4% |

## 3.4 ACID EQUIVALENT (AEQ)

Acid equivalent is a parameter for assessing the overall amount of acidifying substances emitted into the atmosphere. At different spatial and time scales, these substances contribute to the acidification of soil, air and the aquatic environment. The acid equivalent is based on the potential fixation of $H^+$ ion. The calculation only takes into account $SO_2$, NOx and $NH_3$, because it is quite obvious that other acidifying substances such as HCl, only have a negligible effect, regarding their low emission level compared to the other three substances. The acid equivalent is calculated using weight coefficients: 0.0313 for $SO_2$, 0.0217 for NOx and 0.0588 for $NH_3$.

Due to the respective weight of each of three substances, the proportion of $NH_3$ and $NO_x$ emissions have increased: for NOx from 21.3% in 1990 to 31.1% in 2016 and for $NH_3$ from 29.3% in

1990 to 56.3 % in 2016 (Table 3.4-1). In addition, their absolute emissions are slightly decreased during the observed period (Figure 3.4-1). This is mainly due to the significant decrease of $SO_2$ emission during the same period (from 49.4 % in 1990 to 12.6 % in 2016). It can be noticed that the acid equivalent has an overall decreasing trend, as a result of downward trends of all three substance emissions. This acid equivalent should follow a downward trend in coming years, as a result of the expected continuous decrease of $SO_2$, and with no significant change in $NO_x$ and $NH_3$ emissions.



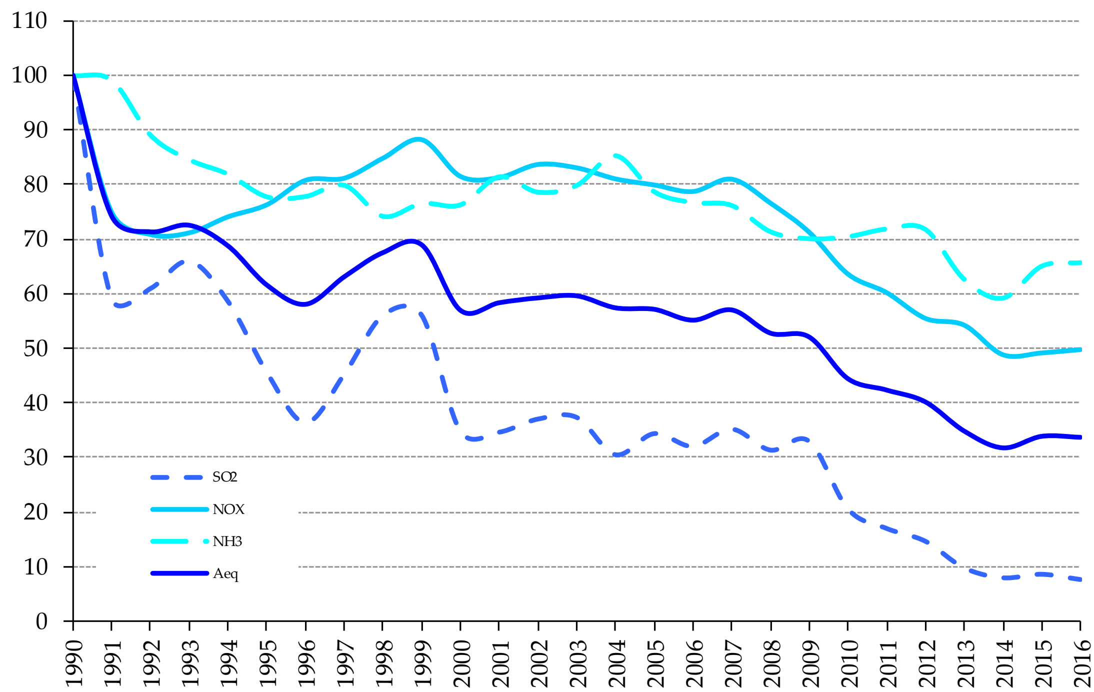




**Figure 3.4-1 Relative emission of substances (without nature) that contribute to acidification and eutrophication for 1990-2016 (1990 = 100%)**

**Table 3.4-1 Emission of acidifying substances that contribute to the acidification expressed in Aeq (*)**

| YEAR | $SO_2$ % Aeq | $NO_x$ % Aeq | $NH_3$ % Aeq | Aeq(**) kt |
|---|---|---|---|---|
| 1990 | 49.4 | 21.3 | 29.3 | 10.8 |
| 1991 | 39.4 | 21.5 | 39.1 | 8.0 |
| 1992 | 42.3 | 21.1 | 36.5 | 7.7 |
| 1993 | 45.0 | 20.9 | 34.1 | 7.8 |
| 1994 | 42.2 | 22.9 | 34.9 | 7.4 |
| 1995 | 36.7 | 26.4 | 36.9 | 6.6 |
| 1996 | 31.1 | 29.6 | 39.2 | 6.3 |
| 1997 | 35.5 | 27.4 | 37.1 | 6.8 |
| 1998 | 41.1 | 26.8 | 32.1 | 7.3 |
| 1999 | 40.3 | 27.2 | 32.5 | 7.4 |
| 2000 | 30.3 | 30.5 | 39.2 | 6.1 |
| 2001 | 29.5 | 29.6 | 40.9 | 6.3 |
| 2002 | 31.0 | 30.1 | 38.9 | 6.4 |
| 2003 | 31.1 | 29.7 | 39.2 | 6.4 |
| 2004 | 26.4 | 30.1 | 43.5 | 6.2 |
| 2005 | 29.9 | 29.8 | 40.3 | 6.2 |
| 2006 | 28.9 | 30.4 | 40.7 | 5.9 |
| 2007 | 30.6 | 30.3 | 39.1 | 6.1 |
| 2008 | 29.5 | 30.9 | 39.6 | 5.7 |
| 2009 | 31.5 | 29.2 | 39.4 | 5.6 |
| 2010 | 23.1 | 30.5 | 46.5 | 4.8 |
| 2011 | 20.0 | 30.3 | 49.7 | 4.6 |
| 2012 | 18.3 | 29.3 | 52.4 | 4.3 |
| 2013 | 14.1 | 33.2 | 52.7 | 3.7 |
| 2014 | 12.5 | 33.4 | 54.1 | 3.4 |
| 2015 | 13.3 | 31.4 | 55.2 | 3.7 |
| 2016 | 12.6 | 31.1 | 56.3 | 3.7 |

(*) Emissions concern only anthropogenic one (without nature)
(**) Acid equivalent: indicator of acid equivalent calculate on the base of potential fixation of H+ ion: 0.0313 for $SO_2$, 0.0217 for NOx and 0.0588 for $NH_3$

## 3.5 CARBON MONOXIDE EMISSION (CO)

Main source in carbon monoxide emission is the incomplete fossil fuel combustion in energy sectors both, stationary and mobile. Emission of CO has decreased from 558.4 kt in 1990 to 202.4 kt in 2016, which was a reduction by 63.7 % (Figure 3.5-1 and Table 3.5-1). Moreover, CO emissions have decreased by 11 % compared to 2015. About 99.8 % of the CO emissions in 2016 come from the energy sector, of which 64.7 % comes from small combustion sector (with domination of residential sector), 18.2 % from transport sector (with domination of road transport), 10.2 % from Refining / storage sector, and about 6 % from fuel combustion in manufacturing industry and construction.

The war for Croatian independence in the period 1991 – 1995 was the reason for the decline in fuel consumption and overall production in almost all sectors and as consequence the decline in emissions. Road transport was a main reason for CO emission reduction since 1990 (by 84.7 % regarding transport sector), due to the introduction of catalytic converters and renewing of the vehicle fleet. Also, changes in the structure of fossil fuel combustion by reducing the use of low quality coal and fuel wood and increasing use of natural gas have contributed to the reduction of CO emissions. Other sectors also have a significant reduction trend since 1990. The small combustion sector (residential, services, forestry/agriculture/fishing) has decreased CO emissions by 34.4 %. The industrial processes and product use sector has recorded a great reduction by 98.8 % since 1990, due to stopping the production of aluminium, paper and pulp (Kraft process) and carbon black production and also due to decline in productions. Emissions from Refining /storage sector have also decrease by 58.9 % since 1990, mostly due to decline in activity regarding catalytic cracking activity (partial burn without CO boiler). Since 2000 the trend of CO emissions has declining due to previously mentioned reasons and since 2007 the economic crisis has contributed to further reduction of CO emissions (Figure 3.2-1). Also, reduction since 2008 is a partly result of gradual replacement of certain percentage of traditional domestic stoves and manual single house boilers with advanced/ecolabelled stoves and boilers and pellet stoves and boilers (see Table 4.5-1 and Figure 4.5-2).

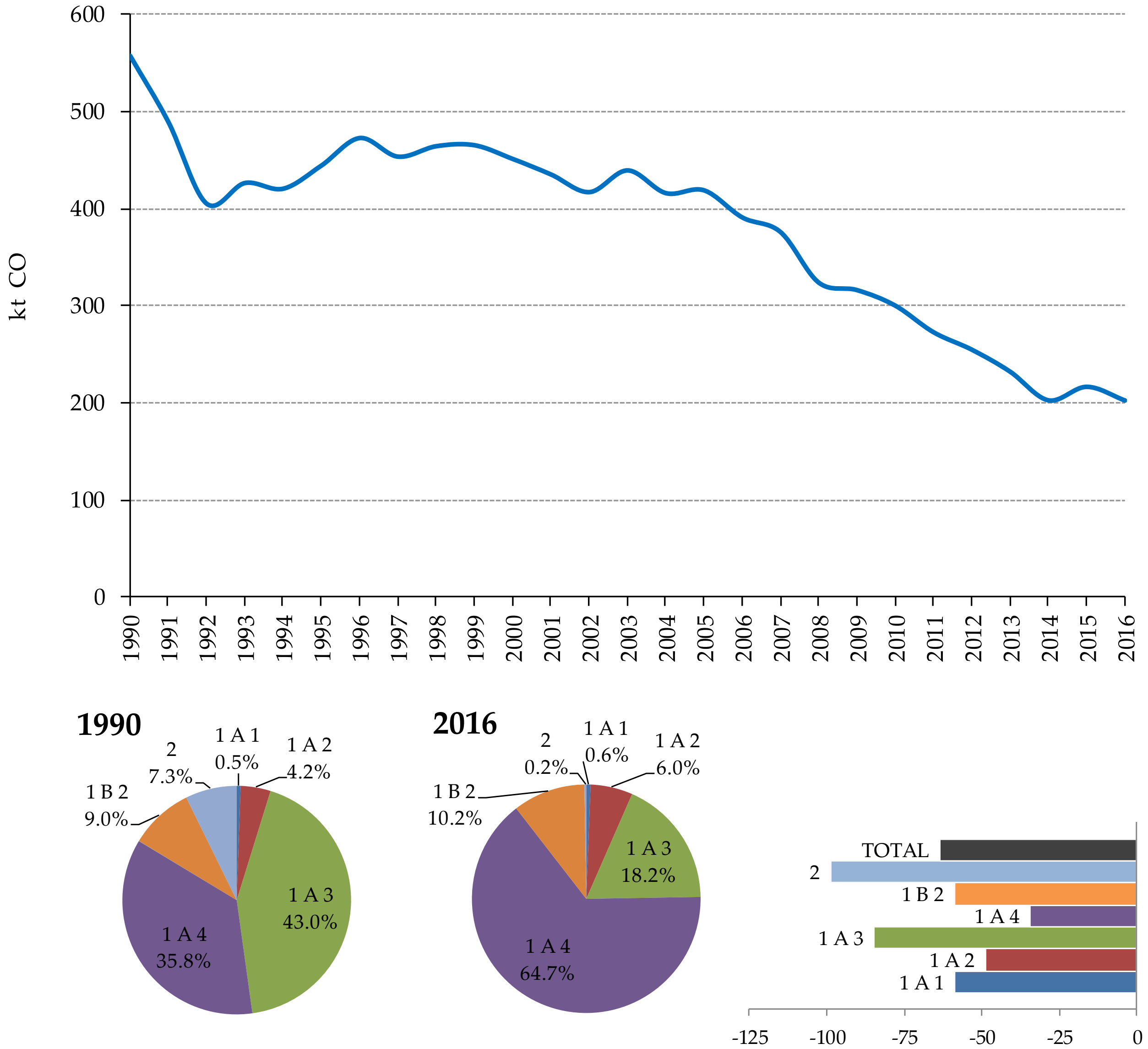



**Figure 3.5-1 The CO emissions (kt/yr.) and percentage share by sector and variation in CO emissions**

**Table 3.5-1 The CO emissions by SNAP nomenclature in the period 1990-2016**

| **CO** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1990 | 3.02 | 192.9 | 20.8 | 90.2 | NA | 0.67 | 236.6 | 12.9 | 0.39 | NA | 557.4 |
| 1991 | 2.20 | 213.3 | 14.3 | 60.3 | NA | 0.62 | 179.0 | 19.2 | 0.29 | NA | 489.2 |
| 1992 | 2.28 | 179.9 | 10.8 | 41.1 | NA | 0.69 | 156.2 | 14.0 | 0.25 | NA | 405.2 |
| 1993 | 2.65 | 189.3 | 9.8 | 54.4 | NA | 0.63 | 153.8 | 15.7 | 0.30 | NA | 426.5 |
| 1994 | 2.55 | 170.4 | 10.0 | 54.6 | NA | 0.27 | 166.7 | 15.8 | 0.28 | NA | 420.5 |
| 1995 | 2.63 | 179.6 | 9.7 | 61.8 | NA | 0.66 | 173.3 | 16.4 | 0.32 | NA | 444.4 |
| 1996 | 2.52 | 201.0 | 9.5 | 54.3 | NA | 0.64 | 186.0 | 18.4 | 0.29 | NA | 472.6 |

| CO | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1997 | 2.37 | 184.7 | 10.3 | 51.7 | NA | 0.63 | 186.6 | 17.0 | 0.29 | NA | 453.5 |
| 1998 | 2.55 | 185.9 | 10.2 | 59.4 | NA | 0.67 | 188.8 | 16.5 | 0.30 | NA | 464.3 |
| 1999 | 2.63 | 183.1 | 9.8 | 61.3 | NA | 0.77 | 186.5 | 20.9 | 0.33 | NA | 465.3 |
| 2000 | 2.19 | 162.6 | 9.8 | 84.2 | NA | 0.75 | 171.7 | 19.5 | 0.32 | NA | 451.2 |
| 2001 | 1.71 | 178.0 | 10.4 | 71.6 | NA | 0.99 | 153.3 | 18.8 | 0.31 | NA | 435.2 |
| 2002 | 1.65 | 170.8 | 9.9 | 75.6 | NA | 1.07 | 141.3 | 16.4 | 0.30 | NA | 417.0 |
| 2003 | 1.96 | 196.9 | 9.4 | 77.0 | NA | 1.13 | 133.8 | 18.9 | 0.31 | NA | 439.4 |
| 2004 | 1.86 | 191.5 | 10.7 | 70.6 | NA | 0.83 | 121.8 | 18.5 | 0.30 | NA | 416.0 |
| 2005 | 1.48 | 203.2 | 10.9 | 71.8 | NA | 0.83 | 113.5 | 16.9 | 0.30 | NA | 418.8 |
| 2006 | 1.82 | 180.6 | 11.4 | 83.7 | NA | 0.81 | 94.9 | 17.5 | 0.31 | NA | 390.9 |
| 2007 | 2.39 | 167.9 | 12.2 | 88.5 | NA | 0.81 | 86.1 | 17.7 | 0.34 | NA | 375.9 |
| 2008 | 1.67 | 163.1 | 11.6 | 50.9 | NA | 0.86 | 76.7 | 18.7 | 0.31 | NA | 323.8 |
| 2009 | 1.45 | 164.1 | 9.9 | 52.0 | NA | 0.63 | 70.3 | 17.4 | 0.33 | NA | 316.2 |
| 2010 | 1.35 | 170.6 | 10.2 | 40.3 | NA | 0.73 | 62.0 | 14.8 | 0.17 | NA | 300.1 |
| 2011 | 1.53 | 159.9 | 8.7 | 32.8 | NA | 0.64 | 54.3 | 14.4 | 0.21 | NA | 272.6 |
| 2012 | 1.38 | 153.2 | 9.0 | 35.4 | NA | 0.61 | 41.7 | 13.2 | 0.22 | NA | 254.7 |
| 2013 | 1.30 | 145.9 | 9.1 | 22.1 | NA | 0.54 | 40.0 | 12.9 | 0.21 | NA | 232.1 |
| 2014 | 1.18 | 121.8 | 9.0 | 21.9 | NA | 0.47 | 34.8 | 13.3 | 0.24 | NA | 202.6 |
| 2015 | 1.23 | 135.0 | 9.5 | 20.7 | NA | 0.46 | 36.7 | 12.8 | 0.26 | NA | 216.6 |
| 2016 | 1.25 | 124.1 | 8.2 | 20.5 | NA | 0.46 | 34.8 | 12.8 | 0.29 | NA | 202.4 |
| 2016 vs 1990 | -58.6% | -35.7% | -60.3% | -77.3% | NA | -31.6% | -85.3% | -0.8% | -24.8% | NA | -63.7% |
| 2016 vs 2015 | 1.4% | -8.1% | -13.5% | -1.1% | NA | 0.5% | -4.9% | 0.1% | 11.9% | NA | -6.5% |

## 3.6 NON-METHANE VOLATILE ORGANIC COMPOUNDS (NMVOC)

The VOCs play a significant role in the formation of ozone and fine particulates in the atmosphere. Under sunlight, VOCs react with NOx emitted mainly from vehicles, power plants and industrial activities to form ozone, which in turn helps the formation of fine particulates. The accumulation of ozone, fine particulates and other gaseous pollutants results in smog. Some of NMVOCs may have undesirable ecotoxicological properties, for example benzene and xylene.

Production and use of products containing solvent, road transport, refineries and combustion of wood in households have domination in NMVOCs emissions in Croatia. Road transport leads to the greatest emissions in the transport sector, but road transport has also shown the greatest reduction in NMVOC emission due to new exhaust emission requirements. Environmental requirements for reduction of NMVOC emission from products containing solvents have also contributed to lower NMVOC emission.

The NMVOCs emission in 2016 amounted to 69.9 kt. Emissions of NMVOCs in 2016 have sharply declined, by 60.1 % since 1990, and increase by 1.3 % compared to year before (Figure 3.6-1). The decline since 1990 is strong in the industrial processes and product use sector (by 65.4 %) and in transport sector (with road transport domination) (by 81 %). In 2016, emissions of NMVOCs from almost all sectors recording increase in comparison to 1990 (Table 3.6-1). The sector with constant increasing trend in NMVOC emissions since 1990 is the waste sector, due to increasing activities regarding solid waste disposal on land. The sharply decreasing trend since 1990 has occurred mainly due to reduced emissions from products containing solvent partly as a result of implementation of best available techniques (BAT) in the industrial processes and product use sector, also due to reducing the production activities and continuous decreasing population trend. The road transport sector has also contributed to this decreasing trend of NMVOC emission due to increased use of the energy-efficient cars, the introduction of new exhaust requirements. Fugitive NMVOC emissions from oil and natural gas products have also recorded a decline by 44.1 % since 1990. Also, the war for Croatian independence in the period 1991 – 1995 was the reason for the decline due to lower fuel consumption and overall reduction of production activities in almost all sectors. The economic crisis has contributed to further reduction of NMVOC emissions since 2007 (Figure 3.6-1). Also, reduction since 2008 is a partly result of gradual replacement of certain percentage of traditional domestic stoves and manual single house boilers with advanced/ecolabelled stoves and boilers and pellet stoves and boilers (see Table 4.5-1 and Figure 4.5-2).

The NMVOC emission in 2016 (Figure 3.6-1) was below the value of 90 kt set under the Gothenburg Protocol and the NEC Directive.

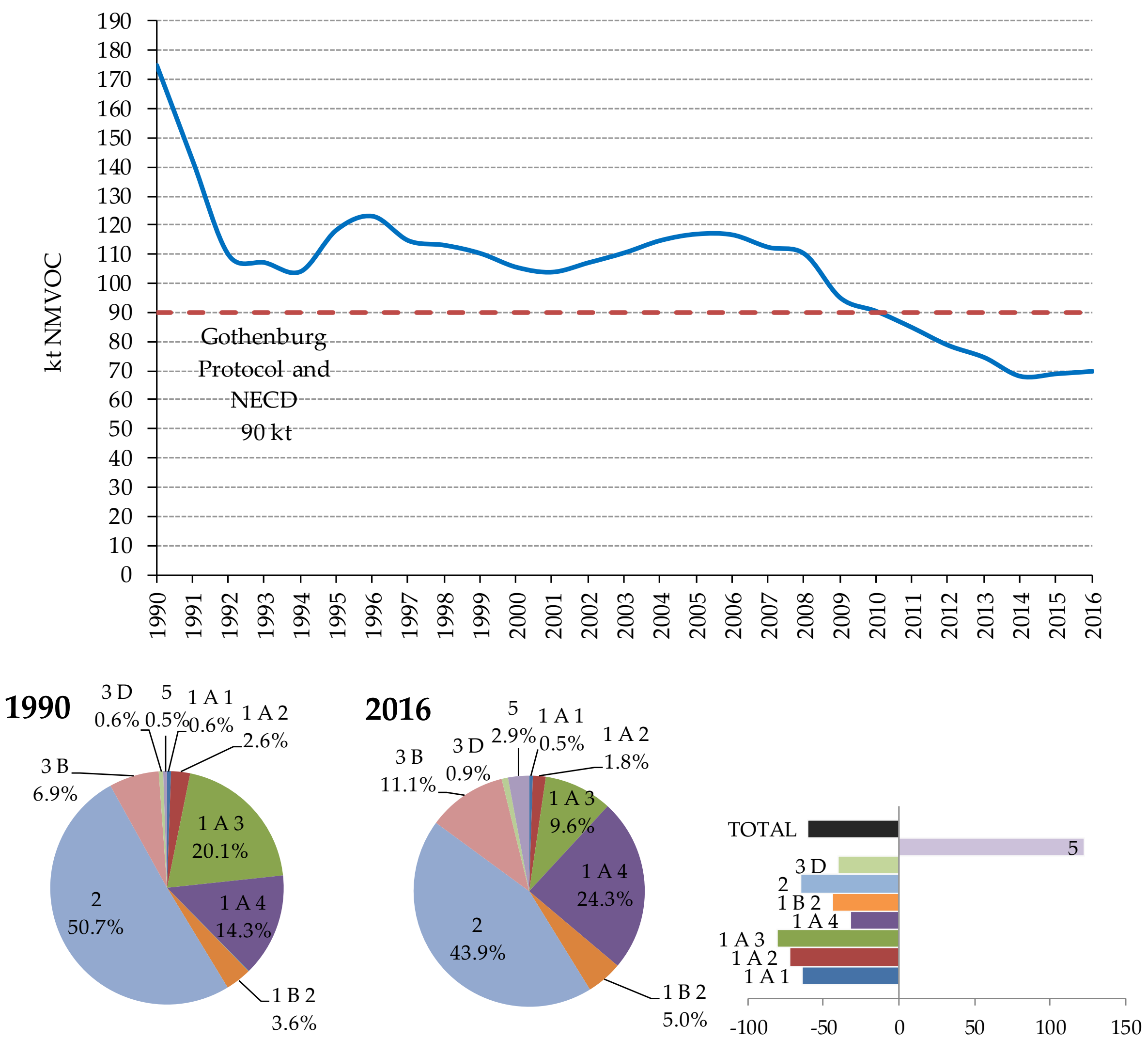



**Figure3.6-1 The NMVOCs emissions (kt/yr.) and percentage share by sector and variation in NMVOCs**

**Table 3.6-1 The NMVOC emissions by SNAP nomenclature in the period 1990-2016**

| **NMVOC** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1990 | 1.0 | 23.4 | 3.6 | 25.6 | 4.2 | 65.3 | 34.6 | 3.2 | 0.97 | 13.2 | 175.0 |
| 1991 | 0.8 | 26.9 | 2.8 | 21.8 | 2.3 | 43.3 | 27.0 | 3.4 | 0.97 | 12.8 | 142.2 |
| 1992 | 0.8 | 23.1 | 2.2 | 13.8 | 2.8 | 28.2 | 23.9 | 3.2 | 0.99 | 10.6 | 109.7 |
| 1993 | 1.0 | 24.4 | 2.2 | 12.9 | 2.8 | 27.3 | 22.6 | 2.1 | 1.04 | 10.8 | 107.2 |
| 1994 | 0.9 | 22.0 | 2.0 | 9.8 | 3.1 | 27.6 | 24.7 | 2.5 | 1.09 | 10.4 | 104.2 |
| 1995 | 0.8 | 23.3 | 2.0 | 10.3 | 3.4 | 39.3 | 25.7 | 2.5 | 1.18 | 9.9 | 118.5 |
| 1996 | 0.8 | 26.1 | 2.0 | 11.6 | 3.4 | 37.6 | 28.0 | 2.8 | 1.26 | 9.5 | 123.1 |
| 1997 | 0.9 | 24.0 | 2.2 | 10.1 | 3.5 | 31.1 | 29.6 | 2.6 | 1.36 | 9.4 | 114.7 |
| 1998 | 0.8 | 24.2 | 2.2 | 9.7 | 3.6 | 29.8 | 29.7 | 2.7 | 1.47 | 9.2 | 113.2 |

| NMVOC | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1999 | 0.9 | 23.9 | 1.8 | 9.7 | 3.9 | 26.3 | 29.8 | 3.0 | 1.58 | 9.6 | 110.4 |
| 2000 | 0.8 | 21.2 | 1.7 | 9.3 | 3.7 | 26.5 | 28.5 | 3.1 | 1.52 | 9.2 | 105.6 |
| 2001 | 0.5 | 23.3 | 1.7 | 8.6 | 3.7 | 26.9 | 25.0 | 3.1 | 1.63 | 9.6 | 104.0 |
| 2002 | 0.5 | 22.4 | 1.7 | 9.1 | 3.7 | 32.8 | 23.3 | 2.7 | 1.73 | 9.3 | 107.2 |
| 2003 | 0.5 | 25.8 | 1.7 | 8.8 | 3.7 | 33.7 | 22.3 | 2.9 | 1.83 | 9.4 | 110.6 |
| 2004 | 0.5 | 25.2 | 1.9 | 9.4 | 3.7 | 39.4 | 20.3 | 2.7 | 1.94 | 9.7 | 114.8 |
| 2005 | 0.5 | 26.8 | 1.8 | 10.4 | 3.5 | 41.5 | 18.7 | 2.6 | 2.04 | 9.3 | 117.0 |
| 2006 | 0.5 | 23.8 | 1.9 | 9.8 | 3.5 | 46.2 | 16.6 | 2.6 | 2.30 | 9.5 | 116.7 |
| 2007 | 0.5 | 22.2 | 2.0 | 7.9 | 3.8 | 46.5 | 15.2 | 2.6 | 2.56 | 9.2 | 112.5 |
| 2008 | 0.5 | 21.6 | 1.7 | 7.4 | 3.4 | 47.6 | 13.8 | 2.7 | 2.74 | 8.8 | 110.2 |
| 2009 | 0.5 | 21.8 | 1.6 | 6.9 | 3.6 | 34.1 | 12.5 | 2.3 | 2.81 | 9.0 | 95.1 |
| 2010 | 0.5 | 22.6 | 1.7 | 6.8 | 3.3 | 31.7 | 10.9 | 1.9 | 2.52 | 8.6 | 90.5 |
| 2011 | 0.5 | 21.2 | 1.5 | 7.0 | 3.0 | 29.3 | 9.8 | 1.7 | 2.50 | 8.3 | 84.8 |
| 2012 | 0.4 | 20.3 | 1.6 | 6.2 | 2.7 | 27.8 | 7.6 | 1.5 | 2.21 | 8.5 | 78.7 |
| 2013 | 0.4 | 19.3 | 1.4 | 5.9 | 2.6 | 26.2 | 7.1 | 1.4 | 2.29 | 8.0 | 74.6 |
| 2014 | 0.3 | 16.1 | 1.2 | 6.5 | 2.4 | 23.8 | 6.3 | 1.4 | 2.13 | 8.0 | 68.2 |
| 2015 | 0.4 | 17.9 | 1.0 | 5.4 | 2.5 | 23.4 | 6.5 | 1.3 | 2.15 | 8.4 | 69.0 |
| 2016 | 0.4 | 16.4 | 1.0 | 6.4 | 2.5 | 25.2 | 6.3 | 1.3 | 2.08 | 8.4 | 69.9 |
| 2016 vs 1990 | -64.2% | -29.8% | -73.5% | -74.9% | -40.4% | -61.3% | -81.9% | -60.0% | 114.5% | -36.4% | -60.1% |
| 2016 vs 2015 | 1.2% | -8.3% | -7.8% | 18.9% | -0.5% | 7.7% | -3.5% | -3.0% | -3.2% | -0.2% | 1.3% |

## 3.7 PARTICLES (TSP, $PM_{10}$ AND $PM_{2.5}$) AND BLACK CARBON (BC)

"Particulate matter" (PM), is an air pollutant consisting of a mixture of particles suspended in the air. These particles differ in their physical properties (such as size and shape) and chemical composition[17]. Calculation of particulate matter emissions and its fractions ($PM_{10}$ and $PM_{2.5}$) is the obligation of the Parties to CLRTAP since 2002. The TSP and BC is the substances for which emission reporting is encouraged in the LRTAP Convention by Executive Body. The BC emission calculation is introduced in the reporting Guidelines as a component of $PM_{2.5}$.

[17] ece.eb.125, Advance version of Guidelines for Reporting Emissions and Projections Data under the Convention on Long-range Transboundary Air Pollution, TFEIP, March 2014

The TSP emission trend for source category 2.A.1 cement production is lower than $PM_{10}$, and $PM_{2.5}$ trends. The reason for that is abatement technologies installed in all four cement production facilities in Croatia. Abatement technologies are ESP on main stacks and smaller fabric filters for moderate control of fugitive sources with default efficiency of 93% for TSP emission reduction, 40% for $PM_{10}$ emission reduction and 34% for $PM_{2.5}$ emission reduction.

### 3.7.1 Total suspended particles (TSP)

Emission of TSP is voluntary reported as an additional air pollutant. In 2016, total emissions of TSP amounted to 37.5 kt. The TSP emissions have decreased by 33.2 % since 1990, and decrease by 7.3 % compared to 2015 (Figure 3.7.1-1 and Table 3.7.1-1). In 2016, about one - half (50.6 %) of TSP emission has originated from energy sector. Small sources (with domination of biomass combustion in residential sector) are large contributor to TSP emissions (38.8 %), while transport sector, combustion in manufacturing industry and construction sector, fugitive sector and public electricity and heat production have contributed with smaller extent: as follow 6.2 %, 1.3 %, 1.3 % and 3 %. Road transport has domination in TSP emissions within the transport sector, with equal participation of emissions that originate from fuel combustion and fugitive emissions from road wear and tire and brake wear. The industrial processes and solvent use sector contributes to about 38.9 % of the total emission and it is the largest source in TSP emission in Croatia. The agricultural sector is also a source of TSP in Croatia, with a contribution of 10.1 % of total national emissions in 2016. Crop production and agricultural soils contributes to 3 %, while manure management contributes to 7 % of the total emissions of TSP in 2016. Emissions from agriculture sector have decreased compared to 1990 (about 45%), due to a drop in the number of animals and reduced crop production. Combustion in industry and construction contributes to total national emissions by 1.3 % in 2016 and in the period of 1990 this sector has significantly reduced the emission of TSP by 85.3 % due to reduced consumption of solid fuels and biomass and the simultaneous increase in consumption and gaseous and liquid fuels.

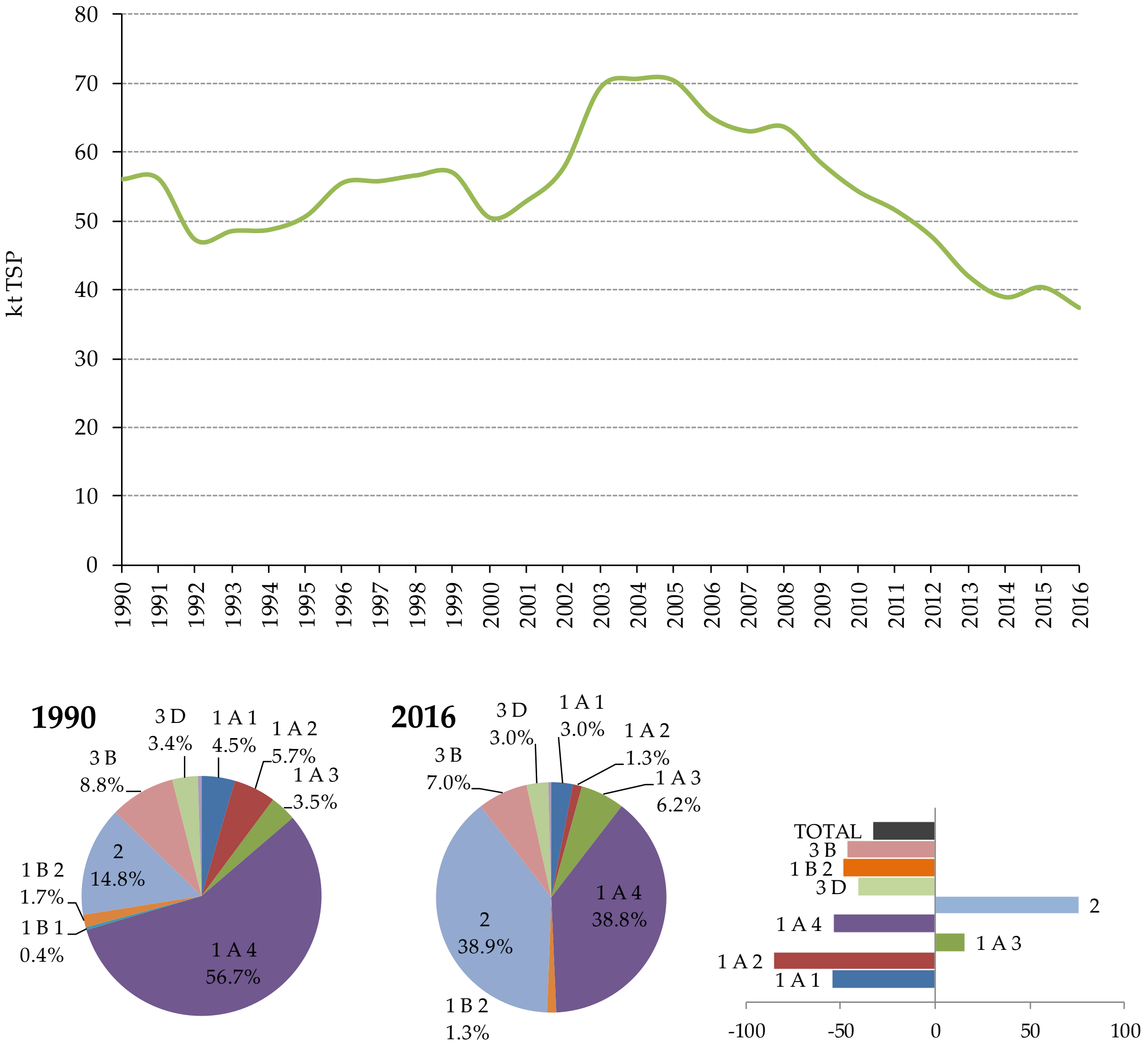



**Figure 3.7.1-1: The TSP emissions (kt/yr.) and percentage share by sector and variation in TSP emissions**

The trend of TSP emissions has several dips and peak between 1990 and 2016. Great decline in the period from 1991 to 1994 was a result of the war for Croatian independence (1991 – 1995), due to lower fuel consumption and overall reduction of production activities in almost all sectors. In 1994 began the reconstruction of areas devastated by war so the emissions from the sectors of mineral products increased, and increasing trend lasted until 1999. Second increasing trend started in 2002 mostly due to increase in road paving with asphalt, and with small influence due to increasing of quarrying and mining, construction and demolition, cement production, and inorganic chemicals production (such as carbon black, ammonium phosphate, urea and NPK fertilizers). Road paving with asphalt has recorded great increase in 2002 mainly due to the longest highway in Croatia "A1"

(Dalmatians) was started to build from Zagreb to Dubrovnik (total length 456 km). The economic crisis which most hit construction sector in Croatia has contributed to reduction of TSP emissions since 2008 (Figure 3.7.1-1). A significant reduction since 2005 is a result of gradual replacement of certain percentage of traditional domestic stoves and manual single house boilers with advanced/ecolabelled stoves and boilers and pellet stoves and boilers (see Table 4.5-1 and Figure 4.5-2).

**Table 3.7.1-1 The TSP emissions by SNAP nomenclature in the period 1990-2016**

| TSP | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1990 | 2.5 | 31.0 | 2.6 | 8.9 | 1.5E-02 | 0.5 | 1.7 | 1.7 | 3.2E-01 | 6.9 | 56.1 |
| 1991 | 1.7 | 36.1 | 1.8 | 6.5 | 1.4E-02 | 0.4 | 1.4 | 1.2 | 2.3E-01 | 6.7 | 56.1 |
| 1992 | 2.3 | 31.1 | 1.3 | 4.5 | 1.1E-02 | 0.5 | 1.5 | 0.8 | 3.7E-01 | 5.1 | 47.3 |
| 1993 | 2.5 | 32.9 | 1.2 | 4.0 | 1.0E-02 | 0.4 | 1.6 | 0.6 | 2.3E-01 | 5.1 | 48.6 |
| 1994 | 2.1 | 29.7 | 1.1 | 7.7 | 9.2E-03 | 0.3 | 1.7 | 0.8 | 2.7E-01 | 5.1 | 48.8 |
| 1995 | 1.9 | 31.4 | 1.1 | 8.0 | 7.3E-03 | 0.5 | 1.9 | 0.7 | 3.1E-01 | 4.8 | 50.7 |
| 1996 | 1.8 | 35.2 | 1.0 | 9.3 | 5.9E-03 | 0.6 | 2.0 | 0.8 | 3.1E-01 | 4.6 | 55.6 |
| 1997 | 2.7 | 32.4 | 1.1 | 11.1 | 4.3E-03 | 0.6 | 2.2 | 0.8 | 3.0E-01 | 4.6 | 55.8 |
| 1998 | 3.4 | 32.6 | 1.0 | 11.1 | 4.5E-03 | 0.6 | 2.3 | 0.9 | 3.1E-01 | 4.5 | 56.7 |
| 1999 | 3.1 | 32.1 | 0.8 | 12.0 | 1.4E-03 | 0.6 | 2.4 | 0.8 | 3.2E-01 | 4.8 | 57.0 |
| 2000 | 1.2 | 28.6 | 0.8 | 11.4 | NA | 0.5 | 2.4 | 0.9 | 3.2E-01 | 4.4 | 50.6 |
| 2001 | 1.7 | 31.4 | 0.8 | 10.2 | NA | 0.7 | 2.5 | 1.0 | 3.1E-01 | 4.5 | 53.0 |
| 2002 | 1.4 | 30.2 | 0.8 | 15.6 | NA | 1.6 | 2.6 | 0.9 | 2.9E-01 | 4.5 | 57.8 |
| 2003 | 1.5 | 34.8 | 0.7 | 21.9 | NA | 1.9 | 2.8 | 0.9 | 3.3E-01 | 4.5 | 69.4 |
| 2004 | 0.8 | 33.9 | 0.8 | 25.3 | NA | 1.2 | 2.9 | 0.8 | 2.8E-01 | 4.6 | 70.6 |
| 2005 | 1.1 | 36.0 | 0.7 | 23.2 | NA | 0.8 | 3.0 | 0.8 | 2.9E-01 | 4.3 | 70.3 |
| 2006 | 1.0 | 31.4 | 0.7 | 22.4 | NA | 0.8 | 3.2 | 0.8 | 3.0E-01 | 4.5 | 65.1 |
| 2007 | 1.7 | 28.6 | 0.8 | 22.8 | NA | 0.7 | 3.1 | 0.8 | 2.9E-01 | 4.4 | 63.1 |
| 2008 | 0.9 | 27.1 | 0.6 | 26.3 | NA | 0.6 | 2.9 | 0.9 | 2.8E-01 | 4.1 | 63.6 |
| 2009 | 1.5 | 26.5 | 0.6 | 21.9 | NA | 0.4 | 2.2 | 0.8 | 2.6E-01 | 4.3 | 58.4 |
| 2010 | 0.9 | 26.7 | 0.7 | 18.1 | NA | 0.5 | 2.5 | 0.6 | 2.3E-01 | 4.0 | 54.3 |
| 2011 | 0.8 | 24.2 | 0.6 | 18.6 | NA | 0.4 | 2.3 | 0.6 | 2.6E-01 | 3.8 | 51.6 |
| 2012 | 0.8 | 22.3 | 0.6 | 16.9 | NA | 0.3 | 2.1 | 0.5 | 2.4E-01 | 3.9 | 47.7 |
| 2013 | 0.5 | 20.3 | 0.6 | 13.7 | NA | 0.5 | 2.0 | 0.5 | 2.2E-01 | 3.7 | 42.0 |
| 2014 | 0.6 | 16.1 | 0.4 | 15.2 | NA | 0.4 | 2.0 | 0.5 | 1.7E-01 | 3.6 | 39.0 |
| 2015 | 0.9 | 16.9 | 0.5 | 15.4 | NA | 0.4 | 2.1 | 0.5 | 1.7E-01 | 3.7 | 40.5 |
| 2016 | 1.1 | 14.4 | 0.4 | 14.6 | NA | 0.4 | 2.1 | 0.4 | 1.8E-01 | 3.8 | 37.5 |
| 2016 vs 1990 | -54.7% | -53.3% | -85.1% | 65.4% | NA | -23.2% | 21.8% | -75.3% | -45.0% | -44.9% | -33.2% |
| 2016 vs 2015 | 29.6% | -14.3% | -18.2% | -4.7% | NA | 6.8% | -2.6% | -4.9% | 1.0% | 1.2% | -7.3% |

### 3.7.2 Particulate matter ($PM_{10}$)

Total $PM_{10}$ emission in 2016 has amounted to 25.6 kt. The emissions have decreased by 45.9 % since 1990 and by 8.4 % compared to 2015 (Figure 3.7.2-1). The energy sector is the largest source of $PM_{10}$ emission and accounts for about 68.7 % of the national total in 2016 (Table 3.7.2-1). Small combustion and mainly biomass combustion in residential sector are key sources of $PM_{10}$ emission and account with 54.2 % to total emission in 2016. Transport sector which contributed with smaller extent (8.1 % in 2016) has recorded an increase by 13.9 % since 1990. Road transport has domination in $PM_{10}$ emissions within the transport sector, with equal participation of emissions that originate from fuel combustion and fugitive emissions from road wear and tire and brake wear. The industrial processes and solvent use sector is the second largest source in $PM_{10}$ emissions (19.1 % in national $PM_{10}$ total emission). This sector is recorded a great increase (by 23.3 %) since 1990. The agriculture is also source of $PM_{10}$ emissions in Croatia, with 11.6 % of contribution to national total in 2016. The manure management has contributed with 7.1 % to total $PM_{10}$ emission in 2016, and the crop production and agricultural soils with 4.5 %. Emissions from agriculture sector have decrease since 1990 (for about 50 %), due to decline in number of animals and decline in crop production. Combustion in Industry and construction contributes to total national emissions by 1.7 % in 2016 and in the period since 1990 this sector has significantly reduced $PM_{10}$ emission by 86.2 %, due to reduced consumption of solid fuels and biomass and the simultaneous increase in consumption of gaseous and liquid fuels.

The trend of $PM_{10}$ emissions has several dips and peak between 1990 and 2016. Great decline in the period from 1991 to 1994 was a result of the war for Croatian independence (1991 – 1995), due to lower fuel consumption and overall reduction of production activities in almost all sectors. In 1994 began the reconstruction of areas devastated by war so the emissions from the sectors of mineral products increased, and increasing trend lasted until 1999. Second increasing trend started in 2002 mostly due to increase in road paving with asphalt, and with small influence due to increasing of quarrying and mining, construction and demolition, cement production, and inorganic chemicals production (such as carbon black, ammonium phosphate, urea and NPK fertilizers). Road paving with asphalt has recorded great increase in 2002 mainly due to the longest highway in Croatia "A1" (Dalmatians) was started to build from Zagreb to Dubrovnik (total length 456 km). The economic crisis which most hit construction sector in Croatia has contributed to reduction of $PM_{10}$ emissions since 2008 (Table 3.7.2-1). A significant reduction since 2005 is a result of gradual replacement of certain percentage of traditional domestic stoves and manual single house boilers with advanced/ecolabelled stoves and boilers and pellet stoves and boilers (see Table 4.5-1 and Figure 4.5-2).

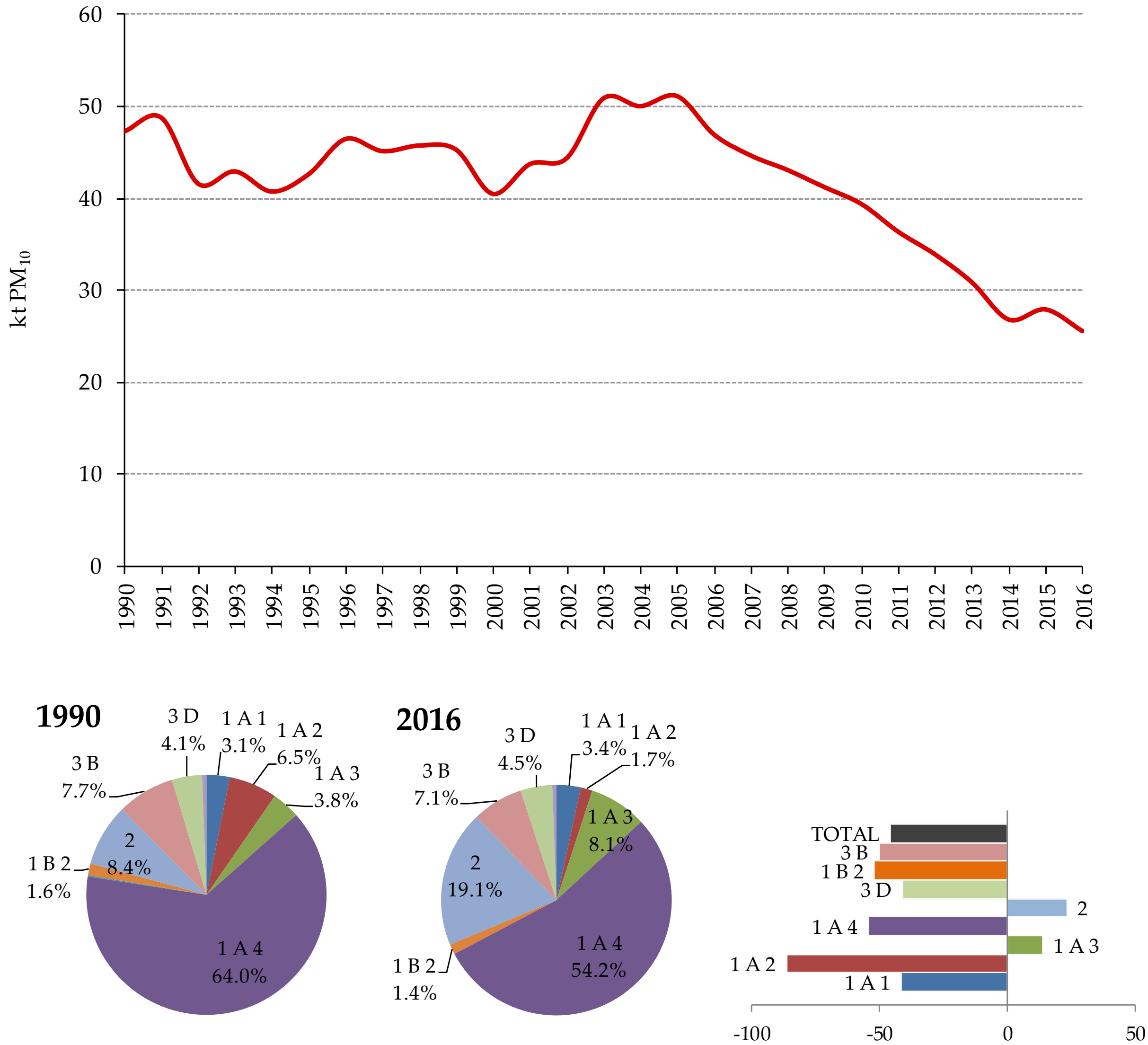



**Figure 3.7.2-1 The $PM_{10}$ emissions (kt/yr.) and percentage share by sector and variation in $PM_{10}$ emissions**

**Table 3.7.2-1 The $PM_{10}$ emissions by SNAP nomenclature in the period 1990-2016**

| PM10 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1990 | 1.5 | 29.4 | 2.5 | 4.3 | 7.3E-03 | 0.5 | 1.5 | 1.7 | 0.32 | 5.6 | 47.3 |
| 1991 | 1.0 | 34.4 | 1.8 | 3.1 | 6.5E-03 | 0.4 | 1.3 | 1.2 | 0.23 | 5.4 | 48.8 |
| 1992 | 1.3 | 29.7 | 1.2 | 2.4 | 5.1E-03 | 0.5 | 1.3 | 0.8 | 0.37 | 4.1 | 41.6 |
| 1993 | 1.4 | 31.3 | 1.1 | 2.3 | 4.8E-03 | 0.4 | 1.5 | 0.6 | 0.22 | 4.1 | 43.0 |
| 1994 | 1.3 | 28.3 | 1.0 | 3.2 | 4.3E-03 | 0.3 | 1.5 | 0.8 | 0.27 | 4.1 | 40.8 |
| 1995 | 1.2 | 29.9 | 1.0 | 3.3 | 3.5E-03 | 0.5 | 1.7 | 0.7 | 0.31 | 3.9 | 42.7 |
| 1996 | 1.1 | 33.6 | 1.0 | 3.6 | 2.8E-03 | 0.5 | 1.8 | 0.8 | 0.31 | 3.6 | 46.5 |
| 1997 | 2.0 | 30.9 | 1.0 | 3.9 | 2.0E-03 | 0.6 | 2.1 | 0.8 | 0.30 | 3.7 | 45.2 |
| 1998 | 2.3 | 31.0 | 1.0 | 4.0 | 2.1E-03 | 0.6 | 2.1 | 0.9 | 0.31 | 3.6 | 45.8 |
| 1999 | 1.8 | 30.6 | 0.8 | 4.4 | 6.4E-04 | 0.6 | 2.2 | 0.8 | 0.32 | 3.9 | 45.3 |
| 2000 | 0.8 | 27.2 | 0.8 | 4.4 | NA | 0.5 | 2.2 | 0.9 | 0.32 | 3.5 | 40.6 |
| 2001 | 1.1 | 30.0 | 0.7 | 4.2 | NA | 0.7 | 2.3 | 1.0 | 0.30 | 3.6 | 43.7 |
| 2002 | 0.9 | 28.7 | 0.7 | 5.5 | NA | 1.5 | 2.4 | 0.9 | 0.29 | 3.5 | 44.4 |
| 2003 | 0.9 | 33.1 | 0.7 | 7.0 | NA | 1.8 | 2.6 | 0.9 | 0.33 | 3.5 | 50.9 |
| 2004 | 0.6 | 32.3 | 0.8 | 7.9 | NA | 1.1 | 2.7 | 0.8 | 0.28 | 3.6 | 50.0 |
| 2005 | 0.6 | 34.3 | 0.6 | 7.5 | NA | 0.8 | 2.8 | 0.8 | 0.29 | 3.4 | 51.1 |
| 2006 | 0.6 | 29.9 | 0.7 | 7.4 | NA | 0.7 | 3.0 | 0.8 | 0.29 | 3.5 | 47.0 |
| 2007 | 1.0 | 27.2 | 0.7 | 7.7 | NA | 0.6 | 2.9 | 0.8 | 0.29 | 3.5 | 44.7 |
| 2008 | 0.6 | 25.8 | 0.5 | 8.4 | NA | 0.6 | 2.7 | 0.9 | 0.28 | 3.3 | 43.1 |
| 2009 | 0.8 | 25.3 | 0.6 | 7.2 | NA | 0.4 | 2.5 | 0.7 | 0.26 | 3.4 | 41.2 |
| 2010 | 0.5 | 25.4 | 0.7 | 6.0 | NA | 0.5 | 2.3 | 0.6 | 0.23 | 3.2 | 39.4 |
| 2011 | 0.5 | 23.0 | 0.5 | 5.9 | NA | 0.4 | 2.1 | 0.6 | 0.26 | 3.0 | 36.4 |
| 2012 | 0.5 | 21.2 | 0.6 | 5.5 | NA | 0.3 | 1.9 | 0.5 | 0.24 | 3.1 | 33.9 |
| 2013 | 0.4 | 19.3 | 0.6 | 4.7 | NA | 0.4 | 1.8 | 0.5 | 0.22 | 2.9 | 30.9 |
| 2014 | 0.4 | 15.3 | 0.4 | 5.0 | NA | 0.4 | 1.8 | 0.5 | 0.16 | 2.8 | 26.9 |
| 2015 | 0.6 | 16.1 | 0.4 | 5.0 | NA | 0.4 | 1.9 | 0.4 | 0.17 | 2.9 | 28.0 |
| 2016 | 0.9 | 13.7 | 0.3 | 4.8 | NA | 0.4 | 1.8 | 0.4 | 0.17 | 3.0 | 25.6 |
| 2016 vs 1990 | -41.4% | -53.2% | -86.2% | 13.9% | NA | -22.9% | 19.8% | -75.4% | -44.9% | -46.9% | -45.9% |
| 2016 vs 2015 | 37.1% | -14.3% | -17.7% | -3.8% | NA | 6.7% | -3.4% | -4.9% | 1.0% | 1.6% | -8.4% |

### 3.7.3 Particulate matter ($PM_{2.5}$)

Total $PM_{2.5}$ emission in 2016 has amounted to 18.4 kt. The emissions have decreased by 51.5 % since 1990 and by 10.9 % compared to 2015 (Figure 3.7.3-1). The energy sector is the largest source of $PM_{2.5}$ emission and accounts for about 89.4 % of the national total in 2016 (Table 3.7.3-1).

Small combustion and mainly biomass combustion in residential sector are key sources of $PM_{2.5}$ emission and account with 73.6 % to total emission in 2016. This sector has also recorded a decrease of 14.3 % comparing to 2015. Transport sector have contributed with smaller extent with 8.1 % and has recorded an increase by 13.9 % since 1990. Road transport has domination in $PM_{2.5}$ emissions within the transport sector, with equal participation of emissions that originate from fuel combustion and fugitive emissions from road wear and tire and brake wear. The industrial processes and solvent use sector is also large source in $PM_{2.5}$ emissions (7.5 % in 2016), which has recorded a decrease by 7.4% since 1990. Agriculture is also a source of $PM_{2.5}$ emissions in Croatia, with a share of 2.3% in the national share in 2016. Manure management contributes with 2.1% of total $PM_{2.5}$ emissions in 2016, while crop and agricultural production with 0.2%. Combustion in industry and construction contributes to total national emissions with 2.1 % in 2016 and in the period of 1990 this sector has significantly reduced the emission of $PM_{2.5}$ (up to 86.7 %) due to reduced consumption of solid fuels and biomass and the simultaneous increase in consumption and gaseous and liquid fuels.

The trend of $PM_{2.5}$ emissions has several dips and peak between 1990 and 2016. Great decline in the period from 1991 to 1994 was a result of the war for Croatian independence (1991 – 1995), due to lower fuel consumption and overall reduction of production activities in almost all sectors. In 1994 began the reconstruction of areas devastated by war so the emissions from the sectors of mineral products increased, and increasing trend lasted until 1999. Second increasing trend started in 2002 mostly due to increase in road paving with asphalt, and with small influence due to increasing of quarrying and mining, construction and demolition, cement production, and inorganic chemicals production (such as carbon black, ammonium phosphate, urea and NPK fertilizers). Road paving with asphalt has recorded great increase in 2002 mainly due to the longest highway in Croatia "A1" (Dalmatians) was started to build from Zagreb to Dubrovnik (total length 456 km). The economic crisis which most hit construction sector in Croatia has contributed to reduction of $PM_{2.5}$ emissions since 2008 (Table 3.7.3-1). A significant reduction since 2005 is a result of gradual replacement of certain percentage of traditional domestic stoves and manual single house boilers with advanced/ecolabelled stoves and boilers and pellet stoves and boilers (see Table 4.5-1 and Figure 4.5-2).

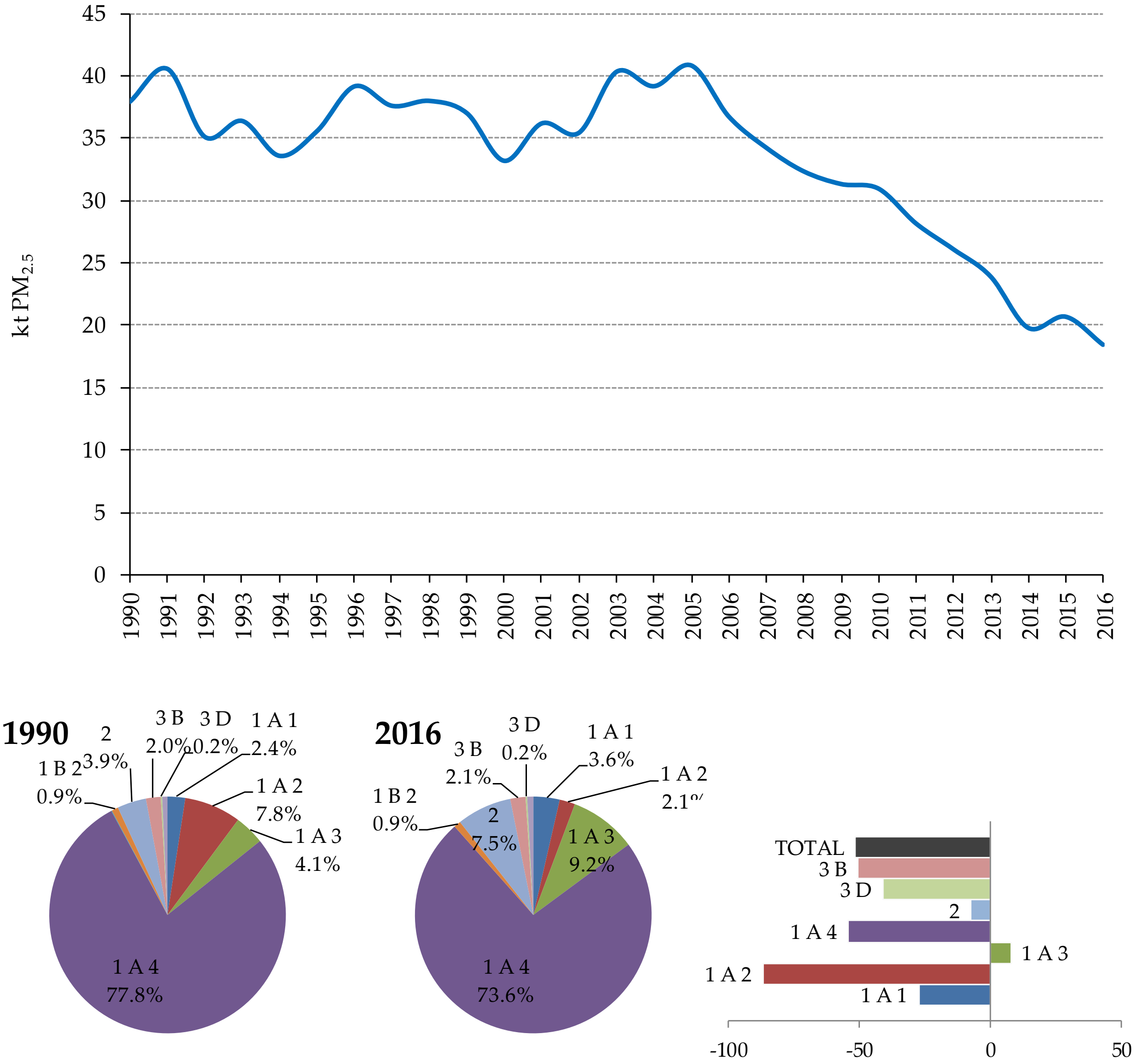



**Figure 3.7.3-1 The $PM_{2.5}$ emissions (kt/yr.) and percentage share by sector and variation in $PM_{2.5}$ emissions**

**Table 3.7.3-1 The $PM_{2.5}$ emissions by SNAP nomenclature in the period 1990-2016**

| $PM_{2.5}$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1990 | 0.9 | 28.7 | 2.4 | 1.4 | 8.7E-04 | 0.4 | 1.3 | 1.7 | 0.32 | 0.8 | 37.9 |
| 1991 | 0.7 | 33.5 | 1.7 | 1.1 | 7.7E-04 | 0.4 | 1.1 | 1.2 | 0.23 | 0.8 | 40.6 |
| 1992 | 0.8 | 28.9 | 1.2 | 0.8 | 6.0E-04 | 0.4 | 1.2 | 0.8 | 0.37 | 0.7 | 35.1 |
| 1993 | 0.9 | 30.6 | 1.1 | 0.8 | 5.8E-04 | 0.4 | 1.3 | 0.6 | 0.22 | 0.7 | 36.4 |
| 1994 | 0.8 | 27.6 | 1.0 | 1.0 | 5.2E-04 | 0.2 | 1.3 | 0.8 | 0.27 | 0.6 | 33.6 |
| 1995 | 0.9 | 29.2 | 1.0 | 0.9 | 4.1E-04 | 0.4 | 1.5 | 0.7 | 0.31 | 0.6 | 35.6 |
| 1996 | 0.7 | 32.7 | 1.0 | 1.0 | 3.3E-04 | 0.4 | 1.6 | 0.8 | 0.31 | 0.6 | 39.2 |
| 1997 | 1.6 | 30.1 | 1.0 | 1.0 | 2.4E-04 | 0.5 | 1.8 | 0.8 | 0.30 | 0.6 | 37.6 |
| 1998 | 1.7 | 30.3 | 1.0 | 1.0 | 2.5E-04 | 0.5 | 1.9 | 0.9 | 0.31 | 0.5 | 38.0 |

| **$PM_{2.5}$** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1999 | 1.1 | 29.8 | 0.7 | 1.2 | 7.7E-05 | 0.5 | 1.9 | 0.8 | 0.32 | 0.6 | 37.1 |
| 2000 | 0.5 | 26.5 | 0.8 | 1.3 | NA | 0.4 | 1.9 | 0.9 | 0.32 | 0.5 | 33.3 |
| 2001 | 0.7 | 29.2 | 0.7 | 1.2 | NA | 0.6 | 2.0 | 1.0 | 0.30 | 0.5 | 36.2 |
| 2002 | 0.6 | 28.0 | 0.7 | 1.3 | NA | 1.0 | 2.1 | 0.9 | 0.29 | 0.5 | 35.4 |
| 2003 | 0.6 | 32.3 | 0.7 | 1.6 | NA | 1.2 | 2.3 | 0.9 | 0.33 | 0.5 | 40.3 |
| 2004 | 0.4 | 31.5 | 0.8 | 1.8 | NA | 0.8 | 2.4 | 0.8 | 0.28 | 0.6 | 39.2 |
| 2005 | 0.4 | 33.5 | 0.6 | 1.7 | NA | 0.6 | 2.5 | 0.8 | 0.29 | 0.5 | 40.8 |
| 2006 | 0.4 | 29.2 | 0.7 | 1.7 | NA | 0.6 | 2.6 | 0.8 | 0.29 | 0.5 | 36.8 |
| 2007 | 0.6 | 26.6 | 0.7 | 1.8 | NA | 0.5 | 2.5 | 0.8 | 0.29 | 0.5 | 34.2 |
| 2008 | 0.5 | 25.1 | 0.5 | 1.8 | NA | 0.5 | 2.3 | 0.9 | 0.28 | 0.5 | 32.3 |
| 2009 | 0.4 | 24.6 | 0.6 | 1.6 | NA | 0.4 | 2.1 | 0.7 | 0.26 | 0.5 | 31.3 |
| 2010 | 0.3 | 24.8 | 0.7 | 1.5 | NA | 0.4 | 2.0 | 0.6 | 0.23 | 0.5 | 31.0 |
| 2011 | 0.3 | 22.5 | 0.5 | 1.4 | NA | 0.4 | 1.7 | 0.6 | 0.26 | 0.4 | 28.2 |
| 2012 | 0.3 | 20.7 | 0.6 | 1.4 | NA | 0.3 | 1.6 | 0.5 | 0.24 | 0.4 | 26.1 |
| 2013 | 0.3 | 18.9 | 0.5 | 1.2 | NA | 0.4 | 1.5 | 0.5 | 0.22 | 0.4 | 23.9 |
| 2014 | 0.3 | 15.0 | 0.4 | 1.3 | NA | 0.3 | 1.4 | 0.5 | 0.16 | 0.4 | 19.8 |
| 2015 | 0.5 | 15.7 | 0.4 | 1.3 | NA | 0.3 | 1.5 | 0.4 | 0.17 | 0.4 | 20.7 |
| 2016 | 0.7 | 13.4 | 0.3 | 1.2 | NA | 0.3 | 1.5 | 0.4 | 0.17 | 0.4 | 18.4 |
| 2016 vs 1990 | -27.4% | -53.2% | -86.9% | -13.2% | NA | -27.7% | 13.1% | -75.3% | -45.0% | -49.6% | -51.5% |
| 2016 vs 2015 | 44.0% | -14.3% | -17.8% | -4.0% | NA | 4.1% | -5.1% | -5.0% | 1.0% | 0.6% | -10.9% |

### 3.7.4 Black carbon (BC)

The BC emission in 2016 has amounted to 2.96 kt (Figure 3.7.4-1) and has recorded a decrease by 45.7 % since 1990, and an increase by 1.3 % in comparison to 2015. The energy sector is the largest contributor of BC emissions and accounts for 95.6 % of the estimated BC emissions. The rest of the emissions (4.4 %) come from the industrial processes and product use sector. The major contributor to BC emission are small combustion sector (66.8 % of total national emissions in 2015) with domination of residential.

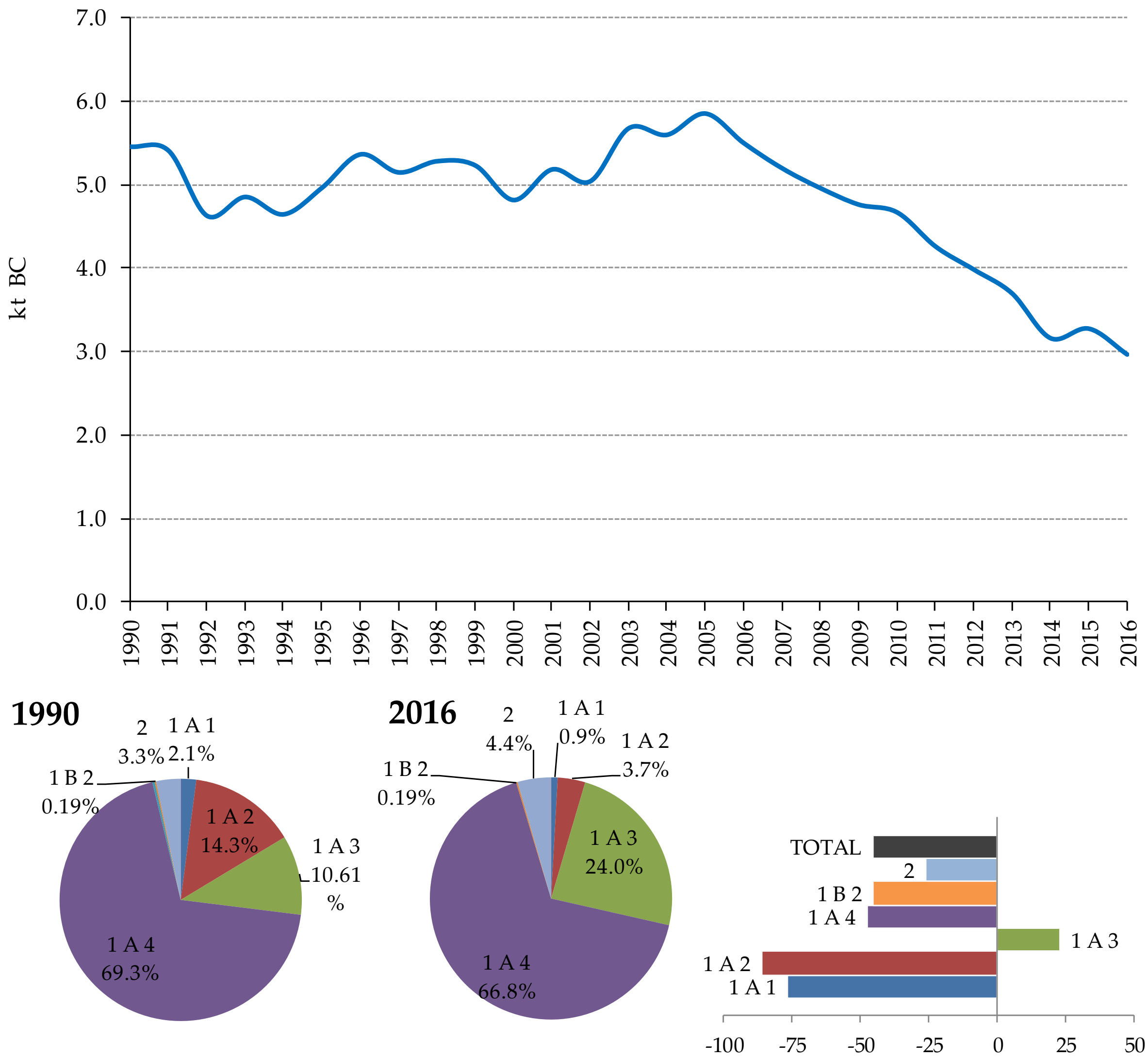



**Figure 3.7.4-1 The BC emissions (kt/yr.) and percentage share by sector and variation in BC emissions**

Trend of BC emissions follows the trend of $PM_{2.5}$ emissions so the reasons for present peaks and dips are the same. Great decline in the period from 1991 to 1994 was a result of the war for Croatian independence (1991 – 1995), due to lower fuel consumption and overall reduction of production activities in almost all sectors. In 1994 began the reconstruction of areas devastated by war so the emissions from the sectors of mineral products increased, and increasing trend lasted until 1999. Second increasing trend started in 2002 mostly due to increase in road paving with asphalt, and with small influence due to increasing of quarrying and mining, construction and demolition, cement production, and inorganic chemicals production (such as carbon black, ammonium phosphate, urea and NPK fertilizers). Road paving with asphalt has recorded great increase in 2002 mainly due to the longest highway in Croatia "A1" (Dalmatians) was started to build from Zagreb to Dubrovnik (total length 456 km). The economic crisis has contributed to reduction of BC emissions since 2007 (Figure 3.7.4-1). The economic crisis which most hit construction sector in Croatia has contributed to reduction of BC emissions since 2008. A significant reduction since 2005 is a result of gradual replacement of certain percentage of traditional domestic stoves and manual single house boilers with advanced/ecolabelled stoves and boilers and pellet stoves and boilers (see Table 4.5-1 and Figure 4.5-2).

**Table 3.7.4-1 The BC emissions by SNAP nomenclature in the period 1990-2016**

| BC | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| 1990 | 0.11 | 3.31 | 0.45 | 0.049 | NA | 0.15 | 575 | 0.81 | 1.0E-02 | NA | 5.46 |
| 1991 | 0.10 | 3.80 | 0.34 | 0.038 | NA | 0.14 | 468 | 0.52 | 9.1E-03 | NA | 5.41 |
| 1992 | 0.11 | 3.32 | 0.26 | 0.030 | NA | 0.15 | 523 | 0.23 | 6.5E-03 | NA | 4.64 |
| 1993 | 0.11 | 3.51 | 0.27 | 0.026 | NA | 0.14 | 613 | 0.19 | 8.3E-03 | NA | 4.86 |
| 1994 | 0.17 | 3.16 | 0.23 | 0.029 | NA | 0.06 | 624 | 0.36 | 6.8E-03 | NA | 4.65 |
| 1995 | 0.20 | 3.34 | 0.25 | 0.019 | NA | 0.14 | 728 | 0.29 | 5.6E-03 | NA | 4.97 |
| 1996 | 0.16 | 3.75 | 0.25 | 0.021 | NA | 0.14 | 753 | 0.29 | 5.2E-03 | NA | 5.37 |
| 1997 | 0.14 | 3.45 | 0.25 | 0.026 | NA | 0.14 | 857 | 0.29 | 6.2E-03 | NA | 5.15 |
| 1998 | 0.17 | 3.43 | 0.27 | 0.025 | NA | 0.15 | 883 | 0.36 | 5.7E-03 | NA | 5.29 |
| 1999 | 0.17 | 3.40 | 0.20 | 0.029 | NA | 0.17 | 916 | 0.35 | 6.9E-03 | NA | 5.24 |
| 2000 | 0.074 | 3.02 | 0.19 | 0.028 | NA | 0.16 | 925 | 0.42 | 6.0E-03 | NA | 4.82 |
| 2001 | 0.051 | 3.30 | 0.18 | 0.025 | NA | 0.21 | 983 | 0.42 | 7.3E-03 | NA | 5.19 |
| 2002 | 0.045 | 3.16 | 0.18 | 0.033 | NA | 0.22 | 575 | 0.36 | 7.7E-03 | NA | 4.60 |
| 2003 | 0.049 | 3.64 | 0.18 | 0.043 | NA | 0.23 | 1159 | 0.38 | 7.9E-03 | NA | 5.68 |
| 2004 | 0.041 | 3.54 | 0.20 | 0.050 | NA | 0.17 | 1232 | 0.35 | 8.0E-03 | NA | 5.60 |
| 2005 | 0.040 | 3.74 | 0.18 | 0.047 | NA | 0.18 | 1309 | 0.36 | 8.3E-03 | NA | 5.86 |
| 2006 | 0.036 | 3.29 | 0.19 | 0.045 | NA | 0.18 | 1402 | 0.36 | 9.8E-03 | NA | 5.50 |
| 2007 | 0.039 | 3.04 | 0.19 | 0.046 | NA | 0.18 | 1352 | 0.34 | 1.0E-02 | NA | 5.20 |
| 2008 | 0.028 | 2.91 | 0.16 | 0.050 | NA | 0.19 | 1241 | 0.38 | 9.9E-03 | NA | 4.96 |
| 2009 | 0.032 | 2.90 | 0.18 | 0.042 | NA | 0.14 | 1167 | 0.31 | 8.8E-03 | NA | 4.76 |
| 2010 | 0.024 | 2.96 | 0.15 | 0.038 | NA | 0.16 | 1067 | 0.27 | 5.5E-03 | NA | 4.67 |
| 2011 | 0.027 | 2.73 | 0.13 | 0.038 | NA | 0.14 | 939 | 0.25 | 6.8E-03 | NA | 4.26 |
| 2012 | 0.022 | 2.57 | 0.13 | 0.035 | NA | 0.14 | 868 | 0.21 | 5.1E-03 | NA | 3.98 |
| 2013 | 0.015 | 2.40 | 0.12 | 0.032 | NA | 0.12 | 821 | 0.19 | 5.0E-03 | NA | 3.70 |
| 2014 | 0.015 | 1.96 | 0.09 | 0.035 | NA | 0.10 | 780 | 0.17 | 6.9E-03 | NA | 3.16 |
| 2015 | 0.020 | 2.13 | 0.07 | 0.034 | NA | 0.10 | 767 | 0.15 | 5.6E-03 | NA | 3.27 |
| 2016 | 0.027 | 1.91 | 0.05 | 0.033 | NA | 0.10 | 708 | 0.13 | 5.6E-03 | NA | 2.96 |
| 2016 vs 1990 | -76.6% | -42.4% | -88.5% | -32.5% | NA | -32.5% | 23.2% | -83.5% | -45.0% | NA | -45.7% |
| 2016 vs 2015 | 29.6% | -10.5% | -24.8% | -3.3% | NA | 0.1% | -7.6% | -11.1% | 0.0% | NA | -9.5% |

## 3.8 PRIORITY HEAVY METAL EMISSIONS (Pb, Cd AND Hg)

Heavy metals emissions from anthropogenic sources became of importance to UNECE/LRTAP Convention, after various studies showed that heavy metals attached to air-borne particles can be widely dispersed on very large scales. They are stable and cannot be degraded or destroyed, and therefore they tend to accumulate in soils and sediments. Because of their toxicity and other mentioned properties, heavy metals are also hazardous for living organisms. Recognized danger from heavy metals accelerated UN decision to include the Protocol on heavy metals in the framework of the LRTAP Convention. The Republic of Croatia has signed this Protocol in June 1999 at the meeting of the ministers of environmental protection in Aarhus and ratified it by Low on ratification of the Protocol to the 1979 Convention on long-range transboundary air pollution on Heavy Metals (OG-IT 05/07) in 2007.

Emissions of priority metals are mainly a result of fuel combustion. The emission depends on the type and quantity of combusted fuel, so Cd emission will be greater if in the observed year more fuel oil was used, while the Hg emission increases with higher consumption of natural gas.

### 3.8.1 Lead (Pb)

The lead emission (Figure 3.8.1-1 and Table 3.8.1-1) in 2016 has amounted to 7.96 t. The Pb emission has decrease by 98.5 % since 1990 and has stay at the same level comparing to 2015. Key sources in Pb emission in 2016, were transport sector (53.4 %) with the dominance of road transport, small combustion sector (16.6 %) with the domination of residential sector and the industrial processes and product use sector (19.3 %) with the domination of glass production and production of steel in electric arc furnaces. Pb emissions from these activities originates from the lead content in the raw material of production process respectively in the fuel.

The trend of lead emissions has recorded several dips. The majority of Pb emission in the nineties has come from road transport sector, from leaded motor gasoline usage. Between 1990 and 2016, Pb emissions from the transport sector have significantly decreased by 99.1% as a result of legislative efforts to remove lead from gasoline. Efforts began in 1996 when the Pb content in leaded gasoline was reduced from 0.6 g/l to 0.74 g/l, while unleaded with 0.02 g/l to 0.013 g/l, then in 2003 Pb content in leaded gasoline was reduced to 0.15 g/l, and in unleaded one at 0.005 g/l and, in 2006, leaded gasoline was completely thrown out of use. Reduction in 1992 has occurred due to stopping the process of steel production in the Siemens-Martin furnaces. Stopping the process was a result of the war for Croatian independence (1991 - 1995). Also, the war for Croatian independence caused a reduction in fuel consumption and reduction in overall production in the industrial processes and product use sector (Figure 3.8.1-1).

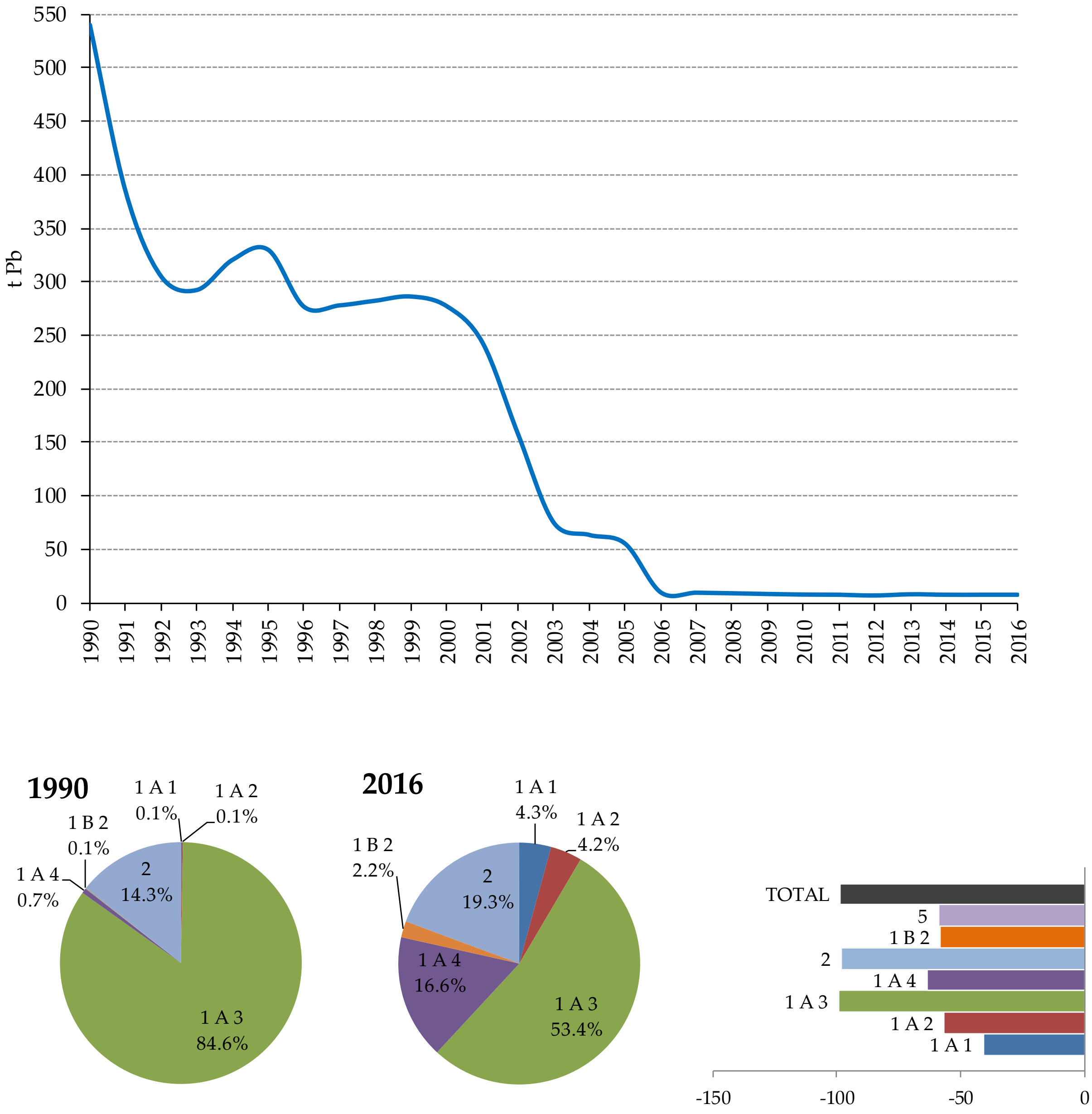



**Figure 3.8.1-1 The Pb emissions (t/yr.) and percentage share by sector and variation in Pb emissions**

**Table 3.8.1-1 The Pb emissions by SNAP nomenclature in the period 1990-2016**

| **Pb** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1990 | 0.57 | 1.91 | 0.64 | 77.48 | NA | 0.56 | 456.1 | 2.21 | 1.3E-02 | NA | 539.5 |
| 1991 | 0.48 | 1.75 | 0.43 | 29.45 | NA | 0.56 | 344.8 | 6.86 | 1.2E-02 | NA | 384.3 |
| 1992 | 0.61 | 1.30 | 0.35 | 0.89 | NA | 0.56 | 298.0 | 3.08 | 1.2E-02 | NA | 304.8 |
| 1993 | 0.48 | 1.41 | 0.30 | 0.88 | NA | 0.56 | 282.6 | 5.99 | 1.2E-02 | NA | 292.2 |
| 1994 | 0.36 | 1.21 | 0.32 | 0.82 | NA | 0.56 | 311.3 | 5.83 | 1.2E-02 | NA | 320.4 |
| 1995 | 0.38 | 1.27 | 0.29 | 0.69 | NA | 0.95 | 320.5 | 5.61 | 1.3E-02 | NA | 329.8 |
| 1996 | 0.42 | 1.41 | 0.28 | 0.61 | NA | 1.40 | 267.7 | 4.80 | 1.3E-02 | NA | 276.7 |
| 1997 | 0.52 | 1.30 | 0.32 | 0.63 | NA | 1.38 | 270.0 | 3.69 | 1.4E-02 | NA | 277.9 |
| 1998 | 0.64 | 1.34 | 0.33 | 0.82 | NA | 0.94 | 275.2 | 2.95 | 1.5E-02 | NA | 282.3 |
| 1999 | 0.67 | 1.30 | 0.35 | 0.77 | NA | 0.76 | 278.6 | 3.75 | 1.6E-02 | NA | 286.2 |
| 2000 | 0.44 | 1.16 | 0.41 | 0.87 | NA | 0.55 | 271.2 | 2.67 | 1.7E-02 | NA | 277.3 |
| 2001 | 0.51 | 1.23 | 0.43 | 0.80 | NA | 1.30 | 237.2 | 1.97 | 1.8E-02 | NA | 243.5 |
| 2002 | 0.56 | 1.20 | 0.41 | 0.76 | NA | 6.50 | 147.7 | 0.92 | 1.6E-02 | NA | 158.0 |
| 2003 | 0.72 | 1.39 | 0.42 | 0.83 | NA | 9.01 | 62.3 | 0.65 | 1.4E-02 | NA | 75.3 |
| 2004 | 0.49 | 1.32 | 0.46 | 1.02 | NA | 4.86 | 55.1 | 0.52 | 1.4E-02 | NA | 63.8 |
| 2005 | 0.56 | 1.41 | 0.47 | 1.03 | NA | 2.17 | 49.5 | 0.41 | 1.4E-02 | NA | 55.6 |
| 2006 | 0.54 | 1.29 | 0.54 | 0.97 | NA | 1.64 | 4.8 | 0.36 | 1.5E-02 | NA | 10.2 |
| 2007 | 0.58 | 1.22 | 0.45 | 1.04 | NA | 1.15 | 5.0 | 0.37 | 1.6E-02 | NA | 9.8 |
| 2008 | 0.54 | 1.23 | 0.40 | 1.12 | NA | 0.80 | 4.8 | 0.34 | 1.3E-02 | NA | 9.3 |
| 2009 | 0.51 | 1.28 | 0.38 | 0.95 | NA | 0.36 | 4.9 | 0.34 | 1.5E-02 | NA | 8.7 |
| 2010 | 0.35 | 1.39 | 0.40 | 1.00 | NA | 0.14 | 4.6 | 0.22 | 5.4E-03 | NA | 8.1 |
| 2011 | 0.39 | 1.35 | 0.34 | 0.94 | NA | 0.12 | 4.6 | 0.22 | 6.0E-03 | NA | 7.9 |
| 2012 | 0.34 | 1.34 | 0.35 | 0.70 | NA | 0.01 | 4.3 | 0.19 | 8.5E-03 | NA | 7.3 |
| 2013 | 0.30 | 1.33 | 0.36 | 0.78 | NA | 1.14 | 4.3 | 0.19 | 5.5E-03 | NA | 8.4 |
| 2014 | 0.29 | 1.17 | 0.36 | 1.10 | NA | 0.81 | 4.0 | 0.19 | 5.7E-03 | NA | 7.9 |
| 2015 | 0.32 | 1.33 | 0.34 | 0.96 | NA | 0.78 | 4.1 | 0.16 | 6.2E-03 | NA | 8.0 |
| 2016 | 0.34 | 1.29 | 0.32 | 0.70 | NA | 1.00 | 4.1 | 0.19 | 6.8E-03 | NA | 8.0 |
| 2016 vs 1990 | -40.6% | -32.1% | -50.3% | -99.1% | NA | 0.3% | -99.1% | -91.6% | -48.7% | NA | -98.5% |
| 2016 vs 2015 | 6.4% | -2.9% | -4.9% | -27.0% | NA | 7.8% | 1.2% | 17.1% | 9.6% | NA | 0.0% |

### 3.8.2 Cadmium (Cd)

The cadmium emission in 2016 was amounted to 0.85 t. The Cd emission has decrease by 28.5 % since 1990 and by 4.8 % in comparison to 2015 (Figure 3.8.2-1 and Table 3.8.2-1). Majority of Cd emission originates from the fuel combustion in energy sector (89.6 % in 2016), with domination of small combustion sector (75.1%). The sector, second in domination of Cd emissions in 2016, was production processes and products use with a contribution of 10.2 %. The Cd emission originates from Cd content in fuels (biomass, fuel oil, coal) and in raw materials at the entrance of the production process.

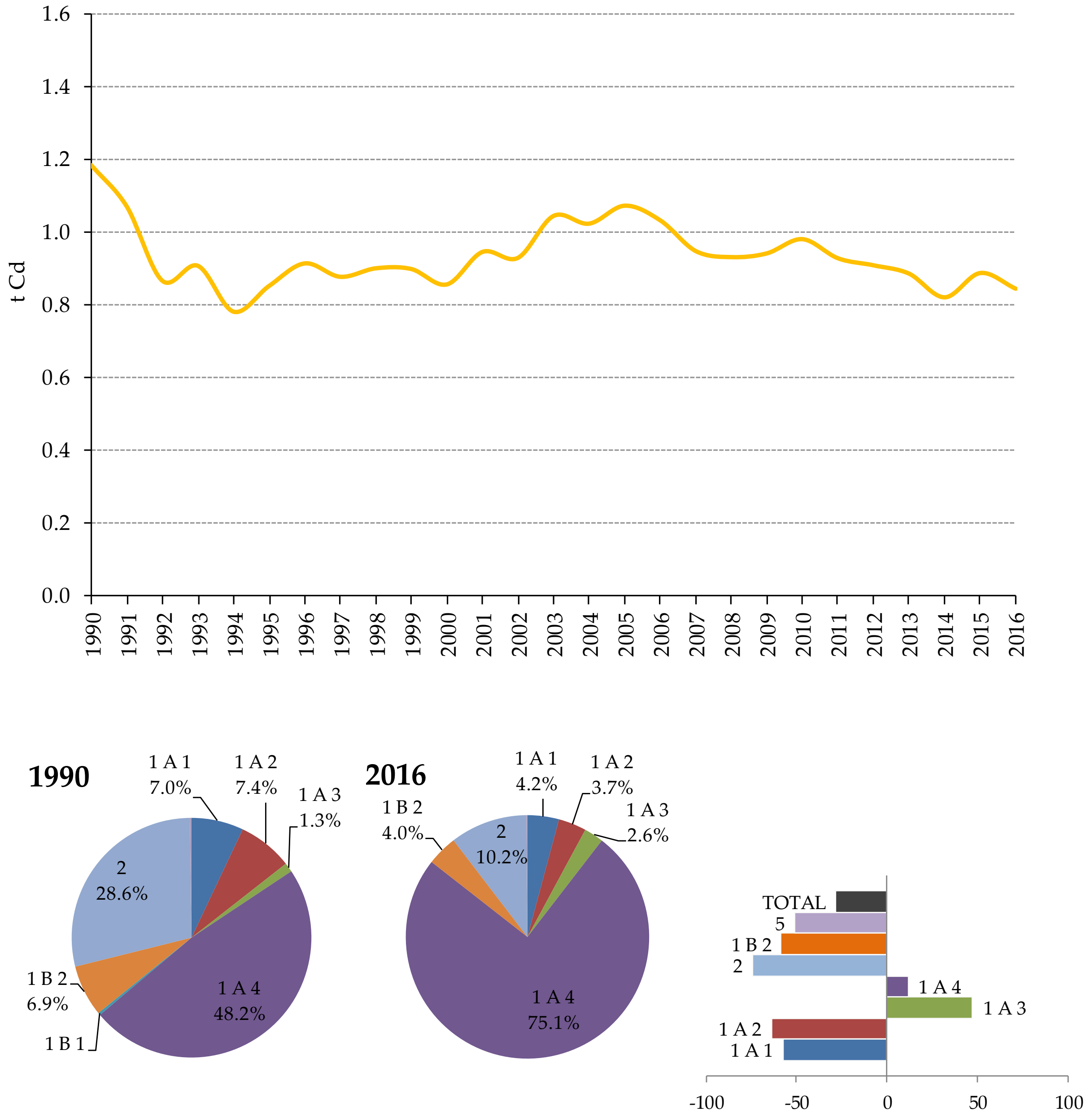



**Figure 3.8.2-1 The Cd emissions (t/yr.) and percentage share by sector and variation in Cd emissions**

Total of Cd emissions has a decreasing trend in the period 1990 - 2016, as a result of reduced consumption of fuel oil and a simultaneous increase in natural gas consumption. Also, lower consumption of fossil fuels in the energy sector has contributed to the reduction of Cd emissions. Cd emissions has significantly decreased in the period 1991 - 1992 (about 43%), due to stopping the process of steel production in the Siemens-Martin furnaces in Sisak, 1992. Stopping the process was a result of the war for Croatian independence (1991 - 1995). Also, the war for Croatian independence caused a reduction in fuel consumption and production in production processes and product use sector.

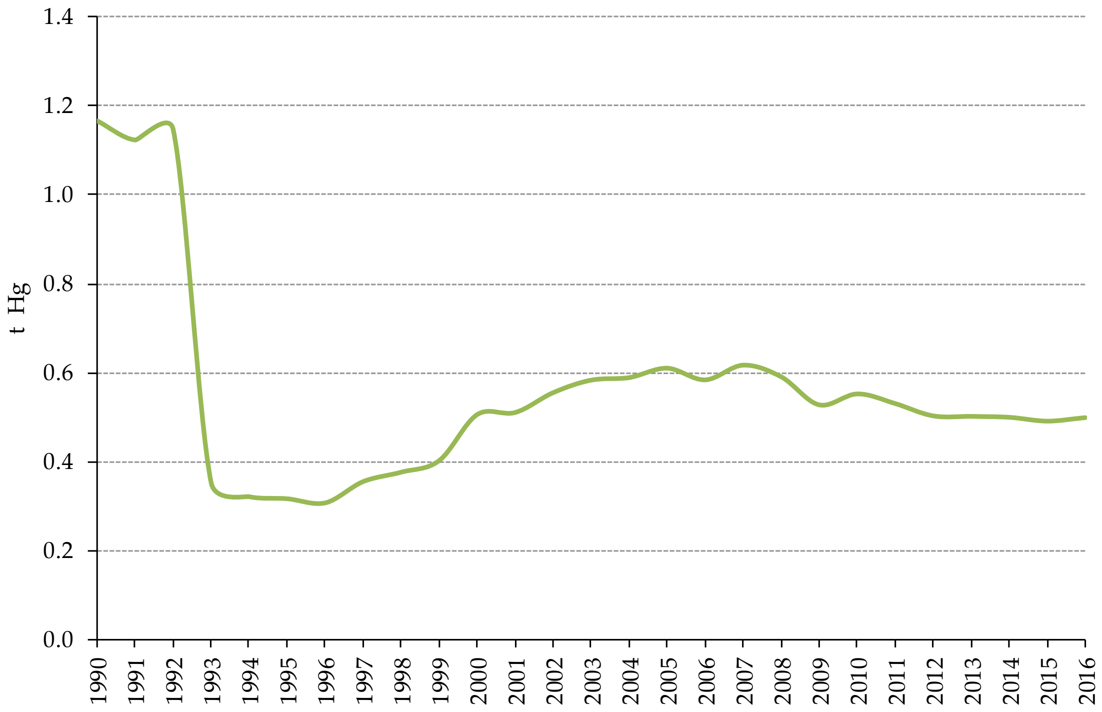
**Table 3.8.2-1 The Cd emissions by SNAP nomenclature in the period 1990-2016**

| Cd | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1990 | 0.08 | 0.57 | 0.09 | 0.36 | NA | 6.6E-02 | 1.4E-02 | 4.7E-03 | 4.2E-03 | NA | 1.18 |
| 1991 | 0.06 | 0.67 | 0.07 | 0.19 | NA | 6.2E-02 | 1.0E-02 | 3.4E-03 | 3.4E-03 | NA | 1.07 |
| 1992 | 0.06 | 0.58 | 0.06 | 0.09 | NA | 6.8E-02 | 9.7E-03 | 2.0E-03 | 4.1E-03 | NA | 0.87 |
| 1993 | 0.07 | 0.61 | 0.05 | 0.09 | NA | 6.2E-02 | 1.0E-02 | 1.8E-03 | 3.4E-03 | NA | 0.91 |
| 1994 | 0.05 | 0.55 | 0.05 | 0.09 | NA | 2.7E-02 | 1.1E-02 | 2.4E-03 | 3.6E-03 | NA | 0.78 |
| 1995 | 0.05 | 0.59 | 0.05 | 0.09 | NA | 6.6E-02 | 1.2E-02 | 2.3E-03 | 4.1E-03 | NA | 0.85 |
| 1996 | 0.06 | 0.65 | 0.05 | 0.07 | NA | 6.4E-02 | 1.3E-02 | 2.6E-03 | 4.0E-03 | NA | 0.91 |
| 1997 | 0.06 | 0.60 | 0.06 | 0.07 | NA | 6.3E-02 | 1.4E-02 | 2.5E-03 | 3.9E-03 | NA | 0.88 |
| 1998 | 0.06 | 0.60 | 0.07 | 0.10 | NA | 6.6E-02 | 1.5E-02 | 2.8E-03 | 4.1E-03 | NA | 0.92 |
| 1999 | 0.06 | 0.59 | 0.07 | 0.10 | NA | 7.6E-02 | 1.6E-02 | 2.8E-03 | 4.3E-03 | NA | 0.92 |
| 2000 | 0.06 | 0.53 | 0.10 | 0.12 | NA | 7.4E-02 | 1.6E-02 | 3.3E-03 | 4.4E-03 | NA | 0.91 |
| 2001 | 0.04 | 0.58 | 0.10 | 0.11 | NA | 9.8E-02 | 1.6E-02 | 3.5E-03 | 4.4E-03 | NA | 0.95 |
| 2002 | 0.04 | 0.56 | 0.09 | 0.11 | NA | 1.1E-01 | 1.7E-02 | 3.4E-03 | 4.1E-03 | NA | 0.93 |
| 2003 | 0.05 | 0.64 | 0.10 | 0.11 | NA | 1.2E-01 | 1.8E-02 | 3.7E-03 | 4.2E-03 | NA | 1.04 |
| 2004 | 0.04 | 0.62 | 0.11 | 0.13 | NA | 8.6E-02 | 1.8E-02 | 3.5E-03 | 4.0E-03 | NA | 1.02 |
| 2005 | 0.05 | 0.66 | 0.12 | 0.13 | NA | 8.3E-02 | 1.9E-02 | 3.7E-03 | 4.0E-03 | NA | 1.07 |
| 2006 | 0.04 | 0.61 | 0.15 | 0.12 | NA | 8.1E-02 | 2.0E-02 | 4.0E-03 | 4.2E-03 | NA | 1.03 |
| 2007 | 0.05 | 0.59 | 0.07 | 0.13 | NA | 8.1E-02 | 2.2E-02 | 4.1E-03 | 4.3E-03 | NA | 0.95 |
| 2008 | 0.04 | 0.59 | 0.06 | 0.13 | NA | 8.5E-02 | 2.1E-02 | 4.7E-03 | 3.9E-03 | NA | 0.93 |
| 2009 | 0.05 | 0.62 | 0.07 | 0.12 | NA | 6.2E-02 | 2.1E-02 | 4.2E-03 | 4.0E-03 | NA | 0.94 |
| 2010 | 0.05 | 0.66 | 0.06 | 0.12 | NA | 7.2E-02 | 2.0E-02 | 3.8E-03 | 2.3E-03 | NA | 0.98 |
| 2011 | 0.04 | 0.65 | 0.05 | 0.10 | NA | 6.3E-02 | 2.0E-02 | 3.8E-03 | 2.6E-03 | NA | 0.93 |
| 2012 | 0.04 | 0.64 | 0.05 | 0.09 | NA | 6.0E-02 | 2.0E-02 | 3.5E-03 | 2.9E-03 | NA | 0.91 |
| 2013 | 0.03 | 0.64 | 0.05 | 0.08 | NA | 5.4E-02 | 2.0E-02 | 3.4E-03 | 2.4E-03 | NA | 0.89 |
| 2014 | 0.03 | 0.57 | 0.05 | 0.11 | NA | 4.7E-02 | 2.0E-02 | 3.4E-03 | 2.1E-03 | NA | 0.82 |
| 2015 | 0.04 | 0.65 | 0.04 | 0.09 | NA | 4.6E-02 | 2.1E-02 | 3.3E-03 | 2.3E-03 | NA | 0.89 |
| 2016 | 0.04 | 0.63 | 0.03 | 0.07 | NA | 4.6E-02 | 2.1E-02 | 3.3E-03 | 2.5E-03 | NA | 0.85 |
| 2016 vs 1990 | -57.6% | 11.5% | -64.5% | -79.4% | NA | -30.7% | 55.8% | -29.5% | -41.7% | NA | -28.5% |
| 2016 vs 2015 | 0.6% | -2.7% | -18.5% | -21.3% | NA | 1.0% | 2.4% | -0.3% | 7.1% | NA | -4.8% |

### 3.8.3 Mercury (Hg)

The mercury emission in 2016 was amounted to 0.5 t (Figure 3.8.3-1 and Table 3.8.3-1). Emission has decreased by 57.1 % since 1990, and in comparison to 2015 has increased for 1.6 %. The majority of mercury emissions in 2016, resulting from fuel combustion and processing in the energy sector (84.4 % in 2016), with the dominance of a few sectors: electricity and heat production (40.9 %), combustion in manufacturing industry and construction (23.6 %), small combustion (9.5 %) and fugitive emissions from liquid fuels (7.7 %). Apart from the energy sector and second in dominance by Hg emissions in 2016 was the production processes and products use sector with a contribution of 15.2 %. Mercury emissions originate from its content of in fuels (coal, natural gas) and in raw materials at the entrance of the production processes (steel and glass production).

In 1990, dominant source in Hg emission was fugitive emissions from fuels, in particularly, fugitive emission from production and processing of natural gas (67.8 % in 1990). In 1993, the process units for removal of mercury from natural gas were put into operation. With this measure for mercury emission reduction, the inlet average mercury concentration of 516 $\mu g/m^3$ has decreased at the outlet to 0.12 $\mu g/m^3$ of average mercury concentration (Lit. 6). The above was the reason for reducing Hg emission in observed period. Since 2000, Hg emissions have started to increase, due to entry in operation of the second of two thermal power plants on coal in Croatia.



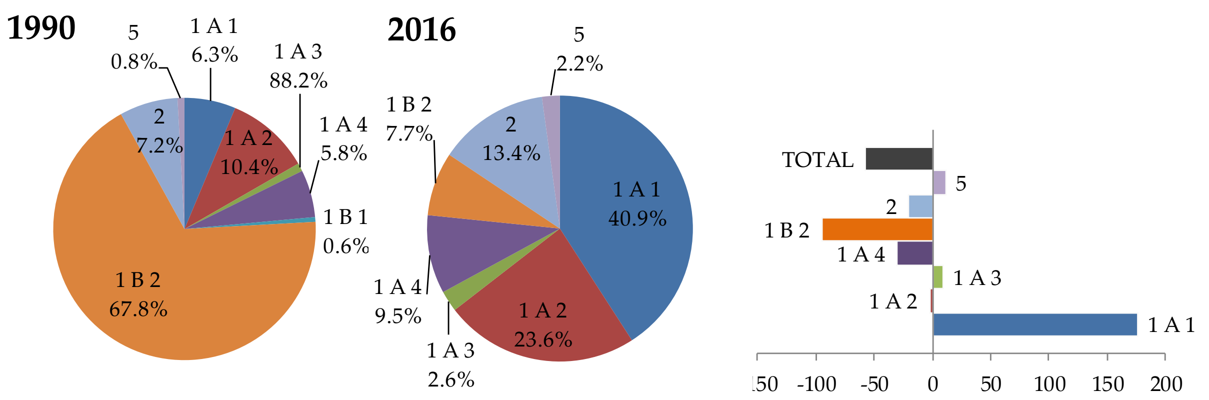




**Figure 3.8.3-1 The Hg emissions (t/yr.) and percentage share by sector and variation in Hg emissions**

**Table 3.8.3-1 The Hg emissions by SNAP nomenclature in the period 1990-2016**

| **Hg** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1990 | 0.07 | 0.07 | 0.12 | 0.11 | 0.70 | 7.5E-02 | 8.5E-03 | 3.2E-03 | 1.0E-02 | NA | 1.17 |
| 1991 | 0.05 | 0.06 | 0.08 | 0.07 | 0.77 | 7.0E-02 | 6.4E-03 | 1.8E-03 | 1.0E-02 | NA | 1.12 |
| 1992 | 0.07 | 0.04 | 0.09 | 0.06 | 0.80 | 7.0E-02 | 5.9E-03 | 1.4E-03 | 1.2E-02 | NA | 1.15 |
| 1993 | 0.06 | 0.05 | 0.08 | 0.08 | 2.3E-03 | 7.2E-02 | 6.1E-03 | 1.3E-03 | 1.1E-02 | NA | 0.35 |
| 1994 | 0.02 | 0.04 | 0.09 | 0.07 | 2.0E-03 | 7.3E-02 | 6.6E-03 | 8.1E-04 | 1.2E-02 | NA | 0.32 |
| 1995 | 0.03 | 0.04 | 0.07 | 0.07 | 2.4E-03 | 7.3E-02 | 7.0E-03 | 1.1E-03 | 1.3E-02 | NA | 0.32 |

| Hg | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1996 | 0.03 | 0.05 | 0.08 | 0.06 | 2.8E-03 | 7.0E-02 | 7.6E-03 | 1.5E-03 | 1.3E-02 | NA | 0.31 |
| 1997 | 0.06 | 0.05 | 0.09 | 0.06 | 2.0E-03 | 7.1E-02 | 8.4E-03 | 1.2E-03 | 1.3E-02 | NA | 0.36 |
| 1998 | 0.06 | 0.05 | 0.10 | 0.07 | 2.9E-03 | 7.0E-02 | 9.0E-03 | 1.1E-03 | 1.3E-02 | NA | 0.38 |
| 1999 | 0.06 | 0.05 | 0.12 | 0.08 | 2.0E-03 | 7.1E-02 | 9.5E-03 | 1.0E-03 | 1.3E-02 | NA | 0.41 |
| 2000 | 0.13 | 0.04 | 0.13 | 0.11 | 1.9E-03 | 6.8E-02 | 9.6E-03 | 1.0E-03 | 1.3E-02 | NA | 0.51 |
| 2001 | 0.13 | 0.05 | 0.15 | 0.09 | 2.1E-03 | 6.7E-02 | 9.6E-03 | 1.0E-03 | 1.3E-02 | NA | 0.51 |
| 2002 | 0.17 | 0.05 | 0.15 | 0.10 | 7.3E-04 | 6.8E-02 | 1.0E-02 | 1.2E-03 | 1.3E-02 | NA | 0.56 |
| 2003 | 0.19 | 0.05 | 0.15 | 0.10 | 7.5E-04 | 6.8E-02 | 1.1E-02 | 1.2E-03 | 1.4E-02 | NA | 0.58 |
| 2004 | 0.18 | 0.05 | 0.16 | 0.10 | 7.8E-04 | 6.8E-02 | 1.1E-02 | 1.1E-03 | 1.4E-02 | NA | 0.59 |
| 2005 | 0.19 | 0.05 | 0.16 | 0.11 | 7.6E-04 | 6.7E-02 | 1.1E-02 | 1.2E-03 | 1.5E-02 | NA | 0.61 |
| 2006 | 0.18 | 0.05 | 0.17 | 0.09 | 7.1E-04 | 6.7E-02 | 1.2E-02 | 1.2E-03 | 1.5E-02 | NA | 0.58 |
| 2007 | 0.19 | 0.05 | 0.17 | 0.11 | 7.1E-04 | 6.7E-02 | 1.2E-02 | 1.3E-03 | 1.6E-02 | NA | 0.62 |
| 2008 | 0.20 | 0.05 | 0.16 | 0.09 | 5.0E-05 | 6.7E-02 | 1.2E-02 | 1.5E-03 | 1.4E-02 | NA | 0.59 |
| 2009 | 0.14 | 0.05 | 0.14 | 0.10 | 4.2E-05 | 6.7E-02 | 1.2E-02 | 1.6E-03 | 1.5E-02 | NA | 0.53 |
| 2010 | 0.19 | 0.05 | 0.13 | 0.08 | 3.9E-05 | 6.7E-02 | 1.1E-02 | 1.3E-03 | 1.0E-02 | NA | 0.55 |
| 2011 | 0.20 | 0.05 | 0.12 | 0.07 | 4.1E-05 | 6.7E-02 | 1.1E-02 | 1.3E-03 | 1.0E-02 | NA | 0.53 |
| 2012 | 0.18 | 0.05 | 0.11 | 0.07 | 4.1E-05 | 6.7E-02 | 1.1E-02 | 1.3E-03 | 1.2E-02 | NA | 0.50 |
| 2013 | 0.20 | 0.05 | 0.12 | 0.05 | 4.1E-05 | 6.6E-02 | 1.1E-02 | 1.4E-03 | 1.0E-02 | NA | 0.50 |
| 2014 | 0.19 | 0.04 | 0.13 | 0.05 | 4.1E-05 | 6.6E-02 | 1.1E-02 | 1.5E-03 | 1.0E-02 | NA | 0.50 |
| 2015 | 0.18 | 0.05 | 0.12 | 0.05 | 4.1E-05 | 6.6E-02 | 1.1E-02 | 1.4E-03 | 1.1E-02 | NA | 0.49 |
| 2016 | 0.20 | 0.05 | 0.12 | 0.04 | 4.1E-05 | 6.5E-02 | 1.1E-02 | 1.5E-03 | 1.1E-02 | NA | 0.50 |
| 2016 vs 1990 | 176.7% | -30.0% | -2.3% | -61.7% | -100.0% | -12.6% | 32.6% | -54.7% | 10.2% | NA | -57.1% |
| 2016 vs 2015 | 10.9% | 0.4% | -4.3% | -14.7% | 0.0% | -0.7% | 1.9% | 2.3% | -1.5% | NA | 1.6% |

## 3.9 OTHER HEAVY METALS (As, Cr, Cu, Ni, Se, Zn)

Emissions of other heavy metals (As, Cr, Cu, Ni, Se and Zn) Croatia voluntary reports as an additional air pollutants.

A group of other heavy metals included Arsenic (As), Chrome (Cr), Copper (Cu), Nickel (Ni), Selenium (Se) and Zinc (Zn). Sources of their emissions are different, e.g. the emission of arsenic, chromium and nickel occur because of their presence (trace) in the solid fuel and heavy fuel oil, and partly in the composition of the individual input materials in manufacturing processes such as glass, iron and steel. Copper is mostly emitted as a result of tire and brake wear, zinc is mostly emitted as a result of biomass combustion in residential sector, while selenium is emitted due to their presence (in trace) in raw materials for e.g. glass and mineral wool production.

### 3.9.1 Arsenic (As)

The arsenic emission in 2016 was estimated to 0.41 t (Figure 3.9.1-1 and Table 3.9.1-1). Emission has decreased by 95.3 % since 1990 and by 16.7% since 2015. The energy sector is a significant source of arsenic in 2016 (86.1 %), and the key sources were: fugitive emissions from liquid fuels (35.6 %), electricity and heat production sector (30.6 %), and manufacturing industry and construction sector (16.3%). Apart from the energy sector, non-energy sector - industry production and product use has contributed by 13.5 % in As emission in 2016 (glass production and steel production with less extent). Arsenic emissions originate from the As content in raw materials and in fuels.

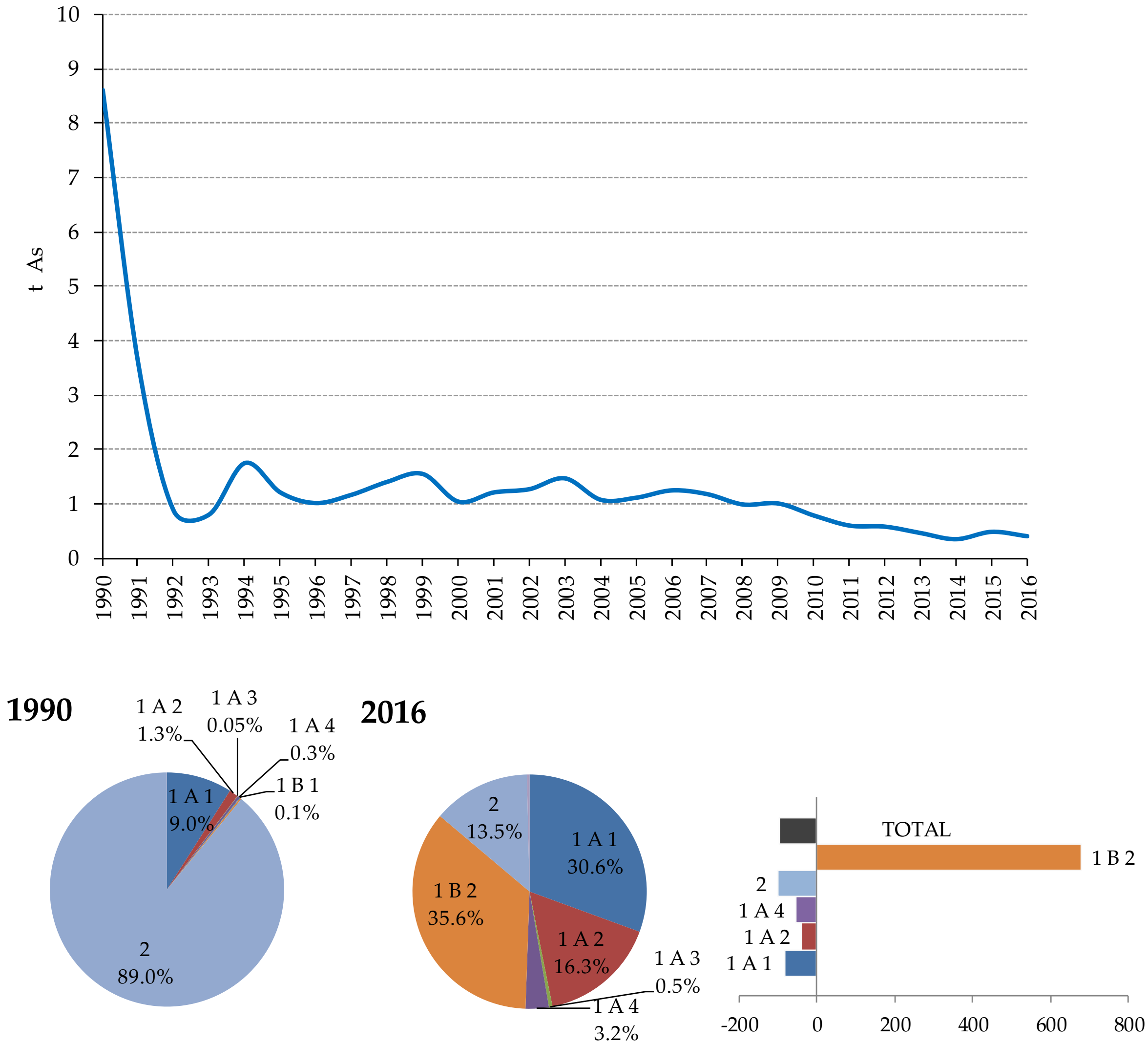



**Figure 3.9.1-1 The As emissions (t/yr.) and percentage share by sector and variation in As emissions**

Industrial processes and steelmaking activity in open hearth furnace steel plant was the key source in As emission in 1990. Stopping the steelmaking activity in Siemens-Marten furnace in Sisak, 1992 has resulted with great decline of As emissions. Stopping the process was a result of the war for Croatian independence (1991 – 1995). The war has also caused a decrease in fuel consumption and other production activities in industrial processes and product use sector.

**Table 3.9.1-1 The As emissions by SNAP nomenclature in the period 1990-2016**

| As | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1990 | 0.78 | 2.8E-02 | 0.11 | 7.67 | NA | 9.4E-04 | 2.6E-04 | 3.9E-03 | 3.2E-03 | NA | 8.59 |
| 1991 | 0.57 | 2.1E-02 | 0.07 | 2.89 | NA | 9.4E-04 | 2.0E-04 | 3.3E-03 | 2.2E-03 | NA | 3.56 |
| 1992 | 0.74 | 1.3E-02 | 0.06 | 0.04 | NA | 9.4E-04 | 1.8E-04 | 7.6E-03 | 3.6E-03 | NA | 0.87 |
| 1993 | 0.68 | 1.5E-02 | 0.05 | 0.05 | NA | 9.4E-04 | 1.8E-04 | 8.4E-03 | 2.2E-03 | NA | 0.81 |
| 1994 | 1.27 | 1.2E-02 | 0.06 | 0.40 | NA | 9.4E-04 | 2.0E-04 | 1.3E-03 | 2.7E-03 | NA | 1.75 |
| 1995 | 0.74 | 1.3E-02 | 0.05 | 0.40 | NA | 1.6E-03 | 2.1E-04 | 5.2E-03 | 3.2E-03 | NA | 1.21 |
| 1996 | 0.60 | 1.5E-02 | 0.05 | 0.33 | NA | 2.4E-03 | 2.3E-04 | 1.2E-02 | 3.2E-03 | NA | 1.01 |
| 1997 | 0.74 | 1.4E-02 | 0.06 | 0.34 | NA | 2.3E-03 | 2.5E-04 | 8.7E-03 | 3.0E-03 | NA | 1.17 |
| 1998 | 0.94 | 1.4E-02 | 0.07 | 0.38 | NA | 1.6E-03 | 2.7E-04 | 3.3E-03 | 3.2E-03 | NA | 1.42 |
| 1999 | 0.99 | 1.4E-02 | 0.08 | 0.47 | NA | 1.3E-03 | 2.8E-04 | 2.6E-03 | 3.3E-03 | NA | 1.56 |
| 2000 | 0.48 | 1.3E-02 | 0.12 | 0.47 | NA | 9.4E-04 | 2.9E-04 | 2.0E-03 | 3.3E-03 | NA | 1.09 |
| 2001 | 0.59 | 1.3E-02 | 0.13 | 0.47 | NA | 2.2E-03 | 2.8E-04 | 3.4E-03 | 3.1E-03 | NA | 1.21 |
| 2002 | 0.60 | 1.3E-02 | 0.12 | 0.52 | NA | 1.1E-02 | 2.9E-04 | 6.1E-03 | 2.9E-03 | NA | 1.27 |
| 2003 | 0.83 | 1.5E-02 | 0.12 | 0.47 | NA | 1.5E-02 | 3.0E-04 | 5.8E-03 | 3.2E-03 | NA | 1.47 |
| 2004 | 0.46 | 1.4E-02 | 0.14 | 0.45 | NA | 8.2E-03 | 3.0E-04 | 1.2E-03 | 2.8E-03 | NA | 1.07 |
| 2005 | 0.54 | 1.5E-02 | 0.15 | 0.39 | NA | 3.7E-03 | 3.0E-04 | 1.3E-03 | 2.8E-03 | NA | 1.11 |
| 2006 | 0.56 | 1.4E-02 | 0.18 | 0.48 | NA | 2.8E-03 | 3.1E-04 | 1.4E-03 | 2.8E-03 | NA | 1.25 |
| 2007 | 0.59 | 1.3E-02 | 0.10 | 0.46 | NA | 2.0E-03 | 3.3E-04 | 1.4E-03 | 2.8E-03 | NA | 1.18 |
| 2008 | 0.55 | 1.3E-02 | 0.10 | 0.32 | NA | 1.4E-03 | 3.1E-04 | 2.7E-03 | 2.7E-03 | NA | 0.99 |
| 2009 | 0.57 | 1.4E-02 | 0.09 | 0.33 | NA | 6.1E-04 | 3.1E-04 | 2.2E-03 | 2.6E-03 | NA | 1.01 |
| 2010 | 0.22 | 1.5E-02 | 0.08 | 0.47 | NA | 2.4E-04 | 3.0E-04 | 2.8E-03 | 2.2E-03 | NA | 0.78 |
| 2011 | 0.26 | 1.4E-02 | 0.06 | 0.26 | NA | 2.1E-04 | 3.0E-04 | 2.7E-03 | 2.5E-03 | NA | 0.60 |
| 2012 | 0.20 | 1.4E-02 | 0.06 | 0.30 | NA | 1.4E-05 | 2.8E-04 | 2.7E-03 | 2.4E-03 | NA | 0.58 |
| 2013 | 0.13 | 1.3E-02 | 0.07 | 0.24 | NA | 1.9E-03 | 2.8E-04 | 1.6E-03 | 2.2E-03 | NA | 0.46 |
| 2014 | 0.11 | 1.2E-02 | 0.07 | 0.15 | NA | 1.4E-03 | 2.7E-04 | 1.7E-03 | 1.7E-03 | NA | 0.35 |
| 2015 | 0.15 | 1.3E-02 | 0.07 | 0.25 | NA | 1.3E-03 | 2.8E-04 | 1.7E-03 | 1.8E-03 | NA | 0.49 |
| 2016 | 0.12 | 1.3E-02 | 0.07 | 0.20 | NA | 1.7E-03 | 2.8E-04 | 1.7E-03 | 1.9E-03 | NA | 0.41 |
| 2016vs 1990 | -84.0% | -53.1% | -38.6% | -97.4% | NA | 80.3% | 7.6% | -55.9% | -39.5% | NA | -95.3% |
| 2016 vs 2015 | -15.0% | -0.7% | -5.2% | -22.2% | NA | 27.8% | 1.5% | 1.6% | 3.5% | NA | -16.7% |

### 3.9.2 Chromium (Cr)

The chromium emission in 2016 was amounted to 2.05 t (Figure 3.9.2-1 and Table 3.9.2-1). Emission of Cr has decreased by 61.5 % since 1990 mostly due to reducing the consumption of heavy fuel oil in stationary energy sector and simultaneously increasing consumption of natural gas. Also, the great reduction in Cr emission (by 92.6%) in comparison to 1990, was happened in industrial processes and product use sector, due to stopping the process of pig iron production (blast furnace charging) in Sisak and Split in 1992 and steel production in the open hearth furnace steel plant (Siemens Martin' furnaces) in Sisak, 1992. Stopping these processes were a result of the war for the Croatian independence (1991 – 1995).

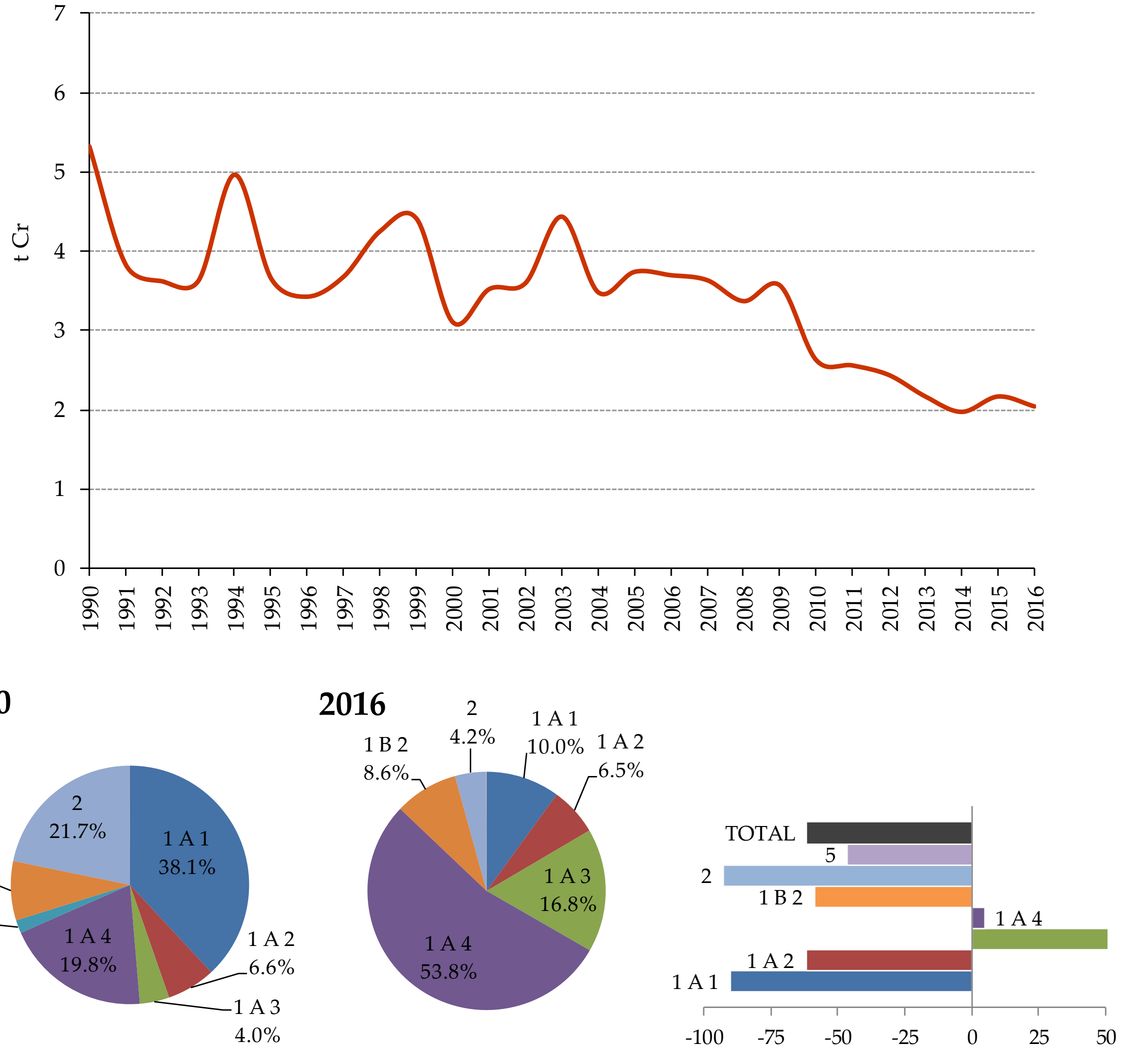



**Figure 3.9.2-1 The Cr emissions (t/yr.) and percentage share by sector and variation in Cr emissions**

About 10% of Cr emissions in 2016 originated from the public electricity and heat production sector whereas the impact of this sector in the nineties was significantly higher (38.1% in 1990). The annual Cr emissions from this source show long-term trend fluctuations between 1990 and 2016 which mostly depends on the type of fuel. Higher consumption of biomass, solid fuel and heavy fuel oil leads to higher Cr emissions. Small peak in 2015 is the result of an increase in biomass consumption in the residential sector.

**Table 3.9.2-1 The Cr emissions by SNAP nomenclature in the period 1990-2016**

| **Cr** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1990 | 2,03 | 1,04 | 0,34 | 1,7 | NA | 1,1E-02 | 0,20 | 2,6E-02 | 7,7E-03 | NA | 5,3 |
| 1991 | 1,49 | 1,19 | 0,24 | 0,72 | NA | 1,1E-02 | 0,15 | 1,9E-02 | 5,5E-03 | NA | 3,8 |
| 1992 | 1,88 | 1,02 | 0,19 | 0,34 | NA | 1,1E-02 | 0,15 | 1,6E-02 | 6,6E-03 | NA | 3,6 |
| 1993 | 1,76 | 1,08 | 0,17 | 0,42 | NA | 1,1E-02 | 0,16 | 1,6E-02 | 5,8E-03 | NA | 3,6 |
| 1994 | 3,25 | 0,97 | 0,17 | 0,37 | NA | 1,1E-02 | 0,17 | 1,3E-02 | 6,2E-03 | NA | 5,0 |
| 1995 | 1,91 | 1,02 | 0,16 | 0,33 | NA | 1,9E-02 | 0,18 | 1,5E-02 | 7,5E-03 | NA | 3,7 |
| 1996 | 1,60 | 1,15 | 0,16 | 0,27 | NA | 2,8E-02 | 0,20 | 2,3E-02 | 7,0E-03 | NA | 3,4 |
| 1997 | 1,91 | 1,05 | 0,18 | 0,27 | NA | 2,8E-02 | 0,22 | 1,9E-02 | 6,9E-03 | NA | 3,7 |
| 1998 | 2,41 | 1,06 | 0,22 | 0,34 | NA | 1,9E-02 | 0,23 | 1,6E-02 | 7,5E-03 | NA | 4,3 |
| 1999 | 2,53 | 1,04 | 0,21 | 0,38 | NA | 1,5E-02 | 0,25 | 1,6E-02 | 8,0E-03 | NA | 4,5 |
| 2000 | 1,22 | 0,92 | 0,30 | 0,50 | NA | 1,1E-02 | 0,25 | 1,7E-02 | 8,4E-03 | NA | 3,2 |
| 2001 | 1,49 | 1,02 | 0,30 | 0,44 | NA | 2,6E-02 | 0,22 | 2,0E-02 | 8,0E-03 | NA | 3,5 |
| 2002 | 1,50 | 0,97 | 0,27 | 0,45 | NA | 1,3E-01 | 0,25 | 2,2E-02 | 7,1E-03 | NA | 3,6 |
| 2003 | 2,08 | 1,12 | 0,30 | 0,46 | NA | 1,8E-01 | 0,27 | 2,3E-02 | 7,0E-03 | NA | 4,4 |
| 2004 | 1,16 | 1,09 | 0,33 | 0,50 | NA | 9,7E-02 | 0,28 | 1,8E-02 | 6,3E-03 | NA | 3,5 |
| 2005 | 1,35 | 1,16 | 0,36 | 0,52 | NA | 4,3E-02 | 0,29 | 1,9E-02 | 6,3E-03 | NA | 3,7 |
| 2006 | 1,39 | 1,06 | 0,44 | 0,44 | NA | 3,3E-02 | 0,31 | 2,0E-02 | 6,3E-03 | NA | 3,7 |
| 2007 | 1,48 | 1,02 | 0,24 | 0,51 | NA | 2,3E-02 | 0,33 | 2,1E-02 | 6,6E-03 | NA | 3,6 |
| 2008 | 1,34 | 1,03 | 0,22 | 0,42 | NA | 1,6E-02 | 0,32 | 2,5E-02 | 6,1E-03 | NA | 3,4 |
| 2009 | 1,43 | 1,07 | 0,21 | 0,50 | NA | 7,1E-03 | 0,33 | 2,1E-02 | 6,4E-03 | NA | 3,6 |
| 2010 | 0,54 | 1,15 | 0,20 | 0,40 | NA | 2,8E-03 | 0,32 | 2,1E-02 | 3,9E-03 | NA | 2,6 |
| 2011 | 0,61 | 1,12 | 0,16 | 0,34 | NA | 2,4E-03 | 0,31 | 2,0E-02 | 4,7E-03 | NA | 2,6 |
| 2012 | 0,47 | 1,12 | 0,17 | 0,35 | NA | 1,7E-04 | 0,31 | 1,9E-02 | 5,0E-03 | NA | 2,4 |
| 2013 | 0,27 | 1,11 | 0,17 | 0,25 | NA | 2,3E-02 | 0,32 | 1,7E-02 | 4,6E-03 | NA | 2,2 |
| 2014 | 0,22 | 0,98 | 0,16 | 0,26 | NA | 1,6E-02 | 0,31 | 1,7E-02 | 4,2E-03 | NA | 2,0 |
| 2015 | 0,29 | 1,13 | 0,14 | 0,24 | NA | 1,6E-02 | 0,33 | 1,7E-02 | 5,0E-03 | NA | 2,2 |
| 2016 | 0,21 | 1,09 | 0,13 | 0,24 | NA | 2,0E-02 | 0,34 | 1,7E-02 | 5,5E-03 | NA | 2,0 |
| 2016 vs 1990 | -89,9% | 5,0% | -62,5% | -85,6% | NA | 80,3% | 66,8% | -35,7% | -28,3% | NA | -61,5% |
| 2016 vs 2015 | -30,4% | -2,9% | -10,3% | -1,5% | NA | 27,8% | 3,6% | -0,2% | 11,0% | NA | -5,7% |

### 3.9.3 Copper (Cu)

Domination in the copper emission in Croatia has the transport sector. The Cu emissions in 2016 have amounted to 8.43 t (Figure and Table 3.9.3-1). Transport sector (mostly automobile tire and brake wear) has contributed with 77.6 % in total of Cu emission. Emission of Cu has decrease by 6.2 % since 1990. Great decline happened in 1991, as a consequence of the war for Croatian independence (1991 – 1995). After decline period, the Cu emission has long-term increase period, mostly due to constant increase of road vehicle population and annual mileage, what leads to higher automobile tire and brake wear. The period of high emissions from 2002 to 2005 with a peak in 2003 was the result of the increasing trend of use of fireworks and signalling rockets (NFR 2.G, SNAP 060601).

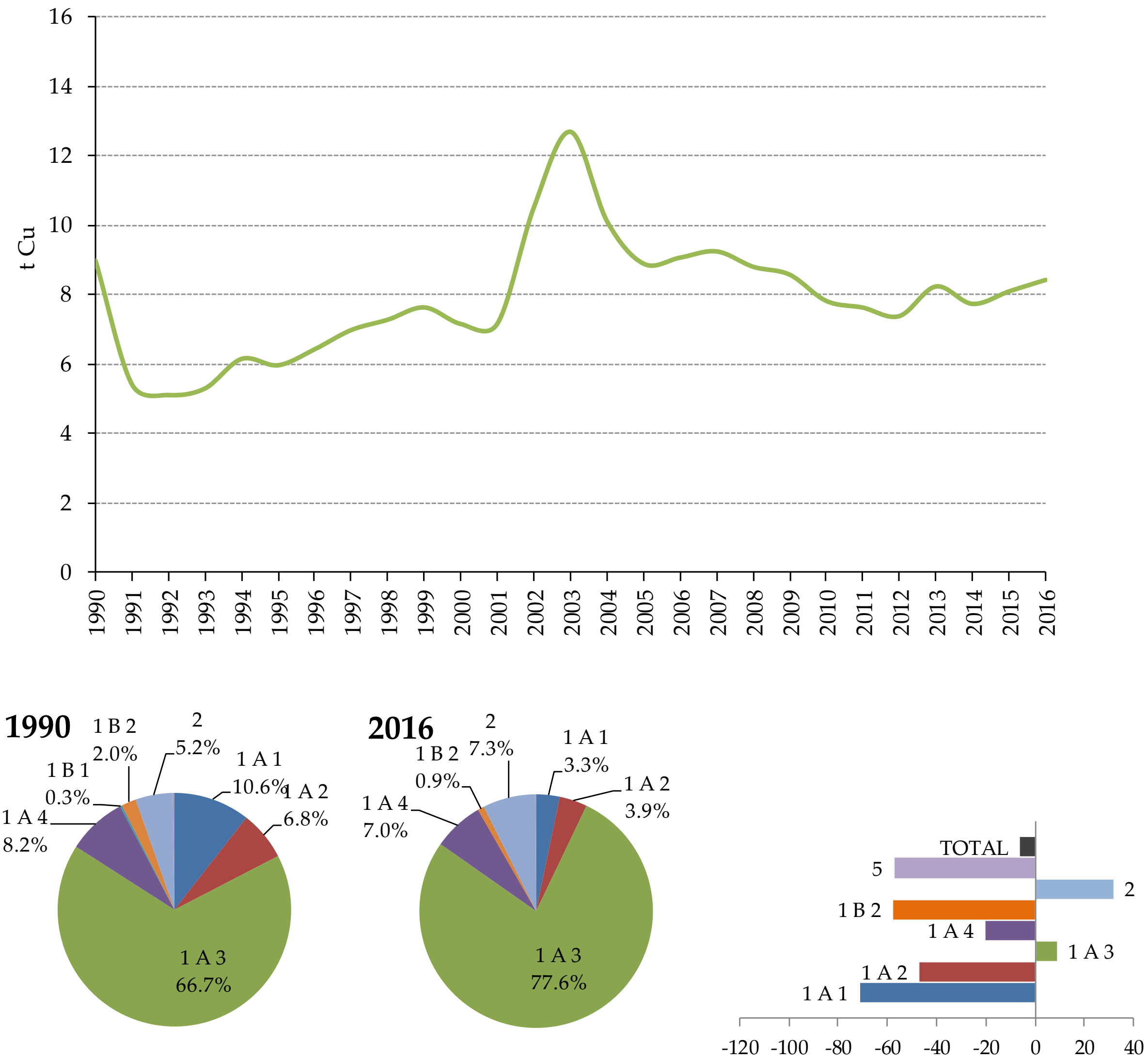


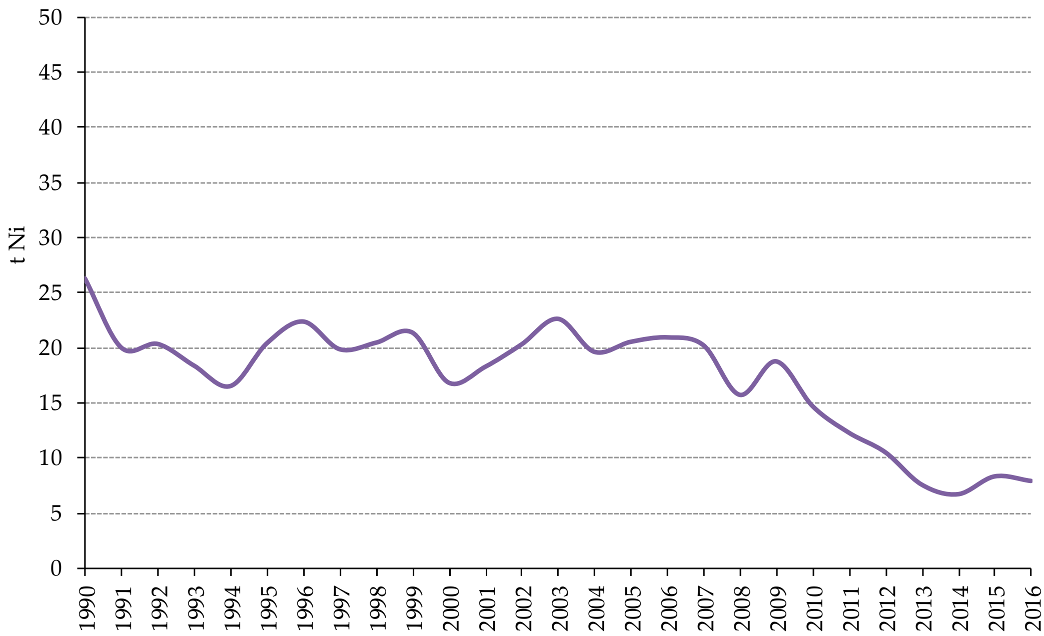

**Figure 3.9.3-1 The Cu emissions (t/yr.) and percentage share by sector and variation in Cu emissions**

**Table 3.9.3-1 The Cu emissions by SNAP nomenclature in the period 1990-2016**

| **Cu** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1990 | 0.95 | 0.38 | 0.38 | 0.29 | NA | 0.38 | 5.88 | 0.70 | 0.02 | NA | 9.0 |
| 1991 | 0.70 | 0.37 | 0.25 | 0.18 | NA | 0.38 | 3.01 | 0.53 | 0.02 | NA | 5.4 |
| 1992 | 0.86 | 0.28 | 0.20 | 0.12 | NA | 0.38 | 2.95 | 0.30 | 0.02 | NA | 5.1 |
| 1993 | 0.80 | 0.30 | 0.17 | 0.16 | NA | 0.38 | 3.21 | 0.27 | 0.02 | NA | 5.3 |
| 1994 | 1.38 | 0.27 | 0.18 | 0.14 | NA | 0.34 | 3.43 | 0.40 | 0.02 | NA | 6.2 |
| 1995 | 0.87 | 0.28 | 0.16 | 0.13 | NA | 0.60 | 3.55 | 0.36 | 0.02 | NA | 6.0 |
| 1996 | 0.76 | 0.31 | 0.16 | 0.10 | NA | 0.85 | 3.83 | 0.39 | 0.02 | NA | 6.4 |
| 1997 | 0.87 | 0.29 | 0.17 | 0.10 | NA | 0.84 | 4.30 | 0.38 | 0.03 | NA | 7.0 |
| 1998 | 1.07 | 0.29 | 0.19 | 0.13 | NA | 0.60 | 4.55 | 0.45 | 0.03 | NA | 7.3 |
| 1999 | 1.12 | 0.29 | 0.21 | 0.15 | NA | 0.51 | 4.90 | 0.46 | 0.03 | NA | 7.7 |
| 2000 | 0.62 | 0.25 | 0.25 | 0.20 | NA | 0.39 | 4.92 | 0.54 | 0.03 | NA | 7.2 |
| 2001 | 0.73 | 0.27 | 0.27 | 0.18 | NA | 0.83 | 4.29 | 0.57 | 0.04 | NA | 7.2 |
| 2002 | 0.76 | 0.26 | 0.26 | 0.18 | NA | 3.78 | 4.71 | 0.55 | 0.03 | NA | 10.5 |
| 2003 | 1.00 | 0.31 | 0.25 | 0.18 | NA | 5.20 | 5.14 | 0.59 | 0.03 | NA | 12.7 |
| 2004 | 0.62 | 0.29 | 0.28 | 0.19 | NA | 2.83 | 5.30 | 0.58 | 0.02 | NA | 10.1 |
| 2005 | 0.70 | 0.31 | 0.29 | 0.20 | NA | 1.31 | 5.44 | 0.61 | 0.02 | NA | 8.9 |
| 2006 | 0.71 | 0.29 | 0.34 | 0.17 | NA | 1.00 | 5.89 | 0.65 | 0.03 | NA | 9.1 |
| 2007 | 0.76 | 0.27 | 0.26 | 0.20 | NA | 0.73 | 6.33 | 0.67 | 0.03 | NA | 9.3 |
| 2008 | 0.68 | 0.27 | 0.24 | 0.16 | NA | 0.54 | 6.13 | 0.77 | 0.02 | NA | 8.8 |
| 2009 | 0.71 | 0.28 | 0.21 | 0.19 | NA | 0.26 | 6.22 | 0.67 | 0.03 | NA | 8.6 |
| 2010 | 0.37 | 0.31 | 0.22 | 0.15 | NA | 0.15 | 6.00 | 0.62 | 0.01 | NA | 7.8 |
| 2011 | 0.41 | 0.30 | 0.18 | 0.12 | NA | 0.13 | 5.87 | 0.61 | 0.01 | NA | 7.6 |
| 2012 | 0.34 | 0.30 | 0.18 | 0.13 | NA | 0.07 | 5.80 | 0.56 | 0.02 | NA | 7.4 |
| 2013 | 0.25 | 0.30 | 0.19 | 0.08 | NA | 0.70 | 6.16 | 0.55 | 0.01 | NA | 8.2 |
| 2014 | 0.23 | 0.26 | 0.19 | 0.08 | NA | 0.51 | 5.92 | 0.54 | 0.01 | NA | 7.7 |
| 2015 | 0.28 | 0.30 | 0.18 | 0.08 | NA | 0.49 | 6.24 | 0.53 | 0.01 | NA | 8.1 |
| 2016 | 0.27 | 0.29 | 0.17 | 0.08 | NA | 0.61 | 6.47 | 0.53 | 0.01 | NA | 8.4 |
| 2016 vs 1990 | -71.1% | -24.4% | -55.4% | -73.6% | NA | 60.9% | 10.0% | -24.5% | -51.8% | NA | -6.2% |
| 2016 vs 2015 | -1.3% | -2.9% | -4.8% | -3.4% | NA | 25.3% | 3.7% | -0.4% | 7.3% | NA | 4.1% |

### 3.9.4 Nickel (Ni)

Emission of nickel totalled about to 10.4 t in 2016 (Figure and Table 3.9.4-1). Emission of Ni has declined by 60.2 %, since 1990. Majority of Ni emissions in historical trend originate from the public electricity and heat production sector (83.3 % in 1990 and 88.4 % in 2016). The historical trend of Ni emission from this source category shows long-term fluctuations between which mostly depend on the type of fuel. Higher consumption of solid fuel and heavy fuel oil leads to higher Ni emissions and vice versa. Decline in Ni emission in 1991 was as a consequence of the war Croatian independence (1991 – 1995). In that period of time there was a reduction in fossil fuel consumptions and stopping the production of steel in the open hearth furnace steel plant (Siemens Martin' furnaces) in Sisak, 1992. In recent years (since 2010) the trend recorded continuous reduction of Ni emission, as a result of the decreasing use of coal as a fuel in general consumption sector (mainly residential).



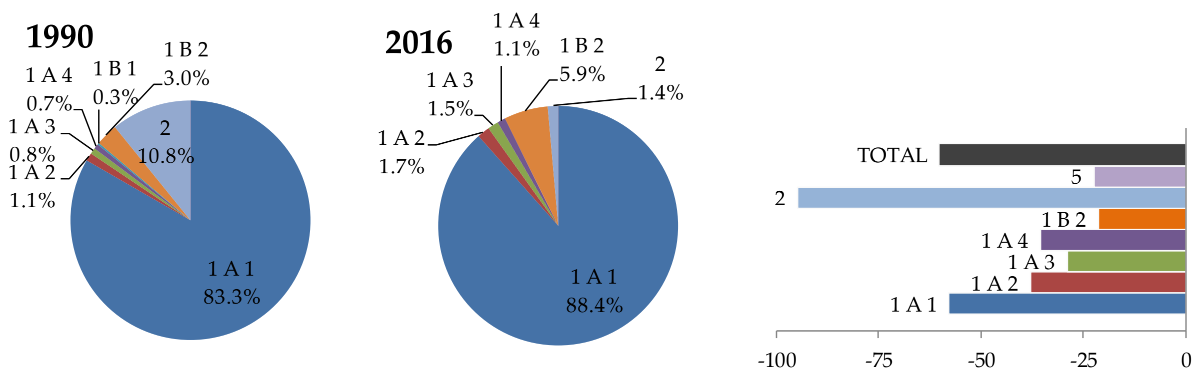




**Figure 3.9.4-1The Ni emissions (t/yr.) and percentage share by sector and variation in Ni emissions**

**Table 3.9.4-1 The Ni emissions by SNAP nomenclature in the period 1990-2016**

| Ni | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1990 | 21.9 | 0.16 | 0.27 | 3.63 | NA | 0.05 | 0.11 | 0.13 | 7.5E-03 | NA | 26.2 |
| 1991 | 17.7 | 0.14 | 0.17 | 1.75 | NA | 0.05 | 0.03 | 0.13 | 5.5E-03 | NA | 19.9 |
| 1992 | 19.0 | 0.10 | 0.14 | 0.62 | NA | 0.05 | 0.03 | 0.33 | 5.0E-03 | NA | 20.3 |
| 1993 | 16.9 | 0.11 | 0.12 | 0.75 | NA | 0.05 | 0.03 | 0.38 | 5.7E-03 | NA | 18.3 |
| 1994 | 15.3 | 0.09 | 0.13 | 0.76 | NA | 0.03 | 0.03 | 0.06 | 5.6E-03 | NA | 16.5 |
| 1995 | 19.0 | 0.10 | 0.11 | 0.74 | NA | 0.07 | 0.04 | 0.23 | 6.7E-03 | NA | 20.3 |
| 1996 | 20.8 | 0.11 | 0.11 | 0.61 | NA | 0.08 | 0.04 | 0.55 | 6.0E-03 | NA | 22.3 |
| 1997 | 18.4 | 0.10 | 0.12 | 0.62 | NA | 0.08 | 0.04 | 0.40 | 6.1E-03 | NA | 19.8 |
| 1998 | 19.1 | 0.10 | 0.76 | 0.78 | NA | 0.07 | 0.05 | 0.15 | 6.4E-03 | NA | 21.0 |
| 1999 | 20.0 | 0.10 | 0.74 | 0.86 | NA | 0.07 | 0.05 | 0.11 | 6.9E-03 | NA | 21.9 |
| 2000 | 15.3 | 0.09 | 1.87 | 1.07 | NA | 0.06 | 0.05 | 0.09 | 7.1E-03 | NA | 18.5 |
| 2001 | 15.1 | 0.09 | 1.74 | 0.96 | NA | 0.10 | 0.05 | 0.16 | 6.7E-03 | NA | 18.2 |
| 2002 | 17.1 | 0.09 | 1.44 | 0.98 | NA | 0.30 | 0.05 | 0.28 | 6.1E-03 | NA | 20.2 |
| 2003 | 19.0 | 0.11 | 1.74 | 0.99 | NA | 0.40 | 0.05 | 0.26 | 6.1E-03 | NA | 22.6 |
| 2004 | 16.0 | 0.10 | 2.02 | 1.09 | NA | 0.22 | 0.05 | 0.05 | 5.8E-03 | NA | 19.6 |
| 2005 | 16.5 | 0.11 | 2.52 | 1.10 | NA | 0.12 | 0.06 | 0.05 | 5.8E-03 | NA | 20.5 |
| 2006 | 16.2 | 0.10 | 3.40 | 0.97 | NA | 0.10 | 0.06 | 0.06 | 5.8E-03 | NA | 20.9 |
| 2007 | 18.2 | 0.09 | 0.54 | 1.11 | NA | 0.08 | 0.07 | 0.06 | 6.4E-03 | NA | 20.2 |
| 2008 | 13.7 | 0.09 | 0.65 | 0.93 | NA | 0.07 | 0.06 | 0.12 | 5.8E-03 | NA | 15.7 |
| 2009 | 16.7 | 0.10 | 0.68 | 1.03 | NA | 0.04 | 0.06 | 0.08 | 6.3E-03 | NA | 18.7 |
| 2010 | 13.1 | 0.10 | 0.25 | 0.92 | NA | 0.04 | 0.06 | 0.12 | 3.1E-03 | NA | 14.6 |
| 2011 | 11.0 | 0.10 | 0.14 | 0.75 | NA | 0.04 | 0.06 | 0.11 | 3.9E-03 | NA | 12.2 |
| 2012 | 9.2 | 0.10 | 0.17 | 0.73 | NA | 0.03 | 0.06 | 0.11 | 4.3E-03 | NA | 10.4 |
| 2013 | 6.5 | 0.10 | 0.20 | 0.56 | NA | 0.07 | 0.06 | 0.06 | 4.0E-03 | NA | 7.5 |
| 2014 | 5.5 | 0.09 | 0.25 | 0.62 | NA | 0.05 | 0.06 | 0.06 | 4.4E-03 | NA | 6.6 |
| 2015 | 7.2 | 0.10 | 0.14 | 0.59 | NA | 0.05 | 0.06 | 0.06 | 5.2E-03 | NA | 8.3 |
| 2016 | 6.9 | 0.10 | 0.13 | 0.51 | NA | 0.06 | 0.06 | 0.06 | 5.9E-03 | NA | 7.8 |
| 2016 vs 1990 | -68.3% | -40.0% | -53.1% | -86.1% | NA | 12.0% | -39.4% | -55.4% | -21.1% | NA | -70.1% |
| 2016 vs 2015 | -4.3% | -2.9% | -10.7% | -14.3% | NA | 16.1% | 3.2% | 0.7% | 13.7% | NA | -4.9% |

### 3.9.5 Selenium (Se)

Emission of selenium was amounted to 0.33 t in 2016 (Figure and Table 3.9.5-1) and was reduced by 29 % since 1990. Dominant sector in the selenium emission during whole observe period has industrial processes and product use sector. It has contributed with 55.6 % in 2016, and in 1990 with 47.8 % in total Se emission. Domination within that sector has glass production activity, due to the metal content in the raw material. That activity has recorded a decreasing trend in recent years, as a result of economic crisis since 2007. About 17.5 % of Se emissions in 2016 originated from fuel combustion in manufacturing industry and construction, and 10.7 % from the public electricity and heat production.

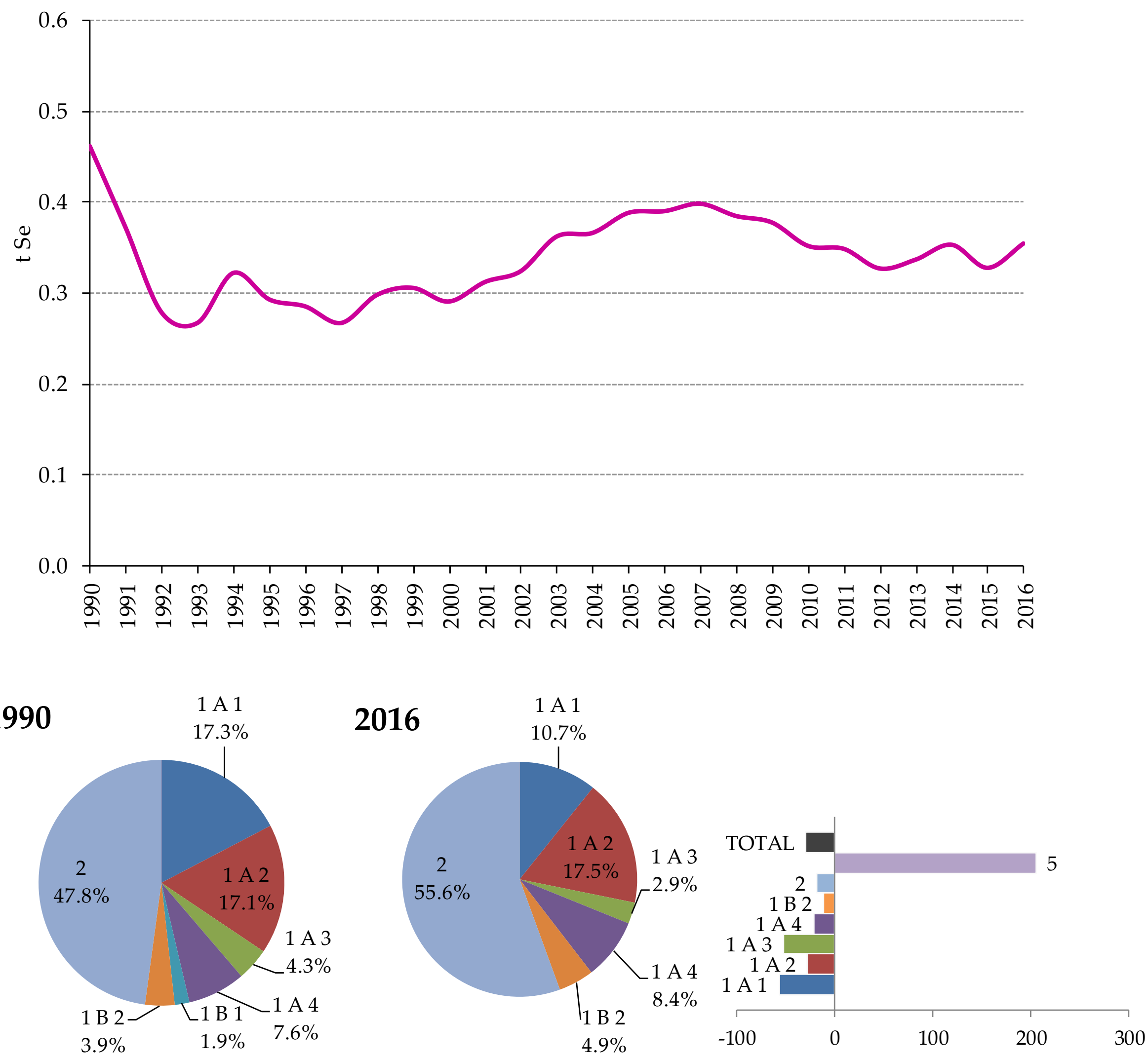



**Figure 3.9.5-1 The Se emissions (t/yr.) and percentage share by sector and variation in Se emissions**

**Table 3.9.5-1 The Se emissions by SNAP nomenclature in the period 1990-2016**

| Se | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1990 | 8.0E-02 | 3.3E-02 | 7.7E-02 | 0.25 | NA | NA | 1.5E-02 | 8.5E-03 | 3.6E-05 | NA | 0.46 |
| 1991 | 5.9E-02 | 3.2E-02 | 5.0E-02 | 0.22 | NA | NA | 2.9E-03 | 6.4E-03 | 4.2E-05 | NA | 0.37 |
| 1992 | 6.5E-02 | 2.5E-02 | 4.8E-02 | 0.13 | NA | NA | 2.8E-03 | 6.8E-03 | 5.0E-05 | NA | 0.28 |
| 1993 | 6.3E-02 | 2.7E-02 | 4.1E-02 | 0.13 | NA | NA | 3.0E-03 | 6.3E-03 | 6.0E-05 | NA | 0.27 |
| 1994 | 9.1E-02 | 2.3E-02 | 5.0E-02 | 0.15 | NA | NA | 3.2E-03 | 4.2E-03 | 6.5E-05 | NA | 0.32 |
| 1995 | 6.9E-02 | 2.4E-02 | 4.1E-02 | 0.15 | NA | NA | 3.3E-03 | 5.5E-03 | 6.5E-05 | NA | 0.29 |
| 1996 | 6.8E-02 | 2.7E-02 | 4.2E-02 | 0.14 | NA | NA | 3.6E-03 | 8.3E-03 | 7.1E-05 | NA | 0.29 |
| 1997 | 6.8E-02 | 2.5E-02 | 4.8E-02 | 0.12 | NA | NA | 4.0E-03 | 6.8E-03 | 7.3E-05 | NA | 0.27 |
| 1998 | 7.7E-02 | 2.5E-02 | 5.1E-02 | 0.14 | NA | NA | 4.3E-03 | 5.6E-03 | 6.9E-05 | NA | 0.30 |
| 1999 | 8.0E-02 | 2.5E-02 | 6.2E-02 | 0.13 | NA | NA | 4.6E-03 | 5.4E-03 | 6.8E-05 | NA | 0.31 |
| 2000 | 5.5E-02 | 2.2E-02 | 6.9E-02 | 0.14 | NA | NA | 4.7E-03 | 5.8E-03 | 6.5E-05 | NA | 0.29 |
| 2001 | 5.7E-02 | 2.4E-02 | 7.8E-02 | 0.14 | NA | NA | 4.3E-03 | 6.4E-03 | 6.4E-05 | NA | 0.31 |
| 2002 | 6.2E-02 | 2.3E-02 | 7.6E-02 | 0.15 | NA | NA | 4.6E-03 | 7.2E-03 | 7.0E-05 | NA | 0.32 |
| 2003 | 7.5E-02 | 2.7E-02 | 7.5E-02 | 0.17 | NA | NA | 5.0E-03 | 7.4E-03 | 7.3E-05 | NA | 0.36 |
| 2004 | 5.6E-02 | 2.6E-02 | 8.0E-02 | 0.19 | NA | NA | 5.2E-03 | 6.0E-03 | 7.3E-05 | NA | 0.37 |
| 2005 | 6.0E-02 | 2.7E-02 | 8.3E-02 | 0.21 | NA | NA | 5.4E-03 | 6.5E-03 | 7.8E-05 | NA | 0.39 |
| 2006 | 5.9E-02 | 2.5E-02 | 8.9E-02 | 0.20 | NA | NA | 5.8E-03 | 6.8E-03 | 7.8E-05 | NA | 0.39 |
| 2007 | 6.4E-02 | 2.4E-02 | 8.7E-02 | 0.21 | NA | NA | 6.3E-03 | 7.1E-03 | 8.6E-05 | NA | 0.40 |
| 2008 | 5.3E-02 | 2.4E-02 | 8.2E-02 | 0.21 | NA | NA | 6.1E-03 | 8.5E-03 | 8.4E-05 | NA | 0.38 |
| 2009 | 5.9E-02 | 2.5E-02 | 6.8E-02 | 0.21 | NA | NA | 6.1E-03 | 8.2E-03 | 8.6E-05 | NA | 0.38 |
| 2010 | 4.0E-02 | 2.7E-02 | 6.6E-02 | 0.21 | NA | NA | 5.9E-03 | 7.2E-03 | 8.9E-05 | NA | 0.35 |
| 2011 | 4.1E-02 | 2.6E-02 | 5.8E-02 | 0.21 | NA | NA | 5.8E-03 | 7.2E-03 | 9.1E-05 | NA | 0.35 |
| 2012 | 3.5E-02 | 2.6E-02 | 5.6E-02 | 0.20 | NA | NA | 5.7E-03 | 6.8E-03 | 9.2E-05 | NA | 0.33 |
| 2013 | 2.6E-02 | 2.5E-02 | 6.1E-02 | 0.21 | NA | NA | 5.9E-03 | 6.8E-03 | 9.4E-05 | NA | 0.34 |
| 2014 | 2.5E-02 | 2.2E-02 | 6.3E-02 | 0.23 | NA | NA | 5.7E-03 | 7.0E-03 | 1.0E-04 | NA | 0.35 |
| 2015 | 2.8E-02 | 2.6E-02 | 6.1E-02 | 0.20 | NA | NA | 6.1E-03 | 6.9E-03 | 1.1E-04 | NA | 0.33 |
| 2016 | 2.8E-02 | 2.5E-02 | 5.8E-02 | 0.23 | NA | NA | 6.2E-03 | 6.9E-03 | 1.1E-04 | NA | 0.35 |
| 2016 vs 1990 | -64.9% | -24.1% | -25.5% | -6.7% | NA | NA | -58.0% | -18.1% | 192.7% | NA | -23.0% |
| 2016 vs 2015 | -1.7% | -2.6% | -5.0% | 15.1% | NA | NA | 3.0% | 0.7% | -4.4% | NA | 8.0% |

### 3.9.6 Zinc (Zn)

The zinc emission in 2016 has amounted to 35 t (Figure and Table 3.9.6-1) and has decreased by 8.4 % since 1990. The major sources of Zn emission in Croatia is fuel combustion in energy sector which has contributed with 99.2 % to national total in 2015. Key sources in 2016 were: small combustion sector (72 %), transport (15.9 %) and manufacturing industry and construction (7.7 %).

Zinc is mostly emitted as a result of biomass combustion in residential sector, due to its content in wood.

The Zn emission trend shows a decline because of stopping the steel production in the open hearth furnace steel plant in 1992. Those emission originated from Zn content in the raw material for Siemens Martin' furnaces. Stopping that process in Sisak in 1992, was a result of the war for Croatian independence (1991-1995).

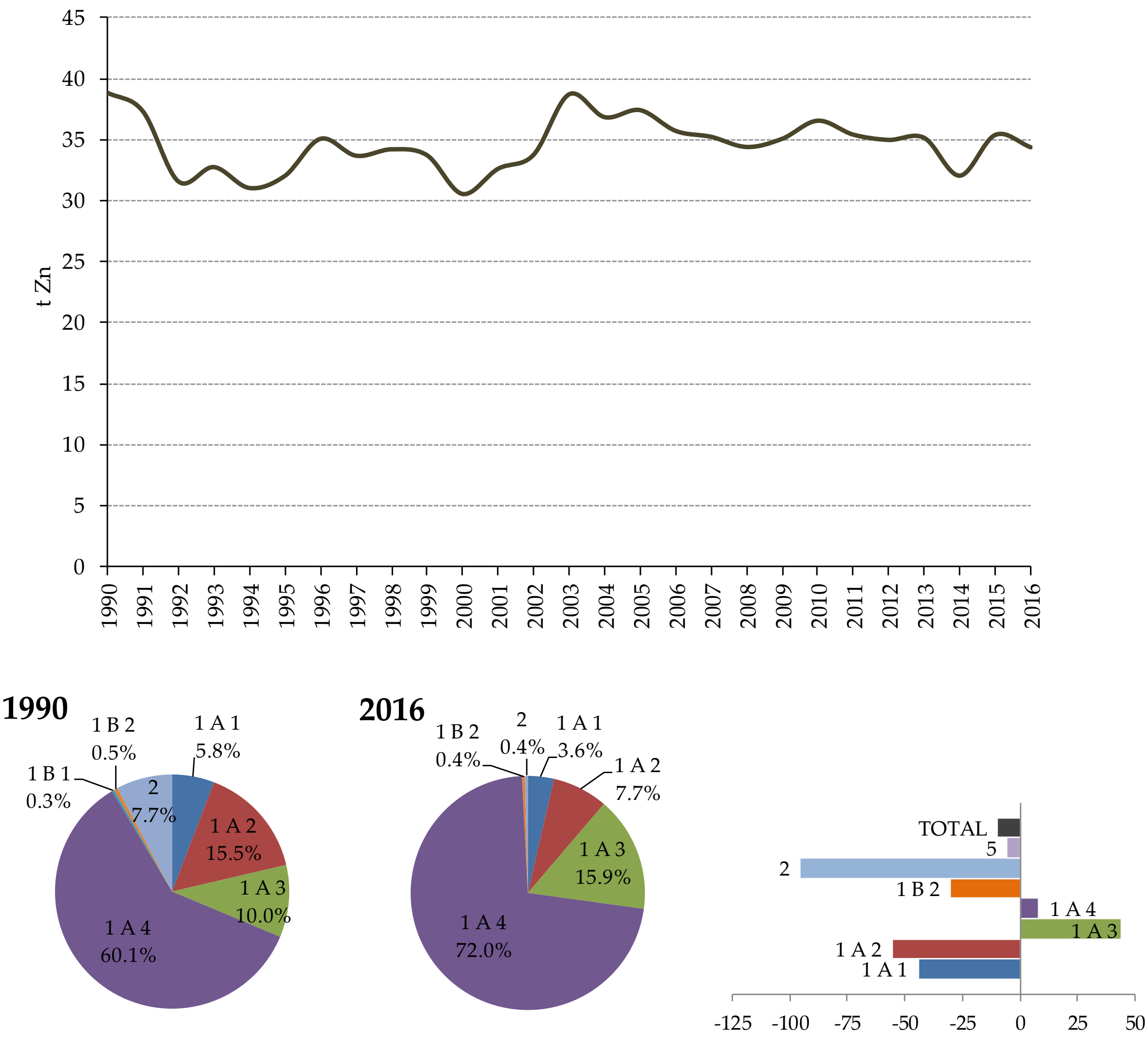



**Figure 3.9.6-1 The Zn emissions (t/yr.) and percentage share by sector and variation in Zn emissions**

**Table 3.9.6-1 The Zn emissions by SNAP nomenclature in the period 1990-2016**

| **Zn** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1990 | 2.3 | 23.1 | 5.9 | 3.1 | NA | 0.22 | 3.7 | 0.5 | 0.05 | NA | 38.8 |
| 1991 | 1.7 | 26.4 | 4.3 | 1.5 | NA | 0.21 | 2.8 | 0.4 | 0.04 | NA | 37.3 |
| 1992 | 1.7 | 22.8 | 3.4 | 0.6 | NA | 0.22 | 2.7 | 0.2 | 0.03 | NA | 31.6 |
| 1993 | 1.7 | 24.1 | 3.1 | 0.5 | NA | 0.21 | 2.8 | 0.2 | 0.04 | NA | 32.8 |
| 1994 | 2.4 | 21.7 | 2.9 | 0.5 | NA | 0.20 | 3.0 | 0.3 | 0.04 | NA | 31.1 |
| 1995 | 2.1 | 22.9 | 2.9 | 0.3 | NA | 0.35 | 3.2 | 0.2 | 0.04 | NA | 32.1 |
| 1996 | 2.0 | 25.7 | 2.8 | 0.3 | NA | 0.50 | 3.5 | 0.3 | 0.04 | NA | 35.1 |
| 1997 | 1.9 | 23.6 | 3.2 | 0.4 | NA | 0.49 | 3.9 | 0.3 | 0.04 | NA | 33.7 |
| 1998 | 2.1 | 23.7 | 3.1 | 0.5 | NA | 0.34 | 4.1 | 0.3 | 0.04 | NA | 34.2 |
| 1999 | 2.2 | 23.3 | 2.8 | 0.5 | NA | 0.29 | 4.4 | 0.3 | 0.05 | NA | 33.7 |
| 2000 | 1.6 | 20.7 | 2.8 | 0.5 | NA | 0.22 | 4.4 | 0.3 | 0.05 | NA | 30.6 |
| 2001 | 1.5 | 22.7 | 2.8 | 0.4 | NA | 0.48 | 4.3 | 0.4 | 0.05 | NA | 32.6 |
| 2002 | 1.7 | 21.8 | 2.8 | 0.3 | NA | 2.21 | 4.6 | 0.4 | 0.04 | NA | 33.8 |
| 2003 | 2.0 | 25.1 | 2.9 | 0.4 | NA | 3.04 | 5.0 | 0.4 | 0.04 | NA | 38.7 |
| 2004 | 1.6 | 24.4 | 3.1 | 0.6 | NA | 1.65 | 5.1 | 0.4 | 0.04 | NA | 36.8 |
| 2005 | 1.6 | 25.8 | 3.0 | 0.5 | NA | 0.76 | 5.3 | 0.4 | 0.04 | NA | 37.4 |
| 2006 | 1.6 | 23.7 | 3.3 | 0.5 | NA | 0.58 | 5.6 | 0.4 | 0.04 | NA | 35.7 |
| 2007 | 1.7 | 22.8 | 3.2 | 0.5 | NA | 0.42 | 6.0 | 0.4 | 0.04 | NA | 35.2 |
| 2008 | 1.4 | 22.9 | 2.7 | 0.7 | NA | 0.31 | 5.9 | 0.5 | 0.04 | NA | 34.4 |
| 2009 | 1.5 | 23.9 | 2.6 | 0.4 | NA | 0.15 | 5.9 | 0.4 | 0.04 | NA | 35.1 |
| 2010 | 1.2 | 25.7 | 2.9 | 0.6 | NA | 0.08 | 5.7 | 0.4 | 0.02 | NA | 36.5 |
| 2011 | 1.4 | 25.1 | 2.4 | 0.5 | NA | 0.07 | 5.5 | 0.4 | 0.03 | NA | 35.4 |
| 2012 | 1.3 | 25.0 | 2.6 | 0.2 | NA | 0.03 | 5.5 | 0.4 | 0.03 | NA | 35.0 |
| 2013 | 1.0 | 24.8 | 2.5 | 0.4 | NA | 0.40 | 5.6 | 0.4 | 0.03 | NA | 35.1 |
| 2014 | 1.0 | 21.9 | 2.2 | 0.8 | NA | 0.29 | 5.5 | 0.4 | 0.03 | NA | 32.1 |
| 2015 | 1.2 | 25.1 | 1.9 | 0.7 | NA | 0.28 | 5.8 | 0.4 | 0.04 | NA | 35.4 |
| 2016 | 1.4 | 24.4 | 1.7 | 0.3 | NA | 0.35 | 5.9 | 0.4 | 0.04 | NA | 34.4 |
| 2016 vs 1990 | -37.1% | 5.4% | -71.5% | -91.7% | NA | 63.3% | 59.1% | -28.7% | -21.9% | NA | -11.4% |
| 2016 vs 2015 | 16.8% | -2.9% | -13.4% | -63.3% | NA | 25.6% | 2.6% | 0.5% | 12.8% | NA | -2.8% |

## 3.10 PERSISTENT ORGANIC POLLUTANTS (POPs)

Persistent organic pollutants (POPs) are organic substances with toxic properties, resistant to chemical, photochemical, and biochemical degradation. They can accumulate in the fatty tissues of living organisms and are toxic to humans and wildlife. They also remain stable in the environment for a long period of time and can distribute easily through air, water and across the national border and can be deposited far from their place of their release.

With the aim for POPs emissions reductions, the Executive Body adopted the Protocol on Persistent Organic Pollutants on June 1998 in Aarhus (Denmark) in the framework of LRTAP Convention for urgent global actions to control, reduce and eliminate emissions of these chemicals. Annual reduction of POPs (polycyclic aromatic hydrocarbons (PAHs), Dioxins/furans, and hexachlorocyclohexane) emissions from a specified reference year achieved by taking appropriate effective measures is one of the Protocols basic obligation for countries that are Parties to the Protocol. Each Party should develop and maintain emission inventories for these substances.

The Republic of Croatia has ratified Protocol on POPs by Low on ratification of the Protocol to the 1979 Convention on long-range transboundary air pollution on Persistent Organic Pollutants (OG-IT 05/07) in 2007.

In 1996, the Republic of Croatia has started to calculate estimate the POPs emissions in accordance with EMEP/CORINAIR methodology, officially adopted by the Executive Body of the LARTAP Convention. Persistent organic pollutants are divided into three groups: industrial chemicals, polycyclic aromatic hydrocarbons and dioxins and furans (Table 3.10-1). Reporting for HCH – Hexachlorocyclohexane (lindan) emissions is excluded from the obligation to report since 2015.

**Table 3.10-1 Persistent organic pollutants (POPs)**

| Group | POPs |
|---|---|
| Dioxins and furans (PCDD/PCDF) | PCDD – polychlorinated dibenzo-dioxins |
| | PCDF – polychlorinated dibenzo-furans |
| Polycyclic aromatic hydrocarbons (PAHs) | Benzo(a) pyrene |
| | Benzo(b) fluoranthene |
| | Benzo(k) fluoranthene |
| | Indeno(1,2,3-cd) pyrene |
| Industrial chemicals or by-product of the chemical synthesis | HCB – Hexachlorobenzene |
| | PCBs – Polychlorinated biphenyls |

### 3.10.1 Dioxin and furans (PCDD/PCDF)

Dioxins and furans are persistent organic compounds that occur as a product of combustion of organic matter that contains chlorine (Cl) at temperatures between 250°C and 400°C and can occur in all sectors. The largest emission of dioxins and furans occur when burning wood in households. Other processes that contribute to these emissions are the processes of steel production in arc furnaces, fuel combustion in transport sectors, waste incineration and cremation.

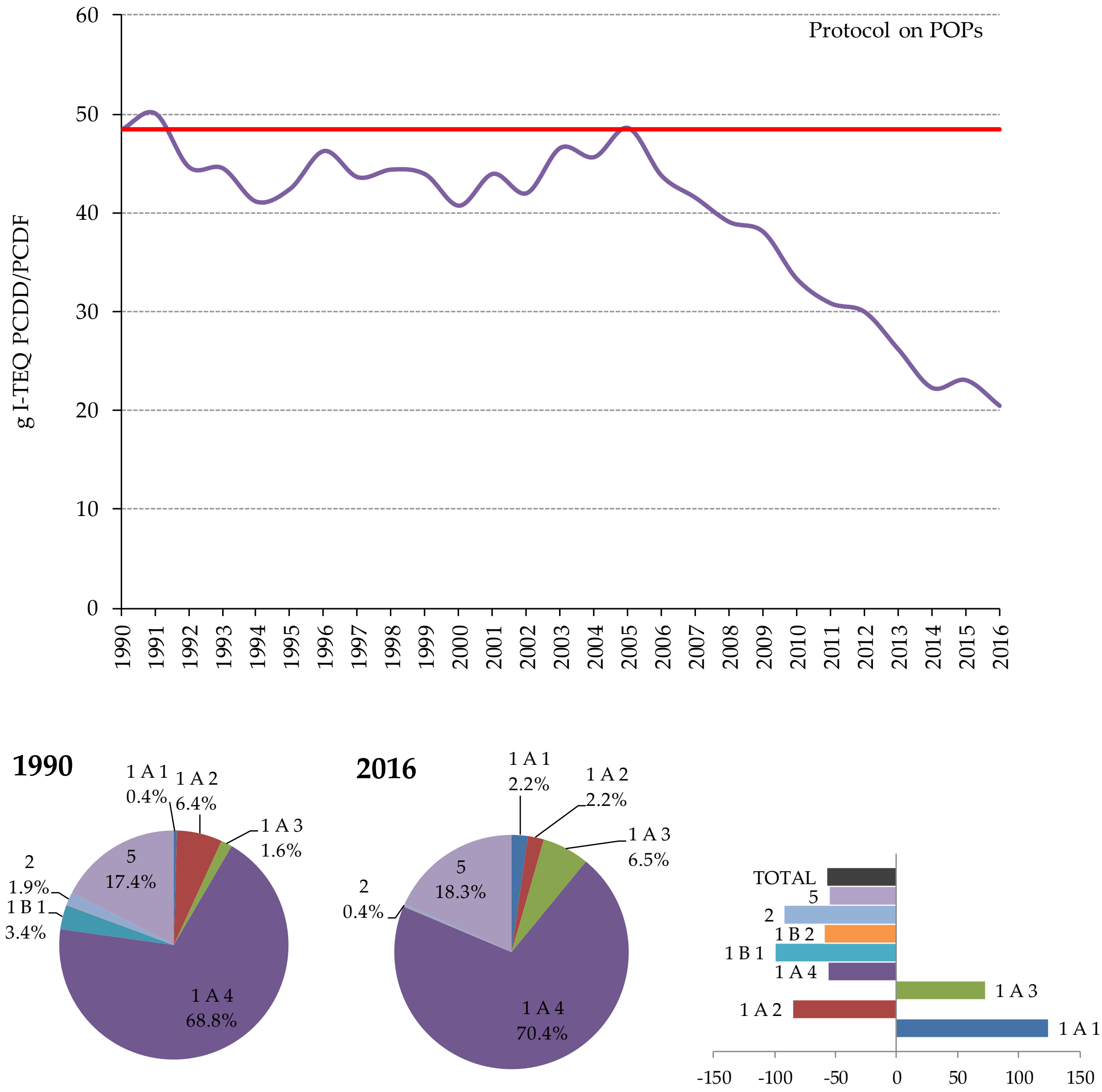



**Figure 3.10.1-1 The PCDD/PCDF emissions (g I-TEQ/yr.) and percentage share by sector and variation in PCDD/PCDF emissions**

In 2016, PCDD/F emission has amounted to 20.5 g I- TEQ (Figure and Table 3.10.1-1). Emission has decreased by 57.7 % since 1990. The main contributor in PCDD/F emission during whole observing period is fuel combustion in energy sector. A key sources in 2016 were small combustion sector with domination of combustion in residential. Fluctuations in the trend are directly dependent on the amount of biomass use in small furnaces, fuel combustion in other energy sectors and on the amount of waste incinerated. A reduction in emissions in 1991 and 1992 is the result of reduced energy consumption in these sectors in particular biomass and coal, due to the war for Croatian independence (1991 - 1995). A significant reduction since 2005 is a result of gradual replacement of certain percentage of traditional domestic stoves and manual single house boilers with advanced/ecolabelled stoves and boilers and pellet stoves and boilers (see Table 4.5-1 and Figure 4.5-2).

Croatia has the obligation toward the Protocol on POPs to keep PCDD/F emissions beyond the value in base year (1990). Croatia is fulfilling an obligation towards the Protocol on POPs.

**Table 3.10.1-1 The PCDD/PCDF emissions by SNAP nomenclature in the period 1990-2016**

| PCDD/ PCDF | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SNAP | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | TOTAL |
| Unit | g I-TEQ | g I-TEQ | g I-TEQ | g I-TEQ | g I-TEQ | g I-TEQ | g I-TEQ | g I-TEQ | g I-TEQ | g I-TEQ | g I-TEQ |
| 1990 | 0.20 | 33.3 | 3.1 | 2.59 | NA | NA | 0.41 | 0.36 | 8.4 | NA | 48.4 |
| 1991 | 0.15 | 37.6 | 2.1 | 2.01 | NA | NA | 0.31 | 0.26 | 7.6 | NA | 50.0 |
| 1992 | 0.19 | 31.9 | 1.3 | 1.54 | NA | NA | 0.27 | 0.30 | 9.1 | NA | 44.6 |
| 1993 | 0.17 | 33.6 | 1.1 | 1.51 | NA | NA | 0.27 | 0.23 | 7.6 | NA | 44.5 |
| 1994 | 0.20 | 30.3 | 1.1 | 1.04 | NA | NA | 0.29 | 0.15 | 8.1 | NA | 41.1 |
| 1995 | 0.16 | 32.0 | 1.1 | 0.15 | NA | NA | 0.31 | 0.19 | 8.6 | NA | 42.4 |
| 1996 | 0.14 | 35.8 | 1.0 | 0.15 | NA | NA | 0.33 | 0.25 | 8.6 | NA | 46.2 |
| 1997 | 0.19 | 32.9 | 1.0 | 0.22 | NA | NA | 0.37 | 0.21 | 8.7 | NA | 43.6 |
| 1998 | 0.21 | 33.2 | 0.8 | 0.33 | NA | NA | 0.40 | 0.21 | 9.2 | NA | 44.4 |
| 1999 | 0.20 | 32.7 | 0.7 | 0.25 | NA | NA | 0.43 | 0.21 | 9.4 | NA | 43.9 |
| 2000 | 0.24 | 29.1 | 0.7 | 0.24 | NA | NA | 0.43 | 0.21 | 9.9 | NA | 40.7 |
| 2001 | 0.26 | 31.9 | 0.6 | 0.19 | NA | NA | 0.40 | 0.21 | 10.3 | NA | 43.9 |
| 2002 | 0.31 | 30.6 | 0.6 | 0.12 | NA | NA | 0.41 | 0.23 | 9.7 | NA | 42.0 |
| 2003 | 0.34 | 35.4 | 0.5 | 0.15 | NA | NA | 0.42 | 0.24 | 9.6 | NA | 46.6 |
| 2004 | 0.29 | 34.4 | 0.6 | 0.28 | NA | NA | 0.40 | 0.24 | 9.4 | NA | 45.6 |
| 2005 | 0.31 | 36.6 | 0.5 | 0.25 | NA | NA | 1.05 | 0.26 | 9.6 | NA | 48.6 |
| 2006 | 0.30 | 31.8 | 0.6 | 0.26 | NA | NA | 0.41 | 0.27 | 10.0 | NA | 43.7 |
| 2007 | 0.32 | 28.9 | 0.7 | 0.25 | NA | NA | 0.42 | 0.28 | 10.6 | NA | 41.5 |
| 2008 | 0.31 | 27.4 | 0.5 | 0.44 | NA | NA | 1.20 | 0.33 | 9.0 | NA | 39.1 |
| 2009 | 0.25 | 26.8 | 0.5 | 0.16 | NA | NA | 0.41 | 0.37 | 9.6 | NA | 38.1 |
| 2010 | 0.28 | 26.9 | 0.8 | 0.33 | NA | NA | 0.38 | 0.28 | 4.3 | NA | 33.3 |
| 2011 | 0.34 | 24.4 | 0.6 | 0.30 | NA | NA | 0.38 | 0.29 | 4.6 | NA | 30.8 |
| 2012 | 0.31 | 22.4 | 0.6 | 0.03 | NA | NA | 0.36 | 0.27 | 5.9 | NA | 30.0 |
| 2013 | 0.33 | 20.4 | 0.6 | 0.21 | NA | NA | 0.35 | 0.31 | 3.9 | NA | 26.2 |

| PCDD/ PCDF | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **g I-TEQ** | **g I-TEQ** | **g I-TEQ** | **g I-TEQ** | **g I-TEQ** | **g I-TEQ** | **g I-TEQ** | **g I-TEQ** | **g I-TEQ** | **g I-TEQ** | **g I-TEQ** |
| 2014 | 0.32 | 16.2 | 0.5 | 0.53 | NA | NA | 1.00 | 0.34 | 3.4 | NA | 22.3 |
| 2015 | 0.36 | 16.8 | 0.5 | 0.46 | NA | NA | 1.04 | 0.33 | 3.6 | NA | 23.1 |
| 2016 | 0.5 | 14.4 | 0.5 | 0.08 | NA | NA | 0.99 | 0.34 | 3.7 | NA | 20.5 |
| 2016 vs 1990 | 124.7% | -56.7% | -85.4% | -96.9% | NA | NA | 142.1% | -5.9% | -55.7% | NA | -57.7% |
| 2016 vs 2015 | 26.8% | -14.4% | -6.4% | -82.3% | NA | NA | -4.6% | 1.5% | 4.8% | NA | -11.3% |

### 3.10.2 Polycyclic aromatic hydrocarbons (PAHs)

There are more than 100 of different polycyclic aromatic hydrocarbons, and annual emission report is provided for four of them as follows: benzo (a) pyrene, benzo (b) fluoranthene, benzo (k) fluoranthene, indeno (1,2,3-cd) pyrene. The four PAHs are those defined by the Aarhus protocol. Emission of PAHs in 2016 by sectors is presented in Figure 3.10.2-1 and Table 3.10.2-1.

Emissions of PAHs were estimated to about 6.9 t in 2016, and have declined by 70.6 % since 1990. Great reduction in PAHs emission has occurred mostly due to decrease in coal consumption in residential sector and also because of stopping the processes of primary aluminium production (with Söderberg anodes) in Šibenik in 1992, pig iron production (blast furnace charging) in Sisak and Split in 1992, and coke production in Bakar in 1994. All this happened as a result of the war for Croatian independence (1991 - 1995). A significant reduction since 2005 is a result of gradual replacement of certain percentage of traditional domestic stoves and manual single house boilers with advanced/ecolabelled stoves and boilers and pellet stoves and boilers (see Table 4.5-1 and Figure 4.5-2).

Croatia has the obligation toward the Protocol on POPs to keep the overall PAHs emission beyond the value in base year (1990). Croatia fulfils the obligation towards the Protocol on POPs.

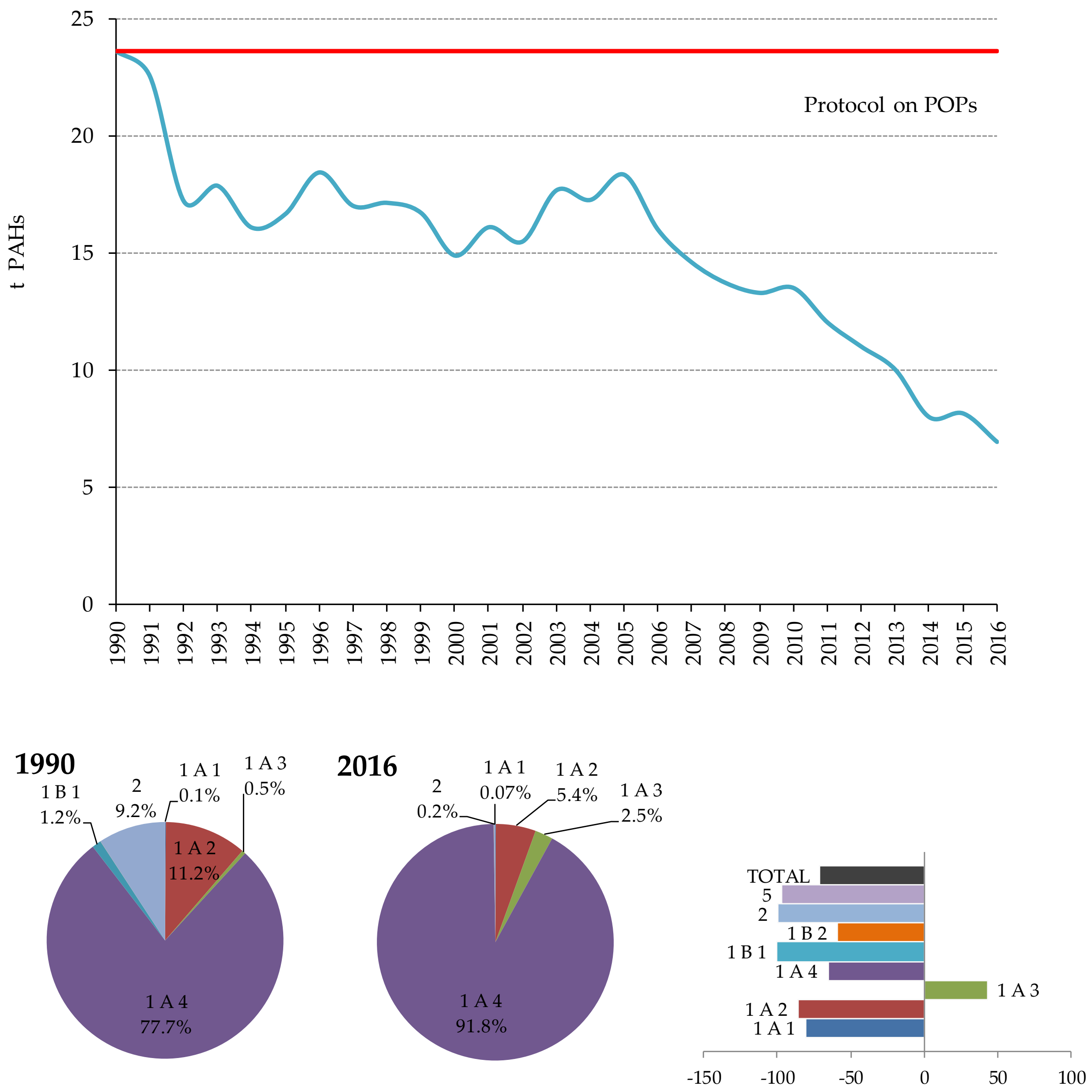



**Figure 3.10.2-1 The PAHs emissions (kg/yr.), percentage share by sector and variation in PAHs emissions**

**Table 3.10.2-1 PAHs emissions by SNAP nomenclature in the period 1990-2016**

| PAH | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1990 | 2,6E-02 | 18,36 | 2,64 | 2,47 | NA | 3,9E-03 | 0,06 | 8,6E-02 | 1,0E-05 | NA | 23,65 |
| 1991 | 1,9E-02 | 19,25 | 1,77 | 1,44 | NA | 3,1E-03 | 0,05 | 4,0E-02 | 8,6E-06 | NA | 22,57 |
| 1992 | 2,5E-02 | 15,71 | 1,16 | 0,27 | NA | 3,8E-03 | 0,05 | 1,7E-02 | 8,3E-06 | NA | 17,23 |
| 1993 | 2,3E-02 | 16,51 | 1,02 | 0,26 | NA | 3,4E-03 | 0,05 | 2,0E-02 | 8,8E-06 | NA | 17,90 |
| 1994 | 4,5E-02 | 14,78 | 1,02 | 0,18 | NA | 2,5E-03 | 0,06 | 3,1E-02 | 8,8E-06 | NA | 16,11 |
| 1995 | 2,5E-02 | 15,54 | 1,01 | NA | NA | 3,9E-03 | 0,06 | 2,8E-02 | 9,7E-06 | NA | 16,69 |

| PAH | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1996 | 2,0E-02 | 17,38 | 0,94 | NA | NA | 4,0E-03 | 0,06 | 3,1E-02 | 9,2E-06 | NA | 18,46 |
| 1997 | 2,5E-02 | 15,95 | 0,91 | NA | NA | 3,8E-03 | 0,07 | 2,9E-02 | 2,5E-05 | NA | 17,03 |
| 1998 | 3,2E-02 | 16,14 | 0,83 | NA | NA | 4,0E-03 | 0,08 | 3,3E-02 | 4,8E-05 | NA | 17,16 |
| 1999 | 3,4E-02 | 15,89 | 0,66 | NA | NA | 4,6E-03 | 0,08 | 3,2E-02 | 5,6E-05 | NA | 16,74 |
| 2000 | 1,5E-02 | 14,10 | 0,64 | NA | NA | 4,0E-03 | 0,08 | 3,5E-02 | 7,8E-05 | NA | 14,91 |
| 2001 | 1,9E-02 | 15,34 | 0,60 | NA | NA | 5,0E-03 | 0,08 | 3,6E-02 | 8,4E-05 | NA | 16,12 |
| 2002 | 1,9E-02 | 14,75 | 0,60 | NA | NA | 5,4E-03 | 0,09 | 3,5E-02 | 4,8E-05 | NA | 15,51 |
| 2003 | 2,7E-02 | 17,03 | 0,47 | NA | NA | 7,7E-03 | 0,10 | 3,6E-02 | 1,2E-05 | NA | 17,70 |
| 2004 | 1,4E-02 | 16,52 | 0,56 | NA | NA | 8,2E-03 | 0,11 | 3,7E-02 | 6,3E-06 | NA | 17,29 |
| 2005 | 1,7E-02 | 17,59 | 0,55 | NA | NA | 7,2E-03 | 0,11 | 4,0E-02 | 3,9E-06 | NA | 18,36 |
| 2006 | 1,7E-02 | 15,21 | 0,56 | NA | NA | 6,1E-03 | 0,12 | 4,3E-02 | 1,1E-05 | NA | 16,00 |
| 2007 | 1,8E-02 | 13,72 | 0,64 | NA | NA | 7,4E-03 | 0,14 | 4,5E-02 | 9,9E-06 | NA | 14,61 |
| 2008 | 1,7E-02 | 12,94 | 0,52 | NA | NA | 7,3E-03 | 0,13 | 5,0E-02 | 1,0E-05 | NA | 13,73 |
| 2009 | 1,8E-02 | 12,57 | 0,52 | NA | NA | 7,4E-03 | 0,13 | 4,5E-02 | 4,3E-06 | NA | 13,31 |
| 2010 | 4,8E-03 | 12,62 | 0,66 | NA | NA | 8,1E-03 | 0,13 | 4,3E-02 | 2,1E-06 | NA | 13,52 |
| 2011 | 7,0E-03 | 11,33 | 0,49 | NA | NA | 6,4E-03 | 0,13 | 4,3E-02 | 2,7E-06 | NA | 12,05 |
| 2012 | 5,6E-03 | 10,35 | 0,48 | NA | NA | 7,3E-03 | 0,13 | 4,1E-02 | 3,0E-06 | NA | 11,01 |
| 2013 | 3,4E-03 | 9,35 | 0,46 | NA | NA | 9,2E-03 | 0,13 | 4,0E-02 | 2,9E-06 | NA | 10,03 |
| 2014 | 2,7E-03 | 7,33 | 0,41 | NA | NA | 3,0E-03 | 0,13 | 4,0E-02 | 3,1E-06 | NA | 8,00 |
| 2015 | 4,7E-03 | 7,52 | 0,37 | NA | NA | 3,6E-03 | 0,14 | 4,1E-02 | 3,7E-06 | NA | 8,16 |
| 2016 | 5,1E-03 | 6,36 | 0,37 | NA | NA | 2,8E-03 | 0,15 | 4,3E-02 | 4,3E-06 | NA | 6,94 |
| 2016 vs 1990 | -80,3% | -65,4% | -86,0% | NA | NA | -28,1% | 143,4% | -50,2% | -57,4% | NA | -70,6% |
| 2016 vs 2015 | 7,7% | -15,5% | -0,1% | NA | NA | -23,7% | 4,7% | 4,3% | 14,3% | NA | -14,9% |

### 3.10.3 Hexachlorobenzene (HCB)

Hexachlorobenzene (HCB) is an industrial chemical. The HCB emission occurs mainly from biomass and solid fuel combustion and in minor extent from waste incineration if it exists in the county. The dominance in HCB emission in the Republic of Croatia has biomass and coal combustion in residential sector.

The HCB emission in 2016 has amounted to 0.30 t (Figure and Table 3.10.3-1). In comparison to 1990, HCB emission has increased by 8.9 %, mainly due to increase in biomass combustion in residential heating furnaces. Public electricity and heat production sector (in particularly, thermal power plants on coal) is the sector with increasing influence in HCB emission over time (11.4 % in 2016).

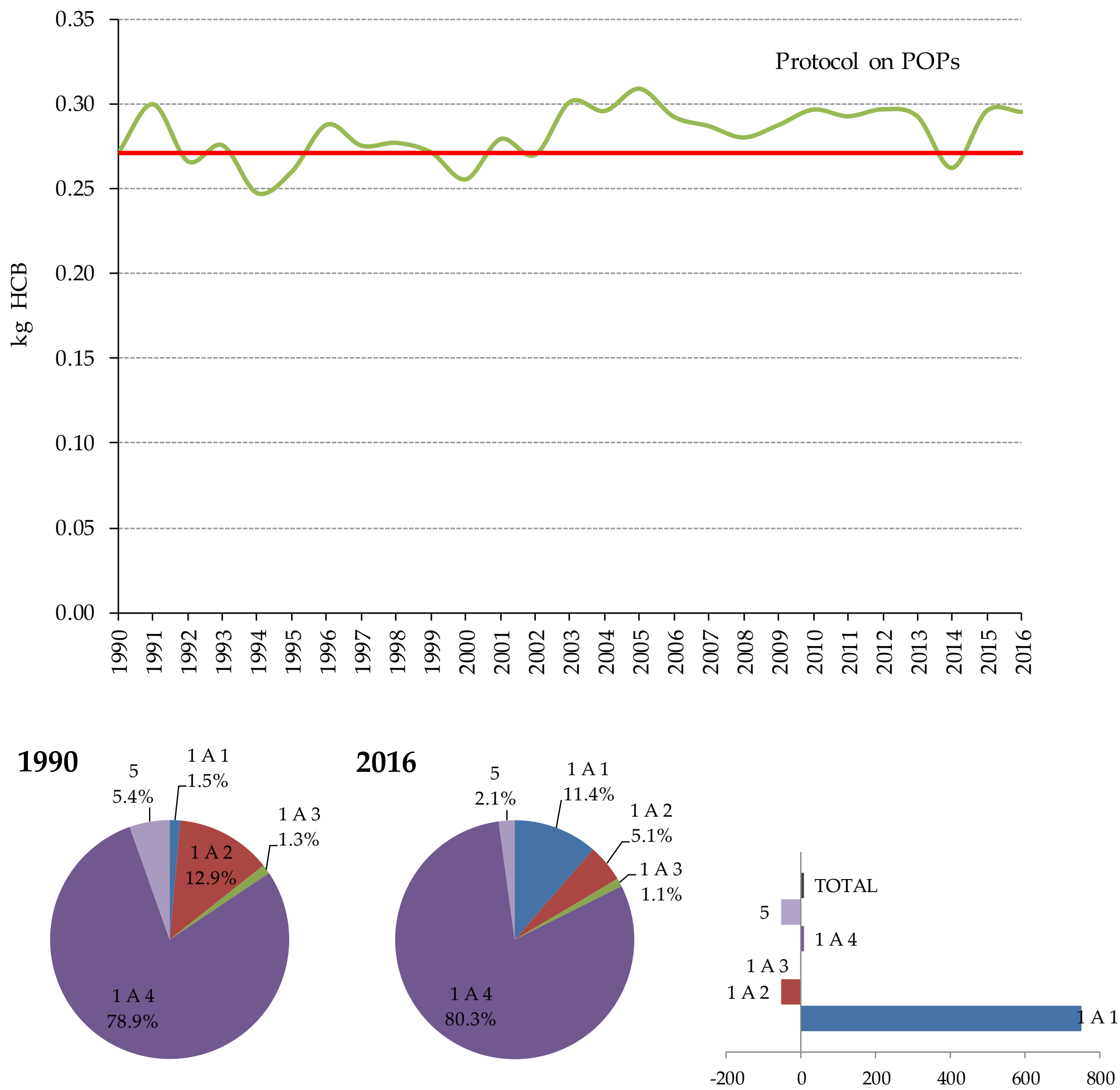



**Figure 3.10.3-1 The HCB emission (kg/yr.), percentage share by sector and variation in HCB emissions**

The Republic of Croatia has the obligation toward the Protocol on POPs to keep the overall HCB emission beyond the value in base year (1990). In 2016, this obligation was not fulfilled. Failure to comply with the obligation is the result of a recalculation of biomass consumption in small combustion sector (with domination of residential), which increased by 33 PJ in the period from 1991 to 2014, except for 1990, for which consumption only increased by 23 PJ. Consequently, there has been a significant increase in HCB emissions throughout the historical trend, except in 1990, for which HCB increase was the lowest. Recalculation of the biomass consumption trend in the small combustion sector (commercial / institutional and residential sector) is the result of the European IPA Project and is officially registered in the EUROSTAT database. In 2016, Croatia exceeded the HCB base year emission level by 24 grams. The new estimated (recalculated) consumption of biomass for 1990 is relatively low compared to the value before recalculation. The amount of biomass in 1990 before recalculation was about 28% higher than the average historical trend, thus enabling fulfilment of the obligation by taking the logical increasing trend of biomass consumption in recent years, due to the relatively lower cost of this energy source compared to the other, but also because of the global policy on the standpoint greenhouse gas emissions, where biomass consumption is encouraged because there is no $CO_2$ emission.

**Table 3.10.3-1 The HCB emission by SNAP nomenclature in the period 1990-2016**

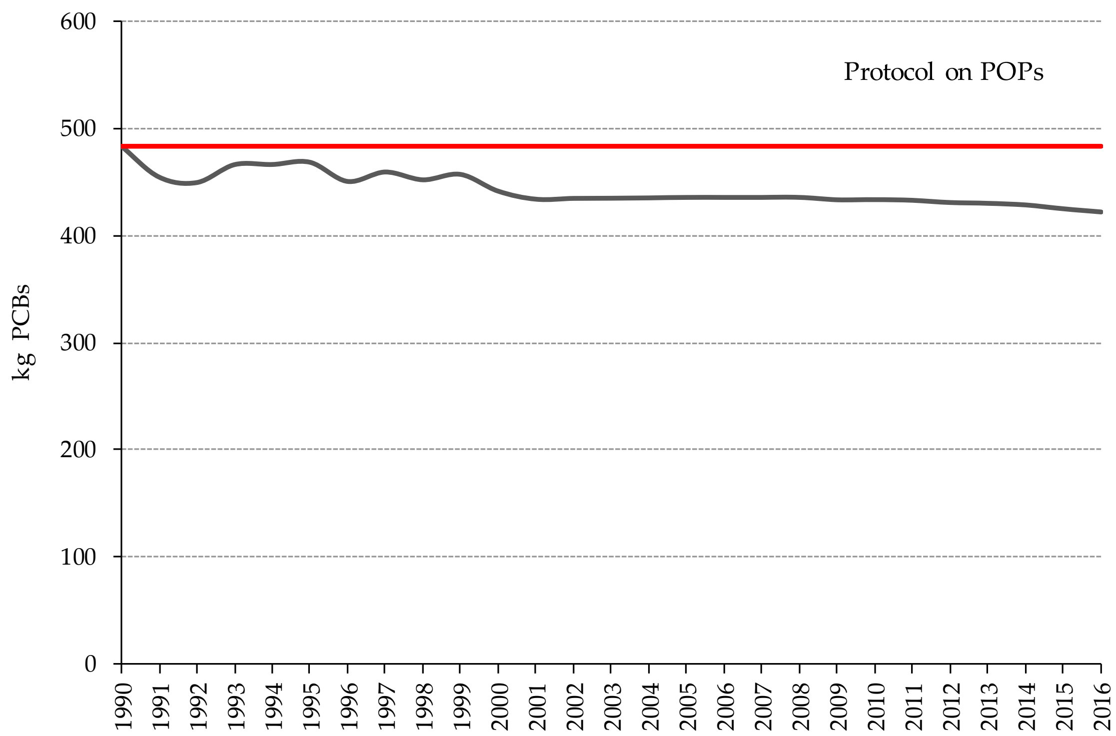
| HCB | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** |
| 1990 | 4.0E-03 | 0.21 | 3.5E-02 | NA | NA | NA | NA | 3.5E-03 | 1.5E-02 | NA | 0.27 |
| 1991 | 2.8E-03 | 0.25 | 2.8E-02 | NA | NA | NA | NA | 2.8E-03 | 1.5E-02 | NA | 0.30 |
| 1992 | 4.0E-03 | 0.22 | 2.4E-02 | NA | NA | NA | NA | 4.1E-03 | 1.5E-02 | NA | 0.27 |
| 1993 | 3.0E-03 | 0.23 | 2.3E-02 | NA | NA | NA | NA | 3.7E-03 | 1.5E-02 | NA | 0.28 |
| 1994 | 6.0E-04 | 0.21 | 2.1E-02 | NA | NA | NA | NA | 1.6E-03 | 1.5E-02 | NA | 0.25 |
| 1995 | 1.5E-03 | 0.22 | 2.0E-02 | NA | NA | NA | NA | 2.7E-03 | 1.5E-02 | NA | 0.26 |
| 1996 | 8.7E-04 | 0.25 | 2.0E-02 | NA | NA | NA | NA | 4.6E-03 | 1.5E-02 | NA | 0.29 |
| 1997 | 3.6E-03 | 0.23 | 2.5E-02 | NA | NA | NA | NA | 3.6E-03 | 1.7E-02 | NA | 0.28 |
| 1998 | 3.6E-03 | 0.23 | 2.4E-02 | NA | NA | NA | NA | 2.5E-03 | 1.9E-02 | NA | 0.28 |
| 1999 | 3.1E-03 | 0.22 | 2.2E-02 | NA | NA | NA | NA | 2.3E-03 | 2.0E-02 | NA | 0.27 |
| 2000 | 9.0E-03 | 0.20 | 2.3E-02 | NA | NA | NA | NA | 2.2E-03 | 2.2E-02 | NA | 0.26 |
| 2001 | 1.0E-02 | 0.22 | 2.4E-02 | NA | NA | NA | NA | 2.5E-03 | 2.4E-02 | NA | 0.28 |
| 2002 | 1.3E-02 | 0.21 | 2.4E-02 | NA | NA | NA | NA | 3.2E-03 | 2.1E-02 | NA | 0.27 |
| 2003 | 1.4E-02 | 0.24 | 2.5E-02 | NA | NA | NA | NA | 3.2E-03 | 1.8E-02 | NA | 0.30 |
| 2004 | 1.3E-02 | 0.24 | 2.7E-02 | NA | NA | NA | NA | 2.3E-03 | 1.8E-02 | NA | 0.30 |
| 2005 | 1.4E-02 | 0.25 | 2.6E-02 | NA | NA | NA | NA | 2.5E-03 | 1.8E-02 | NA | 0.31 |
| 2006 | 1.3E-02 | 0.23 | 2.9E-02 | NA | NA | NA | NA | 2.6E-03 | 1.9E-02 | NA | 0.29 |
| 2007 | 1.4E-02 | 0.22 | 2.8E-02 | NA | NA | NA | NA | 2.7E-03 | 2.1E-02 | NA | 0.29 |
| 2008 | 1.4E-02 | 0.22 | 2.4E-02 | NA | NA | NA | NA | 3.4E-03 | 1.7E-02 | NA | 0.28 |
| 2009 | 9.7E-03 | 0.23 | 2.3E-02 | NA | NA | NA | NA | 3.7E-03 | 1.9E-02 | NA | 0.29 |
| 2010 | 1.4E-02 | 0.25 | 2.5E-02 | NA | NA | NA | NA | 3.1E-03 | 6.1E-03 | NA | 0.30 |
| 2011 | 1.9E-02 | 0.24 | 2.1E-02 | NA | NA | NA | NA | 3.1E-03 | 6.4E-03 | NA | 0.29 |
| 2012 | 1.8E-02 | 0.24 | 2.3E-02 | NA | NA | NA | NA | 2.9E-03 | 1.0E-02 | NA | 0.30 |
| 2013 | 2.0E-02 | 0.24 | 2.3E-02 | NA | NA | NA | NA | 3.1E-03 | 5.5E-03 | NA | 0.29 |
| 2014 | 2.0E-02 | 0.21 | 2.0E-02 | NA | NA | NA | NA | 3.4E-03 | 5.8E-03 | NA | 0.26 |
| 2015 | 2.4E-02 | 0.24 | 1.8E-02 | NA | NA | NA | NA | 3.3E-03 | 6.0E-03 | NA | 0.30 |

| **HCB** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** |
| 2016 | 3.4E-02 | 0.24 | 1.5E-02 | NA | NA | NA | NA | 3.3E-03 | 6.3E-03 | NA | 0.30 |
| 2016 vs 1990 | 750.1% | 10.7% | -56.8% | NA | NA | NA | 0.0 | -5.1% | -56.9% | NA | 8.9% |
| 2016 vs 2015 | 37.3% | -2.9% | -15.8% | NA | NA | NA | 7.0 | 1.5% | 5.9% | NA | -0.2% |

### 3.10.4 Polychlorinated biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are industrial chemicals. The dominant source of PCBs emission is consumption of POPs and heavy metals sector (NFR 2.K), activity in the scope of industrial processes and product use sector. Other sectors steel production (2.C.1), the clinical waste incineration (6.C.a) and fuel combustion have minor contribution in total PCBs emission in Croatia.

Emission of PCBs in 2016 was estimated to about 422.3 kg (Figure and Table 3.10.4-1). A key source in overall trend, consumption of POPs and heavy metals sector includes PCBs emission from the refrigeration and air conditioning equipment using halocarbons (SNAP 060502), the foam blowing (SNAP 060504 except 060304) and the electrical equipment (SNAP 060507 except 060203). This source has contributed with 98.9 % to national PCBs emission in 2016. Changes in PCBs emission are minimal and are directly depending on the population figure in Croatia, since the emission from a key source is calculating on the basis of population.



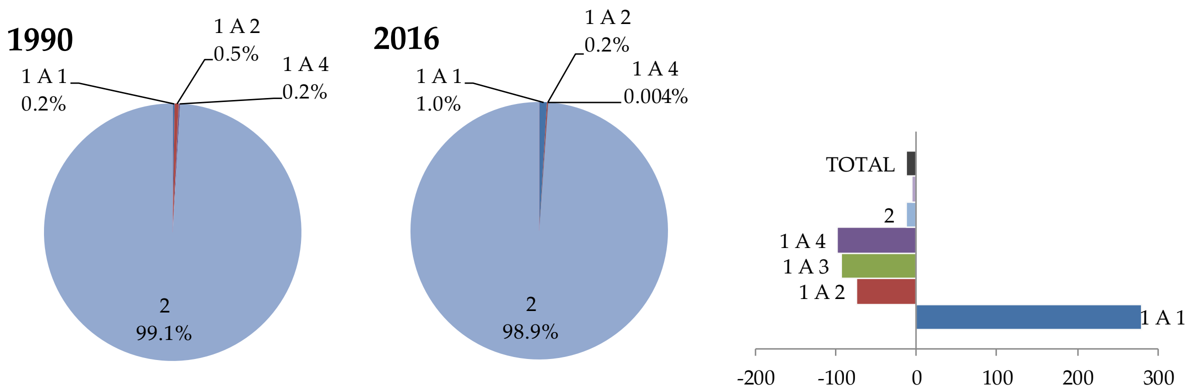




**Figure 3.10.4-1 The PCBs emission (kg/yr.), percentage share by sector and variation in PCBs emissions**

**Table 3.10.4-1 The PCBs emissions by SNAP nomenclature in the period 1990-2016**

| **PCBs** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** |
| 1990 | 1.1 | 0.91 | 2.5 | 0.85 | NA | 477.8 | NA | 4.0E-02 | 3.4E-03 | NA | 483.1 |
| 1991 | 0.8 | 0.47 | 1.5 | 0.35 | NA | 451.3 | NA | 1.7E-02 | 3.5E-03 | NA | 454.5 |
| 1992 | 1.1 | 0.14 | 1.0 | 0.25 | NA | 447.0 | NA | 7.3E-03 | 3.7E-03 | NA | 449.5 |
| 1993 | 0.8 | 0.20 | 0.8 | 0.19 | NA | 464.1 | NA | 7.7E-03 | 3.9E-03 | NA | 466.1 |
| 1994 | 0.2 | 0.10 | 0.8 | 0.16 | NA | 464.9 | NA | 1.5E-03 | 4.0E-03 | NA | 466.2 |
| 1995 | 0.4 | 0.09 | 0.8 | 0.11 | NA | 466.9 | NA | 4.9E-03 | 4.1E-03 | NA | 468.3 |

| **PCBs** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL** |
| **Unit** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** | **kg** |
| 1996 | 0.2 | 0.10 | 0.7 | 0.11 | NA | 449.4 | NA | 1.1E-02 | 4.2E-03 | NA | 450.6 |
| 1997 | 1.0 | 0.09 | 0.7 | 0.17 | NA | 457.3 | NA | 7.9E-03 | 4.2E-03 | NA | 459.2 |
| 1998 | 1.0 | 0.13 | 0.6 | 0.26 | NA | 450.1 | NA | 3.4E-03 | 4.2E-03 | NA | 452.1 |
| 1999 | 0.9 | 0.11 | 0.6 | 0.19 | NA | 455.4 | NA | 2.8E-03 | 4.1E-03 | NA | 457.1 |
| 2000 | 2.5 | 0.10 | 0.6 | 0.17 | NA | 438.1 | NA | 2.3E-03 | 4.1E-03 | NA | 441.4 |
| 2001 | 2.8 | 0.06 | 0.6 | 0.14 | NA | 430.5 | NA | 3.4E-03 | 4.3E-03 | NA | 434.1 |
| 2002 | 3.5 | 0.08 | 0.6 | 0.08 | NA | 430.5 | NA | 5.8E-03 | 4.5E-03 | NA | 434.8 |
| 2003 | 3.7 | 0.10 | 0.4 | 0.10 | NA | 430.6 | NA | 5.5E-03 | 4.6E-03 | NA | 435.0 |
| 2004 | 3.4 | 0.06 | 0.5 | 0.22 | NA | 431.1 | NA | 1.7E-03 | 4.9E-03 | NA | 435.3 |
| 2005 | 3.7 | 0.07 | 0.5 | 0.18 | NA | 431.2 | NA | 1.9E-03 | 5.0E-03 | NA | 435.7 |
| 2006 | 3.5 | 0.06 | 0.6 | 0.20 | NA | 431.4 | NA | 1.9E-03 | 5.2E-03 | NA | 435.7 |
| 2007 | 3.7 | 0.03 | 0.6 | 0.19 | NA | 431.2 | NA | 2.0E-03 | 5.7E-03 | NA | 435.8 |
| 2008 | 3.9 | 0.04 | 0.5 | 0.35 | NA | 431.0 | NA | 3.2E-03 | 4.9E-03 | NA | 435.7 |
| 2009 | 2.7 | 0.03 | 0.5 | 0.12 | NA | 430.3 | NA | 2.9E-03 | 5.4E-03 | NA | 433.6 |
| 2010 | 3.7 | 0.05 | 0.7 | 0.26 | NA | 429.0 | NA | 3.2E-03 | 2.9E-03 | NA | 433.7 |
| 2011 | 4.1 | 0.04 | 0.5 | 0.24 | NA | 428.1 | NA | 3.1E-03 | 2.9E-03 | NA | 433.0 |
| 2012 | 3.6 | 0.04 | 0.5 | 0.01 | NA | 426.8 | NA | 3.1E-03 | 3.7E-03 | NA | 430.9 |
| 2013 | 4.0 | 0.03 | 0.6 | 0.16 | NA | 425.6 | NA | 2.3E-03 | 2.8E-03 | NA | 430.3 |
| 2014 | 3.9 | 0.02 | 0.5 | 0.44 | NA | 423.8 | NA | 2.5E-03 | 3.0E-03 | NA | 428.7 |
| 2015 | 3.7 | 0.02 | 0.7 | 0.37 | NA | 420.4 | NA | 2.4E-03 | 3.2E-03 | NA | 425.1 |
| 2016 | 4.1 | 0.02 | 0.6 | 0.06 | NA | 417.4 | NA | 2.5E-03 | 3.2E-03 | NA | 422.3 |
| 2016 vs 1990 | 279.1% | -98.0% | -74.0% | -93.0% | NA | -12.6% | NA | -93.8% | -5.4% | NA | -12.6% |
| 2016 vs 2015 | 10.5% | 2.9% | -5.5% | -84.1% | NA | -0.7% | NA | 1.5% | -0.7% | NA | -0.7% |

# IV ENERGY (NFR 1)

Sector 1 Energy considers emissions originating from fuel combustion activities (NFR 1.A) and fugitive emissions from fuels (NFR 1.B). Following energy activities are reported in Croatian inventory:

- **1.A.1 Energy Industries**
  - 1.A.1.a Public electricity and heat production
  - 1.A.1.b Petroleum refining
  - 1.A.1.c Manufacture of solid fuel and other energy industries
- **1.A.2 Manufacturing industries and construction**
  - 1.A.2.a Iron and steel
  - 1.A.2.b Non-ferrous metals
  - 1.A.2.c Chemicals
  - 1.A.2.d Pulp, paper and print
  - 1.A.2.e Food processing, beverages and tobacco
  - 1.A.2.f Non-metallic minerals
  - 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction
- **1.A.3 Transport**
  - 1.A.3.a Aviation (civil)
    - 1.A.3.a.i (i) International aviation LTO (civil)
    - 1.A.3.a.ii (i) Domestic aviation LTO (civil)
    - Memo item: 1.A.3.a.i (ii) International aviation cruise (civil)
    - Memo item: 1.A.3.a.ii (ii) Domestic aviation cruise (civil)
  - 1.A.3.b Road transport
    - 1.A.3.b.i Road transport: Passenger cars
    - 1.A.3.b.ii Road transport: Light duty vehicles
    - 1.A.3.b.iii Road transport: Heavy duty vehicles
    - 1.A.3.b.iv Road transport: Mopeds & motorcycles

- 1.A.3.b.v Road transport: Gasoline evaporation
- 1.A.3.b.vi Road transport: Automobile tyre and brake wear
- 1.A.3.b.vii Road transport: Automobile road abrasion

- 1.A.3.c Railways
- 1.A.3.d Navigation (shipping)
    - 1.A.3.d.ii National navigation (shipping)
    - 1.A.3.d.i(ii) International inland waterways
    - Memo item: 1.A.3.d.i(i) International maritime navigation
- 1.A.3.e.i Pipeline transport

- **1.A.4 i Small combustion**
    - 1.A.4.a.i Commercial / institutional
    - 1.A.4.b.i Residential
    - 1.A.4.c.i Agriculture/Forestry/Fishing
- **1.A.4 ii Non-road mobile source and machinery**
    - 1.A.4.a.ii Commercial / institutional: Mobile
    - 1.A.4.b.ii Residential: Mobile
    - 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery
    - 1.A.4.c.iiiAgriculture/Forestry/Fishing: National fishing
- **1.A.5 Other (including military)**
    - 1.A.5.a Other stationary (including military)
    - 1.A.5.b Other, Mobile (including military, land based and recreational boats)
- **1.B.1 Fugitive emissions from solid fuel**
    - 1.B.1.a Coal mining and handling
    - 1.B.1.b Solid fuel transformation
    - 1.B.1.c Other fugitive emissions from solid fuel
- **1.B.2 Fugitive emissions from oil and natural gas**
    - 1.B.2.a.i Oil - Exploration, production, transport
    - 1.B.2.b Natural gas - Exploration, production, transport
    - 1.B.2.a.iv Refining, storage
    - 1.B.2.a.v Distribution of oil products

- 1.B.2.c Venting and flaring
- 1.B.2.d Other fugitive emissions from energy production

For emissions that occur in sector 1.A.3.d.i(ii) International inland waterways Croatia is using notation key "IE" and those emissions are included in the memo item: 1.A.3.d.i(i) International maritime navigation. For emissions that occur in sector 1.A.3.e i Pipeline transport Croatia is using notation key "NO". For emissions that occur in sector 1.A.4.c.iii Agriculture/Forestry/Fishing: National fishing Croatia is using notation key "IE" and those emissions are included in NFR 1.A.3.d.ii (based on total amount of exhausted fuel for national navigation, maritime and river traffic). Emissions that occur in sector 1.A.5.a are included in NFR code 1.A.4.a Combustion in commercial and institutional plants. Emissions that occur in sector 1.A.5.b Other, Mobile (including military, land based and recreational boats) are for military noted as confidential, and for land based and recreational boats are included in NFR codes 1.A.4.a.i and 1.A.3.b (i-iv).

## 4.1 FUEL COMBUSTION (NFR 1.A)

This chapter gives an overview of source categories included the scope of NFR code 1.A. Fuel combustion and their contributions in fuel consumption in Croatia. The overview is given for the non-transport sectors (stationary and non-road mobile sources) and for transport sectors. Non-transport sectors includes following source categories: 1.A.1 Energy Industries, 1.A.2 Manufacturing industries and construction, 1.A.4 Small combustion and Non-road mobile source and machinery. Transport sector includes following source categories: 1.A.3.a Aviation (civil), 1.A.3.b Road transport, 1.A.3.c Railways and 1.A.3.d Navigation (shipping).

In Croatia the domination regarding the fuel consumption has source category 1.A.4 Small combustion (Figure 4.1-1), which has recorded the smallest decrease of fuel consumption (-0.7 % since 1990). Categories 1.A.1 Energy Industries and 1.A.2 Manufacturing Industries and Construction have recorded significantly larger reduction in fuel consumption (as fallow: -42.9 % and 60.7 % since 1990). Regarding 2015, categories 1.A.1 Energy Industries and has recorded increase in fuel consumption by 3.5 %, while categories a 1.A.4 Small combustion and 1.A.2 Manufacturing Industries and

Construction have recorded a decrease by 0.2 % and 0.1 %. The greatest reduction in fuel consumption was in 1991, caused by the war for Croatian independences (1991 – 1995). In the recent past, after 2007 fuel consumption started with continuous decreasing trend due to the economic crisis that is still continuing in Croatia.

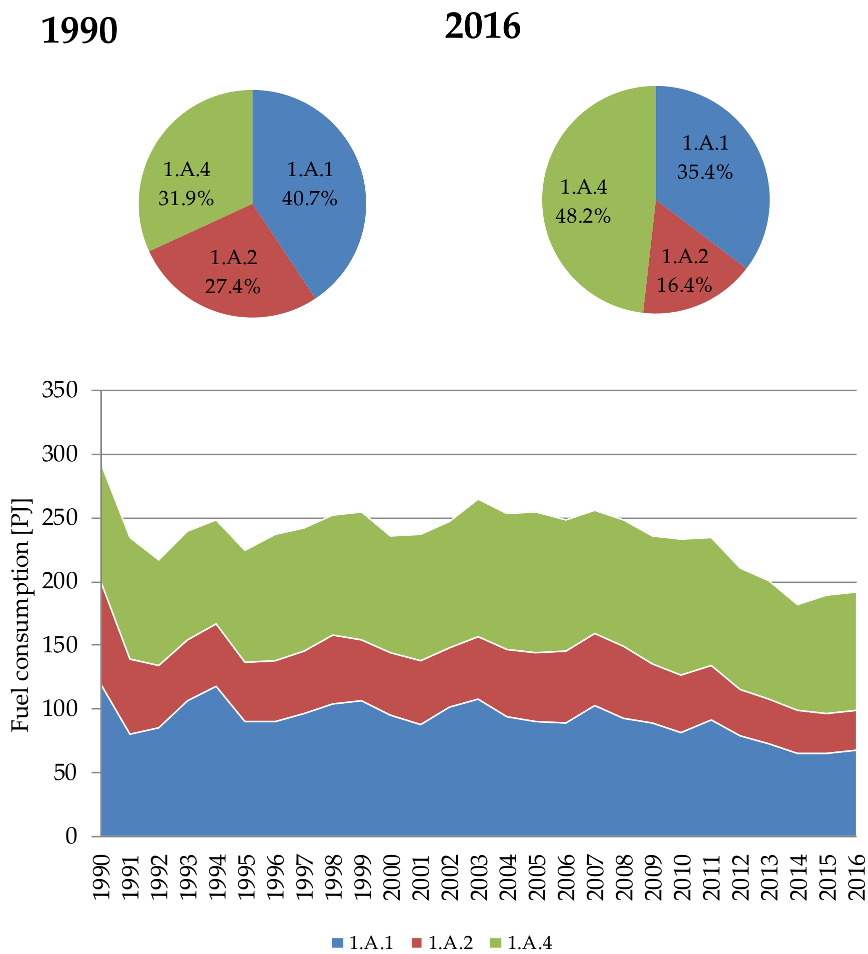



**Figure 4.1-1 Activity data on fuel consumption for NFR codes 1.A.1, 1.A.2, 1.A.4**

The structure of fuel consumption by type in Croatia is presented in Figure 4.1-2. Overall fuel consumption for the observed sectors in the period 1990 - 2016 has decreased by 34.4 %. The consumption of liquid fuel has reduced by 68.7 %, gaseous fuel by 15.1 %, solid fuel by 9.4 %, while the biomass consumption has increased by 13.5 % and other fuels by 8 times (from 0.021 PJ in 1990 to 0.175 PJ in 2016).

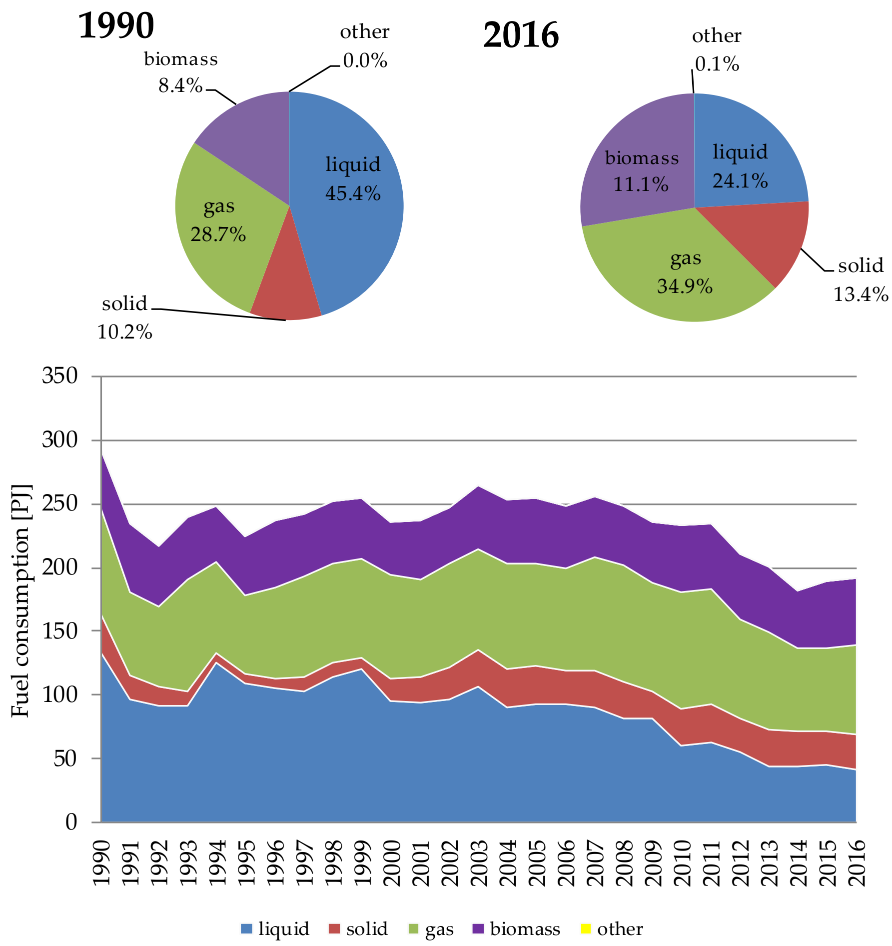



**Figure 4.1-2 Activity data on fuel consumption by type for NFR codes 1.A.1, 1.A.2, 1.A.4**

The source category 1.A.3 Transport includes fuel combustion in road transport, civil aviation, railways and navigation. The dominant NFR sector regarding fuel consumption in period 1990-2016 was 1.A.3.b Road transport. Road transport has contributed to overall transport fuel consumption in 2016 with 95.7%, and has recorded an increase in observing period by 61.8%. The 1.A.3.a Aviation (LTO) has contributed with 2.2% to overall fuel consumption in transport sector 2016, and has recorded a decrease by 17.1%. The 1.A.3.c Railways has contributed with 0.9% to overall transport fuel consumption in 2016, and has recorded a decrease by 57.1% in the observing period. The 1.A.3.d Navigation has contributed with 2.2% to overall transport fuel consumption in 2016 and has recorded an increase by 2.5% in comparison to 1990 (Figure 4.1-3).

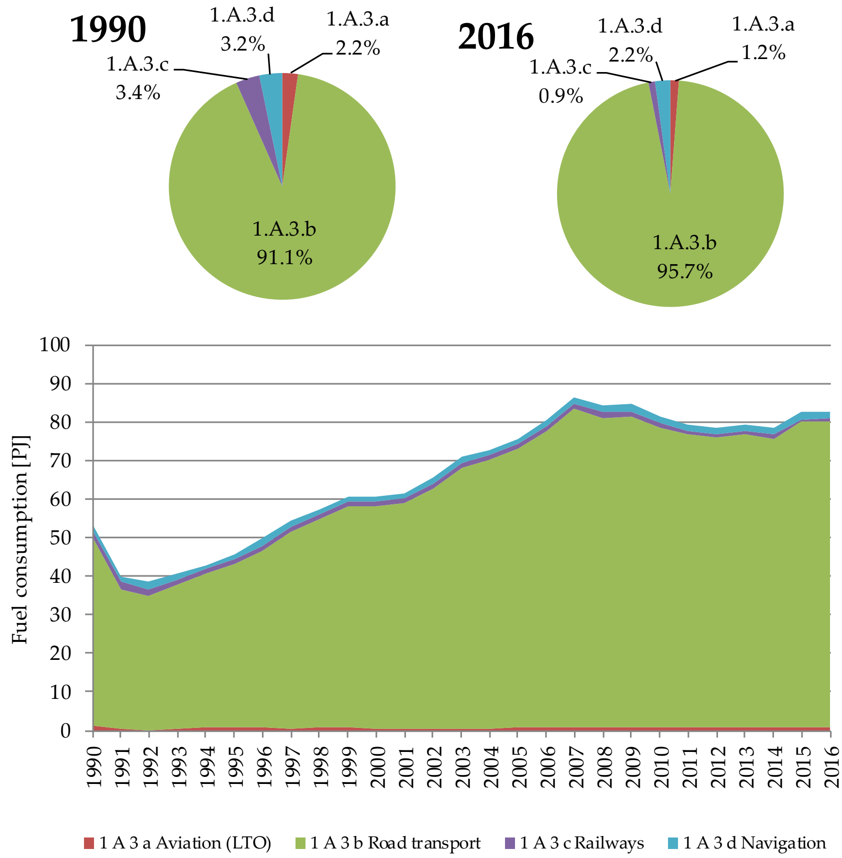



**Figure 4.1-3 Consumption and percentage share for fossil fuel by types in 1.A.3 Transport**

## 4.2 ENERGY INDUSTRIES (NFR 1.A.1)

This chapter gives an overview of source category 1.A.1 Energy industries and it includes information on methodologies, activity data, emission factors and planned improvements. This source category comprises emission from fuel combustion in public electricity and heat production plants (NFR 1.A.1.a), petroleum refining plants (NFR 1.A.1.b), solid transformation plants, oil and gas extraction and coal mining (NFR 1.A.1.c).

**Source category description**

Public Electricity and Heat Production (NFR 1.A.1.a)

The source category NFR 1.A.1.a Public electricity and heat production takes into account consumption of fossil fuel from eight LPSs owned by legal entity HEP-Production Ltd, HEP Group. In public electricity and heat production sector in Croatia there are following types of plants:

- Thermal Power Plants (TPPs), which produce only electricity;
- Public Cogeneration Plants (PCPs), which produce combined heat and electricity;
- Public Heating Plants (PHPs), which produce only heat.

The installed electricity generating capacities in the Republic of Croatia include power plants owned by the HEP Group (Croatian Power Company), a certain number of industrial power plants and a few privately owned power plants (wind power plants, small hydro power plants).

Total capacities serving the needs of the Croatian electric power system amount to 4,105 MW (including TPP Plomin and excluding NPP Krško). Total capacities serving the needs of the Croatian electric power system amount to 4,453 MW (with 50% of Krško capacities). Out of this amount, 1,906 MW is placed in thermal power plant, 2,199 MW in hydro power plant and 348 MW in the nuclear unit Krško (50% of total available capacity). These capacities do not include generating units in other countries from which the Croatian electric power system has the right to withdraw electricity on the basis of capacity lease and share-ownership arrangements. Generating capacities of HPPs, TPPs and NPP Krško are presented in the Table 4.2-1.

During the observed period between 1990 and 2016 in Croatia only 14 to 32 percent of Croatian electricity demands were covered by thermal power plants. The largest contribution to electricity production in Croatia had hydro power plants 36 to 69 percent. Nuclear power plant Krško delivered 50 percent of its electricity to Croatian power system until 1998 after which was a four year period of non-delivery. The delivery of electricity from NPP Krško started again in 2003. The past few years the electricity demand was compensated with import. Therefore, in 2000 the electricity import was larger than production in all Croatian thermal power plants (TPPs). In 2016, the import of electricity was about 50 percent of total electricity consumption in Croatia.

**Table 4.2-1 Generating capacities of HPPs, TPPs and NPP Krško**

| Facility | Available Power (MW), net output | Fuel type |
|---|---|---|
| HPPs | 2,198.7 | - |
| NPP Krško* | 348.00 | uranium oxide ($UO_2$) |
| TPP Plomin 1 | 105.00 | coal |
| TPP Plomin 2** | 192.00 | coal |
| TPP Rijeka | 303.00 | fuel oil |
| TPP Sisak | 631.00 | fuel oil / natural gas |
| CHP Zagreb (east) | 422.00 | fuel oil / natural gas / extra light oil |
| CHP Zagreb (west) | 89.00 | fuel oil / natural gas / extra light oil |
| CPP Osijek | 90.00 | fuel oil / natural gas / extra light oil |
| CCGT Jertovec | 74.00 | natural gas / extra light oil |
| **Total (HPPs+NPP+TPPs)** | **4,452.70** | |

* 50% of NPP Krško is owned by HEP,

** TPP Plomin 2 Ltd. (HEP and RWE Power Co-ownership – share 50% : 50%)

Source:MEE

<u>Petroleum Refining (NFR 1.A.1.b)</u>

The sub-sector 1.A.1.b Petroleum refining takes into account consumption of fossil fuel from two LCPs oil refineries owned by legal entity INA- Oil industry dd. in Rijeka and Sisak, while lubricants are produced in Rijeka and Zagreb. Crude oil is produced from 33 oil fields and gas condensation products from 8 gas-condensations fields, which covers about 35 percent of the total domestic demand. In the refineries, there are two types of fuel combustion – for heating and/or cogeneration and for own use of energy for production processes. Processing capacities of the Croatian refineries are presented in the Table 4.2-2 (Source: MEE).

**Table 4.2-2 Processing Capacities of Oil and Lube Refineries**

| PROCESSING CAPACITIES | INSTALLED (1000 t/year) |
|---|---|
| **Oil Refinery Rijeka (Urinj)** | |
| atmospheric distillation | 5000 |
| reforming | 730 |
| fluidized-bed catalytic cracking (FCC) | 1000 |
| visbreaking | 600 |
| isomerization | 250 |
| hydrodesulphurization (HDS) | 1040 |
| mild hydrocracking (MHC) | 560 |
| hydrocracking | 2600 |

| PROCESSING CAPACITIES | INSTALLED (1000 t/year) |
|---|---|
| **Oil Refinery Sisak** | |
| atmospheric distillation | 4000 |
| reforming | 680 |
| fluidized-bed catalytic cracking (FCC) | 470 |
| coking | 270 |
| vacuum distillation | 850 |
| bitumen | 350 |
| **Lube Refinery Zagreb Ltd.** | |
| lubricants | 60 |

Source: Croatian NIR2018; CAEN

Manufacturing of Solid Fuels and Other Energy Industries (NFR 1.A.1.c)

Sub-sector 1.A.1.c Manufacture of solid fuel and other energy industries takes into account consumption of fossil fuel in following activities: Oil and gas extraction, Coal production, Coke plant and NGL-plant. In Croatia the coal production in the period 1990-1998 was rather low. Last coal mines in Istria were closed in 1999. Coke-oven plant in Bakar, nearby Rijeka, was closed in 1994.

Natural gas is produced from 17 on-shore gas fields and 9 off-shore gas fields, which covers about 67.7 percent of total domestic demand in 2016. The largest share of gas is coming from fields Molve and Kalinovac. They include the units for processing and preparation of gas for transportation – Central Gas Stations (CGS) Molve I, II and III. Their capacities are: 1 mill. $m^3$/day for Molve I, 3 mill. $m^3$/day for Molve II and 5 mill. $m^3$/day for Molve III

**Methodology, emission factors and activity data**

Public Electricity and Heat Production (NFR 1.A.1.a)

Emission sources such as facilities in the scope of source category public electricity and heat production plants observed as a large point source (LPS). For LPS emissions calculation a bottom-up approach is used. Double-check with the national energy balance is always performed. Bottom up approach is used in a way that available direct emission for pollutants from the national Environmental Pollution Register (EPR) entered into CollectER database for each of facilities.

According to the Ordinance on the monitoring of emissions of pollutants into air from immovable sources (OG 129/2012) all large point sources for emission monitoring have installed continuous emission measurement system (CEM). Each year this system as well as emissions are subject to inspections of verified laboratories. Methods of measurements according to the requirements of the standards in the Annex I of this Ordinance are used to measure the parameters of the waste gas and the concentrations of the substance in the waste gases. For determining emissions in waste gas, the original measured weighted concentrations are used. The CEM system algorithm is designed to calculate emissions from raw (data before validation) data. The raw measured value (concentration) is multiplied by the raw amount of flue gas. In that way, determined emissions are correct and not underestimated. Validated average values are used only for the purposes of comparison with the emission limit values prescribed by the Regulation. Validated average values are not used for emission calculation.

For emission calculation for area sources (not LCPs) Tier 1 EMEP / EEA methodology was used, with a top-down approach and based on aggregated fuel consumption from the annual national Energy balance.

Emission factors are expressed as the quantity of emissions of pollutant per GJ fuel consumed. It should be noted that emission factors are changing during the observation period due to: (I) chemical composition of each type of fuel (e.g., sulphur content in the solid and liquid fuel), (II) lower heating different values for the same type of fuel and (III) introduction of technologies to reduce emissions. For 1.A.1.a (Electricity production and Combined heat and power generation) emission factors for large-scale boiler capacity> 50 MW are used, while for 1.A.1.a (Heat plants) used the recommended FE sector 1.A.4.c.i (capacity <50 MW) of GB2016. Emission factors together with the direct emissions for 2016 are given in Appendix 4 of this report.

Activity data for each type of fuel consumed in each of the plant along with measured direct emissions for NOx, $SO_2$, CO and $PM_{10}$ were used, from the EPR database (Tier 2), i.e. the plant specific emission factors were used. For those pollutants for which the LPS doesn’t have obligation to report in the EPR base, the default emission factors from GB2016 were used. In the case of heavy metals, for which emission factors are not available in GB2016, recommended emission factors from PARC ATMOS were used. Also, a chemical analysis were made for facilities in the scope of public electricity and heat production plants for fuel oil and different coal used in Croatia and emission factors for each of heavy metals (Pb, Cd, Hg and Ni) were determined by comparing with default emission factors for different sources. Activity data on fuel used by type in sector 1.A.1.a are presented in Figure 4.2-1.

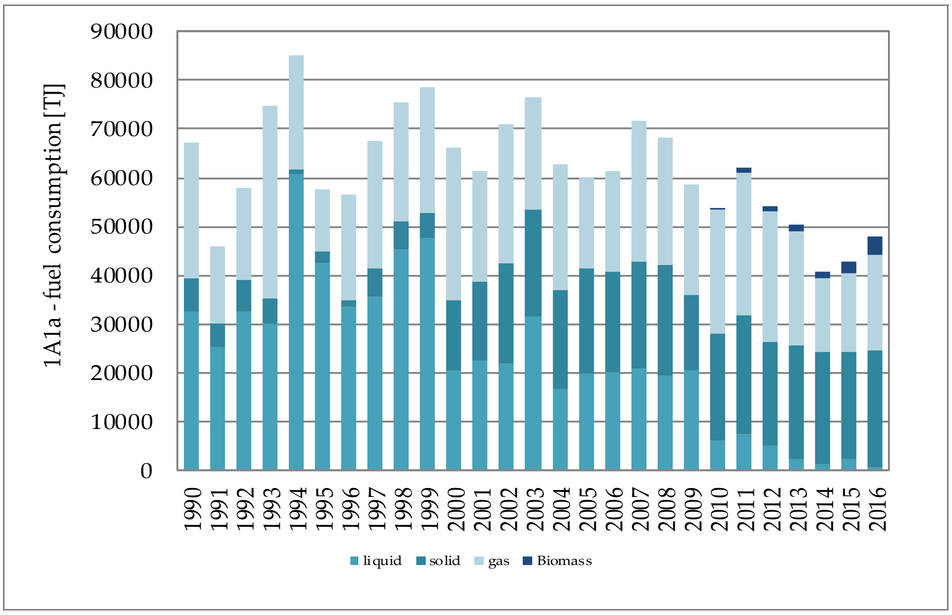



**Figure 4.2-1 Activity data on fuel consumption by type for NFR 1.A.1.a**

Petroleum Refining (NFR 1.A.1.b)

Methodology for emission calculation is Tier 3 EMEP/EEA, performed by multiplying total fuel sold for petroleum refining activities (disaggregated by fuel type) with emission factors.

The default Tier 2 emission factors from GB2016 are used for emission calculations. Emission factors used for emissions calculation in 2016 are given in Appendix 4 of this report. Activity data on fuel used by type in sector 1.A.1.b are presented in Figure 4.2-2.

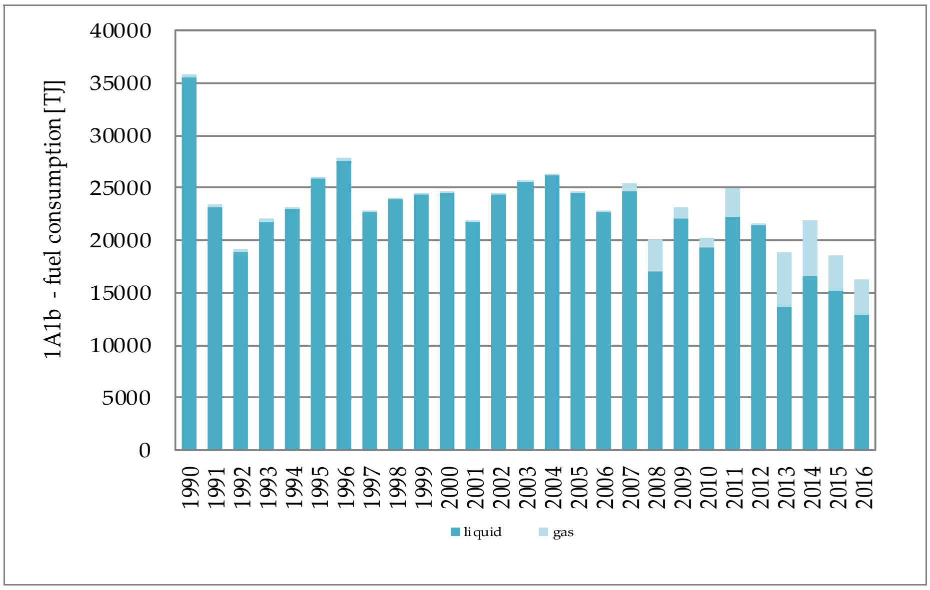



**Figure 4.2-2 Activity data on fuel consumption by type for NFR 1.A.1.b**

Manufacturing of Solid Fuels and Other Energy Industries (NFR 1.A.1.c)

Methodology for emission calculation is Tier 1 EMEP/EEA, performed by multiplying total fuel sold for activities in the scope of category Manufacturing of solid fuels and other energy industries (disaggregated by fuel type) with emission factors. The default Tier 1 emission factors from GB2016 are used for emission calculations. For ammonia emission estimation Tier 1 default EMEP/CORINAIR (1999) emission factor was used by fuel type. Emission factors used for emissions calculation in 2016 are given in Appendix 4 of this report. Activity data on fuel used by type in sector 1.A.1.c is presented in Figure 4.2-3.

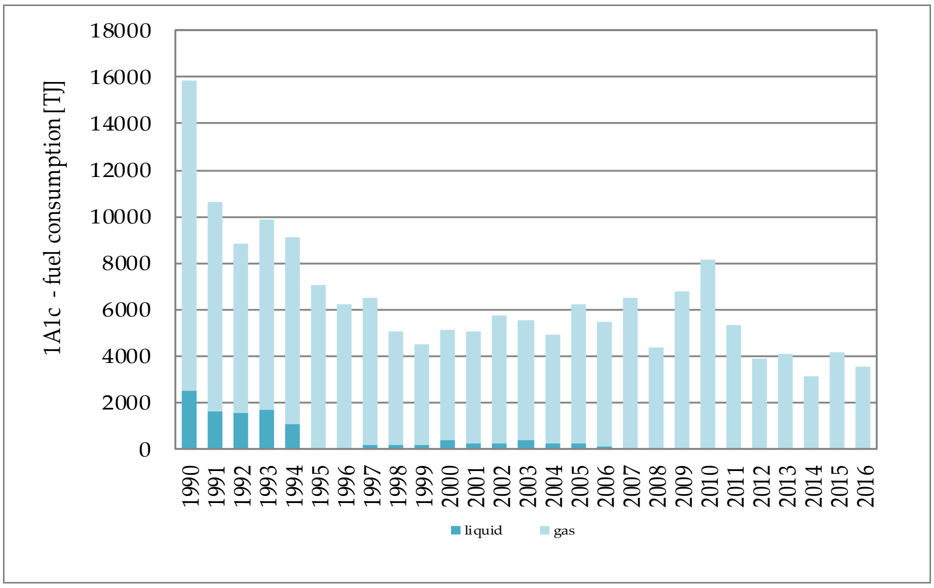



**Figure 4.2-3 Activity data on fuel consumption by type for NFR 1.A.1.c**

**Recalculations and improvements**

Public Electricity and Heat Production (NFR 1.A.1.a)

For the period from 2010-2015 data on biomass consumption were added. All emissions for all pollutants were estimated according Tier 1 methodology.

Petroleum Refining (NFR 1.A.1.b)

In 2014 and 2015 wrong NCV was used for natural gas consumption; 34.00 instead of 34.60 MJ/m$^3$.

Manufacturing of Solid Fuels and Other Energy Industries (NFR 1.A.1.c)

In 2014 and 2015 wrong NCV was used for natural gas consumption; 34.00 instead of 34.60 MJ/m$^3$.

## 4.3 MANUFACTURING INDUSTRIES AND CONSTRUCTION (NFR 1.A.2)

Manufacturing Industries and Construction (NFR 1.A.2) includes emissions from fuel combustion in different industries in Croatia, such as Iron and steel (NFR 1.A.1.a), Non-ferrous metals (NFR 1.A.1.b), Chemicals (NFR 1.A.1.c), Pulp, paper and print (NFR 1.A.1.d), Food processing, beverages and tobacco (NFR 1.A.2.e) and Non-metallic minerals (NFR 1.A.2.f). These are all stationary sources of fuel combustion. In the scope of this source category is also one mobile source Mobile Combustion in manufacturing industries and construction (NFR 1.A.2.g.vii) which is observed within the source category NFR 1.A.4 ii Non road mobile source and machinery.

**Source category description**

This sector also includes the emissions from fuel used for the generation of electricity and heat in industry (industrial cogeneration plants and industrial heating plants). In national energy balance fuel consumed in industrial heating plants and cogenerations were not divided by appropriate industrial branches, so in addition to national energy balance so called "Industry analysis balance" was created annually, for the period from 2001 to 2016. For the period 2001 to 2016 emissions are reported by specific NFR sector while for period 1990 -2000 all emissions are reported under NFR code 1.A.2.f.

**Methodology, emission factors and activity data**

Methodology for emission estimation for almost all NFR codes in the scope of source category 1.A.2 Manufacturing Industries and Construction is default Tier 1 EMEP/EEA, along with Tier 1 emission factors (GB2016). Croatia estimates all emissions for all pollutants which EF are provided in EMEP/EEA GB for 1A2a, 1A2b, 1A2c, 1A2e for all fuel types specified in national energy balance.

For NFR code 1.A.2.f Non-metallic minerals for whole observed trend plant specific emission factor are used for emission calculation of $SO_2$, NOx, CO, and PMs. Non-metallic minerals sector include all facilities for cement production in Croatia which have domination in emissions within the 1.A.2.f Non-metallic minerals sector and within the overall source category 1.A.2.

The amount of fuel consumed and emissions in the sector 1.A.2 Manufacturing Industries and Construction (SNAP 03) is shown as aggregated value (by fuel types) in the scope of sub-sector 1.A.2.f Non-metallic minerals for period 1990 - 2000, while for period 2001 onward are reported on disaggregated value (by fuel types) for each type of industry in the sub-sector where occur.

For emissions calculation for LPSs in NFR sector 1.A.2.f Non-metallic minerals, a bottom-up approach is used. Bottom-up approach is used in cement production and the mineral wool production in a way that direct emissions available from the national Environmental Pollution Register (EPR) are entered into CollectER database. Double-check with the national energy balance is always performed. Fuel amounts related to those direct emissions are subtracted from the amount of fuel from an energy balance depending on the fuel type and activities. For facilities for cement production, since 2007 the emissions reported in the EPR are used for $SO_2$, NOx, CO and NMVOC, which include all the specifics related to fuel, raw materials and production technology in each of facilities. For trend 1990 - 2006 for each plant the plant-specific emission factor are defined.

<u>Country specific EF for SO2</u>

For SO2 emission calculation from combustion of fuel oil and gas oil, Croatia calculate national emission factors on yearly base. This SO2 EFs are calculated on the base of annual fuel (produced and put on the market) by type and sulphur amount in fuels by type. Furthermore, for source categories: 1.A.2.c and 1.A.2.e there is no Tier 2 SO2 EFs provide in GB2016 (chapter 1.A.2). In respect of all mentioned above, Croatia considers that SO2 emission calculation methodology is more detailed than Tier 1.

<u>NOx emission factor</u>

For NOx emission calculation Croatia uses methodology disaggregated by fuel types (gas oil, fuel oil, natural gas, etc.) but not disaggregated by technology. For now Croatia does not have plan for moving from Tier 1 to Tier 2 in respect of technology disaggregation. This recommendation is included in IIR's improvement plan as long term goal.

Activity data on fuel used by type for all activities in the scope of source category 1.A.2 are presented in Figure 4.3-1.

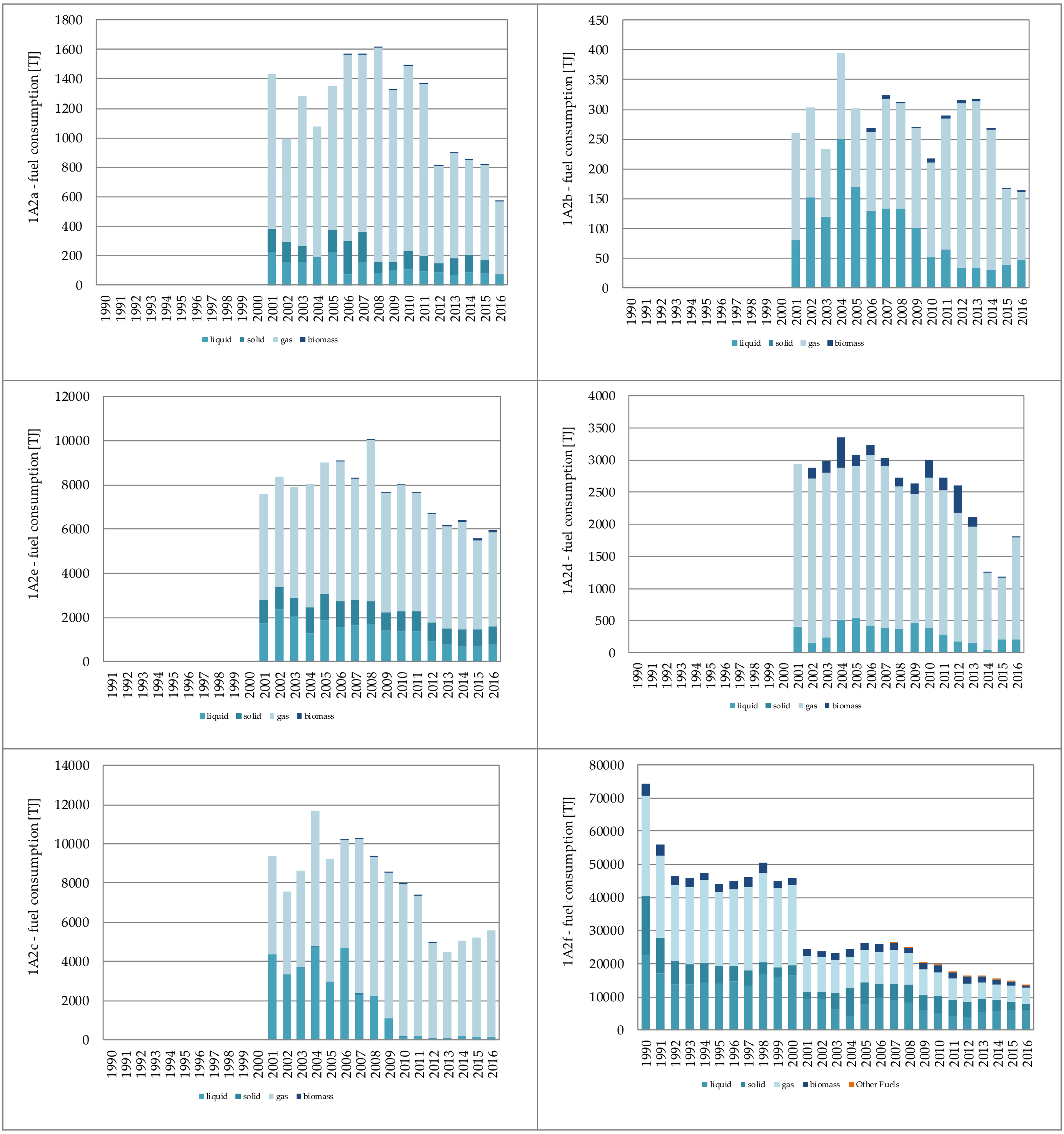



**Figure 4.3-1 Activity data on fuel consumption by type for NFR codes 1.A.2.a, 1.A.2.b, 1.A.2.c, 1.A.2.d, 1.A.2.e, 1.A.2.f.**

**Recalculations and improvements**

Non-metallic minerals (NFR 1.A.2.f).

In 2014 and 2015 error occurred in liquid fuel consumption calculation.

## 4.4 TRANSPORT (NFR 1.A.3)

Fuel consumption in sector 1.A.3 takes into account fossil fuel consumed in sub-sectors: 1.A.3.a Aviation, 1.A.3.b (i-iv) Road transport, 1.A.3.c Railways, and 1.A.3.d.ii Navigation (shipping). Fuel consumption in sub-sector 1.A.3.d.ii National navigation (Shipping) takes into account fuel consumption for sea and river transport. The sub-sector, 1.A.3.d.i (ii) International inland waterways does not take into account.

**Source category description**

Aviation (civil) (NFR 1.A.3.a)

The Republic of Croatia has 7 international airports: Zagreb, Split, Dubrovnik, Zadar, Osijek, Rijeka and Pula and 3 national airports: Brač, Mali Lošinj and Osijek for aircraft in commercial air transport.

The scope of the emissions to be included comprises the civil aviation portion of combustion emissions from mobile sources that concerns the movement of people and/or freight by air. The activities comprise of: international airport traffic (LTO-cycles < 914 m), international cruise traffic (>914 m), domestic airport traffic (LTO-cycles < 914 m), domestic cruise traffic (>914 m). Emissions from two source categories International aviation LTO (civil) (NFR 1.A.3.a.i (i)) and Domestic aviation LTO (civil) (NFR 1.A.3.a.ii (i)) counts in national emission totals, and emissions from two other International aviation cruise (civil) (NFR 1.A.3.a.i (ii)) and Domestic aviation cruise (civil) (NFR 1.A.3.a.ii (ii)) are concerned as memo items, which are excluded from national totals. The scope of the emissions that are included comprises civil commercial use of airplanes, including scheduled and charter traffic for passengers and freight, air taxiing and general aviation. Fuel used at airports for ground transport is excluded from these NFR codes, and are reported under 1.A.3.b, Road transport. Fuel for stationary combustion at airports is also excluded and reported under the appropriate stationary combustion category.

Road transport (NFR 1.A.3.b)

Emissions from Road transport source category in Croatian inventory are reporting in following categories of road vehicles: passenger cars (NFR 1.A.3.b.i), light commercial vehicles (< 3.5 t) (NFR 1.A.3.b.ii), heavy-duty vehicles (> 3.5 t) and buses (NFR 1.A.3.b.iii), mopeds and motorcycles (NFR 1.A.3.b.iv), which are exhaust emission sources and gasoline evaporation (NFR 1.A.3.b.v), and tyre and brake wear (NFR 1.A.3.b.vi), and road abrasion (NFR 1.A.3.b.vii) which are fugitive emission sources.

Railways (NFR 1.A.3.c)

Emissions from rail transport concern the movement of goods or people by rail. Exhaust emissions from railways arise from the combustion of liquid fuels in diesel engines, and solid or liquid fuels in steam engines to provide propulsion Railway locomotives by type in Croatia are: diesel, electric and on steam (the last one in inventory years 1990 and 1991). A few coal-powered locomotives still exist nowadays but they are used for exhibition purposes only. The length of railway lines has decreased in 2014 from 2,722 km to a total of 2,604 km of which 90% are single track and the rest are double track railway. The 37% of the total railway length were electrified. Railways source category isn’t a key source in Croatia.

Navigation (shipping) (NFR 1.A.3.d)

Navigation (shipping) source category covers all water-borne transport from recreational craft to large ocean-going cargo ships that are driven primarily by high-, slow- and medium-speed diesel engines and occasionally by steam or gas turbines. Exhaust emissions from navigation arise from engines used as main propulsion engines and auxiliary engines used to provide power and services within vessels.

Emissions from Navigation (shipping) source category in Croatian inventory are reporting in following NFR categories: 1.A.3.d.ii National navigation (shipping) and memo item: 1.A.3.d.i(i) International maritime navigation.

The Republic of Croatia has six ports of international economic interest in the cities: Rijeka, Zadar, Šibenik, Split, Ploče and Dubrovnik. The network of inland waterways of the Republic of Croatian is 804 km, of which 539 km are international waterways. Inland ports open to international public transport are: Osijek, Sisak, Slavonski Brod and Vukovar.

Fuels used for international inland waterways are covered in category 1.A.3.d.ii. The use of bunker fuels for international inland navigation, for example from a Croatian sea port upstream a river to a neighboured country (Hungary, Serbia) is not possible. Vessels fuelling in Croatia for a trip on the Danube river to are covered in category 1A3dii and that trips from seaport upstream a river are not possible.

Pipeline transport (NFR 1.A.3.e.i)

In Croatia all compressor stations are electric, so no emissions occurred from this source for the whole period from 1990 to 2016. As a confirmation of this claim, in IEA and EUROSTAT energy balance data on consumption of all fuel use for pipeline transport can be found for the whole historical period. In IEA and EUROSTAT energy balance for the whole period, consumption of gas and oil in pipeline transport was 0 TJ. In 2016 for Pipeline transport 3 ktoe electricity is consumed.

In Croatian NGL plant natural gas is consumed in compressor station, but according to IEA methodology only fuel used in compressor stations for oil and natural gas transport through pipelines are part of Pipeline transport sector (excluding compressors on plant location).

Data on input and output fuels from NGL plant Ivanić Grad are collected via annual questionnaire (for the whole historical period). Although according to IEA methodology only input and output of fuels in NGL plant accounts in energy balance (excluding own use), in National energy balance own use of fuels in NGL plant are accounted too. Total amount of fuel used for own use in NGL plant is specified in national energy balance in section Energy sector own use-NGL plant. For 2014 in NGL plant only natural gas was used in own use purposes (3.3*106 $m^3$). This amount of fuel with all other oil and gas extraction in energy industries are summed in 1.A.1.c sector.

**Methodology, emission factors, activity data**

<u>Aviation (civil) (NFR 1.A.3.a)</u>

Emissions from Aviation (civil) source category were calculated using Tier 1 EMEP/EEA methodology, along with the recommended Tier 1 emission factors from GB2016. The methodology consists of fossil fuel distribution into domestic and international traffic, along with distribution of jet fuel into the LTO and cruise cycle. For process of jet fuel distribution the Eurocontrol data were used. The Eurocontrol (European Organisation for the Safety of Air Navigation) data are recommended by ERT and secured over the EEA (European Environment Agency). Quality of Eurocontrol data is checked by the ETC/ACM and can be used for reporting and for checking the quality of data on emissions from aviation to the UNFCCC and the LRTAP reporting. Eurocontrol data are available for the period 2005 - 2016. The Eurocontrol database contains aggregate data on the quantities of fuel, number of flights and emissions for each country as well as for the Republic of Croatia. These aggregated amount of fuel and emissions were calculated using Tier 3 methodology by applying "Advanced Emissions Model" (AEM). Quantities of fuel in the Eurocontrol database do not match completely to the amount of fuel in the energy balance of the Republic of Croatia for the period 2005 - 2016 due to estimation with model. With respect to previously mentioned, for jet fuel distribution real amounts of jet fuel from national energy balance were used and were distributed in accordance with the Eurocontrol jet fuel data distribution. Methodological issues remain a Tier 1, because aviation sector is not a key source category in Croatian inventory. Emission factors are presented in Appendix 4.

Two type of activity data are used for emission calculation from Aviation source category: fuel sold for aviation activities and data for number of LTO cycle regarding Croatia, (preferably with a destination for international LTO and general knowledge of the type of aircraft performing the aviation activity). Sources for those activity data are annual national energy balances for fuel sold, and Eurocontrol database for number of LTO cycle for national and international movements. Two types of fuels are used for aviation activities in Croatia: Jet kerosene for national and international traffic and aviation gasoline only for domestic LTO aviation. The Eurocontrol data will be used as alternative source as long as Croatia will not have available and reliable data regarding number of LTO cycle. Based on Eurocontrol data for Croatia on number of flights in the LTO cycle on domestic and international routes, the average number of flights on domestic LTO routes is established to be around 13%, and the remaining (87%) is international LTO flights. The Eurocontrol data on the amount of fuel for international long distances flights (flights outside the territory of Europe) were also take into account to get average share of fuel consumed for international LTO long distances flights in total fuel consumed for international LTO flights. Activity data on fuel used for all activities in the scope of source category 1.A.3.a are presented in Figure 4.4-1.

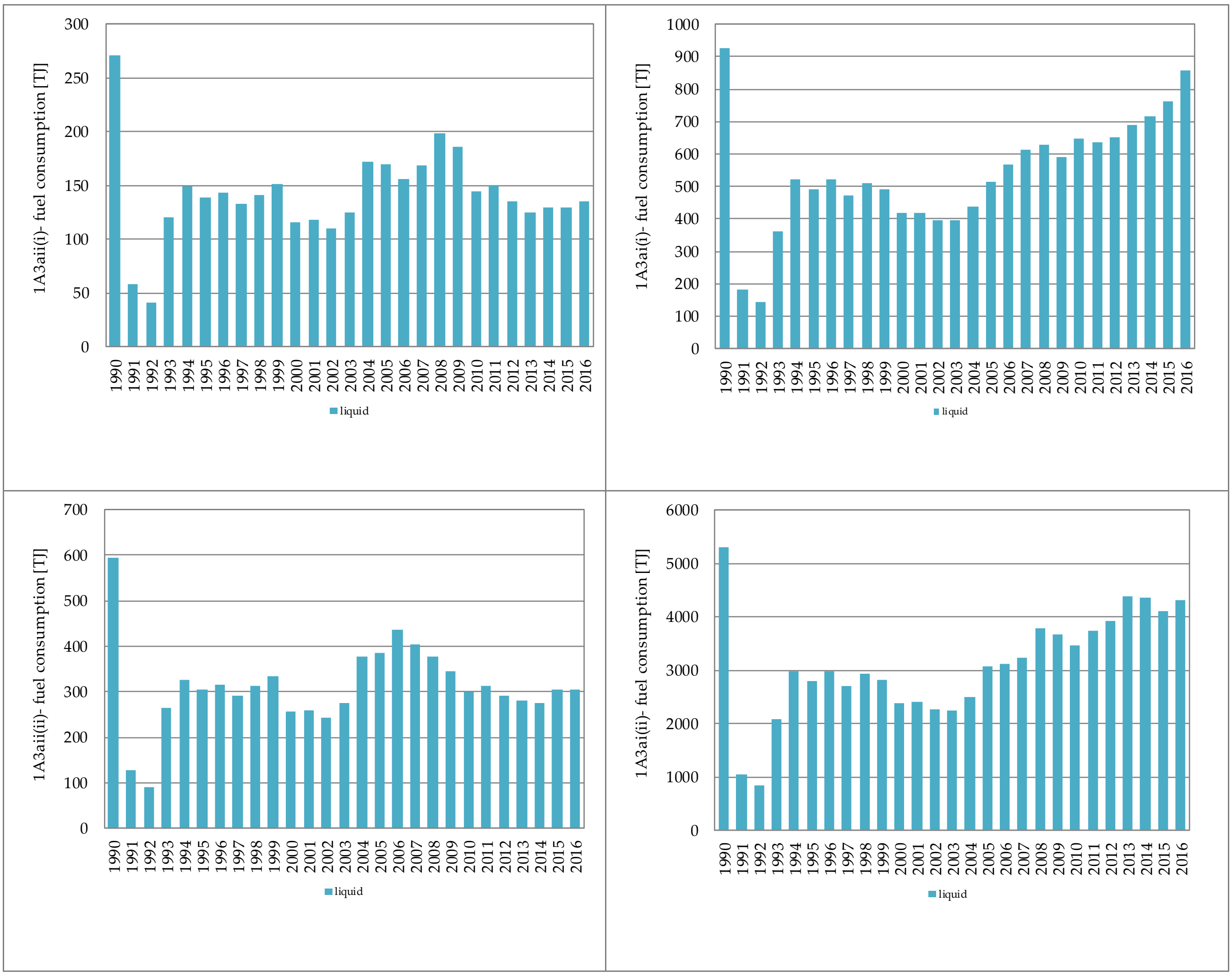



**Figure 4.4-1 Activity data on fuel consumption for NFR codes 1.A.3.a.i(i), 1.A.3.a.ii(i), 1.A.3.a.i(ii), 1.A.3.a.ii(ii)**

The Tier 1 emission factors from GB2016 were used for emission calculation. Default emission factors are stratified due to fuel type (jet kerosene or aviation gasoline), and additional for jet kerosene additional stratification to four different NFR codes and representative aircraft basis. For emission calculation from jet kerosene combustion proposed emission factors for average fleet were used both for LTO and cruise. Additionally for international LTO traffic the average fleet emission factors regarding short or long distance flights were used. Regarding combustion of gasoline in cars, heavy metals and ammonia emission factors from COPERT 4 were used. Regarding combustion of kerosene for stationary combustion, heavy metals, PCDD/PCDF and PAHs emission factors for NFR 1.A.2 were used.

Road transport (NFR 1.A.3.b)

The COPERT 4 ver11.3 package (Tier 2/3 method) was used for air emission calculation from sub-sectors 1 A 3 b (i-vi) Road transport, which requires a detailed set of data as following: type of vehicles (passenger cars, light duty vehicles, heavy duty vehicles, buses, mopeds, motorcycles), type of motor (gasoline four-stroke, gasoline two-stroke, diesel, rotation motor and electromotor), cylinder capacity (<1.4 lit, 1.4-2.0 lit, >2.0 lit), weight class (<3.5 t, 3.5-7.5 t, 7.5-16 t, 16-32 t, >32 t) and age of vehicles (distribution of vehicles per ECE categories according to EC directives). Required detail dataset regarding vehicles characteristics are contained in the Croatian vehicle database. Besides mentioned data, data on amounts of all types of liquid and gaseous fuels consumed in road transportation are also required. The source of fuel sold for road transport is annual national energy balances. Also average monthly minimal and maximal temperature data are required by COPERT model. Required statistical data on temperature were collected yearly for ten biggest towns in Croatia. Additional data like: highway, rural and urban transport mileage, average speed of various vehicles and different road types, average daily trip distance, beta value (the fraction of the monthly mileage driven before the engine and any exhaust components have reached their nominal operation temperature) are expert judgement or COPERT default data. Two assumptions/adjustments were applied when using COPERT model:

1) gasoline or diesel oil tank-filled abroad and consumed in Croatia is equal to amount of same type of fuels tank-filled in Croatia and consumed abroad (this is due to a large number of tourist destination and transit trips in Croatia), so effect of this consumption pattern in neutral to fuel balance;
2) fuel consumption calculated by COPERT, taking into account number of vehicles and annual average vehicle mileage, should be to a highest possible degree equal to

consumption of fuels from the national energy balance (the difference should not be greater than 1%).

For PMs (TSP, $PM_{10}$ and $PM_{2.5}$) emission calculations from source category NFR 1.A.3.b.vii Road transport: Automobile road abrasion, the Tier 1 EMEP/EEA methodology is used, due to this source category is not a key source. The proposed Tier 1 emission factors have been estimated using the Tier 2 method and assuming some default emission values for vehicle characteristics. Emission factors are given as a function of each vehicle category alone. The relevant activity statistics for Tier 1 are the number of vehicles in each defined category, and the average mileage driven per vehicle in each defined category (or their product, i.e. the total vehicle-km for each defined category) (Table 4.4-1). Defined categories are: (I) Two-wheel vehicles that correspond to mopeds and motorcycles, (II) Passenger cars that are small or larger family cars used mainly for the carriage of people, (III) Light-duty trucks that include vans for the carriage of people or goods and (IV) Heavy-duty vehicles which correspond to trucks, urban buses and coaches.

**Table 4.4-1 Activity data for NFR 1.A.3.b.vii**

| Vehicle category | Two-wheelers | Passenger Cars | Light Duty Vehicles | Heavy Duty Vehicles |
|---|---|---|---|---|
| Unit | k(veh*km) | k(veh*km) | k(veh*km) | k(veh*km) |
| 1990 | 121924 | 15680420 | 1184062 | 1273526 |
| 1991 | 129040 | 14689962 | 1221374 | 1283593 |
| 1992 | 134368 | 13704348 | 1245002 | 1282365 |
| 1993 | 99244 | 9144898 | 903254 | 914294 |
| 1994 | 127028 | 10506048 | 1070718 | 1069551 |
| 1995 | 149352 | 11440954 | 1339800 | 1210891 |
| 1996 | 177040 | 12265666 | 1573440 | 1312718 |
| 1997 | 210660 | 13518666 | 1837968 | 1401264 |
| 1998 | 238520 | 14336854 | 1947726 | 1407495 |
| 1999 | 264208 | 15206044 | 2023802 | 1400757 |
| 2000 | 290256 | 16029580 | 2106104 | 1403346 |
| 2001 | 320932 | 16945880 | 2231130 | 1436720 |
| 2002 | 363048 | 17589474 | 2400244 | 1489777 |
| 2003 | 416360 | 18289768 | 2726526 | 1569713 |
| 2004 | 469732 | 18958702 | 2726526 | 1571000 |
| 2005 | 530852 | 19524568 | 2856590 | 1578570 |
| 2006 | 591444 | 20204898 | 2965842 | 1593991 |
| 2007 | 654660 | 20647816 | 3039168 | 1596261 |

| Vehicle category | Two-wheelers | Passenger Cars | Light Duty Vehicles | Heavy Duty Vehicles |
|---|---|---|---|---|
| Unit | k(veh*km) | k(veh*km) | k(veh*km) | k(veh*km) |
| 2008 | 760508 | 21455952 | 3106224 | 1651410 |
| 2009 | 766600 | 21230146 | 2990372 | 1573003 |
| 2010 | 734780 | 20891094 | 2861408 | 1472130 |
| 2011 | 706756 | 20721540 | 2765048 | 1410692 |
| 2012 | 634180 | 19675376 | 2516866 | 1284313 |
| 2013 | 602780 | 18778816 | 2397318 | 1214087 |
| 2014 | 659900 | 20952974 | 2606032 | 1337042 |
| 2015 | 647796 | 21294980 | 2688268 | 1373448 |
| 2016 | 672836 | 21724584 | 2781834 | 1523209 |

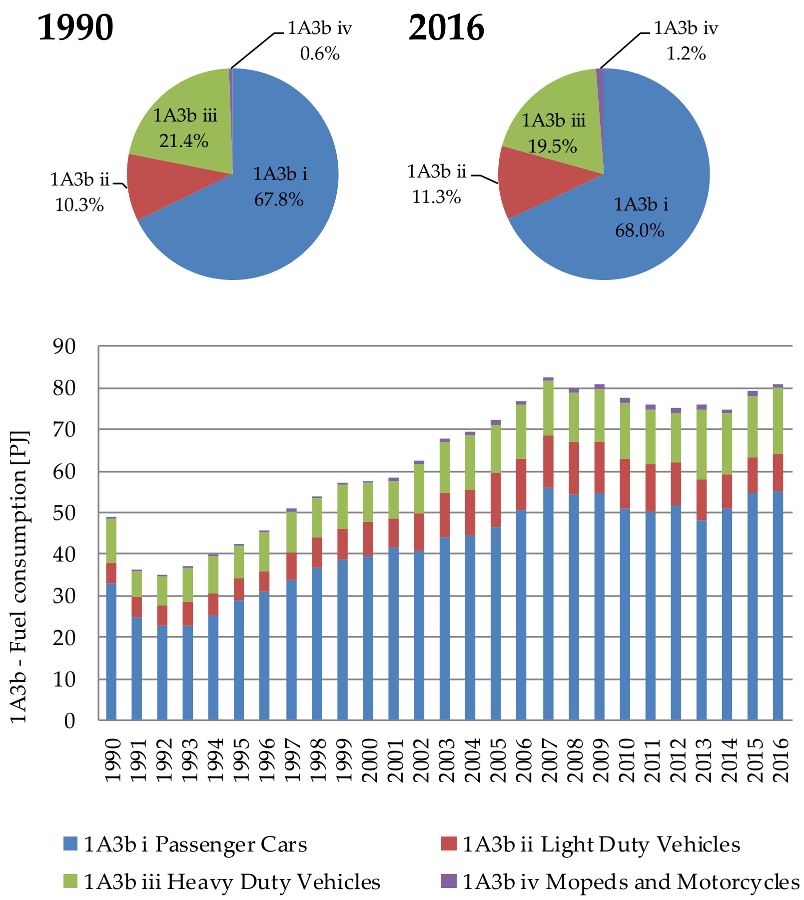
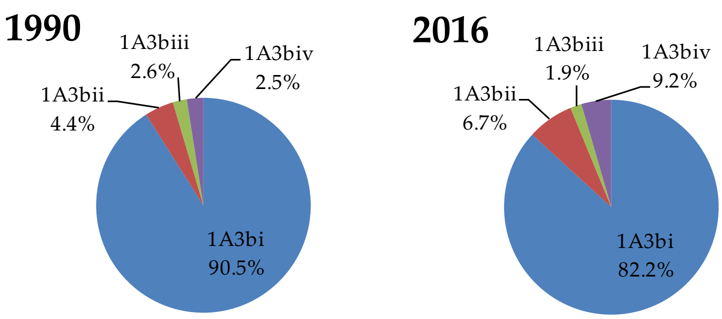



**Figure 4.4-2 Fuel consumption by each type of vehicle in the road transportation**

The dominant fuel consumption activity in the road transport source category in 2016 has 1.A.3.b.i Passenger cars (68.0%) and 1.A.3.b.iv Mopeds and Motorcycles has the smallest contribution

(1.2%). The sub-sector 1.A.3.b.ii Light Duty Vehicles has contributed with 11.3% to overall fuel consumption within the road transportation in 2016, and 1.A.3.b.iii Heavy duty vehicles with 19.5%. The trend of fuel consumption in road transportation has growing character (by 65.5%) in period from 1990 to 2016. The increase in the fuel consumption was the largest in sub-sectors 1.A.3.b.iv Mopeds and Motorcycles (by 3.7 times from 1990 to 2016) and 1.A.3.b.ii Light duty vehicles (82.6%). In sub-sectors 1.A.3.b.iii Heavy duty vehicles and 1.A.3.b.i Passenger cars fuel consumption have increased by 50.7% and 65.9% respectively. The Figure 4.4-2 shows the fuel consumption by type of vehicle in road transport.



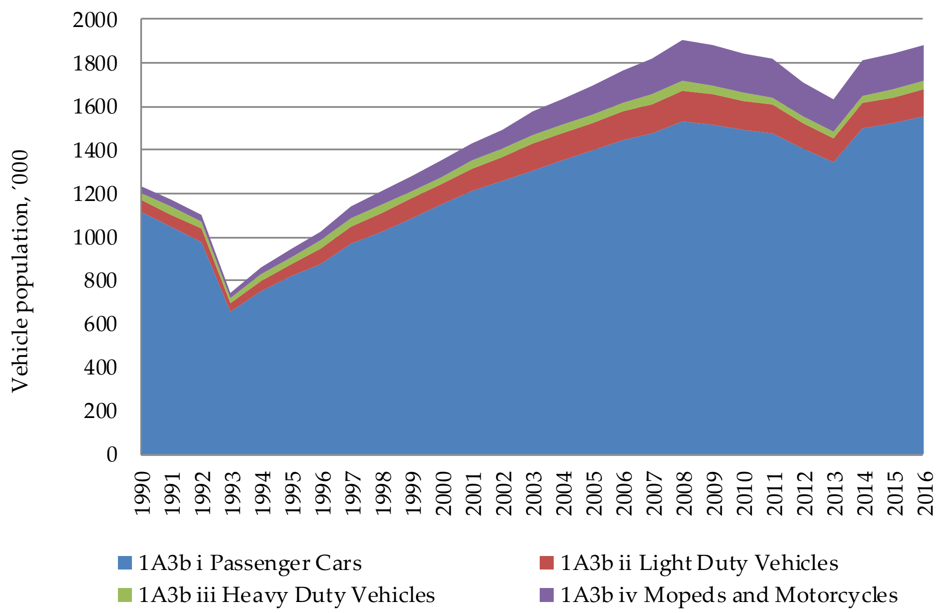




**Figure 4.4-3 Number of each type of vehicle in the road transportation**

The total number of vehicles in the period 1990 - 2016 was increased by 52.4 % (Figure 4.4-3 and Table 4.4-2). The increase was largely a result of increasing number of passenger cars by 38.5 % because they presented 82.3 % of the total number of vehicles in road traffic in 2016. The number of light duty vehicles increase by 2.35 times, mopeds and motorcycles by 5.5 times and heavy duty vehicles by 20.5% in the observing period. The type and class of vehicle, their speed and driving share on each type of road are shown in Table 4.4-3.

**Table 4.4-2 Number of road motor vehicles by type ('000)**

| Vehicle type, ´000 | 1990 | 1995 | 2000 | 2005 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Passenger Cars | 1120 | 817 | 1145 | 1395 | 1492 | 1480 | 1405 | 1341 | 1497 | 1521 | 1552 |
| Light Duty Vehicles | 54 | 61 | 96 | 130 | 130 | 126 | 114 | 109 | 118 | 122 | 126 |
| Heavy Duty Vehicles | 26 | 27 | 32 | 36 | 33 | 32 | 29 | 27 | 29 | 35 | 39 |
| Mopeds Motorcycles | 30 | 37 | 73 | 133 | 184 | 177 | 159 | 151 | 165 | 162 | 168 |

Source: MIA, Processing: Ekonerg Ltd.

**Table 4.4-3 Type and class of vehicle, their speed and driving share on each type of road**

| Sector | Subsector | Trip speed (km/h) | | | Driving share, % | | |
|---|---|---|---|---|---|---|---|
| | | Urban | Rural | Highway | Urban | Rural | Highway |
| Passenger Cars | Gasoline 0,8 - 1,4 l | 30 | 60 | 110 | 40 | 35 | 25 |
| | Gasoline 1,4 - 2,0 l | 30 | 60 | 110 | 40 | 35 | 25 |
| | Gasoline >2,0 l | 30 | 60 | 110 | 40 | 35 | 25 |
| | Diesel 1,4 - 2,0 l | 30 | 60 | 110 | 40 | 35 | 25 |
| | Diesel >2,0 l | 30 | 60 | 110 | 40 | 35 | 25 |
| | LPG | 30 | 60 | 110 | 40 | 35 | 25 |
| | CNG | 30 | 60 | 110 | 40 | 35 | 25 |
| | 2-Stroke | 30 | 60 | 110 | 40 | 35 | 25 |
| | Hybrid Gasoline | 30 | 60 | 110 | 40 | 35 | 25 |
| Light Duty Vehicles | Gasoline <3,5 t | 30 | 60 | 100 | 30 | 50 | 20 |
| | Diesel <3,5 t | 30 | 60 | 100 | 30 | 50 | 20 |
| Heavy Duty Vehicles | Gasoline >3,5 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Rigid <=7,5 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Rigid 7,5 - 12 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Rigid 12 - 14 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Rigid 14 - 20 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Rigid 20 - 26 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Rigid 26 - 28 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Rigid 28 - 32 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Rigid >32 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Articulated 14 - 20 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Articulated 20 - 28 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Articulated 28 - 34 t | 30 | 50 | 80 | 30 | 55 | 15 |

| Sector | Subsector | Trip speed (km/h) | | | Driving share, % | | |
|---|---|---|---|---|---|---|---|
| | | Urban | Rural | Highway | Urban | Rural | Highway |
| | Articulated 34 - 40 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Articulated 40 - 50 t | 30 | 50 | 80 | 30 | 55 | 15 |
| | Articulated 50 - 60 t | 30 | 50 | 80 | 30 | 55 | 15 |
| Buses | Urban Buses Midi <=15 t | 30 | 50 | 0 | 90 | 10 | 0 |
| | Urban Buses Standard 15 - 18 t | 30 | 50 | 0 | 90 | 10 | 0 |
| | Urban Buses Articulated >18 t | 30 | 50 | 0 | 90 | 10 | 0 |
| | Urban CNG Buses | 30 | 50 | 0 | 90 | 10 | 0 |
| | Coaches Standard <=18 t | 30 | 50 | 90 | 25 | 65 | 10 |
| | Coaches Articulated >18 t | 30 | 50 | 90 | 25 | 65 | 10 |
| Mopeds | 2-stroke <50 $cm^3$ | 30 | 50 | 0 | 70 | 30 | 0 |
| | 4-stroke <50 $cm^3$ | 30 | 50 | 0 | 70 | 30 | 0 |
| Motorcycles | 2-stroke >50 $cm^3$ | 30 | 50 | 0 | 60 | 40 | 0 |
| | 4-stroke <250 $cm^3$ | 30 | 50 | 70 | 48 | 50 | 2 |
| | 4-stroke 250 - 750 $cm^3$ | 30 | 50 | 80 | 45 | 51 | 4 |
| | 4-stroke >750 $cm^3$ | 30 | 50 | 90 | 35 | 60 | 5 |

Data source: COPERT default

Railways (NFR 1.A.3.c)

Emissions from Railway source category were calculated using Tier 1 EMEP/EEA methodology, due to this sector isn't a key source. The default Tier 1 emission factors, stratified by fuel types, are from GB2016. For diesel and gas oil recommended FE for NFR 1.A.3.c are used, while for the solid fuel (coal and lignite), heavy fuel oil, kerosene and diesel recommended FE for NFR 1.A.4.a are used. Relevant activity data for Tier 1 approach is fossil fuel consumption data by fuel types from annual national energy balances (Figure 4.4-4).

In the national energy balance there is no recorded coal consumption in rail transport since the 1991. Despite that, two coal locomotives were identified in the national register of locomotives. However, they are used only for exhibition purposes and the symbol "NO" is used for the coal consumption in rail transport, which is in accordance with the national energy balance.

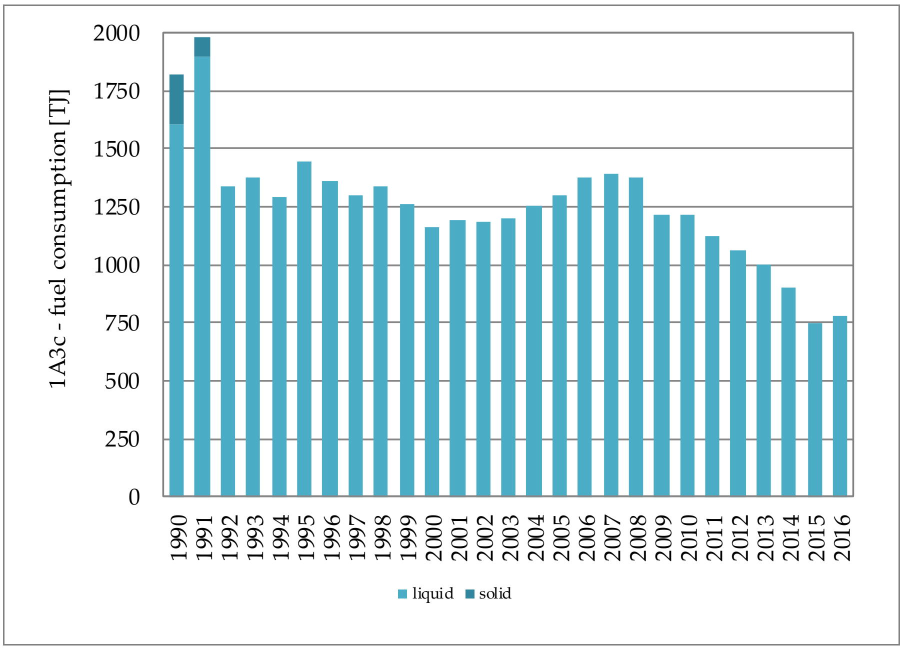



**Figure 4.4-4 Activity data on fuel consumption for NFR 1.A.3.c**

Navigation (shipping) (NFR 1.A.3.d)

Emissions from Navigation source category for NFR codes 1.A.3.d.ii(i) and 1.A.3.d.i(i) were calculated using Tier 1 EMEP/EEA methodology, due to this sectors aren't a key source. Emissions from 1.A.3.d.i(i) International bunkers of ships are not included in the national total emissions and are shown as memo items.

Emission factors are expressed as the quantity of pollutant emissions per GJ fuel consumed by types. Recommended Tier 1 EF from GB2016 were used for fuel: gasoline and fuel oil and for diesel the Tier 2 FE from GB2016 were used, assuming for small recreational boats that they are conventional type. For pollutants for which EF re not recommended in GB2016, EF from *The EMEP / CORINAIR Atmospheric emission inventory Guidebook - Second Edition (1999)* and *The Emission factors manual PARC ATMOS - Emission factors for air pollutants (1992)* were used. The $SO_2$ emission factors depend on the fuel quality, which is change from year to year and from year to year. For Bunker Fuel Oil the sulphur content of fuel for pre-2006 was 2.7% wt. [source: Lloyd's Register, 1995]; For European Union as specified in the Directive 2005/33/EC 1.5 % wt. from 11th August 2006 for Baltic sea and in EU territorial seas, exclusive economic zones and pollution control zones; and 0.1 % wt. from 1 January 2010 for inland water way vessels and ships at berth in Community. Emission factors used are presented by NFR sectors and pollutants in Appendix 4.

Relevant activity data for Tier 1 approach is fossil fuel consumption data by fuel types from annual national energy balances. International bunkers of ships are included in the national energy balance as a separate data only from 1994 onwards, while for period from 1990 to 1994 the data is based on expert judgment. Trends of fuel consumed in NFR sectors 1.A.3.d.ii(i) and 1.A.3.d.i(i) are shown in Figure 4.4-5.

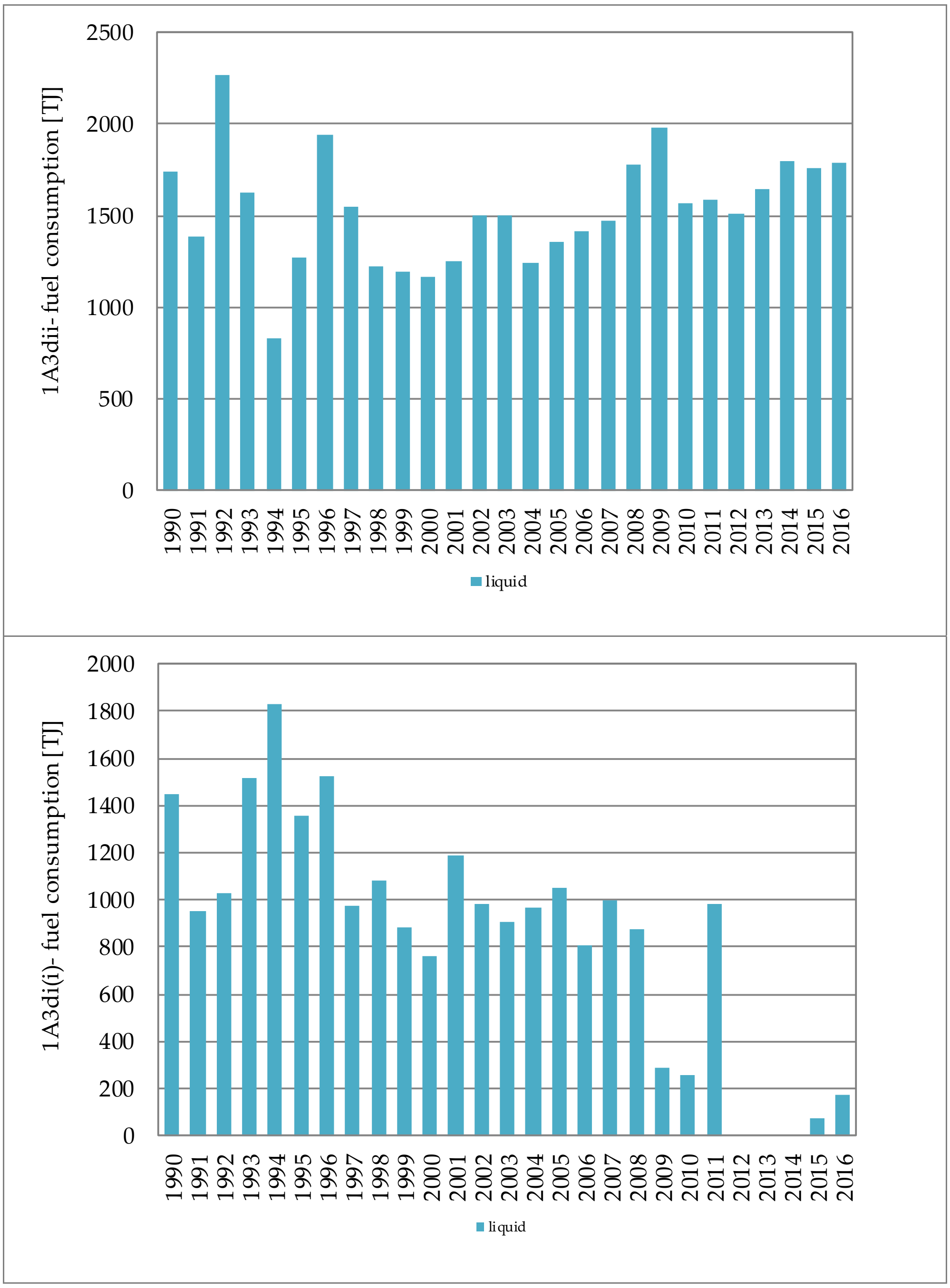



**Figure 4.4-5 Activity data on fuel consumption for NFR codes 1.A.3.d.ii, and 1.A.3.d.i(i)**

It has to be noted that inland navigation is strongly dependent on the navigability and that therefore fluctuations of this size are rather likely.

In accordance with the energy balance of the Republic of Croatia in the category 1.A.3.d.i(i) International navigations (bunkers) there was no fuel sold in the period 2012-2014 and notation key "NO" was used.

As the fuel consumption data for national navigation and international inland waterways are not separated in the national energy balance, emissions from Category 1.A.3.di (ii) International inland waterways are included in Category 1.A.3.d.ii National navigation (shipping), and the mark "IE" was used. International inland waterways transport can take place along the river Danube, and since international inland waterways transport with the beginning in the Croatian sea is not possible, there is no risk of underestimating national emissions by this approach.

It should be noted that in the national energy balance, all consumption of biofuels is allocated to the road transport sector. The calculations in this report are done accordingly, even though biofuels can be used in other sectors, i.e. in railways, navigation, small non-road vehicles and machinery and aviation.

**Recalculations and improvements**

Aviation (civil) (NFR 1.A.3.a)

1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil): Correction due to change of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol.

Road transport (NFR 1.A.3.b)

Revised data on kilometres of mopeds and motorcycles and passenger cars were revised for 2005. Revised data for kilometres for category light and heavy duty vehicles have been revised for 2008.

Railways (1.A.3.c)

There was no recalculation, neither improvement in this source categories.

Navigation (shipping) (1.A.3.d)

1.A.3.d.ii National navigation (shipping): small changes due to the correction of calculation for the $SO_2$ for the period 2013 – 2015.

## 4.5 SMALL COMBUSTION (NFR 1.A.4.i)

**Source category description**

The source category 1.A.4.i Small combustion in Croatia takes into account stationary combustion under NFR sectors 1.A.4.a.i Commercial/Institutional, 1.A.4.b.i Residential, 1.A.4.c.i Agriculture/Forestry. The sectors cover combustion installations activities in the following sectors which, have a thermal capacity ≤ 50 $MW_{th}$. Small combustion activities are commercial and institutional heating, residential heating and cooking, agriculture/forestry and other stationary combustion (including military). Residential heating includes fireplaces, stoves, cookers, small boilers (< 50 kW) while institutional/commercial/agricultural/other heating include heating - boilers, space-heaters (> 50 kW), and smaller-scale combined heat and power generation (CHP).

Emissions from smaller combustion installations are significant due to their numbers, different type of combustion techniques employed, and range of efficiencies and emissions. Many of them have no abatement measures nor low efficiency measures. In the residential sector in particular, the installations are very diverse, strongly depending on national and regional factors including quality of fuel supply.

**Methodology, emission factors, activity data**

Commercial/Institutional (NFR 1.A.4.a)

Methodology for emission calculation is Tier 1 EMEP/EEA, performed by multiplying total fuel sold (disaggregated by fuel type) with emission factors. Sector NFR 1.A.4.a Commercial/Institutional is not a key source.

Emission factors are expressed as the quantity of emissions of pollutants per GJ fuel consumed. All emission factors are default Tier 1 from GB2016, and are presented by NFR sectors in Appendix 4 of this report.

Structure of fuel combustion in Commercial/Institutional sector for period 1990 – 2016 is presented in Figure 4.5-1.

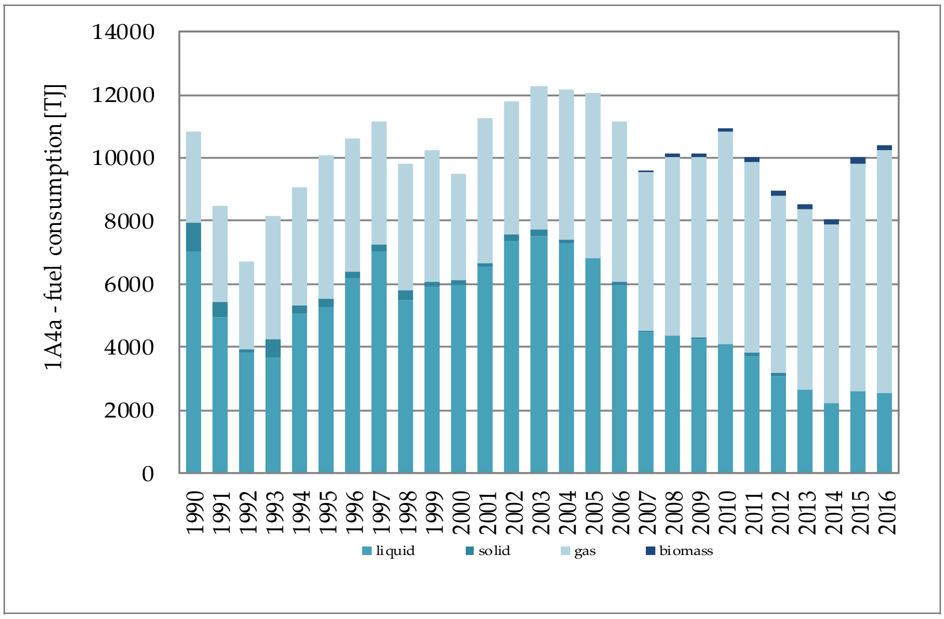



**Figure 4.5-1 Activity data on fuel consumption by fuel type for NFR 1.A.4.a**

Residential (NFR 1.A.4.b.i)

Within Small combustion source category only 1.A.4.b.i Residential is a key source, so Tier 2 EMEP/EEA methodology was applied for emission calculation. Tier 2 methodology was applied. The application of Tier 2 methodology implies knowledge of the structure and combustion techniques applied in residential since 1990 onwards for the territory of the Republic of Croatian. The model was created for solid and biomass fuel types on technology (furnaces) installed with assumed time of entering of certain technologies into usage. Created model on the technology regard to solid fuels and biomass, data from the GAINS model were used. The GAINS model is using those data for modelling the emission projections for Croatia (Table 4.5-1). For biomass, three basic types of technology were assumed: (I) biomass combustion in heating stoves, (II) biomass combustion in fireplaces and (III) biomass combustion in single house boilers (<50 kW), (IV) biomass combustion in advanced / ecolabelled stoves and boilers and (V) pellet stoves and boilers. For coal, two types of technology were assumed: (I) coal combustion in heating stoves and (II) coal combustion in single house boilers (<50 kW). For years in the period 1990 - 2005 the representation of each of technology are calculated by linear regression method, and for years between 2010 and 2030, the extrapolation method was used. Results of these calculations in order to obtain images and time representation of a particular type of technology regarding biomass and solid fuels combustion are shown in Figure 4.5-1.

**Table 4.5-1 Technology structure for solid fuel and biomass distribution in residential sector**

| Fuel type | Technology | 2005 | 2010 | 2030 |
|---|---|---|---|---|
| Solid fuel | single house boilers (<50 kW) | 61.5% | 66.7% | 1.8% |
| | heating stoves | 38.5% | 33.3% | 98.2% |
| Biomass fuel | fireplaces | 5.9% | 6.0% | 7.7% |
| | single house boilers (<50 kW) | 29.4% | 27.4% | 15.5% |
| | heating stoves | 64.7% | 66.5% | 76.8% |

Source: the GAINS model

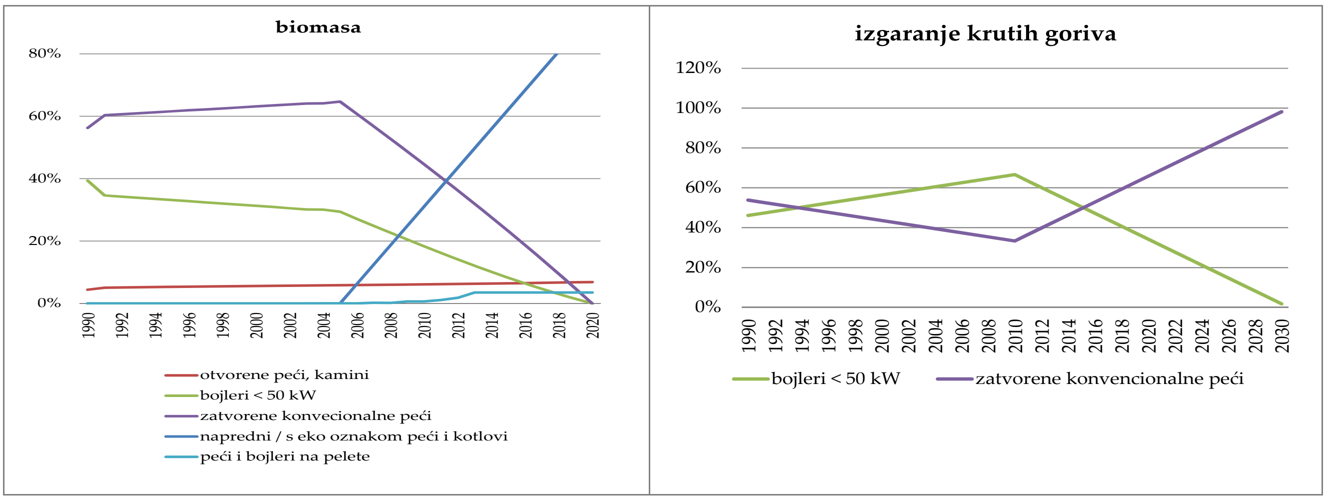



**Figure 4.5-2 Model of entering of certain technologies into usage in Residential sector regarding biomass and solid fuels**

For liquid and gaseous fuels, the GAINS model does not presume different technologies, so for those fuels it is assumed that correspond technologies defined by the GB2016 are represented in equal proportions for the period since 1990 (Table 4.5-2). For liquid fuels two possible technologies in accordance with GB2016 were considered: (I) liquid fuel combustion in heating stoves and (II) liquid fuel combustion in single house boilers (<50 kW). For gaseous fuels two possible technologies in accordance with GB2016 were considered: (I) gaseous fuel combustion in fireplaces and (II) gaseous fuel combustion in single house boilers (<50 kW). It is also assumed that advanced technologies such as energy efficient stoves burning wood, advanced / ecolabelled stoves and boilers burning wood and pellet stoves and boilers burning wood pellets are for now minimally represented in Croatia and as such are neglected in the calculation.

**Table 4.5-2 Technology structure for liquid and gaseous fuel distribution in residential sector**

| Fuel type | Technology | Period since 1990 |
|---|---|---|
| Liquid fuel | heating stoves | 50% |
| | single house boilers (<50 kW) | 50% |
| Gaseous fuel | fireplaces | 50% |
| | single house boilers (<50 kW) | 50% |

Source: the EMEP/EEA GB2013

Two types of solid fuel were used in the residential sector in the Republic of Croatia; lignite and sub-bituminous coal, of liquid fuel: residual fuel oil, gas oil and kerosene, and of gaseous fuels: liquefied petroleum gas, natural gas and LPG gas. Structure of fuel combustion in Residential sector for period 1990 – 2016 is presented in Figure 4.5-3.

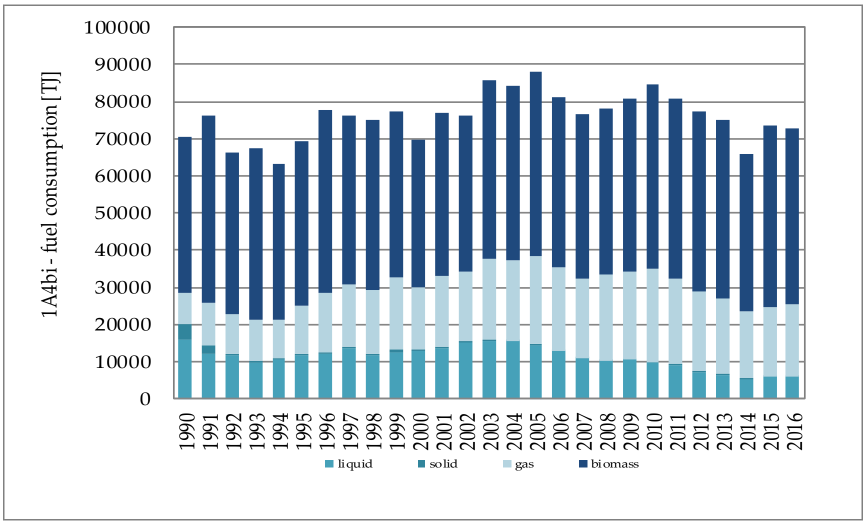



**Figure 4.5-3 Activity data on fuel consumption by fuel type for NFR 1.A.4.b.i**

Emission factors are expressed as the quantity of emissions of pollutants per GJ fuel consumed. Emission factors are stratified by fuel types and are default Tier 2 from GB2013 except for $SO_2$. For $SO_2$ emission calculation, national emission factor were used. National $SO_2$ emission factor assumed two type of solid fuel use in Croatia lignite and sub-bituminous coal with net calorific value of 12.25 GJ/t and 18.2 GJ/t respectively, with their average value of sulphur content of 1.67%, and sulphur ash retention factor of 0.1. All factors are presented for year 2016 by NFR sectors in Appendix 4 of this report.

Agriculture/Forestry (NFR 1.A.4.c.i)

Methodology for emission calculation is Tier 1 EMEP/EEA, performed by multiplying total fuel sold (disaggregated by fuel type) with emission factors. Sector NFR 1.A.4.c.i Agriculture/Forestry is not a key source. Emission factors are expressed as the quantity of emissions of pollutants per GJ fuel consumed. All emission factors are default Tier 1 from GB2013, and are presented by NFR sectors in Appendix 4 of this report. Structure of fuel combustion in Agriculture/Forestry sector for period 1990 – 2016 is presented in Figure 4.5-4.

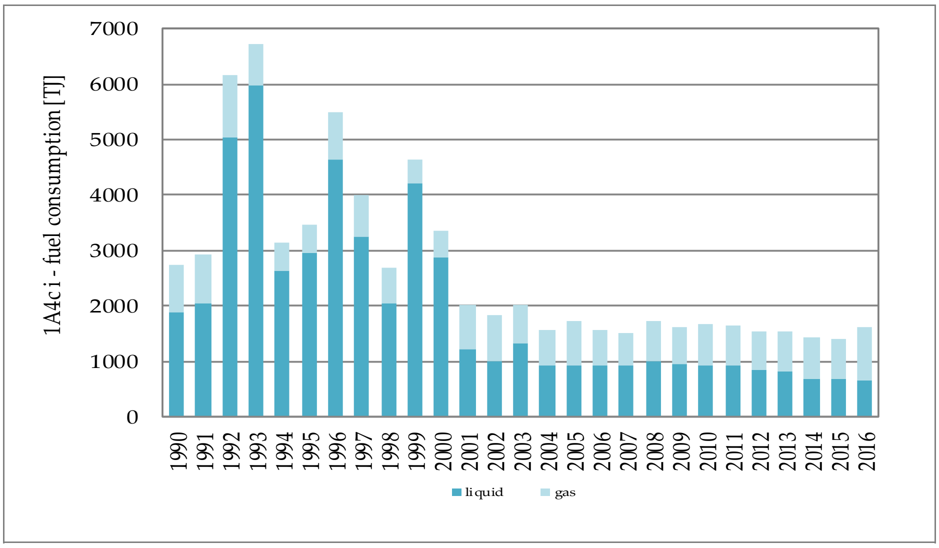



**Figure 4.5-4 Activity data on fuel consumption by fuel type for NFR 1.A.4.c.i**

**Recalculations and improvements**

Commercial/Institutional (NFR 1.A.4.a)

Residential (NFR 1.A.4.b.i)

Agriculture/Forestry (NFR 1.A.4.c.i)

There was no recalculation, neither improvement in this source categories.

## 4.6 NON-ROAD MOBILE SOURCES AND MACHINERY (NFR 1.A.4.ii, 1.A.2.g.vii)

**Source category description**

Non-road mobile sources and machinery source category covers a mixture of 'other' equipment. In Croatian inventory emissions are reported in following NFR sectors in the scope of 1.A.4.ii Non road mobile source and machinery: 1.A.4.b.ii Residential, 1.A.4.c.ii Agriculture/Forestry and 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction. Types of equipment used in manufacturing industries and construction (hereafter Industry) include: Asphalt pavers/concrete pavers (SNAP 080801), Plate compactor/tampers/rammers (SNAP 080802), Rollers (SNAP 080803), Trenchers/mini excavators (SNAP 080804), Excavators (wheel / crawler type) (SNAP 080805), Cement and mortar mixers (SNAP 080806), Cranes (SNAP 080807), Graders/scrapers (SNAP 080808), Off-highway trucks (SNAP 080809), Bulldozers (SNAP 080810), Tractors / loaders/backhoes (SNAP 080811), Skid steer loaders (SNAP 080812), Dumpers/tenders (SNAP 080813), Aerial lifts (SNAP 080814), Fork lifts (SNAP 080815), Generator sets (SNAP 080816), Pumps (SNAP 080817), Air/gas compressors (SNAP 080818), Welders (SNAP 080191), Refrigerating units (SNAP 080820), Other general industrial equipment (sweepers, scrubbers, broomers, pressure washers, slope and brush cutters, swappers, piste machines, ice rink machines, blowers, vacuums, etc.) (SNAP 080821), Other material handling equipment (conveyors, tunnel locomotives, snow clearing machines, industrial tractors, pushing tractors) (SNAP 080822), and Other construction equipment (paving and surfacing equipment, bore/drill rigs, crushing equipment, peat break machines, concrete breakers/saws, pipe layers, etc.) (SNAP 080823). Types of equipment used in Agriculture/Forestry include: Two-Wheel Tractors (SNAP 080601), Agricultural tractors (SNAP 080602), Harvesters/combiners (SNAP 080603), Others (e.g. sprayers, manure distributors, mowers, balers, tillers, swatchers) (SNAP 080604), Professional chain saws/clearing saws (SNAP 080701), Professional chain saws/clearing saws (SNAP 080701), Forest tractors/harvesters/skidders (SNAP 080702), Others (tree processors, haulers, fellers, forestry cultivators, shredders and log cultivators) (SNAP 080703). Types of equipment used in Residential (Household and gardening) include: Trimmers/edgers/brush cutters (SNAP 080901), Lawn mowers (SNAP 080902), Hobby chain saws (SNAP 080903), Snow mobiles/skidoos (SNAP 080904), Other household and gardening equipment (SNAP 080905), Other household and gardening vehicles (all-terrain vehicles, off-road motor cycles, golf carts, etc.) (SNAP 080906)

For all types of equipment, the emissions originate from the combustion of fuel to power the equipment.

**Methodology, emission factors and activity data**

The source categories 1.A.4.ii, 1.a.2.g.vii and 1.A.4.c.iii form the category Non-road mobile sources and machinery is a key source in Croatian inventory and Tier 2 technology-dependent advance method proposed in EMEP/EEA GB2016 is used. In essence this advance method involves sub-dividing the fuel consumption of fuel type used by the NFR sectors into the different technology types.

Emission factors are expressed as the quantity of emissions of pollutants per tonnes of fuel consumed. All emission factors are default Tier 2 from GB2016, stratified by fuel type, NFR sector, pollutant and are grouped according to the EU emission legislation stages, and three additional layers are added to cover the emissions from engines prior to the first EU legislation stages. For heavy metals and POPs, GB2016 is proposing the use of emission factors for Tier 1. That is because for some pollutants (e.g. heavy metals, $SO_2$ and $CO_2$,) the emission factors are independent of the equipment technology, i.e. are simply fuel derived. The key species, which do vary with differing equipment technologies, are particulate matter, NOx, NMVOC and CO. For estimation of emissions of $SO_2$, the country specific factors are used annually stratified by fuel types.

Basic activity data is the fuel consumption data for the different NFR categories from national energy balance annually (Figure 4.6-1). These fuel consumption data are split by the relative proportion of engine technology (< 1981, 1981–1990, 1991–Stage I, Stage I, Stage II, Stage IIIA, Stage IIB, Stage IV) for each particular inventory year. Alternative approach uses data derived from Winther & Nielsen (2006) to split the total fuel consumption into engine technology layers for each inventory year. The percentage split of total fuel consumption as a function of engine age are given for diesel machinery in 1.A.2.g.vii, 1.A.4.c.ii (Agriculture) and 1.A.4.c.ii (Forestry), and for gasoline two-stroke and four-stroke machinery. The layer share of fuel consumption per engine age and inventory year for diesel-fuelled non-road machinery and gasoline fuelled non-road machinery are used. For splitting gasoline consumption between two-stroke and four-stroke gasoline machinery, the Danish fuel consumption percentage split (25/75) is used in all inventory years, having in mind that it is regarded as very uncertain.

In accordance with the distribution in the national energy balance, the consumption of fuels for off-road mobile machinery in category 1.A.4.a.ii Commercial / institutional: Mobile are included in Category 1.A.4.b.ii Residential: Mobile and 1. A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery, therefore the "IE" mark is used.

Also, fuel consumption in category 1.A.4.c.iii is included in category 1.A.3.d.ii National navigation (shipping) (based on the total amount of fuel intended for combustion in domestic air, sea and river transport) and the “IE” mark is used accordingly.

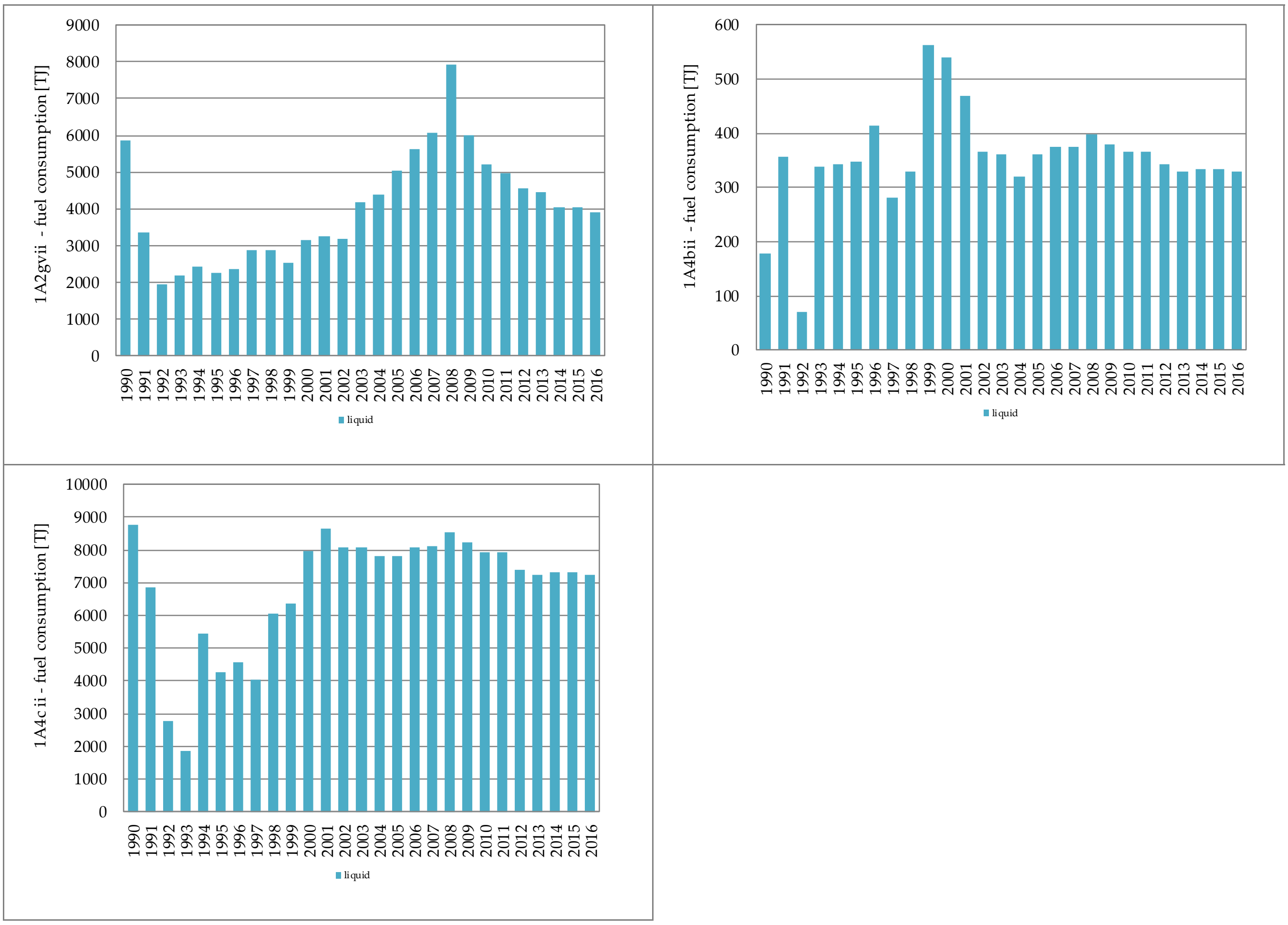



**Figure 4.6-1 Activity data on fuel consumption for NFR codes 1.A.2.g.iv, 1.A.4.b.ii and 1.A.4.c.ii**

## Recalculations and improvements

<u>Non-road mobile sources and machinery: Industry (NFR 1.A.2.g.vii)</u>

<u>Residential (NFR 1.A.4.b.ii)</u>

<u>Agriculture/Forestry (NFR 1.A.4.c.ii)</u>

Small changes due to the harmonization with the GB2016 methodology and FE for the past years

## 4.7 OTHER SECTORS (NFR 1.A.5.a, 1.A.5.b)

### Source category description

Category 1.A.5 is included in IIR in order to improve the transparency of inventory information on military emissions. All military emissions in sector 1.A.5 are specified as included elsewhere (IE).

In national energy balance military fuel consumed are included in 1.A.4.a.i, 1.A.3.a, 1.A.3.b and 1.A.3.d. Data on fuel sold for each category are collected via annual questionnaire by Croatian statistical office. This amount of fuel include as well fuel used for military purposes. Table 4.7-1 shows the link between the source category 1.A.5 and other source categories, where military emissions are included.

Dividing military from national specification is not possible because data for military only are not available and it is not economically justified because fuel used for military purposes is negligibly small for the whole historical period. It is most likely that contribution of military is below the threshold of significance.

**Table 4.7-1 Military emissions specification**

<table>
<tr><th>NFR code</th><th>Sector name</th><th>Notation key</th><th>NFR code where emissions are reported</th><th>Sector name where emissions are reported</th></tr>
<tr><td>1.A.5.a</td><td>Other stationary (including military)</td><td>IE</td><td>1.A.4.a.i</td><td>Commercial/Institutional: Stationary</td></tr>
<tr><td rowspan="5">1.A.5.b</td><td rowspan="5">Other, Mobile (including military)</td><td rowspan="5">IE</td><td>1.A.3.a.i(i), 1.A.3.a.ii(i)</td><td>Domestic and International aviation LTO (civil)</td></tr>
<tr><td>1.A.3.b.i, 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv</td><td>Road transport</td></tr>
<tr><td>1.A.3.d.ii</td><td>National navigation (shipping)</td></tr>
<tr><td>1.A.3.a.i(ii), 1.A.3.a.ii(ii)</td><td>International and Domestic aviation cruise (civil)</td></tr>
<tr><td>1.A.3.d.i(i)</td><td>International maritime navigation</td></tr>
</table>

## 4.8 FUGITIVE EMISSIONS FROM FOSSIL FUEL (NFR 1.B)

Sector 1.B Fugitive emissions from fossil fuels are arising from the production, extraction of coal, oil and natural gas; their storage, processing and distribution. This section includes information on methodologies, activity data, emission factors, recalculations and planned improvements for the sector 1.B Fugitive emissions from fossil fuels. Information on this sector are also available in Croatian national inventory report (NIR 2016), under the UNFCCC.

**Source category description**

<u>Fugitive emissions from solid fuels (NFR 1.B.1)</u>

This chapter provides an overview of the source categories 1.B.1 Fugitive emissions from solid fuels and includes information on methodologies, activity, emission factors and planned improvements. This category includes emissions from coal mining and handling (NFR 1.B.1.a), solid fuel transformation (NFR 1.B.1.b) and other fugitive emissions from solid fuels (NFR 1.B.1.c) for which Croatia does not report emissions bur used the notation key "NO".

This category includes emissions from mining and handling with coal, activity that exist in Croatia until 1999, as well as emissions during the coal transformation (fugitive emission from coke production), activity that exist in the Republic of Croatia until 1994. In the period from 1990 to 1999 coal production in Croatia has been on a steady decline. Until 1999 worked only Istrian underground coal (Tupljak, Ripenda and Koromačno) and they produced from 0.015 to 0.174 mill. tons of coal.

All underground and surface treatment of coal result mainly in fugitive emissions of methane, volatile organic compounds and particulate matter (TSP, $PM_{10}$ and $PM_{2.5}$) during mining and post mining activity, handling with coal. Coke Plant is a major source of fugitive emissions into the air such as: sulphur oxides (SOx), nitrogen oxides (NOx), volatile organic compounds (non-methane VOC and methane (CH4), carbon dioxide ($CO_2$), carbon monoxide (CO) ammonia ($NH_3$), particulate matter and heavy metals and PAHs (polycyclic aromatic hydrocarbons).

Fugitive emissions from oil and natural gas (NFR 1.B.2)

This chapter provides an overview of the source categories 1.B.2 Fugitive emissions from oil and natural gas, and includes information on methodologies, activity, emission factors and planned improvements. This category includes emissions from oil - exploration, production and transport (NFR 1.B.2.a.i), Refining / storage (NFR 1B .2.a.iv), distribution of oil products (NFR 1.B.2.a.v), natural gas –production/processing, and transmission (NFR 1.B.2.b), Flares (NFR 1.B.2.c) and 1.B.2.d Other fugitive emissions from energy production for which Croatia do not report emissions but rather used the notation key "NO".

This category includes the fugitive emissions from exploration and production, refining, storage transportation, processing and distribution of crude oil, petroleum products (gasoline) and natural gas. Fugitive emissions also include the emissions from flared gas on oil- and gas-production installations for safety, and emissions due to degassing in the production of oil and gas. Emissions are also occurring during production and processing of natural gas and oil, transportation and use of fossil fuel. During all phases of the extraction of fossil fuel to their final use, the evaporation of highly volatile material occurs and leakage of fossil fuel is also possible.

Oil - exploration production and transport (NFR 1.B.2.a.i)

Exploration production and transport of oil in the Republic of Croatia is carried out by company INA - Oil Industry d.d in the segment activity SD Exploration & Production of oil and gas (formerly INA NAFTAPLIN). In Croatia, 34 oil fields are active, and the maximum amount of oil came from 8 most important fields, that contain 83% of the total reserves discovered in Croatia. During the war (1991 - 1995) from 34 oil fields, only 22 of them worked. All oil fields in Croatia are "on shore" fields.

Natural gas - production/processing, and transmission (NFR 1.B.2.b)

In Croatia, the production/processing, and transmission of natural gas takes place in private facilities. Extraction and production of natural gas in Croatia carried out by INA - Oil Industry d.d in the segment activity SD Exploration & Production (formerly INA NAFTAPLIN). The main gas fields with 70% of total reserves are located in the three largest gas and gas-condensate fields, namely Molve, Kalinovac and Stari Gradac in the western part of the Drava depression, along the border with

Hungary. The work site "Molve" provides between 70% and 75% of gas and condensate per year in Croatia, satisfying about 50% of the needs. One of the old gas fields around the Sava Depression, turned into underground gas storage capacity of 500 mil. $m^3$ (Lit 27).

Transport system, carried out by transport system operator (OTS) company Plinacro Ltd. and by distribution system operators (35 company). Also, in this sector, the Hg emission that originates from process of cleaning natural gas in central gas station (CPS Molve). Natural gas produced on Croatian gas fields (Molve and Kalinovac) contains great content of Hg (516 $\mu g/m^3$), which wasn´t extracted from natural gas until 1992. In 1993 facility for Hg emission reduction started with work and Hg emission was reduced to about 0.12 $\mu g/m^3$ since then.

The transport system is managed by the transmission system operator Plinacro Ltd, it consists of international, main, regional and developable pipeline and facilities to the pipeline, measuring reduction stations (MRS) of various capacities and other facilities and systems that enable reliable and secure transport system. Basic data of the Croatian transport system are shown in Table 4.8-1.

**Table 4.8-1 Basic data on the natural gas transport system of the Republic of Croatia**

| **Natural gas transport system of the Republic of Croatia** | |
|---|---|
| Number of transmission system operators | 1 |
| The total length of pipeline gas transport system | 2 694 km |
| Interconnection / transmission system operator: | Rogatec / Plinovodi Ltd (SLO)<br>Drávaszerdahely / FGSZ Ltd. (HU) |
| Underground gas storage / gas storage system operator: | Okoli / Podzemno skladište plina Ltd |
| Inputs from domestic production / gas producer | UMS CPS Molve / INA - d.d.<br>UMS Etan, Ivanić Grad / INA - d.d.<br>UMS PS Ferdinandovac / INA - d.d.<br>UMS PS Gola / INA - d.d.<br>UMS PS Hampovica / INA - d.d.<br>UMS Terminal Pula / INAGIP Ltd |
| Number of connections for end users connection to the transmission system: | 34 |
| Number of connections to the distribution systems and the number of distribution system operators: | Number of ports: 153<br>Number of operators DS: 37 |
| Number of balancing zones: | 1 |

Source: Plinacro d.o.o. (http://www.plinacro.hr)

Refining / storage (NFR 1.B.2.a.iv)

Refining / storage in the Republic of Croatia is carried out in an oil refinery owned by a company INA - Oil Industry dd at two locations in Rijeka (INA - RNR) and Sisak (INA - RNS). Production capacities of the Croatian refineries are shown in Table 4.2-2. The calculation of emissions from these categories for INA - RNS includes emissions from FCC regenerators (without CO boiler) (from 1990), catalytic reforming unit (from 1990), coking plant (from 1994) and Claus installation (from 2007). INA - RNR includes emissions from FCC regenerators (without CO boiler) (from 1990), catalytic reforming unit (two units, from 1990) and Claus installation (from 1997). Diffuse emissions from storage and handling of petroleum products in refinery are calculated from 1990 for all refineries.

Distribution of refined petroleum products (NFR 1.B.2.a.v)

In Croatia, the distribution of petroleum products takes place through the following activities:

- Shipping and delivery of products in the refinery dispatch stations (SNAP 050501)
- transport and transfer stations oil products (SNAP 050502) and
- reloading and handling of petroleum products at service stations (retail trade) (SNAP 050503).

Distribution in Croatia is handled by company INA - Oil Industry d.d. segment activity SD Retail trade. The refinery, besides all oil products, NMVOC emissions are significant only for gasoline.

***Shipping and delivery of products in the refinery dispatch stations***

Shipping and delivery of gasoline is carried out in Croatia in two refinery dispatch stations in Sisak and Rijeka. The following describes their specifics related to the shipping and delivery of gasoline fuel.

Shipping and delivery of gasoline fuel in the Sisak refinery is implemented:

- road transport, which uses the shipping installation: road loading PJ terminal Sisak Shipping derivatives tankers. Charging lines are equipped with a present amount of equipment and catheter to prevent overcharging.
- rail transport which uses manipulative place MM1 - delivery,

- Transportation barges carried out on the Sava River south of Sisak in the port for receiving and unloading of crude oil from the river barges, and for loading products into river barges. Installation for unloading oil, and pumping in the container sector RNS is used, the installation of boarding petroleum products not used for a long time.

Shipping and delivery of gasoline fuel in Rijeka Refinery (import, RNS, MOL) products and MTBE is carried out through the dispatch centre for road, rail, marine and pipeline transport as follows:

- Road Transport Shipping derivatives (gasoline) tank trucks is done on the road loading Šoići. Charging the upper filling open system.
- Rail transport: rail tank loading the wagon-charging also applies outdoor charging system without automatic measurement system. Unloading railway tank is done through flexible pipes, the partially closed system and without the possibility of return of hydrocarbon vapours. All manipulation with railway tanks takes place motor locomotives. Charging is carried out by charging hands (top loading) open system.
- Marine transport petrol fuel takes place in the Port Bakar and occasionally Luka Urinj.

***Transportation and transfer stations gasoline fuel***

Emissions from the transport of gas in accordance with GB2016 was identified as negligible. This section includes emissions from gas fuel storage at terminals. According to GB2016, the methodology for calculating emissions from the storage of petrol at terminals in refineries is covered under the category 1.B.2.a.iv refinery / storage in refineries. Therefore, it is necessary to avoid double counting of emissions. The specific emissions using Tier 2 method are calculated and reported in the sector NFR 1.B.2.a.iv refinery / storage in refineries.

***Gas stations***

Handling and manipulation of gas fuel is carried out and at gasoline stations. Most emissions at gasoline stations are emissions from gasoline storage, and GB2016 propose only emission factors for petrol.

Flares (NFR 1.B.2.c)

The inventory included emissions from the two sub-categories: flares in refineries and flares in gas and oil extraction.

**Methodology, emission factors and activity data**

Coal mining and handling (NFR 1.B.1.a)

Fugitive emissions from sub-sectors 1.B.1.a Fugitive emissions from solid fuels: Coal mining and handling (SNAP 050102 Underground mining and SNAP 050103 Storage of solid fuel) are calculated with Tier 1 EMEP/EEA methodology and with „top-down" approach by multiplying process specific activity data with the corresponding EMEP/EEA Tier 1 emission factors. All emission factors used for the preparation of the IIR are presented by NFR sectors and pollutants in Appendix 4.

Sources to activity data for the total mass of coal produced by underground mining for NFR 1.B.1.a are the national energy balance. Annual amounts of total mass of coal produced by underground mining are presented in Table 4.8-2.

Solid fuel transformation (NFR 1.B.1.b)

Fugitive emissions from sub-sectors 1.B.1.b Fugitive emissions from solid fuel: solid fuel transformation (SNAP 040201 Coke oven (door leakage and extinction)) are calculated with Tier 1 EMEP/EEA methodology and with „top-down" approach by multiplying process specific activity data with the corresponding EMEP/EEA Tier 1 emission factors. All emission factors used for the preparation of the IIR are presented by NFR sectors and pollutants in Appendix 4.

Sources to activity data for the production of coke for the NFR 1.B.1.b are the national energy balance. Annual amounts of coke produced are presented in Table 4.8-2.

Other fugitive emissions from solid fuel (NFR 1.B.1.c)

This category refers to fugitive emissions from solid fuels that do not belong in the other categories 1.B.1. In the Republic of Croatia there is no such case and the used mark is "NO".

Oil - Exploration, production and transport (NFR 1.B.2.a.i)

Fugitive emissions from 1.B.2.a.i Extraction, 1st treatment and loading of liquid (SNAP 050200) are calculated with Tier 2 EMEP/EEA methodology by multiplying process specific activity data with the corresponding Tier 2 emission factors. All emission factors used for the preparation of the IIR are presented by NFR sectors and pollutants in Appendix 4. Relevant activity data is annual mass of crude oil extracted in Croatia from the national energy balance and are presented in Table 4.8-2.

**Table 4.8-2 Activity data for NFR code 1.B.1.a, 1.B.1.b, 1.B.1.c, 1.B.2.i and 1.B.3**

| NFR | 1 B 1 a | 1 B 1 b | 1 B 1 c | 1 B 2 a i | 1 B 3 |
|---|---|---|---|---|---|
| Name | Fugitive emissions from solid fuel: coal mining / handling | Fugitive emissions from solid fuel: transformation | Other fugitive emiss. from solid fuel | Fugitive emission from oil: exploration/ production/ transport | Other fugitive emissions not incl. in 1 B 2 |
| Unit | kt | kt | - | kt | - |
| 1990 | 173.7 | 556.0 | NA | 2696.2 | NO |
| 1991 | 154.8 | 456.0 | NA | 1930.9 | NO |
| 1992 | 120.3 | 408.0 | NA | 1742.9 | NO |
| 1993 | 115.1 | 422.0 | NA | 1727.1 | NO |
| 1994 | 103.2 | 277.0 | NA | 1576.6 | NO |
| 1995 | 82.2 | NO | NA | 1500.3 | NO |
| 1996 | 66.3 | NO | NA | 1469.1 | NO |
| 1997 | 48.5 | NO | NA | 1496.2 | NO |
| 1998 | 50.8 | NO | NA | 1389.4 | NO |
| 1999 | 15.3 | NO | NA | 1292.7 | NO |
| 2000 | NO | NO | NA | 1213.9 | NO |
| 2001 | NO | NO | NA | 1120.8 | NO |
| 2002 | NO | NO | NA | 1108.5 | NO |
| 2003 | NO | NO | NA | 1052.1 | NO |
| 2004 | NO | NO | NA | 1001.0 | NO |
| 2005 | NO | NO | NA | 946.0 | NO |
| 2006 | NO | NO | NA | 917.4 | NO |
| 2007 | NO | NO | NA | 879.1 | NO |
| 2008 | NO | NO | NA | 835.4 | NO |
| 2009 | NO | NO | NA | 776.2 | NO |
| 2010 | NO | NO | NA | 720.4 | NO |
| 2011 | NO | NO | NA | 664.4 | NO |
| 2012 | NO | NO | NA | 599.9 | NO |
| 2013 | NO | NO | NA | 600.7 | NO |
| 2014 | NO | NO | NA | 593.2 | NO |
| 2015 | NO | NO | NA | 670.2 | NO |
| 2016 | NO | NO | NA | 737.1 | NO |

Sources: ME with assistance of EIHP, CBS; Processing: Ekonerg Ltd

Refining / storage (NFR 1.B.2.a.iv)

Fugitive emissions during refining / storage (NFR 1.B.2.a.iv) were calculated using the Tier 2 EMEP/EEA methodology and "bottom-up" approach, multiplying relevant activity data with the recommended EMEP/EEA Tier 2 emission factors for specific process activities. All emission factors used for the calculation are presented by NFR sectors and pollutants in Annex 4.

Scope of process activities within the 1.B.2.a.iv Refining / storage are: SNAP 040102a – Catalytic Cracking unit regenerators, Partial burn without CO boiler, SNAP 040102b – Catalytic reforming units, SNAP 040103 - Sulphur recovery plants, SNAP 040104 - Storage and handling of petroleum products in refinery, SNAP 040103 - Other - Fluid coking units. For catalytic cracking unit regenerators, the proposed Tier 2 emission factors are for partial burn without a CO boiler, and with a primary cyclone installed, and other abatement techniques were not taking into account. Further, the existing facilities for refining haven’t got abatement techniques installed within activity catalytic cracking (FCC) units in sub-sector 1.B.2.a.iv. Data on annual throughput of each refinery of fresh feed in FCC, reforming and coking units, and sulphur annual production were obtained from CAEN (survey request). Activity data for calculating emissions from storage and handling of petroleum products in refinery, diffuse emissions is annual total throughput of crude oil in each refinery which are from annual national energy balance. Detail activity data for sub-sector 1.B.2.a.iv by SNAP, are presented in Table 4.8-3.

**Table 4.8-3 Activity data for NFR code 1.B.2.a.iv, represented by the relevant SNAP codes**

| SNAP | 040102a | 040102b | 040105 | 040103 | 040104 |
|---|---|---|---|---|---|
| SNAP, Name | Catalytic Cracking unit regenerator | Catalytic reforming unit | Other (Fluid coking unit) | Sulphur recovery plant | Storage and handling of petroleum products in refinery |
| Unit | $m^3$ | $m^3$ | $m^3$ | t product | kt product |
| 1990 | 1281386.9 | 1604752.5 | NO | NO | 6860.7 |
| 1991 | 894923.1 | 1025834.7 | NO | NO | 4510.9 |
| 1992 | 698051.1 | 765189.2 | NO | NO | 3935.0 |
| 1993 | 945750.0 | 1089993.2 | NO | NO | 4914.8 |
| 1994 | 842190.2 | 965896.8 | 160057.6 | NO | 4994.3 |
| 1995 | 883426.3 | 1240143.5 | 160156.6 | NO | 5336.1 |
| 1996 | 702792.0 | 1218952.5 | 130610.0 | NO | 5112.7 |
| 1997 | 699881.1 | 1105752.4 | 139063.5 | 2182.0 | 5112.0 |
| 1998 | 898859.7 | 1035149.7 | 154889.9 | 5328.0 | 5007.5 |
| 1999 | 1037236.9 | 1136591.1 | 194651.3 | 5898.0 | 5474.8 |
| 2000 | 1385177.6 | 1208675.6 | 190477.4 | 8344.0 | 5162.8 |

| SNAP | 040102a | 040102b | 040105 | 040103 | 040104 |
|---|---|---|---|---|---|
| SNAP, Name | Catalytic Cracking unit regenerator | Catalytic reforming unit | Other (Fluid coking unit) | Sulphur recovery plant | Storage and handling of petroleum products in refinery |
| Unit | $m^3$ | $m^3$ | $m^3$ | t product | kt product |
| 2001 | 1217423.5 | 1159479.8 | 190477.4 | 6742.0 | 4831.6 |
| 2002 | 1247837.5 | 1028707.7 | 214165.0 | 7069.0 | 4830.0 |
| 2003 | 1242743.7 | 1204451.0 | 189346.3 | 7471.0 | 4861.7 |
| 2004 | 1348940.9 | 1184513.3 | 176767.0 | 8463.0 | 5079.3 |
| 2005 | 1394164.7 | 1048203.3 | 149598.6 | 8134.0 | 4944.7 |
| 2006 | 1138184.8 | 1033704.3 | 191970.8 | 6694.0 | 4716.4 |
| 2007 | 1369880.4 | 1067431.1 | 181216.5 | 8910.0 | 5077.4 |
| 2008 | 1065994.3 | 925676.0 | 116827.1 | 9511.0 | 4308.7 |
| 2009 | 1330001.8 | 1048720.6 | 122365.0 | 10037.0 | 4824.4 |
| 2010 | 1027809.8 | 930965.3 | 184824.0 | 6370.0 | 4256.6 |
| 2011 | 836242.29 | 743097.3 | 91182.9 | 16317.0 | 3502.7 |
| 2012 | 906166.8 | 775119.3 | 109368.5 | 17534.2 | 2924.9 |
| 2013 | 562661.8 | 729726.9 | 83736.2 | 15902.3 | 3062.5 |
| 2014 | 553299.8 | 661857.0 | 38501.3 | 19384.5 | 2444.4 |
| 2015 | 524311.0 | 681111.0 | 89984.0 | 17539.6 | 2998.2 |
| 2016 | 523721.0 | 718614.0 | 61966.0 | 21690.0 | 3250.5 |

Sources: CAEN (survey request: oil refineries); Processing: Ekonerg Ltd

Distribution of oil products (NFR 1.B.2.a.v)

Fugitive emissions from sub-sectors: 1.B.2.a.v Distribution of oil products (SNAP 050400 Liquid fuel distribution (except gasoline distribution), SNAP 050502 Refinery dispatch station, and SNAP 050503 Service stations (including refuelling of cars)) were calculated with Tier 2 EMEP/EEA methodology and "bottom-up" approach by multiplying relevant activity data with the recommended EMEP / EEA Tier 2 emission factors, both stratified according to the different techniques in the distribution of oil products occurring in the national oil industry. According to the proposed methodology emissions from refinery, storage tanks are reported in 1.B.2.a.iv and emission from loading of mobile container in refinery are reported in 1.B.2.a.v. For source category SNAP 050502 Transport and depots (except 050503) according to GB2016 emissions from transport were identified as negligible, emissions from filling mobile containers at depots are calculated in the scope of refinery dispatch stations and emissions at depots is gasoline storage which is covered in 1.B.2.a.iv.

Detail activity country specific data are collected and this includes:

- loading facilities at refinery dispatch stations, terminals and depots — volume of volatile products loaded into different transport modes (road, rail and marine tanker); loading practices for specific modes of transport (top, bottom); type and extent of emission control measures in place (VRU), data source is national oil company;
- service stations — volume of gasoline sold; type and extent of emission control measures in place (Stage IB, Stage II), data source is national oil company, and national energy balance;
- average ambient temperature, data source is Meteorological and hydrological service;
- Reid vapour pressure (RVP) of distributed volatile products (gasoline) — is calculated from the annual average RVP value and average temperature data the true vapour pressure.

Activity data on annual amount of gasoline handled for sub-sector 1.B.2.a.v by SNAP, are presented in Table 4.8-4.

**Table 4.8-4 Activity data for NFR code 1.B.2.a.v, represented by the relevant SNAP codes**

| Activity | Service stations, Storage tank filling | Service stations, Storage tank breathing | Service stations, Automobile refuelling | Service stations, Automobile refuelling: drips and spills | Refinery dispatch station, Road tanker | Refinery dispatch station, Rail tanker | Refinery dispatch station, Marine tanker |
|---|---|---|---|---|---|---|---|
| SNAP | 50503 | 50503 | 50503 | 50503 | 50501 | 50501 | 50501 |
| Unit | kt gasoline | kt gasoline | kt gasoline | kt gasoline | kt gasoline | kt gasoline | kt gasoline |
| 1990 | 764 | 764 | 764 | 764 | 426.4 | 399.9 | 995.3 |
| 1991 | 590.5 | 590.5 | 590.5 | 590.5 | 324.5 | 304.3 | 757.5 |
| 1992 | 511.4 | 511.4 | 511.4 | 511.4 | 227.5 | 213.4 | 531.1 |
| 1993 | 497 | 497 | 497 | 497 | 298.6 | 280.0 | 697.1 |
| 1994 | 545.63 | 545.63 | 545.63 | 545.63 | 321.0 | 301.1 | 749.4 |
| 1995 | 575.1 | 575.1 | 575.1 | 575.1 | 360.7 | 338.2 | 842.0 |
| 1996 | 626 | 626 | 626 | 626 | 319.6 | 299.7 | 746.0 |
| 1997 | 678 | 678 | 678 | 678 | 325.7 | 305.5 | 760.4 |
| 1998 | 737.3 | 737.3 | 737.3 | 737.3 | 338.8 | 317.7 | 790.9 |
| 1999 | 781.7 | 781.7 | 781.7 | 781.7 | 296.2 | 277.8 | 691.5 |
| 2000 | 784.4 | 784.4 | 784.4 | 784.4 | 313.5 | 293.9 | 731.7 |
| 2001 | 753.8 | 753.8 | 753.8 | 753.8 | 293.1 | 274.8 | 684.1 |
| 2002 | 759 | 759 | 759 | 759 | 301.1 | 282.3 | 702.8 |
| 2003 | 757.3 | 757.3 | 757.3 | 757.3 | 315.9 | 296.3 | 737.5 |

| Activity | Service stations, Storage tank filling | Service stations, Storage tank breathing | Service stations, Automobile refuelling | Service stations, Automobile refuelling: drips and spills | Refinery dispatch station, Road tanker | Refinery dispatch station, Rail tanker | Refinery dispatch station, Marine tanker |
|---|---|---|---|---|---|---|---|
| **SNAP** | **50503** | **50503** | **50503** | **50503** | **50501** | **50501** | **50501** |
| **Unit** | **kt gasoline** | **kt gasoline** | **kt gasoline** | **kt gasoline** | **kt gasoline** | **kt gasoline** | **kt gasoline** |
| 2004 | 723.7 | 723.7 | 723.7 | 723.7 | 319.1 | 299.3 | 744.9 |
| 2005 | 709.6 | 709.6 | 709.6 | 709.6 | 333.5 | 312.7 | 778.5 |
| 2006 | 711.3 | 711.3 | 711.3 | 711.3 | 325.4 | 305.1 | 759.5 |
| 2007 | 725.3 | 725.3 | 725.3 | 725.3 | 341.1 | 319.9 | 796.3 |
| 2008 | 696.3 | 696.3 | 696.3 | 696.3 | 308.2 | 250.8 | 730.1 |
| 2009 | 692.3 | 692.3 | 692.3 | 692.3 | 269.8 | 286.5 | 871.4 |
| 2010 | 650.5 | 650.5 | 650.5 | 650.5 | 229.4 | 275.6 | 819.1 |
| 2011 | 634.9 | 634.9 | 634.9 | 634.9 | 192.0 | 243.3 | 651.6 |
| 2012 | 590.1 | 590.1 | 590.1 | 590.1 | 178.4 | 234.4 | 746.5 |
| 2013 | 576.2 | 576.2 | 576.2 | 576.2 | 170.8 | 198.3 | 657.7 |
| 2014 | 532.7 | 532.7 | 532.7 | 532.7 | 141.8 | 241.7 | 562.9 |
| 2015 | 531.5 | 531.5 | 531.5 | 531.5 | 132.3 | 238.0 | 690.0 |
| 2016 | 533.4 | 533.4 | 533.4 | 533.4 | 362.9 | 126.1 | 568.5 |

Source: MIA with EIHP, CAEN INA d.d; Processing: Ekonerg Ltd

Flares (NFR 1.B.2.c)

Fugitive emissions from sub-sector 1.B.2.c Venting and Flaring are calculated for two SNAP categories: SNAP 090203 Flaring in oil refinery and SNAP 090206 Flaring in gas and oil extraction. EMEP/EEA methodology is used with Tier 2 approach. Both the activity data and the emission factors are stratified according to the different techniques that occur in Croatia. In the venting and flaring sector, these are refinery flares, flares in natural gas extraction and well testing. Well testing is not occurring in Croatia. Tier 2 approach for emission calculation is carried out by multiplying process specific activity data for the specific technology with the corresponding EMEP/EEA Tier 2 emission factor for this technology and this pollutant. All emission factors used for the preparation of the IIR are presented by NFR sectors and pollutants in Appendix 4.

Activity data for SNAP 090203 Flaring in oil refinery is the annual flared amount for each refinery. The data for the flared amount for each refinery were collected for the period 2010 – 2016, and used for methodology improvement, e.g. move to Tier 2. The source of data are the national oil refinery company INA Ltd. For NMVOC and $SO_2$ emission calculation Tier 1 approach is used, because the data on the gaseous streams composition destructed in flares were not available. Activity data used for Tier 1 approach is the annual total throughput of refineries. Besides, these data, the data on total amount of crude oil at the entrance to the refineries is use, along with amount of fuel used by type in each of refinery. Source for the total amount of crude oil is from the national energy balance. Source for the annual amount of fuels for the period 2008 – 2016 is the national EPR. Source for the annual amount of fuels for the period 1990-2004 is the basis for the preparation of the Energy Development Strategy of the Republic of Croatia (OG 130/09) collected from oil refinery company INA Ltd. For the period 2005-2007 the amount of fuels by type and refinery were calculated by using of the linear interpolation method. The data on annual fuel amount by refinery is used to determine the annual amount of crude oil at the entrance to each refinery. The data on total crude oil by each of two refineries in Croatia is confidential. Amount of gas flared at the each refinery in the period 1990 - 2009 were calculated by using weighting factors calculated as the average value of the known quantities of gas flared at the refinery for the period 2010-2014 and by multiplying with the estimated amount of crude oil at the entrance to each refinery. It is assumed that the average crude oil density in Croatia is 0.86 kg/dm$^3$.

Table 4.8-5 gives the overview of activity data for NFR 1.B.2.c Venting and Flaring, SNAP 090203 Flaring in oil refinery and SNAP 090206 Flaring in gas and oil extraction.

**Table 4.8-5 Activity data for NFR 1.B.2.c Venting and Flaring, SNAP 090203 Flaring in oil refinery and SNAP 090206 Flaring in gas and oil extraction**

| Activity data | Gas flared in refineries | | Crude oil truthput in refineries | Gas flared in gas and oil extraction |
|---|---|---|---|---|
| Unit | GJ | GJ | t | m$^3$ |
| 1990 | 211317 | 727761 | 6860700 | 22313460 |
| 1991 | 145779 | 630090 | 4510900 | 19824633 |
| 1992 | 64444 | 337790 | 3935000 | 14236376 |
| 1993 | 138202 | 558377 | 4914800 | 18026024 |
| 1994 | 141458 | 534205 | 4994300 | 14848538 |
| 1995 | 117437 | 762467 | 5336100 | 12105367 |
| 1996 | 144703 | 705871 | 5112700 | 11294150 |
| 1997 | 166576 | 726555 | 5112000 | 13557402 |
| 1998 | 162667 | 861277 | 5007500 | 12396234 |

| Activity data | Gas flared in refineries | | Crude oil truthput in refineries | Gas flared in gas and oil extraction |
|---|---|---|---|---|
| Unit | GJ | GJ | t | m³ |
| 1999 | 178518 | 889818 | 5474800 | 14990742 |
| 2000 | 150652 | 1002606 | 5162800 | 12934101 |
| 2001 | 153651 | 929303 | 4831600 | 15866449 |
| 2002 | 181054 | 834244 | 4830000 | 16733125 |
| 2003 | 166945 | 885158 | 4861700 | 17279182 |
| 2004 | 193983 | 713208 | 5079300 | 17345753 |
| 2005 | 185887 | 715937 | 4944700 | 18018016 |
| 2006 | 179773 | 742919 | 4716400 | 21409983 |
| 2007 | 171970 | 801227 | 5077400 | 22818263 |
| 2008 | 142593 | 855865 | 4308700 | 21534636 |
| 2009 | 140486 | 855909 | 4824400 | 19029619 |
| 2010 | 125923 | 512107 | 4256600 | 12015485 |
| 2011 | 135550 | 683021 | 3502700 | 14906257 |
| 2012 | 208873 | 730163 | 2924900 | 11197569 |
| 2013 | 114215 | 774082 | 3062500 | 10813905 |
| 2014 | 54193 | 893471 | 2444000 | 15176368 |
| 2015 | 44524 | 1114887 | 2998000 | 12451453 |
| 2016 | 160202 | 176112 | 3250500 | 12911506 |

Source: MZOE with EIHP, CAEN, INA d.d.; Processing: Ekonerg Ltd.

Activity data for SNAP 090206 Flaring in gas and oil extraction is the annual volume of gas flared in hydrocarbons (oil and gas) extraction. The data were collected for the period 2009 – 2016 from national oil refinery company INA Ltd., and used for methodology improvement, e.g. move to Tier 2. Annual volume of gas flared in gas and oil extraction in the period 1990 - 2008 were calculated by using weighting factor calculated as the average value of the known quantities of annual gas flared in gas and oil extraction for the period 2009-2015 and by multiplying with the annual volume of total gas and crude oil extracted in Croatia. It is assumed that the average crude oil density in Croatia is 0.86 kg/dm$^3$ and average density of natural gas 0.73 kg/m$^3$.

Natural gas - production / processing and transmission (NFR 1.B.2.b)

Emissions from the production / processing and transmission of natural gas are calculated by applying the Tier 2 EMEP / EEA methodology. Company OTS Plinacro Ltd reports $CH_4$ emissions to the EPR. Data were available from 2011 to 2015. $CH_4$ emissions from natural gas transmission are estimated on the basis of the registered loss in transmission networks and emissions from natural gas consumption on measuring reduction stations for pressure regulation (MRS) (Oertenblad, 2007). In Croatian natural gas transmission system, the only loss in network is during the maintenance on specific pipeline section. According to OTS Plinacro Ltd, there is a very good maintenance of pipelines in the network, and loses are minimized because they are the expense of the system. Furthermore, the plan is to include the compressors during the maintenance of the pipeline sequence so the losses will be further reduced.

NMVOC emissions from natural gas distribution was calculated on the base of direct $CH_4$ emissions reported in EPR basis and are directly related on the quality of natural gas that are published by the company Plinacro Ltd. (Equation 1). Standard quality gas in Croatia is regulated by the following legal framework: The Energy Act (OG 120/12, 14/14, 95/15, 102/15), Gas Market Act (OG 28/13, 14/14, 16/17) and the General Terms of gas supply (OG 158/13, 74/17). Monitoring the quality of natural gas and reporting of the same in the legal competence of the OTS company Plinacro Ltd. and ODS which every 15 days, in accordance with the Grid Code Gas Distribution System (OG 155/14, 43/17) and Grid Code Gas Transport System (OG 3/2017), based on samples of natural gas to take measurement-reduction station (PMRS) by a certified laboratory, delivers suppliers of natural gas report on testing the quality of gas. All values refer to the volume of gas of 1 $m^3$ in standard condition in which the absolute pressure of the gas 101.325 Pa (1.01325 bar) and temperature of gas 288.15 K (15° C).

$$E_{NMHOS} = E_{CH4} \times (W_{NMHOS} / W_{CH4}) \qquad \text{(Equation 1)}$$

where:

$W_{NMVOC}$ - the weight-% NMVOC

$W_{CH4}$ - the weight-% of $CH_4$, according to gas quality of the current year

$E_{CH4}$ - the annual $CH_4$ emission reported in RPR

For the calculation of emissions from the transmission and distribution of natural gas Tier 2 methodology was used with activity data on the quantities of natural gas transported in period from 2002 to 2015 (Table 4.8-4). For the period from 1990 to 2001, data on the natural gas quantities were estimated on the basis of production data for natural gas (source: National energy balance) and the average share for gas transportation in the total amount of natural gas produced (2002 - 2013). Based on specific data for $CH_4$ emission available since 2010 and specific data on mass composition of natural gas available since 2010. Specific NMVOC emission factors were calculated on the yearly base and their average value was applied to the historical trend from 1990 – 2009 (Table 4.8-6). Since there was no CH4 emission data available for 2016, the factor was taken as the average for the last 5 years before 2016. The recommended Tier 2 emission factor is used to calculate NMHOS emissions from natural gas extraction (Table 4.8-7).

**Table 4.8-6 Activity data for NMVOC emission estimation for sector NFR 1.B.2.b.2 Transmission of natural gas**

| NFR 1.B.2.b.2 | Transported amount NG (historical data) (IMRS +PSP) | | |
|---|---|---|---|
| **Year** | **GWh** | **GJ** | **1000 m3*** |
| 1990 | | | 2507.45 |
| 1991 | | | 2355.86 |
| 1992 | | | 2233.00 |
| 1993 | | | 2537.67 |
| 1994 | | | 2219.38 |
| 1995 | | | 2476.37 |
| 1996 | | | 2336.29 |
| 1997 | | | 2215.54 |
| 1998 | | | 2026.42 |
| 1999 | | | 2017.32 |
| 2000 | | | 2117.20 |
| 2001 | | | 2610.62 |
| 2002 | 27900 | 100440000 | 2954.12 |
| 2003 | 29500 | 106200000 | 3123.53 |
| 2004 | 29100 | 104760000 | 3081.18 |
| 2005 | 29900 | 107640000 | 3165.88 |
| 2006 | 29700 | 106920000 | 3144.71 |
| 2007 | 32300 | 116280000 | 3420.00 |
| 2008 | 33100 | 119160000 | 3504.71 |
| 2009 | 30147 | 108529200 | 3192.04 |
| 2010 | 32425 | 116730000 | 3433.24 |
| 2011 | 31679 | 114044400 | 3354.25 |
| 2012 | 31259 | 112532400 | 3309.78 |
| 2013 | 28700 | 103320000 | 3038.82 |
| 2014 | 25200 | 90720000 | 2668.24 |
| 2015 | 26400 | 95040000 | 2795.29 |
| 2016 | 27648 | 99531663 | 2927.40 |

Note:* Grey fields contain estimated values
NG – natural gas

Source: Plinacro Ltd. and IIR2016

**Table 4.8-7 Tier 2 emission factor for NMVOC emission calculation for sector NFR 1.B.2.b**

| Activity | Category | Pollutant | Tier 2 emission factor | Unit |
|---|---|---|---|---|
| Natural gas production / processing | 1.B.2.b.1 | NMVOC | 0.1 | g/m3 |

**Table 4.8-8 Tier 2 emission factor for NMVOC emission calculation for sector NFR 1.B.2.b.2**

| Activity | | Transmission of natural gas (transport + distribution) |
|---|---|---|
| Category | | 1.B.2.b.2 |
| Pollutant | | NMVOC |
| Tier 2 emission factor, t/m3 | *1990– 2009 | 0.008 |
| | 2010 | 0.004 |
| | 2011 | 0.005 |
| | 2012 | 0.014 |
| | 2013 | 0.010 |
| | 2014 | 0.019 |
| | 2015 | 0.004 |
| | 2016 | 0.010 |

* FE NMVOC estimated on average value for period 2010-2015

**Table 4.8-9 Activity data for NFR code 1.B.2.b, represented by the relevant SNAP codes**

| NFR | 1 B 2 b 1 | 1 B 2 b 2 |
|---|---|---|
| SNAP | 050300 | 050600 |
| Name | Fugitive emission from natural gas (production / processing) | Fugitive emission from natural gas: Transmission |
| Jed. | 1000 $m^3$ | 1000 $m^3$ |
| 1990 | 1982300 | 2507.45 |
| 1991 | 1824300 | 2355.86 |
| 1992 | 1803000 | 2233.00 |
| 1993 | 2049000 | 2537.67 |
| 1994 | 1792000 | 2219.38 |
| 1995 | 1966400 | 2476.37 |
| 1996 | 1785600 | 2336.29 |
| 1997 | 1717200 | 2215.54 |
| 1998 | 1570100 | 2026.42 |
| 1999 | 1550550 | 2017.32 |
| 2000 | 1638500 | 2117.20 |
| 2001 | 2010400 | 2610.62 |
| 2002 | 2120300 | 2954.12 |
| 2003 | 2189600 | 3123.53 |
| 2004 | 2198100 | 3081.18 |

| **NFR** | **1 B 2 b 1** | **1 B 2 b 2** |
|---|---|---|
| **SNAP** | **050300** | **050600** |
| **Name** | **Fugitive emission from natural gas (production / processing)** | **Fugitive emission from natural gas: Transmission** |
| **Jed.** | **1000 m³** | **1000 m³** |
| 2005 | 2283400 | 3165.88 |
| 2006 | 2713500 | 3144.71 |
| 2007 | 2892100 | 3420.00 |
| 2008 | 2729400 | 3504.71 |
| 2009 | 2704800 | 3192.04 |
| 2010 | 2727200 | 3433.24 |
| 2011 | 2471400 | 3354.25 |
| 2012 | 2013100 | 3309.78 |
| 2013 | 1856100 | 3038.82 |
| 2014 | 1747000 | 2668.24 |
| 2015 | 1780500 | 2795.29 |
| 2016 | 1647200 | 2927.40 |

Source: MIA with EIHP, CAEN and Plinacro Ltd.
Processing: Ekonerg Ltd.

Other fugitive emissions from energy production (NFR 1.B.2.d)

Emissions in this category are calculated based on the use of geothermal energy for electricity generation. There were not yet such activities in the Republic of Croatia and the "NO" mark was used.

**Recalculations and improvements**

Other fugitive emissions from solid fuel (1.B.1.c)

Oil - Exploration, production, transport (1.B.2.a.i)

Refining, storage (1.B.2.a.iv)

There was no recalculation, neither improvement in this source categories.

Distribution of oil products (NFR 1.B.2.a.v)

Changes due to the correction of calculation in past years because of the small manual error in the previous years.

Natural gas - Exploration, production, transport (NFR 1.B.2.b)

Small changes due to the correction of calculation for the period 2013. – 2015.

Venting and flaring (NFR 1.B.2.c)

Small changes due to the correction of calculation for the period 2014. – 2015.

# V INDUSTRIAL PROCESSES AND PRODUCT USE (NFR 2)

This chapter gives an overview of the sector 2 Industrial processes and product use and contains information on methodologies, activity data, emission factors, recalculations and planned improvements. Information on this sector is also available in the Croatian NIR 2017 under the UNFCCC. Industrial process includes emissions that originate from the process (called process emissions). Emissions from fuel combustion in industry are distributed in NFR sector 1.A.2.f.i fuel combustion in industry and construction (see section 3.1). Product use is concerning solvent and solvent-based products which are the source of NMVOC emission. Solvents are chemical compounds, which are used to dissolve substances as paint, glues, ink, rubber, plastic, pesticides or for cleaning purposes (degreasing). After application of these substances or other procedures of solvent use most of the solvents are released into air. Because solvents consist mainly of NMVOC, solvent use is a major source for anthropogenic NMVOC emissions. Once released into the atmosphere NMVOCs react with reactive molecules (mainly HO-radicals) to finally form $CO_2$.

This source category includes the following sub-sectors from which certain pollutant emissions in the Republic of Croatia occur:

- **2.A Mineral product**
    - 2.A.1 Cement production
    - 2.A.2 Lime production
    - 2.A.3 Glass production
    - 2.A.5.a Quarrying and mining of minerals other than coal
    - 2.A.5.b Construction and demolition
    - 2.A.5.c Storage, handling and transport of mineral products
    - 2.A.6 Other mineral products
- **2.B Chemical industry**
    - 2.B.1 Ammonia production
    - 2.B.2 Nitric acid production

- 2.B.10.a Other (production of carbon black, ethylene, styrene, NPK fertilizers, ammonium phosphate, formaldehyde, ethyl benzene, polystyrene, polyvinylchloride, polyethylene LD, vinyl chloride, propylene, urea and sulfuric acid)
- 2.B.7 Soda ash production

- **2.C Metal production**
  - 2.C.1 Iron and Steel production
    - 2.C.1.1 Steel production
    - 2.C.1.2 Iron production
    - 2.C.1.5 Other (Rolling mills)
  - 2.C.2 Ferro alloys production
  - 2.C.3 Aluminium production

- **2 D – 2 L Other solvent and product use**
  - 2.D.3.a Domestic solvent use including fungicides
  - 2.D.3.b Road paving with asphalt
  - 2.D.3.c Asphalt roofing
  - 2.D.3.d Coating applications
  - 2.D.3.e Degreasing
  - 2.D.3.f Dry cleaning
  - 2.D.3.g Chemical products
  - 2.D.3.h Printing
  - 2.D.3.i, 2.G Other solvent and product use
  - 2.H.1 Pulp and paper industry
  - 2.H.2 Food and beverages industry
  - 2.H.3, 2.L Other industrial processes including production, consumption, storage etc. of bulk products
  - 2.I Wood processing
  - 2.J Production of POPs
  - 2.K Consumption of POPs and heavy metals

Generally, method for emission calculation from industrial processes and product use includes product of observed activity data with the appropriate emission factors (Tier 1 and Tier 2). Methodology for specified activity in NFR code 2 is providing in following sub-chapters.

Emission factors are expressed as the quantity of pollutant emission per unit of production or per population. Used emission factors are from the *EMEP / CORINAIR Atmospheric emission inventory Guidebook - Second Edition (1999)* and *EMEP/EEA Guidebook – 2016*. The source of emission factors used for emission calculation is noted in each of sub-sector under NFR code 2. Emission factors used for the preparation of the IIR presented by NFR sectors and pollutants are given in Appendix 4.

Generally three sources of information concerning activity and emission data for the processes and product use have been used:

- Emission data as reported annually by facilities in legally required forms under the Croatian EPR.
- National production statistics at national level from the Croatian CBS (the Annual Statistical Reports, Industrial production, Annual PRODCOM Results).
- Plant specific data collected by direct contacts with facilities mainly for LCPs (e.g. facilities for production of cement, lime, sugar etc.)

## 5.1 MINERAL PRODUCTS (NFR 2.A)

This source category gives overview of the production of various mineral products in the Republic of Croatia. The following processes are represented under source category 2.A Mineral products (SNAP codes are included) in Croatia: Cement production (NFR 2.A.1, SNAP 040612), Lime production (NFR 2.A.2, SNAP 040614), Glass production (NFR 2.A.3, SNAP 040613), Quarrying and mining of minerals other than coal (NFR 2.A.5.a, SNAP 040623), Construction and demolition (NFR 2.A.5.b, SNAP 040624) and Storage, handling and transport of mineral products (NFR 2.A.5.c). For source category 2.A.5.c Croatia is using notation key "IE" due to PM emissions are included in other NFR 2.A codes.

**Source category description**

Cement production (NFR 2.A.1)

Cement production occurs at four facilities in Croatia. In three facilities Portland cement is producing and in one Aluminate cement is producing. Different raw materials are used for Portland cement and Aluminate cement production.

Lime production (NFR 2.A.2)

During the reporting period, in operation were total of four manufacturers (five factories) of lime in Croatia; one of them was producing both quicklime and dolomitic lime and the others were producing only quicklime, which had a varying production and even periods of halted operations over the years. Since March 2011, two of the factories cancelled their production and since 2012 yet another. An amount of quicklime produced in sugar factories (in three facilities) during observing period, together with amounts of quicklime produced in the blast furnace processes during 1990 and 1991, have been also included in this source category.

Glass production (NFR 2.A.3)

This source category includes production of flat glass production, container glass production, and mineral wool production. Facility for mineral wool production has started to work in 2007.

Quarrying and mining of minerals other than coal (NFR 2.A.5.a)

Quarrying and mining of minerals other than coal in Croatia include quarrying of ornamental and building stone, limestone, gypsum, chalk and slate, operation of gravel and sand pits; mining of clays and kaolin, mining of chemical and fertiliser minerals, extraction of salt and mining and quarrying of other minerals not elsewhere classified. Information on production statistic by type of minerals is using for emission calculation.

Construction and demolition (NFR 2.A.5.b)

The basis for the calculations is national statistical data on construction and demolition activities, specifically annual floor area of the building constructed or demolished are used.

**Methodology, emission factors and activity data**

Cement production (NFR 2.A.1)

Methodology for emission calculation for cement production is based on Tier 2 EMEP/EEA methodology, by multiplying the annual amount of clinker produced with the appropriate emission factor. Emission factors for cement production are from GB2016. In direct contacts with all existing facilities for cement production it was decided to include Tier 2 emission factors for PM for source category 2.A.1 Cement production with inclusion of existing abatement technologies in all of facilities: ESP on main stack and smaller fabric filters for moderate control of fugitive sources for whole observed trend. For each of facilities and emissions of pollutants specific for fuel combustion are allocated in energy sector, source category 1.A.2.f.i for whole trend since 1990.

Besides TSP, $PM_{2.5}$ and $PM_{10}$ emissions, BC emissions are reported for 1990 onwards and are calculated as a fraction of $PM_{2.5}$ according to GB2016.

The activity data on clinker and cement production are collected by survey of all cement manufacturers in Croatia and cross-checked with cement and clinker production data from Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS) and with data provide in EPR data base. Results of comparison showed that there is no significant difference between these sets of data. The activity data on clinker and cement (Portland and Aluminate) production are presented in Table 5.1-1. Emission factors used for the preparation of the IIR 2018, presented by NFR sectors and pollutants, are given in Appendix 4.

Lime production (NFR 2.A.2)

Methodology for emission calculation for lime production is based on Tier 2 EMEP/EEA methodology, by multiplying the annual amount of quicklime produced with the appropriate emission factor. For lime production Tier 2 controlled emission factors for PM from GB2016 are used. All facilities for lime production have installed fabric filter on rotary kilns and bag filters for de-dust the emissions during lime hydrating, and also fabric filters for emissions control from conveyor belts of quicklime in all of facilities. Emission of pollutants which are specific for fuel combustion, were allocated in energy sector, source category 1.A.2.f for whole trend since 1990.

Besides TSP, $PM_{2.5}$ and $PM_{10}$ emissions, BC emissions are reported for 1990 onwards and are calculated as a fraction of $PM_{2.5}$ according to GB2016.

Data on the amount of lime produced in Croatia includes the amount of lime produced in a lime facilities (1990 - 2016), quicklime produced in blast furnaces in 1990 and 1991 and the quantity produced in sugar production facilities. The activity data for quicklime and dolomitic lime production were collected by survey among all lime manufacturers in Croatia and cross-checked with lime production data from Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS) and with data provide in EPR data base. Results of comparison showed that there is no significant difference between these sets of data. The activity data on lime production are presented in Table 5.1-1. Emission factors used for the preparation of the IIR 2018, presented by NFR sectors and pollutants, are given in Appendix 4.

Glass production (NFR 2.A.3)

Methodology for emission calculation for glass production is based on Tier 1 EMEP/EEA methodology, by multiplying the annual amount of glass produced with the appropriate emission factor. Methodology for emission calculation for mineral wool production is based on Tier 3 EMEP/EEA methodology and is based on continuously measured and verified annual emissions from one facility. For the activity glass production, the recommended Tier 1 emission factors from GB2016 were used. Emissions of PMs and HMs were estimated using Tier 1 EMEP/EEA methodology. For activity mineral wool production, facility specific emission factors for $NH_3$, NMVOC, and PMs were calculated from facility direct emissions and annual production capacity.

The activity data on glass and mineral wool production are taken from the Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS) and from EPR facilities reports. The activity data on glass production which includes also the data for mineral wool production are presented in Table 5.1-1. Emission factors used for the preparation of the IIR 2018, presented by NFR sectors and pollutants, are given in Appendix 4.

Quarrying and mining of minerals other than coal (NFR 2.A.5.a)

Methodology for emission calculation for quarrying and mining of minerals other than coal is based on Tier 1 EMEP/EEA methodology, by multiplying the annual amount of minerals with the appropriate emission factor. The recommended Tier 1 emission factors from GB2016 were used. The activity data on quarrying and mining of minerals other than coal are taken from the Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS) and presented in Table 5.1-1. Emission factors used for the preparation of the IIR 2018, presented by NFR sectors and pollutants, are given in Appendix 4.

Construction and demolition (NFR 2.A.5.b)

Methodology for emission calculation for construction and demolition is based on Tier 1 EMEP/EEA methodology, by multiplying the annual amount of floor area of the building constructed with the appropriate emission factor. The recommended Tier 1 emission factors from GB2013 were used. The plan is to recalculate emissions for the entire reporting period for this category after collecting activity data required under Tier 1 EMEP/EEA GB2016 methodology, which would include: Construction of houses, Construction of apartments, Non-residential construction and Road construction. Because of their comprehensiveness, these data could not be collected for this submission. In order to achieve this, efforts will be made to collect the specified data, if possible for the next submission. The activity data are taken from the Annual Statistical Reports and presented in Table 5.1-1. Emission factors used for the preparation of the IIR 2018, presented by NFR sectors and pollutants, are given in Appendix 4.

**Table 5.1-1 Activity data for NFR codes 2.A.1, 2.A.2, 2.A.3, 2.A.5.a and 2.A.5.b**

| NFR | 2.A.1 | | | 2.A.2 | 2.A.3 | 2.A.5.a | 2.A.5.b |
|---|---|---|---|---|---|---|---|
| Name | Clinker | Portland Cement | Aluminate Cement | Lime production | Glass production | Quarrying and mining of minerals other than coal | Construction and demolition |
| Unit | kt | kt | kt | kt | kt | kt | $m^2$ |
| 1990 | 1888.11 | 2598.07 | 44.70 | 232.30 | 275.49 | 27.02 | 2826634 |
| 1991 | 1177.59 | 1702.59 | 33.18 | 165.40 | 252.94 | 18.86 | 2119965 |
| 1992 | 1401.77 | 1810.78 | 30.53 | 124.49 | 143.90 | 18.51 | 1411541 |
| 1993 | 1206.36 | 1596.24 | 36.90 | 134.48 | 134.41 | 16.77 | 1345926 |
| 1994 | 1531.48 | 2049.14 | 31.50 | 140.12 | 162.22 | 19.84 | 1499057 |
| 1995 | 1182.29 | 1571.42 | 39.73 | 139.70 | 166.81 | 20.43 | 1918453 |
| 1996 | 1286.50 | 1643.05 | 51.65 | 175.74 | 153.76 | 23.25 | 2359648 |
| 1997 | 1505.72 | 1906.13 | 59.37 | 186.91 | 127.32 | 17.60 | 2216206 |
| 1998 | 1649.11 | 2161.83 | 68.50 | 195.38 | 148.33 | 18.83 | 2206747 |
| 1999 | 2151.01 | 2549.73 | 79.74 | 189.11 | 136.26 | 19.39 | 2012288 |
| 2000 | 2382.15 | 2909.47 | 83.39 | 193.01 | 139.06 | 20.76 | 717801 |

| NFR | 2.A.1 | | | 2.A.2 | 2.A.3 | 2.A.5.a | 2.A.5.b |
|---|---|---|---|---|---|---|---|
| Name | Clinker | Portland Cement | Aluminate Cement | Lime production | Glass production | Quarrying and mining of minerals other than coal | Construction and demolition |
| Unit | kt | kt | kt | kt | kt | kt | $m^2$ |
| 2001 | 2739.25 | 3152.81 | 84.66 | 239.36 | 150.34 | 23.66 | 2061231 |
| 2002 | 2698.60 | 3415.01 | 76.74 | 269.27 | 158.54 | 26.19 | 2942136 |
| 2003 | 2692.09 | 3607.84 | 81.86 | 249.34 | 186.97 | 31.23 | 3438150 |
| 2004 | 2852.24 | 3553.99 | 89.56 | 284.01 | 210.65 | 33.20 | 3449089 |
| 2005 | 2926.58 | 3528.54 | 100.51 | 309.59 | 227.81 | 30.92 | 4089576 |
| 2006 | 3104.37 | 3657.89 | 98.04 | 366.24 | 228.67 | 35.95 | 4570084 |
| 2007 | 3160.52 | 3613.55 | 111.62 | 376.59 | 237.50 | 37.51 | 5218050 |
| 2008 | 2995.05 | 3671.83 | 108.89 | 367.38 | 255.07 | 43.89 | 4882190 |
| 2009 | 2439.06 | 2847.05 | 80.95 | 251.00 | 280.92 | 35.02 | 3967687 |
| 2010 | 2320.48 | 2687.54 | 93.13 | 222.47 | 295.17 | 24.16 | 3388897 |
| 2011 | 2071.66 | 2602.96 | 104.69 | 182.14 | 320.47 | 25.60 | 2703950 |
| 2012 | 1979.91 | 2155.36 | 100.20 | 139.61 | 300.11 | 24.86 | 2727335 |
| 2013 | 2198.30 | 2333.11 | 103.04 | 126.99 | 327.38 | 23.73 | 1961243 |
| 2014 | 2278.48 | 2375.33 | 112.17 | 135.62 | 364.92 | 23.48 | 1695871 |
| 2015 | 2158.66 | 2355.90 | 118.36 | 134.24 | 334.80 | 24.29 | 1924884 |
| 2016 | 2058.69 | 2285.37 | 118.88 | 125.08 | 378.08 | 22.99 | 1853646 |

Source: CBS, (with survey request: cement and lime producers and EPR data base)
Processing: Ekonerg Ltd

**Recalculations and improvements**

Cement production (NFR 2.A.1)

Recalculation was performed for 2014 and 2015 due to harmonization of activity data with NIR2018.

Lime production (NFR 2.A.2)

There was no recalculation and other improvement in this report.

Glass production (NFR 2.A.3)

Recalculation was performed for BC emissions from mineral wool production for the period 2007-2015 due to incorrect EF previously used.

Quarrying and mining of minerals other than coal (NFR 2.A.5.a)

Construction and demolition (NFR 2.A.5.b)

There was no recalculation and other improvement in this report.

## 5.2 CHEMICAL INDUSTRY (NFR 2.B)

**Source category description**

The present sub-chapter gives overview of the production of various inorganic and organic chemicals in the Republic of Croatia. The following processes are represented under sub-sector 2.B Chemical industry (SNAP codes are included) in Croatia: Ammonia production (NFR 2.B.1, SNAP 040403), Nitric acid production (NFR 2.B.2, SNAP 040402), Other chemical industry (NFR 2.B.10.a, SNAP 0404 and 0405) and Storage, handling, transport of chemical products (NFR 2.B.10.b).

Other chemical industry includes production of various chemical products: Sulphuric acid (SNAP 040401), Ammonium phosphate (SNAP 040406), NPK fertilizers (SNAP 040407), Urea (SNAP 040408), Carbon black (SNAP 040409), Ethylene (SNAP 040501), Propylene (SNAP 040502), 1,2 dichloroethane (SNAP 040503), Vinyl chloride (SNAP 040504), Polyethylene LD (SNAP 040506), Polyvinylchloride (SNAP 040508), Styrene (SNAP 040510), Polystyrene (SNAP 040511), Formaldehyde (SNAP 040517) and Ethyl benzene (SNAP 040518).

Neither Adipic acid production (2.B.3) nor Carbide production (2.B.5) occurs in Croatia.

For source category 2.A.10.b Croatia is using notation key “IE” due to PM emissions are included in other NFR 2.B codes.

Ammonia production (NFR 2.B.1, SNAP 040403)

There is only one facility of ammonia in Croatia. Ammonia is produced by catalytic steam reforming of natural gas in which hydrogen is chemically separated from natural gas and combined with nitrogen to produce ammonia. Carbon dioxide that is formed from carbon monoxide in CO shift converter is removed by using two methods: monoethanolamine scrubbing and hot potassium scrubbing. The same manufacturer also has facilities for nitric acid production, sulphuric acid production and mineral fertilizers production. Also the same manufacturer had facility for black carbon production which was shut down during 2009. Data on emissions have been obtained directly from the facilities and from official statistics.

Nitric acid production (NFR 2.B.2, SNAP 040402)

There is one manufacturer of nitric acid in Croatia. Nitric acid is used in the manufacture of fertilizers by same facility. Data on emissions have been obtained directly from the facilities and from official statistics.

Other chemical industry (NFR 2.B.10.a, SNAP 0404 and 0405)

Other chemical industry includes production of various chemical products such as sulphuric acid, ammonium phosphate, NPK fertilizers, urea, carbon black, ethylene, propylene, vinyl chloride, polyethylene LD, 1,2 dichloroethane, polyvinylchloride, styrene, polystyrene, formaldehyde and ethyl benzene. Production of following chemical products was shut down: ammonium phosphate and carbon black during 2009; ethylene, propylene, polyethylene LD and polystyrene during 2011; 1,2 dichloroethane during 2001; vinyl chloride during 2002; polyvinylchloride during 2000, styrene and ethyl benzene during 1991 (with a short term reactivation of ethyl benzene production during 1995 and 1996). Production of polyethylene LD was reactivated in 2014 and 2015 and was stopped in 2016. Production of sulphuric acid has been stopped for two years in 2010 and 2011. Data on emissions have been obtained directly from production facilities for sulphuric acid, NPK fertilizers, urea, and carbon black and from official statistics for all other activities. In 2016 there was no production of carbon black, styrene, ammonium phosphate, ethylene, propylene, 1,2 dichloroethane, vinyl chloride, polyvinylchloride, polyethylene LD, polystyrene and ethyl benzene.

**Methodology, emission factors and activity data**

Ammonia production (NFR 2.B.1, SNAP 040403)

The methodology of the emission calculation is based on the Tier 2 EMEP/EEA methodology by means of multiplying annual amount of ammonia produced with the appropriate emission factor. For ammonia production Tier 2 EF from GB2016 were used for CO and $NH_3$ emissions while for NOx, the facility specific annual emission factors were used since 1998. For years in period 1990 to 1997 an average NOx emission factor was calculated and used, based on available direct NOx emissions. Data on the ammonia production were collected from the survey of one manufacturer in Croatia and verified by comparison with Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS). Data are presented in Table 5.2-1.

Nitric acid production (NFR 2.B.2, SNAP 040402)

For nitric acid production the NOx emission is estimated. The methodology of the emission calculation for nitric acid production is Tier 2 EMEP/EEA methodology. Since 1998, facility specific emission factors were calculated from direct measured NOx emissions and annual production capacity. For years in period 1990 to 1997 an average NOx emission factor was calculated and used, based on available direct NOx emissions. Data on the production of nitric acid were collected from the survey of the one existing manufacturer in Croatia and verified by comparison with Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS). Data are presented in Table 5.2-1.

Other chemical industry (NFR 2.B.10.a, SNAP 0404 and 0405)

Emission factors are expressed as the quantity of pollutants emission per unit of production. For Polyethylene Low Density, PVC (suspension PVC and emulsion PVC), Styrene, Polystyrene (expandable - EPS) and Ethyl benzene, Ethylene, Propylene, 1,2 dichloroethane, Vinyl chloride, Formaldehyde and Ammonium phosphate production Tier 2 methodology with Tier 2 emission factors from GB2013 were used.

For NPK fertilizers production, since 1998 (for TSP since 2007), facility specific NOx, $NH_3$ and TSP emission factors were calculated from direct measured emissions and annual production capacity. For years in period 1990 to 1997 (for TSP period 1990 - 2006) an average NOx, $NH_3$ and TSP emission factors were calculated and used, based on available direct emissions.

For Sulphuric acid production $SO_2$ emissions were reported. Those direct $SO_2$ emissions are facility specific emission since 1998. For years in period 1990 to 1997 an average $SO_2$ emission factor was calculated and used, based on available direct $SO_2$ emissions and annual production capacity.

For Urea production $NH_3$, TSP, $PM_{2.5}$, $PM_{10}$ and BC emissions were reported. For TSP, $PM_{2.5}$, $PM_{10}$ and BC emission calculation Tier 2 emission factors from GB2013 were used. Regarding $NH_3$, direct facility specific emissions since 1998 were used. For years in period 1990 to 1997 an average $NH_3$ emission factor was calculated and used, based on available direct $NH_3$ emissions and annual production capacity.

For Carbon black production Tier 2 EMEP/EEA methodology and Tier 2 emission factors were used for $SO_2$, NOx, NMVOC, CO and TSP emission calculation. Those emissions were reported for the period 1990 – 2009. In the period 2000 - 2009 a facility specific direct CO emissions were reported.

For Ammonium phosphate production Tier 2 emission factors form GB2013 were used for TSP, PMs and BC emission estimation.

Data on the production of ammonia, nitric acid, sulfuric acid, NPK fertilizer and urea were collected from the survey of the main manufacturers of these inorganic chemicals in Croatia and verified by comparison with Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS). For all other chemicals in the scope of this source category, activity data are from national statistic (Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS)). All activity data regarding source category other chemical industry (NFR 2.B.10.a) are presented in Tables 5.2-1 and 5.2-2. Emission factors used for the preparation of the IIR 2018, presented by NFR sectors and pollutants, are given in Appendix 4.

**Table 5.2-1 Activity data for NFR codes 2.B.1, 2.B.2 and 2.B.10.a, represented by the relevant SNAP codes**

| NFR | 2.B.1 | 2.B.2 | 2.B.10.a | | | | |
|---|---|---|---|---|---|---|---|
| Name | Ammonia | Nitric acid | Carbon black | Sulphuric acid | Ammonium phosphate | NPK fertilisers | Urea |
| SNAP | 040403 | 040402 | 040409 | 040401 | 040406 | 040407 | 040408 |
| Unit | t | t | t | t | t | t | t |
| 1990 | 344947 | 332459 | 30624 | 241759 | 66711 | 556522 | 280354 |
| 1991 | 347524 | 291997 | 18783 | 187009 | 42365 | 532082 | 328029 |
| 1992 | 425719 | 381797 | 13479 | 278434 | 53635 | 716537 | 356995 |

| NFR | 2.B.1 | 2.B.2 | 2.B.10.a | | | | |
|---|---|---|---|---|---|---|---|
| Name | Ammonia | Nitric acid | Carbon black | Sulphuric acid | Ammonium phosphate | NPK fertilisers | Urea |
| SNAP | 040403 | 040402 | 040409 | 040401 | 040406 | 040407 | 040408 |
| Unit | t | t | t | t | t | t | t |
| 1993 | 344812 | 287805 | 17123 | 178269 | 43719 | 482845 | 273226 |
| 1994 | 350184 | 311236 | 21468 | 265550 | 48193 | 554370 | 278981 |
| 1995 | 377589 | 299297 | 27185 | 233122 | 65332 | 548305 | 314137 |
| 1996 | 373728 | 278683 | 26735 | 223201 | 52067 | 516058 | 383822 |
| 1997 | 402407 | 292892 | 24214 | 202191 | 47760 | 536732 | 361730 |
| 1998 | 301758 | 220508 | 24087 | 164011 | 40661 | 457556 | 279110 |
| 1999 | 387159 | 260198 | 20627 | 192587 | 47557 | 523246 | 360427 |
| 2000 | 395024 | 306201 | 20029 | 199585 | 32112 | 583243 | 352553 |
| 2001 | 315388 | 257534 | 21180 | 126284 | 19080 | 407087 | 279682 |
| 2002 | 285937 | 249992 | 19416 | 135224 | 24496 | 468376 | 265811 |
| 2003 | 321598 | 235583 | 21295 | 123248 | 22131 | 499870 | 336593 |
| 2004 | 404157 | 375926 | 20272 | 186318 | 52782 | 554096 | 396655 |
| 2005 | 398547 | 280746 | 18498 | 220625 | 65840 | 582543 | 372627 |
| 2006 | 388821 | 277590 | 26264 | 259014 | 78936 | 365118 | 370549 |
| 2007 | 430154 | 306619 | 23724 | 243149 | 75040 | 862263 | 407863 |
| 2008 | 444925 | 312928 | 16904 | 256988 | 76418 | 526041 | 405950 |
| 2009 | 375284 | 261478 | 3976 | 91486 | 32203 | 230963 | 389071 |
| 2010 | 438662 | 336795 | NO | NO | NO | 440289 | 439310 |
| 2011 | 447499 | 332713 | NO | NO | NO | 447284 | 445160 |
| 2012 | 416358 | 288207 | NO | 4465 | NO | 373566 | 428931 |
| 2013 | 417505 | 297545 | NO | 4584 | NO | 223515 | 439062 |
| 2014 | 458049 | 307296 | NO | 7687 | NO | 208530 | 465373 |
| 2015 | 455235 | 344638 | NO | 35333 | NO | 344827 | 447934 |
| 2016 | 420372 | 293260 | NO | 63792 | NO | 238178 | 393544 |

Source: CBS (survey request: fertilizers producers), Processing: Ekonerg Ltd

**Table 5.2-2 Activity data for NFR code 2.B.10.a, represented by the relevant SNAP codes**

| NFR | 2.B.10.a | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Name | Styrene | Ethyl-ene | Propyl-ene | 1,2 dichloro-ethane | Vinyl-chloride | Poly-ethylene LD | Poly-vinyl-chloride | Poly-styrene | Ethyl-benzene | Form-aldehyde |
| SNAP | 040510 | 040501 | 040502 | 040503 | 040504 | 040506 | 040508 | 040511 | 040518 | 040517 |
| Unit | t | t | t | t | t | t | t | t | t | t |
| 1990 | 8923 | 72631 | 17586 | 72653 | 98976 | 171800 | 104602 | 46913 | 2725 | NO |
| 1991 | NO | 66871 | 15272 | 68325 | 88135 | 136039 | 67934 | 33719 | 288 | NO |
| 1992 | NO | 68318 | 13349 | 92089 | 118570 | 141614 | 70969 | 44389 | NO | NO |
| 1993 | NO | 68634 | 9026 | 79608 | 103851 | 144415 | 44259 | 64269 | NO | NO |
| 1994 | NO | 65285 | 7127 | 97528 | 128257 | 130805 | 79038 | 67498 | NO | 22.0 |

| **NFR** | **2.B.10.a** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **Styrene** | **Ethyl-ene** | **Propyl-ene** | **1,2 dichloro-ethane** | **Vinyl-chloride** | **Poly-ethylene LD** | **Poly-vinyl-chloride** | **Poly-styrene** | **Ethyl-benzene** | **Form-aldehyde** |
| **SNAP** | **040510** | **040501** | **040502** | **040503** | **040504** | **040506** | **040508** | **040511** | **040518** | **040517** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| 1995 | NO | 67547 | 8221 | 84374 | 112560 | 145235 | 93897 | 55805 | 4162 | 25.0 |
| 1996 | NO | 64782 | 7796 | 48631 | 63124 | 144100 | 45456 | 64121 | 2922 | 22.0 |
| 1997 | NO | 63554 | 7631 | 26264 | 35488 | 145439 | 47805 | 78580 | NO | 22.0 |
| 1998 | NO | 60148 | 6535 | 31308 | 41115 | 184493 | 73647 | 99960 | NO | 30.0 |
| 1999 | NO | 60295 | 6981 | 47686 | 62236 | 179745 | 31304 | 84928 | NO | 21.0 |
| 2000 | NO | 38918 | 6443 | 71364 | 64875 | 83983 | 2953 | 20172 | NO | 19.0 |
| 2001 | NO | 46632 | 5542 | 64442 | 14432 | 113146 | NO | 33168 | NO | 20.0 |
| 2002 | NO | 43554 | 5074 | NO | 6950 | 112771 | NO | 45439 | NO | 19.0 |
| 2003 | NO | 41252 | 4622 | NO | NO | 160944 | NO | 46361 | NO | 14.2 |
| 2004 | NO | 49886 | 5135 | NO | NO | 193430 | NO | 35331 | NO | 16.3 |
| 2005 | NO | 50263 | 4860 | NO | NO | 191958 | NO | 54617 | NO | 15.6 |
| 2006 | NO | 48824 | 4740 | NO | NO | 123217 | NO | 58721 | NO | 11.5 |
| 2007 | NO | 45438 | 4498 | NO | NO | 119015 | NO | 69841 | NO | 10.2 |
| 2008 | NO | 43045 | 4053 | NO | NO | 119838 | NO | 60471 | NO | 5.4 |
| 2009 | NO | 38797 | 3174 | NO | NO | 115646 | NO | 56359 | NO | 6.9 |
| 2010 | NO | 36271 | 2909 | NO | NO | 139032 | NO | 54194 | NO | 6.3 |
| 2011 | NO | 23323 | 2068 | NO | NO | 83920 | NO | 12849 | NO | 5.9 |
| 2012 | NO | NO | NO | NO | NO | NO | NO | NO | NO | 5.5 |
| 2013 | NO | NO | NO | NO | NO | NO | NO | NO | NO | 4.2 |
| 2014 | NO | NO | NO | NO | NO | 577 | NO | NO | NO | 3.9 |
| 2015 | NO | NO | NO | NO | NO | 610 | NO | NO | NO | 2.0 |
| 2016 | NO | NO | NO | NO | NO | NO | NO | NO | NO | 2.0 |

Source: CBS, Processing: Ekonerg Ltd

**Recalculations and improvements**

Ammonia (NFR 2.B.1, SNAP 040403)

Nitric acid (NFR 2.B.2, SNAP 040402)

Other chemical industry (NFR 2.B.10.a, SNAP 040400 and 040500)

There was no recalculation and other improvement in this report.

## 5.3 METAL PRODUCTION (NFR 2.C)

**Source category description**

The present sub-chapter gives an overview of the production of various metals in the Republic of Croatia. The following primary metal production processes are represented under sub-sector 2.C Metal production in Croatia (SNAP codes are included): Iron and steel production (NFR 2.C.1, SNAP 0402), Ferroalloys production (NFR 2.C.2, SNAP 0403) and Aluminium production (NFR 2.C.3, SNAP 0401). There is no primary production of non-ferrous metals such as magnesium, lead, zinc, copper, nickel etc. in Croatia.

Iron and steel production (NFR 2.C.1, SNAP 0402)

In the scope of primary Iron and steel production there are: Steel production (NFR 2.C.1.1, SNAP 040205 - Open hearth furnace steel plant and SNAP 040207 - Electric furnace steel plant), Iron production (NFR 2.C.1.2 SNAP 040202 - Blast furnace charging) and Other (Rolling mills) (NFR 2.C.1.5 SNAP 040208 – Rolling mills). The primary production of Pig iron produced in blast furnaces was existed up to 1992 when it is stopped. It should be noted that in 1990 and 1991 the required amount of sinter and pellets needed for the production of pig iron were imported from abroad, so these activities were not present in Croatia at that time. The steel was produced in the open hearth furnaces with Siemens Marten (SM) process up to 1991 when it was stopped and in the electric-arc steel furnaces (EAF) which is still present in Croatia. During the period 1990-2016, there were five steel manufacturers in Croatia. Steel production by one manufacturer was stopped in 2009. In 2012, steel production was considerably reduced, while in 2013 it increased. In 2016, steel production decreased again due to suspension of production of one manufacturer. Since 1990, there were two rolling manufacturing processes in Croatia, hot and cold. In 2009, the cold rolling mill process was stopped. Data on production have been obtained from official statistics and from existing facilities.

Ferroalloys production (NFR 2.C.2, SNAP 0403)

Ferroalloys are alloys of iron and metals such as silicon, manganese and chromium. Primary ferroalloys production was stopped in 2003. Ferroalloys production fluctuated over the period. It is mainly a result of discontinuous operation, caused by the war of independence in Croatia. Data on production have been obtained from official statistics.

Aluminium production (NFR 2.C.3, SNAP 0401)

There was only one facility for primary aluminium production in Croatia and it was shut down during 1991 mainly as a result of war activities near the location of aluminium plant. Production was carried out in two steps: 1) Preparation of bauxite ore; grind, purification and calcinations as a result of which is aluminium oxide ($Al_2O_3$) and 2) Electrical reduction of $Al_2O_3$ to aluminium by smelting. Two types of furnace were used - indoor and outdoor types. Data on primary aluminium production were collected by survey of aluminium manufacturer. Data on production have been obtained from official statistics.

**Methodology, emission factors and activity data**

The methodology for emission calculation for the sector 2.C Metal production is based on the Tier 2 of the EMEP/EEA methodology and implies multiplication of annual amount of products with the appropriate emission factor for a specific production process of metal.

Emission factors are expressed as the quantity of emissions of pollutants per unit of production.

All emission factors are recommended ones for activities in the sub-sector 2.C Metal production and are in accordance with the GB2016. Emission factors used for the preparation of the IIR 2018, presented by NFR sectors and pollutants, are given in Appendix 4.

Information on the annual amounts of pig iron produced, are taken from the Croatian NIR 2018. Activity data for the quantities of steel produced (with both methods) and for rolling mills for period 1990 – 2008 that are presented in the published scientific article *Sofilić et all., Archives of Metallurgy and Materials, Vol. 53, 2008 Issue 2* are verified with data from the Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS) as well with the data for steel production presented in the NIR 2018. Data for the quantities of steel produced in electric furnace steel plant were taken from NIR 2018 for entire reporting period. Activity data for rolling mills for the period 1990 – 2008 were taken from abovementioned scientific article, and since 2008 data were taken from the Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS). Activity data for ferroalloys production were taken from the Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS). Activity data for aluminium production were collected by direct survey of manufacturer. Production of iron and steel, ferroalloys and aluminium are shown in Table 5.3-1.

**Table 5.3-1 Activity data for NFR codes 2.C.1, 2.C.2 and 2.C.3, represented by the relevant SNAP codes**

| NFR | 2.C.1 | | | | 2.C.2 | 2.C.3 |
|---|---|---|---|---|---|---|
| Name | Electric furnace steel plant | Open hearth furnace steel plant | Blast furnace charging | Rolling mills | Ferroalloys production | Aluminium production |
| SNAP | 040207 | 040205 | 040202 | 040208 | 040302 | 040301 |
| Unit | t | t | t | t | t | t |
| 1990 | 171138 | 253161 | 209308 | 575928 | 129955 | 74248 |
| 1991 | 119734 | 94165 | 25713 | 310104 | 124263 | 50931 |
| 1992 | 101944 | NO | NO | 226086 | 81630 | NO |
| 1993 | 74082 | NO | NO | 190097 | 36605 | NO |
| 1994 | 63355 | NO | NO | 159068 | 54337 | NO |
| 1995 | 45370 | NO | NO | 108862 | 26081 | NO |
| 1996 | 45754 | NO | NO | 101965 | 10559 | NO |
| 1997 | 69895 | NO | NO | 110997 | 24694 | NO |
| 1998 | 103204 | NO | NO | 163059 | 12615 | NO |
| 1999 | 75877 | NO | NO | 128562 | 14142 | NO |
| 2000 | 69641 | NO | NO | 110266 | 16112 | NO |
| 2001 | 56169 | NO | NO | 98372 | 701 | NO |
| 2002 | 32789 | NO | NO | 55252 | 220 | NO |
| 2003 | 40942 | NO | NO | 111530 | 724 | NO |
| 2004 | 86105 | NO | NO | 115471 | NO | NO |
| 2005 | 73640 | NO | NO | 116393 | NO | NO |
| 2006 | 80516 | NO | NO | 147189 | NO | NO |
| 2007 | 76252 | NO | NO | 144409 | NO | NO |
| 2008 | 138865 | NO | NO | 188307 | NO | NO |
| 2009 | 46264 | NO | NO | 79187 | NO | NO |
| 2010 | 103427 | NO | NO | 78472 | NO | NO |
| 2011 | 95907 | NO | NO | 82310 | NO | NO |
| 2012 | 5896 | NO | NO | 28060 | NO | NO |
| 2013 | 65258 | NO | NO | 42248 | NO | NO |
| 2014 | 174620 | NO | NO | 35851 | NO | NO |
| 2015 | 148583 | NO | NO | 24886 | NO | NO |
| 2016 | 23620 | NO | NO | 13084 | NO | NO |

Source: CBS (survey request: steel producers), Processing: Ekonerg Ltd

**Recalculations and improvements**

Iron and steel production (NFR 2.C.1, SNAP 040202, 400205, 040207 and 040208)

Ferroalloys production (NFR 2.C.2, SNAP 040300)

Aluminium production (NFR 2.C.3, SNAP 040100)

There was no recalculation and other improvement in this report.

## 5.4 OTHER SOLVENT AND PRODUCT USE (NFR 2.D – 2.L)

**Source category description**

This chapter gives an overview of source categories NFR 2.D - 2L Other solvent and product use in the framework of which will address the sub-sectors: Domestic solvent use including fungicides (NFR 2.D.3.a), Road paving with asphalt (NFR 2.D.3.b), Asphalt roofing (NFR 2.D.3.c), Coating applications (NFR 2.D.3.d), Degreasing (NFR 2.D.3.e), Dry cleaning (NFR 2.D.3.f), Chemical products (NFR 2.D.3.g), Printing (NFR 2.D.3.h), Other solvent and product use (NFR 2.D.3.i, 2.G), Pulp and paper industry (NFR 2.H.1), Food and beverages industry (NFR 2.H.2), Other industrial processes (NFR 2.H.3), Wood processing (NFR 2.I), Production of POPs (NFR 2.J) and Consumption of POPs and heavy metals (NFR 2.K). Emissions from source category 2.L Other industrial processes including production, consumption, storage etc. of bulk products are included in other NFR 2.D-2.K.

Domestic solvent use including fungicides (NFR 2.D.3.a)

Domestic solvent use including fungicides includes emissions of NMVOCs and other pollutants (e.g. Hg) arising from the domestic use of solvent-containing products. Many of these products are also used in industry and commerce. The Croatian inventory stratified following solvent-containing products use by the public: Cosmetics and toiletries products, Car care products, DIY/buildings, Paint/varnish removers and solvents, DIY/buildings, Sealants, filling agents, Hg (fluorescent tubes), Pesticides, and Domestic use of pharmaceutical products. A further distinction between aerosol and non-aerosol products is not available in national statistics.

Road paving with asphalt (NFR 2.D.3.b)

Asphalt for road paving is commonly referred to as bitumen, asphalt cement, asphalt concrete or road oil and is produced in petroleum refineries. The annual statistical weight of asphalt produced for road paving is used to calculate emissions of NMVOCs and PM from this source category.

Asphalt roofing (NFR 2.D.3.c)

The asphalt roofing industry manufactures saturated felt, roofing and siding shingles, and roll roofing and sidings. Most of these products are used in roofing and other building applications. This source category covers emissions of NMVOC, CO and PM from all related facilities. The national production of shingles is used as activity data.

Coating applications (NFR 2.D.3.d)

Paints are used within the industrial and domestic sectors. Traditionally, the term paint has often been used to describe pigmented coating materials only, thus excluding clear coatings such as lacquers and varnishes. However, here the term paint is taken to include all materials applied as a continuous layer to a surface with the exception of glues and adhesives which are covered by NFR source category 2.D.3.i, 2.G Other solvent and product use. Inks, which are coatings applied in a non-continuous manner to a surface in order to form an image, are excluded by the definition given above.

Application of coatings during the manufacture of a number of other industrial products is covered by NFR source category 2.D.3.g Chemical products: adhesive, magnetic tapes, films and photographs manufacturing (SNAP 060311); textile finishing (SNAP 060312); leather tanning (SNAP 060313).

The use of paint is a major source of non-methane volatile organic compounds (NMVOC) emissions. The use of paints is generally not considered relevant for emissions of particulate matter, heavy metals or persistent organic pollutants (POPs).

Degreasing (NFR 2.D.3.e)

Degreasing is a process for cleaning products from water-insoluble substances as grease, fats, oils, waxes, carbon deposits, fluxes and tars. In most cases the process is applied to metal products, but also plastic, fiberglass, printed circuit boards and other products are treated by the same process. The metal-working industries are the major users of solvent degreasing. Industrial metal degreasing by using organic solvents takes place in specially designed cleaning equipment. Emission limits required by the Solvents Emissions Directive 1999/13/EC can only be achieved by using hermetically-sealed cleaning equipment. This leads to a significant reduction of emissions and increased workplace safety. Metal degreasing by using organic solvents takes place in either open top or closed tanks. The open-top tanks, however, have been phased out in the European Union due to the Solvents Emissions Directive 1999/13/EC. Only small facilities, using not more than 1 or 2 tonnes of solvent per year (depending on the risk profile of the solvent) are still allowed to use open top tanks. The most common organic solvents for vapour cleaning are: methylene chloride (MC), tetrachloroethylene (PER), trichloroethylene (TRI) and xylenes (XYL).

Dry cleaning (NFR 2.D.3.f)

Dry cleaning refers to any process to remove contamination from furs, leather, down leathers, textiles or other objects made of fibers, using organic solvents.

Chemical products (NFR 2.D.3.g)

Source category Chemical products cover the emissions from the use of various chemical products in manufacturing or processing of chemical products. In Croatia in the period since 1990 this source category include many activities such as: Polyester processing (SNAP 060301), Polyvinylchloride processing (SNAP 060302), Polyurethane processing (SNAP 060303), Polystyrene foam processing (SNAP 060304), Rubber processing (SNAP 060305), Pharmaceutical products manufacturing (SNAP 060306), Paints manufacturing (SNAP 060307), Inks manufacturing (SNAP 060308), Glues manufacturing (SNAP 060309) and Adhesive, magnetic tapes, films and photographs manufacturing (SNAP 060311). Almost all activities still exist in Croatia with the exception of the rubber production which was stopped during 2006, and polystyrene foam processing which was stopped during 2011. Leather tanning (SNAP 060313) is present in Croatia but ammonium salts are not used in any phase of this activity thus there are no $NH_3$ emissions. Emission from asphalt blowing (SNAP 060310) are included in the emission calculation within the activity 1.B.2.a.iv Refining / Storage (and also within 2.D.3.b Road paving and 2.D.3.c Asphalt roofing).

Printing (NFR 2.D.3.h)

Printing includes NMVOC emissions arising from solvents used in printing industry. Printing involves the use of inks which may contain a proportion of organic solvents. These inks may then be subsequently diluted before use. Different inks have different proportions of organic solvents and require dilution to different extents. Printing can also require the use of cleaning solvents and organic dampeners. Ink solvents, diluents, cleaners and dampeners may all make a significant contribution to emissions from industrial printing. Printing processes convert original text and pictures into an image on a carrier and the main process types are named according to how this image is carried.

Other solvent and product use (NFR 2.D.3.i, 2.G)

Other solvent and product use includes emissions of NMVOCs arising from following activities that are present in Croatia with corresponding SNAP code: Oil extraction (SNAP 060404), Application of glues and adhesives (SNAP 060405), Wood preservation - Creosote preservation type (SNAP 060406), Wood preservation - Organic solvent-borne preservative (SNAP 060406), Car dewaxing (SNAP 060409), Use of shoes (SNAP 060412-1), Concrete additive (SNAP 060412-2), Cooling lubricant (SNAP 060412-3), Lubricant (SNAP 060412-4), Tobacco combustion (SNAP 060413) and Use of fireworks (SNAP 060601).

Pulp and paper industry (NFR 2.H.1)

There are three types of processes for pulp and paper production that were existed and still exist in Croatia: Kraft (sulphate), acid sulphite and neutral sulphite semi-chemical process. Sulphate pulping was used until 1990 and acid sulphite pulping was used until 1994, while the neutral sulphite semi-chemical process still exists.

Food and beverages industry (NFR 2.H.2)

Croatian Informative inventory reports are considering following activities in scope of NFR 2.H.2 Food and drink: production of wine (white and unspecific colour wine), spirits, beer, bread, coffee roasting, meat, fish etc. frying / curing, sugar production, animal feed, margarine and solid fats and final cakes, biscuits and breakfast cereals production.

Wood processing (NFR 2.I)

Wood processing activity includes the manufacture of plywood, reconstituted wood products and engineered wood products. This source category is only important for particulate emissions. The relevant activity statistic is the mass of wood products processed in Croatia.

Production of POPs (NFR 2.J)

According to GB2016 the production of POPs is not a key source category since the production processes are mostly highly controlled in order to manage health and environmental effects. In addition, no emission factors are available for the production of POPs.

Consumption of POPs and heavy metals (NFR 2.K)

NFR 2.K Consumption of POPs and heavy metals is considering the losses of PCBs and mercury (Hg) from electrical equipment. These substances are used in e.g. refrigerators, air conditioning equipment and electrical equipment. Electrical equipment is the largest source of PCBs emissions mainly from capacitors and transformers. The majority of capacitors used (70 %) are power capacitors and high frequency capacitors. Power capacitors are used in high and low voltage transmission lines or in high frequency transmission units. They can be used both as separate units and in the form of complex capacitor units or batteries. Mercury (Hg) emissions mainly come from the use of batteries, measurement and control instruments (including laboratory and hospital instruments), electrical equipment and light bodies (light bulbs). Other products (e.g. paints, pharmaceuticals, other medical/health problems and dental amalgams) may also be a source of Hg emissions but are unlikely to be very significant on a national level. The majority of emissions of PCBs arise from leaks from electrical transformers and capacitors which contain PCBs and which are in a poor condition and/or are poorly maintained.

**Methodology, emission factors and activity data**

Domestic solvent use including fungicides (NFR 2.D.3.a)

The methodology for emission estimation is based on the Tier 2b of EMEP/EEA 2016 methodology; multiplication of annual products amount with the appropriate emission factor. Emission factor is expressed as the amount of NMVOC emissions per annual production unit or per number of inhabitants and are shown in Appendix 4. Activity data for NFR code 2.D.3.a, represented by the relevant SNAP code are presented in Table 5.4-1.

**Table 5.4-1 Activity data for NFR code 2.D.3.a, represented by the relevant SNAP code**

| NFR 2.D.3.a | Cosmetics and toiletries | House-hold products | Car care products | DIY/ build-ings, Paint/ varnish removers & solvents | DIY/ buildings , Sealants, filling agents | Pharma-ceutical products | Various products: Hg (fluoresce nt tubes) | Various products: pesticide s |
|---|---|---|---|---|---|---|---|---|
| **SNAP** | **060408-1** | **060408-2** | **060408-3** | **060408-4** | **060408-5** | **060411** | **060408-6** | **060408-7** |
| **Unit** | **kg products** | **kg products** | **kg products** | **kg solvent** | **kg products** | **population** | | **kg products** |
| 1990 | 749437 | 11009000 | 7277000 | 7106000 | 9431000 | 4778000 | | 13937 |
| 1991 | 810098 | 8458000 | 5003000 | 4072000 | 5471000 | 4513000 | | 11578 |
| 1992 | 755473 | 6974000 | 5574000 | 2525000 | 3285000 | 4470000 | | 4982 |
| 1993 | 771290 | 6917000 | 4701000 | 2259000 | 2959000 | 4641000 | | 6647 |
| 1994 | 840915 | 4953149 | 4536000 | 2409000 | 4786000 | 4649000 | | 10047 |
| 1995 | 668622 | 5378897 | 3609000 | 1815000 | 5821000 | 4669000 | | 10901 |
| 1996 | 380755 | 4190651 | 4764000 | 1909000 | 6608000 | 4494000 | | 9994 |
| 1997 | 380919 | 7007809 | 3692000 | 1716000 | 7912000 | 4572500 | | 9194 |
| 1998 | 382291 | 6481108 | 2876000 | 1674000 | 9980000 | 4501000 | | 7674 |
| 1999 | 426322 | 6045846 | 3044000 | 1544000 | 8409000 | 4554000 | | 6081 |
| 2000 | 508522 | 5813441 | 2275000 | 1528000 | 7300000 | 4381000 | | 7182 |
| 2001 | 497411 | 5956084 | 2505000 | 1474000 | 7383000 | 4305494 | | 8570 |
| 2002 | 571345 | 7219129 | 3475000 | 1663000 | 9146000 | 4305384 | | 7164 |
| 2003 | 625157 | 8590884 | 3009101 | 1661000 | 6225000 | 4305725 | | 4799 |
| 2004 | 723313 | 8560240 | 2629826 | 1712000 | 8696000 | 4310861 | | 6675 |
| 2005 | 483679 | 9004148 | 2764705 | 1693000 | 15084000 | 4312487 | | 4423 |
| 2006 | 460002 | 9405593 | 1503195 | 1591000 | 12429000 | 4313530 | | 4297 |
| 2007 | 578606 | 9957008 | 1324135 | 1430000 | 9255000 | 4311967 | | 3993 |
| 2008 | 694125 | 8955890 | 2111528 | 1656000 | 13272000 | 4309796 | | 3188 |
| 2009 | 581419 | 7663580 | 2136197 | 1405000 | 6968000 | 4302847 | | 2372 |
| 2010 | 1281127 | 7584616 | 2961162 | 1182000 | 6804000 | 4289857 | | 2445 |
| 2011 | 1544609 | 9098104 | 2616124 | 1112000 | 6686000 | 4280622 | | 1923 |

| NFR 2.D.3.a | Cosmetics and toiletries | House-hold products | Car care products | DIY/ build-ings, Paint/ varnish removers & solvents | DIY/ buildings , Sealants, filling agents | Pharma-ceutical products | Various products: Hg (fluorescent tubes) | Various products: pesticides |
|---|---|---|---|---|---|---|---|---|
| **SNAP** | **060408-1** | **060408-2** | **060408-3** | **060408-4** | **060408-5** | **060411** | **060408-6** | **060408-7** |
| **Unit** | **kg products** | **kg products** | **kg products** | **kg solvent** | **kg products** | **population** | | **kg products** |
| 2012 | 1370629 | 8984782 | 2977454 | 847000 | 5350000 | 4267558 | | 1547 |
| 2013 | 696184 | 8713631 | 2557159 | 812000 | 4260000 | 4255689 | | 939 |
| 2014 | 927176 | 8269223 | 2517049 | 711000 | 3529000 | 4238389 | | 581 |
| 2015 | 498006 | 10871273 | 3850747 | 759000 | 3624000 | 4203604 | | 528 |
| 2016 | 263372 | 8314330 | 4241600 | 764000 | 4033000 | 4174349 | | 535 |

Source: CBS, Processing: Ekonerg Ltd

Road paving with asphalt (NFR 2.D.3.b)

The methodology for emission estimation is based on the Tier 1 of EMEP/EEA 2016 methodology; multiplication of annual products amount with the appropriate emission factor. The recommended Tier 1 emission factors from the GB2016 are used. Emission factor is expressed as the amount of NMVOC emissions per annual production unit and are shown in Appendix 4. Activity data for NFR code 2.D.3.b is represented in Table 5.4-2.

Asphalt roofing (NFR 2.D.3.c)

The methodology for emission estimation is based on the Tier 1 of EMEP/EEA 2016 methodology; multiplication of annual products amount with the appropriate emission factor. The recommended Tier 1 emission factors from the GB2016 are used. Emission factor is expressed as the amount of NMVOC emissions per annual production unit and are shown in Appendix 4. Activity data for NFR code 2.D.3.c is represented in Table 5.4-2.

Coating applications (NFR 2.D.3.d)

For the 2018 submission, technical correction was calculated, taking into account recommendations of the review team with respect to the NEC Directive. The previous methodology included NMVOC emission calculations based on the amounts of paint produced in Croatia, resulting in underestimated emissions for this source. This year's submission includes activity data for paint imported, exported and produced.

The emission calculation is performed using Tier 1 EMEP/EEA 2016 methodology; multiplication of annual consumption of paint by the appropriate emission factor. There is no information on the amounts of paint used in point sources. It is assumed that all paint was used in diffuse sources. For the calculation, data from the Eurostat database (from the year 2001 onward) were used, as well as annual statistical reports on industrial production (annual PRODCOM results) (1990-2000) and expert estimates for the amounts of paint based on GDP (Source: Eurostat: June 2017, Market Survey / Feb 2016, CHP survey / June 2017, SHARES2015 from Feb 2017, ECFIN: AMECO GDP June 2017, EEA / UNFCCC June 2017). The Eurostat data on the amounts of solvent-based paint (import, export and sold production) and amounts of water-based paint (import, export and sold production) were used, whereby the total amount of water-based and solvent-based paint used was equivalent to the imported amounts reduced by the exported amounts and increased by the produced amounts (i.e. sales, product realization). In the calculation, it is assumed that the total applied paint in Croatia is equal to consumption in decorative, industrial and other applications.

Emission factor is expressed as the amount of NMVOC emissions per total paint consumption and are shown in Appendix 4. Activity data for NFR code 2.D.3.d is represented in Table 5.4-2.

Degreasing (NFR 2.D.3.e)

For the 2018 submission, calculation correction was made, taking into account recommendations of the review team with respect to the NEC Directive. The previous methodology included NMVOC emission calculations based on the number of inhabitants in Croatia, resulting in great uncertainty of emissions from this source. This year's submission includes methodology based on the amount of solvent (import/export/production) for vapour cleaning, while the EF based on the number of inhabitants was still used for cold cleaning.

For the calculation of NMVOC emissions from vapour cleaning, the consumption of the most common organic solvents for vapour cleaning was used (according to GB2016). Data on quantities of the most common organic solvents (import / export / production) for the years 2001 – onward, were taken from the Eurostat database. The calculation does not include the organic solvent trichlorethylene because it is assumed that this solvent is completely consumed within the activity NFR 2.D.3.f Dry cleaning. In addition to data from the Eurostat database (2001-onward), for the NMVOC emission calculation from this source for the period 1990-2000, the annual statistical reports on industrial production (annual PRODCOM results) and expert estimates for the quantities of degreasing products based on GDP were used (Source: Eurostat: June 2017; Market Survey/Feb 2016; CHP survey/June 2017; SHARES2015 from Feb 2017; ECFIN: AMECO GDP June 2017; EEA/UNFCCC June 2017).

NMVOC emission factor for vapour cleaning is the GB2016 Tier 1 EF, and it is expressed as the amount of NMVOC per annual unit of degreasing product. NMVOC emission factor for cold cleaning derives from the expert estimate by VTT Technical Research Centre of Finland (Source: SYKE (2011). Air Pollutant Emissions in Finland 1980-2009; Informative Inventory Report. p. 252), and it is expressed as the amount of NMVOC per annual number of inhabitants. Emission factors are given in Annex 4. Activity data for NFR code 2.D.3.e is given in Table 5.4-2.

Dry cleaning (NFR 2.D.3.f)

For the 2018 submission, calculation correction was made, taking into account recommendations of the review team with respect to the NEC Directive. The previous methodology included NMVOC emission calculations based on the number of inhabitants in Croatia, resulting in great uncertainty of emissions from this source. This year's submission includes methodology based on the amount of solvent (import/export/production) for dry cleaning.

The EMEP/EEA GB2016 assumes that the most widespread solvent used in dry cleaning, accounting for about 90 % of the total consumption, is tetrachloroethene (also called tetrachloroethylene or perchloroethylene (PER)). Data for import / export / production are available from the Eurostat database. PER production data are available only in PRODCOM codes, where PER is linked to trichlorethylene, which is mostly used in metal degreasing processes (NFR 2.D.3.e). Given the above mentioned, the assumption that all PER (including the amount of trichlorethylene) is used only in dry cleaning sector is included in the calculation, thus minimizing the possibility of double counting. Since NMVOC EF for dry cleaning is shown in GB2016 as grams per kilogram of cleaned textiles, TERT has proposed using the following NMVOC emission calculation methods: the second paragraph of Section 3.2.1. Dry Cleaning in GB2016 explains that solvent emissions directly from the cleaning machine into the air represent little more than 40 % for a closed-circuit machine, which is most likely the main type of machines currently used for dry cleaning. Open-circuit equipment may be in use somewhere in small quantities, but it was basically removed from the use around the 1990s.

According to the previous explanation, TERT has recommended that it should be assumed that the EF for dry cleaning can be 400 g of NMVOC / kg solvent, which has been applied in this submission. The same method is applied in the Estonian Inventory. In addition to data from the Eurostat database (2001-onward), for the NMVOC emission calculation from this source for the period 1990-2000, the annual statistical reports on industrial production (annual PRODCOM results) and expert estimates for the quantities of dry cleaning products based on GDP were used (Source: Eurostat: June 2017; Market Survey/Feb 2016; CHP survey/June 2017; SHARES2015 from Feb 2017; ECFIN: AMECO GDP June 2017; EEA/UNFCCC June 2017).

The emission factor is expressed as the amount of NMVOC emissions per annual product unit (solvent) for dry cleaning, and it is shown in Annex 4. Activity data for NFR code 2.D.3.f is represented in Table 5.4-2.

**Table 5.4-2 Activity data for NFR codes 2.D.3.b, 2.D.3.c, 2.D.3.d, 2.D.3.e and 2.D.3.f, represented by the relevant SNAP code**

| NFR | 2.D.3.b | 2.D.3.c | 2.D.3.d | 2.D.3.d | 2.D.3.d | 2.D.3.e | | 2.D.3.f |
|---|---|---|---|---|---|---|---|---|
| Name | Road paving with asphalt | Asphalt roofing | Decorative coating application | Industrial coating application | Other coating application | Degreasing (Cold cleaning) | Degreasing (Vapour cleaning) | Dry cleaning |
| SNAP | 040611 | 040610 | 060100 | 060100 | 060100 | 060201 | | 060202 |
| Unit | kt | kt | t | t | t | population | t | t |
| 1990 | 200.42 | 24.52 | 28819.10 | 28819.10 | 28819.10 | 4778000 | 2614.70 | 368.90 |
| 1991 | 143.65 | 14.45 | 20840.03 | 20840.03 | 20840.03 | 4513000 | 2344.50 | 380.40 |
| 1992 | 35.60 | 14.34 | 14493.30 | 14493.30 | 14493.30 | 4470000 | 2488.00 | 390.80 |
| 1993 | 28.01 | 13.02 | 13355.30 | 13355.30 | 13355.30 | 4641000 | 2506.80 | 403.30 |
| 1994 | 254.33 | 13.62 | 13014.20 | 13014.20 | 13014.20 | 4649000 | 3269.90 | 288.50 |
| 1995 | 270.20 | 14.83 | 13863.73 | 13863.73 | 13863.73 | 4669000 | 2944.00 | 261.00 |
| 1996 | 338.82 | 19.65 | 15231.27 | 15231.27 | 15231.27 | 4494000 | 3423.10 | 230.80 |
| 1997 | 511.19 | 6.03 | 16263.90 | 16263.90 | 16263.90 | 4572500 | 3911.50 | 224.20 |
| 1998 | 500.75 | 9.87 | 16483.20 | 16483.20 | 16483.20 | 4501000 | 3778.90 | 176.70 |
| 1999 | 547.49 | 13.57 | 15941.83 | 15941.83 | 15941.83 | 4554000 | 3370.30 | 143.60 |
| 2000 | 491.33 | 23.41 | 15471.97 | 15471.97 | 15471.97 | 4381000 | 3627.80 | 132.80 |
| 2001 | 385.04 | 11.63 | 15480.43 | 15480.43 | 15480.43 | 4305494 | 3097.30 | 132.10 |
| 2002 | 741.29 | 9.50 | 16434.57 | 16434.57 | 16434.57 | 4305384 | 2985.80 | 112.70 |
| 2003 | 1139.45 | 24.74 | 17151.77 | 17151.77 | 17151.77 | 4305725 | 155.50 | 65.80 |
| 2004 | 1350.26 | 24.87 | 18860.13 | 18860.13 | 18860.13 | 4310861 | 84.40 | 144.10 |
| 2005 | 1212.13 | 43.79 | 19481.90 | 19481.90 | 19481.90 | 4312487 | 142.70 | 98.90 |
| 2006 | 1118.12 | 72.73 | 21080.07 | 21080.07 | 21080.07 | 4313530 | 85.40 | 122.60 |
| 2007 | 1108.25 | 46.82 | 18429.30 | 18429.30 | 18429.30 | 4311967 | 2614.70 | 368.90 |

| NFR | 2.D.3.b | 2.D.3.c | 2.D.3.d | 2.D.3.d | 2.D.3.d | 2.D.3.e | | 2.D.3.f |
|---|---|---|---|---|---|---|---|---|
| Name | Road paving with asphalt | Asphalt roofing | Decorative coating application | Industrial coating application | Other coating application | Degreasing (Cold cleaning) | Degreasing (Vapour cleaning) | Dry cleaning |
| SNAP | 040611 | 040610 | 060100 | 060100 | 060100 | 060201 | | 060202 |
| Unit | kt | kt | t | t | t | population | t | t |
| 2008 | 1338.68 | 25.28 | 21103.13 | 21103.13 | 21103.13 | 4309796 | 2344.50 | 380.40 |
| 2009 | 1107.73 | 23.49 | 16636.07 | 16636.07 | 16636.07 | 4302847 | 2488.00 | 390.80 |
| 2010 | 915.53 | 17.96 | 16047.40 | 16047.40 | 16047.40 | 4289857 | 2506.80 | 403.30 |
| 2011 | 973.45 | 16.60 | 16160.30 | 16160.30 | 16160.30 | 4280622 | 3269.90 | 288.50 |
| 2012 | 863.56 | 9.96 | 15173.50 | 15173.50 | 15173.50 | 4267558 | 2944.00 | 261.00 |
| 2013 | 669.99 | 8,22 | 14051.83 | 14051.83 | 14051.83 | 4255689 | 3423.10 | 230.80 |
| 2014 | 780.64 | 13.08 | 14170.17 | 14170.17 | 14170.17 | 4238389 | 3911.50 | 224.20 |
| 2015 | 763.90 | 38.49 | 13911.90 | 13911.90 | 13911.90 | 4203604 | 3778.90 | 176.70 |
| 2016 | 749.65 | 17.34 | 16368.70 | 16368.70 | 16368.70 | 4174349 | 3370.30 | 143.60 |

Source: CBS, EUROSTAT; Processing: Ekonerg Ltd

Chemical products (NFR 2.D.3.g)

Emission calculation from the source category Chemical products is performed with Tier 2 of EMEP/EEA methodology. For the Tier 2 approach, both the activity data and the emission factors need to be stratified according to the different products that are used in Croatia, represented by the relevant SNAP codes. For chemical products with SNAP code as following: Polyvinyl-chloride processing (SNAP 060302), Polyurethane solid and soft foam processing (SNAP 060303), Rubber processing (SNAP 060305), Pharmaceutical products manufacturing (SNAP 060306), Paints manufacturing (SNAP 060307), Inks manufacturing (SNAP 060308), Glues manufacturing (SNAP 060309), recommended emission factors from *CORINAIR Technical Annexes. Vol. 2 Default emission factors handbook (1994)* were used. Emission factor is expressed as the amount of NMVOC emissions per unit of annual manufactured organic chemicals (polyester, polyvinylchloride, polyurethane soft and solid foam, polystyrene foam, rubber, paints, inks and glues), or per population (for pharmaceutical products manufacturing), and are presented in Appendix 4. For activities following activities Tier 2 default emission factors from EMEP/EEA 2016 are used: Polyester processing and Polystyrene foam processing. Activity data for various activities in the scope of NFR code 2.D.3.g are represented in Table 5.4-3.

**Table 5.4-3 Activity data for NFR code 2.D.3.g, represented by the relevant SNAP codes**

| NFR 2.D.3.g | Polyester process. | Polyvinylchloride process. | Polyurethane process. | Polystyrene foam process. | Rubber process. | Pharmaceutical products manufact. | Paints manufac. | Inks manufac. | Glues manufac. | Adhesive, magnetic tapes, films and photogr. manufac. |
|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP** | **060301** | **060302** | **060303** | **060304** | **060305** | **060306** | **060307** | **060308** | **060309** | **060311** |
| **Unit** | **t** | **t** | **t** | **t** | **t** | **1000 caput** | **t** | **t** | **t** | **m²** |
| 1990 | 6.05 | 49.71 | 3.76 | 7.84 | 5.74 | 4778 | 21.96 | 4.71 | 21.59 | 1009000 |
| 1991 | 4.16 | 30.72 | 2.80 | 7.34 | 5.44 | 4513 | 13.83 | 3.65 | 13.45 | 776000 |
| 1992 | 3.52 | 19.98 | 1.68 | 6.74 | 2.44 | 4470 | 9.49 | 1.37 | 7.15 | 469000 |
| 1993 | 2.57 | 15.15 | 2.05 | 6.60 | 2.48 | 4641 | 9.06 | 1.05 | 10.91 | 299000 |
| 1994 | 2.55 | 5.51 | 2.46 | 9.28 | 2.34 | 4649 | 10.80 | 1.48 | 11.17 | 239000 |
| 1995 | 2.23 | 5.35 | 2.91 | 6.45 | 2.29 | 4669 | 10.77 | 1.42 | 10.08 | 320000 |
| 1996 | 3.37 | 5.34 | 1.82 | 7.61 | 1.28 | 4494 | 13.93 | 1.47 | 17.20 | 592000 |
| 1997 | 7.02 | 5.21 | 1.75 | 10.41 | 0.03 | 4573 | 15.00 | 1.45 | 10.87 | 404000 |
| 1998 | 8.26 | 4.16 | 1.83 | 9.95 | 0.02 | 4501 | 15.47 | 1.09 | 10.38 | 419000 |
| 1999 | 5.61 | 2.90 | 1.83 | 5.35 | 0.02 | 4554 | 15.19 | 0.81 | 8.21 | 257000 |
| 2000 | 12.85 | 1.46 | 1.86 | 3.65 | 0.02 | 4381 | 15.11 | 0.92 | 10.36 | 344000 |
| 2001 | 9.66 | 1.04 | 2.75 | 1.42 | 0.02 | 4305 | 16.79 | 0.83 | 12.39 | 339000 |
| 2002 | 14.69 | 8.39 | 5.61 | NO | 0.02 | 4305 | 15.17 | 0.87 | 25.85 | 323000 |
| 2003 | 9.70 | 8.39 | 2.93 | NO | 0.01 | 4306 | 15.33 | 0.79 | 30.87 | 138000 |
| 2004 | 10.95 | 10.06 | 2.48 | 1.02 | 0.01 | 4311 | 14.98 | 0.88 | 46.12 | 27000 |
| 2005 | 10.89 | 9.40 | 2.92 | 1.68 | 4.0E-03 | 4312 | 16.39 | 0.67 | 56.57 | 109000 |
| 2006 | 14.11 | 8.05 | 2.36 | 10.97 | 4.0E-03 | 4314 | 17.32 | 0.69 | 71.33 | 108000 |
| 2007 | 16.55 | 8.61 | 1.87 | 15.77 | NO | 4312 | 20.10 | 0.92 | 81.77 | 75330 |
| 2008 | 16.55 | 9.34 | 1.87 | 16.23 | NO | 4310 | 19.72 | 0.94 | 77.70 | 93351 |
| 2009 | 13.99 | 6.82 | 1.03 | 11.05 | NO | 4303 | 15.19 | 0.62 | 33.82 | 95430 |
| 2010 | 7.27 | 4.67 | 0.78 | 10.13 | NO | 4290 | 16.39 | 0.34 | 35.51 | 95200 |
| 2011 | 7.07 | 3.83 | 0.62 | 0.58 | NO | 4281 | 16.62 | 0.42 | 28.72 | 74000 |
| 2012 | 7.66 | 3.77 | 0.56 | NO | NO | 4268 | 14.26 | 0.26 | 28.80 | 41000 |
| 2013 | 7.87 | 3.16 | 0.55 | NO | NO | 4256 | 12.62 | 0.28 | 31.62 | 0 |
| 2014 | 7.28 | 0.70 | 0.56 | NO | NO | 4238 | 14.18 | 0.30 | 21.62 | 0 |
| 2015 | 8.51 | 0.90 | 0.40 | NO | NO | 4204 | 14.56 | 0.35 | 18.81 | 0 |
| 2016 | 8.11 | 0.95 | 0.64 | NO | NO | 4174 | 17.36 | 0.33 | 18.96 | 0 |

Source: CBS, Processing: Ekonerg Ltd

Printing (NFR 2.D.3.h)

For the 2018 submission, calculation correction was made, taking into account recommendations of the review team with respect to the NEC Directive. The previous methodology included NMVOC emission calculations based on the ink produced in Croatia, resulting in underestimated emissions for this source. This year's submission includes methodology based on the amounts of ink (imported, exported and produced) for the printing industry.

The emission calculation is performed by using Tier 1 EMEP/EEA 2016 methodology.

Data on the amounts of ink (import/export/production) were taken from the Eurostat database (from the year 2001 onward). In addition to data from the Eurostat database (2001-onward), for the NMVOC emission calculation from this source for the period 1990-2000, the annual statistical reports on industrial production (annual PRODCOM results) and expert estimates for the quantities of ink for printing industry based on GDP were used (Source: Eurostat: June 2017; Market Survey/Feb 2016; CHP survey/June 2017; SHARES2015 from Feb 2017; ECFIN: AMECO GDP June 2017; EEA/UNFCCC June 2017).

The emission factor (GB2016, Tier 1) is expressed as the amount of NMVOC emissions per annual unit of ink used, and it is shown in Annex 4. Activity data for NFR code 2.D.3.h are represented in Table 5.4-3.

Other solvent and product use (NFR 2.D.3.i, 2.G)

The methodology for emission estimation is based on the Tier 2 of EMEP/EEA 2016 methodology; multiplication of annual products amount with the appropriate emission factor. Used Tier 2 emission factors are expressed as the amount of NMVOC emissions per annual production unit or per number of inhabitants and are shown in Appendix 4.

For source category 2.D.3.i, 2.G basic activity statistics are stratified by the activities involved and are separated to sub-categories 2.D.3.i Other solvent use and 2.G Other product use.

For activity under SNAP code 060404 Oil extractions the relevant activity statistics are the quantities of seed used in units of tonnes per year.

For activity under SNAP 060405 Application of glues and adhesives the relevant activity statistic are quantity of glues produced in units of tonnes per year for industry, DIY/buildings (construction) and domestic uses.

For activities under SNAP 060406 Wood preservation (Creosote preservation type and Organic solvent-borne preservative), the preservative consumption data is not available and the “quantity of wood preserved” (volume of wood impregnated with creosote ($m^3$/yr.) and volume of wood impregnated with solvent borne preservative ($m^3$/yr.) combined with proposed assumptions in EMEP/EEA 2016.

For Car dewaxing (SNAP 060409) relevant activity data annual number of motor vehicles (passenger and light cargo) imported by sea on Croatian territory. Data are available for the period 2000 - 2016, and for the years in the period 1990-1999 expert assessment was applied. Data are the result of processing the Uniform Customs declaration for the customs procedure of release goods into free circulation (import) by Croatian Ministry of Finance, Customs Administration.

For activity under SNAP 060602 Tobacco combustion the relevant activity statistics are the quantities of cigarettes and cigars used in units of tonnes per year combined with assumptions that one cigarette contains 1g of tobacco and one cigar contains 5g of tobacco.

For Use of shoes (SNAP 060603) the relevant activity statistics is annual number of sold pairs of shoes.

For Concrete additive (SNAP 060604-1) the relevant activity statistics is annual quantity of sold additives for construction activities.

For Cooling lubricant (SNAP 060604-2) and Lubricant (SNAP 060604-3) national energy balance was used as source of activity data. Relevant activity data is non-energy use of various lubricants in energy sector, petrochemical industry, other industry, construction, transport and agriculture. Annual aggregated value on non-energy use of various lubricants was available for whole trend. Detail data by various type was available since 1999, and for years in trend from 1990 to 1998 the average factor by lubricant type was estimate. Types of lubricants are following: white spirit, oil and fats, paraffin and wax and other lubricants. Cooling lubricants (SNAP 060604-2) are assumed to be oils and fats and all other types of lubricant are assumed to be Lubricant (SNAP 060604-3).

Basic activity statistics are taken from Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS). Activity data for SNAP 060406 and 060406 in the scope of NFR code 2.D.3.i and for SNAP codes: 060602 and 060601 within NFR 2.G are shown in Table 5.4-4. Activity data for SNAP codes: 060404, 060405, 060409 within NFR 2.D.3.i and for SNAP codes: 0600603, 060604-1, 060604-2, 060604-3 within NFR 2.G are shown in Table 5 4-5.

**Table 5.4-4 Activity data for NFR codes 2.D.3.h, 2.D.3.i, 2G, represented by the relevant SNAP codes**

| NFR | 2.D.3.h | 2.D.3.i | | 2.G | |
|---|---|---|---|---|---|
| Name | Printing | Wood preservation with solvent borne preservative | Wood preservation with creosote | Tobacco combustion | Use of fireworks |
| SNAP | 060403 | 060406b | 060406a | 060602 | 060601 |
| Unit | kt | t | t | t | t |
| 1990 | 6.53 | 31.69 | 334.83 | 12091 | 709 |
| 1991 | 5.09 | 11.77 | 124.32 | 11232 | 709 |
| 1992 | 2.63 | 25.50 | 269.43 | 12428 | 709 |
| 1993 | 2.17 | 21.40 | 226.08 | 11271 | 709 |
| 1994 | 2.67 | 51.41 | 508.73 | 4856 | 709 |
| 1995 | 2.71 | 50.68 | 362.50 | 11845 | 1214 |
| 1996 | 2.84 | 50.05 | 473.00 | 11327 | 1787 |
| 1997 | 2.95 | 43.21 | 409.63 | 11185 | 1766 |
| 1998 | 2.62 | 47.91 | 402.58 | 11965 | 1197 |
| 1999 | 2.33 | 33.54 | 434.43 | 13839 | 973 |
| 2000 | 2.50 | 34.33 | 243.73 | 13531 | 707 |
| 2001 | 2.47 | 37.54 | 234.65 | 17674 | 1659 |
| 2002 | 2.59 | 53.54 | 334.65 | 18350 | 8292 |
| 2003 | 2.95 | 60.63 | 1145.83 | 19070 | 11487 |
| 2004 | 3.33 | 53.11 | 1761.98 | 14256 | 6201 |
| 2005 | 3.61 | 32.86 | 1361.48 | 14634 | 2773 |
| 2006 | 4.09 | 18.54 | 971.35 | 14422 | 2088 |
| 2007 | 4.47 | 96.01 | 1451.90 | 14595 | 1471 |
| 2008 | 4.46 | 422.14 | 1337.15 | 15405 | 1024 |
| 2009 | 4.03 | 2058.15 | 1750.10 | 11335 | 456 |
| 2010 | 4.06 | 401.83 | 1819.20 | 13279 | 181 |
| 2011 | 4.20 | 448.51 | 1319.18 | 11665 | 156 |
| 2012 | 4.14 | 421.02 | 1712.98 | 11144 | 11 |
| 2013 | 4.79 | 572.80 | 2600.20 | 9598 | 1455 |
| 2014 | 4.71 | 518.98 | 364.18 | 8377 | 1036 |
| 2015 | 4.69 | 675.70 | 617.23 | 8157 | 1000 |
| 2016 | 4.70 | 507.70 | 290.00 | 8162 | 1278 |

Source: CBS, EUROSTAT; Processing: Ekonerg Ltd

**Table 5.4-5 Activity data for NFR code 2.D.3.i, 2.G, represented by the relevant SNAP code**

| NFR | 2.D.3.i | | | 2.G | | | |
|---|---|---|---|---|---|---|---|
| Name | Fat, edible and non-edible oil extraction | Use of adhesives | Vehicles dewaxing | Use of Shoes | Concrete additive | Cooling lubricant | Lubricant |
| SNAP | 060404 | 060405 | 060409 | 060412-1 | 060412-2 | 060412-3 | 060412-4 |
| Unit | t | t of glue | number of vehicle | pair of shoes | t | t | t |
| 1990 | 121158 | 21591 | 751 | 26384000 | 3109 | 130496 | 63304 |
| 1991 | 28401 | 13209 | 704 | 11977000 | 1152 | 111631 | 54153 |
| 1992 | 72700 | 7079 | 657 | 8751000 | 757 | 79388 | 38512 |

| NFR | 2.D.3.i | | | 2.G | | | |
|---|---|---|---|---|---|---|---|
| Name | Fat, edible and non-edible oil extraction | Use of adhesives | Vehicles dewaxing | Use of Shoes | Concrete additive | Cooling lubricant | Lubricant |
| SNAP | 060404 | 060405 | 060409 | 060412-1 | 060412-2 | 060412-3 | 060412-4 |
| Unit | t | t of glue | number of vehicle | pair of shoes | t | t | t |
| 1993 | 42622 | 7479 | 438 | 13865000 | 778 | 97300 | 47200 |
| 1994 | 72922 | 6280 | 503 | 8407000 | 1081 | 108198 | 52487 |
| 1995 | 73551 | 7180 | 548 | 9408000 | 934 | 105380 | 51120 |
| 1996 | 69991 | 8972 | 588 | 5766000 | 964 | 113931 | 55269 |
| 1997 | 132847 | 10874 | 648 | 6715000 | 1124 | 124705 | 60495 |
| 1998 | 157060 | 10379 | 687 | 5191800 | 1102 | 93394 | 45306 |
| 1999 | 100509 | 8206 | 729 | 5159000 | 1123 | 33500 | 15500 |
| 2000 | 25260 | 10355 | 768 | 2381000 | 603 | 30000 | 14600 |
| 2001 | 24256 | 12385 | 673 | 2279000 | 539 | 31100 | 20600 |
| 2002 | 155631 | 25851 | 58 | 3891000 | 912 | 33600 | 24200 |
| 2003 | 151524 | 30873 | 7 | 4935000 | 1583 | 29000 | 25100 |
| 2004 | 95505 | 46119 | 36 | 7130000 | 1983 | 39400 | 19400 |
| 2005 | 123783 | 56573 | 152 | 5477000 | 4724 | 35400 | 21700 |
| 2006 | 129269 | 71330 | 45 | 5776000 | 6319 | 38100 | 19400 |
| 2007 | 98045 | 81768 | 70 | 5803000 | 3872 | 45100 | 16400 |
| 2008 | 96740 | 77701 | 48 | 5443000 | 2023 | 38900 | 17200 |
| 2009 | 76898 | 33849 | 25 | 5069000 | 1722 | 37300 | 14800 |
| 2010 | 83669 | 35507 | 26 | 5276000 | 2449 | 33200 | 11200 |
| 2011 | 86646 | 28722 | 10 | 4966000 | 1668 | 33400 | 10300 |
| 2012 | 26214 | 28801 | 16 | 4486000 | 1989 | 29700 | 10200 |
| 2013 | 34087 | 31622 | 5 | 4533000 | 1394 | 28700 | 9700 |
| 2014 | 44358 | 21616 | 5 | 5148000 | 522 | 29800 | 12200 |
| 2015 | 51005 | 18810 | 5 | 5010000 | 500 | 32200 | 10900 |
| 2016 | 47170 | 18955 | 5 | 4989000 | 827 | 34500 | 18400 |

Source: CBS, Processing: Ekonerg Ltd

Pulp and paper industry (NFR 2.H.1)

The methodology for emission estimation is based on the Tier 2 of EMEP/EEA 2016 methodology; multiplication of annual products amount with the appropriate emission factor. For all activities in the source category 2.H.1 Pulp and paper recommended Tier 2 emission factors are used according to the EMEP/EEA 2016. Emission factor is expressed as the amount of NMVOC emissions per annual production unit and are shown in Appendix 4. Activity data for different SNAP codes within the NFR code 2.H.1 are represented in Table 5.4-6.

**Table 5.4-6 Activity data for NFR codes 2.H.1, 2.I and 2.K, represented by the relevant SNAP codes**

| NFR | 2.H.1 | | | 2.I | 2.K |
|---|---|---|---|---|---|
| Name | Paper pulp (Neutral Sulphite Semi-Chemical process) | Paper pulp (Acid sulphite process) | Paper pulp (Kraft process) | Wood processing | Consumption of POPs and heavy metals |
| SNAP | 040604 | 040603 | 040602 | 040620 | 060508 (includes: 060502, 060504, 060507) |
| Unit | t | t | t | t | population |
| 1990 | 94703 | 1623 | 14609 | 91422 | 4778000 |
| 1991 | 68778 | 1074 | NO | 60789 | 4513000 |
| 1992 | 62985 | 703 | NO | 74862 | 4470000 |
| 1993 | 74304 | 476 | NO | 69093 | 4641000 |
| 1994 | 92838 | 71 | NO | 63325 | 4649000 |
| 1995 | 78246 | NO | NO | 52779 | 4669000 |
| 1996 | 62933 | NO | NO | 53954 | 4494000 |
| 1997 | 69885 | NO | NO | 50541 | 4572500 |
| 1998 | 57552 | NO | NO | 52254 | 4501000 |
| 1999 | 71158 | NO | NO | 47461 | 4554000 |
| 2000 | 88607 | NO | NO | 50308 | 4381000 |
| 2001 | 77232 | NO | NO | 51038 | 4305494 |
| 2002 | 78247 | NO | NO | 54988 | 4305384 |
| 2003 | 52526 | NO | NO | 62789 | 4305725 |
| 2004 | 66065 | NO | NO | 68151 | 4310861 |
| 2005 | 55489 | NO | NO | 89565 | 4312487 |
| 2006 | 63331 | NO | NO | 110134 | 4313530 |
| 2007 | 49554 | NO | NO | 121040 | 4311967 |
| 2008 | 52122 | NO | NO | 123953 | 4309796 |
| 2009 | 36946 | NO | NO | 94985 | 4302847 |
| 2010 | 53340 | NO | NO | 93545 | 4289857 |
| 2011 | 61192 | NO | NO | 97483 | 4280622 |
| 2012 | 42966 | NO | NO | 102444 | 4267558 |
| 2013 | 40366 | NO | NO | 143088 | 4255689 |
| 2014 | 32648 | NO | NO | 134822 | 4238389 |
| 2015 | 31957 | NO | NO | 134552 | 4203604 |
| 2016 | 33596 | NO | NO | 87228 | 4174349 |

Source: CBS, Processing: Ekonerg Ltd

<u>Food and beverages industry (NFR 2.H.2)</u>

The methodology for emission estimation is based on the Tier 2 of EMEP/EEA 2016 methodology; multiplication of annual products amount with the appropriate emission factor. For all activities in the source category Food and beverages recommended emission factors are used according to the EMEP/EEA 2016. Tier 2 default emission factors are used and they are based on various food and beverages products. Emission factors used for the preparation of the inventory are presented by NFR sectors and pollutants in Appendix 4. Activity data for different SNAP codes within the NFR code 2.H.2 are represented in Table 5.4-7.

**Table 5.4-7 Activity data for NFR code 2.H.2, represented by the relevant SNAP codes**

| NFR 2.H.2 | Bread | Wine | Beer | Spirit | Cakes, biscuits, cereals | Margarine and solid fats | Animal feed | Sugar | Meat frying/ curing | Coffee roasting |
|---|---|---|---|---|---|---|---|---|---|---|
| SNAP | 040605 | 040606 | 040607 | 040608 | 040615 | 040616 | 040617 | 040625 | 040626 | 040630 |
| Unit | t | hl | hl | hl | t | t | t | t | t | t |
| 1990 | 250489 | 1299550 | 2800220 | 1222918 | 40848 | 24507 | 970853 | 200645 | 135315 | 12905 |
| 1991 | 205425 | 1114993 | 2247510 | 1125981 | 32337 | 21000 | 755750 | 100162 | 104501 | 12591 |
| 1992 | 202327 | 1099244 | 2720037 | 611939 | 23525 | 17723 | 653431 | 94666 | 90577 | 8248 |
| 1993 | 185419 | 851302 | 2481344 | 551763 | 21307 | 14687 | 650745 | 78847 | 86103 | 7296 |
| 1994 | 201668 | 858680 | 3156610 | 323896 | 22371 | 13094 | 530053 | 115440 | 86112 | 8420 |
| 1995 | 172510 | 829480 | 3170134 | 310632 | 23505 | 24507 | 519900 | 175340 | 86795 | 8003 |
| 1996 | 154330 | 793676 | 3291972 | 418724 | 24146 | 16637 | 477753 | 195316 | 89773 | 8144 |
| 1997 | 154443 | 548426 | 3662853 | 358295 | 26151 | 16170 | 476549 | 141380 | 84603 | 8643 |
| 1998 | 139070 | 626098 | 3759435 | 315762 | 26507 | 15755 | 537653 | 139207 | 82321 | 8429 |
| 1999 | 124364 | 483515 | 3606546 | 326754 | 25666 | 16124 | 496339 | 113966 | 79562 | 7639 |
| 2000 | 122585 | 612812 | 3993439 | 320831 | 26320 | 20261 | 694835 | 56729 | 134297 | 7768 |
| 2001 | 123620 | 548667 | 3779271 | 253721 | 26943 | 16414 | 530348 | 130693 | 84992 | 7955 |
| 2002 | 138063 | 600463 | 3638502 | 265219 | 29454 | 22232 | 559542 | 173896 | 101742 | 11056 |
| 2003 | 136241 | 638412 | 3701131 | 247523 | 36822 | 27378 | 583495 | 146561 | 101212 | 11181 |
| 2004 | 140597 | 631784 | 3606304 | 218749 | 34988 | 30635 | 758976 | 214934 | 101972 | 10545 |
| 2005 | 136930 | 504248 | 3495910 | 281664 | 36322 | 25427 | 534785 | 245387 | 106546 | 9697 |
| 2006 | 144683 | 534735 | 3688972 | 203974 | 36313 | 31814 | 590284 | 320345 | 116218 | 13040 |
| 2007 | 202890 | 652852 | 3810230 | 49582 | 39349 | 29600 | 643886 | 328322 | 115739 | 13549 |
| 2008 | 194473 | 508689 | 3879887 | 52652 | 46395 | 4688 | 637284 | 315764 | 223998 | 12832 |
| 2009 | 191204 | 556945 | 3674323 | 48824 | 47396 | 17284 | 602422 | 255956 | 133945 | 13934 |
| 2010 | 193074 | 463463 | 3438947 | 55617 | 49494 | 16136 | 599633 | 261568 | 131874 | 13010 |
| 2011 | 192282 | 488750 | 3738332 | 51300 | 49221 | 17542 | 654202 | 329322 | 141720 | 14203 |
| 2012 | 193307 | 441905 | 3625144 | 41924 | 47762 | 16200 | 656880 | 296728 | 137243 | 12129 |
| 2013 | 157647 | 487803 | 3443429 | 53504 | 47365 | 15010 | 654983 | 273843 | 130385 | 11667 |
| 2014 | 194812 | 452727 | 3416678 | 49926 | 50662 | 13574 | 736066 | 335388 | 130027 | 11620 |
| 2015 | 190523 | 472699 | 3396272 | 44607 | 49691 | 12839 | 517659 | 248827 | 125013 | 11927 |
| 2016 | 183009 | 484895 | 3365899 | 41339 | 47555 | 12039 | 696173 | 333866 | 135622 | 14513 |

Source: CBS; Processing: Ekonerg Ltd

Wood processing (NFR 2.I)

The methodology for emission estimation is based on the Tier 1 of EMEP/EEA 2016 methodology; multiplication of annual products amount with the appropriate emission factor.

Proposed Tier 1 emission factors are used according to the EMEP/EEA GB2016 and are presented in Appendix 4. Activity data is from the Annual Statistical Reports, Industrial production, Annual PRODCOM Results (CBS). Activity data for NFR code 2.I is represented in Table 5.4-6.

Consumption of POPs and heavy metals (NFR 2.K)

For PCBs and Hg emission calculation from sub-sector 2.K, a Tier 1 default emission factors were used which is according to GB2016 only available Tier 1 method. Tier 1 emission factors are expressed as the quantity of pollutant by population in Croatia and are presented in Appendix 4. Annual national population statistics is using as activity data for pollutants emission calculation (Table 5.4-6).

**Recalculations and improvements**

Domestic solvent use including fungicides (NFR 2.D.3.a)

Recalculation for the trend was performed due to the EF adjustment according to Tier 2 from GB2016 related to the following products: Household products, Car care products and Pesticides.

Road paving with asphalt (NFR 2.D.3.b)

Asphalt roofing (NFR 2.D.3.c)

Pulp and paper production (NFR 2.H.1)

Wood processing (NFR 2.I)

Consumption of POPs and heavy metals (NFR 2.K)

There was no recalculation and other improvement in this report.

Coating applications (NFR 2.D.3.d)

Recalculation for the trend was performed due to the use of new calculation methodology that includes a more comprehensive set of activity data.

<u>Degreasing (NFR 2.D.3.e)</u>

Recalculation for the trend was performed taking into account the amount of solvent used (for vapour cleaning), rather than just the number of inhabitants.

<u>Dry cleaning (NFR 2.D.3.f)</u>

Recalculation for the trend was performed taking into account the amounts of imported/exported/produced perchlorethylene, rather than previously used number of inhabitants.

<u>Chemical products (NFR 2.D.3.g)</u>

New activity - Adhesive, magnetic tapes, films and photographs manufacturing (SNAP 060311) was included in this category, thus the recalculation was performed for the entire trend.

<u>Printing (NFR 2.D.3.h)</u>

Recalculation for the trend was performed due to the use of new calculation methodology that includes a more comprehensive set of activity data.

<u>Other solvent and product use (NFR 2.D.3.i, 2G)</u>

New activity – Use of fireworks (SNAP 060601) was included in this category, thus the recalculation was performed for the entire trend.

Recalculation was performed for NMVOC emissions for 2015 for the activity – use of adhesives due to the incorrect calculation.

<u>Food and beverages (NFR 2.H.2)</u>

Recalculation was performed for NMVOC emissions for 2015 for the activity - production of wine due to the incorrect calculation.

# VI AGRICULTURE (NFR 3)

This chapter gives an overview of the sector 3 Agriculture and contains information on methodologies, activity data, emission factors, recalculations used for the calculation of emission estimates and planned improvements. Under NFR sector 3, emissions of ammonia, particles (TSP, $PM_{2.5}$ and $PM_{10}$) and NOx are reported. This sector includes the following sub-sectors from which certain pollutant emissions in the Republic of Croatia are reported:

- **3.B Manure Management**
    - 3.B.1.a Dairy cattle
    - 3.B.1.b Non-dairy cattle
    - 3.B.2 Sheep
    - 3.B.3 Swine
    - 3.B.4.d Goats
    - 3.B.4.e Horses
    - 3.B.4.f Mules and asses
    - 3.B.4.g.i Poultry
    - 3.B.4.g.i Laying hens
    - 3.B.4.g.ii Broilers
    - 3.B.4.g.iii Turkeys
    - 3.B.4.g.iv Other poultry

- **3.D Crop production and agricultural soils**
    - 3.D.1.a Mineral N-fertilizers
    - 3.D.a.2.a Animal manure applied to soils
    - 3.D.a.2.b Sewage sludge applied to soils
    - 3.D.a.3 Urine and dung deposited by grazing animals
    - 3.D.b Indirect emissions from managed soils
    - 3.D.c Farm-level agricultural operations including storage, handling and transport of agricultural products

- 3.D.f Use of pesticides

- **3.F Fild burning of agricultural residues**

There are five main sources of activity data for emission calculation: the Central Bureau of Statistics (CBS), Croatian Agricultural Agency (CAA), FAOSTAT and fertilizer companies.

For source category NFR 3.F Field burning of agricultural residues the notation key "NE" is used.

## 6.1 MANURE MANAGEMENT (NFR 3.B)

**Source category description**

The manure management is source of emissions of $NH_3$, NO, NMVOC and PM. The $NH_3$, NO, NMVOC arise from the excreta of agricultural livestock deposited in and around buildings and collected as liquid slurry, solid manure or litter-based farmyard manure (FYM) and the last two are observed together as solid. Those emissions take place from buildings housing livestock and outdoor yard areas, from manure stores, following land spreading of manures and during grazing. The PM emissions arise mainly from feed, and also from bedding, animal skin or feathers, and take place from buildings housing livestock. There are five main sources of emissions from animal husbandry and manure management: livestock feeding (PM), livestock housing and holding areas ($NH_3$, PM, NMVOC), manure storage ($NH_3$, NO, NMVOC), field-applied manure ($NH_3$, NO, NMVOC) and manure deposited during grazing ($NH_3$, NO, NMVOC). Croatia is reported ammonia, NOx and PM emissions for animal husbandry, while NMVOC emission is not reported for now.

Key source in 2014 of ammonia emissions are following source category: 3.B.3 Swine, 3.B.1.a Dairy cattle, 3.B.1.b Non-dairy cattle and 3.B.4.g.i Poultry. Listed below, are national specifics for manure management regarding key categories.

**National specifics regarding Swine**: Currently in Croatia, swine production is based on the using of high producing breeds (landrace type breeds or hybreed such as PIC, Topics etc.) in housing system based on slurry manure type. The type of production is similar to that in Western European countries (Netherlands, Denmark, and Germany), from where are animals and equipment imported. Local characteristics (climate condition in each part of Croatia) should be also taken into account. In the period 2000 - 2010 there were changes which resulted in intensifying of the pig production. The number of sows, especially sows kept outdoors in partial or full time grazing system decrease (to the proportion of < 5 %), as well the number of sows in litter based housing (about 40% in 2012 and 2013, compared to > 80 % in the period 1990 - 2000). Intensive fattening of pigs makes > 90 % and takes place in housing system based on slatted floor and liquid/slurry manure type, which is a significant change in comparison to 1990 in which it is estimated that was less than 50 %. Increasing the number of piglets produced per sow per year, increasing the daily gain and the higher meatiness of pigs (52% in 1990 to 58 % in 2012), result in higher nutritional demand of pigs to protein (N) in feed. It is estimated that fattening pigs intake about 20.0 kg of N by feed, from which about 13.5 kg or 70 % is excreted with excrements (feces and urine; IPCC, 2006; SN, 2012). For breeding sows N intake is estimated to 48.7 kg animal from which about 30.8 kg per animal per year is excreted with excrements. This amount of N is the basis for the TAN content in manure and ammonia emission, depending on the method of manure removal (4.5 kg N), storage (0.85 kg N per $m^2$ per year) and the application of manure (> 15 % TAN). For grazing sows (outdoor production system) N loss is < 3.0 kg per animal (Misselbrook et al., 2000).

**National specifics regarding Cattle dairy:** In the 1990s the milk production was based on keeping the double purpose dairy cows (milk and meat) in extensive production system. The average milk production amounted to 1,930.0 kg cow-1 year-1 in 1990 and 2307.0 kg in 2000 (CBS, 1990-2000). Because the average milk production per cow was relatively low during this time period, N excretion by manure was low due to the low nutritional demand of cow to protein (N) content in the feed. Increase in milk production per cow is closely associated with increase in DMI and the protein (N) content. Assuming that about 20% of N intake with feed is retained in the organism of the cow for milk synthesis and demands of their own tissues, the rest (80%) is excreted with faeces and urine and makes a pool for the emission of ammonia (IPCC, 2006). In the 1990s more than 80% of the dairy cows were in production system which was based on a combination of grazing (6 months) and housing (6 months) system or only housing system with the use of large amounts of litter (> 7.0 kg head day). Only about 20% of dairy cows were in the housing system based on liquid manure type. In the last 15 years significant changes in the structure of milk production could be observed. The number of cows was reduced, but the average production of milk per cow has significantly increased. In 2010 milk production per cow amounted to 4370 kg and for 2013 it is estimated to approach 5000 kg per cow per year. Above mentioned results in significantly greater demands to feed protein (N) intake and consequently a greater amount of N excreted with feces and urine as the basis for the emission of ammonia. In spite of this the nutritional protein demands risen more than twice and despite of higher efficiency of protein digestion increase the amount of N excreted in faeces and urine. Recently, milk production is based on a smaller number of specialized dairy farms in comparison to 15 years ago. The share of dairy cows kept in housing system based on liquid/slurry manure type (slatted floor or solid floor) increased. This is particularly evident after the adoption of the "Operative program for development of cattle production in Croatia" by the Croatian government that has resulted in building of new and reconstruction of existing farms dairy modelled on a farm in western European countries (Germany, Netherlands and Austria) that are based on the liquid manure. Milk production based on using of large amounts of litter and pasture as the favourable production systems from the point of ammonia emissions, are gradually reduced (currently their share is less than 30%) and are retained mainly on smaller farms with lower milk production per cow. In housing systems based on liquid manure, excrements are collected in lagoons (above ground level, open plan, solid floor) or in the pit storage (closed type, below the ground level, slatted floor). Housing system based on liquid manure and solid floor (the use of scrapers) as well the manure storage in lagoons is significantly less favourable from the point of ammonia emissions in comparison to previous using grazing system or housing system based on high amount of bedding material. Change from the grazing to the housing system has resulted in average increase of ammonia emission, while the move from the litter based to liquid/slurry based housing has resulted in additional increase of ammonia emission. In addition, the amount of ammonia which is lost during storage and during the application of manure should also be accounted for (Misselbrook et al., 2000).

**National specifics regarding Cattle non-dairy:** The category of non-dairy cattle represents the ammonia emission from the beef and/or suckling cows and finishing cattle (calves, bulls, heifers). Beef cows make up 5% of the total number of cows in Croatia and are characterized by full time grazing with feed supplement during winter season and use of poor pasture in relation to crude protein content (N). The fattening of cattle takes place in housing with predominantly slurry based system (slatted) or more rarely with litter. Intensive fattening is based on using of high amounts of grains and maize silage, which brings about 45 kg N per animal per year of which 36 kg N per animal per year is excreted with the faeces and urine as a basis of TAN and the ammonia emissions from manure (SN, 2012). In the period 1990 - 2013 there were no significant changes in beef cattle production systems and manure management.

**National specifics regarding Poultry**: Average annual N feed intake and in excretion is dependent on the type of poultry and their purpose (production of eggs, meat, and breeding flocks). The N intake in broilers is about 1.05 kg per animal per year, from which around 0.55 kg N is excreted with excrements as uric acid. In laying hens the amount of excreted N is about 0.75 kg animal per year, in ducks 0.76 kg animal per year and in turkey 1.71 kg animal per year (SN, 2012). The above mentioned is resulting with different emission of ammonia for different animal category. It should be noted that the production of poultry meat and eggs in Croatia in their characteristics are compatible with the same production in Western European countries (Netherlands, Germany, the same genetic basis of animal, housing and feeding, manure management).

**Methodology, emission factors and activity data**

The methodology used is in accordance with the GB2016. For the calculation of $NH_3$ emissions from the NFR sector 3.B Animal husbandry and manure management, Tier 2 methodology was used. National specifics described in the previous chapter were implemented within the Tier 2 methodology. Emission factors used for emission are presented in Appendix 4. Emission factor for a certain part of the poultry sub-category "Other poultry" (pheasants, quails, guinea fowls, ostriches, chickens other than laying hens) correspond to the emission factor for ducks, in accordance with the ERT recommendation.

National implemented proportions of livestock category housed on slurry and solid based systems and national specifics in manure management (nitrogen exchange rate (Nex), animal mass, N rate) were developed by the experts from the Faculty of Agriculture, University of Zagreb and are presented in Table 6.1-1 for the year 2016.

**Table 6.1-1 Animal categories N rate, NEX and percentage of slurry % for the year 2016**

| Animal category | N rate | Nex | Slurry manure type (%) |
|---|---|---|---|
| Dairy cows (100501) | 0.415 | 89.37 | 59.2 |
| Other cattle (100502) | 0.342 | 49.93 | 42 |
| Sheep (100505) | 0.88 | 8.03 | 82 |
| Goats (100511) | 1.28 | 16.35 | 82 |
| Horses etc. (100506) | 0.285 | 41.61 | 70 |
| Fattening pigs (100953) | 0.535 | 9.76 | 90.4 |
| Sows (100504) | 0.445 | 30.86 | 81 |
| Layers (100507) | 0.837 | 0.55 | - |
| Broilers (100508) | 1.1 | 0.4 | 2 |
| Turkeys (100509) | 0.74 | 1.62 | 3 |
| Ducks (100509) | 0.83 | 0.76 | 7 |
| Geese (100509) | 0.83 | 1.21 | 10 |

NMVOC methodology and EF used for emissions calculation was Tier 1 methodology, using the default Tier 1 EFs for NMVOCs (Table 3.4, GB2016) for the whole time period. Since default EFs (Table 3.3, GB2016) are provided for silage and without silage feeding, proportion of animals on silage feed was estimated by the experts from the Faculty of Agriculture, University of Zagreb, and are presented in Table 6.1-2.

**Table 6.1-2 Percentage (%) of animal categories on sillage feeding for selected years and year 2016.**

| Year | Dairy cows (SNAP 100901) | Other cattle (SNAP 100902) | Sheep & goats (SNAP 100905) |
|---|---|---|---|
| 1990 | 20 | 10 | 0 |
| 2000 | 50 | 50 | 0.5 |
| 2010 | 70 | 65 | 0.5 |
| 2016 | 81 | 71 | 1 |

NOx emissions were calculated using GB2016 Tier 2 methodology and EF for categories 3.B.1.a (100501 Cattle dairy) and 3.B.3 (100504 Fattening pigs). NOx emission from other livestock categories was calculated using Tier 1 methodology and EF (Table 3.3, GB2016) for the entire time period. Emission from each animal category was calculated using national estimates proportions of livestock category housed on slurry and solid based systems (table 6.1-1).

Relevant activity data are the number of certain livestock categories in Croatia which were attained in more detail. The categories were defined according to typical examples provided in the Guidebook; thus including goats and mules/asses in the emission calculation. Camels, buffalo and fur animals were not included because the first two animal categories do not exist in Croatia while data on fur animals' number are not available. Since the total poultry number in Croatia includes some other animals such as pheasants, quails, guinea fowls, ostriches and chickens other than laying hens, in order to ensure the completeness of the calculation and the comparability with statistical data, they were attributed to the reported sub-category Other poultry. Therefore sub-category Other poultry includes ducks, geese, pheasants, quails, guinea fowls, ostriches and chickens other than laying hens. The main data source is the Central Bureau of Statistics, Croatian Agricultural Agency (dairy cattle) and for some categories (primarily mules/asses) the FAOSTAT database. Data sources for each year and livestock category are presented in Table 6.1-3. Trend of animal number for each livestock category is presented in Tables 6.1-4 and 6.1-5.

**Table 6.1-3 Sources for activity data for NFR code 4.B Animal husbandry and manure management**

| Livestock categories | CBS | FAO | CAA | Extrapolation |
|---|---|---|---|---|
| Dairy cattle | | | 2008-2016 | 1990-2007 |
| Other cattle | 1990-2016 | | | |
| Swine | 1990-2016 | | | |
| Sheep | 1990-1991; 2000-2016 | 1992-1998 | | |
| Goats | 1990-1995 | | 1995-2016 | |
| Horses | 1990-1991 | 1992-1994 | 1995-2016 | |
| Mules/assess | 1990-2016 | | | |
| Poultry | 1990-2016 | | | |

**Table 6.1-4 Activity data for NFR codes 3.B.1.a, 3.B.1.b, 3.B.2, 3.B.3, 3.B.4.d, 3.B.4.e and 3.B.4.f**

| NFR | 3.B.1.a | 3.B.1.b | | 3.B.2 | 3.B.4.d | 3.B.4.e | 3.B.4.f | 3.B.3 | |
|---|---|---|---|---|---|---|---|---|---|
| SNAP | 100501 | 100502 | 100502 | 100505 | 100511 | 100506 | 100512 | 100503 | 100504 |
| Name | Cattle Dairy | Cattle Non-Dairy | Cattle Non-Dairy (Calves) | Sheep | Goats | Horses | Mules and asses | Sows | Fattening pigs |
| Unit | animal | animal | animal | animal | animal | animal | animal | animal | animal |
| 1990 | 487511 | 47405 | 315804 | 751000 | 172000 | 39000 | 17000 | 232000 | 1341000 |
| 1991 | 467535 | 65873 | 268586 | 753000 | 133000 | 36000 | 13000 | 234000 | 1387000 |
| 1992 | 448378 | 29830 | 195326 | 539000 | 113809 | 26000 | 13440 | 180000 | 1002000 |
| 1993 | 430006 | 47269 | 209368 | 525000 | 105000 | 22000 | 12430 | 193000 | 1069000 |
| 1994 | 412386 | 28338 | 162736 | 444000 | 107685 | 21000 | 6640 | 198000 | 1149000 |

| NFR | 3.B.1.a | 3.B.1.b | | 3.B.2 | 3.B.4.d | 3.B.4.e | 3.B.4.f | 3.B.3 | |
|---|---|---|---|---|---|---|---|---|---|
| SNAP | 100501 | 100502 | 100502 | 100505 | 100511 | 100506 | 100512 | 100503 | 100504 |
| Name | Cattle Dairy | Cattle Non-Dairy | Cattle Non-Dairy (Calves) | Sheep | Goats | Horses | Mules and asses | Sows | Fattening pigs |
| Unit | animal | animal | animal | animal | animal | animal | animal | animal | animal |
| 1995 | 395489 | 35873 | 149209 | 453000 | 107292 | 4685 | 1549 | 182000 | 993000 |
| 1996 | 379283 | 36373 | 141822 | 427000 | 105271 | 5274 | 1750 | 181000 | 1016000 |
| 1997 | 363742 | 33965 | 137815 | 453000 | 99544 | 5886 | 1902 | 185000 | 991000 |
| 1998 | 348838 | 38451 | 134112 | 427000 | 84403 | 6540 | 2077 | 186000 | 980000 |
| 1999 | 334544 | 29339 | 140920 | 488000 | 78000 | 7309 | 2255 | 205000 | 1157000 |
| 2000 | 320836 | 26933 | 137428 | 528675 | 79393 | 9611 | 2518 | 185249 | 1048296 |
| 2001 | 307690 | 28104 | 156223 | 539498 | 92943 | 10871 | 2780 | 187102 | 1046721 |
| 2002 | 295082 | 32285 | 137802 | 580016 | 96534 | 13570 | 3097 | 190189 | 1096308 |
| 2003 | 282991 | 29424 | 162685 | 586641 | 86087 | 15217 | 3033 | 200907 | 1145756 |
| 2004 | 271396 | 48078 | 191568 | 721578 | 126060 | 17057 | 3195 | 229446 | 1259889 |
| 2005 | 260275 | 38787 | 197272 | 796480 | 134483 | 17883 | 3146 | 199351 | 1005609 |
| 2006 | 249610 | 37300 | 212682 | 679839 | 102877 | 18885 | 3299 | 198668 | 1289820 |
| 2007 | 239382 | 21928 | 209618 | 645992 | 91902 | 18075 | 3415 | 182635 | 1165708 |
| 2008 | 226000 | 30526 | 203131 | 643384 | 83877 | 19687 | 3591 | 162063 | 941819 |
| 2009 | 224719 | 28102 | 206647 | 619044 | 76119 | 19958 | 3617 | 167649 | 1082225 |
| 2010 | 209336 | 47626 | 214243 | 629437 | 75215 | 20537 | 3722 | 163956 | 1066618 |
| 2011 | 206291 | 26742 | 236127 | 638608 | 70030 | 21836 | 3365 | 129375 | 1104031 |
| 2012 | 191354 | 29175 | 244547 | 679313 | 71978 | 22426 | 3363 | 125966 | 1056381 |
| 2013 | 180946 | 39447 | 236940 | 620000 | 69000 | 21256 | 3273 | 127643 | 983007 |
| 2014 | 178827 | 45282 | 218954 | 604866 | 60697 | 21144 | 2159 | 119277 | 1036943 |
| 2015 | 174805 | 66613 | 236157 | 607711 | 62057 | 21868 | 2468 | 150377 | 1044762 |
| 2016 | 167628 | 72104 | 243746 | 618896 | 75530 | 22775 | 2862 | 152593 | 1040696 |

Source: CBS, FAO, CAA
Processing: Ekonerg Ltd, 2018

**Table 6.1-5 Activity data for NFR codes 3.B.4.g.i, 3.B.4.g.ii, 3.B.4.g.iii, and 3.B.4.g.iv**

| NFR | 3.B.4.g.i | 3.B.4.g.ii | 3.B.4.g.iii | 3.B.4.g.iv | | |
|---|---|---|---|---|---|---|
| SNAP | 100507 | 100508 | 100509a | 100509z | | |
| Name | Laying hens | Broilers | Turkeys | Ducks | Gees | Other poultry |
| Unit | animal | animal | animal | animal | animal | animal |
| 1990 | 7756000 | 4416916 | 854870 | 345557 | 113147 | 3615510 |
| 1991 | 7671000 | 4264538 | 825378 | 333635 | 109243 | 3308206 |
| 1992 | 6648000 | 3394171 | 656923 | 265542 | 86948 | 2090416 |
| 1993 | 6321000 | 3279241 | 634679 | 256551 | 84003 | 2121525 |
| 1994 | 6253000 | 3229137 | 624982 | 252631 | 82720 | 2060530 |
| 1995 | 6503000 | 3105426 | 601038 | 242953 | 79551 | 1492032 |
| 1996 | 6260000 | 2839151 | 549502 | 222121 | 72730 | 1049497 |
| 1997 | 6089000 | 2826754 | 547103 | 221151 | 72412 | 1188581 |
| 1998 | 5853000 | 2572101 | 497816 | 201228 | 65889 | 768967 |
| 1999 | 5851000 | 2673000 | 545000 | 219655 | 71923 | 1510422 |

| NFR | 3.B.4.g.i | 3.B.4.g.ii | 3.B.4.g.iii | 3.B.4.g.iv | | |
|---|---|---|---|---|---|---|
| SNAP | 100507 | 100508 | 100509a | 100509z | | |
| Name | Laying hens | Broilers | Turkeys | Ducks | Gees | Other poultry |
| Unit | animal | animal | animal | animal | animal | animal |
| 2000 | 5988000 | 3235000 | 516000 | 227435 | 74470 | 1215096 |
| 2001 | 5709000 | 3352000 | 497000 | 237356 | 77718 | 1873926 |
| 2002 | 5775000 | 3686000 | 528000 | 235699 | 77176 | 1363126 |
| 2003 | 5610000 | 3936000 | 477000 | 237982 | 77923 | 1439095 |
| 2004 | 6447000 | 2634000 | 599000 | 226000 | 74000 | 1205000 |
| 2005 | 6056000 | 2520000 | 431000 | 175000 | 68000 | 1390000 |
| 2006 | 5758000 | 2068000 | 573000 | 219000 | 76000 | 1394000 |
| 2007 | 5529907 | 2097961 | 677474 | 191000 | 70000 | 1487000 |
| 2008 | 5486401 | 2281879 | 577486 | 184000 | 57000 | 1429000 |
| 2009 | 5673000 | 3111000 | 584000 | 186976 | 62203 | 1170187 |
| 2010 | 4357905 | 3377605 | 726301 | 200785 | 45972 | 760873 |
| 2011 | 4078789 | 4420993 | 608666 | 172387 | 39176 | 203421 |
| 2012 | 3696170 | 4980156 | 470701 | 210080 | 45994 | 757258 |
| 2013 | 3979081 | 4524637 | 444116 | 120215 | 26213 | 212428 |
| 2014 | 3722447 | 5556971 | 369446 | 96024 | 49011 | 523209 |
| 2015 | 3017389 | 5974694 | 495034 | 74476 | 21675 | 606517 |
| 2016 | 3500000 | 5362104 | 511844 | 91514 | 21009 | 369876 |

Source: CBS
Processing: Ekonerg Ltd, 2017

**Recalculations and improvements**

Manure Management (NFR 3.B)

- During the 2017 ESD revision of the NIR 2016, issue was detected with the activity data of certain animal categories in the CRF tables due to NAPA → AAP (2006 IPCC guidelines) conversion. Emissions were recalculated for the entire 1990-2015 period due to correction of activity data in order to ensure consistent AD between CRF and NFR tables. This resulted in a change of emission for NFR 3.B.1.a Cattle dairy, 3.B.3 Fattening pigs and 3.B.4.g Poultry.
- During the 2017 ESD revision of the NIR 2016, issue was detected with NOx emissions – emissions were missing for certain animal categories in the NRF tables. NOx estimates for categories 3B1b, 3B2, 3B4a, 3B4d, 3B4e, 3B4f, 3B4gi, 3B4gii, 3B4giii and 3B4giv have been recalculated for the entire 1990-2015 time period.

- Up to this Report, $NH_3$ emissions from urine and dung deposited by grazing animals (3.B.1.a Dairy cows, 3.B.1.b Other cattle, 3.B.2 Sheep, 3.B.4.d Goats, 3.b.4.e Horses and 3.4.b.f Mules and asses) were included in 3.B source category. Starting with this report, as a part of the improvement programme and TERT recommendation, emissions from the aforementioned grazing animals has been moved to the correct category (3.D.a.3 Urine and dung deposited by grazing animals). This resulted in a recalulcation change of NH3 emissions from 3.B category.

## 6.2 CROP PRODUCTION AND AGRICULTURAL SOILS (NFR 3.D)

**Source category description**

Crop production and agricultural soils sector is a source of $NH_3$, NO, NMVOC and PM emission. This includes emissions both from land to which nitrogen (N)-containing fertilisers are applied and soils cultivated for crop production and grasslands, where N-fertiliser was not applied.

There are four main sources of emissions from crop production and agricultural soils: fertiliser application ($NH_3$), soil microbial processes (NO), crop processes ($NH_3$ and NMVOC) and soil cultivation and crop harvesting (PM). This chapter gives information for sub-sector 3.D.a.1 Mineral N fertilizers.

For NOx and $NH_3$ emissions from the source categories 3.D.a.2.a Animal manure applied to soil the notation key IE is used, and those emissions are included within the source category 3.B

Notation key NE is used for the emissions from the source categories:

- 3.D.a.2.c Other organic fertilizers (due to lack of AD)
- 3.D.a.4 Crop residues applied to soils,
- 3.D.b Indirect emissions from managed soils,
- 3.D.d Off-farm storage, handling and transport of bulk agricultural products,
- 3.D.e Cultivated crops

For the emissions from the source categories 3.D.c Farm-level agricultural operations including storage, handling and transport of agricultural products, the notation key IE is used, and that emissions are included within the source category 3.D.a.1.

Emissions of NMVOC regarding source category 3.D.f Use of pesticides are presented in the scope of source category NFR 2.D.3.a Domestic solvent use including fungicides.

**Methodology, emission factors and activity data**

An assumption that all mineral fertilizers sold and imported in Croatia are actually applied to soil is used for emissions calculation. Methodology also includes preparation of activity data that includes calculation the amount of nitrogen (N) in each of mineral fertilizers produced minus mineral fertilizers exported plus mineral fertilizers imported in Croatia. This calculation is performing on the basis of data obtained from all fertilizers producer in Croatia and amounts of a particular mineral fertilizer formulation and N content in each formulation.

Relevant activity data for ammonia emission calculation is the mineral N-fertilizer consumed (applied). The consumed amount refers to the amount produced and sold for domestic use and also to the imported amounts. The activity data providers are producers of mineral fertilizers in Croatia. There are three mineral fertilizer producers in Croatia, among whom one produces a dominant share. The other two have started with production in the year 2006 and 2010, respectively. Preparation of activity data relates to calculation of the amount of nitrogen (N) in each of the mineral fertilizer type produced, excluding mineral fertilizers exported and including mineral fertilizers imported in Croatia. This calculation is performed using information on particular mineral fertilizer formulation and N content in each formulation obtained from fertilizers producer in Croatia. Regarding activity data received from the main fertilizer company, due to lack of data, the consumed amount was estimated by extrapolation method for the years 1990 and 1991 using the trend from the 1992 to 2006 time period. The activity data on import before the year 2000 were negligible due to tariffs which were eliminated in 2000; thus, the activity data regarding imported amounts is available from 2000 onwards. Regarding activity data received from fertilizer company that started with production in 2006, for period 2007 – 2010, due to lack of formulation data, interpolation was conducted to obtain N in mineral fertilizer (NIR 2012). Activity data for nitrogen (N) applied for each type of mineral fertilizer is shown in Table 6.2-3. The methodology used is in accordance with GB2016. For $NH_3$ emission calculation from the source category 3.D.1.a Mineral N fertilizers, Tier 2 methodology was used, and for NOx, NMVOC and PM emission calculations Tier 1 methodology was used. Emission factors used for $NH_3$ emission calculation from source category 3.D.1.a Mineral N fertilizers are default Tier 2 factors attained from GB2016, Table 3.2. Entire agricultural land area in Croatia is in "Cool" climate zone. The 32% of the land is estimated to have pH below 7 (*Mesić, M. et al*).

Relevant activity data for NOx, NMVOC and PM emission calculations is the area covered by crop (ha). There are two type of crops in Croatia N-fixing crops (Soyabeans, Beans - dry, Cow peas – dry, Lentils, Peas – dry, Vetches, Clover, and Alfaalfa) and non N-fixing crops (wheat, maize, potatoes, Sugar beets, Tobacco, Sunflowers, Rape seed, Tomatoes, Barley, Oats, Cabbages and other brassicas, Garlic, Onions, Rye, Sorghum and Watermelons). The activity data on the area under crops were obtained from the Central Bureau of Statistics, FAO database and for certain years by extrapolation. National data (provided by Croatian CBS) are considered to be the most accurate source and was always used when available. For crops where national data was not available, FAO data was considered an adequate replacement source. Where only a part of the national dataset was missing for a specific crop, trend of FAO data was found to be in line with the national data trends and was used for the missing years rather than interpolation. Extrapolation was used only where no national or FAO data was available. Data sources used regarding crop production (t) and total area covered by crop (ha) for the period 1990 – 2016 are presented in tables 6.2-1 and 6.2-2.

Currently the calculation is performed using Tier 1 methodology, where $E_{pollutant} = AR_{area} \times EF_{pollutant}$, using default EF for PMs (GB2016, Table 3.1).

**Table 6.2-1 Data sources regarding N-fixing crop production**

| Crop | Crop yield | | | Crop area | | |
|---|---|---|---|---|---|---|
| | CBS | FAO | Extrapolatio | CBS | FAO | Extrapolati |
| Soyabeans | 1990-2016 | | | 1990-2016 | | |
| Beans, dry | 1990-2016 | | | 1990-2016 | | |
| Cow peas, dry | 2008-2016 | 1992-2007 | 1990-1991 | 1998-1999 | 1992-1997 | 1990-1991 |
| Lentils | 1990-1991 | 1992-2016 | | 1990-1998 | 1999-2016 | |
| Peas, dry | 1990-2016 | | | 1990-2016 | | |
| Vetches | 1990-1997 | 1998-2016 | | 1990-1997 | 1998-2016 | |

| Crop | Crop yield | | | Crop area | | |
|---|---|---|---|---|---|---|
| | CBS | FAO | Extrapolatio | CBS | FAO | Extrapolati |
| Clover | 1990-2016 | | | 1990-2016 | | |
| Alfaalfa | 1990-2016 | | | 1990-2016 | | |
| Wheat | 1990-2016 | | | 1990-2016 | | |
| Maize | 1990-2016 | | | 1990-2016 | | |
| Potatoes | 1990-2016 | | | 1990-2016 | | |
| Sugar beets | 1990-2016 | | | 1990-2016 | | |
| Tobacco | 1990-2016 | | | 1990-2016 | | |
| Sunflowers | 1990-2016 | | | 1990-2016 | | |
| Rape seed | 1990-2016 | | | 1990-2016 | | |
| Tomatoes | 1990-2016 | | | 1990-2016 | | |
| Barley | 1990-2016 | | | 1990-2016 | | |
| Oats | 1990-2016 | | | 1990-2016 | | |
| Cabbages and | 1990-2016 | | | 1990-2016 | | |
| Garlic** | 1990-2016 | | | 1990-2016 | | |
| Onions** | 1990-2016 | | | 1990-2016 | | |
| Rye | 2014-2016 | 1992-2013 | 1990-1991 | 2014-2016 | 1992-2013 | 1990-1991 |
| Sorghum*** | 1990-1997 | 1998-2016 | | 1990-1997 | 1998-2016 | |
| Watermelons | 1990-2016 | | | 1990-2016 | | |

**Extrapolation was based on data for the period of 5 consecutive years.*

***CBS provides aggregated data for garlic & onions.*

*FAO data was used to calculate yearly ratios of garlic and onions in the total, aggregated number.*

****CBS did not obtain sorghum production data from 1997 to 2012*

**Table 6.2-2 Activity data for NFR code 3.D.1.a**

| NFR 3.D.1a | | N (nitrogen) applied | | | | | |
|---|---|---|---|---|---|---|---|
| Name | Area covered by crops | Urea | Calcium ammonium nitrate | NPK | Ammonium nitrate | Urea ammonium nitrate | TOTAL |
| Unit | ha | kg N | kg N | kg N | kg N | kg N | kg N |
| 1990 | 1233513 | 31376015 | 39030122 | 36285992 | 721273 | 0 | 107413402 |
| 1991 | 1210370 | 31957265 | 38643459 | 37441717 | 672217 | 0 | 108714658 |
| 1992 | 835996 | 41093640 | 43521030 | 39921424 | 282405 | 0 | 124818499 |
| 1993 | 886083 | 32705540 | 27743580 | 29856295 | 1053575 | 0 | 91358990 |
| 1994 | 876272 | 29839280 | 36707850 | 29814546 | 549065 | 0 | 96910741 |
| 1995 | 875068 | 29038880 | 35701020 | 28395908 | 279725 | 0 | 93415533 |
| 1996 | 859808 | 32894140 | 34644780 | 30768659 | 81740 | 0 | 98389319 |
| 1997 | 876071 | 42897760 | 43609050 | 35924213 | 920915 | 0 | 123351938 |
| 1998 | 971787 | 27755940 | 38790630 | 28358872 | 341030 | 0 | 95246472 |
| 1999 | 946098 | 31669160 | 34221420 | 39495688 | 235170 | 0 | 105621438 |
| 2000 | 740424 | 38179540 | 39921660 | 39861790 | 41875 | 0 | 118004865 |
| 2001 | 756112 | 57768640 | 37933110 | 32340631 | 300495 | 0 | 128342876 |

| NFR 3.D.1a | | N (nitrogen) applied | | | | | |
|---|---|---|---|---|---|---|---|
| Name | Area covered by crops | Urea | Calcium ammonium nitrate | NPK | Ammonium nitrate | Urea ammonium nitrate | TOTAL |
| Unit | ha | kg N | kg N | kg N | kg N | kg N | kg N |
| 2002 | 761276 | 50655660 | 38065680 | 31650894 | 96815 | 0 | 120469049 |
| 2003 | 749144 | 42176480 | 31017330 | 33360691 | 5203220 | 1863300 | 113621021 |
| 2004 | 738479 | 45109440 | 32069520 | 33626100 | 5126170 | 1647300 | 117578530 |
| 2005 | 767863 | 41939580 | 36264780 | 36438613 | 4983125 | 1682700 | 121308798 |
| 2006 | 775406 | 37505180 | 36121410 | 34055422 | 2729580 | 1390200 | 111801792 |
| 2007 | 746278 | 44424040 | 37700910 | 38342618 | 3415660 | 777300 | 124660528 |
| 2008 | 757417 | 46659180 | 39456180 | 34110027 | 332990 | 589500 | 121147877 |
| 2009 | 762733 | 39667180 | 36485910 | 31102130 | 18760 | 737400 | 108011380 |
| 2010 | 730839 | 40999128 | 34811640 | 23196556 | 21105 | 498000 | 99526430 |
| 2011 | 728375 | 51674687 | 35651194 | 26631440 | 17755 | 603528 | 114578604 |
| 2012 | 760610 | 53465647 | 31327414 | 22413618 | 0 | 661994 | 107868673 |
| 2013 | 760948 | 37397929 | 32440150 | 18356241 | 0 | 314577 | 88508897 |
| 2014 | 658852 | 30539658 | 31633103 | 18212749 | 0 | 321603 | 80707112 |
| 2015 | 682053 | 35377731 | 32176818 | 19825933 | 8375 | 347040 | 87735897 |
| 2016 | 731058 | 40110160 | 33633469 | 18656698 | 689815 | 417549 | 93507692 |

Source: CBS, FAO, producers of mineral fertilizers
Processing: Ekonerg Ltd, 2018

$NH_3$ and NOx emissions from source 3.D.a.2.b Sewage sludge applied to soil are reported for the first time in this Report. The methodology used is in accordance with Guidebook 2016, using Tier 1 EFs. Calculation was performed for the entire national territory. Activity data on human population used in calculation were estimates of the population connected to wastewater treatment plants, calculated as a deduced population of individual waste water disposal systems (source: Croatian Waters) from the total population in Croatia (Source: CBS, Croatian Waters) and is presented in table 6-2.3.

**Table 6.2-3 Activity data for NFR code 3.D.a.2.b**

| NFR 3Da2b | Total population * | Population on individual waste water disposal system ** | Population on wastewater treatment plants (estimated) |
|---|---|---|---|
| 1990 | 4778000 | 2866000 | *1912000* |
| 1991 | 4513000 | 2842800 | *1670200* |
| 1992 | 4470000 | 2819600 | *1650400* |
| 1993 | 4641000 | 2796400 | *1844600* |
| 1994 | 4649000 | 2773200 | *1875800* |

| NFR 3Da2b | Total population * | Population on individual waste water disposal system ** | Population on wastewater treatment plants (estimated) |
|---|---|---|---|
| 1995 | 4669000 | 2750000 | *1919000* |
| 1996 | 4494000 | 2732000 | *1762000* |
| 1997 | 4572500 | 2714000 | *1858500* |
| 1998 | 4501000 | 2696000 | *1805000* |
| 1999 | 4554000 | 2678000 | *1876000* |
| 2000 | 4381000 | 2660000 | *1721000* |
| 2001 | 4305494 | 2630333 | *1675161* |
| 2002 | 4305384 | 2601666 | *1703718* |
| 2003 | 4305725 | 2574000 | *1731725* |
| 2004 | 4310861 | 2560000 | *1750861* |
| 2005 | 4312487 | 2541460 | *1771027* |
| 2006 | 4313530 | 2525460 | *1788070* |
| 2007 | 4311967 | 2514488 | *1797479* |
| 2008 | 4309796 | 2478889 | *1830907* |
| 2009 | 4302847 | 2459300 | *1843547* |
| 2010 | 4289857 | 2450000 | *1839857* |
| 2011 | 4280622 | 2450000 | *1830622* |
| 2012 | 4267558 | 2300000 | *1967558* |
| 2013 | 4255689 | 2275700 | *1979989* |
| 2014 | 4238389 | 2254000 | *1984389* |
| 2015 | 4203604 | 2232000 | *1971604* |
| 2016 | 4203604 | 2232000 | *1971604* |

Source: CBS*, Croatian Waters**
Processing: Ekonerg Ltd, 2018

**Recalculations and improvements**

- During the revision, The TERT noted that for 3.D.a.1 Inorganic N-fertilizers (includes also urea application) emission calculation 2013 EMEP/EEA Guidebook and 2009 EMEP/EEA Guidebook methodologies were used. Emissions for the entire time period 1990-2015 were recalculated using the Guidebook 2016 EFs (Table 3.2).
- Starting with this Report, as a part of the improvement programme and TERT recommendation, $NH_3$ emissions from the from urine and dung deposited by grazing animals (3.B.1.a Dairy cows, 3.B.1.b Other cattle, 3.B.2 Sheep, 3.B.4.d Goats, 3.b.4.e Horses and 3.4.b.f Mules and asses) has been moved and reported in the correct category

(3.D.a.3 Urine and dung deposited by grazing animals) instead of being included in 3.B source category.

- Starting with this Report, as a part of the improvement programme and TERT recommendation, $NH_3$ emissions from the source 3.D.a.2.b Sewage sludge applied to soil are now being reported using Tier 1 methodology and EFs are from Guidebook 2016.

# VII WASTE (NFR 5)

Croatia reports for the following source categories of the sector NFR 5 Waste:

- **5.A Biological treatment of waste - Solid waste disposal on land**
- **5.B.1 Biological treatment of waste - Composting**
- **5.C Waste Incineration**
  - 5.C.1.b.i Industrial waste incineration
  - 5.C.1.b.iii Clinical waste incineration
  - 5.C.1.b.v Cremation
- **5.D Wastewater Handling**
  - 5.D.1 Domestic wastewater handling
  - 5.D.1 Industrial wastewater handling
  - 5.D.2 Other wastewater handling
- **5.E Other Waste**
  - SNAP code 091009 Car fire
  - SNAP code 091010 Detached house fire
  - SNAP code 091011 Undetached house fire
  - SNAP code 091012 Apartment building fire
  - SNAP code 091013 Industrial building fire

The source category NFR 5.A includes emissions of NMVOC and PMs; 5.B.1 includes emission of $NH_3$; 5.C includes emissions of NOx, NMVOC, $SO_2$, PMs, heavy metals, PCDD/PCDF, PAHs, HCB and PCBs; 5.D includes emissions of NMVOC and $NH_3$; 5.E includes emissions of PMs, heavy metals and PCDD/PCDF.

Implementation and establishment of the integral waste management system in Croatia are ensured by applying and fulfilling the objectives defined by the Sustainable Waste Management Act [18] and Waste Management Plan[19]. The main act regulating waste management issues in the Republic of Croatia is the Sustainable Waste Management Act. There are a number of ordinances that have been adopted according to Sustainable Waste Management Act, some of them regulating certain waste management operations, some regulating management of specific waste types. Waste Framework Directive[20] is transposed in the area of waste management into the Croatian legislation by the Sustainable Waste Management Act which is adopted in 2013. The following waste hierarchy shall apply as a priority order in waste prevention and management legislation and policy: (a) prevention; (b) preparing for re-use; (c) recycling; (d) other recovery, e.g. energy recovery; and (e) disposal. Avoiding and reducing of waste generation has the highest priority and results in reduction of quantity and adversity of produced waste which enters into the next phase. Reuse/recovery of produced waste has the purpose to use material and energy potentials of waste, in the framework of technical, ecological and economic possibilities. Disposal of remaining inert waste at the managed controlled landfills has the lowest rank in the waste management hierarchy. According to the Waste Management Plan the backbone of the system will be recycling centres with sorting of waste. Waste management system in Croatia will be organized as integral unit of all subjects at the national, regional and local level.

**Methodology, emission factors and activity data**

In general the EMEP/EEA simple methodology, multiplying activity data for each sub category with an emission factor, is applied.

Emission factors are expressed as the quantity of pollutant emission per unit of waste treated. Used emission factors are from GB2016 and GB2009 (for emission factors not estimated in GB2016, for

[18] Sustainable Waste Management Act (OG 94/2013)

[19] Waste Management Plan of the Republic of Croatia for the period 2017 - 2022 (OG 3/2017)

[20] Waste Framework Directive 2008/98/EC

NFR 5.C.1.b.i). The source of emission factors used for emission calculation is noted in each of sub-sector under NFR code 5. Emission factors used for the preparation of the IIR 2018, presented by NFR sectors and pollutants, are given in Appendix 4.

Generally four sources of information concerning activity and emission data for the source category waste have been used:

- Activity data as reported annually by facilities in legally required forms under the Croatian Environmental Emission Register and Waste Management Information System (CAEN);
- National statistical reports at national level from the Croatian CBS (the Annual Statistical Reports and Releases, Census1981, Census 1991, Census 2001 and Census 2011);
- Plant specific activity data collected by direct contacts with facility (e.g. facilities for cremation, industrial combustion facility);
- Ministry of Interior.

## 7.1 BIOLOGICAL TREATMENT OF WASTE - SOLID WASTE DISPOSAL ON LAND (NFR 5.A)

### Source category description

This source is only a minor source of air pollutant emissions, greenhouse gas $CH_4$ is the major pollutant. Small quantities of NMVOC, $PM_{10}$, $PM_{2.5}$, TSP, $NH_3$ and CO may be emitted. Croatia reports emissions of NMVOC and PMs from solid waste disposal.

Following information, which are also relevant for IIR, are taken from GHG emissions report (NIR).

Data source for disposed waste amounts is Croatian Agency for Environment and Nature/CAEN. Data collection system for waste is based on the Sustainable Waste Management Act and by-laws and enforcement regulations. All detail regarding data collection is in detail described in Croatian NIR, according to IPCC methodology. The CAEN is collecting and processing waste data, among other the data reported to the Environmental Pollution Register; data on waste management permits and certificates, and data for Waste Management Information System. By the Ordinance on the Environmental Pollution Register (OG 87/15), adopted according to Environment Protection Act, the CAEN is collecting data on the quantities and types of waste produced, collected, recovered or disposed. Data on quantities are available for each waste code (based on European LoW- List of Waste) and NACE activity. Four forms are available for data delivery (for waste producer, waste collector of municipal waste, waste collector for industrial waste and operator of waste treatment facility). Waste data are reported by operators electronically, using internet based application, on annual basis. Validation and verification of data is done first by county offices (with appropriate support from the environment protection inspectors), and then by the CAEN. The CAEN is cooperating with competent offices in counties and with companies collecting municipal solid waste (MSW) or operating landfills, in order to strengthen data quality. Data is checked for completeness, correctness and consistency in time-series. In cases that collected or disposed waste is not reported, quantities are determined on the basis of previous year report or calculation on the basis of average MSW production per capita. Quality of municipal data is gradually improving as scales are installed at landfills, but still large amount of municipal waste is not being weighted, which usually lead to overestimation of collected and disposed quantities.

Main source for activity data on MSW is Environmental Pollution Register database and Waste Management Information System database, operated by CAEN from 2005 onwards. Total annual MSW disposed to SWDSs for the period 1990-1998 has been evaluated from available relevant data compiled into Report; Fundurulja, D., Mužinić, M. (2000) *Estimation of the Quantities of Municipal Solid Waste in the Republic of Croatia in the period 1990 – 1998 and 1998 – 2010*, Zagreb. Insufficient data for the quantity of disposed MSW in 1999 were evaluated by interpolation method. Data for the quantity of disposed MSW in 2000 were obtained from *Report of Environment Condition*, Ministry of Environmental and Nature Protection. Data for the quantity of disposed MSW in 2005 were obtained from *Waste Management Plan in the Republic of Croatia for 2007 - 2015* (OG *85/2007, 126/2010, 31/2011*). Taking into account the pattern over 2000 and 2005, quantity of disposed MSW for the period 2001 to 2004 were assessed by interpolation method. Data for the quantity of disposed MSW for the period 2006-2009 was obtained from the Environmental Pollution Register. Due to low quality of data provided by operators of landfills, the data was taken from the reports of companies collecting the MSW (reporting destination of MSW). Data on the quantity of generated and disposed municipal and industrial solid waste for the period 2010 - 2016 was obtained from the Environmental Pollution Register - reports delivered by the operators of active landfills. Data on the quantity of disposed biodegradable municipal and industrial solid waste as well sludge from wastewater treatment for the period 2010 - 2016 was obtained from the Waste Management Information System- reports on landfills and waste disposal.

Waste Management Information System contains various data on landfills, such as implementation of technical measures (e.g. fence, scale, flares…) or environment protection measures (e.g. degassing, compacting, aligning, monitoring etc.). Database also contains data on the status of remediation of landfills (in preparation/ongoing/finished) and status of operation (active/closed). Active landfills for municipal waste are obligated by legislation to deliver this data to CEAN in prescribed form (Form on landfills and landfilling of waste), as for the rest (closed landfills and landfills for the industrial waste) the data forms are periodically sent to landfill operators by CAEN or the update is done upon receiving the information on individual landfill from other sources. Data on remediation status is requested by CAEN once a year from the Environment Protection and Energy Efficiency Fund which is co-financing remediation of almost all of official landfills.

**Methodology, emission factors and activity data**

The Tier 1 EMEP/EEA methodology from GB2016 is used for emissions calculation. Tier 2 is not available for this source. Recommended Tier 1 emission factors from GB2016 that expressed as the amount of pollutant per amount of landfilled waste are used (emission factors is presented in Appendix 4).

Relevant activity data is an annual amount of landfilled waste. The activity data is presented in Table 7.1-1.

**Table 7.1-1 Activity data for NFR codes 5.A, 5.B.1, 5.C.1.b.i, 5.C.1.b.iii, 5.C.1.b.v, 5.D.1, 5.D.2 and 5.D.3, represented by the relevant SNAP codes**

| NFR | 5.A | 5.B.1 | 5.C.1.b.i | 5.C.1.b.iii | 5.C.1.b.v | 5.D.1 | 5.D.2 | 5.D.3 |
|---|---|---|---|---|---|---|---|---|
| SNAP | 090401 | 091005 | 090202 | 090207 | 090901 | 091002 | 091001 | 091007 |
| Name | Solid waste disposal on land | Composting | Industrial waste incineration | Clinical waste incineration | Cremation | Domestic wastewater | Industrial wastewater | Latrines |
| Unit | t | t | t | t | corps | 1000 m³ | 1000 m³ | inhabitant |
| 1990 | 590000 | NE | 250 | NO | 1464 | NO | 104000 | 433305 |
| 1991 | 598780 | NE | 250 | NO | 1786 | NO | 94488 | 431084 |
| 1992 | 613040 | NE | 250 | NO | 2287 | NO | 46785 | 428862 |
| 1993 | 643205 | NE | 250 | NO | 2760 | NO | 87343 | 428862 |
| 1994 | 677370 | NE | 250 | NO | 3037 | NO | 34419 | 426640 |
| 1995 | 736700 | NE | 250 | NO | 3109 | 54353 | 33758 | 422196 |
| 1996 | 787600 | NE | 250 | NO | 3385 | 58009 | 93836 | 419974 |
| 1997 | 847550 | NE | 1031 | NO | 3476 | 61661 | 41857 | 417752 |
| 1998 | 913390 | NE | 2168 | NO | 3312 | 87796 | 30985 | 415531 |
| 1999 | 976087 | NE | 2580 | NO | 3201 | 88785 | 28924 | 413309 |
| 2000 | 938400 | NE | 3652 | 1.50 | 3080 | 86579 | 22208 | 411087 |
| 2001 | 1007000 | NE | 3967 | 15.58 | 2972 | 83533 | 21337 | 408865 |
| 2002 | 1077000 | NE | 2206 | 18.45 | 3254 | 81196 | 21883 | 406643 |
| 2003 | 1147000 | NE | 400 | 22.64 | 3392 | 84283 | 28408 | 404421 |
| 2004 | 1216000 | NE | 120 | 33.20 | 3404 | 160277 | 22468 | 402199 |
| 2005 | 1286078 | NE | 5 | 35.70 | 3633 | 132280 | 15984 | 399978 |
| 2006 | 1447984 | NE | 350 | 47.56 | 3593 | 140906 | 19758 | 397756 |
| 2007 | 1609890 | 10966 | 285 | 64.89 | 3962 | 140228 | 14118 | 395534 |
| 2008 | 1730671 | 10699 | 316 | 165.00 | 3911 | 192033 | 16507 | 393312 |
| 2009 | 1778143 | 8993 | IE | 185.17 | 4060 | 206042 | 17445 | 391090 |
| 2010 | 1599358 | 9706 | IE | 54.40 | 4314 | 205709 | 26679 | 388868 |
| 2011 | 1583406 | 10094 | IE | 57.45 | 4344 | 209150 | 7205 | 386646 |
| 2012 | 1400176 | 18691 | IE | 93.10 | 4478 | 259135 | 11536 | 384425 |
| 2013 | 1453326 | 28517 | IE | 48.00 | 4601 | 295264 | 12574 | 382203 |
| 2014 | 1348581 | 28594 | IE | 51.08 | 4803 | 268002 | 13301 | 379981 |
| 2015 | 1360908 | 61607 | IE | 51.79 | 5373 | 256690 | 12943 | 377759 |
| 2016 | 1316103 | 27436 | IE | 55.68 | 5128 | 267767 | 11901 | 375537 |

Source: 5.A, 5.B.1 and 5.C CAEN, 5.D CBS, Processing: Ekonerg Ltd

## Recalculation and improvements

There was no recalculation and other improvement in this report.

## 7.2 BIOLOGICAL TREATMENT OF WASTE - COMPOSTING (NFR 5.B.1)

**Source category description**

According to GB2016, $NH_3$ emission resulting from composting are included in this category (Technologies – Compost production, SNAP 091005). Emissions from anaerobic digestion of organic waste at biogas facilities (NFR 5.B.2) are included in the Energy sector, due to energy recovery.

$NH_3$ emission from composting of municipal and industrial solid waste, sludge and other organic waste are included in emission estimates for the period 2007 – 2016. Data on different types of waste (dry weight) presented in the GHG emissions report (NIR) have been used for $NH_3$ emission calculation. Emissions for previous period (1990 – 2006) are not estimated because activity data are not available. The notation key "NE" is used for the period 1990 – 2006.

The official source of activity data for waste composting is CAEN that is collecting and processing waste data, among other data reported to the Environmental Pollution Register and Waste Management Information System. By the Ordinance on the Environmental Pollution Register (OG 87/15), adopted according to Environment Protection Act, the CAEN is collecting data on the quantities and types of waste produced, collected, recovered or disposed. The CAEN coordinates activities relating to data quality assurance and control.

**Methodology, emission factors and activity data**

The Tier 2 EMEP/EEA methodology and recommended Tier 2 emission factor from GB2016 are used for $NH_3$ emission calculation. The $NH_3$ emission factor is presented in Appendix 4. Relevant activity data is the annual quantity of municipal and industrial solid waste, sludge and other organic waste composted. The activity data is presented in Table 7.1-1.

**Recalculation and improvements**

Category 5.B.1 Biological treatment of waste - Composting (Technologies – Compost production, SNAP 091005) has been included in the IIR 2018 for the first time. Accordingly, recalculation was performed for the period 1990 – 2015.

Future improvements are related primarily to aggregation of accurate data for $NH_3$ emission calculations for the whole reporting period.

## 7.3 WASTE INCINERATION (NFR 5.C)

This sector considers the emission of pollutants from activities in the industrial waste incineration (NFR 5.C.1.b.i), clinical waste incineration (NFR 5.C.1.b.iii) and cremation (NFR 5.C.1.b.v), without energy recovery. There is no incineration of municipal waste (NFR 5.C.1.a), neither incineration of sludge from wastewater treatment (NFR 5.C.1.b.iv) in Croatia, and notation key "NO" for that source activities are reported. Also, there is no incineration of carcasses in Croatia.

Emissions that occur as a result of waste incineration with energy recovery are presented in the Energy Sector 1.A.

**Source category description**

<u>Industrial waste incineration (NFR 5.C.1.b.i)</u>

The official source of activity data for industrial waste incineration is CAEN that collects data from emission point sources in the Environmental Pollution Register database. According to the Article 21 of Ordinance on the Environmental Pollution Register (OG 87/2015), the completed forms should be submitted for the previous calendar year not later than March 31 of the current year. The competent authority (administrative department of the county and the City of Zagreb) ensures the checking of data submitted in terms of their completeness, consistency and credibility. The CAEN coordinates activities relating to data quality assurance and control.

In the period from 1997 to 2002, an incineration of hazardous waste was existed in Croatia and those emissions are reported in the scope of source category NFR 5.C.1.b.i Industrial waste incineration. For the source category NFR 5.C.1.b.ii Hazardous waste incineration the notation key "IE" is used, due to energy recovery. Croatia uses EWC codes for waste classification that is part of the Regulation on categories, types and classification of waste with a Waste Catalogue and List of hazardous waste (OG 50/05 and 39/09) and Ordinance on Waste Catalogue (OG 90/15).

Clinical waste incineration (NFR 5.C.1.b.iii)

The official source of activity data for clinical waste incineration is CAEN that collects data from emission point sources in the Environmental Pollution Register database. According to the Article 21 of Ordinance on the Environmental Pollution Register (OG 87/15), the completed forms should be submitted for the previous calendar year not later than March 31 of the current year.

In the period from 1990 to 2016, an incineration of clinical waste was existed in Croatia and those emissions are reported in the scope of source category NFR 5.C.1.b.iii.

Cremation (NFR 5.C.1.b.v)

The official source of activity data for cremation is CAEN that collects data from a crematorium in Croatia, located in the city of Zagreb.

**Methodology, emission factors and activity data**

Industrial waste incineration (NFR 5.C.1.b.i)

The Tier 1 EMEP/EEA methodology and recommended Tier 1 emission factors from GB2016 (and GB2009 for emission factors not estimated in GB2016) are used for emissions calculation. Emission factors are presented in Appendix 4. Relevant activity data is the annual quantity of industrial waste incinerated.

Data for the period 1990 -2007 were obtained in direct contact with facilities for industrial and hazardous waste incineration. For years 2007 and 2008, plant specific emission factors were used. These are based on direct emission reported in EPR database. Data for the period 2009 - 2016 on the total amount of incinerated waste by operation D10 (Waste incineration on land) and operation R1 (Waste usage as a fuel or other means to generate energy) have been based on validated PL-OPKO forms - Registration form for entities carrying out the municipal and/or industrial waste recovery/disposal. Regarding previously mentioned, since 2009 there is no more facility operating without energy recovery, so from 2009 all emissions regarding Industrial waste incineration are reported in the scope of energy sector. From 2009 for source category Industrial waste incineration (NFR 5.C.1.b.i) the notation key "IE" is reported. The activity data is presented in Table 7.1-1.

Clinical waste incineration (NFR 5.C.1.b.iii)

The Tier 1 EMEP/EEA methodology and recommended Tier 1 emission factors from GB2016 are used for emissions calculation. Emission factors are presented in Appendix 4. Relevant activity data for clinical waste incineration is the annual quantity of clinical waste incinerated. The activity data is presented in Table 7.1-1.

Cremation (NFR 5.C.1.b.v)

The Tier 1 EMEP/EEA methodology and recommended Tier 1 emission factors from GB2016 are used for emissions calculation. Emission factors are presented in Appendix 4. Relevant activity data for cremation is the number of corps incinerated. The activity data is presented in Table 7.1-1.

**Recalculation and improvements**

Industrial waste incineration (NFR 5.C.1.b.i)

There was no recalculation and other improvement in this report.

Clinical waste incineration (NFR 5.C.1.b.iii)

Correction of unit for TSP and BC emission factors has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015.

Cremation (NFR 5.C.1.b.v)

There was no recalculation and other improvement in this report.

## 7.4 WASTEWATER HANDLING (NFR 5.D)

This section covers emissions from Wastewater handling (NFR 5.D). Activities considered within this sector in Croatia are biological treatment plants for Domestic wastewater handling (NFR 5.D.1), Industrial wastewater handling (NFR 5.D.2) and Other wastewater handling – latrines (NFR 5.D.3).

**Source category description**

Domestic wastewater handling (NFR 5.D.1) and Industrial wastewater handling (NFR 5.D.2)

Processing wastewater is most commonly used aerobic biological treatment. Only, disposal of domestic and commercial wastewater, particularly in rural areas, where systems such as septic tanks, are used partly anaerobic treatment. Biological treatment plants have minor influence on the emissions of pollutants. Only NMVOC emissions are reporting in this two source categories.

Other wastewater handling (NFR 5.D.3)

In the scope of source category Other wastewater handling Croatia is reporting emissions from latrines. A latrine is a simple "dry" toilet built outside the house, usually in a backyard without water flushing. A storage tank under the latrine can be a hole dug in the ground, or a concrete reservoir. Capacity of the tank can vary between 1 $m^3$ and 2 $m^3$. The time of storage can vary between a few months and "forever". Latrines are source of $NH_3$ emissions in Croatia.

**Methodology, emission factors and activity data**

Domestic wastewater handling (NFR 5.D.1)

The Tier 2 EMEP/EEA methodology and recommended Tier 2 emission factor from GB2016 are used for NMVOC emission calculation. The NMVOC emission factor is presented in Appendix 4. The relevant activity data is the annual amount of total wastewater treated in residential / commercial sectors. The source of activity data is Statistical Bureau of Statistics – First Release; Public Sewage System; Source, Treatment and Discharge of Waste Waters. Unavailable data for 1997 was estimated with interpolation method. Data for other years in the period 1990 – 2016 are available from statistical reports and releases. The activity data is presented in Table 7.1-1.

Industrial wastewater handling (NFR 5.D.2)

The Tier 2 EMEP/EEA methodology and recommended Tier 2 emission factor from GB2016 are used for NMVOC emission calculation. The NMVOC emission factor is presented in Appendix 4. The relevant activity data is the annual amount of total wastewater treated in industry sectors. The source of activity data is Statistical Bureau of Statistics – First Release; Utilization of Waters and Protection of Waters from Pollution in Industry; Discharge of Treated Waste Water, according to NKD 2007. Unavailable data for 1997 was estimated with interpolation method. Data for other years in the period 1990 – 2015 are available from statistical reports and releases. Data for other years in the period 1990 – 2016 are available from statistical reports and releases. The activity data is presented in Table 7.1-1.

Other wastewater handling (NFR 5.D.3)

The Tier 2 EMEP/EEA methodology and recommended Tier 2 emission factor from GB2016 are used for $NH_3$ emission calculation. The $NH_3$ emission factor is presented in Appendix 4. The relevant activity data is the number of residents who use latrines. The source of activity data is Statistical Bureau of Statistics; Census 1981, Census 1991, Census 2001 and Census 2011. Activity data that is the number of population in the housing units without toilets was collected for years: 1981, 1991, 2001 and 2011. Data for other years in the period 1990 – 2016 are assessed according to these statistical data with extrapolation method. The activity data is presented in Table 7.1-1.

**Recalculation and improvements**

Domestic wastewater handling (NFR 5.D.1)

Correction of unit for NMVOC emission factor has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015.

Industrial wastewater handling (NFR 5.D.2)

Correction of unit for NMVOC emission factor has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015.

Other wastewater handling (NFR 5.D.3)

Correction of value for $NH_3$ emission factor has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015.

## 7.5 OTHER WASTE (NFR 5.E)

**Source category description**

The source category Other waste (NFR 5.E) in Croatia covers the emissions from the activities car fires and house fires. Car and house fires include mostly unwanted fires in cars and various types of houses. Types of fires in house that are covered are: detached house fire, undetached house fire, apartment building fire and industrial building fire.

**Methodology, emission factors and activity data**

The Tier 2 EMEP/EEA methodology and recommended Tier 2 emissions factor from GB2016 are used for emissions calculation. Emission factors are presented in Appendix 4. Both the activity data and the emission factors are stratified according to the different activity. For car and house fires, the relevant activity statistics are the standard statistics on number of fires per year, collected by MIA. The activity data is presented in Table 7.5-1.

**Table 7.5-1 Activity data for NFR code 5.E, represented by the relevant SNAP codes**

| NFR | 5.E | | | | |
|---|---|---|---|---|---|
| Name | Car fire | Detached house fire | Undetached house fire | Apartment building fire | Industrial building fire |
| SNAP | 091009 | 091010 | 091011 | 091012 | 091013 |
| Unit | fire | fire | fire | fire | fire |
| 1990 | 306 | 1655 | 185 | 73 | 742 |
| 1991 | 278 | 1119 | 164 | 68 | 554 |
| 1992 | 294 | 2127 | 155 | 86 | 844 |
| 1993 | 291 | 1095 | 154 | 54 | 687 |
| 1994 | 383 | 1406 | 174 | 69 | 708 |
| 1995 | 484 | 1698 | 214 | 69 | 907 |
| 1996 | 487 | 1726 | 211 | 57 | 860 |
| 1997 | 474 | 1552 | 219 | 55 | 1030 |
| 1998 | 559 | 1645 | 187 | 54 | 1042 |
| 1999 | 576 | 1759 | 204 | 35 | 873 |
| 2000 | 639 | 1735 | 141 | 60 | 1031 |
| 2001 | 565 | 1616 | 150 | 47 | 999 |
| 2002 | 544 | 1527 | 130 | 48 | 922 |
| 2003 | 604 | 1723 | 152 | 60 | 1141 |
| 2004 | 562 | 1425 | 120 | 67 | 1011 |
| 2005 | 537 | 1444 | 146 | 37 | 1189 |
| 2006 | 542 | 1438 | 141 | 39 | 1189 |
| 2007 | 486 | 1357 | 141 | 33 | 1256 |
| 2008 | 484 | 1326 | 190 | 32 | 1061 |
| 2009 | 461 | 1239 | 134 | 41 | 1076 |
| 2010 | 415 | 1200 | 148 | 28 | 851 |
| 2011 | 415 | 1280 | 172 | 31 | 1116 |
| 2012 | 379 | 1261 | 132 | 24 | 1016 |
| 2013 | 353 | 1157 | 149 | 31 | 845 |

| **NFR** | **5.E** | | | | |
|---|---|---|---|---|---|
| **Name** | **Car fire** | **Detached house fire** | **Undetached house fire** | **Apartment building fire** | **Industrial building fire** |
| **SNAP** | **091009** | **091010** | **091011** | **091012** | **091013** |
| **Unit** | **fire** | **fire** | **fire** | **fire** | **fire** |
| 2014 | 314 | 767 | 89 | 19 | 626 |
| 2015 | 433 | 845 | 98 | 21 | 690 |
| 2016 | 439 | 854 | 99 | 22 | 697 |

Source: MIA, Processing: Ekonerg Ltd

**Recalculation and improvements**

For categories included into NFR code 5.E harmonization of $PM_{2.5}$, $PM_{10}$, TSP, Pb, Cd, Hg, As, Cr, Cu and PCDD/PCDF emission factors with GB2016 has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015.

# VIII NATURAL SOURCES (NFR 11)

## 8.1 FOREST FIRES (NFR 11.B)

**Source category description**

Forest fires (NFR 11.B) are classified as natural source of emissions although they may be caused by the intentional or unintentional human activity. These emissions are reported as memo items and are not included in the national total of pollutant emissions.

**Methodology, emission factors and activity data**

For emission calculation from forest fires source category Tier 1 methodology and emission factors recommended by the EMEP/EEA GB2016 were applied.

The activity data is the area of land burned (source: annual Statistical Yearbook, CBS).

Croatia estimates the emission of $SO_2$, NOx, NMVOC, CO and $NH_3$ from this source category. The emission of other pollutants (TSP, $PM_{10}$, $PM_{2.5}$, BC) will be calculated at the moment when the specific activity data kg wood burned proposed recommended by the EMEP/EEA GB2016 will be available.

The overview of activity data used for emission calculation from forest fire are presented in Table 8.1-1.

**Table 8.1-1 Activity data of the sector 11.B**

| NFR 11.B | Area of forest burnt |
|---|---|
| Unit | ha |
| 1990 | 3805 |
| 1991 | 3805 |
| 1992 | 964 |
| 1993 | 8196 |
| 1994 | 3723 |
| 1995 | 633 |
| 1996 | 2550 |
| 1997 | 4025 |
| 1998 | 7660 |
| 1999 | 483 |
| 2000 | 14030 |
| 2001 | 3503 |
| 2002 | 1798 |
| 2003 | 8270 |
| 2004 | 355 |
| 2005 | 629 |
| 2006 | 2981 |
| 2007 | 12628 |
| 2008 | 3449 |
| 2009 | 2789 |
| 2010 | 1944 |
| 2011 | 3277 |
| 2012 | 5668 |
| 2013 | 1999 |
| 2014 | 191 |
| 2015 | 6064 |
| 2016 | 6064 |

Data source: CBS, St.Y.

## Recalculation and improvements

No recalculations, neither improvement was made for reporting round 2016.

# IX RECALCULATIONS AND IMPROVEMENTS

This chapter gives an overview of all recalculations and other changes included into this report within the chapters from 3 to 9. Also, reasons for performed recalculations and other changes is given as well the result of performed recalculations within the meaning of decrease or increase of pollutant emission.

## 9.1 RECALCULATIONS AND OTHER CHANGES

### ENERGY SECTOR

Public Electricity and Heat Production (NFR 1.A.1.a)

Consumption of biomass was added for the period from 2010-2015

Petroleum Refining (NFR 1.A.1.b)

In 2014 and 2015 wrong NCV was used for natural gas consumption; 34.00 instead of 34.60 MJ/m3.

Manufacturing of Solid Fuels and Other Energy Industries (NFR 1.A.1.c)

In 2014 and 2015 wrong NCV was used for natural gas consumption; 34.00 instead of 34.60 MJ/m3.

Non-metallic minerals (NFR 1.A.2.f).

In 2014 and 2015 error occurred in liquid fuel consumption calculation. This error was corrected.

Road transport (NFR 1.A.3.b)

In road transport sector three recalculations were preformed:

- data on mileage for mopeds and motorcycles for 2005 were adjusted with mileage for passenger cars
- data on mileage for light duty vehicles for 2008 were adjusted with mileage for heavy duty vehicles

1.A.3.a Aviation (civil),1.A.3.a.i (i) International aviation LTO (civil), 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil), 1.A.3.a.ii (ii) Domestic aviation cruise (civil)

Correction due to changes of historical activity data in the national energy balance in the period 1990-2013 and due to new data from Eurocontrol for the period 2005-2016.

1.A.3.d.ii National navigation (shipping)

Small changes due to the correction of calculation for the SO2 for the period 2013. – 2015.

Non-road mobile source and machinery: 1.A.2.g.vii Mobile Combustion in manufacturing industries and construction, 1.A.4.b.i Residential: Mobile, 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery

Small changes due to the harmonization with the GB2016 methodology and FE for the past years

1.B.2.a.v Fugitive emission from distribution of oil products

1.B.2.b.ii Natural gas - Exploration, production, transport

1.B.2.c Venting and flaring

Small changes due to the correction of calculation in past years.

INDUSTRIAL PROCESSES AND PRODUCT USE SECTOR

Cement production (NFR 2.A.1)

Recalculation was performed for 2014 and 2015 due to harmonization of activity data with NIR2018.

Glass production (NFR 2.A.3)

Recalculation was performed for BC emissions from mineral wool production for the period 2007-2015 due to incorrect EF previously used.

Domestic solvent use including fungicides (NFR 2.D.3.a)

Recalculation for the trend was performed due to the EF adjustment according to Tier 2 from GB2016 related to the following products: Household products, Car care products and Pesticides.

Coating applications (NFR 2.D.3.d)

Recalculation for the trend was performed due to the use of new calculation methodology that includes a more comprehensive set of activity data.

Degreasing (NFR 2.D.3.e)

Recalculation for the trend was performed taking into account the amount of solvent used (for vapour cleaning), rather than just the number of inhabitants.

Dry cleaning (NFR 2.D.3.f)

Recalculation for the trend was performed taking into account the amounts of imported/exported/produced perchlorethylene, rather than previously used number of inhabitants.

Chemical products (NFR 2.D.3.g)

New activity - Adhesive, magnetic tapes, films and photographs manufacturing (SNAP 060311) was included in this category, thus the recalculation was performed for the entire trend.

Printing (NFR 2.D.3.h)

Recalculation for the trend was performed due to the use of new calculation methodology that includes a more comprehensive set of activity data.

Other solvent and product use (NFR 2.D.3.i, 2G)

New activity – Use of fireworks (SNAP 060601) was included in this category, thus the recalculation was performed for the entire trend.

Recalculation was performed for NMVOC emissions for 2015 for the activity – use of adhesives due to the incorrect calculation.

Food and beverages (NFR 2.H.2)

Recalculation was performed for NMVOC emissions for 2015 for the activity - production of wine due to the incorrect calculation.

AGRICULTURE SECTOR

Manure Management (NFR 3.B)

During the 2017 ESD revision of the NIR 2016, issue was detected with the activity data of certain animal categories in the CRF tables due to NAPA → AAP (2006 IPCC guidelines) conversion. Emissions were recalculated for the entire 1990-2015 period due to correction of activity data in order to ensure consistent AD between CRF and NFR tables. This resulted in a change of emission for NFR 3.B.1.a Cattle dairy, 3.B.3 Fattening pigs and 3.B.4.g Poultry.

During the 2017 ESD revision of the NIR 2016, issue was detected with NOx emissions – emissions were missing for certain animal categories in the NRF tables. NOx estimates for categories 3B1b, 3B2, 3B4a, 3B4d, 3B4e, 3B4f, 3B4gi, 3B4gii, 3B4giii and 3B4giv have been recalculated for the entire 1990-2015 time period.

Up to this Report, NH3 emissions from urine and dung deposited by grazing animals (3.B.1.a Dairy cows, 3.B.1.b Other cattle, 3.B.2 Sheep, 3.B.4.d Goats, 3.b.4.e Horses and 3.4.b.f Mules and asses) were included in 3.B source category. Starting with this report, as a part of the improvement programme and TERT recommendation, emissions from the aforementioned grazing animals has been moved to the correct category (3.D.a.3 Urine and dung deposited by grazing animals). This resulted in a recalulcation change of NH3 emissions from 3.B category.

<u>Inorganic N-fertilizers (includes also urea application) (NFR 3.D.1.a)</u>

During the revision, The TERT noted that for .D.a.1 Inorganic N-fertilizers (includes also urea application) emission calculation 2013 EMEP/EEA Guidebook and 2009 EMEP/EEA Guidebook methodologies were used. Emissions for the entire time period 1990-2015 were recalculated using the Guidebook 2016 EFs (Table 3.2).

<u>Urine and dung deposited by grazing animals (NFR 3.D.a.3)</u>

Starting with this report, as a part of the improvement programme and TERT recommendation, $NH_3$ emissions from the from urine and dung deposited by grazing animals ((3.B.1.a Dairy cows, 3.B.1.b Other cattle, 3.B.2 Sheep, 3.B.4.d Goats, 3.b.4.e Horses and 3.4.b.f Mules and asses) has been moved and reported in the correct category (3.D.a.3 Urine and dung deposited by grazing animals) instead of being included in 3.B source category.

<u>Sewage sludge applied to soil (NFR 3.D.a.2.b)</u>

Starting with this Report, as a part of the improvement programme and TERT recommendation, $NH_3$ emissions from the source 3.D.a.2.b Sewage sludge applied to soil are now being reported, using Tier 1 methodology and EFs are from Guidebook 2016.

WASTE SECTOR

<u>Biological treatment of waste - Composting (5.B.1)</u>

Category 5.B.1 Biological treatment of waste - Composting (Technologies – Compost production, SNAP 091005) has been included in the IIR 2018 for the first time. Accordingly, recalculation was performed for the period 1990 – 2015.

Clinical waste incineration (NFR 5.C.1.b.iii)

Correction of unit for TSP and BC emission factors has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015.

Domestic wastewater handling (NFR 5.D.1)

Correction of unit for NMVOC emission factor has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015.

Industrial wastewater handling (NFR 5.D.2)

Correction of unit for NMVOC emission factor has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015.

Other wastewater handling (NFR 5.D.3)

Correction of value for $NH_3$ emission factor has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015.

Other waste (5.E)

For categories included into NFR code 5.E harmonization of $PM_{2.5}$, $PM_{10}$, TSP, Pb, Cd, Hg, As, Cr, Cu and PCDD/PCDF emission factors with GB2016 has been made for the whole reporting period. Accordingly, recalculation was performed for the period 1990 – 2015.

## 9.2 PLANNED IMPROVEMENTS

### ENERGY SECTOR

1.A.1.a Public electricity and Heat production

As long term goal Croatia will take certain steps to justify the use of direct emissions for large point sources in the inventory.

1.A.2 Stationary combustion in manufacturing industries and construction

On short term basis it is planned to divide total consumption of fuel to appropriate branches for the whole period from 1990 to 2000.

For NOx emission calculation Croatia uses methodology disaggregated by fuel types (gas oil, fuel oil, natural gas, etc.) but not disaggregated by technology. As long term goal Croatia will estimate NOx emission by technology type.

Aviation (civil) (NFR 1.A.3.a)

For the harmonization of the calculation methodology with the GB2016 for the aviation, it is necessary to estimate the representative aircraft. For that it is necessary to collect more detailed data on aircrafts and their movements in all airports in Croatia.

Road Transportation (NFR 1.A.3.b)

The application of COPERT 5 software programme is planned for next submission.

Also, during the processing of "raw" data (Ministry of interior vehicle data base in text form), it was noted that some vehicles are missing, so clarification of data was requested from the Ministry of Interior. Interior Ministry drew attention to the different categorization of vehicles in 2014. Consequently the model for the processing of "raw" vehicle data was amended and it was found that the model should be applied to the whole historical trend, because some vehicles due to insufficiently described categorization were not counting. The above improvement will be carried out in one of the following submissions.

In 2014 Croatia reported annual mileage of each vehicle type to Odyssee database. It is planned to incorporate those data in COPERT 5 model

Croatia calculates emissions from all lubricants in the scope of 2D3I Other Solvent Use, 2G. As long term goal Croatia will divide lubricant used for solvent purposes and lubricant used for road transportation purposes according EMEP/EEA Guidebook and TERT recommendation.

INDUSTRIAL PROCESSES AND PRODUCT USE SECTOR

2.A.5.b Construction and demolition

The plan is to recalculate emissions for the entire reporting period for this category after collecting the required activity data according to Tier 1 EMEP/EEA GB2016 methodology, which would include: Construction of houses, Construction of apartments, Non-residential construction and Road construction. In order to achieve this, efforts will be made to collect these data, if possible for the next submission.

2.D.3.d Coating applications

The plan is to recalculate emissions for the entire reporting period for this category after further investigation of available data which would enable transition to Tier 2 EMEP/EEA GB2016 methodology. Trend analysis should be carried out so the recalculations will be included in one of the next submissions.

2.D.3.h Printing

The plan is to recalculate emissions for the entire reporting period for this category after further investigation of available data which would enable transition to Tier 2 EMEP/EEA GB2016 methodology. Trend analysis should be carried out so the recalculations will be included in one of the next submissions.

AGRICULTURE SECTOR

Manure management (NFR 3.B)

Improving emission calculation of NMVOC by moving from emission calculation Tier 1 to Tier 2 methodology is a planned short-term improvement.

The plan is also to improve emission calculation of $NH_3$ (Nex and other parameters used in the emission estimates are taken from the „Improvement of NH3, CH4 i N2O emission calculation from manure management and development of national factors", developed by the experts from the Faculty of Agriculture, 2015). Factors and parameters in question will undergo a revision during a new project that is planned due to issues raised by the ERT in the NIR reviews in 2016. As a part of this revised project, updated national emission factors and parameters are expected. The above mentioned improvement will be carried out in one of the following submissions.

Farm-level agricultural operations including storage, handling and transport of agricultural products (NFR 3.D.c)

Reporting PM emissions from this source in the appropriate current category (currently 3DC is included in 3Da1) and moving from emission calculation Tier 1 to Tier 2 methodology are both planned short-term improvements.

Field burning of agricultural residues (NFR 3.F)

Although the activity of burning of agricultural residues in the open field is forbidden according to Croatian low, according to IIASA statement such activities are carried out on Croatia territory (in possession of satellite images that confirmed the statement). A plan is to calculate relevant emissions from this source category, when the activity data will be available.

WASTE SECTOR

Biological treatment of waste - Composting (5.B.1)

Future improvements are related primarily to aggregation of accurate data for $NH_3$ emission calculations for the whole reporting period.

# X PROJECTIONS

## 10.1 METHODOLOGY

Methodology for estimating projections is prescribed in chapter 8 Projections, Part A: general guidance chapters EMEP / EEA guidebook - 2016 (hereinafter: GB2016). The Program consider two groups of scenarios: scenario with existing measures (WEM) and scenario with additional measures (WAM), taking into account the definition of scenario without measures (WOM).

Historic year due to the used starting assumptions and parameters for the projections was 2012 years ago and emissions of pollutants reported pursuant to the LRTAP Convention in 2015.

Pollutants emission projections were for the first time coordinated with greenhouse gas emission projections in the Republic of Croatia. The Republic of Croatia reported greenhouse gas emission projections in accordance to obligation at EU and international level related to UNFCCC and pollutants emission projections in accordance to obligation at EU and international level related to CLRTAP and new NEC Directive. Stakeholders for greenhouse gas emission projections and pollutants emission projections recognized the importance and the need for mutual understanding. Consequently, all of the activities necessary for pollutants emission projections are based on identical initial assumptions and parameters as well as for greenhouse gas emission projections.

Scenario without measures (WOM): projection excludes all policies and measures implemented, adopted or planned after the year chosen as the starting point for this projection

Scenario with existing measures (WEM): projection includes policies and measures currently implement and adopted:

- Implemented policies and measures: legislation in force, or one or more voluntary agreements have been established or financial resources have been allocated or human resources have been mobilized.
- The adopted policies and measures: an official government decision has been made and there is a clear commitment to proceed with implementation.

Scenario with additional measures (WAM): encompasses planned policies and measures

- Planned policies and measures: options under discussion and having a realistic chance of being adopted and implemented in future.

Scenario with existing measures (WEM) is considered as the reference scenario (NUR) in accordance with standard nomenclature CLRTAP and the UNFCCC and the scenario with additional measures (WAM) is considered as a scenario of moderate transition (LC1) and scenario of strong transition (LC2) according to standard nomenclature CLRTAP and the UNFCCC.

To understand the meaning of the states following terms:

- Planned policies / measures are those that have not yet been formally laid down in the legislation;
- Adopted policies / measures are those that have been agreed and stipulated in the legislation,
- Implementation of policies / measures when action taken or is being taken to undertake activities that are often carried out over several years.

Emission projections are the function of (future) activity data combined with an emission factor. On a range of datasets including projections of economic growth (Gross domestic product (GDP)), industrial growth, population growth, changes in land use patterns, and transportation demand. Future emission factors should reflect technological advances, environmental regulations, deterioration in operating conditions and any expected changes in fuel formulations. Rates of penetration of new technologies and/or controls are important in developing the right sectoral emission factors for any particular projection year.

For estimating projection the Tier 2 model from GB2013 is applied which includes sector-specific projections of activity data and, where appropriate, the inclusion of future emission factors depending on the sector (and pollutants) when measures are included in the concerned industry. In this sense, the application of the Tier 2 model included the stratification of defined source categories on the sub-activities and thus, it is possible to include the penetration of new technologies in emission factor. The stratification allows for over the years to include measures intended only for that particular activity in an appropriate volume (capacity controlled) for each year of the projection.

Sources for activity data that have been used as a starting point for the projection estimation are:

- Technical basis for the preparation of the low-carbon development strategy of the Republic of Croatia for the period until 2030, The Green Paper and
- The Republic of Croatia 2015 Informative Inventory Report (1990-2013) - IIR Croatia 2015

Activity levels in 2012 result from official national data set for all sectors: the Republic of Croatia 2015 Informative Inventory Report (1990-2013) (IIR 2015). Also, all data used for the pollutants emissions calculation in 2013 and further for developing emission reduction scenario for 2020, 2025 and 2030, and activity levels and emission factors are published and referenced in the GAINS model. All underlying assumptions are listed in the tables in the prescribed form for reporting "Annex IV: Projections reporting template - Projected national emissions and activity parameters of main pollutants and PM"

(http://www.ceip.at/ms/ceip_home1/ceip_home/status_reporting/2016_submissions/).

Sources of current and new technologies and their impact on the emissions involved in the emission factors are: GB2013 and GAINS model. Information on the rate of penetration of different technologies have been taken from: (1) Technical basis for the preparation of the low-carbon development strategy of the Republic of Croatia for the period until 2030, The Green Paper and (2) GAINS model.

The model used for the projections is the LEAP (The Long-range Energy Alternatives Planning System).

Making projections included three basic steps:

- The first step: determining the key sources of pollutants and of their share in the total emissions of substances observed in 2012 in Croatia,
- The second step: the inclusion of data on activity from available development plans,
- Third step: where development plans were not available, future activity data were assumed (expert judgement). The above is worked out by relevant pollutants and key sectors.

## 10.2 SCENARIOS

**Reference scenario (WEM):** The referent scenario includes current legislations of the Republic of Croatia and the EU's adopted legislations for the period until 2030. Strategies, plans and programmes that have been adopted, but are not supported by implementing regulations are not included in the referent scenario.

In the power system the Reference scenario presumes technology penetration depending on their price which is reduced over time. Technology price reduction curves for the production of renewable energy sources are taken from the JRC-EU-TIMES model, also used for fossil fuel technologies. The referent scenario is not a 'frozen state' scenario. It presumes the development of technologies and their use.

**The gradual transition scenario (LC1) (WAM1)** is scenario reduces emissions appropriately to Croatia's economic possibilities. The transition is accomplished in a way that does not jeopardize economic growth, with a change which is realistically achievable, in the technical, economic and sociological sense. This scenario is pursuant with the 2030 Framework and other strategic planning documents of the EU. It is the scenario of minimum obligations according to the internal allocation of EU's efforts.

## 10.3 RESULTS

Results of emission projections for NOx, $SO_2$, NMVOCs, $NH_3$, $PM_{2.5}$ and $PM_{10}$ are presented in Figures 11.3-1 to 11.3-6. Each of the graphic figures gives an overview by individual pollutant of the historical emission trend (1990 - 2016) according to calculated emissions, applied scenarios, and compliance with emission reduction commitment prescribed in the Gothenburg Protocol - original and revised one.

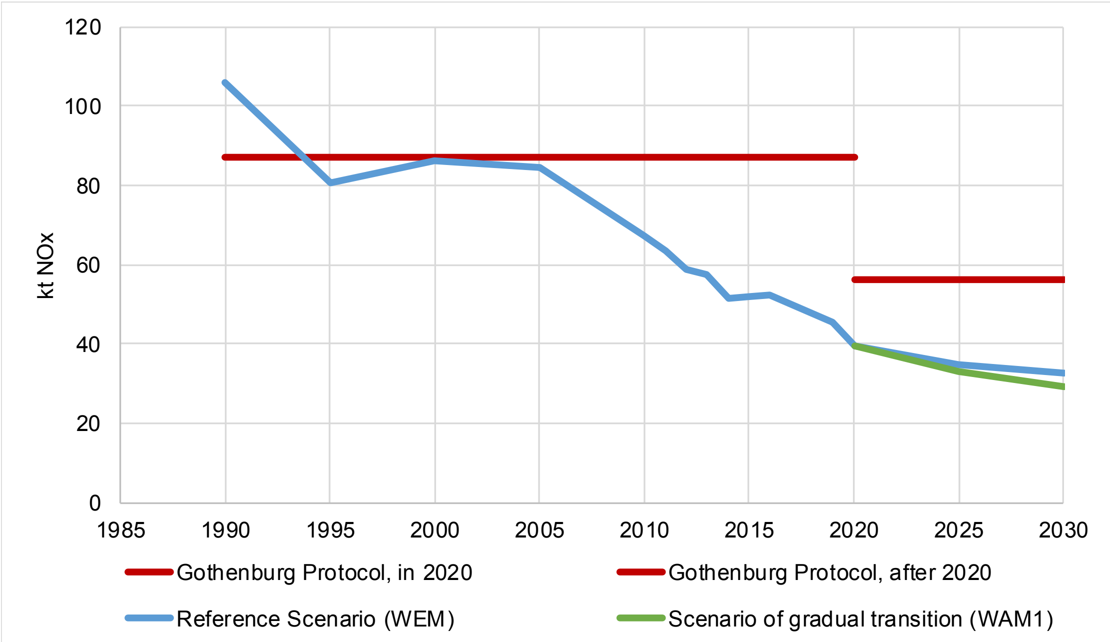



**Figure 10.3-1 Trend and projections of NOx emissions**

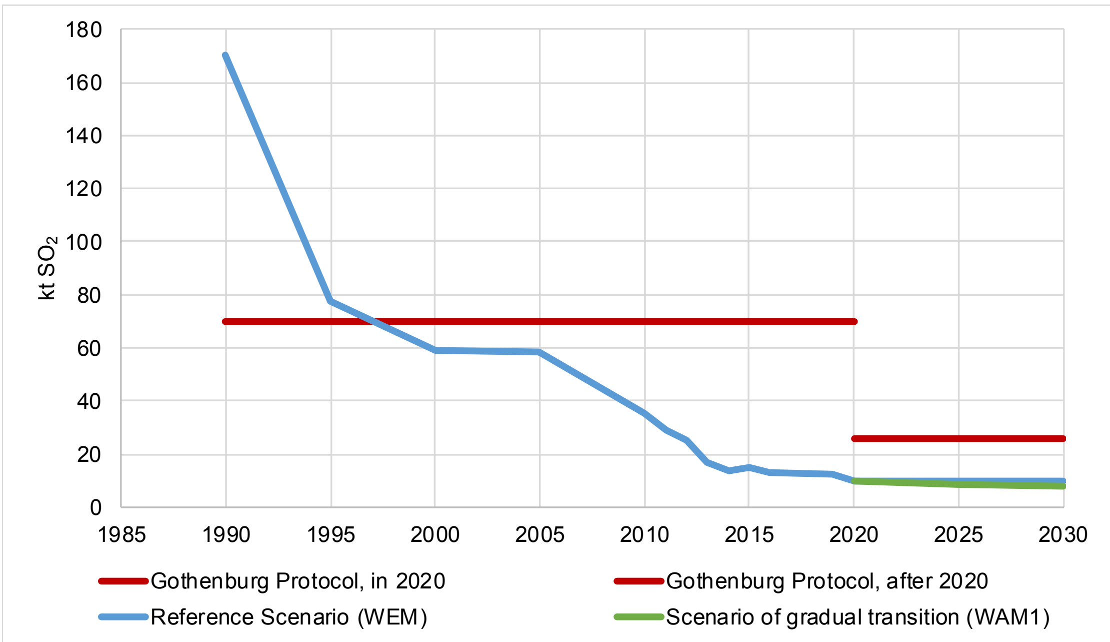



**Figure 10.3-2 Trend and projections of $SO_2$ emissions**

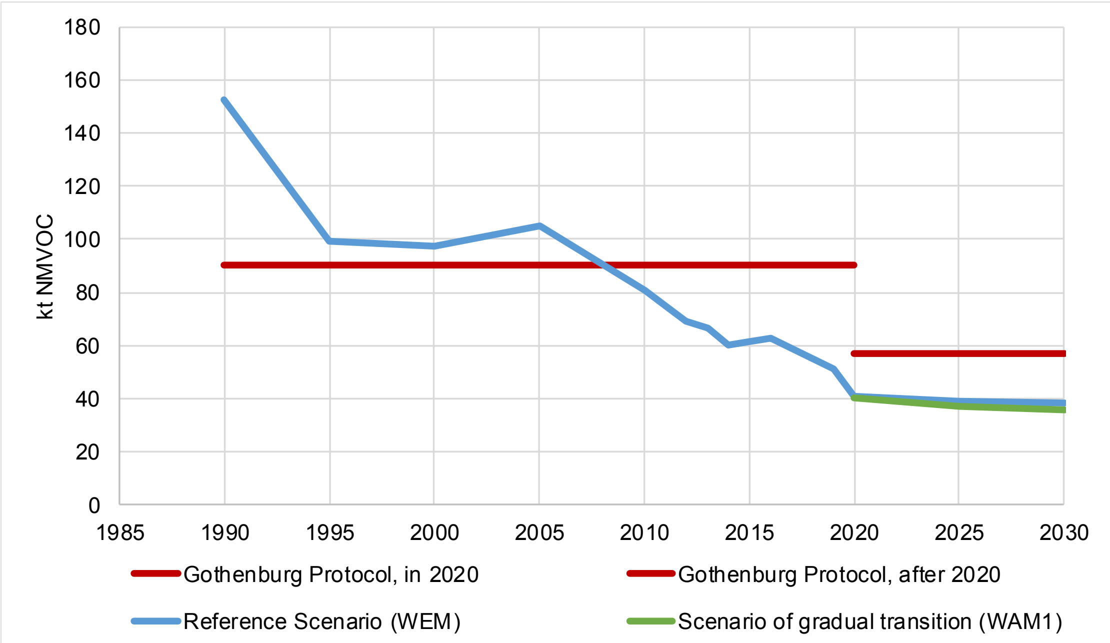



**Figure 10.3-3 Trend and projections of NMVOC emissions**

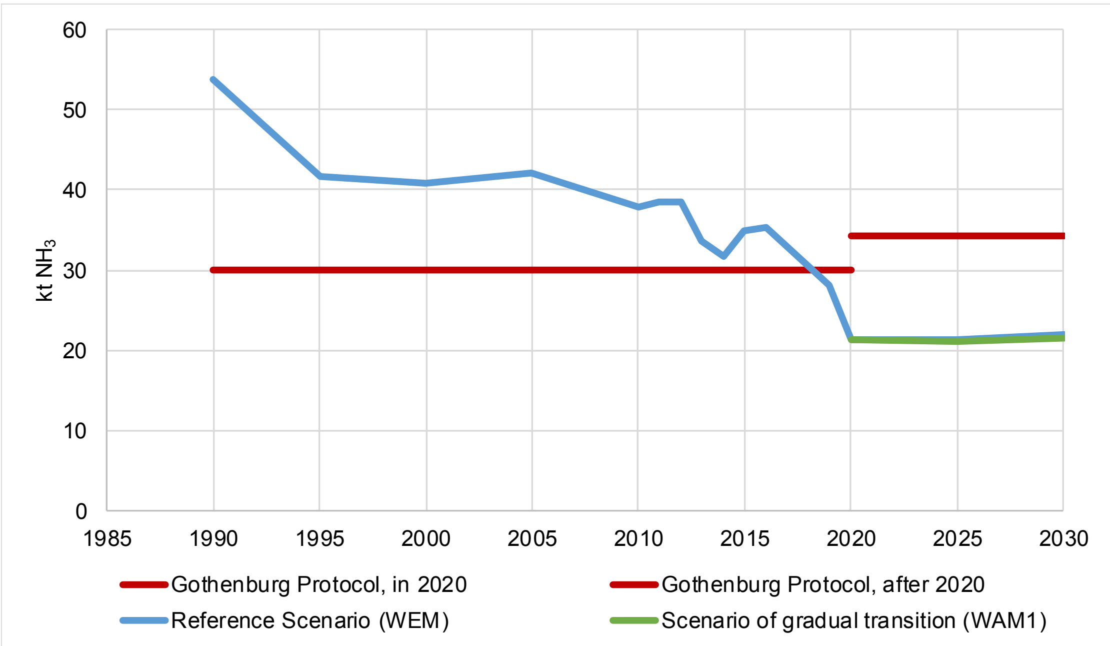



**Figure 10.3-4 Trend and projections of $NH_3$ emissions**

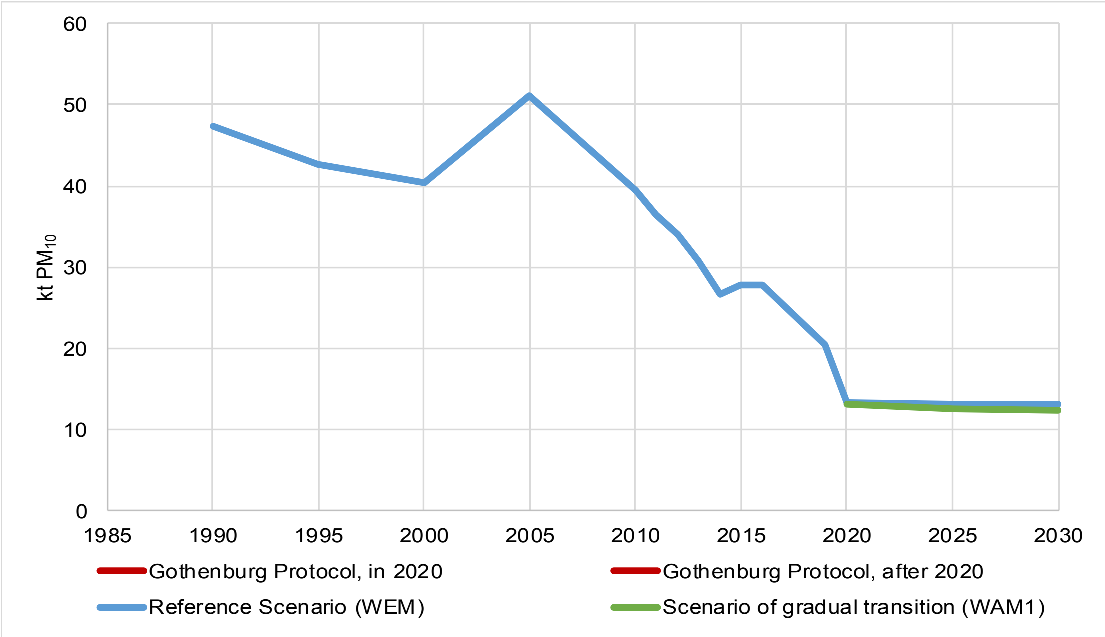



**Figure 10.3-5 Trend and projections of $PM_{2.5}$ emissions**

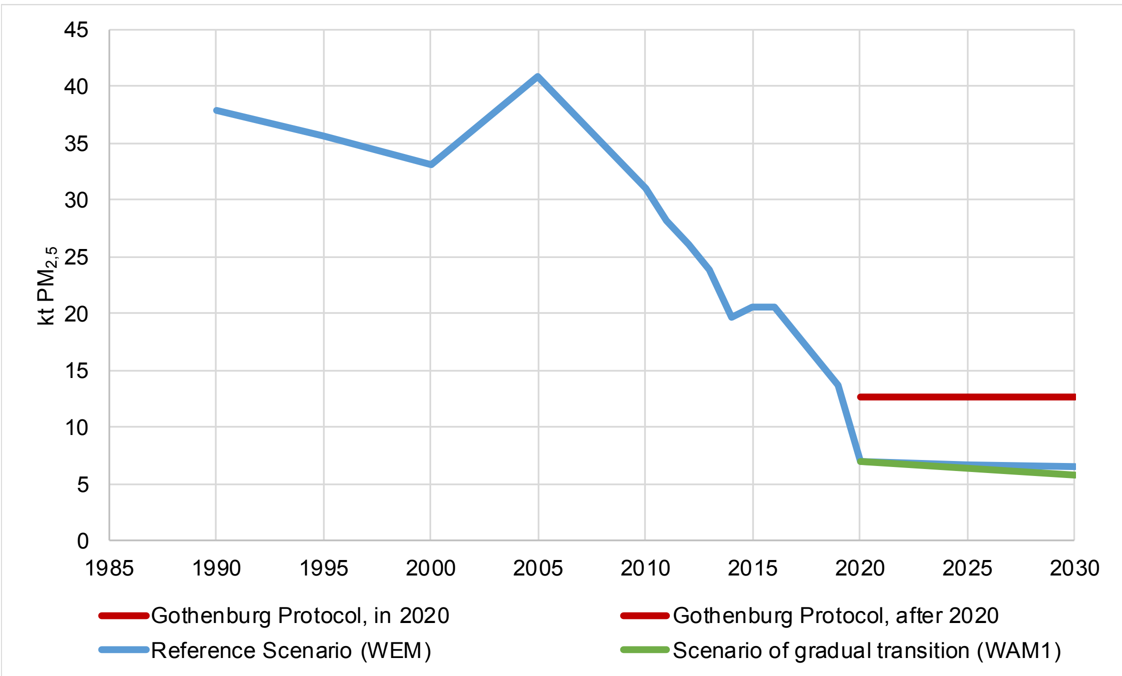



**Figure 10.3-6 Trend and projections of $PM_{10}$ emissions**

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# IIR APPENDICES

APPENDIX 1: QA/QC activities

APPENDIX 2: Description of SNAP97 sectors

APPENDIX 3: NFR and correspond SNAP codes

APPENDIX 4: Emission factors – 2016

APPENDIX 5: National energy balance for 2016

APPENDIX 6: NFR 2015

APPENDIX 7: Uncertainty analysis

APPENDIX 8: Influence of recalculations 1990 – 2015 in respect to pollutant and SNAP97 sector

# APPENDIX 1. QA/QC activities

**Table Appendix 1 QA/QC activities**

| Activity | QC checks / reviews | | QC others (Correction) | |
|---|---|---|---|---|
| | Expert name | Period / deadline | QA / QC manager / other person | Deadline |
| **DATA COLLECTION ACTIVITIES** | | | | |
| Checks all input data for emission calculations properly referenced | Mirela Poljanac | Until the beginning of December | Vladimir Jelavić | December |
| Check availability of literature material | Mirela Poljanac | = | Vladimir Jelavić | December |
| Confirm that bibliographical data references are properly cited | Mirela Poljanac | = | Vladimir Jelavić | December |
| **ACTIVITY DATA ENTRY IN DATABASES AND EMISSION CALCULATION** | | | | |
| Check whether the documented assumptions and criteria for selection of activity data, emission factors and other necessary parameters for emissions calculation | Mirela Poljanac | December | Vladimir Jelavić | December |
| Cross-check descriptions of input data and the emission factors with information about categories | Mirela Poljanac | December | Vladimir Jelavić | December |
| Check the correctness of interpretation and use of activity data and emission factors | Mirela Poljanac | December | Vladimir Jelavić | December |
| Check that the parameters and units are accurately recorded | Mirela Poljanac | December | Vladimir Jelavić | December |
| Check that used appropriate conversion factors | Mirela Poljanac | December | Vladimir Jelavić | December |
| Check whether the unit is properly marked in the worksheets | Mirela Poljanac | December | Vladimir Jelavić | December |
| Check the consistency of data between the categories | Mirela Poljanac | December | Vladimir Jelavić | December |
| Identified e.g. activity data common to several categories | Mirela Poljanac | December | Vladimir Jelavić | December |
| Check the consistency of the activity data | Mirela Poljanac | December | Vladimir Jelavić | December |
| Check the consistency of time series of input activity data for each category | Mirela Poljanac | December | Vladimir Jelavić | December |
| **DATABASES ITEMS** | | | | |
| Check whether all the categories covered by the emission sources that exist in the country, if not whether there are marked with the appropriate notation key („NO“) | Mirela Poljanac | December | Vladimir Jelavić | December |
| Check whether there is double counting, i.e. duplication of entries | Mirela Poljanac | December | Vladimir Jelavić | December |
| Check out the use of units and all necessary conversions of the same | Mirela Poljanac | December | Vladimir Jelavić | December |
| Used to check the consistency of data on activities for each pollutant within each category. | Mirela Poljanac | December | Vladimir Jelavić | December |

| Activity | QC checks / reviews | | QC others (Correction) | |
|---|---|---|---|---|
| | Expert name | Period / deadline | QA / QC manager / other person | Deadline |
| **DATABASES ITEMS** | | | | |
| Check the correctness of the emissions calculation | Mirela Poljanac | December | Vladimir Jelavić | December |
| Check the consistency of trends | Mirela Poljanac | December | Vladimir Jelavić | December |
| Check *Tier 2* method for emissions calculation by using *Tier 1* | Mirela Poljanac | December | Vladimir Jelavić | December |
| **FILLING ANNEXES TABLES (Annex_I_Emissions_reporting_template, Annex_IV_Projections_reporting_template, Annex_VI_LPS_emissions_template)** | | | | |
| Check pollutants emission totals by pollutants and by sectors | Mirela Poljanac | beginning February | Nina Zovko/ Vladimir Jelavić | week before the 15th February |
| Check NFR national totals | Mirela Poljanac | beginning February | Nina Zovko/ Vladimir Jelavić | week before the 15th February |
| Check for major changes compared to previous year | Mirela Poljanac | beginning February | Nina Zovko/ Vladimir Jelavić | week before the 15th February |
| Check totals in NFR codes with totals in SNAP codes | Mirela Poljanac | beginning February | Nina Zovko/ Vladimir Jelavić | week before the 15th February |
| Check longitude, latitude and height class of LPSs | Mirela Poljanac | beginning February | Mirela Poljanac | week before the 15th February |
| Automate work due to avoid errors by linking working Excels | Mirela | beginning February | Mirela Poljanac | week before the 15th February |
| **PREPARING IIR (INFORMATIVE INVENTORY REPORT)** | | | | |
| Check the values in the text and excel tables | Mirela Poljanac | 10. February to 14th March | Nina Zovko / Vladimir Jelavić | the 14th March |
| Check out the Figures | Mirela Poljanac | 10. February to 14th March | Nina Zovko / Vladimir Jelavić | the 14th March |
| **ARCHIVING** | | | | |
| Production of "*hard*" copies of the database | Mirela Poljanac | from April -… | - | - |
| Archiving Excel Table | Mirela Poljanac | from April -… | - | - |
| Archiving of data sources | Mirela Poljanac | from April -… | - | - |
| Archiving of all manuals | Mirela Poljanac | from April -… | - | - |
| Archiving IIR | Mirela Poljanac | from April -… | - | - |

# APPENDIX 2. DESCRIPTION OF SNAP97 SECTORS

***SNAP 01. Combustion in energy transformation industry***

This sector covers emissions from boilers, gas turbines and stationary engines as point sources and emission from combustion plants as area sources where the fossil fuel is combusted for the purpose of electricity generation and thermal production. This sector also includes emissions from combustion processes within a refinery for the heating of crude and petroleum products without contact between flame and products (crude oil transformation into derivates such as benzene, diesel, gas oil, kerosene, etc.), emissions from solid fuel transformation plants and combustion during oil / gas extraction and coal mining. Production of electricity and thermal energy for own consumption is also included. Dominant emissions from sector 01 are the following: $SO_2$, $NO_x$, TSP and heavy metals (arsenic, cadmium, chrome, mercury, zinc and nickel).

***SNAP 02. Non-industrial combustion plants***

Sector 02 includes all stationary energy plants with the exception of combustion in manufacturing industry (sector 03) and energy transformation industry (sector 01). Mainly, this sector includes emissions from small and medium combustion plants for thermal energy production like, commercial and institutional plants, residential plants and plants in agriculture, forestry and aquaculture. Production of electricity and thermal energy for own consumption is also included. Dominant emissions from sector 02 are the following: $SO_2$, $NO_x$, NMVOC, CO, TSP, particulate matter, heavy metals (cadmium, zinc and mercury) and persistent organic pollutants (PAHs, DIOX).

***SNAP 03. Combustion in manufacturing industry***

Emission because of production process (sector 04) and emission due to fuel combustion in manufacturing industry (sector 03) must be distinguished. The sector Combustion in manufacturing industry covers emissions released from: electricity generation and thermal energy production for manufacturing processes, combustion in order to generate thermal energy for processes without contact and non-energy fuel consumption. Non-energy fuel consumption comprises natural gas consumption for fertilizers, ethane, paraffin and wax production in chemical industry, bitumen production in construction industry and oil and fat production in different areas of application. Dominant emissions from sector 03 are the following: $SO_2$, $NO_X$, CO, TSP, particulate matter and heavy metals (arsenic, cadmium, chrome, mercury, zinc and nickel).

***SNAP 04. Production processes***

Sector 04 includes emissions which are the result of different production processes. These are the processes in petroleum industries, iron and steel industries, non-ferrous metal industries, inorganic and organic chemical industries, wood, paper pulp, food, drink, cement, glass and other industries, etc. The dominant emissions from sector 04 are: $NO_X$, NMVOC, $NH_3$, CO, TSP, particulate matter and heavy metals (cadmium, arsenic, chrome, selenium and zinc).

***SNAP 05. Extraction and distribution of fossil fuel and geothermal energy***

The extraction and first treatment of solid, oil and gas fuel results in non-methane volatile organic compounds emissions (NMVOC) and it is a dominant emission from sector 05. The largest NMVOCs emissions are the fugitive emissions from gas stations and emissions that occur during loading of gaseous and liquid fossil fuel from on-shore and offshore facilities. During the gaseous fossil fuel extraction and first treatment, emissions of mercury (Hg) occur. Those emissions can be of considerable amount if the mercury concentration in gaseous fossil fuel is high and if no additional measures for emission reduction are implemented. This sector also includes emissions from geothermal energy extraction. The SNAP code 05 is a key source of NMVOC emissions.

***SNAP 06. Solvent and other product use***

All activities, in which organic solvents are used and are emitted, are included in sector 06. Solvent use is a major contributor to NMVOC emissions. These emissions come from paint application, degreasing, dry cleaning and electronics, production or processing of chemical products and other use of solvents and related activities. The SNAP code 06 is also a key source of PCBs emission.

***SNAP 07. Road transport***

This sector includes emissions from all types of vehicles (passenger cars, light and heavy duty vehicles, buses, mopeds and motorcycles), emissions from gasoline evaporation from vehicles and also emissions from automobile tyre and brake wear. For emission calculation in road transport COPERT 4 (v11.3) software, developed for the purposes of European Environmental Agency, was used. Road transport is the key source of heavy metals emissions (lead, chrome, zinc and copper), $NO_x$, NMVOC, CO, and TSP, and particulate matter.

***SNAP 08. Other mobile source and machinery***

Emissions from sector 08 include emissions from off-road machinery. In other words, emissions from railways, inland waterways, maritime activities, air traffic. Furthermore, the emissions from agriculture, forestry, industry, household, gardening and other off-road mobile machinery are calculated. Emissions from international air traffic and waterways are excluded. Dominant emissions from this sector are: $NO_x$ and $PM_{2.5}$.

***SNAP 09. Waste treatment and disposal***

Sector 09 includes emissions which are the result of biological treatment of waste - solid waste disposal on land, waste incineration (waste thermal treatment and cremation), wastewater handling and other activities such as car fires and house fires.

The dominant emissions from sector 09 are NMVOC and $NH_3$.

If the waste is used as fuel for energy and thermal generation, the emissions that occur must be included in one of the stationary sectors (sectors 01, 02 and 03).

***SNAP 10. Agriculture***

The sector agriculture includes emissions that occur from application of nitrogen (N)-containing fertilizers and pesticides on agricultural land and also emissions from manure management, regarding organic compounds (emissions from animal excreta). The dominant emission from sector 10 is emission of ammonia ($NH_3$). Production and use of HCH (Lindane) has been permanently prohibited since July 2001. Therefore, the emission of Lindane no longer occurs on the territory of the Republic of Croatia.

***11. Other sources and sinks***

Sector 11 is the only sector that includes non-anthropogenic emissions (caused by nature). This sector includes emissions from non-managed and managed deciduous and coniferous forests and forests soils, natural grassland and other vegetation, marshes and waters (rivers and lakes), volcanoes, lightning, changes in forest and other woody biomass stocks, etc. In Croatia only SNAP code 110300 Forest and other vegetation fires is considering within sector 11. The SNAP 11 is not the key source of emissions.

# APPENDIX 3. NFR AND CORRESPOND SNAP CODES

| *NFR Code* | *Long name* | *SNAP code* |
|---|---|---|
| **1 A** | **Energy – fuel combustion** | |
| **1 A 1** | **Energy industry** | **01 00 00** |
| **1 A 1 a** | Public Electricity and Heat Production | 01 01 and 01 02 |
| **1 A 1 b** | Petroleum refining | 01 03 00 |
| **1 A 1 c** | Manufacture of Solid Fuel and Other Energy Industries | 01 05 00 |
| **1 A 2** | **Manufacturing Industries and Construction** | **01 00 00** |
| **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: Non- metallic minerals | 03 01 and 03 03 |
| **1 A 2 g vii** | Mobile Combustion in Manufacturing Industries and Construction | 08 08 01 |
| **1 A 3** | **Transport** | |
| **1 A 3 a ii (i)** | Civil Aviation (Domestic, LTO) | 08 05 01 |
| **1 A 3 a i (i)** | International Aviation (LTO) | 08 85 02 |
| **1 A 3 b i** | Road Transport:, Passenger cars | 07 07 01 |
| **1 A 3 b ii** | Road Transport:, Light duty vehicles | 07 07 02 |
| **1 A 3 b iii** | Road Transport:, Heavy duty vehicles | 07 07 03 |
| **1 A 3 b iv** | Road Transport:, Mopeds & Motorcycles | 07 07 04 and 07 07 05 |
| **1 A 3 b v** | Road Transport:, Gasoline evaporation | 07 07 06 |
| **1 A 3 b vi** | Road Transport:, Automobile tyre and brake wear | 07 07 07 |
| **1 A 3 b vii** | Road Transport:, Automobile road abrasion | 07 07 08 |
| **1 A 3 c** | Railways | 08 02 |
| **1 A 3 d i (ii)** | International inland waterways | - |
| **1 A 3 d ii** | National Navigation (Shipping) | 08 03 and 08 04 |
| **1 A 3 e** | Pipeline compressors | - |
| **1 A 4** | **Other sectors** | |
| **1 A 4 a i** | Commercial / Institutional: Stationary | 02 01 00 |
| **1 A 4 a ii** | Commercial / Institutional: Mobile | |
| **1 A 4 b i** | Residential: Stationary plants | 02 02 00 |
| **1 A 4 b ii** | Residential: Household and gardening (mobile) | 08 09 01 |
| **1 A 4 c i** | Agriculture/Forestry/Fishing: Stationary | 02 03 00 |
| **1 A 4 c ii** | Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery | 08 06 and 08 07 |
| **1 A 5** | **Other (including Military)** | |
| **1 A 5 a** | Other, Stationary (including Military) | - |
| **1 A 5 b** | Other, Mobile (Including military, land based and recreational boats) | - |
| **1 B** | **Fugitive emission from Fuel** | |
| **1 B 1** | **Fugitive emission from Solid Fuel** | |
| **1 B 1 a** | Coal Mining and Handling | - |
| **1 B 1 b** | Solid fuel transformation | - |

| *NFR Code* | *Long name* | *SNAP code* |
|---|---|---|
| **1 B 1 c** | Other fugitive emissions from solid fuel | - |
| **1 B 2** | **Fugitive emission from oil and natural gas** | |
| **1 B 2 a i** | Exploration Production, Transport | |
| **1 B 2 a iv** | Refining / Storage | 04 01 |
| **1 B 2 a v** | Distribution of oil products | 05 04 and 05 05 |
| **1 B 2 a vi** | Geothermal energy extraction | - |
| **1 B 2 b** | Natural gas | 05 03 and 05 06 |
| **1 B 2 c** | Venting and flaring | 09 02 03 and 09 02 06 |
| **2 A** | **Mineral Products** | |
| **2 A 1** | Cement Production | 04 06 12 |
| **2 A 2** | Lime Production | 04 06 14 |
| **2 D 3 c** | Asphalt Roofing | 04 04 10 |
| **2 D 3 b** | Road Paving with Asphalt | 04 04 11 |
| **2 A 5 a** | Quarrying and mining of minerals other than coal | 04 06 23 |
| **2 A 5 b** | Construction and demolition | 04 06 24 |
| **2 A 3** | Other Mineral products | 04 06 13 |
| **2 B** | **Chemical industry** | |
| **2 B 1** | Ammonia Production | 04 04 03 |
| **2 B 2** | Nitric Acid Production | 04 04 02 |
| **2 B 10 a** | Other chemical industry | 04 04, 04 05 |
| **2 C** | **Metal production** | |
| **2 C 1** | Iron and Steel Production | 04 02 |
| **2 C 2** | Ferroalloys Production | 04 03 02 |
| **2 C 3** | Aluminium Production | 04 03 01 |
| **2 C 5 a** | Copper Production | - |
| **2 C 5 b** | Lead Production | - |
| **2 C 5 c** | Nickel Production | - |
| **2 C 5 d** | Zinc Production | - |
| **2 C 5 e** | Other metal production | - |
| **2 C 5 f** | Storage, handling and transport of metal products | - |
| **2 D 3 a** | Domestic solvent use including fungicides | 06 04 08 |
| **2 D 3 d** | Coating application | 06 01 00 |
| **2 D 3 e** | Metal degreasing | 06 02 01 |
| **2 D 3 f** | Dry cleaning | 06 02 02 |
| **2 D 3 g** | Chemical products | 06 03 |
| **2 D 3 h** | Printing | 06 04 03 |
| **2 H 1** | Pulp and Paper | 04 06 02, 04 06 03 and 04 06 04 |
| **2 H 2** | Food and Drink | 04 06 05, 04 06 06 and 04 06 08 |
| **2 I** | Wood processing | - |
| **2 K** | Consumption of POPs and Heavy Metals (e.g. electrical and scientific equipment) | 06 05 08 |
| **2 D 3 i, 2 G** | **Other** | |
| **3 B** | **Manure management** | |
| **3 B 1 a** | Cattle Dairy | 10 05 01 |
| **3 B 1 b** | Cattle Non-Dairy | 10 05 02 |
| **3 B 2** | Sheep | 10 05 05 |
| **3 B 4 d** | Goats | - |
| **3 B 4 e** | Horses | 10 05 06 |

| *NFR Code* | *Long name* | *SNAP code* |
|---|---|---|
| **3 B 4 f** | Mules and Asses | - |
| **3 B 3** | Swine | 10 05 03 and 10 05 04 |
| **3 B 4 g i** | Laying Hens | 10 05 07 |
| **3 B 4 g ii** | Broilers | 10 05 08 |
| **3 B 4 g iii** | Turkeys | 10 05 09a |
| **3 B 4 g iv** | Other Poultry | 10 05 09z |
| **3 D 1** | **Direct Soil Emission** | |
| **3 D 1 a** | Inorganic N-fertilizers | 10 01 |
| **3 D f** | Use of pesticide | |
| **3 F** | **FIELD BURNING OF AGRICULTURAL WASTES** | **-** |
| **3 G** | **Agriculture OTHER** | **10 06** |
| **5 A** | **SOLID WASTE DISPOSAL ON LAND** | 09 04 01 |
| **5 C** | **Waste incineration** | |
| **5 C 1 b iii** | Clinical Waste Incineration | 09 02 07 |
| **5 C 1 b i** | Industrial Waste Incineration | 09 02 02 |
| **5 C 1 d** | Cremation | 09 02 01 |
| **5 C e** | Small Scale Waste Burning | - |
| **5 D 1** | Domestic wastewater handling | 09 10 01 |
| **5 D 2** | Industrial wastewater handling | 09 10 02 |
| **5 D 3** | Other wastewater handling (latrines) | 09 10 07 |
| **Memo Items** | **NOT TO BE INCLUDED IN NATIONAL TOTALS** | |
| **1 A 3 a ii (ii)** | Civil Aviation (Domestic, Cruise) | - |
| **1 A 3 a i (ii)** | International Aviation (Cruise) | - |
| **1 A 3 d i (i)** | International maritime Navigation | 08 04 04 |
| **11 B** | **Forest fires** | **11 03** |

# APPENDIX 4. EMISSION FACTORS – 2016

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 3 | Residual fuel oil | 1.A.1.a | As | 24.88 | mg/GJ |
| 3 | Residual fuel oil | 1.A.1.a | Cr | 62.2 | mg/GJ |
| 3 | Residual fuel oil | 1.A.1.a | Cu | 24.88 | mg/GJ |
| 3 | Residual fuel oil | 1.A.1.a | Se | 1.24 | mg/GJ |
| 3 | Residual fuel oil | 1.A.1.a | Zn | 24.88 | mg/GJ |
| 3 | Residual fuel oil | 1.A.1.a | DIOX | 2.5 | ng/GJ |
| 3 | Residual fuel oil | 1.A.1.a | Benzo(b) | 505.1 | µg/GJ |
| 3 | Residual fuel oil | 1.A.1.a | Benzo(k) | 99.03 | µg/GJ |
| 3 | Residual fuel oil | 1.A.1.a | Benzo(a) | 116.45 | µg/GJ |
| 3 | Residual fuel oil | 1.A.1.a | Indeno | 188.36 | µg/GJ |
| 3 | Residual fuel oil | 1.A.1.a | NH3 | 0.01 | g/GJ |
| 3 | Residual fuel oil | 1.A.1.a | NMVOC | 3 | g/GJ |
| 6 | Natural gas | 1.A.1.a | DIOX | 0.5 | ng/GJ |
| 6 | Natural gas | 1.A.1.a | NH3 | 0.15 | g/GJ |
| 6 | Natural gas | 1.A.1.a | NMVOC | 4 | g/GJ |
| 6 | Natural gas | 1.A.1.a | Benzo(a) | 0.6 | µg/GJ |
| 6 | Natural gas | 1.A.1.a | Benzo(b) | 0.8 | µg/GJ |
| 6 | Natural gas | 1.A.1.a | Benzo(k) | 0.8 | µg/GJ |
| 6 | Natural gas | 1.A.1.a | Indeno | 0.8 | µg/GJ |
| 14 | Gas oil | 1.A.1.a | As | 1.17 | mg/GJ |
| 14 | Gas oil | 1.A.1.a | Cr | 0.47 | mg/GJ |
| 14 | Gas oil | 1.A.1.a | Cu | 1.17 | mg/GJ |
| 14 | Gas oil | 1.A.1.a | Se | 0.023 | mg/GJ |
| 14 | Gas oil | 1.A.1.a | Zn | 2.34 | mg/GJ |
| 14 | Gas oil | 1.A.1.a | DIOX | 1.5 | ng/GJ |
| 14 | Gas oil | 1.A.1.a | Benzo(b) | 475.3 | µg/GJ |
| 14 | Gas oil | 1.A.1.a | Benzo(k) | 93.19 | µg/GJ |
| 14 | Gas oil | 1.A.1.a | Benzo(a) | 109.58 | µg/GJ |
| 14 | Gas oil | 1.A.1.a | Indeno | 177.24 | µg/GJ |
| 14 | Gas oil | 1.A.1.a | NH3 | 0.01 | g/GJ |
| 14 | Gas oil | 1.A.1.a | NMVOC | 3 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Pb | 0.011 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Se | 0.058 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Zn | 0.73 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | DIOX | 0.52 | ng/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Benzo(b) | 2.9 | µg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Benzo(k) | 1.1 | µg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Benzo(a) | 0.72 | µg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Indeno | 1.08 | µg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | SO2 | 0.67 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.a | NOX | 74 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.a | NMVOC | 23 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.a | CO | 29 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.a | TSP | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.a | PM25 | 0.78 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5294 | gaseous fuel | 1.A.1.a | PM10 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.a | BC | 0.0312 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.a | As | 0.1 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Cd | 1.8 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Cr | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Cu | 0.0026 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Hg | 0.54 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | Ni | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.a | NH3 | 0.15 | g/GJ |
| 1 | Plomin | 1.A.1.a | NMVOC | 3 | g/GJ |
| 1 | Plomin | 1.A.1.a | NH3 | 0.31 | g/GJ |
| 1 | Plomin | 1.A.1.a | As | 2.13 | mg/GJ |
| 1 | Plomin | 1.A.1.a | Cr | 1.55 | mg/GJ |
| 1 | Plomin | 1.A.1.a | Cu | 3.99 | mg/GJ |
| 1 | Plomin | 1.A.1.a | Se | 0.27 | mg/GJ |
| 1 | Plomin | 1.A.1.a | Zn | 9.88 | mg/GJ |
| 1 | Plomin | 1.A.1.a | Benzo(b) | 0.28 | µg/GJ |
| 1 | Plomin | 1.A.1.a | Benzo(k) | 0.28 | µg/GJ |
| 1 | Plomin | 1.A.1.a | Benzo(a) | 0.14 | µg/GJ |
| 1 | Plomin | 1.A.1.a | Indeno | 0.27 | µg/GJ |
| 1 | Plomin | 1.A.1.a | DIOX | 10 | ng/GJ |
| 1 | Plomin | 1.A.1.a | PCBs | 170 | µg/GJ |
| 1 | Plomin | 1.A.1.a | HCB | 0.62 | µg/GJ |
| 6158 | TE-TO Zg 2016 | 1.A.1.a | Cd | 0 | mg/GJ |
| 6158 | TE-TO Zg 2016 | 1.A.1.a | Hg | 1.138 | mg/GJ |
| 6158 | TE-TO Zg 2016 | 1.A.1.a | Ni | 0 | mg/GJ |
| 6158 | TE-TO Zg 2016 | 1.A.1.a | Pb | 0 | mg/GJ |
| 6158 | TE-TO Zg 2016 | 1.A.1.a | SO2 | 30.83 | g/GJ |
| 6158 | TE-TO Zg 2016 | 1.A.1.a | NOX | 234.69 | g/GJ |
| 6158 | TE-TO Zg 2016 | 1.A.1.a | CO | 28.6 | g/GJ |
| 6158 | TE-TO Zg 2016 | 1.A.1.a | TSP | 14.06 | g/GJ |
| 6158 | TE-TO Zg 2016 | 1.A.1.a | PM25 | 3.515 | g/GJ |
| 6158 | TE-TO Zg 2016 | 1.A.1.a | PM10 | 7.03 | g/GJ |
| 6158 | TE-TO Zg 2016 | 1.A.1.a | BC | 0.09 | g/GJ |
| 6150 | EL-TO Zg 2016 | 1.A.1.a | Cd | 0 | mg/GJ |
| 6150 | EL-TO Zg 2016 | 1.A.1.a | Hg | 0.63 | mg/GJ |
| 6150 | EL-TO Zg 2016 | 1.A.1.a | Ni | 0 | mg/GJ |
| 6150 | EL-TO Zg 2016 | 1.A.1.a | Pb | 0 | mg/GJ |
| 6150 | EL-TO Zg 2016 | 1.A.1.a | SO2 | 8.04 | g/GJ |
| 6150 | EL-TO Zg 2016 | 1.A.1.a | NOX | 455.59 | g/GJ |
| 6150 | EL-TO Zg 2016 | 1.A.1.a | CO | 30.32 | g/GJ |
| 6150 | EL-TO Zg 2016 | 1.A.1.a | TSP | 5.76 | g/GJ |
| 6150 | EL-TO Zg 2016 | 1.A.1.a | PM25 | 1.44 | g/GJ |
| 6150 | EL-TO Zg 2016 | 1.A.1.a | PM10 | 2.88 | g/GJ |
| 6150 | EL-TO Zg 2016 | 1.A.1.a | BC | 0.04 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6151 | KTE Jertovec 2016 | 1.A.1.a | Hg | 0.002 | mg/GJ |
| 6151 | KTE Jertovec 2016 | 1.A.1.a | SO2 | 0 | g/GJ |
| 6151 | KTE Jertovec 2016 | 1.A.1.a | NOX | 1.91 | g/GJ |
| 6151 | KTE Jertovec 2016 | 1.A.1.a | CO | 0 | g/GJ |
| 6151 | KTE Jertovec 2016 | 1.A.1.a | TSP | 0 | g/GJ |
| 6151 | KTE Jertovec 2016 | 1.A.1.a | PM25 | 0 | g/GJ |
| 6151 | KTE Jertovec 2016 | 1.A.1.a | PM10 | 0 | g/GJ |
| 6151 | KTE Jertovec 2016 | 1.A.1.a | Cd | 0 | mg/GJ |
| 6151 | KTE Jertovec 2016 | 1.A.1.a | Pb | 0 | mg/GJ |
| 6151 | KTE Jertovec 2016 | 1.A.1.a | Ni | 0 | mg/GJ |
| 6151 | KTE Jertovec 2016 | 1.A.1.a | BC | 0 | g/GJ |
| 6157 | TE Sisak 2016 | 1.A.1.a | Cd | 0 | mg/GJ |
| 6157 | TE Sisak 2016 | 1.A.1.a | Hg | 0 | mg/GJ |
| 6157 | TE Sisak 2016 | 1.A.1.a | BC | 0.03 | g/GJ |
| 6157 | TE Sisak 2016 | 1.A.1.a | Ni | 0 | mg/GJ |
| 6157 | TE Sisak 2016 | 1.A.1.a | Pb | 0 | mg/GJ |
| 6157 | TE Sisak 2016 | 1.A.1.a | SO2 | 2.56 | g/GJ |
| 6157 | TE Sisak 2016 | 1.A.1.a | NOX | 94.96 | g/GJ |
| 6157 | TE Sisak 2016 | 1.A.1.a | CO | 18.02 | g/GJ |
| 6157 | TE Sisak 2016 | 1.A.1.a | TSP | 4.96 | g/GJ |
| 6157 | TE Sisak 2016 | 1.A.1.a | PM25 | 1.24 | g/GJ |
| 6157 | TE Sisak 2016 | 1.A.1.a | PM10 | 2.48 | g/GJ |
| 6153 | TE Plomin1-2016 | 1.A.1.a | Cd | 2.04 | mg/GJ |
| 6153 | TE Plomin1-2016 | 1.A.1.a | Hg | 72.87 | mg/GJ |
| 6153 | TE Plomin1-2016 | 1.A.1.a | Ni | 99.11 | mg/GJ |
| 6153 | TE Plomin1-2016 | 1.A.1.a | Pb | 83.07 | mg/GJ |
| 6153 | TE Plomin1-2016 | 1.A.1.a | SO2 | 2904.12 | g/GJ |
| 6153 | TE Plomin1-2016 | 1.A.1.a | NOX | 2006.66 | g/GJ |
| 6153 | TE Plomin1-2016 | 1.A.1.a | CO | 79.35 | g/GJ |
| 6153 | TE Plomin1-2016 | 1.A.1.a | TSP | 199.56 | g/GJ |
| 6153 | TE Plomin1-2016 | 1.A.1.a | PM25 | 49.89 | g/GJ |
| 6153 | TE Plomin1-2016 | 1.A.1.a | PM10 | 99.78 | g/GJ |
| 6153 | TE Plomin1-2016 | 1.A.1.a | BC | 1.1 | g/GJ |
| 6155 | TE Plomin2-2016 | 1.A.1.a | Cd | 3.39 | mg/GJ |
| 6155 | TE Plomin2-2016 | 1.A.1.a | Hg | 121.17 | mg/GJ |
| 6155 | TE Plomin2-2016 | 1.A.1.a | Ni | 164.79 | mg/GJ |
| 6155 | TE Plomin2-2016 | 1.A.1.a | Pb | 138.13 | mg/GJ |
| 6155 | TE Plomin2-2016 | 1.A.1.a | SO2 | 242.05 | g/GJ |
| 6155 | TE Plomin2-2016 | 1.A.1.a | NOX | 1550.21 | g/GJ |
| 6155 | TE Plomin2-2016 | 1.A.1.a | CO | 71.55 | g/GJ |
| 6155 | TE Plomin2-2016 | 1.A.1.a | TSP | 125.4202 | g/GJ |
| 6155 | TE Plomin2-2016 | 1.A.1.a | PM25 | 31.35505 | g/GJ |
| 6155 | TE Plomin2-2016 | 1.A.1.a | PM10 | 62.71 | g/GJ |
| 6155 | TE Plomin2-2016 | 1.A.1.a | BC | 0.69 | g/GJ |
| 6156 | TE Rijeka-2016 | 1.A.1.a | Cd | 0.001 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6156 | TE Rijeka-2016 | 1.A.1.a | Hg | 0 | mg/GJ |
| 6156 | TE Rijeka-2016 | 1.A.1.a | Ni | 0.686 | mg/GJ |
| 6156 | TE Rijeka-2016 | 1.A.1.a | Pb | 0.052 | mg/GJ |
| 6156 | TE Rijeka-2016 | 1.A.1.a | SO2 | 0 | mg/GJ |
| 6156 | TE Rijeka-2016 | 1.A.1.a | NOX | 0 | g/GJ |
| 6156 | TE Rijeka-2016 | 1.A.1.a | CO | 0.22 | g/GJ |
| 6156 | TE Rijeka-2016 | 1.A.1.a | TSP | 0 | g/GJ |
| 6156 | TE Rijeka-2016 | 1.A.1.a | PM25 | 0 | g/GJ |
| 6156 | TE Rijeka-2016 | 1.A.1.a | PM10 | 0 | g/GJ |
| 6156 | TE Rijeka-2016 | 1.A.1.a | BC | 0 | g/GJ |
| 6154 | TE-TO Os-2016 | 1.A.1.a | Cd | 0 | mg/GJ |
| 6154 | TE-TO Os-2016 | 1.A.1.a | Hg | 0.22 | mg/GJ |
| 6154 | TE-TO Os-2016 | 1.A.1.a | Ni | 0 | mg/GJ |
| 6154 | TE-TO Os-2016 | 1.A.1.a | Pb | 0 | mg/GJ |
| 6154 | TE-TO Os-2016 | 1.A.1.a | SO2 | 5.95 | g/GJ |
| 6154 | TE-TO Os-2016 | 1.A.1.a | NOX | 96.3 | g/GJ |
| 6154 | TE-TO Os-2016 | 1.A.1.a | CO | 2.83 | g/GJ |
| 6154 | TE-TO Os-2016 | 1.A.1.a | TSP | 2.58 | g/GJ |
| 6154 | TE-TO Os-2016 | 1.A.1.a | PM25 | 0.645 | g/GJ |
| 6154 | TE-TO Os-2016 | 1.A.1.a | PM10 | 1.29 | g/GJ |
| 6154 | TE-TO Os-2016 | 1.A.1.a | BC | 0.02 | g/GJ |
| 6152 | PTE Os-2016 | 1.A.1.a | Hg | 0.03785 | mg/GJ |
| 6152 | PTE Os-2016 | 1.A.1.a | NOX | 48.46 | mg/GJ |
| 6152 | PTE Os-2016 | 1.A.1.a | CO | 0.01 | mg/GJ |
| 6152 | PTE Os-2016 | 1.A.1.a | SO2 | 0 | mg/GJ |
| 6152 | PTE Os-2016 | 1.A.1.a | TSP | 0 | g/GJ |
| 6152 | PTE Os-2016 | 1.A.1.a | PM25 | 0 | g/GJ |
| 6152 | PTE Os-2016 | 1.A.1.a | PM10 | 0 | g/GJ |
| 6152 | PTE Os-2016 | 1.A.1.a | Cd | 6E-05 | g/GJ |
| 6152 | PTE Os-2016 | 1.A.1.a | Pb | 0.00542 | g/GJ |
| 6152 | PTE Os-2016 | 1.A.1.a | Ni | 0.071 | g/GJ |
| 6152 | PTE Os-2016 | 1.A.1.a | BC | 0 | g/GJ |
| 6408 | biomass | 1.A.1.a | Pb | 20.6 | mg/GJ |
| 6408 | biomass | 1.A.1.a | Se | 1.2 | mg/GJ |
| 6408 | biomass | 1.A.1.a | Zn | 181 | mg/GJ |
| 6408 | biomass | 1.A.1.a | DIOX | 50 | ng/GJ |
| 6408 | biomass | 1.A.1.a | Benzo(b) | 0.043 | mg/GJ |
| 6408 | biomass | 1.A.1.a | Benzo(k) | 0.0155 | mg/GJ |
| 6408 | biomass | 1.A.1.a | Benzo(a) | 1.12 | mg/GJ |
| 6408 | biomass | 1.A.1.a | Indeno | 0.0374 | mg/GJ |
| 6408 | biomass | 1.A.1.a | NOX | 81 | g/GJ |
| 6408 | biomass | 1.A.1.a | NMVOC | 7.31 | g/GJ |
| 6408 | biomass | 1.A.1.a | CO | 90 | g/GJ |
| 6408 | biomass | 1.A.1.a | TSP | 172 | g/GJ |
| 6408 | biomass | 1.A.1.a | PM25 | 133 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6408 | biomass | 1.A.1.a | PM10 | 155 | g/GJ |
| 6408 | biomass | 1.A.1.a | BC | 4.389 | g/GJ |
| 6408 | biomass | 1.A.1.a | PCBs | 3.5 | µg/GJ |
| 6408 | biomass | 1.A.1.a | HCB | 5 | µg/GJ |
| 6408 | biomass | 1.A.1.a | As | 9.46 | mg/GJ |
| 6408 | biomass | 1.A.1.a | Cd | 1.76 | mg/GJ |
| 6408 | biomass | 1.A.1.a | Cr | 9.03 | mg/GJ |
| 6408 | biomass | 1.A.1.a | Cu | 21.1 | mg/GJ |
| 6408 | biomass | 1.A.1.a | Hg | 0.56 | mg/GJ |
| 6408 | biomass | 1.A.1.a | Ni | 14.2 | mg/GJ |
| 6408 | biomass | 1.A.1.a | SO2 | 10.8 | g/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Pb | 0.08 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Se | 0.11 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Zn | 29 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | DIOX | 1.4 | ng/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Benzo(b) | 15 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Benzo(k) | 1.7 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Benzo(a) | 1.9 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Indeno | 1.5 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | SO2 | 37.46 | g/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | NOX | 513 | g/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | NMVOC | 25 | g/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | CO | 66 | g/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | TSP | 20 | g/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | PM25 | 20 | g/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | PM10 | 20 | g/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | BC | 11.2 | g/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | As | 0.03 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Cd | 0.006 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Cr | 0.2 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Cu | 0.22 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Hg | 0.12 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | Ni | 0.008 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.1.a | NH3 | 0.01 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Pb | 0.08 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Se | 0.11 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Zn | 29 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | DIOX | 1.4 | ng/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Benzo(b) | 15 | µg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Benzo(k) | 1.7 | µg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Benzo(a) | 1.9 | µg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Indeno | 1.5 | µg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | SO2 | 445.38 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | NOX | 513 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | NMVOC | 25 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6421 | residual fuel_2016 | 1.A.1.a | CO | 66 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | TSP | 20 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | PM25 | 20 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | PM10 | 20 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | BC | 11.2 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | As | 0.03 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Cd | 0.006 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Cr | 0.2 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Cu | 0.22 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Hg | 0.12 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | Ni | 0.008 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.1.a | NH3 | 0.01 | g/GJ |
| 4507 | Petroleum refining | 1.A.1.b | As | 0.343 | mg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Cd | 0.712 | mg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Cr | 2.74 | mg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Cu | 2.22 | mg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Hg | 0.086 | mg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Ni | 3.6 | mg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Pb | 1.79 | mg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Benzo(b) | 1.14 | µg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Benzo(k) | 0.631 | µg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Benzo(a) | 0.669 | µg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Indeno | 0.631 | µg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | SO2 | 0.281 | g/GJ |
| 4507 | Petroleum refining | 1.A.1.b | NOX | 63 | g/GJ |
| 4507 | Petroleum refining | 1.A.1.b | NMVOC | 2.58 | g/GJ |
| 4507 | Petroleum refining | 1.A.1.b | CO | 39.3 | g/GJ |
| 4507 | Petroleum refining | 1.A.1.b | TSP | 0.89 | g/GJ |
| 4507 | Petroleum refining | 1.A.1.b | PM25 | 0.89 | g/GJ |
| 4507 | Petroleum refining | 1.A.1.b | PM10 | 0.89 | g/GJ |
| 4507 | Petroleum refining | 1.A.1.b | BC | 0.1638 | g/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Se | 0.42 | mg/GJ |
| 4507 | Petroleum refining | 1.A.1.b | Zn | 25.5 | mg/GJ |
| 5452 | Natural gas | 1.A.1.b | As | 0.12 | mg/GJ |
| 5452 | Natural gas | 1.A.1.b | Cd | 0.00025 | mg/GJ |
| 5452 | Natural gas | 1.A.1.b | Cr | 0.00076 | mg/GJ |
| 5452 | Natural gas | 1.A.1.b | Cu | 7.6E-05 | mg/GJ |
| 5452 | Natural gas | 1.A.1.b | Hg | 0.1 | mg/GJ |
| 5452 | Natural gas | 1.A.1.b | Ni | 0.00051 | mg/GJ |
| 5452 | Natural gas | 1.A.1.b | Pb | 0.0015 | mg/GJ |
| 5452 | Natural gas | 1.A.1.b | Benzo(b) | 0.84 | µg/GJ |
| 5452 | Natural gas | 1.A.1.b | Benzo(k) | 0.84 | µg/GJ |
| 5452 | Natural gas | 1.A.1.b | Benzo(a) | 0.56 | µg/GJ |
| 5452 | Natural gas | 1.A.1.b | Indeno | 0.84 | µg/GJ |
| 5452 | Natural gas | 1.A.1.b | SO2 | 0.281 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5452 | Natural gas | 1.A.1.b | NOX | 63 | g/GJ |
| 5452 | Natural gas | 1.A.1.b | NMVOC | 2.58 | g/GJ |
| 5452 | Natural gas | 1.A.1.b | CO | 39.3 | g/GJ |
| 5452 | Natural gas | 1.A.1.b | TSP | 0.89 | g/GJ |
| 5452 | Natural gas | 1.A.1.b | PM25 | 0.89 | g/GJ |
| 5452 | Natural gas | 1.A.1.b | PM10 | 0.89 | g/GJ |
| 5452 | Natural gas | 1.A.1.b | DIOX | 0.5 | ng/GJ |
| 5452 | Natural gas | 1.A.1.b | Se | 0.0112 | mg/GJ |
| 5452 | Natural gas | 1.A.1.b | Zn | 0.0015 | mg/GJ |
| 5452 | Natural gas | 1.A.1.b | BC | 0.077 | g/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | DIOX | 2.5 | ng/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | As | 3.98 | mg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Cd | 1.2 | mg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Cr | 14.8 | mg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Cu | 11.9 | mg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Hg | 0.3 | mg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Ni | 1030 | mg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Pb | 4.6 | mg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Benzo(b) | 3.7 | μg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Benzo(k) | 0.2 | μg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Benzo(a) | 0.6 | μg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Indeno | 1.3 | μg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | SO2 | 472.75 | g/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | NOX | 142 | g/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | NMVOC | 2.3 | g/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | CO | 15 | g/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | TSP | 20 | g/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | PM25 | 9 | g/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | PM10 | 15 | g/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | BC | 0.504 | g/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Se | 2.1 | mg/GJ |
| 5881 | Residual oil_2016 | 1.A.1.b | Zn | 49.3 | mg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Zn | 49.3 | mg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | DIOX | 2.5 | ng/GJ |
| 5427 | Petroleum coke | 1.A.1.b | As | 3.98 | mg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Cd | 1.2 | mg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Cr | 14.8 | mg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Cu | 11.9 | mg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Hg | 0.3 | mg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Ni | 1030 | mg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Pb | 4.6 | mg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Benzo(b) | 3.7 | μg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Benzo(k) | 0.2 | μg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Benzo(a) | 0.6 | μg/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Indeno | 1.3 | μg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5427 | Petroleum coke | 1.A.1.b | SO2 | 485 | g/GJ |
| 5427 | Petroleum coke | 1.A.1.b | NOX | 142 | g/GJ |
| 5427 | Petroleum coke | 1.A.1.b | NMVOC | 2.3 | g/GJ |
| 5427 | Petroleum coke | 1.A.1.b | CO | 15 | g/GJ |
| 5427 | Petroleum coke | 1.A.1.b | TSP | 20 | g/GJ |
| 5427 | Petroleum coke | 1.A.1.b | PM25 | 9 | g/GJ |
| 5427 | Petroleum coke | 1.A.1.b | PM10 | 15 | g/GJ |
| 5427 | Petroleum coke | 1.A.1.b | BC | 0.504 | g/GJ |
| 5427 | Petroleum coke | 1.A.1.b | Se | 2.1 | mg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | As | 0.12 | mg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Cd | 0.00025 | mg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Cr | 0.00076 | mg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Cu | 7.6E-05 | mg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Hg | 0.1 | mg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Ni | 0.00051 | mg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Pb | 0.0015 | mg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Benzo(b) | 0.84 | µg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Benzo(k) | 0.84 | µg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Benzo(a) | 0.56 | µg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Indeno | 0.84 | µg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | SO2 | 0.281 | g/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | NOX | 89 | g/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | NMVOC | 2.6 | g/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | CO | 39 | g/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | TSP | 0.89 | g/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | PM25 | 0.89 | g/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | PM10 | 0.89 | g/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Se | 0.0112 | mg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | Zn | 0.0015 | mg/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | BC | 0.02225 | g/GJ |
| 5974 | 1.A.1.b_GF_LPG | 1.A.1.b | DIOX | 0.5 | ng/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Pb | 0.011 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Se | 0.058 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Zn | 0.73 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | DIOX | 0.52 | ng/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Benzo(b) | 2.9 | µg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Benzo(k) | 1.1 | µg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Benzo(a) | 0.72 | µg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Indeno | 1.08 | µg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | SO2 | 0.67 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.c | NOX | 74 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.c | NMVOC | 23 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.c | CO | 29 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.c | TSP | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.c | PM25 | 0.78 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5294 | gaseous fuel | 1.A.1.c | PM10 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.c | BC | 0.0312 | g/GJ |
| 5294 | gaseous fuel | 1.A.1.c | As | 0.1 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Cd | 1.8 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Cr | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Cu | 0.0026 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Hg | 0.54 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | Ni | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.1.c | NH3 | 0.15 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Pb | 0.08 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Se | 0.11 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Zn | 29 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | DIOX | 1.4 | ng/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Benzo(b) | 15 | μg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Benzo(k) | 1.7 | μg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Benzo(a) | 1.9 | μg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Indeno | 1.5 | μg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | SO2 | 47 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.a | NOX | 513 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.a | NMVOC | 25 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.a | CO | 66 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.a | TSP | 20 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.a | PM25 | 20 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.a | PM10 | 20 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.a | BC | 11.2 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.a | As | 0.03 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Cd | 0.006 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Cr | 0.2 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Cu | 0.22 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Hg | 0.12 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.a | Ni | 0.008 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Pb | 0.011 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Se | 0.058 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Zn | 0.73 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | DIOX | 0.52 | ng/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Benzo(b) | 2.9 | μg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Benzo(k) | 1.1 | μg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Benzo(a) | 0.72 | μg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Indeno | 1.08 | μg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | SO2 | 0.67 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | NOX | 74 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | NMVOC | 23 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | CO | 29 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | TSP | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | PM25 | 0.78 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5240 | Gaseous fuels | 1.A.2.a | PM10 | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | BC | 0.0312 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | As | 0.1 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Cd | 0.0009 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Cr | 0.013 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Cu | 0.0026 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Hg | 0.54 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.a | Ni | 0.013 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | PM25 | 108 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | PM10 | 117 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | BC | 6.912 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | PCBs | 170 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | HCB | 0.62 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | As | 4 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Cd | 1.8 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Cr | 13.5 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Cu | 17.5 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Hg | 0.56 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Ni | 13 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Pb | 27 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Se | 1.8 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Zn | 200 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | DIOX | 203 | ng/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Benzo(b) | 58.9 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Benzo(k) | 23.7 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Benzo(a) | 45.5 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | Indeno | 18.5 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | SO2 | 900 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | NOX | 173 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | NMVOC | 88.8 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | CO | 931 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.a | TSP | 124 | g/GJ |
| 5287 | Biomass | 1.A.2.a | PM25 | 140 | g/GJ |
| 5287 | Biomass | 1.A.2.a | PM10 | 143 | g/GJ |
| 5287 | Biomass | 1.A.2.a | BC | 39.2 | g/GJ |
| 5287 | Biomass | 1.A.2.a | PCBs | 0.06 | µg/GJ |
| 5287 | Biomass | 1.A.2.a | HCB | 5 | µg/GJ |
| 5287 | Biomass | 1.A.2.a | As | 0.19 | mg/GJ |
| 5287 | Biomass | 1.A.2.a | Cd | 13 | mg/GJ |
| 5287 | Biomass | 1.A.2.a | Cr | 23 | mg/GJ |
| 5287 | Biomass | 1.A.2.a | Cu | 6 | mg/GJ |
| 5287 | Biomass | 1.A.2.a | Hg | 0.56 | mg/GJ |
| 5287 | Biomass | 1.A.2.a | Ni | 2 | mg/GJ |
| 5287 | Biomass | 1.A.2.a | Pb | 27 | mg/GJ |
| 5287 | Biomass | 1.A.2.a | Se | 0.5 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5287 | Biomass | 1.A.2.a | Zn | 512 | mg/GJ |
| 5287 | Biomass | 1.A.2.a | DIOX | 100 | ng/GJ |
| 5287 | Biomass | 1.A.2.a | Benzo(b) | 16 | µg/GJ |
| 5287 | Biomass | 1.A.2.a | Benzo(k) | 5 | µg/GJ |
| 5287 | Biomass | 1.A.2.a | Benzo(a) | 10 | µg/GJ |
| 5287 | Biomass | 1.A.2.a | Indeno | 4 | µg/GJ |
| 5287 | Biomass | 1.A.2.a | SO2 | 11 | g/GJ |
| 5287 | Biomass | 1.A.2.a | NOX | 91 | g/GJ |
| 5287 | Biomass | 1.A.2.a | NH3 | 37 | g/GJ |
| 5287 | Biomass | 1.A.2.a | NMVOC | 300 | g/GJ |
| 5287 | Biomass | 1.A.2.a | CO | 570 | g/GJ |
| 5287 | Biomass | 1.A.2.a | TSP | 150 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | As | 4.2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Cd | 0.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Cr | 3.1 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Cu | 2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Hg | 4.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Ni | 3.9 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Pb | 3.9 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Se | 1.8 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Zn | 10.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | DIOX | 9.07 | ng/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Benzo(b) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Benzo(k) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Benzo(a) | 32.2 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | Indeno | 967.03 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | SO2 | 37.46 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | NOX | 155 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | NH3 | 0.31 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | NMVOC | 20 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | CO | 73 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | TSP | 100 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | PM25 | 35 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | PM10 | 60 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | HCB | 0.62 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.a | PCBs | 170 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Pb | 0.08 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Se | 0.11 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Zn | 29 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | DIOX | 1.4 | ng/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Benzo(b) | 15 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Benzo(k) | 1.7 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Benzo(a) | 1.9 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Indeno | 1.5 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | SO2 | 445.38 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6411 | LF-HFO_2016 | 1.A.2.a | NOX | 513 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | NMVOC | 25 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | CO | 66 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | TSP | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | PM25 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | PM10 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | BC | 11.2 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | As | 0.03 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Cd | 0.006 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Cr | 0.2 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Cu | 0.22 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Hg | 0.12 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.a | Ni | 0.008 | mg/GJ |
| 5287 | Biomass | 1.A.2.b | PM25 | 140 | g/GJ |
| 5287 | Biomass | 1.A.2.b | PM10 | 143 | g/GJ |
| 5287 | Biomass | 1.A.2.b | BC | 39.2 | g/GJ |
| 5287 | Biomass | 1.A.2.b | PCBs | 0.06 | µg/GJ |
| 5287 | Biomass | 1.A.2.b | HCB | 5 | µg/GJ |
| 5287 | Biomass | 1.A.2.b | As | 0.19 | mg/GJ |
| 5287 | Biomass | 1.A.2.b | Cd | 13 | mg/GJ |
| 5287 | Biomass | 1.A.2.b | Cr | 23 | mg/GJ |
| 5287 | Biomass | 1.A.2.b | Cu | 6 | mg/GJ |
| 5287 | Biomass | 1.A.2.b | Hg | 0.56 | mg/GJ |
| 5287 | Biomass | 1.A.2.b | Ni | 2 | mg/GJ |
| 5287 | Biomass | 1.A.2.b | Pb | 27 | mg/GJ |
| 5287 | Biomass | 1.A.2.b | Se | 0.5 | mg/GJ |
| 5287 | Biomass | 1.A.2.b | Zn | 512 | mg/GJ |
| 5287 | Biomass | 1.A.2.b | DIOX | 100 | ng/GJ |
| 5287 | Biomass | 1.A.2.b | Benzo(b) | 16 | µg/GJ |
| 5287 | Biomass | 1.A.2.b | Benzo(k) | 5 | µg/GJ |
| 5287 | Biomass | 1.A.2.b | Benzo(a) | 10 | µg/GJ |
| 5287 | Biomass | 1.A.2.b | Indeno | 4 | µg/GJ |
| 5287 | Biomass | 1.A.2.b | SO2 | 11 | g/GJ |
| 5287 | Biomass | 1.A.2.b | NOX | 91 | g/GJ |
| 5287 | Biomass | 1.A.2.b | NH3 | 37 | g/GJ |
| 5287 | Biomass | 1.A.2.b | NMVOC | 300 | g/GJ |
| 5287 | Biomass | 1.A.2.b | CO | 570 | g/GJ |
| 5287 | Biomass | 1.A.2.b | TSP | 150 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | Pb | 0.011 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | Se | 0.058 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | Zn | 0.73 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | DIOX | 0.52 | ng/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | Benzo(b) | 2.9 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | Benzo(k) | 1.1 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | Benzo(a) | 0.72 | µg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5240 | Gaseous fuels | 1.A.2.b | Indeno | 1.08 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | SO2 | 0.67 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | NOX | 74 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | NMVOC | 23 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | CO | 29 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | TSP | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | PM25 | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | PM10 | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | BC | 0.0312 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | As | 0.1 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | Cd | 0.0009 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | Cr | 0.013 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | Cu | 0.0026 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | Hg | 0.54 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.b | Ni | 0.013 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | As | 4.2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Cd | 0.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Cr | 3.1 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Cu | 2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Hg | 4.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Ni | 3.9 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Pb | 3.9 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Se | 1.8 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Zn | 10.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | DIOX | 9.07 | ng/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Benzo(b) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Benzo(k) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Benzo(a) | 32.2 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | Indeno | 967.03 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | SO2 | 37.46 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | NOX | 155 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | NH3 | 0.31 | ng/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | NMVOC | 20 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | CO | 73 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | TSP | 100 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | PM25 | 35 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | PM10 | 60 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | HCB | 0.62 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.b | PCBs | 170 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | Pb | 0.08 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | Se | 0.11 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | Zn | 29 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | DIOX | 1.4 | ng/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | Benzo(b) | 15 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | Benzo(k) | 1.7 | µg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6411 | LF-HFO_2016 | 1.A.2.b | Benzo(a) | 1.9 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | Indeno | 1.5 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | SO2 | 445.38 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | NOX | 513 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | NMVOC | 25 | ng/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | CO | 66 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | TSP | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | PM25 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | PM10 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | BC | 11.2 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | As | 0.03 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | Cd | 0.006 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | Cr | 0.2 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | Cu | 0.22 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | Hg | 0.12 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.b | Ni | 0.008 | mg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | As | 24.88 | mg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Cd | 24.88 | mg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Cr | 62.2 | mg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Cu | 24.88 | mg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Hg | 0 | mg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Ni | 870.86 | mg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Pb | 32.35 | mg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Se | 1.24 | mg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Zn | 24.88 | mg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | DIOX | 2.5 | ng/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Benzo(b) | 45.04 | µg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Benzo(k) | 70.17 | µg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Benzo(a) | 85.34 | µg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | Indeno | 170.19 | µg/GJ |
| 3700 | 1.A.2.a_203A | 1.A.2.c | NMVOC | 3 | g/GJ |
| 3701 | 1.A.2.a_301A | 1.A.2.c | Hg | 0.61 | mg/GJ |
| 3701 | 1.A.2.a_301A | 1.A.2.c | DIOX | 0.03 | DIOX [g] |
| 3701 | 1.A.2.a_301A | 1.A.2.c | NMVOC | 7 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Pb | 0.011 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Se | 0.058 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Zn | 0.73 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | DIOX | 0.52 | ng/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Benzo(b) | 2.9 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Benzo(k) | 1.1 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Benzo(a) | 0.72 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Indeno | 1.08 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | SO2 | 0.67 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | NOX | 74 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | NMVOC | 23 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5240 | Gaseous fuels | 1.A.2.c | CO | 29 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | TSP | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | PM25 | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | PM10 | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | BC | 0.0312 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | As | 0.1 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Cd | 0.0009 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Cr | 0.013 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Cu | 0.0026 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Hg | 0.54 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.c | Ni | 0.013 | mg/GJ |
| 5287 | Biomass | 1.A.2.c | PM25 | 140 | g/GJ |
| 5287 | Biomass | 1.A.2.c | PM10 | 143 | g/GJ |
| 5287 | Biomass | 1.A.2.c | BC | 39.2 | g/GJ |
| 5287 | Biomass | 1.A.2.c | PCBs | 0.06 | μg/GJ |
| 5287 | Biomass | 1.A.2.c | HCB | 5 | μg/GJ |
| 5287 | Biomass | 1.A.2.c | As | 0.19 | mg/GJ |
| 5287 | Biomass | 1.A.2.c | Cd | 13 | mg/GJ |
| 5287 | Biomass | 1.A.2.c | Cr | 23 | mg/GJ |
| 5287 | Biomass | 1.A.2.c | Cu | 6 | mg/GJ |
| 5287 | Biomass | 1.A.2.c | Hg | 0.56 | mg/GJ |
| 5287 | Biomass | 1.A.2.c | Ni | 2 | mg/GJ |
| 5287 | Biomass | 1.A.2.c | Pb | 27 | mg/GJ |
| 5287 | Biomass | 1.A.2.c | Se | 0.5 | mg/GJ |
| 5287 | Biomass | 1.A.2.c | Zn | 512 | mg/GJ |
| 5287 | Biomass | 1.A.2.c | DIOX | 100 | ng/GJ |
| 5287 | Biomass | 1.A.2.c | Benzo(b) | 16 | μg/GJ |
| 5287 | Biomass | 1.A.2.c | Benzo(k) | 5 | μg/GJ |
| 5287 | Biomass | 1.A.2.c | Benzo(a) | 10 | μg/GJ |
| 5287 | Biomass | 1.A.2.c | Indeno | 4 | μg/GJ |
| 5287 | Biomass | 1.A.2.c | SO2 | 11 | g/GJ |
| 5287 | Biomass | 1.A.2.c | NOX | 91 | g/GJ |
| 5287 | Biomass | 1.A.2.c | NH3 | 37 | g/GJ |
| 5287 | Biomass | 1.A.2.c | NMVOC | 300 | g/GJ |
| 5287 | Biomass | 1.A.2.c | CO | 570 | g/GJ |
| 5287 | Biomass | 1.A.2.c | TSP | 150 | g/GJ |
| 6161 | Petrokemija | 1.A.2.c | SO2 | 45 | SO2 [Gg] |
| 6161 | Petrokemija | 1.A.2.c | NOX | 179.83 | NOX [Gg] |
| 6161 | Petrokemija | 1.A.2.c | CO | 2.1 | CO [Gg] |
| 6413 | Gas oil_2016 | 1.A.2.c | As | 4.2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | Cd | 0.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | Cr | 3.1 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | Cu | 2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | Hg | 4.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | Ni | 3.9 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6413 | Gas oil_2016 | 1.A.2.c | Pb | 3.9 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | Se | 1.8 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | Zn | 10.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | DIOX | 9.07 | ng/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | Benzo(b) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | Benzo(k) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | Benzo(a) | 32.2 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | Indeno | 967.03 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | SO2 | 37.46 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | NOX | 155 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | NH3 | 0.31 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | NMVOC | 20 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | CO | 73 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | TSP | 100 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | PM25 | 35 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | PM10 | 60 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | HCB | 0.62 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.c | PCBs | 170 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Pb | 0.08 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Se | 0.11 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Zn | 29 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | DIOX | 1.4 | ng/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Benzo(b) | 15 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Benzo(k) | 1.7 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Benzo(a) | 1.9 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Indeno | 1.5 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | SO2 | 445.38 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | NOX | 513 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | NMVOC | 25 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | CO | 66 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | TSP | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | PM25 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | PM10 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | BC | 11.2 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | As | 0.03 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Cd | 0.006 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Cr | 0.2 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Cu | 0.22 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Hg | 0.12 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.c | Ni | 0.008 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | Pb | 0.011 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | Se | 0.058 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | Zn | 0.73 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | DIOX | 0.52 | ng/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | Benzo(b) | 2.9 | µg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5240 | Gaseous fuels | 1.A.2.d | Benzo(k) | 1.1 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | Benzo(a) | 0.72 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | Indeno | 1.08 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | SO2 | 0.67 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | NOX | 74 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | NMVOC | 23 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | CO | 29 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | TSP | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | PM25 | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | PM10 | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | BC | 0.0312 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | As | 0.1 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | Cd | 0.0009 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | Cr | 0.013 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | Cu | 0.0026 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | Hg | 0.54 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.d | Ni | 0.013 | mg/GJ |
| 5287 | Biomass | 1.A.2.d | PM25 | 140 | g/GJ |
| 5287 | Biomass | 1.A.2.d | PM10 | 143 | g/GJ |
| 5287 | Biomass | 1.A.2.d | BC | 39.2 | g/GJ |
| 5287 | Biomass | 1.A.2.d | PCBs | 0.06 | µg/GJ |
| 5287 | Biomass | 1.A.2.d | HCB | 5 | µg/GJ |
| 5287 | Biomass | 1.A.2.d | As | 0.19 | mg/GJ |
| 5287 | Biomass | 1.A.2.d | Cd | 13 | mg/GJ |
| 5287 | Biomass | 1.A.2.d | Cr | 23 | mg/GJ |
| 5287 | Biomass | 1.A.2.d | Cu | 6 | mg/GJ |
| 5287 | Biomass | 1.A.2.d | Hg | 0.56 | mg/GJ |
| 5287 | Biomass | 1.A.2.d | Ni | 2 | mg/GJ |
| 5287 | Biomass | 1.A.2.d | Pb | 27 | mg/GJ |
| 5287 | Biomass | 1.A.2.d | Se | 0.5 | mg/GJ |
| 5287 | Biomass | 1.A.2.d | Zn | 512 | mg/GJ |
| 5287 | Biomass | 1.A.2.d | DIOX | 100 | ng/GJ |
| 5287 | Biomass | 1.A.2.d | Benzo(b) | 16 | µg/GJ |
| 5287 | Biomass | 1.A.2.d | Benzo(k) | 5 | µg/GJ |
| 5287 | Biomass | 1.A.2.d | Benzo(a) | 10 | µg/GJ |
| 5287 | Biomass | 1.A.2.d | Indeno | 4 | µg/GJ |
| 5287 | Biomass | 1.A.2.d | SO2 | 11 | g/GJ |
| 5287 | Biomass | 1.A.2.d | NOX | 91 | g/GJ |
| 5287 | Biomass | 1.A.2.d | NH3 | 37 | g/GJ |
| 5287 | Biomass | 1.A.2.d | NMVOC | 300 | g/GJ |
| 5287 | Biomass | 1.A.2.d | CO | 570 | g/GJ |
| 5287 | Biomass | 1.A.2.d | TSP | 150 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | As | 4.2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | Cd | 0.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | Cr | 3.1 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6413 | Gas oil_2016 | 1.A.2.d | Cu | 2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | Hg | 4.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | Ni | 3.9 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | Pb | 3.9 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | Se | 1.8 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | Zn | 10.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | DIOX | 9.07 | ng/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | Benzo(b) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | Benzo(k) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | Benzo(a) | 32.2 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | Indeno | 967.03 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | SO2 | 37.46 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | NOX | 155 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | NH3 | 0.31 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | NMVOC | 20 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | CO | 73 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | TSP | 100 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | PM25 | 35 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | PM10 | 60 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | HCB | 0.62 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.d | PCBs | 170 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Pb | 0.08 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Se | 0.11 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Zn | 29 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | DIOX | 1.4 | ng/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Benzo(b) | 15 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Benzo(k) | 1.7 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Benzo(a) | 1.9 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Indeno | 1.5 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | SO2 | 445.38 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | NOX | 513 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | NMVOC | 25 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | CO | 66 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | TSP | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | PM25 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | PM10 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | BC | 11.2 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | As | 0.03 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Cd | 0.006 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Cr | 0.2 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Cu | 0.22 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Hg | 0.12 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.d | Ni | 0.008 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.e | PM25 | 108 | PM25 [Gg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | PM10 | 117 | PM10 [Gg] |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5288 | Solid fuels (coals) | 1.A.2.e | BC | 6.912 | BC [Gg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | PCBs | 170 | PCBs[µg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | HCB | 0.62 | HCB [kg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | As | 4 | As [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Cd | 1.8 | Cd [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Cr | 13.5 | Cr [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Cu | 17.5 | Cu [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Hg | 0.56 | Hg [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Ni | 13 | Ni [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Pb | 27 | Pb [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Se | 1.8 | Se [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Zn | 200 | Zn [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | DIOX | 203 | DIOX [g] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Benzo(b) | 58.9 | Benzo(b) [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Benzo(k) | 23.7 | Benzo(k) [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Benzo(a) | 45.5 | Benzo(a) [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | Indeno | 18.5 | Indeno [Mg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | SO2 | 900 | SO2 [Gg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | NOX | 173 | NOX [Gg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | NMVOC | 88.8 | NMVOC [Gg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | CO | 931 | CO [Gg] |
| 5288 | Solid fuels (coals) | 1.A.2.e | TSP | 124 | TSP [Gg] |
| 5240 | Gaseous fuels | 1.A.2.e | Pb | 0.011 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | Se | 0.058 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | Zn | 0.73 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | DIOX | 0.52 | ng/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | Benzo(b) | 2.9 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | Benzo(k) | 1.1 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | Benzo(a) | 0.72 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | Indeno | 1.08 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | SO2 | 0.67 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | NOX | 74 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | NMVOC | 23 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | CO | 29 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | TSP | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | PM25 | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | PM10 | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | BC | 0.0312 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | As | 0.1 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | Cd | 0.0009 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | Cr | 0.013 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5240 | Gaseous fuels | 1.A.2.e | Cu | 0.0026 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | Hg | 0.54 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.e | Ni | 0.013 | mg/GJ |
| 5287 | Biomass | 1.A.2.e | PM25 | 140 | g/GJ |
| 5287 | Biomass | 1.A.2.e | PM10 | 143 | g/GJ |
| 5287 | Biomass | 1.A.2.e | BC | 39.2 | g/GJ |
| 5287 | Biomass | 1.A.2.e | PCBs | 0.06 | µg/GJ |
| 5287 | Biomass | 1.A.2.e | HCB | 5 | µg/GJ |
| 5287 | Biomass | 1.A.2.e | As | 0.19 | mg/GJ |
| 5287 | Biomass | 1.A.2.e | Cd | 13 | mg/GJ |
| 5287 | Biomass | 1.A.2.e | Cr | 23 | mg/GJ |
| 5287 | Biomass | 1.A.2.e | Cu | 6 | mg/GJ |
| 5287 | Biomass | 1.A.2.e | Hg | 0.56 | mg/GJ |
| 5287 | Biomass | 1.A.2.e | Ni | 2 | mg/GJ |
| 5287 | Biomass | 1.A.2.e | Pb | 27 | mg/GJ |
| 5287 | Biomass | 1.A.2.e | Se | 0.5 | mg/GJ |
| 5287 | Biomass | 1.A.2.e | Zn | 512 | mg/GJ |
| 5287 | Biomass | 1.A.2.e | DIOX | 100 | ng/GJ |
| 5287 | Biomass | 1.A.2.e | Benzo(b) | 16 | µg/GJ |
| 5287 | Biomass | 1.A.2.e | Benzo(k) | 5 | µg/GJ |
| 5287 | Biomass | 1.A.2.e | Benzo(a) | 10 | µg/GJ |
| 5287 | Biomass | 1.A.2.e | Indeno | 4 | µg/GJ |
| 5287 | Biomass | 1.A.2.e | SO2 | 11 | g/GJ |
| 5287 | Biomass | 1.A.2.e | NOX | 91 | g/GJ |
| 5287 | Biomass | 1.A.2.e | NH3 | 37 | g/GJ |
| 5287 | Biomass | 1.A.2.e | NMVOC | 300 | g/GJ |
| 5287 | Biomass | 1.A.2.e | CO | 570 | g/GJ |
| 5287 | Biomass | 1.A.2.e | TSP | 150 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | As | 4.2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Cd | 0.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Cr | 3.1 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Cu | 2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Hg | 4.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Ni | 3.9 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Pb | 3.9 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Se | 1.8 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Zn | 10.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | DIOX | 9.07 | ng/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Benzo(b) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Benzo(k) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Benzo(a) | 32.2 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | Indeno | 967.03 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | SO2 | 37.46 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | NOX | 155 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | NH3 | 0.31 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6413 | Gas oil_2016 | 1.A.2.e | NMVOC | 20 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | CO | 73 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | TSP | 100 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | PM25 | 35 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | PM10 | 60 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | HCB | 0.62 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.e | PCBs | 170 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Pb | 0.08 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Se | 0.11 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Zn | 29 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | DIOX | 1.4 | ng/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Benzo(b) | 15 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Benzo(k) | 1.7 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Benzo(a) | 1.9 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Indeno | 1.5 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | SO2 | 445.38 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | NOX | 513 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | NMVOC | 25 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | CO | 66 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | TSP | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | PM25 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | PM10 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | BC | 11.2 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | As | 0.03 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Cd | 0.006 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Cr | 0.2 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Cu | 0.22 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Hg | 0.12 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.e | Ni | 0.008 | mg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | As | 4 | mg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Cd | 1.8 | mg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Cr | 13.5 | mg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Cu | 17.5 | mg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Hg | 7.9 | mg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Ni | 13 | mg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Pb | 134 | mg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Se | 1.8 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Zn | 200 | mg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | DIOX | 203 | ng/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | HCB | 0.62 | µg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | PCBs | 170 | µg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Benzo(a) | 45.5 | µg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Benzo(b) | 58.9 | µg/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Benzo(k) | 23.7 | g/GJ |
| 4833 | coke oven coke from browe coal | 1.A.2.f.1 | Indeno | 18.5 | g/GJ |
| 4834 | natural gas | 1.A.2.f.1 | As | 0.09 | mg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Cd | 0.5 | mg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Cr | 0.7 | mg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Cu | 0.4 | mg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Hg | 0.2 | mg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Ni | 1 | mg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Pb | 0.2 | mg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Se | 0.01 | mg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Zn | 14 | mg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | DIOX | 2 | ng/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Benzo(a) | 0.6 | µg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Benzo(b) | 0.8 | µg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Benzo(k) | 0.8 | µg/GJ |
| 4834 | natural gas | 1.A.2.f.1 | Indeno | 0.8 | µg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | As | 0.09 | mg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Cd | 0.5 | mg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Cr | 0.7 | mg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Cu | 0.4 | mg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Hg | 0.2 | mg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Ni | 1 | mg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Pb | 0.2 | mg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Se | 0.01 | mg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Zn | 14 | mg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | DIOX | 2 | ng/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Benzo(a) | 0.6 | µg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Benzo(b) | 0.8 | µg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Benzo(k) | 0.8 | µg/GJ |
| 4948 | derived gas - gas oil (ELLU) | 1.A.2.f.1 | Indeno | 0.8 | µg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | Pb | 0.011 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5240 | Gaseous fuels | 1.A.2.f.1 | Se | 0.058 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | Zn | 0.73 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | DIOX | 0.52 | ng/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | Benzo(b) | 2.9 | μg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | Benzo(k) | 1.1 | μg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | Benzo(a) | 0.72 | μg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | Indeno | 1.08 | μg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | SO2 | 0.67 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | NOX | 74 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | NMVOC | 23 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | CO | 29 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | TSP | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | PM25 | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | PM10 | 0.78 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | BC | 0.0312 | g/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | As | 0.1 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | Cd | 0.0009 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | Cr | 0.013 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | Cu | 0.0026 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | Hg | 0.54 | mg/GJ |
| 5240 | Gaseous fuels | 1.A.2.f.1 | Ni | 0.013 | mg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | PM25 | 140 | g/GJ |
| 5287 | Biomass | 1.A.2.f.1 | PM10 | 143 | g/GJ |
| 5287 | Biomass | 1.A.2.f.1 | BC | 39.2 | g/GJ |
| 5287 | Biomass | 1.A.2.f.1 | PCBs | 0.06 | μg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | HCB | 5 | μg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | As | 0.19 | mg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Cd | 13 | mg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Cr | 23 | mg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Cu | 6 | mg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Hg | 0.56 | mg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Ni | 2 | mg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Pb | 27 | mg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Se | 0.5 | mg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Zn | 512 | mg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | DIOX | 100 | ng/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Benzo(b) | 16 | μg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Benzo(k) | 5 | μg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Benzo(a) | 10 | μg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | Indeno | 4 | μg/GJ |
| 5287 | Biomass | 1.A.2.f.1 | SO2 | 11 | g/GJ |
| 5287 | Biomass | 1.A.2.f.1 | NOX | 91 | g/GJ |
| 5287 | Biomass | 1.A.2.f.1 | NH3 | 37 | g/GJ |
| 5287 | Biomass | 1.A.2.f.1 | NMVOC | 300 | g/GJ |
| 5287 | Biomass | 1.A.2.f.1 | CO | 570 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5287 | Biomass | 1.A.2.f.1 | TSP | 150 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | PM25 | 108 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | PM10 | 117 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | BC | 6.912 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | PCBs | 170 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | HCB | 0.62 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | As | 4 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Cd | 1.8 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Cr | 13.5 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Cu | 17.5 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Hg | 0.56 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Ni | 13 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Pb | 27 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Se | 1.8 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Zn | 200 | mg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | DIOX | 203 | ng/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Benzo(b) | 58.9 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Benzo(k) | 23.7 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Benzo(a) | 45.5 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | Indeno | 18.5 | µg/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | SO2 | 900 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | NOX | 173 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | NMVOC | 88.8 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | CO | 931 | g/GJ |
| 5288 | Solid fuels (coals) | 1.A.2.f.1 | TSP | 124 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | Pb | 0.08 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | Se | 0.11 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | Zn | 29 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | DIOX | 1.4 | ng/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | Benzo(b) | 15 | µg/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | Benzo(k) | 1.7 | µg/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | Benzo(a) | 1.9 | µg/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | Indeno | 1.5 | µg/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | SO2 | 47 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | NOX | 513 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | NMVOC | 25 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | CO | 66 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | TSP | 20 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | PM25 | 20 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | PM10 | 20 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | BC | 11.2 | g/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | As | 0.03 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | Cd | 0.006 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | Cr | 0.2 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | Cu | 0.22 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5289 | Petroleum coke | 1.A.2.f.1 | Hg | 0.12 | mg/GJ |
| 5289 | Petroleum coke | 1.A.2.f.1 | Ni | 0.008 | mg/GJ |
| 6162 | Rockwool_2016 | 1.A.2.f.1 | NOX | 74.68129 | t DE |
| 6162 | Rockwool_2016 | 1.A.2.f.1 | CO | 24.35025 | t DE |
| 6162 | Rockwool_2016 | 1.A.2.f.1 | SO2 | 315.3228 | t DE |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | As | 4.2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Cd | 0.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Cr | 3.1 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Cu | 2 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Hg | 4.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Ni | 3.9 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Pb | 3.9 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Se | 1.8 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Zn | 10.4 | mg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | DIOX | 9.07 | ng/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Benzo(b) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Benzo(k) | 1285.71 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Benzo(a) | 32.2 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | Indeno | 967.03 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | SO2 | 37.46 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | NOX | 155 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | NH3 | 0.31 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | NMVOC | 20 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | CO | 73 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | TSP | 100 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | PM25 | 35 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | PM10 | 60 | g/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | HCB | 0.62 | µg/GJ |
| 6413 | Gas oil_2016 | 1.A.2.f.1 | PCBs | 170 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Pb | 0.08 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Se | 0.11 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Zn | 29 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | DIOX | 1.4 | ng/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Benzo(b) | 15 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Benzo(k) | 1.7 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Benzo(a) | 1.9 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Indeno | 1.5 | µg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | SO2 | 445.38 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | NOX | 513 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | NMVOC | 25 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | CO | 66 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | TSP | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | PM25 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | PM10 | 20 | g/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | BC | 11.2 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | As | 0.03 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Cd | 0.006 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Cr | 0.2 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Cu | 0.22 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Hg | 0.12 | mg/GJ |
| 6411 | LF-HFO_2016 | 1.A.2.f.1 | Ni | 0.008 | mg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Cd | 0.008 | mg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Hg | 0.049 | mg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | As | 0.0265 | mg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Cr | 0.041 | mg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Cu | 0.0647 | mg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Ni | 0.049 | mg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Se | 0.0253 | mg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Zn | 0.424 | mg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | HCB | 4.6 | µg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | PCBs | 103 | µg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | DIOX | 4.1 | µg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Benzo(a) | 6.5E-05 | µg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Benzo(b) | 0.00028 | µg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Benzo(k) | 7.7E-05 | µg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Indeno | 4.3E-05 | µg/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | SO2 | 50.2 | g/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | NOX | 1617.9 | g/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | NMVOC | 18 | g/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | CO | 1980.63 | g/GJ |
| 6417 | Cemex_2016 | 1.A.2.f.1 | Pb | 0.098 | mg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Pb | 0.098 | mg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Cd | 0.008 | mg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Hg | 0.049 | mg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | As | 0.0265 | mg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Cr | 0.041 | mg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Cu | 0.0647 | mg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Ni | 0.049 | mg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Se | 0.0253 | mg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Zn | 0.424 | mg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | HCB | 4.6 | µg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | PCBs | 103 | µg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | DIOX | 4.1 | µg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Benzo(a) | 6.5E-05 | µg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Benzo(b) | 0.00028 | µg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Benzo(k) | 7.7E-05 | µg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | Indeno | 4.3E-05 | µg/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | SO2 | 888.1 | g/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | NOX | 1039.3 | g/GJ |
| 6414 | Našicecement_2016 | 1.A.2.f.1 | NMVOC | 369 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6414 | Našicecement_2016 | 1.A.2.f.1 | CO | 3091.6 | g/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Cd | 0.008 | μg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Hg | 0.049 | μg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | As | 0.0265 | g/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Cr | 0.041 | g/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Cu | 0.0647 | g/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Ni | 0.049 | g/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Se | 0.0253 | mg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Zn | 0.424 | mg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | HCB | 4.6 | mg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | PCBs | 103 | mg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | DIOX | 4.1 | mg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Benzo(a) | 6.5E-05 | mg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Benzo(b) | 0.00028 | mg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Benzo(k) | 7.7E-05 | mg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Indeno | 4.3E-05 | mg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | SO2 | 293.3 | μg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | NOX | 1599.3 | μg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | NMVOC | 54.3 | μg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | CO | 1100.9 | μg/GJ |
| 6418 | Holcim_2016 | 1.A.2.f.1 | Pb | 0.098 | μg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Pb | 0.098 | mg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Cd | 0.008 | mg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Hg | 0.049 | mg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | As | 0.0265 | mg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Cr | 0.041 | mg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Cu | 0.0647 | mg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Ni | 0.049 | mg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Se | 0.0253 | mg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Zn | 0.424 | mg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | HCB | 4.6 | μg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | PCBs | 103 | μg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | DIOX | 4.1 | μg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Benzo(a) | 6.5E-05 | μg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Benzo(b) | 0.00028 | μg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Benzo(k) | 7.7E-05 | μg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | Indeno | 4.3E-05 | μg/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | SO2 | 2333.9 | g/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | NOX | 2482.01 | g/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | NMVOC | 18 | g/GJ |
| 6419 | CALUCEM_2016 | 1.A.2.f.1 | CO | 16617.8 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | PM25 | 1.93 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | PM10 | 1.93 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Benzo(k) | 1.7 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Indeno | 1.5 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | DIOX | 1.4 | ng/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Hg | 0.12 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | As | 0.03 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Cd | 0.006 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Cr | 0.2 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Cu | 0.22 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Ni | 0.008 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Pb | 0.08 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Se | 0.11 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Zn | 29 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Benzo(b) | 15 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | BC | 0.93 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | Benzo(a) | 1.9 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | SO2 | 57.38 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | NOX | 228.86 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | NMVOC | 13.79 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | CO | 325.36 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.1.1 | TSP | 1.93 | g/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | PM25 | 1.93 | g/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | PM10 | 1.93 | g/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Benzo(k) | 1.7 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Indeno | 1.5 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | DIOX | 1.4 | ng/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Hg | 0.12 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | As | 0.03 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Cd | 0.006 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Cr | 0.2 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Cu | 0.22 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Ni | 0.008 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Pb | 0.08 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Se | 0.11 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Zn | 29 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Benzo(b) | 15 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | BC | 0.93 | g/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | Benzo(a) | 1.9 | mg/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | SO2 | 57.38 | g/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | NOX | 228.86 | g/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | NMVOC | 13.79 | g/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | CO | 325.36 | g/GJ |
| 6166 | 1.A.3.a_kerosene_LTO2_2016 | 1.A.3.a.1.1 | TSP | 1.93 | g/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Hg | 0.12 | g/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | As | 0.03 | g/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Cd | 0.006 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Cr | 0.2 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Cu | 0.22 | ng/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Ni | 0.008 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Pb | 0.08 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Se | 0.11 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Zn | 29 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Benzo(b) | 15 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Benzo(a) | 1.9 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | SO2 | 57.38 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | NOX | 291.17 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | NMVOC | 11.37 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | CO | 25.02 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | TSP | 4.55 | g/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | PM25 | 4.55 | mg/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | PM10 | 4.55 | g/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Benzo(k) | 1.7 | g/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | Indeno | 1.5 | g/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | DIOX | 1.4 | g/GJ |
| 6167 | 1.A.3.a_kerosene_cruise2_2016 | 1.A.3.a.1.2 | BC | 2.18 | g/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | Cu | 60.555 | mg/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | Ni | 0.77 | mg/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | Pb | 6140.899 | mg/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | Se | 0.072 | mg/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | Zn | 71.602 | mg/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | Benzo(b) | 226.509 | mg/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | Benzo(a) | 137.657 | mg/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | SO2 | 0.207 | g/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | NOX | 89.706 | g/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | NH3 | 7.04 | g/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | NMVOC | 426.105 | g/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | CO | 26911.864 | g/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | TSP | 6.099 | g/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | PM25 | 3.626 | g/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | PM10 | 6.099 | g/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | Benzo(k) | 92.881 | mg/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | Indeno | 261.54 | mg/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | DIOX | 0.006 | ng/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | Cd | 0.276 | mg/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | Cr | 3.008 | mg/GJ |
| 6168 | 1.A.3.a_gasoline_2016 | 1.A.3.a.2.1 | BC | 0.544 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | PM25 | 1.93 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | PM10 | 1.93 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Benzo(k) | 1.7 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Indeno | 1.5 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | DIOX | 1.4 | ng/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Hg | 0.12 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | As | 0.03 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Cd | 0.006 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Cr | 0.2 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Cu | 0.22 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Ni | 0.008 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Pb | 0.08 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Se | 0.11 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Zn | 29 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Benzo(b) | 15 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | BC | 0.93 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | Benzo(a) | 1.9 | mg/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | SO2 | 57.38 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | NOX | 228.86 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | NMVOC | 13.79 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | CO | 325.36 | g/GJ |
| 6165 | 1.A.3.a_kerosene_LTO1_2016 | 1.A.3.a.2.1 | TSP | 1.93 | g/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Benzo(b) | 15 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Benzo(a) | 1.9 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | SO2 | 57.38 | g/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | NOX | 234.3 | g/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | NMVOC | 2.27 | g/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | CO | 45.5 | g/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | TSP | 4.55 | g/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | PM25 | 4.55 | g/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | PM10 | 4.55 | g/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Benzo(k) | 1.7 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Indeno | 1.5 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | DIOX | 1.4 | ng/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Hg | 0.12 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | As | 0.03 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Cd | 0.006 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Cr | 0.2 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Cu | 0.22 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Ni | 0.008 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Pb | 0.08 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Se | 0.11 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | Zn | 29 | mg/GJ |
| 6096 | 1.A.3.a_kerosene_cruise1_2016 | 1.A.3.a.2.2 | BC | 2.18 | g/GJ |
| 4725 | 1.A.3.b.7-Passenger Cars | 1.A.3.b.7 | TSP | 15 | g/k(veh*km) |
| 4725 | 1.A.3.b.7-Passenger Cars | 1.A.3.b.7 | PM25 | 4.1 | g/k(veh*km) |
| 4725 | 1.A.3.b.7-Passenger Cars | 1.A.3.b.7 | PM10 | 7.5 | g/k(veh*km) |
| 4726 | 1.A.3.b.7-Two-wheelers | 1.A.3.b.7 | TSP | 6 | g/k(veh*km) |
| 4726 | 1.A.3.b.7-Two-wheelers | 1.A.3.b.7 | PM25 | 1.6 | g/k(veh*km) |
| 4726 | 1.A.3.b.7-Two-wheelers | 1.A.3.b.7 | PM10 | 3 | g/k(veh*km) |
| 4723 | 1.A.3.b.7-Heavy Duty Vehicles | 1.A.3.b.7 | TSP | 76 | g/k(veh*km) |
| 4723 | 1.A.3.b.7-Heavy Duty Vehicles | 1.A.3.b.7 | PM25 | 20.5 | g/k(veh*km) |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 4723 | 1.A.3.b.7-Heavy Duty Vehicles | 1.A.3.b.7 | PM10 | 38 | g/k(veh*km) |
| 4724 | 1.A.3.b.7-Light Duty Vehicles | 1.A.3.b.7 | TSP | 15 | g/k(veh*km) |
| 4724 | 1.A.3.b.7-Light Duty Vehicles | 1.A.3.b.7 | PM25 | 4.1 | g/k(veh*km) |
| 4724 | 1.A.3.b.7-Light Duty Vehicles | 1.A.3.b.7 | PM10 | 7.5 | g/k(veh*km) |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Ni | 1.64 | mg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | NH3 | 0.16 | g/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Pb | 0.08 | mg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Se | 0.23 | mg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Zn | 23.41 | mg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | DIOX | 1.4 | ng/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Benzo(b) | 1.17 | mg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Benzo(k) | 1.7 | µg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Benzo(a) | 0.7 | mg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Indeno | 1.5 | µg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | SO2 | 0.3 | g/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | NOX | 1226.88 | g/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | NMVOC | 108.87 | g/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | CO | 250.53 | g/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | TSP | 35.59 | g/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | PM25 | 32.08 | g/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | PM10 | 33.72 | g/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | BC | 0.21 | g/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | As | 0.03 | mg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Cd | 0.23 | mg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Cr | 1.17 | mg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Cu | 39.8 | mg/GJ |
| 6425 | 1.A.3.c_diesel-2016 | 1.A.3.c | Hg | 0.12 | mg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | As | 0.94 | mg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | Hg | 0.7 | mg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | Pb | 3.04 | mg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | HCB | 1.87 | µg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | DIOX | 3.04 | µg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | PCBs | 0.89 | ng/GJ |
| 5980 | International navigation | 1.A.3.d.1 | Cd | 0.234 | mg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | Cr | 1.171 | mg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | Cu | 20.604 | mg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | Ni | 23.414 | mg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | Se | 2.341 | mg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | Zn | 28.096 | mg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | Benzo(b) | 1170.686 | µg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | Benzo(a) | 702.412 | µg/GJ |
| 5980 | International navigation | 1.A.3.d.1 | SO2 | 46.83 | g/GJ |
| 5980 | International navigation | 1.A.3.d.1 | NOX | 1837.98 | g/GJ |
| 5980 | International navigation | 1.A.3.d.1 | NH3 | 0.164 | g/GJ |
| 5980 | International navigation | 1.A.3.d.1 | NMVOC | 65.56 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5980 | International navigation | 1.A.3.d.1 | CO | 173.26 | g/GJ |
| 5980 | International navigation | 1.A.3.d.1 | TSP | 35.12 | g/GJ |
| 5980 | International navigation | 1.A.3.d.1 | PM10 | 35.12 | g/GJ |
| 5980 | International navigation | 1.A.3.d.1 | PM25 | 32.78 | g/GJ |
| 5980 | International navigation | 1.A.3.d.1 | BC | 0.102 | g/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | As | 0.94 | mg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | Cd | 0.234 | g/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | Cr | 1.171 | mg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | Cu | 39.803 | mg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | Ni | 1.639 | mg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | Se | 0.234 | ng/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | Zn | 23.414 | mg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | Benzo(b) | 1170.686 | µg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | Benzo(a) | 702.412 | mg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | SO2 | 0.3 | µg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | NOX | 899.09 | g/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | NH3 | 163.9 | g/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | NMVOC | 174.43 | g/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | CO | 463.59 | g/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | TSP | 107.7 | g/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | PM10 | 107.7 | g/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | PM25 | 107.7 | g/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | Hg | 0.7 | g/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | Pb | 3.04 | mg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | HCB | 1.87 | mg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | DIOX | 3.04 | mg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | PCBs | 8.9 | mg/GJ |
| 6426 | 1.A.3.d.2_diesel_2016 | 1.A.3.d.2 | BC | 0.59 | mg/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | Pb | 3.04 | mg/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | HCB | 1.87 | µg/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | DIOX | 3.04 | ng/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | PCBs | 0.89 | µg/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | As | 0.94 | mg/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | Cd | 0.234 | mg/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | Cr | 1.171 | mg/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | Cu | 20.604 | mg/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | Ni | 23.414 | mg/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | Se | 2.341 | mg/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | BC | 0.59 | g/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | Zn | 28.096 | mg/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | SO2 | 0.3 | g/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | NOX | 899.09 | g/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | NH3 | 0.164 | g/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | NMVOC | 174.43 | g/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | CO | 463.59 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | TSP | 107.7 | g/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | PM10 | 107.7 | g/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | PM25 | 107.7 | g/GJ |
| 6427 | 1.A.3.d.ii_gas oil/diesel_2016 | 1.A.3.d.2 | Hg | 0.7 | mg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | Hg | 0.5 | mg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | Pb | 4.48 | mg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | HCB | 3.48 | mg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | PCBs | 14.18 | mg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | DIOX | 11.69 | mg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | Cd | 0.5 | mg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | Cr | 17.91 | mg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | Cu | 31.1 | µg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | Ni | 796.22 | µg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | Se | 5.23 | g/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | Zn | 29.86 | g/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | Benzo(b) | 1244.091 | mg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | Benzo(a) | 746.454 | g/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | SO2 | 445.38 | g/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | NOX | 1973.13 | g/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | NH3 | 0.174 | g/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | NMVOC | 67.18 | g/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | CO | 184.13 | mg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | TSP | 154.27 | mg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | PM10 | 154.27 | µg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | PM25 | 139.34 | ng/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | BC | 0.167 | µg/GJ |
| 6436 | 1.A.3.d.ii_ fuel oil_2016 | 1.A.3.d.2 | As | 16.92 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Pb | 0.011 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Se | 0.058 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Zn | 0.73 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | DIOX | 0.52 | ng/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(b) | 2.9 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(k) | 1.1 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(a) | 0.72 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Indeno | 1.08 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | SO2 | 0.67 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | NOX | 74 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | NMVOC | 23 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | CO | 29 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | TSP | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | PM25 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | PM10 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | BC | 0.0312 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | As | 0.1 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Cd | 1.8 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5294 | gaseous fuel | 1.A.4.a.1 | Cr | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Cu | 0.0026 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Hg | 0.54 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Ni | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | NH3 | 0.15 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Pb | 0.011 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Se | 0.058 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Zn | 0.73 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | DIOX | 0.52 | ng/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(b) | 2.9 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(k) | 1.1 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(a) | 0.72 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Indeno | 1.08 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | SO2 | 0.67 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | NOX | 74 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | NMVOC | 23 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | CO | 29 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | TSP | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | PM25 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | PM10 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | BC | 0.0312 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | As | 0.1 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Cd | 1.8 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Cr | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Cu | 0.0026 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Hg | 0.54 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Ni | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | NH3 | 0.15 | g/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Pb | 134 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Se | 1.8 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Zn | 200 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | DIOX | 203 | ng/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Benzo(b) | 58.9 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Benzo(k) | 23.7 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Benzo(a) | 45.5 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Indeno | 18.5 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | SO2 | 2469.14 | g/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | NOX | 173 | g/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | NH3 | 0.3 | g/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | NMVOC | 88.8 | g/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | CO | 931 | g/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | TSP | 124 | g/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | PM25 | 108 | g/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | PM10 | 117 | g/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | BC | 6.912 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5290 | sub-bituminous coal | 1.A.4.a.1 | PCBs | 170 | µg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | HCB | 0.62 | µg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | As | 4 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Cd | 1.8 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Cr | 13.5 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Cu | 17.5 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Hg | 7.9 | mg/GJ |
| 5290 | sub-bituminous coal | 1.A.4.a.1 | Ni | 13 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | Pb | 134 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | Se | 1.8 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | Zn | 200 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | DIOX | 203 | ng/GJ |
| 5291 | lignit | 1.A.4.a.1 | Benzo(b) | 58.9 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | Benzo(k) | 23.7 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | Benzo(a) | 45.5 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | Indeno | 18.5 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | SO2 | 1648.35 | g/GJ |
| 5291 | lignit | 1.A.4.a.1 | NOX | 173 | g/GJ |
| 5291 | lignit | 1.A.4.a.1 | NH3 | 0.3 | g/GJ |
| 5291 | lignit | 1.A.4.a.1 | NMVOC | 88.8 | g/GJ |
| 5291 | lignit | 1.A.4.a.1 | CO | 931 | g/GJ |
| 5291 | lignit | 1.A.4.a.1 | TSP | 124 | g/GJ |
| 5291 | lignit | 1.A.4.a.1 | PM25 | 108 | g/GJ |
| 5291 | lignit | 1.A.4.a.1 | PM10 | 117 | g/GJ |
| 5291 | lignit | 1.A.4.a.1 | BC | 6.912 | g/GJ |
| 5291 | lignit | 1.A.4.a.1 | PCBs | 170 | µg/GJ |
| 5291 | lignit | 1.A.4.a.1 | HCB | 0.62 | µg/GJ |
| 5291 | lignit | 1.A.4.a.1 | As | 4 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | Cd | 1.8 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | Cr | 13.5 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | Cu | 17.5 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | Hg | 7.9 | mg/GJ |
| 5291 | lignit | 1.A.4.a.1 | Ni | 13 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | Pb | 27 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | Se | 0.5 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | Zn | 512 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | DIOX | 100 | ng/GJ |
| 5295 | biomass | 1.A.4.a.1 | Benzo(b) | 16 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | Benzo(k) | 5 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | Benzo(a) | 10 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | Indeno | 4 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | SO2 | 11 | g/GJ |
| 5295 | biomass | 1.A.4.a.1 | NOX | 91 | g/GJ |
| 5295 | biomass | 1.A.4.a.1 | NH3 | 37 | g/GJ |
| 5295 | biomass | 1.A.4.a.1 | NMVOC | 300 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5295 | biomass | 1.A.4.a.1 | CO | 570 | g/GJ |
| 5295 | biomass | 1.A.4.a.1 | TSP | 150 | g/GJ |
| 5295 | biomass | 1.A.4.a.1 | PM25 | 140 | g/GJ |
| 5295 | biomass | 1.A.4.a.1 | PM10 | 143 | g/GJ |
| 5295 | biomass | 1.A.4.a.1 | BC | 39.2 | g/GJ |
| 5295 | biomass | 1.A.4.a.1 | PCBs | 0.06 | µg/GJ |
| 5295 | biomass | 1.A.4.a.1 | HCB | 5 | µg/GJ |
| 5295 | biomass | 1.A.4.a.1 | As | 0.19 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | Cd | 13 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | Cr | 23 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | Cu | 6 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | Hg | 0.56 | mg/GJ |
| 5295 | biomass | 1.A.4.a.1 | Ni | 2 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Pb | 0.011 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Se | 0.058 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Zn | 0.73 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | DIOX | 0.52 | ng/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(b) | 2.9 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(k) | 1.1 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(a) | 0.72 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Indeno | 1.08 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | SO2 | 0.67 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | NOX | 74 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | NMVOC | 23 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | CO | 29 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | TSP | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | PM25 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | PM10 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | BC | 0.0312 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | As | 0.1 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Cd | 1.8 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Cr | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Cu | 0.0026 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Hg | 0.54 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Ni | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | NH3 | 0.15 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Pb | 0.011 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Se | 0.058 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Zn | 0.73 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | DIOX | 0.52 | ng/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(b) | 2.9 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(k) | 1.1 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Benzo(a) | 0.72 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Indeno | 1.08 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | SO2 | 0.67 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5294 | gaseous fuel | 1.A.4.a.1 | NOX | 74 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | NMVOC | 23 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | CO | 29 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | TSP | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | PM25 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | PM10 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | BC | 0.0312 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | As | 0.1 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Cd | 1.8 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Cr | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Cu | 0.0026 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Hg | 0.54 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | Ni | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.a.1 | NH3 | 0.15 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Pb | 0.08 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Se | 0.11 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Zn | 29 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | DIOX | 1.4 | ng/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Benzo(b) | 15 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Benzo(k) | 1.7 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Benzo(a) | 1.9 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Indeno | 1.5 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | SO2 | 37.46 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | NOX | 513 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | NMVOC | 25 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | CO | 66 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | TSP | 20 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | PM25 | 20 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | PM10 | 20 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | BC | 11.2 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | As | 0.03 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Cd | 0.006 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Cr | 0.2 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Cu | 0.22 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Hg | 0.12 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | Ni | 0.008 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.a.1 | NH3 | 0.01 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Pb | 0.08 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Se | 0.11 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Zn | 29 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | DIOX | 1.4 | ng/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Benzo(b) | 15 | µg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Benzo(k) | 1.7 | µg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Benzo(a) | 1.9 | µg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Indeno | 1.5 | µg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6421 | residual fuel_2016 | 1.A.4.a.1 | SO2 | 445.38 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | NOX | 513 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | NMVOC | 25 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | CO | 66 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | TSP | 20 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | PM25 | 20 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | PM10 | 20 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | BC | 11.2 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | As | 0.03 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Cd | 0.006 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Cr | 0.2 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Cu | 0.22 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Hg | 0.12 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | Ni | 0.008 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.a.1 | NH3 | 0.01 | g/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Pb | 27 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Se | 0.5 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Zn | 512 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | DIOX | 550 | ng/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Benzo(b) | 111 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Benzo(k) | 42 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Benzo(a) | 121 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Indeno | 71 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | SO2 | 11 | g/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | NOX | 80 | g/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | NH3 | 74 | g/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | NMVOC | 350 | g/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | CO | 4000 | g/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | TSP | 500 | g/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | PM25 | 470 | g/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | PM10 | 480 | g/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | BC | 75.2 | g/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | PCBs | 0.06 | µg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | HCB | 5 | µg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | As | 0.19 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Cd | 13 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Cr | 23 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Cu | 6 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Hg | 0.56 | mg/GJ |
| 5155 | Single house boilers <50kWth | 1.A.4.b.1 | Ni | 2 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | Pb | 27 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | Se | 0.5 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | Zn | 512 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | DIOX | 800 | ng/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | Benzo(b) | 111 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5154 | Open fireplaces | 1.A.4.b.1 | Benzo(k) | 42 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | Benzo(a) | 121 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | Indeno | 71 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | SO2 | 11 | g/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | NOX | 50 | g/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | NH3 | 74 | g/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | NMVOC | 600 | g/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | CO | 4000 | g/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | TSP | 880 | g/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | PM25 | 820 | g/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | PM10 | 840 | g/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | BC | 57.4 | g/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | PCBs | 0.06 | µg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | HCB | 5 | µg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | As | 0.19 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | Cd | 13 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | Cr | 23 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | Cu | 6 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | Hg | 0.56 | mg/GJ |
| 5154 | Open fireplaces | 1.A.4.b.1 | Ni | 2 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Pb | 27 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Se | 0.5 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Zn | 512 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | DIOX | 800 | ng/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Benzo(b) | 111 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Benzo(k) | 42 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Benzo(a) | 121 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Indeno | 71 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | SO2 | 11 | g/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | NOX | 50 | g/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | NH3 | 70 | g/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | NMVOC | 600 | g/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | CO | 4000 | g/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | TSP | 800 | g/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | PM25 | 740 | g/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | PM10 | 760 | g/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | BC | 74 | g/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | PCBs | 0.06 | µg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | HCB | 5 | µg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | As | 0.19 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Cd | 13 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Cr | 23 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Cu | 6 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Hg | 0.56 | mg/GJ |
| 5156 | Domestic stoves | 1.A.4.b.1 | Ni | 2 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Pb | 27 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Se | 0.5 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Zn | 512 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | DIOX | 100 | ng/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Benzo(b) | 16 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Benzo(k) | 5 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Benzo(a) | 10 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Indeno | 4 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | SO2 | 11 | g/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | NOX | 80 | g/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | NH3 | 12 | g/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | NMVOC | 10 | g/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | CO | 300 | g/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | TSP | 31 | g/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | PM25 | 29 | g/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | PM10 | 29 | g/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | BC | 4.35 | g/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | PCBs | 0.01 | µg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | HCB | 5 | µg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | As | 0.19 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Cd | 13 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Cr | 23 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Cu | 6 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Hg | 0.56 | mg/GJ |
| 5825 | Pellete stoves and boilers | 1.A.4.b.1 | Ni | 2 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Pb | 27 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Se | 0.5 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Zn | 512 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | DIOX | 100 | ng/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Benzo(b) | 16 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Benzo(k) | 5 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Benzo(a) | 10 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Indeno | 4 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | SO2 | 11 | g/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | NOX | 95 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | NH3 | 37 | g/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | NMVOC | 250 | g/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | CO | 2000 | g/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | TSP | 100 | g/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | PM25 | 93 | g/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | PM10 | 95 | g/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | BC | 26.04 | g/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | PCBs | 0.007 | µg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | HCB | 5 | µg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | As | 0.19 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Cd | 13 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Cr | 23 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Cu | 6 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Hg | 0.56 | mg/GJ |
| 5878 | Advanced/ecolabelled stoves and boilers | 1.A.4.b.1 | Ni | 2 | mg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Pb | 100 | mg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Se | 2 | mg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Zn | 200 | mg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | DIOX | 1000 | ng/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Benzo(b) | 400 | µg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Benzo(k) | 150 | µg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Benzo(a) | 250 | µg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Indeno | 120 | µg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | SO2 | 1648.35 | g/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | NOX | 100 | g/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | NH3 | 0.3 | g/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | NMVOC | 600 | g/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | CO | 5000 | g/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | TSP | 500 | g/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | PM25 | 450 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | PM10 | 450 | g/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | BC | 28.8 | g/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | PCBs | 170 | μg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | HCB | 0.62 | μg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | As | 1.5 | mg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Cd | 1 | mg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Cr | 10 | mg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Cu | 20 | mg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Hg | 5 | mg/GJ |
| 5237 | BC - Sub-bituminous_STOVES | 1.A.4.b.1 | Ni | 10 | mg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Pb | 200 | mg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Se | 2 | mg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Zn | 300 | mg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | DIOX | 500 | ng/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Benzo(b) | 250 | μg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Benzo(k) | 100 | μg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Benzo(a) | 270 | μg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Indeno | 90 | μg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | SO2 | 1648.35 | g/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | NOX | 158 | g/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | NH3 | 0.3 | g/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | NMVOC | 174 | g/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | CO | 4787 | g/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | TSP | 261 | g/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | PM25 | 201 | g/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | PM10 | 225 | g/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | BC | 12.864 | g/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | PCBs | 170 | μg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | HCB | 0.62 | μg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | As | 5 | mg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Cd | 4 | mg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Cr | 15 | mg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Cu | 30 | mg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Hg | 6 | mg/GJ |
| 5236 | BC - Sub-bituminous_SHB | 1.A.4.b.1 | Ni | 20 | mg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Pb | 100 | mg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Se | 2 | mg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Zn | 200 | mg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | DIOX | 1000 | ng/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Benzo(b) | 400 | μg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Benzo(k) | 150 | μg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Benzo(a) | 250 | μg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Indeno | 120 | μg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | SO2 | 2469.14 | g/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | NOX | 100 | g/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | NH3 | 0.3 | g/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | NMVOC | 600 | g/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | CO | 5000 | g/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | TSP | 500 | g/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | PM25 | 450 | g/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | PM10 | 450 | g/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | BC | 28.8 | g/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | PCBs | 170 | µg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | HCB | 0.62 | µg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | As | 1.5 | mg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Cd | 1 | mg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Cr | 10 | mg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Cu | 20 | mg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Hg | 5 | mg/GJ |
| 5231 | BC - Lignit_STOVES | 1.A.4.b.1 | Ni | 10 | mg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Pb | 200 | mg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Se | 2 | mg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Zn | 300 | mg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | DIOX | 500 | ng/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Benzo(b) | 250 | µg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Benzo(k) | 100 | µg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Benzo(a) | 270 | µg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Indeno | 90 | µg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | SO2 | 2469.14 | g/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | NOX | 158 | g/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | NH3 | 0.3 | g/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | NMVOC | 174 | g/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | CO | 4787 | g/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | TSP | 261 | g/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | PM25 | 201 | g/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | PM10 | 225 | g/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | BC | 12.864 | g/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | PCBs | 170 | µg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | HCB | 0.62 | µg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | As | 5 | mg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Cd | 4 | mg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Cr | 15 | mg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Cu | 30 | mg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Hg | 6 | mg/GJ |
| 5235 | BC - Lignit_SHB | 1.A.4.b.1 | Ni | 20 | mg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | Pb | 0.0015 | mg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | Se | 0.011 | mg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | Zn | 0.0015 | mg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | DIOX | 1.5 | ng/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | Benzo(b) | 0.84 | µg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5157 | Gaseous fuels | 1.A.4.b.1 | Benzo(k) | 0.84 | µg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | Benzo(a) | 0.56 | µg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | Indeno | 0.84 | µg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | SO2 | 0.3 | g/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | NOX | 51 | g/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | NMVOC | 1.9 | g/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | CO | 26 | g/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | TSP | 1.2 | g/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | PM25 | 1.2 | g/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | PM10 | 1.2 | g/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | BC | 0.06 | g/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | As | 0.12 | mg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | Cd | 0.00025 | mg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | Cr | 0.00076 | mg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | Cu | 7.6E-05 | mg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | Hg | 0.68 | mg/GJ |
| 5157 | Gaseous fuels | 1.A.4.b.1 | Ni | 0.00051 | mg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Cd | 0.001 | mg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Cr | 0.2 | mg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Cu | 0.13 | mg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Hg | 0.12 | mg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Ni | 0.005 | mg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Pb | 0.012 | mg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Se | 0.002 | mg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Zn | 0.42 | mg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | DIOX | 5.9 | ng/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Benzo(b) | 40 | µg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Benzo(k) | 70 | µg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Benzo(a) | 80 | µg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | Indeno | 160 | µg/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | SO2 | 445.38 | g/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | NOX | 51 | g/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | NMVOC | 0.69 | g/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | CO | 57 | g/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | TSP | 1.9 | g/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | PM25 | 1.9 | g/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | PM10 | 1.9 | g/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | BC | 0.16 | g/GJ |
| 6423 | LF-HFO_2016 | 1.A.4.b.1 | As | 0.002 | mg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | TSP | 1.9 | g/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | PM25 | 1.9 | g/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | PM10 | 1.9 | g/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | BC | 0.16 | g/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | As | 0.002 | mg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Cd | 0.001 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Cr | 0.2 | mg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Cu | 0.13 | mg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Hg | 0.12 | mg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Ni | 0.005 | mg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Pb | 0.012 | mg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Se | 0.002 | mg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Zn | 0.42 | mg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | DIOX | 5.9 | ng/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Benzo(b) | 40 | µg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Benzo(k) | 70 | µg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Benzo(a) | 80 | µg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | Indeno | 160 | µg/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | SO2 | 37.46 | g/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | NOX | 51 | g/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | NMVOC | 0.69 | g/GJ |
| 6422 | LF-GO_2016 | 1.A.4.b.1 | CO | 57 | g/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | PM10 | 1.9 | g/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | BC | 0.16 | g/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | As | 0.002 | mg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Cd | 0.001 | mg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Cr | 0.2 | mg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Cu | 0.13 | mg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Hg | 0.12 | mg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Ni | 0.005 | mg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Pb | 0.012 | mg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Se | 0.002 | mg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Zn | 0.42 | mg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | DIOX | 5.9 | ng/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Benzo(b) | 40 | µg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Benzo(k) | 70 | µg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Benzo(a) | 80 | µg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | Indeno | 160 | µg/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | SO2 | 57.38 | g/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | NOX | 51 | g/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | NMVOC | 0.69 | g/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | CO | 57 | g/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | TSP | 1.9 | g/GJ |
| 6424 | LF-KER_2016 | 1.A.4.b.1 | PM25 | 1.9 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | Pb | 0.011 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | Se | 0.058 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | Zn | 0.73 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | DIOX | 0.52 | ng/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | Benzo(b) | 2.9 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | Benzo(k) | 1.1 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | Benzo(a) | 0.72 | µg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5294 | gaseous fuel | 1.A.4.c.1 | Indeno | 1.08 | µg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | SO2 | 0.67 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | NOX | 74 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | NMVOC | 23 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | CO | 29 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | TSP | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | PM25 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | PM10 | 0.78 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | BC | 0.0312 | g/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | As | 0.1 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | Cd | 1.8 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | Cr | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | Cu | 0.0026 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | Hg | 0.54 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | Ni | 0.013 | mg/GJ |
| 5294 | gaseous fuel | 1.A.4.c.1 | NH3 | 0.15 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Pb | 0.08 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Se | 0.11 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Zn | 29 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | DIOX | 1.4 | ng/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Benzo(b) | 15 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Benzo(k) | 1.7 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Benzo(a) | 1.9 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Indeno | 1.5 | µg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | SO2 | 37.46 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | NOX | 513 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | NMVOC | 25 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | CO | 66 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | TSP | 20 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | PM25 | 20 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | PM10 | 20 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | BC | 11.2 | g/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | As | 0.03 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Cd | 0.006 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Cr | 0.2 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Cu | 0.22 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Hg | 0.12 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | Ni | 0.008 | mg/GJ |
| 6420 | gas oil_2016 | 1.A.4.c.1 | NH3 | 0.01 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Pb | 0.08 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Se | 0.11 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Zn | 29 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | DIOX | 1.4 | ng/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Benzo(b) | 15 | µg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Benzo(k) | 1.7 | µg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Benzo(a) | 1.9 | µg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Indeno | 1.5 | µg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | SO2 | 445.38 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | NOX | 513 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | NMVOC | 25 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | CO | 66 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | TSP | 20 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | PM25 | 20 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | PM10 | 20 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | BC | 11.2 | g/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | As | 0.03 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Cd | 0.006 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Cr | 0.2 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Cu | 0.22 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Hg | 0.12 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | Ni | 0.008 | mg/GJ |
| 6421 | residual fuel_2016 | 1.A.4.c.1 | NH3 | 0.01 | g/GJ |
| 3824 | 1.B.2.a.1_201A | 1.B.2.a.1 | NMVOC | 0.095 | kg/t |
| 4504 | Sulphur recovery plants | 1.B.2.a.4 | SO2 | 140 | kg/t |
| 4505 | Fluid coking units | 1.B.2.a.4 | As | 2.2 | g/m3 |
| 4505 | Fluid coking units | 1.B.2.a.4 | Cu | 0.015 | g/m3 |
| 4505 | Fluid coking units | 1.B.2.a.4 | Hg | 0.03 | g/m3 |
| 4505 | Fluid coking units | 1.B.2.a.4 | Ni | 0.57 | g/m3 |
| 4505 | Fluid coking units | 1.B.2.a.4 | Pb | 0.045 | g/m3 |
| 4505 | Fluid coking units | 1.B.2.a.4 | Zn | 0.045 | g/m3 |
| 4505 | Fluid coking units | 1.B.2.a.4 | NMVOC | 0.046 | kg/m3 |
| 4505 | Fluid coking units | 1.B.2.a.4 | PM10 | 0.77 | kg/m3 |
| 4505 | Fluid coking units | 1.B.2.a.4 | TSP | 1.5 | kg/m3 |
| 4505 | Fluid coking units | 1.B.2.a.4 | PM25 | 0.33 | kg/m3 |
| 4505 | Fluid coking units | 1.B.2.a.4 | Se | 0.03 | g/m3 |
| 4506 | Diffuse NMVOC emissions | 1.B.2.a.4 | NMVOC | 0.2 | kg/t |
| 4502 | Catalytic reforming units | 1.B.2.a.4 | SO2 | 4 | g/m3 |
| 4502 | Catalytic reforming units | 1.B.2.a.4 | CO | 42 | g/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | As | 0.014 | g/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | Cd | 0.063 | g/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | Cu | 0.14 | g/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | Hg | 0.07 | g/m3 |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | Ni | 0.61 | g/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | Pb | 0.32 | g/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | Zn | 0.12 | g/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | SO2 | 1.4 | kg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | NOX | 0.2 | kg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | NH3 | 0.16 | kg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | NMVOC | 0.63 | kg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | CO | 39 | kg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | PM10 | 0.55 | kg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | TSP | 0.7 | kg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | PM25 | 0.24 | kg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | BC | 0.000312 | kg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | Se | 0.014 | g/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | DIOX | 0.019 | µg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | Cr | 0.33 | g/m3 |
| 4503 | Catalytic Cracking unit | 1.B.2.a.4 | Benzo(b) | 1.2 | mg/m3 |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| | regenerators-Partial burn without CO boiler | | | | |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | Benzo(k) | 0.82 | mg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | Benzo(a) | 0.71 | mg/m3 |
| 4503 | Catalytic Cracking unit regenerators-Partial burn without CO boiler | 1.B.2.a.4 | Indeno | 0.62 | mg/m3 |
| 3826 | Imported oil | 1.B.2.a.5 | NMVOC | 0.3 | kg/t |
| 3827 | Total crude oil | 1.B.2.a.5 | NMVOC | 0.02 | kg/t |
| 6123 | Road tanker, bottom loading, VRU | 1.B.2.a.5 | NMVOC | 0.247 | kg/kt*kPa |
| 6126 | Marine tanker, uncontrolled | 1.B.2.a.5 | NMVOC | 5.48 | kg/kt*kPa |
| 6127 | Storage tank-Filling without Stage 1B | 1.B.2.a.5 | NMVOC | 32.88 | kg/kt*kPa |
| 6128 | Storage tank-Breathing | 1.B.2.a.5 | NMVOC | 4.11 | kg/kt*kPa |
| 6129 | Storage tank-Auto refuelling uncontrolled | 1.B.2.a.5 | NMVOC | 50.68 | kg/kt*kPa |
| 6130 | Storage tank-Auto refuelling: drips and spills | 1.B.2.a.5 | NMVOC | 2.74 | kg/kt*kPa |
| 6123 | Road tanker, bottom loading, VRU | 1.B.2.a.5 | NMVOC | 0.247 | kg/kt*kPa |
| 6125 | Rail tanker, VRU | 1.B.2.a.5 | NMVOC | 0.301 | kg/kt*kPa |
| 6125 | Rail tanker, VRU | 1.B.2.a.5 | NMVOC | 0.301 | kg/kt*kPa |
| 6122 | Road tanker, top loading | 1.B.2.a.5 | NMVOC | 12.33 | kg/kt*kPa |
| 6124 | Rail tanker, uncontrolled | 1.B.2.a.5 | NMVOC | 15.07 | kg/kt*kPa |
| 6124 | Rail tanker, uncontrolled | 1.B.2.a.5 | NMVOC | 15.07 | kg/kt*kPa |
| 4836 | CPS I, II, III_2011 | 1.B.2.b.1 | Hg | 0.041 | kg DE |
| 5975 | 1.B.2.b.1 | 1.B.2.b.1 | NMVOC | 0.1 | kg/1000 m3 |
| 6433 | 1.B.2.b.ii_NG transmission_2015 | 1.B.2.b.2 | NMVOC | 10.26 | kg/1000 m3 |
| 6132 | INA-RNS | 1.B.2.c.1 | NOX | 32.2 | g/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | CO | 177 | g/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | TSP | 0.89 | g/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | PM25 | 0.89 | g/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | PM10 | 0.89 | g/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | As | 0.3 | mg/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | Cd | 0.7 | mg/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | Cr | 3 | mg/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | Hg | 0.09 | mg/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | Cu | 2 | mg/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | Ni | 4 | mg/GJ |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6132 | INA-RNS | 1.B.2.c.1 | Pb | 2 | mg/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | Zn | 26 | mg/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | Benzo(b) | 1.14 | µg/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | Benzo(k) | 0.63 | µg/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | Benzo(a) | 0.67 | µg/GJ |
| 6132 | INA-RNS | 1.B.2.c.1 | Indeno | 0.63 | µg/GJ |
| 6133 | INA-RNS | 1.B.2.c.1 | SO2 | 77 | g/m3 |
| 6133 | INA-RNS | 1.B.2.c.1 | NMVOC | 2 | g/m3 |
| 6134 | INA-RNR | 1.B.2.c.1 | SO2 | 77 | g/m3 |
| 6134 | INA-RNR | 1.B.2.c.1 | NMVOC | 2 | g/m3 |
| 6135 | INA-RNR | 1.B.2.c.1 | NOX | 32.2 | g/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | CO | 177 | g/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | TSP | 0.89 | g/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | PM25 | 0.89 | g/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | PM10 | 0.89 | g/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | As | 0.3 | mg/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | Cd | 0.7 | mg/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | Cr | 3 | mg/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | Hg | 0.09 | mg/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | Cu | 2 | mg/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | Ni | 4 | mg/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | Pb | 2 | mg/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | Zn | 26 | mg/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | Benzo(b) | 1.14 | µg/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | Benzo(k) | 0.63 | µg/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | Benzo(a) | 0.67 | µg/GJ |
| 6135 | INA-RNR | 1.B.2.c.1 | Indeno | 0.63 | µg/GJ |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | NOX | 1.4 | kg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | NMVOC | 1.8 | kg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | CO | 6.3 | kg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | SO2 | 0.013 | kg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | TSP | 2.6 | kg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | PM25 | 2.6 | kg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | PM10 | 2.6 | kg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | BC | 0.624 | kg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | Pb | 4.9 | mg/t waste gas |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | Cd | 20 | mg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | Hg | 4.7 | mg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | As | 3.8 | mg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | Cr | 1.3 | mg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | Cu | 1.6 | mg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | Ni | 38 | mg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | Zn | 520 | mg/t waste gas |
| 198 | 1.B.2.c.2_Venting and flaring (gas) | 1.B.2.c.2 | Se | 0.43 | mg/t waste gas |
| 4448 | Forest Fires | 11.A | SO2 | 20 | kg/ha |
| 4448 | Forest Fires | 11.A | NOX | 100 | kg/ha |
| 4448 | Forest Fires | 11.A | NH3 | 20 | kg/ha |
| 4448 | Forest Fires | 11.A | NMVOC | 300 | kg/ha |
| 4448 | Forest Fires | 11.A | CO | 3000 | kg/ha |
| 5454 | HOLCIM_abated FE | 2.A.1 | TSP | 18.2 | g/t |
| 5454 | HOLCIM_abated FE | 2.A.1 | PM25 | 78 | g/t |
| 5454 | HOLCIM_abated FE | 2.A.1 | PM10 | 154.44 | g/t |
| 5454 | HOLCIM_abated FE | 2.A.1 | BC | 3.9 | g/t |
| 5372 | CALUCEM_abated FE | 2.A.1 | TSP | 18.2 | g/t |
| 5372 | CALUCEM_abated FE | 2.A.1 | PM25 | 78 | g/t |
| 5372 | CALUCEM_abated FE | 2.A.1 | PM10 | 154.44 | g/t |
| 5372 | CALUCEM_abated FE | 2.A.1 | BC | 3.9 | g/t |
| 5456 | CEMEX_sve godine | 2.A.1 | TSP | 18.2 | g/t |
| 5456 | CEMEX_sve godine | 2.A.1 | PM25 | 78 | g/t |
| 5456 | CEMEX_sve godine | 2.A.1 | PM10 | 154.44 | g/t |
| 5456 | CEMEX_sve godine | 2.A.1 | BC | 3.9 | g/t |
| 5455 | NAŠICECEMENT_sve godine | 2.A.1 | TSP | 18.2 | g/t |
| 5455 | NAŠICECEMENT_sve godine | 2.A.1 | PM25 | 78 | g/t |
| 5455 | NAŠICECEMENT_sve godine | 2.A.1 | PM10 | 154.44 | g/t |
| 5455 | NAŠICECEMENT_sve godine | 2.A.1 | BC | 3.9 | g/t |
| 5128 | 2.A.2_Tier 2_EMEP/EEA2013 | 2.A.2 | TSP | 400 | g/t |
| 5128 | 2.A.2_Tier 2_EMEP/EEA2013 | 2.A.2 | PM25 | 30 | g/t |
| 5128 | 2.A.2_Tier 2_EMEP/EEA2013 | 2.A.2 | PM10 | 200 | g/t |
| 5128 | 2.A.2_Tier 2_EMEP/EEA2013 | 2.A.2 | BC | 0.138 | g/t |
| 103 | Mineral Industry, Asfalt Roofing | 2.A.5 | NMVOC | 130 | g/t |
| 103 | Mineral Industry, Asfalt Roofing | 2.A.5 | CO | 9.5 | g/t |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 103 | Mineral Industry, Asfalt Roofing | 2.A.5 | TSP | 1600 | g/t |
| 103 | Mineral Industry, Asfalt Roofing | 2.A.5 | BC | 0.0104 | g/t |
| 103 | Mineral Industry, Asfalt Roofing | 2.A.5 | PM25 | 80 | g/t |
| 103 | Mineral Industry, Asfalt Roofing | 2.A.5 | PM10 | 400 | g/t |
| 104 | Mineral Production, Road Paving with Asphalt | 2.A.6 | NMVOC | 16 | g/t |
| 104 | Mineral Production, Road Paving with Asphalt | 2.A.6 | TSP | 14000 | g/t |
| 104 | Mineral Production, Road Paving with Asphalt | 2.A.6 | PM25 | 400 | g/t |
| 104 | Mineral Production, Road Paving with Asphalt | 2.A.6 | PM10 | 3000 | g/t |
| 104 | Mineral Production, Road Paving with Asphalt | 2.A.6 | BC | 22.8 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | As | 0.19 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | Cd | 0.13 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | Cr | 0.23 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | Cu | 0.007 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | Hg | 0.003 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | Ni | 0.49 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | Pb | 1.7 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | Se | 0.8 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | Zn | 0.37 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | TSP | 300 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | PM25 | 240 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | PM10 | 270 | g/t |
| 108 | 2.A.7.d_glass production | 2.A.7.1 | BC | 0.1488 | g/t |
| 6139 | Rockwool_2016 | 2.A.7.1 | NH3 | 66.61 | t DE |
| 6139 | Rockwool_2016 | 2.A.7.1 | NMVOC | 35.72 | t DE |
| 6139 | Rockwool_2016 | 2.A.7.1 | TSP | 68.47 | t DE |
| 6139 | Rockwool_2016 | 2.A.7.1 | PM25 | 53.12 | t DE |
| 6139 | Rockwool_2016 | 2.A.7.1 | PM10 | 60.26 | t DE |
| 6139 | Rockwool_2016 | 2.A.7.1 | BC | 1.062344 | t DE |
| 4430 | Mineral Industry, Quaring and mining of minerals other than coal | 2.A.7.a | TSP | 102 | g/t |
| 4430 | Mineral Industry, Quaring and mining of minerals other than coal | 2.A.7.a | PM25 | 5 | g/t |
| 4430 | Mineral Industry, Quaring and mining of minerals other than | 2.A.7.a | PM10 | 50 | g/t |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| | coal | | | | |
| 4432 | Mineral Industry, Construction and demolition | 2.A.7.b | TSP | 0.162 | kg/m2 |
| 4432 | Mineral Industry, Construction and demolition | 2.A.7.b | PM25 | 0.00812 | kg/m2 |
| 4432 | Mineral Industry, Construction and demolition | 2.A.7.b | PM10 | 0.0812 | kg/m2 |
| 6141 | Ammonia-2016 | 2.B.1 | NOX | 1.763 | kg/t |
| 6141 | Ammonia-2016 | 2.B.1 | NH3 | 0.01 | kg/t |
| 6141 | Ammonia-2016 | 2.B.1 | CO | 0.008 | kg/t |
| 6142 | Nitric acid-2016 | 2.B.2 | NOX | 0.61 | kg/t |
| 4436 | Ammonium phosphate production | 2.B.5.a | TSP | 300 | g/t |
| 4436 | Ammonium phosphate production | 2.B.5.a | PM25 | 180 | g/t |
| 4436 | Ammonium phosphate production | 2.B.5.a | PM10 | 240 | g/t |
| 4436 | Ammonium phosphate production | 2.B.5.a | BC | 9 | g/t |
| 5422 | Formaldehid | 2.B.5.a | NMVOC | 7 | kg/t |
| 5422 | Formaldehid | 2.B.5.a | CO | 12 | kg/t |
| 4652 | Expended polystiren foam | 2.B.5.a | NMVOC | 3.2 | kg/t |
| 4652 | Expended polystiren foam | 2.B.5.a | TSP | 30 | g/t |
| 4652 | Expended polystiren foam | 2.B.5.a | PM10 | 24 | g/t |
| 4652 | Expended polystiren foam | 2.B.5.a | PM25 | 18 | g/t |
| 4652 | Expended polystiren foam | 2.B.5.a | BC | 0.324 | g/t |
| 4651 | Polystirene; in primary forms | 2.B.5.a | NMVOC | 120 | g/t |
| 4651 | Polystirene; in primary forms | 2.B.5.a | TSP | 4 | g/t |
| 4651 | Polystirene; in primary forms | 2.B.5.a | PM10 | 3.2 | g/t |
| 4651 | Polystirene; in primary forms | 2.B.5.a | PM25 | 2.4 | g/t |
| 4651 | Polystirene; in primary forms | 2.B.5.a | BC | 0.324 | g/t |
| 4653 | 2.B.5.a_Polyethylene Low Density | 2.B.5.a | NMVOC | 2.4 | kg/t |
| 4653 | 2.B.5.a_Polyethylene Low Density | 2.B.5.a | TSP | 31 | g/t |
| 4653 | 2.B.5.a_Polyethylene Low Density | 2.B.5.a | PM10 | 24.8 | g/t |
| 4653 | 2.B.5.a_Polyethylene Low Density | 2.B.5.a | PM25 | 18.6 | g/t |
| 4653 | 2.B.5.a_Polyethylene Low Density | 2.B.5.a | BC | 0.335 | g/t |
| 6143 | Sulfuric acid-2016 | 2.B.5.a | SO2 | 3.14 | kg/t |
| 6144 | NPK-2016 | 2.B.5.a | NOX | 0.09 | kg/t |
| 6144 | NPK-2016 | 2.B.5.a | NH3 | 6.48 | kg/t |
| 6144 | NPK-2016 | 2.B.5.a | TSP | 0.43 | kg/t |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6145 | Urea-2016 | 2.B.5.a | NH3 | 1.35 | kg/t |
| 6145 | Urea-2016 | 2.B.5.a | TSP | 1.5 | kg/t |
| 6145 | Urea-2016 | 2.B.5.a | PM25 | 0.9 | kg/t |
| 6145 | Urea-2016 | 2.B.5.a | PM10 | 1.2 | kg/t |
| 6145 | Urea-2016 | 2.B.5.a | BC | 0.0162 | kg/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | As | 0.015 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | Cd | 0.2 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | Cr | 0.1 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | Cu | 0.02 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | Hg | 0.05 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | Ni | 0.7 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | Pb | 2.6 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | Zn | 3.6 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | DIOX | 3 | µg/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | PAH | 0.48 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | PCBs | 2.5 | mg/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | SO2 | 60 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | NOX | 130 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | NMVOC | 46 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | CO | 1.7 | kg/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | TSP | 30 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | PM25 | 21 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | PM10 | 24 | g/t |
| 5425 | Steelmaking, Electric Arc Furnace Steel Plant (EAF) | 2.C.1.1 | BC | 0.0756 | g/t |
| 4428 | Rolling mills - hot | 2.C.1.5 | NMVOC | 7 | g/t |
| 4428 | Rolling mills - hot | 2.C.1.5 | TSP | 9 | g/t |
| 4487 | Rolling mills - cold | 2.C.1.5 | TSP | 96 | g/t |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 3813 | 2.D.1_Paper pulp: Neutral Sulphite Semi-Chemical process | 2.D.1 | NMVOC | 0.05 | kg/t |
| 4490 | Margarine and solid cooking fats | 2.D.2 | NMVOC | 10 | kg/t |
| 4494 | Cakes, biscuits and breakfast cereals | 2.D.2 | NMVOC | 1 | kg/t |
| 98 | Bread (white bread) | 2.D.2 | NMVOC | 2 | kg/t |
| 3815 | White wine | 2.D.2 | NMVOC | 0.035 | kg/hl |
| 3816 | Wine (unspecified color) | 2.D.2 | NMVOC | 0.08 | kg/hl |
| 3817 | 2.D.2_Beer | 2.D.2 | NMVOC | 35 | g/hl |
| 3818 | 2.D.2_Spirits | 2.D.2 | NMVOC | 15000 | g/hl |
| 4493 | Coffee roasting | 2.D.2 | NMVOC | 0.55 | kg/t |
| 4488 | Meat, fish etc. frying / curing | 2.D.2 | NMVOC | 0.3 | kg/t |
| 4489 | Sugar | 2.D.2 | NMVOC | 10 | kg/t |
| 4492 | Animal feed | 2.D.2 | NMVOC | 1 | kg/t |
| 4500 | 040620_wood processing | 2.D.3 | TSP | 1 | kg/t |
| 4449 | Consumption of POPs and HMs | 2.F.8 | Hg | 0.01 | g/inhabitant |
| 4449 | Consumption of POPs and HMs | 2.F.8 | PCBs | 0.1 | g/inhabitant |
| 4647 | Decorative coating application | 3.A.1 | NMVOC | 150 | kg/t |
| 4649 | Industrial coating application | 3.A.2 | NMVOC | 400 | kg/t |
| 4650 | Other coating application | 3.A.3 | NMVOC | 200 | kg/t |
| 6431 | Degreasing - Vapour cleaning | 3.B.1 | NMVOC | 460 | g/kg product |
| 6434 | Degreasing - Cold cleaning | 3.B.1 | NMVOC | 0.7 | kg/inhabitant |
| 6429 | Dry cleaning | 3.B.2 | NMVOC | 400 | g/kg product |
| 120 | Polyester processing | 3.C | NMVOC | 50 | kg/t |
| 3836 | 3.C_PVC process. | 3.C | NMVOC | 40 | kg/t |
| 3837 | Polyurethane_Solid foam | 3.C | NMVOC | 15 | kg/t |
| 3838 | Polyurethane_Soft foam | 3.C | NMVOC | 25 | kg/t |
| 3840 | 3.C_Rubber manufac. | 3.C | NMVOC | 15 | kg/t |
| 3841 | 3.C_Pharmaceuticals products manufac. | 3.C | NMVOC | 0.014 | kg/inhabitant |
| 3842 | 3.C_Paints manufac. | 3.C | NMVOC | 15 | kg/t |
| 3843 | 3.C_Inks manufac. | 3.C | NMVOC | 30 | kg/t |
| 3844 | 3.C_Glues manufac. | 3.C | NMVOC | 20 | kg/t |
| 4797 | Expandible PS | 3.C | NMVOC | 60 | kg/t |
| 6148 | Adhesive tape manufacturing | 3.C | NMVOC | 3 | kg/t |
| 6147 | Other: Shoes manufacturing | 3.C | NMVOC | 0.045 | kg/t |
| 6149 | Leather tanning | 3.C | NH3 | 0.68 | kg/t |
| 6430 | Printing industry | 3.D.1 | NMVOC | 500 | kg/t |
| 5353 | Pharmaceutical products | 3.D.2 | NMVOC | 48 | kg/t |
| 5352 | Cosmetics and toiletries | 3.D.2 | NMVOC | 127 | kg/t |
| 5347 | Household products | 3.D.2 | NMVOC | 16 | kg/t |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5348 | Car care product | 3.D.2 | NMVOC | 180 | kg/t |
| 5349 | DIY/buildings, Paint/varnish removers and solvents | 3.D.2 | NMVOC | 950 | kg/t |
| 5350 | DIY/buildings, Sealants, filling agents | 3.D.2 | NMVOC | 45 | kg/t |
| 5351 | Various_Hg (fluorescent tubes) | 3.D.2 | Hg | 5.6 | kg/t |
| 5355 | Various_Pesticide use incl. fungicides | 3.D.2 | NMVOC | 150 | kg/t |
| 4846 | 2.G Tabacco combustion | 3.D.3 | Ni | 2.7 | g/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | Cd | 5.4 | g/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | Zn | 2.7 | g/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | Benzo(b) | 0.045 | g/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | NMVOC | 4.84 | kg/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | TSP | 27 | kg/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | PM25 | 27 | kg/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | PM10 | 27 | kg/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | NOX | 1.8 | kg/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | CO | 55.1 | kg/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | Cu | 5.4 | g/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | DIOX | 0.1 | µg/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | Benzo(k) | 0.045 | g/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | Benzo(a) | 0.111 | g/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | BC | 12.15 | kg/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | NH3 | 4.15 | kg/t tobaccoa |
| 4846 | 2.G Tabacco combustion | 3.D.3 | Indeno | 0.045 | g/t tobaccoa |
| 4842 | 2.D.3.i Fat, edible and non-edible oil extraction | 3.D.3 | NMVOC | 1.57 | kg/t seed |
| 4842 | 2.D.3.i Fat, edible and non-edible oil extraction | 3.D.3 | TSP | 1.1 | kg/t seed |
| 4842 | 2.D.3.i Fat, edible and non-edible oil extraction | 3.D.3 | PM25 | 0.6 | kg/t seed |
| 4842 | 2.D.3.i Fat, edible and non-edible oil extraction | 3.D.3 | PM10 | 0.9 | kg/t seed |
| 4844 | 2.D.3.i Organic solventborne preservative | 3.D.3 | NMVOC | 945 | kg/t seed |
| 4843 | 2.D.3.i Creosote preservative type | 3.D.3 | NMVOC | 105 | kg/t creosote |
| 4843 | 2.D.3.i Creosote preservative type | 3.D.3 | Benzo(a) | 1.05 | g/t creosote |
| 4843 | 2.D.3.i Creosote preservative type | 3.D.3 | Benzo(b) | 0.53 | g/t creosote |
| 4843 | 2.D.3.i Creosote preservative type | 3.D.3 | Benzo(k) | 0.53 | g/t creosote |
| 4843 | 2.D.3.i Creosote preservative type | 3.D.3 | Indeno | 0.53 | g/t creosote |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5354 | 2.G Use of shoes | 3.D.3 | NMVOC | 60 | g/pair |
| 5356 | Car dewaxing | 3.D.3 | NMVOC | 1 | g/t |
| 5358 | 2.G Other: Concrete aditive | 3.D.3 | NMVOC | 915 | g/t |
| 5359 | 2.G Other: Cooling lubricant | 3.D.3 | NMVOC | 1000 | g/t |
| 5360 | 2.G Other: Lubricant | 3.D.3 | NMVOC | 28000 | g/t |
| 6137 | Application of glues_2016 | 3.D.3 | NMVOC | 150213 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | Ni | 30 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | Cd | 1.48 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | Zn | 260 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | TSP | 109830 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | PM25 | 51940 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | PM10 | 99920 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | NOX | 260 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | CO | 7150 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | Cu | 444 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | SO2 | 3020 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | As | 1.33 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | Hg | 0.057 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | Pb | 784 | g/t |
| 6138 | 2.G Use of Firework | 3.D.3 | Cr | 15.6 | g/t |
| 6169 | Dairy cattle | 4.B.01.a | NH3 | 27.42251 | kg/animal |
| 6169 | Dairy cattle | 4.B.01.a | TSP | 1.38 | kg/animal |
| 6169 | Dairy cattle | 4.B.01.a | PM25 | 0.41 | kg/animal |
| 6169 | Dairy cattle | 4.B.01.a | NOX | 0.1028 | kg/animal |
| 6169 | Dairy cattle | 4.B.01.a | NMVOC | 16.058 | kg/animal |
| 6169 | Dairy cattle | 4.B.01.a | PM10 | 0.63 | kg/animal |
| 6170 | Calves (telad) | 4.B.01.b | NH3 | 14.35084 | kg/animal |
| 6170 | Calves (telad) | 4.B.01.b | TSP | 0.34 | kg/animal |
| 6170 | Calves (telad) | 4.B.01.b | PM25 | 0.1 | kg/animal |
| 6170 | Calves (telad) | 4.B.01.b | NOX | 0.08478 | kg/animal |
| 6170 | Calves (telad) | 4.B.01.b | NMVOC | 7.354 | kg/animal |
| 6170 | Calves (telad) | 4.B.01.b | PM10 | 0.16 | kg/animal |
| 6171 | Non-dairy cattle | 4.B.01.b | NH3 | 14.35084 | kg/animal |
| 6171 | Non-dairy cattle | 4.B.01.b | TSP | 0.59 | kg/animal |
| 6171 | Non-dairy cattle | 4.B.01.b | PM25 | 0.18 | kg/animal |
| 6171 | Non-dairy cattle | 4.B.01.b | NOX | 0.08478 | kg/animal |
| 6171 | Non-dairy cattle | 4.B.01.b | NMVOC | 7.354 | kg/animal |
| 6171 | Non-dairy cattle | 4.B.01.b | PM10 | 0.27 | kg/animal |
| 6174 | Sheep | 4.B.03 | PM25 | 0.0167 | kg/animal |
| 6174 | Sheep | 4.B.03 | NOX | 0.008 | kg/animal |
| 6174 | Sheep | 4.B.03 | NMVOC | 0.1701 | kg/animal |
| 6174 | Sheep | 4.B.03 | PM10 | 0.0556 | kg/animal |
| 6174 | Sheep | 4.B.03 | NH3 | 0.13897 | kg/animal |
| 6174 | Sheep | 4.B.03 | TSP | 0.139 | kg/animal |
| 6175 | Goats | 4.B.04 | NH3 | 0.28307 | kg/animal |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6175 | Goats | 4.B.04 | TSP | 0.139 | kg/animal |
| 6175 | Goats | 4.B.04 | PM25 | 0.0167 | kg/animal |
| 6175 | Goats | 4.B.04 | NOX | 0.008 | kg/animal |
| 6175 | Goats | 4.B.04 | NMVOC | 0.54282 | kg/animal |
| 6175 | Goats | 4.B.04 | PM10 | 0.0556 | kg/animal |
| 6176 | Horses | 4.B.06 | NH3 | 4.19199 | kg/animal |
| 6176 | Horses | 4.B.06 | TSP | 0.48 | kg/animal |
| 6176 | Horses | 4.B.06 | PM25 | 0.14 | kg/animal |
| 6176 | Horses | 4.B.06 | NOX | 0.201 | kg/animal |
| 6176 | Horses | 4.B.06 | NMVOC | 4.275 | kg/animal |
| 6176 | Horses | 4.B.06 | PM10 | 0.22 | kg/animal |
| 6177 | Mules and asses | 4.B.07 | NH3 | 4.19199 | kg/animal |
| 6177 | Mules and asses | 4.B.07 | TSP | 0.34 | kg/animal |
| 6177 | Mules and asses | 4.B.07 | PM25 | 0.1 | kg/animal |
| 6177 | Mules and asses | 4.B.07 | NOX | 0.201 | kg/animal |
| 6177 | Mules and asses | 4.B.07 | NMVOC | 1.47 | kg/animal |
| 6177 | Mules and asses | 4.B.07 | PM10 | 0.16 | kg/animal |
| 6172 | Swine: Sows | 4.B.08 | NH3 | 15.91269 | kg/animal |
| 6172 | Swine: Sows | 4.B.08 | TSP | 1.53 | kg/animal |
| 6172 | Swine: Sows | 4.B.08 | PM25 | 0.12 | kg/animal |
| 6172 | Swine: Sows | 4.B.08 | NOX | 0.04362 | kg/animal |
| 6172 | Swine: Sows | 4.B.08 | NMVOC | 1.704 | kg/animal |
| 6172 | Swine: Sows | 4.B.08 | PM10 | 0.69 | kg/animal |
| 6173 | Swine: Fattng pigs | 4.B.08 | NH3 | 5.48788 | kg/animal |
| 6173 | Swine: Fattng pigs | 4.B.08 | TSP | 0.75 | kg/animal |
| 6173 | Swine: Fattng pigs | 4.B.08 | PM25 | 0.06 | kg/animal |
| 6173 | Swine: Fattng pigs | 4.B.08 | NOX | 0.00843 | kg/animal |
| 6173 | Swine: Fattng pigs | 4.B.08 | NMVOC | 0.551 | kg/animal |
| 6173 | Swine: Fattng pigs | 4.B.08 | PM10 | 0.34 | kg/animal |
| 6183 | Laying hens | 4.B.09.a | NMVOC | 0.165 | kg/animal |
| 6183 | Laying hens | 4.B.09.a | PM10 | 0.119 | kg/animal |
| 6183 | Laying hens | 4.B.09.a | NH3 | 0.39004761 | kg/animal |
| 6183 | Laying hens | 4.B.09.a | TSP | 0.119 | kg/animal |
| 6183 | Laying hens | 4.B.09.a | PM25 | 0.023 | kg/animal |
| 6183 | Laying hens | 4.B.09.a | NOX | 0.00182 | kg/animal |
| 6182 | Broilers | 4.B.09.b | NMVOC | 0.108 | kg/animal |
| 6182 | Broilers | 4.B.09.b | PM10 | 0.069 | kg/animal |
| 6182 | Broilers | 4.B.09.b | NH3 | 0.25856587 | kg/animal |
| 6182 | Broilers | 4.B.09.b | TSP | 0.069 | kg/animal |
| 6182 | Broilers | 4.B.09.b | PM25 | 0.009 | kg/animal |
| 6182 | Broilers | 4.B.09.b | NOX | 0.008 | kg/animal |
| 6181 | Turkeys | 4.B.09.c | NMVOC | 0.489 | kg/animal |
| 6181 | Turkeys | 4.B.09.c | PM10 | 0.52 | kg/animal |
| 6181 | Turkeys | 4.B.09.c | NH3 | 0.984243247 | kg/animal |
| 6181 | Turkeys | 4.B.09.c | TSP | 0.52 | kg/animal |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 6181 | Turkeys | 4.B.09.c | PM25 | 0.07 | kg/animal |
| 6181 | Turkeys | 4.B.09.c | NOX | 0.008 | kg/animal |
| 6178 | Other polutry | 4.B.09.d | NMVOC | 0.489 | kg/animal |
| 6178 | Other polutry | 4.B.09.d | PM10 | 0.24 | kg/animal |
| 6178 | Other polutry | 4.B.09.d | NH3 | 0.72424707 | kg/animal |
| 6178 | Other polutry | 4.B.09.d | TSP | 0.24 | kg/animal |
| 6178 | Other polutry | 4.B.09.d | PM25 | 0.03 | kg/animal |
| 6178 | Other polutry | 4.B.09.d | NOX | 0.002 | kg/animal |
| 6179 | Other polutry | 4.B.09.d | NMVOC | 0.489 | kg/animal |
| 6179 | Other polutry | 4.B.09.d | PM10 | 0.14 | kg/animal |
| 6179 | Other polutry | 4.B.09.d | NH3 | 0.41595123 | kg/animal |
| 6179 | Other polutry | 4.B.09.d | TSP | 0.14 | kg/animal |
| 6179 | Other polutry | 4.B.09.d | PM25 | 0.02 | kg/animal |
| 6179 | Other polutry | 4.B.09.d | NOX | 0.004 | kg/animal |
| 6180 | Other polutry | 4.B.09.d | NMVOC | 0.489 | kg/animal |
| 6180 | Other polutry | 4.B.09.d | PM10 | 0.24 | kg/animal |
| 6180 | Other polutry | 4.B.09.d | NH3 | 0.72424707 | kg/animal |
| 6180 | Other polutry | 4.B.09.d | TSP | 0.24 | kg/animal |
| 6180 | Other polutry | 4.B.09.d | PM25 | 0.03 | kg/animal |
| 6180 | Other polutry | 4.B.09.d | NOX | 0.004 | kg/animal |
| 5410 | N from fertilizers use | 4.D.1.a | NOX | 0.026 | kg/kg |
| 5413 | Urea | 4.D.1.a | NH3 | 0.15788 | kg/t |
| 5411 | KAN | 4.D.1.a | NH3 | 0.01088 | kg/t |
| 5415 | NPK | 4.D.1.a | NH3 | 0.02044 | kg/kg |
| 5414 | Amonij nitrat | 4.D.1.a | NH3 | 0.02044 | kg/kg |
| 5412 | Urea Amonij nitrat | 4.D.1.a | NH3 | 0.15788 | kg/kg |
| 5409 | Crop production and agricultural soils | 4.D.1.a | PM25 | 0.06 | kg/ha |
| 5409 | Crop production and agricultural soils | 4.D.1.a | PM10 | 1.56 | kg/ha |
| 5409 | Crop production and agricultural soils | 4.D.1.a | NMVOC | 0.86 | kg/ha |
| 5409 | Crop production and agricultural soils | 4.D.1.a | TSP | 1.56 | kg/ha |
| 6224 | Sheep - grazing | 4.D.2.c | NH3 | 0.3946635 | kg/animal |
| 6250 | Mules and asses - grazing | 4.D.2.c | NH3 | 5.37795 | kg/animal |
| 6276 | Horses - grazing | 4.D.2.c | NH3 | 5.37795 | kg/animal |
| 6303 | Goats - grazing | 4.D.2.c | NH3 | 0.803580102739726 | kg/animal |
| 6328 | Non dairy (young)- grazing | 4.D.2.c | NH3 | 0.817576908023483 | kg/animal |
| 6354 | Non dairy (other) - grazing | 4.D.2.c | NH3 | 0.817576908023483 | kg/animal |
| 6380 | Dairy cows - grazing | 4.D.2.c | NH3 | 2.47516423679061 | kg/animal |
| 6212 | Sewage sludge applied to soils | 4.D.4 | NH3 | 0.0066 | kg/animal |
| 6212 | Sewage sludge applied to soils | 4.D.4 | NOX | 0.002 | kg/animal |
| 4469 | Solid waste disposal on land | 6.A.1 | NMVOC | 1.56 | kg/t |
| 4469 | Solid waste disposal on land | 6.A.1 | TSP | 0.463 | g/t |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 4469 | Solid waste disposal on land | 6.A.1 | PM25 | 0.033 | g/t |
| 4469 | Solid waste disposal on land | 6.A.1 | PM10 | 0.219 | g/t |
| 4471 | Waste water treatment in industry | 6.B.1 | NMVOC | 15 | mg/1000 m3 |
| 4472 | Waste water treatment in residental / commercial sector | 6.B.2 | NMVOC | 15 | mg/1000 m3 |
| 4470 | Latrines | 6.B.3 | NH3 | 1.6 | kg/inhabitant |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | As | 0.2 | g/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | Cd | 8 | g/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | Cr | 2 | g/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | Cu | 98 | g/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | Hg | 43 | g/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | Ni | 2 | g/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | Pb | 62 | g/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | DIOX | 40 | mg/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | PCBs | 0.02 | g/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | SO2 | 0.54 | kg/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | NOX | 2.3 | kg/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | CO | 0.19 | kg/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | TSP | 17 | kg/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | HCB | 0.1 | g/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | PAH | 0.04 | mg/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | BC | 0.391 | kg/t |
| 5362 | 5.C.1.b.iii Clinical waste incineration | 6.C.a | NMVOC | 0.7 | kg/t |
| 196 | Incineration of industrial waste | 6.C.b | As | 0.016 | g/t |
| 196 | Incineration of industrial waste | 6.C.b | Cd | 0.1 | g/t |
| 196 | Incineration of industrial | 6.C.b | Cr | 0.3 | g/t |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| | waste | | | | |
| 196 | Incineration of industrial waste | 6.C.b | Cu | 3 | g/t |
| 196 | Incineration of industrial waste | 6.C.b | Hg | 0.056 | g/t |
| 196 | Incineration of industrial waste | 6.C.b | Ni | 0.14 | g/t |
| 196 | Incineration of industrial waste | 6.C.b | Pb | 1.3 | g/t |
| 196 | Incineration of industrial waste | 6.C.b | Zn | 2.1 | g/t |
| 196 | Incineration of industrial waste | 6.C.b | HCB | 0.002 | g/t |
| 196 | Incineration of industrial waste | 6.C.b | DIOX | 350 | µg/t |
| 196 | Incineration of industrial waste | 6.C.b | PAH | 0.02 | g/t |
| 196 | Incineration of industrial waste | 6.C.b | SO2 | 0.047 | kg/t |
| 196 | Incineration of industrial waste | 6.C.b | NOX | 0.87 | kg/t |
| 196 | Incineration of industrial waste | 6.C.b | NMVOC | 7.4 | kg/t |
| 196 | Incineration of industrial waste | 6.C.b | CO | 0.07 | kg/t |
| 196 | Incineration of industrial waste | 6.C.b | TSP | 0.01 | kg/t |
| 196 | Incineration of industrial waste | 6.C.b | PM25 | 0.004 | kg/t |
| 196 | Incineration of industrial waste | 6.C.b | PM10 | 0.007 | kg/t |
| 196 | Incineration of industrial waste | 6.C.b | BC | 0.00014 | kg/t |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Hg | 1.49 | g/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | SO2 | 0.113 | kg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | NOX | 0.825 | kg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | CO | 0.14 | kg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | TSP | 38.56 | g/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | PM25 | 34.7 | g/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | PM10 | 34.7 | g/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | NMVOC | 0.013 | kg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Pb | 30.03 | mg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Cd | 5.03 | mg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | As | 13.61 | mg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Cr | 13.56 | mg/body |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Cu | 12.43 | mg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Ni | 17.33 | mg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Se | 19.78 | mg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Zn | 160.12 | mg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | PCBs | 0.41 | mg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | DIOX | 0.027 | µg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | HCB | 0.15 | mg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Benzo(a) | 13.2 | µg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Benzo(b) | 7.21 | µg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Benzo(k) | 6.44 | µg/body |
| 5361 | 5.C.1.b.v Cremation | 6.C.d | Indeno | 6.99 | µg/body |
| 4841 | Car fire | 6.D | DIOX | 0.048 | µg/fire |
| 4841 | Car fire | 6.D | TSP | 2.3 | kg/fire |
| 4841 | Car fire | 6.D | PM25 | 2.3 | kg/fire |
| 4841 | Car fire | 6.D | PM10 | 2.3 | kg/fire |
| 4837 | Detached house fire | 6.D | As | 1.35 | mg/fire |
| 4837 | Detached house fire | 6.D | Cd | 0.85 | mg/fire |
| 4837 | Detached house fire | 6.D | Cr | 1.29 | mg/fire |
| 4837 | Detached house fire | 6.D | Cu | 2.99 | mg/fire |
| 4837 | Detached house fire | 6.D | Hg | 0.85 | mg/fire |
| 4837 | Detached house fire | 6.D | Pb | 0.42 | mg/fire |
| 4837 | Detached house fire | 6.D | DIOX | 1.44 | µg/fire |
| 4837 | Detached house fire | 6.D | TSP | 143.82 | kg/fire |
| 4837 | Detached house fire | 6.D | PM25 | 143.82 | kg/fire |
| 4837 | Detached house fire | 6.D | PM10 | 143.82 | kg/fire |
| 4838 | Undetached house fire | 6.D | As | 0.58 | mg/fire |
| 4838 | Undetached house fire | 6.D | Cd | 0.36 | mg/fire |
| 4838 | Undetached house fire | 6.D | Cr | 0.55 | mg/fire |
| 4838 | Undetached house fire | 6.D | Cu | 1.28 | mg/fire |
| 4838 | Undetached house fire | 6.D | Hg | 0.36 | mg/fire |
| 4838 | Undetached house fire | 6.D | Pb | 0.18 | mg/fire |
| 4838 | Undetached house fire | 6.D | DIOX | 0.62 | µg/fire |
| 4838 | Undetached house fire | 6.D | TSP | 61.62 | kg/fire |
| 4838 | Undetached house fire | 6.D | PM25 | 61.62 | kg/fire |
| 4838 | Undetached house fire | 6.D | PM10 | 61.62 | kg/fire |
| 4839 | Apartment building fire | 6.D | As | 0.41 | mg/fire |
| 4839 | Apartment building fire | 6.D | Cd | 0.26 | mg/fire |
| 4839 | Apartment building fire | 6.D | Cr | 0.39 | mg/fire |
| 4839 | Apartment building fire | 6.D | Cu | 0.91 | mg/fire |
| 4839 | Apartment building fire | 6.D | Hg | 0.26 | mg/fire |
| 4839 | Apartment building fire | 6.D | Pb | 0.13 | mg/fire |
| 4839 | Apartment building fire | 6.D | DIOX | 0.44 | µg/fire |
| 4839 | Apartment building fire | 6.D | TSP | 43.78 | kg/fire |
| 4839 | Apartment building fire | 6.D | PM25 | 43.78 | kg/fire |
| 4839 | Apartment building fire | 6.D | PM10 | 43.78 | kg/fire |

| Tech. ID | Technology Name | Category | Pollutant | Emission Factor | Unit |
|---|---|---|---|---|---|
| 4840 | Industrial building fire | 6.D | As | 0.25 | mg/fire |
| 4840 | Industrial building fire | 6.D | Cd | 0.16 | mg/fire |
| 4840 | Industrial building fire | 6.D | Cr | 0.24 | mg/fire |
| 4840 | Industrial building fire | 6.D | Cu | 0.57 | mg/fire |
| 4840 | Industrial building fire | 6.D | Hg | 0.16 | mg/fire |
| 4840 | Industrial building fire | 6.D | Pb | 0.08 | mg/fire |
| 4840 | Industrial building fire | 6.D | DIOX | 0.27 | µg/fire |
| 4840 | Industrial building fire | 6.D | TSP | 27.23 | kg/fire |
| 4840 | Industrial building fire | 6.D | PM25 | 27.23 | kg/fire |
| 4840 | Industrial building fire | 6.D | PM10 | 27.23 | kg/fire |
| 6159 | Compost production | 6.D | NH3 | 0.24 | kg/t waste |

# APPENDIX 5. CROATIAN ENERGY BALANCE FOR REPUBLIC OF CROATIA 2016

| PJ | Anthracite | Hard coal | Brown coal | Lignite | Crude oil | Natural gas | Hydro energy | Fuel wood | Wind energy | Solar energy | Geothermal energy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Production | - | - | - | - | 28.62 | 61.605 | 61.63 | 53.895 | 7.486 | 0.974 | 0.449 |
| Import | 0.03 | 25.15 | 0.86 | 0.07 | 99.41 | 36.333 | - | 0.30 | - | - | - |
| Export | - | 0.71 | 0.00 | - | - | 12.712 | - | 6.20 | - | - | - |
| Import-processing | - | - | - | - | - | - | - | - | - | - | - |
| Export-processing | - | - | - | - | - | - | - | - | - | - | - |
| Stock change | - | - 0.58 | - 0.21 | - | - 3.60 | 1.938 | - | - | - | - | - |
| Bunkers | - | - | - | - | - | - | - | - | - | - | - |
| **Energy supplied** | **0.03** | **23.87** | **0.64** | **0.07** | **124.42** | **87.16** | **61.63** | **47.99** | **7.49** | **0.97** | **0.45** |
| ***Production*** | - | - | - | - | - | - | - | - | - | - | - |
| hydro power plants | - | - | - | - | - | - | - | - | - | - | - |
| – small HPP | - | - | - | - | - | - | - | - | - | - | - |
| Wind power plants | - | - | - | - | - | - | - | - | - | - | - |
| Solar power plants | - | - | - | - | - | - | - | - | - | - | - |
| Geothermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| thermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| public cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| public heating plants | - | - | - | - | - | - | - | - | - | - | - |
| industrial cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| – in rafineries | - | - | - | - | - | - | - | - | - | - | - |
| – in gas production | - | - | - | - | - | - | - | - | - | - | - |
| Industrial heating plants | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | - | - | - | - | - | - | - | - | - | - | - |
| NGL-plant | - | - | - | - | - | - | - | - | - | - | - |
| Coke plant | - | - | - | - | - | - | - | - | - | - | - |
| Gas works | - | - | - | - | - | - | - | - | - | - | - |
| **Total production** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Gross production** | **0.03** | **23.87** | **0.64** | **0.07** | **124.42** | **87.16** | **61.63** | **47.99** | **7.49** | **0.97** | **0.45** |
| ***Transformation sector*** | - | - | - | - | - | - | - | - | - | - | - |
| hydro power plants | - | - | - | - | - | - | 61.63 | - | - | - | - |
| – small HPP | - | - | - | - | - | - | 0.95 | - | - | - | - |
| Wind power plants | - | - | - | - | - | - | - | - | 7.49 | - | - |
| Solar power plants | - | - | - | - | - | - | - | - | - | 0.54 | - |
| Geothermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| thermal power plants | - | 21.82 | - | - | - | 1.82 | - | - | - | - | - |
| public cogeneration plants | - | - | - | - | - | 11.89 | - | - | - | - | - |
| public heating plants | - | - | - | - | - | 2.51 | - | - | - | - | - |
| industrial cogeneration plants | - | - | 0.58 | - | - | 8.91 | - | - | - | - | - |
| – in rafineries | - | - | - | - | - | 1.52 | - | - | - | - | - |
| – in gas production | - | - | - | - | - | 1.40 | - | - | - | - | - |
| Industrial heating plants | - | - | - | - | - | 1.89 | - | - | - | - | - |
| Petroleum refineries | - | - | - | - | 122.22 | 3.06 | - | - | - | - | - |
| NGL-plant | - | - | - | - | 2.19 | 0.42 | - | - | - | - | - |
| Coke plant | - | - | - | - | - | - | - | - | - | - | - |
| Gas works | - | - | - | - | - | 0.01 | - | - | - | - | - |
| **Total transformation sector** | **-** | **21.82** | **0.58** | **-** | **124.42** | **30.50** | **61.63** | **-** | **7.49** | **0.54** | **-** |
| ***Energy sector own use*** | - | - | - | - | - | - | - | - | - | - | - |
| Oil and gas extraction | - | - | - | - | - | 2.63 | - | - | - | - | - |
| Coal production | - | - | - | - | - | - | - | - | - | - | - |
| Electric energy supply industry | - | - | - | - | - | - | - | - | - | - | - |
| hydro power plants | - | - | - | - | - | - | - | - | - | - | - |
| thermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| public cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| industrial cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| Industrial heating plants | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | - | - | - | - | - | 1.66 | - | - | - | - | - |
| NGL-plant | - | - | - | - | - | 0.17 | - | - | - | - | - |
| Gas works | - | - | - | - | - | - | - | - | - | - | - |
| **Total energy sector own use** | **-** | **-** | **-** | **-** | **-** | **4.46** | **-** | **-** | **-** | **-** | **-** |
| **Losses** | - | - | - | - | - | 1.10 | - | - | - | - | - |
| **Final energy demand** | **0.03** | **2.04** | **0.07** | **0.07** | **-** | **51.10** | **-** | **47.99** | **-** | **0.44** | **0.45** |
| **Non energy use** | **-** | **-** | **-** | **-** | **-** | **17.15** | **-** | **-** | **-** | **-** | **-** |
| Energy sector | - | - | - | - | - | - | - | - | - | - | - |
| Petrochemical industry | - | - | - | - | - | 17.15 | - | - | - | - | - |
| Other industry | - | - | - | - | - | - | - | - | - | - | - |
| Construction | - | - | - | - | - | - | - | - | - | - | - |
| Transport | - | - | - | - | - | - | - | - | - | - | - |
| Agriculture | - | - | - | - | - | - | - | - | - | - | - |
| **Energy consumption** | **0.03** | **2.04** | **0.07** | **0.07** | **-** | **33.95** | **-** | **47.99** | **-** | **0.44** | **0.45** |
| **Industry** | **0.03** | **2.04** | **0.05** | **-** | **-** | **7.30** | **-** | **0.38** | **-** | **-** | **-** |
| Iron and steel | 0.03 | 0.05 | - | - | - | 0.57 | - | 0.00 | - | - | - |
| Non-ferrous metals | - | - | - | - | - | 0.09 | - | 0.00 | - | - | - |
| Non-metallic minerals | - | - | - | - | - | 1.34 | - | - | - | - | - |
| Chemical | - | - | - | - | - | 0.40 | - | - | - | - | - |
| Construction materials | - | 1.99 | 0.05 | - | - | 1.41 | - | 0.01 | - | - | - |
| Pulp and paper | - | - | - | - | - | 0.23 | - | 0.00 | - | - | - |
| Food production | - | - | - | - | - | 1.98 | - | 0.12 | - | - | - |
| Not elsewhere specified | - | - | - | - | - | 1.28 | - | 0.25 | - | - | - |
| **Transport** | **-** | **-** | **-** | **-** | **-** | **0.14** | **-** | **-** | **-** | **-** | **-** |
| Rail | - | - | - | - | - | - | - | - | - | - | - |
| Road | - | - | - | - | - | 0.01 | - | - | - | - | - |
| Air | - | - | - | - | - | - | - | - | - | - | - |
| – international | - | - | - | - | - | - | - | - | - | - | - |
| – domestic | - | - | - | - | - | - | - | - | - | - | - |
| Sea and River | - | - | - | - | - | - | - | - | - | - | - |
| Public transport | - | - | - | - | - | 0.13 | - | - | - | - | - |
| Not elsewhere specified | - | - | - | - | - | - | - | - | - | - | - |
| **Other sectors** | **-** | **-** | **0.02** | **0.07** | **-** | **26.51** | **-** | **47.61** | **-** | **0.44** | **0.45** |
| Households | - | - | 0.02 | 0.07 | - | 18.68 | - | 47.49 | - | 0.44 | - |
| Services | - | - | - | 0.00 | - | 7.09 | - | 0.12 | - | - | 0.28 |
| Agriculture | - | - | - | - | - | 0.74 | - | - | - | - | 0.17 |
| Construction | - | - | - | - | - | - | - | - | - | - | - |

| PJ | Landfill gas | Biofuels | Other biomass | Coke oven coke | Liquefied petroleum gases | Unleaded motor gasoline | Standard motor gasoline | Petroleum | Jet fuel | Diesel oil | Light heating oil |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Production | 1.5066 | 0.648 | 10.299 | - | - | - | - | - | - | - | - |
| Import | - | 0.40 | 0.49 | 0.77 | 1.68 | 9.69 | 0.02 | 0.11 | 1.06 | 45.02 | 2.12 |
| Export | - | 0.03 | 6.25 | 0.03 | 6.70 | 23.13 | - | - | 0.27 | 23.51 | 2.08 |
| Import-processing | - | - | - | - | - | - | - | - | - | - | - |
| Export-processing | - | - | - | - | - | - | - | - | - | - | - |
| Stock change | - | - | 0.16 | - | -0.04 | -0.45 | - | - | -0.08 | -1.96 | -0.00 |
| Bunkers | - | - | - | - | - | - | - | - | - | 0.06 | - |
| **Energy supplied** | **1.5066** | **1.02** | **4.70** | **0.74** | **-5.05** | **-13.89** | **0.02** | **0.11** | **0.71** | **19.48** | **0.04** |
| ***Production*** | - | - | - | - | - | - | - | - | - | - | - |
| hydro power plants | - | - | - | - | - | - | - | - | - | - | - |
| – small HPP | - | - | - | - | - | - | - | - | - | - | - |
| Wind power plants | - | - | - | - | - | - | - | - | - | - | - |
| Solar power plants | - | - | - | - | - | - | - | - | - | - | - |
| Geothermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| thermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| public cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| public heating plants | - | - | - | - | - | - | - | - | - | - | - |
| industrial cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| – in rafineries | - | - | - | - | - | - | - | - | - | - | - |
| – in gas production | - | - | - | - | - | - | - | - | - | - | - |
| Industrial heating plants | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | - | - | - | - | 9.80 | 37.58 | - | - | 4.59 | 46.22 | 7.15 |
| NGL-plant | - | - | - | - | 1.81 | - | - | - | - | - | - |
| Coke plant | - | - | - | - | - | - | - | - | - | - | - |
| Gas works | - | - | - | - | - | - | - | - | - | - | - |
| **Total production** | **-** | **-** | **-** | **-** | **11.62** | **37.58** | **-** | **-** | **4.59** | **46.22** | **7.15** |
| **Gross production** | **1.5066** | **1.02** | **4.70** | **0.74** | **6.56** | **23.70** | **0.02** | **0.11** | **5.30** | **65.70** | **7.19** |
| ***Transformation sector*** | - | - | - | - | - | - | - | - | - | - | - |
| hydro power plants | - | - | - | - | - | - | - | - | - | - | - |
| – small HPP | - | - | - | - | - | - | - | - | - | - | - |
| Wind power plants | - | - | - | - | - | - | - | - | - | - | - |
| Solar power plants | - | - | - | - | - | - | - | - | - | - | - |
| Geothermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| thermal power plants | 0.2487 | - | - | - | - | - | - | - | - | - | 0.09 |
| public cogeneration plants | 1.0724 | - | 2.19 | - | - | - | - | - | - | - | - |
| public heating plants | - | - | - | - | - | - | - | - | - | - | 0.17 |
| industrial cogeneration plants | 0.1431 | - | - | - | - | - | - | - | - | - | - |
| – in rafineries | - | - | - | - | - | - | - | - | - | - | - |
| – in gas production | - | - | - | - | - | - | - | - | - | - | - |
| Industrial heating plants | - | - | 0.49 | - | - | - | - | - | - | - | 0.02 |
| Petroleum refineries | - | - | - | - | - | - | - | - | - | - | - |
| NGL-plant | - | - | - | - | - | - | - | - | - | - | - |
| Coke plant | - | - | - | - | - | - | - | - | - | - | - |
| Gas works | - | - | - | - | - | - | - | - | - | - | - |
| **Total transformation sector** | **1.4642** | **-** | **2.68** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **0.27** |
| ***Energy sector own use*** | - | - | - | - | - | - | - | - | - | - | - |
| Oil and gas extraction | - | - | - | - | - | - | - | - | - | - | - |
| Coal production | - | - | - | - | - | - | - | - | - | - | - |
| Electric energy supply industry | - | - | - | - | - | - | - | - | - | - | - |
| hydro power plants | - | - | - | - | - | - | - | - | - | - | - |
| thermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| public cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| industrial cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| Industrial heating plants | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | - | - | - | - | - | - | - | - | - | - | - |
| NGL-plant | - | - | - | - | - | - | - | - | - | - | - |
| Gas works | - | - | - | - | - | - | - | - | - | - | - |
| **Total energy sector own use** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Losses** | 0.0424 | - | - | - | - | - | - | - | - | - | - |
| **Final energy demand** | **0.0000** | **1.02** | **2.01** | **0.74** | **6.56** | **23.70** | **0.02** | **0.11** | **5.30** | **65.70** | **6.92** |
| **Non energy use** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| Energy sector | - | - | - | - | - | - | - | - | - | - | - |
| Petrochemical industry | - | - | - | - | - | - | - | - | - | - | - |
| Other industry | - | - | - | - | - | - | - | - | - | - | - |
| Construction | - | - | - | - | - | - | - | - | - | - | - |
| Transport | - | - | - | - | - | - | - | - | - | - | - |
| Agriculture | - | - | - | - | - | - | - | - | - | - | - |
| **Energy consumption** | **0.0000** | **1.02** | **2.01** | **0.74** | **6.56** | **23.70** | **0.02** | **0.11** | **5.30** | **65.70** | **6.92** |
| **Industry** | **-** | **-** | **0.78** | **0.74** | **0.41** | **-** | **-** | **0.11** | **-** | **0.47** | **0.69** |
| Iron and steel | - | - | - | 0.02 | 0.04 | - | - | - | - | - | 0.03 |
| Non-ferrous metals | - | - | - | - | 0.04 | - | - | 0.01 | - | - | 0.04 |
| Non-metallic minerals | - | - | - | - | 0.01 | - | - | - | - | - | - |
| Chemical | - | - | - | - | - | - | - | 0.11 | - | - | 0.02 |
| Construction materials | - | - | 0.68 | 0.60 | 0.08 | - | - | - | - | 0.47 | 0.12 |
| Pulp and paper | - | - | 0.01 | - | 0.00 | - | - | - | - | - | - |
| Food production | - | - | - | 0.12 | 0.07 | - | - | - | - | - | 0.35 |
| Not elsewhere specified | - | - | 0.09 | - | 0.18 | - | - | - | - | - | 0.14 |
| **Transport** | **-** | **1.02** | **-** | **-** | **3.14** | **23.19** | **0.02** | **-** | **5.30** | **54.52** | **-** |
| Rail | - | - | - | - | - | - | - | - | - | 0.75 | - |
| Road | - | 0.98 | - | - | 3.14 | 23.19 | - | - | - | 51.06 | - |
| Air | - | - | - | - | - | - | 0.02 | - | 5.30 | - | - |
| – international | - | - | - | - | - | - | 0.00 | - | 4.88 | - | - |
| – domestic | - | - | - | - | - | - | 0.01 | - | 0.42 | - | - |
| Sea and River | - | - | - | - | - | - | - | - | - | 1.76 | - |
| Public transport | - | 0.04 | - | - | - | - | - | - | - | 0.96 | - |
| Not elsewhere specified | - | - | - | - | - | - | - | - | - | - | - |
| **Other sectors** | **-** | **-** | **1.23** | **-** | **3.02** | **0.51** | **-** | **-** | **-** | **10.70** | **6.23** |
| Households | - | - | 1.13 | - | 2.23 | - | - | - | - | - | 3.61 |
| Services | - | - | 0.10 | - | 0.58 | - | - | - | - | - | 1.90 |
| Agriculture | - | - | - | - | 0.12 | 0.33 | - | - | - | 7.32 | 0.48 |
| Construction | - | - | - | - | 0.09 | 0.18 | - | - | - | 3.38 | 0.23 |

| PJ | Low sulphur fuel oil | Standard fuel oil | Naphta | White spirit | Bitumen | Lubricants | Paraffin and wax | Petroleum coke | Etan | Other derivates | Refinery gas |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Production | - | - | - | - | - | - | - | - | - | - | - |
| Import | 0.33 | 1.91 | - | 0.10 | 3.61 | 0.94 | 0.26 | 5.24 | - | - | - |
| Export | 0.06 | 15.10 | 2.20 | 0.01 | 0.02 | 0.31 | 0.00 | 0.47 | - | 5.61 | - |
| Import-processing | - | - | - | - | - | - | - | - | - | - | - |
| Export-processing | - | - | - | - | - | - | - | - | - | - | - |
| Stock change | - | 1.96 | -0.14 | - | - | -0.01 | - | -0.26 | - | 0.79 | - |
| Bunkers | - | 0.01 | - | - | - | - | - | - | - | - | - |
| **Energy supplied** | **0.27** | **-11.23** | **-2.34** | **0.09** | **3.59** | **0.63** | **0.26** | **4.51** | **-** | **-4.82** | **-** |
| ***Production*** | - | - | - | - | - | - | - | - | - | - | - |
| hydro power plants | - | - | - | - | - | - | - | - | - | - | - |
| – small HPP | - | - | - | - | - | - | - | - | - | - | - |
| Wind power plants | - | - | - | - | - | - | - | - | - | - | - |
| Solar power plants | - | - | - | - | - | - | - | - | - | - | - |
| Geothermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| thermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| public cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| public heating plants | - | - | - | - | - | - | - | - | - | - | - |
| industrial cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| – in rafineries | - | - | - | - | - | - | - | - | - | - | - |
| – in gas production | - | - | - | - | - | - | - | - | - | - | - |
| Industrial heating plants | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | - | 19.66 | 2.34 | - | - | 0.45 | - | 1.65 | - | 4.83 | 8.87 |
| NGL-plant | - | - | 0.78 | - | - | - | - | - | - | - | - |
| Coke plant | - | - | - | - | - | - | - | - | - | - | - |
| Gas works | - | - | - | - | - | - | - | - | - | - | - |
| **Total production** | **-** | **19.66** | **3.12** | **-** | **-** | **0.45** | **-** | **1.65** | **-** | **4.83** | **8.87** |
| **Gross production** | **0.27** | **8.43** | **0.78** | **0.09** | **3.59** | **1.08** | **0.26** | **6.16** | **-** | **0.01** | **8.87** |
| ***Transformation sector*** | - | - | - | - | - | - | - | - | - | - | - |
| hydro power plants | - | - | - | - | - | - | - | - | - | - | - |
| – small HPP | - | - | - | - | - | - | - | - | - | - | - |
| Wind power plants | - | - | - | - | - | - | - | - | - | - | - |
| Solar power plants | - | - | - | - | - | - | - | - | - | - | - |
| Geothermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| thermal power plants | - | 0.43 | - | - | - | - | - | - | - | - | - |
| public cogeneration plants | - | 1.44 | - | - | - | - | - | - | - | - | - |
| public heating plants | - | 0.15 | - | - | - | - | - | - | - | - | - |
| industrial cogeneration plants | - | 2.76 | - | - | - | - | - | - | - | - | 0.72 |
| – in rafineries | - | 2.72 | - | - | - | - | - | - | - | - | 0.72 |
| – in gas production | - | - | - | - | - | - | - | - | - | - | - |
| Industrial heating plants | - | 2.23 | - | - | - | - | - | - | - | - | 0.21 |
| Petroleum refineries | - | - | 0.78 | - | - | - | - | - | - | - | - |
| NGL-plant | - | - | - | - | - | - | - | - | - | - | - |
| Coke plant | - | - | - | - | - | - | - | - | - | - | - |
| Gas works | - | - | - | - | - | - | - | - | - | - | - |
| **Total transformation sector** | **-** | **7.01** | **0.78** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **0.92** |
| ***Energy sector own use*** | - | - | - | - | - | - | - | - | - | - | - |
| Oil and gas extraction | - | - | - | - | - | - | - | - | - | - | - |
| Coal production | - | - | - | - | - | - | - | - | - | - | - |
| Electric energy supply industry | - | - | - | - | - | - | - | - | - | - | - |
| hydro power plants | - | - | - | - | - | - | - | - | - | - | - |
| thermal power plants | - | - | - | - | - | - | - | - | - | - | - |
| public cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| industrial cogeneration plants | - | - | - | - | - | - | - | - | - | - | - |
| Industrial heating plants | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | - | 0.82 | - | - | - | - | - | 0.97 | - | - | 7.94 |
| NGL-plant | - | - | - | - | - | - | - | - | - | - | - |
| Gas works | - | - | - | - | - | - | - | - | - | - | - |
| **Total energy sector own use** | **-** | **0.82** | **-** | **-** | **-** | **-** | **-** | **0.97** | **-** | **-** | **7.94** |
| **Losses** | - | - | - | - | - | - | - | - | - | - | - |
| **Final energy demand** | **0.27** | **0.59** | **-0.00** | **0.09** | **3.59** | **1.08** | **0.26** | **5.19** | **-** | **0.01** | **0.00** |
| **Non energy use** | **-** | **-** | **-** | **0.0905** | **3.5912** | **1.0787** | **0.2580** | **-** | **-** | **0.0080** | **-** |
| Energy sector | - | - | - | - | - | 0.07 | - | - | - | - | - |
| Petrochemical industry | - | - | - | - | - | - | - | - | - | - | - |
| Other industry | - | - | - | 0.09 | 0.33 | 0.21 | 0.26 | - | - | 0.01 | - |
| Construction | - | - | - | - | 3.26 | 0.04 | - | - | - | - | - |
| Transport | - | - | - | - | - | 0.72 | - | - | - | - | - |
| Agriculture | - | - | - | - | - | 0.05 | - | - | - | - | - |
| **Energy consumption** | **0.27** | **0.59** | **-0.00** | **-** | **-** | **-** | **-** | **5.19** | **-** | **-** | **0.00** |
| **Industry** | **0.27** | **0.23** | **-** | **-** | **-** | **-** | **-** | **5.19** | **-** | **-** | **-** |
| Iron and steel | 0.01 | 0.01 | - | - | - | - | - | 0.01 | - | - | - |
| Non-ferrous metals | - | - | - | - | - | - | - | - | - | - | - |
| Non-metallic minerals | - | - | - | - | - | - | - | - | - | - | - |
| Chemical | - | - | - | - | - | - | - | - | - | - | - |
| Construction materials | 0.14 | 0.02 | - | - | - | - | - | 5.18 | - | - | - |
| Pulp and paper | - | - | - | - | - | - | - | - | - | - | - |
| Food production | 0.08 | 0.17 | - | - | - | - | - | - | - | - | - |
| Not elsewhere specified | 0.03 | 0.03 | - | - | - | - | - | - | - | - | - |
| **Transport** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| Rail | - | - | - | - | - | - | - | - | - | - | - |
| Road | - | - | - | - | - | - | - | - | - | - | - |
| Air | - | - | - | - | - | - | - | - | - | - | - |
| – international | - | - | - | - | - | - | - | - | - | - | - |
| – domestic | - | - | - | - | - | - | - | - | - | - | - |
| Sea and River | - | - | - | - | - | - | - | - | - | - | - |
| Public transport | - | - | - | - | - | - | - | - | - | - | - |
| Not elsewhere specified | - | - | - | - | - | - | - | - | - | - | - |
| **Other sectors** | **-** | **0.37** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| Households | - | 0.17 | - | - | - | - | - | - | - | - | - |
| Services | - | 0.11 | - | - | - | - | - | - | - | - | - |
| Agriculture | - | 0.08 | - | - | - | - | - | - | - | - | - |
| Construction | - | - | - | - | - | - | - | - | - | - | - |

| PJ | Refinery semiproducts | Aditives | Gas works gas | Electricity | Steam and hot water | Industrial waste, non renewable |
|---|---|---|---|---|---|---|
| Production | - | - | - | - | 0.64 | 0.39 |
| Import | 16.35 | 2.28 | - | 31.93 | - | - |
| Export | - | - | - | 7.49 | - | - |
| Import-processing | - | - | - | - | - | - |
| Export-processing | - | - | - | - | - | - |
| Stock change | 0.01 | - | - | - | - | - |
| Bunkers | - | - | - | - | - | - |
| **Energy supplied** | **16.36** | **2.28** | **-** | **24.44** | **0.64** | **0.39** |
| ***Production*** | - | - | - | - | - | - |
| hydro power plants | - | - | - | 23.60 | - | - |
| – small HPP | - | - | - | 0.36 | - | - |
| Wind power plants | - | - | - | 2.87 | - | - |
| Solar power plants | - | - | - | 0.21 | - | - |
| Geothermal power plants | - | - | - | - | - | - |
| thermal power plants | - | - | - | 9.35 | - | - |
| public cogeneration plants | - | - | - | 3.92 | 8.83 | - |
| public heating plants | - | - | - | - | 2.27 | - |
| industrial cogeneration plants | - | - | - | 1.11 | 9.61 | - |
| – in rafineries | - | - | - | 0.33 | 3.78 | - |
| – in gas production | - | - | - | 0.30 | 0.70 | - |
| Industrial heating plants | - | - | - | - | 4.01 | - |
| Petroleum refineries | - | - | - | - | - | - |
| NGL-plant | - | - | - | - | - | - |
| Coke plant | - | - | - | - | - | - |
| Gas works | - | - | 0.01 | - | - | - |
| **Total production** | **-** | **-** | **0.01** | **41.05** | **24.72** | **-** |
| **Gross production** | **16.36** | **2.28** | **0.01** | **65.49** | **25.36** | **0.39** |
| ***Transformation sector*** | - | - | - | - | - | - |
| hydro power plants | - | - | - | - | - | - |
| – small HPP | - | - | - | - | - | - |
| Wind power plants | - | - | - | - | - | - |
| Solar power plants | - | - | - | - | - | - |
| Geothermal power plants | - | - | - | - | - | - |
| thermal power plants | - | - | - | - | - | - |
| public cogeneration plants | - | - | - | - | - | - |
| public heating plants | - | - | - | - | - | - |
| industrial cogeneration plants | - | - | - | - | - | - |
| – in rafineries | - | - | - | - | - | - |
| – in gas production | - | - | - | - | - | - |
| Industrial heating plants | - | - | - | - | - | - |
| Petroleum refineries | 16.36 | 2.28 | - | - | - | - |
| NGL-plant | - | - | - | - | - | - |
| Coke plant | - | - | - | - | - | - |
| Gas works | - | - | - | - | - | - |
| **Total transformation sector** | **16.36** | **2.28** | **-** | **-** | **-** | **-** |
| ***Energy sector own use*** | - | - | - | - | - | - |
| Oil and gas extraction | - | - | - | 0.45 | 0.42 | - |
| Coal production | - | - | - | - | 0.12 | - |
| Electric energy supply industry | - | - | - | 0.11 | - | - |
| hydro power plants | - | - | - | 0.97 | - | - |
| thermal power plants | - | - | - | 0.85 | - | - |
| public cogeneration plants | - | - | - | 0.47 | 0.54 | - |
| industrial cogeneration plants | - | - | - | - | - | - |
| Industrial heating plants | - | - | - | 0.01 | - | - |
| Petroleum refineries | - | - | - | 0.92 | 5.57 | - |
| NGL-plant | - | - | - | 0.07 | 0.28 | - |
| Gas works | - | - | - | - | - | - |
| **Total energy sector own use** | **-** | **-** | **-** | **3.85** | **6.94** | **-** |
| **Losses** | - | - | 0.00 | 6.49 | 1.59 | - |
| **Final energy demand** | **-** | **-** | **0.01** | **55.15** | **16.84** | **0.39** |
| **Non energy use** | **-** | **-** | **-** | **-** | **-** | **-** |
| Energy sector | - | - | - | - | - | - |
| Petrochemical industry | - | - | - | - | - | - |
| Other industry | - | - | - | - | - | - |
| Construction | - | - | - | - | - | - |
| Transport | - | - | - | - | - | - |
| Agriculture | - | - | - | - | - | - |
| **Energy consumption** | **-** | **-** | **0.01** | **55.15** | **16.84** | **0.39** |
| **Industry** | **-** | **-** | **-** | **12.09** | **9.62** | **0.39** |
| Iron and steel | - | - | - | 1.31 | 0.06 | - |
| Non-ferrous metals | - | - | - | 0.13 | - | - |
| Non-metallic minerals | - | - | - | 0.48 | 0.09 | - |
| Chemical | - | - | - | 1.11 | 4.24 | - |
| Construction materials | - | - | - | 1.76 | - | 0.39 |
| Pulp and paper | - | - | - | 0.68 | 0.82 | - |
| Food production | - | - | - | 2.52 | 2.63 | - |
| Not elsewhere specified | - | - | - | 4.09 | 1.78 | - |
| **Transport** | **-** | **-** | **-** | **1.05** | **-** | **-** |
| Rail | - | - | - | 0.55 | - | - |
| Road | - | - | - | - | - | - |
| Air | - | - | - | 0.09 | - | - |
| – international | - | - | - | - | - | - |
| – domestic | - | - | - | 0.09 | - | - |
| Sea and River | - | - | - | 0.08 | - | - |
| Public transport | - | - | - | 0.22 | - | - |
| Not elsewhere specified | - | - | - | 0.11 | - | - |
| **Other sectors** | **-** | **-** | **0.01** | **42.01** | **7.21** | **-** |
| Households | - | - | 0.00 | 22.33 | 5.65 | - |
| Services | - | - | 0.01 | 19.18 | 1.39 | - |
| Agriculture | - | - | - | 0.22 | 0.18 | - |
| Construction | - | - | - | 0.27 | - | - |

| *ENERGY BALANCE 2015* *natural units* | Anthracite | Hard coal | Brown coal | Lignite | Crude oil | Natural gas | Hydro energy | Fuel wood | Wind energy | Solar energy | Geothermal energy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^6$ $m^3$ | TJ | $10^3$ $m^3$ | TJ | TJ | TJ |
| Production | | | | | 670.2 | 1780.5 | 61625.7 | 5988.3 | 7485.8 | 973.8 | 449.3 |
| Import | 0.9 | 1000.5 | 50.3 | 7.1 | 2328.0 | 1050.1 | | 33.2 | | | |
| Export | | 28.2 | 0.2 | | | 367.4 | | 689.1 | | | |
| Import-processing | | | | | | | | | | | |
| Export-processing | | | | | | | | | | | |
| Stock change | | -22.9 | -12.2 | | -84.4 | 56.0 | | | | | |
| Bunkers | | | | | | | | | | | |
| **Energy supplied** | **0.9** | **949.4** | **37.9** | **7.1** | **2913.8** | **2519.2** | **61625.7** | **5332.4** | **7485.8** | **973.8** | **449.3** |
| ***Production*** | | | | | | | | | | | |
| hydro power plants | | | | | | | | | | | |
| – small HPP | | | | | | | | | | | |
| Wind power plants | | | | | | | | | | | |
| Solar power plants | | | | | | | | | | | |
| Geothermal power plants | | | | | | | | | | | |
| thermal power plants | | | | | | | | | | | |
| public cogeneration plants | | | | | | | | | | | |
| public heating plants | | | | | | | | | | | |
| industrial cogeneration plants | | | | | | | | | | | |
| – in rafineries | | | | | | | | | | | |
| – in gas production | | | | | | | | | | | |
| Industrial heating plants | | | | | | | | | | | |
| Petroleum refineries | | | | | | | | | | | |
| NGL-plant | | | | | | | | | | | |
| Coke plant | | | | | | | | | | | |
| Gas works | | | | | | | | | | | |
| **Total production** | | | | | | | | | | | |
| ***Transformation sector*** | | | | | | | | | | | |
| hydro power plants | | | | | | | 61625.7 | | | | |
| – small HPP | | | | | | | 947.6 | | | | |
| Wind power plants | | | | | | | | | 7485.8 | | |
| Solar power plants | | | | | | | | | | 538.7 | |
| Geothermal power plants | | | | | | | | | | | |
| thermal power plants | | 872.9 | | | | 52.5 | | | | | |
| public cogeneration plants | | | | | | 343.7 | | | | | |
| public heating plants | | | | | | 72.4 | | | | | |
| industrial cogeneration plants | | | 34.0 | | | 257.5 | | | | | |
| – in rafineries | | | | | | 43.8 | | | | | |
| – in gas production | | | | | | 40.4 | | | | | |
| Industrial heating plants | | | | | | 54.6 | | | | | |
| Petroleum refineries | | | | | 2862.4 | 88.4 | | | | | |
| NGL-plant | | | | | 51.4 | 12.2 | | | | | |
| Coke plant | | | | | | | | | | | |
| Gas works | | | | | | 0.3 | | | | | |
| **Total transformation sector** | | **872.9** | **34.0** | | **2913.8** | **881.6** | **61625.7** | | **7485.8** | **538.7** | |
| ***Energy sector own use*** | | | | | | | | | | | |
| Oil and gas extraction | | | | | | 75.9 | | | | | |
| Coal production | | | | | | | | | | | |
| Electric energy supply industry | | | | | | | | | | | |
| hydro power plants | | | | | | | | | | | |
| thermal power plants | | | | | | | | | | | |
| public cogeneration plants | | | | | | | | | | | |
| industrial cogeneration plants | | | | | | | | | | | |
| Wind power | | | | | | | | | | | |
| Petroleum refineries | | | | | | 48.1 | | | | | |
| NGL-plant | | | | | | 5.0 | | | | | |
| Gas works | | | | | | | | | | | |
| **Total energy sector own use** | | | | | | **129.0** | | | | | |
| **Losses** | | | | | | **31.7** | | | | | |
| **Final energy demand** | **0.9** | **76.5** | **3.9** | **7.1** | **0.0** | **1476.9** | | **5332.4** | | **435.1** | **449.3** |
| **Non energy use** | | | | | | **495.6** | | | | | |
| Energy sector | | | | | | | | | | | |
| Petrochemical industry | | | | | | 495.6 | | | | | |
| Other industry | | | | | | | | | | | |
| Construction | | | | | | | | | | | |
| Transport | | | | | | | | | | | |
| Agriculture | | | | | | | | | | | |
| **Energy consumption** | **0.9** | **76.5** | **3.9** | **7.1** | **0.0** | **981.3** | | **5332.4** | | **435.1** | **449.3** |
| **Industry** | **0.9** | **76.5** | **2.7** | | | **211.1** | | **42.6** | | | |
| Iron and steel | 0.9 | 1.8 | | | | 16.5 | | 0.5 | | | |
| Non-ferrous metals | | | | | | 2.6 | | 0.2 | | | |
| Non-metallic minerals | | | | | | 38.7 | | | | | |
| Chemical | | | | | | 11.5 | | | | | |
| Construction materials | | 74.7 | 2.7 | | | 40.7 | | 0.9 | | | |
| Pulp and paper | | | | | | 6.7 | | 0.1 | | | |
| Food production | | | | | | 57.3 | | 13.5 | | | |
| Not elsewhere specified | | | | | | 37.1 | | 27.4 | | | |
| **Transport** | | | | | | **4.0** | | | | | |
| Rail | | | | | | | | | | | |
| Road | | | | | | 0.2 | | | | | |
| Air | | | | | | | | | | | |
| – international | | | | | | | | | | | |
| – domestic | | | | | | | | | | | |
| Sea and River | | | | | | | | | | | |
| Public transport | | | | | | 3.8 | | | | | |
| Not elsewhere specified | | | | | | | | | | | |
| **Other sectors** | | | **1.2** | **7.1** | | **766.2** | | **5289.8** | | **435.1** | **449.3** |
| Households | | | 1.2 | 7.0 | | 540.0 | | 5277.0 | | 435.1 | |
| Services | | | | 0.1 | | 204.8 | | 12.8 | | | 280.0 |
| Agriculture | | | | | | 21.4 | | | | | 169.3 |
| Construction | | | | | | | | | | | |

| *ENERGY BALANCE 2015* *natural units* | Landfill gas | Biofuels | Other biomass | Coke oven coke | petroleum gases | motor gasoline | motor gasoline | Petroleum | Jet fuel | Diesel oil | Light heating oil |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $10^3$ $m^3$ | $10^3$ t | TJ | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t |
| Production | 84873.0 | 17.4 | 10299.1 | | 247.8 | 842.9 | | | 104.3 | 1082.1 | 167.5 |
| Import | | 10.7 | 486.4 | 26.2 | 35.9 | 217.4 | 0.4 | 2.6 | 24.2 | 1054.0 | 49.7 |
| Export | | 0.7 | 6251.3 | 1.0 | 142.8 | 518.8 | | | 6.1 | 550.4 | 48.7 |
| Import-processing | | | | | | | | | | | |
| Export-processing | | | | | | | | | | | |
| Stock change | | | 160.8 | | -0.9 | -10.0 | | | -1.9 | -46.0 | -0.1 |
| Bunkers | | | | | | | | | | 1.5 | |
| **Energy supplied** | **84873.0** | **27.4** | **4695.0** | **25.2** | **140.0** | **531.5** | **0.4** | **2.6** | **120.5** | **1538.2** | **168.4** |
| ***Production*** | | | | | | | | | | | |
| hydro power plants | | | | | | | | | | | |
| – small HPP | | | | | | | | | | | |
| Wind power plants | | | | | | | | | | | |
| Solar power plants | | | | | | | | | | | |
| Geothermal power plants | | | | | | | | | | | |
| thermal power plants | | | | | | | | | | | |
| public cogeneration plants | | | | | | | | | | | |
| public heating plants | | | | | | | | | | | |
| industrial cogeneration plants | | | | | | | | | | | |
| – in rafineries | | | | | | | | | | | |
| – in gas production | | | | | | | | | | | |
| Industrial heating plants | | | | | | | | | | | |
| Petroleum refineries | | | | | 209.1 | 842.9 | | | 104.3 | 1082.1 | 167.5 |
| NGL-plant | | | | | 38.7 | | | | | | |
| Coke plant | | | | | | | | | | | |
| Gas works | | | | | | | | | | | |
| **Total production** | | | | | **247.8** | **842.9** | | | **104.3** | **1082.1** | **167.5** |
| ***Transformation sector*** | | | | | | | | | | | |
| hydro power plants | | | | | | | | | | | |
| – small HPP | | | | | | | | | | | |
| Wind power plants | | | | | | | | | | | |
| Solar power plants | | | | | | | | | | | |
| Geothermal power plants | | | | | | | | | | | |
| thermal power plants | 14409.0 | | | | | | | | | | 2.1 |
| public cogeneration plants | 60968.0 | | 2189.0 | | | | | | | | |
| public heating plants | | | | | | | | | | | 3.9 |
| industrial cogeneration plants | 7037.0 | | | | | | | | | | |
| – in rafineries | | | | | | | | | | | |
| – in gas production | | | | | | | | | | | |
| Industrial heating plants | | | 494.4 | | | | | | | | 0.4 |
| Petroleum refineries | | | | | | | | | | | |
| NGL-plant | | | | | | | | | | | |
| Coke plant | | | | | | | | | | | |
| Gas works | | | | | | | | | | | |
| **Total transformation sector** | **82414.0** | | **2683.4** | | | | | | | | **6.4** |
| ***Energy sector own use*** | | | | | | | | | | | |
| Oil and gas extraction | | | | | | | | | | | |
| Coal production | | | | | | | | | | | |
| Electric energy supply industry | | | | | | | | | | | |
| hydro power plants | | | | | | | | | | | |
| thermal power plants | | | | | | | | | | | |
| public cogeneration plants | | | | | | | | | | | |
| industrial cogeneration plants | | | | | | | | | | | |
| Wind power | | | | | | | | | | | |
| Petroleum refineries | | | | | | | | | | | |
| NGL-plant | | | | | | | | | | | |
| Gas works | | | | | | | | | | | |
| **Total energy sector own use** | | | | | | | | | | | |
| **Losses** | **2459.0** | | | | | | | | | | |
| **Final energy demand** | | **27.4** | **2011.6** | **25.2** | **140.0** | **531.5** | **0.4** | **2.6** | **120.5** | **1538.2** | **162.0** |
| **Non energy use** | | | | | | | | | | | |
| Energy sector | | | | | | | | | | | |
| Petrochemical industry | | | | | | | | | | | |
| Other industry | | | | | | | | | | | |
| Construction | | | | | | | | | | | |
| Transport | | | | | | | | | | | |
| Agriculture | | | | | | | | | | | |
| **Energy consumption** | | **27.4** | **2011.6** | **25.2** | **140.0** | **531.5** | **0.4** | **2.6** | **120.5** | **1538.2** | **162.0** |
| **Industry** | | | **783.6** | **25.2** | **8.7** | | | **2.6** | | **11.1** | **16.2** |
| Iron and steel | | | | 0.6 | 0.8 | | | | | | 0.6 |
| Non-ferrous metals | | | | | 0.8 | | | 0.2 | | | 0.9 |
| Non-metallic minerals | | | | | 0.2 | | | | | | |
| Chemical | | | | | | | | 2.4 | | | 0.5 |
| Construction materials | | | 679.0 | 20.6 | 1.6 | | | | | 11.1 | 2.7 |
| Pulp and paper | | | 14.0 | | 0.1 | | | | | | |
| Food production | | | | 4.0 | 1.4 | | | | | | 8.3 |
| Not elsewhere specified | | | 90.6 | | 3.8 | | | | | | 3.2 |
| **Transport** | | **27.4** | | | **67.0** | **520.0** | **0.4** | | **120.5** | **1276.5** | |
| Rail | | | | | | | | | | 17.5 | |
| Road | | 26.3 | | | 67.0 | 520.0 | | | | 1195.4 | |
| Air | | | | | | | 0.4 | | 120.5 | | |
| – international | | | | | | | 0.1 | | 111.0 | | |
| – domestic | | | | | | | 0.3 | | 9.5 | | |
| Sea and River | | | | | | | | | | 41.2 | |
| Public transport | | 1.1 | | | | | | | | 22.4 | |
| Not elsewhere specified | | | | | | | | | | | |
| **Other sectors** | | | **1228.0** | | **64.3** | **11.5** | | | | **250.6** | **145.8** |
| Households | | | 1129.7 | | 47.6 | | | | | | 84.5 |
| Services | | | 98.3 | | 12.3 | | | | | | 44.6 |
| Agriculture | | | | | 2.5 | 7.5 | | | | 171.4 | 11.2 |
| Construction | | | | | 1.9 | 4.0 | | | | 79.2 | 5.5 |

| *ENERGY BALANCE 2015* *natural units* | Low sulphur fuel oil | Standard fuel oil | Naphta | White spirit | Bitumen | Other oils | Lubricants | Petroleum coke | Etan | Other derivates | Refinery gas |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t | $10^3$ t |
| Production | | 489.2 | 69.9 | | | 13.5 | | 53.3 | | 120.1 | 208.1 |
| Import | 8.2 | 47.6 | | 2.9 | 107.8 | 28.1 | 7.8 | 169.0 | | | |
| Export | 1.5 | 375.7 | 49.4 | 0.2 | 0.6 | 9.2 | 0.1 | 15.2 | | 139.6 | |
| Import-processing | | | | | | | | | | | |
| Export-processing | | | | | | | | | | | |
| Stock change | | 48.8 | -3.1 | | | -0.2 | | -8.3 | | 19.7 | |
| Bunkers | | 0.2 | | | | | | | | | |
| **Energy supplied** | **6.7** | **209.7** | **17.4** | **2.7** | **107.2** | **32.2** | **7.7** | **198.8** | | **0.2** | **208.1** |
| ***Production*** | | | | | | | | | | | |
| hydro power plants | | | | | | | | | | | |
| – small HPP | | | | | | | | | | | |
| Wind power plants | | | | | | | | | | | |
| Solar power plants | | | | | | | | | | | |
| Geothermal power plants | | | | | | | | | | | |
| thermal power plants | | | | | | | | | | | |
| public cogeneration plants | | | | | | | | | | | |
| public heating plants | | | | | | | | | | | |
| industrial cogeneration plants | | | | | | | | | | | |
| – in rafineries | | | | | | | | | | | |
| – in gas production | | | | | | | | | | | |
| Industrial heating plants | | | | | | | | | | | |
| Petroleum refineries | | 489.2 | 52.5 | | | 13.5 | | 53.3 | | 120.1 | 208.1 |
| NGL-plant | | | 17.4 | | | | | | | | |
| Coke plant | | | | | | | | | | | |
| Gas works | | | | | | | | | | | |
| **Total production** | | **489.2** | **69.9** | | | **13.5** | | **53.3** | | **120.1** | **208.1** |
| ***Transformation sector*** | | | | | | | | | | | |
| hydro power plants | | | | | | | | | | | |
| – small HPP | | | | | | | | | | | |
| Wind power plants | | | | | | | | | | | |
| Solar power plants | | | | | | | | | | | |
| Geothermal power plants | | | | | | | | | | | |
| thermal power plants | | 10.6 | | | | | | | | | |
| public cogeneration plants | | 35.8 | | | | | | | | | |
| public heating plants | | 3.7 | | | | | | | | | |
| industrial cogeneration plants | | 68.7 | | | | | | | | | 16.8 |
| – in rafineries | | 67.6 | | | | | | | | | 16.8 |
| – in gas production | | | | | | | | | | | |
| Industrial heating plants | | 55.6 | | | | | | | | | 4.9 |
| Petroleum refineries | | | 17.4 | | | | | | | | |
| NGL-plant | | | | | | | | | | | |
| Coke plant | | | | | | | | | | | |
| Gas works | | | | | | | | | | | |
| **Total transformation sector** | | **174.4** | **17.4** | | | | | | | | **21.7** |
| ***Energy sector own use*** | | | | | | | | | | | |
| Oil and gas extraction | | | | | | | | | | | |
| Coal production | | | | | | | | | | | |
| Electric energy supply industry | | | | | | | | | | | |
| hydro power plants | | | | | | | | | | | |
| thermal power plants | | | | | | | | | | | |
| public cogeneration plants | | | | | | | | | | | |
| industrial cogeneration plants | | | | | | | | | | | |
| Wind power | | | | | | | | | | | |
| Petroleum refineries | | 20.5 | | | | | | 31.3 | | | 186.4 |
| NGL-plant | | | | | | | | | | | |
| Gas works | | | | | | | | | | | |
| **Total energy sector own use** | | **20.5** | | | | | | **31.3** | | | **186.4** |
| **Losses** | | | | | | | | | | | |
| **Final energy demand** | **6.7** | **14.8** | **0.0** | **2.7** | **107.2** | **32.2** | **7.7** | **167.5** | | **0.2** | **0.0** |
| **Non energy use** | | | | **2.7** | **107.2** | **32.2** | **7.7** | | | **0.2** | |
| Energy sector | | | | | | 2.1 | | | | | |
| Petrochemical industry | | | | | | | | | | | |
| Other industry | | | | 2.7 | 9.8 | 6.2 | 7.7 | | | 0.2 | |
| Construction | | | | | 97.4 | 1.1 | | | | | |
| Transport | | | | | | 21.4 | | | | | |
| Agriculture | | | | | | 1.4 | | | | | |
| **Energy consumption** | **6.7** | **14.8** | **0.0** | | | | | **167.5** | | **0.0** | **0.0** |
| **Industry** | **6.7** | **5.7** | | | | | | **167.5** | | | |
| Iron and steel | 0.3 | 0.3 | | | | | | 0.3 | | | |
| Non-ferrous metals | | | | | | | | | | | |
| Non-metallic minerals | | | | | | | | | | | |
| Chemical | | | | | | | | | | | |
| Construction materials | 3.5 | 0.4 | | | | | | 167.2 | | | |
| Pulp and paper | | | | | | | | | | | |
| Food production | 2.1 | 4.2 | | | | | | | | | |
| Not elsewhere specified | 0.8 | 0.8 | | | | | | | | | |
| **Transport** | | | | | | | | | | | |
| Rail | | | | | | | | | | | |
| Road | | | | | | | | | | | |
| Air | | | | | | | | | | | |
| – international | | | | | | | | | | | |
| – domestic | | | | | | | | | | | |
| Sea and River | | | | | | | | | | | |
| Public transport | | | | | | | | | | | |
| Not elsewhere specified | | | | | | | | | | | |
| **Other sectors** | | **9.1** | | | | | | | | | |
| Households | | 4.3 | | | | | | | | | |
| Services | | 2.7 | | | | | | | | | |
| Agriculture | | 2.1 | | | | | | | | | |
| Construction | | | | | | | | | | | |

| *ENERGY BALANCE 2015* <br> *natural units* | Refinery semiproducts | Aditives | Gas works gas | Electricity | Steam and hot water | waste, non renewable |
|---|---|---|---|---|---|---|
| | $10^3$ t | $10^3$ t | $10^3$ $m^3$ | GWh | TJ | TJ |
| Production | | | 600.0 | 11402.0 | 25363.6 | 390.0 |
| Import | 382.8 | 53.4 | | 8868.5 | | |
| Export | | | | 2080.1 | | |
| Import-processing | | | | | | |
| Export-processing | | | | | | |
| Stock change | 0.3 | | | | | |
| Bunkers | | | | | | |
| **Energy supplied** | **383.1** | **53.4** | **600.0** | **18190.4** | **25363.6** | **390.0** |
| ***Production*** | | | | | | |
| hydro power plants | | | | 6555.4 | | |
| – small HPP | | | | 100.8 | | |
| Wind power plants | | | | 796.3 | | |
| Solar power plants | | | | 57.3 | | |
| Geothermal power plants | | | | | | |
| thermal power plants | | | | 2595.9 | | |
| public cogeneration plants | | | | 1087.6 | 8832.6 | |
| public heating plants | | | | | 2272.7 | |
| industrial cogeneration plants | | | | 309.5 | 9611.3 | |
| – in rafineries | | | | 90.8 | 3777.0 | |
| – in gas production | | | | 84.4 | 702.4 | |
| Industrial heating plants | | | | | 4006.9 | |
| Petroleum refineries | | | | | | |
| NGL-plant | | | | | | |
| Coke plant | | | | | | |
| Gas works | | | 600.0 | | | |
| **Total production** | | | **600.0** | **11402.0** | **24723.5** | |
| ***Transformation sector*** | | | | | | |
| hydro power plants | | | | | | |
| – small HPP | | | | | | |
| Wind power plants | | | | | | |
| Solar power plants | | | | | | |
| Geothermal power plants | | | | | | |
| thermal power plants | | | | | | |
| public cogeneration plants | | | | | | |
| public heating plants | | | | | | |
| industrial cogeneration plants | | | | | | |
| – in rafineries | | | | | | |
| – in gas production | | | | | | |
| Industrial heating plants | | | | | | |
| Petroleum refineries | 383.1 | 53.4 | | | | |
| NGL-plant | | | | | | |
| Coke plant | | | | | | |
| Gas works | | | | | | |
| **Total transformation sector** | **383.1** | **53.4** | | | | |
| ***Energy sector own use*** | | | | | | |
| Oil and gas extraction | | | | 125.2 | 420.0 | |
| Coal production | | | | | 120.9 | |
| Electric energy supply industry | | | | 31.1 | | |
| hydro power plants | | | | 269.7 | | |
| thermal power plants | | | | 236.4 | | |
| public cogeneration plants | | | | 129.8 | 543.1 | |
| industrial cogeneration plants | | | | | | |
| Wind power | | | | 3.9 | | |
| Petroleum refineries | | | | 255.7 | 5573.5 | |
| NGL-plant | | | | 18.7 | 282.4 | |
| Gas works | | | | | | |
| **Total energy sector own use** | | | | **1070.5** | **6939.9** | |
| **Losses** | | | **13.9** | **1801.5** | **1588.1** | |
| **Final energy demand** | | | **586.1** | **15318.4** | **16835.6** | **390.0** |
| **Non energy use** | | | | | | |
| Energy sector | | | | | | |
| Petrochemical industry | | | | | | |
| Other industry | | | | | | |
| Construction | | | | | | |
| Transport | | | | | | |
| Agriculture | | | | | | |
| **Energy consumption** | | | **586.1** | **15318.4** | **16835.6** | **390.0** |
| **Industry** | | | | **3358.6** | **9621.4** | **390.0** |
| Iron and steel | | | | 365.1 | 59.2 | |
| Non-ferrous metals | | | | 35.7 | | |
| Non-metallic minerals | | | | 132.5 | 92.6 | |
| Chemical | | | | 309.5 | 4238.6 | |
| Construction materials | | | | 489.9 | | 390.0 |
| Pulp and paper | | | | 189.9 | 816.6 | |
| Food production | | | | 699.6 | 2634.4 | |
| Not elsewhere specified | | | | 1136.4 | 1780.0 | |
| **Transport** | | | | **290.7** | | |
| Rail | | | | 152.4 | | |
| Road | | | | | | |
| Air | | | | 24.6 | | |
| – international | | | | | | |
| – domestic | | | | 24.6 | | |
| Sea and River | | | | 21.5 | | |
| Public transport | | | | 61.8 | | |
| Not elsewhere specified | | | | 30.4 | | |
| **Other sectors** | | | **586.1** | **11669.1** | **7214.2** | |
| Households | | | 193.5 | 6202.5 | 5646.8 | |
| Services | | | 392.6 | 5328.0 | 1392.0 | |
| Agriculture | | | | 62.3 | 175.4 | |
| Construction | | | | 76.3 | | |

# APPENDIX 6. NFR 2016

## ANNEX 1: National sector emissions: Main pollutants, particulate matter, heavy metals and persistent organic pollutants

NFR 2014-1

| | | |
|---|---|---|
| COUNTRY: | HR | (as ISO2 code) |
| DATE: | 29.01.2018 | (as DD.MM.YYYY) |
| YEAR: | 2016 | (as YYYY, year of emissions and activity data) |
| Version: | v1.0 | (as v1.0 for the initial submission) |

XML Export for all entered years

Add a new year

| HR: 29.01.2018: 2016 | NFR sectors to be reported | | | Main Pollutants (from 1990) | | | | Particulate Matter (from 2000) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx (as $NO_2$) | NMVOC | SOx (as $SO_2$) | $NH_3$ | $PM_{2.5}$ | $PM_{10}$ | TSP | BC |
| **NFR Aggregation for Gridding and LPS (GNFR)** | **NFR Code** | **Longname** | **Notes** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| A_PublicPower | 1A1a | Public electricity and heat production | | 5.131118117 | 0.23273 | 3.30764 | 0.01038 | 0.592264 | 0.762413 | 1.001997 | 0.02185433 |
| B_Industry | 1A1b | Petroleum refining | | 1.53589 | 0.04043 | 3.03842 | NE | 0.066407 | 0.104763 | 0.136726 | 0.00456385 |
| B_Industry | 1A1c | Manufacture of solid fuels and other energy industries | | 0.26498808 | 0.08236 | 0.0024 | 0.00054 | 0.002793 | 0.002793 | 0.002793 | 0.00011172 |
| B_Industry | 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | | 0.064127135 | 0.0149 | 0.02976 | 0.00014 | 0.003766 | 0.004416 | 0.005377 | 0.00072229 |
| B_Industry | 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | | 0.016040105 | 0.00464 | 0.00188 | 0.00015 | 0.002237 | 0.003423 | 0.005327 | 0.00014467 |
| B_Industry | 1A2c | Stationary combustion in manufacturing industries and construction: Chemicals | | 0.261870381 | 0.05344 | 0.0516 | 0.00 | 0.006283 | 0.010344 | 0.01684 | 2.3977E-05 |
| B_Industry | 1A2d | Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print | | 0.22509615 | 0.04219 | 0.09416 | 4.4E-05 | 0.005589 | 0.005593 | 0.005601 | 0.00243736 |
| B_Industry | 1A2e | Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco | | 0.74634376 | 0.21681 | 0.947 | 0.00372 | 0.124154 | 0.139306 | 0.157781 | 0.01469832 |
| B_Industry | 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | | 3.793800998 | 0.62587 | 1.78596 | 0.02633 | 0.165715 | 0.178321 | 0.196699 | 0.03388111 |
| I_Offroad | 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | | 1.47 | 0.30 | 0.00115 | 0.00 | 0.08 | 0.08 | 0.08 | 0.06 |
| B_Industry | 1A2gviii | Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR) | | IE | IE | IE | IE | IE | IE | IE | IE |
| H_Aviation | 1A3ai(i) | International aviation LTO (civil) | | 0.19597236 | 0.01181 | 0.04913 | NE | 0.001653 | 0.001653 | 0.001653 | 0.00079636 |
| H_Aviation | 1A3aii(i) | Domestic aviation LTO (civil) | | 0.027789771 | 0.01105 | 0.00647 | 0.00016 | 0.000298 | 0.000353 | 0.000353 | 0.00011693 |
| F_RoadTransport | 1A3bi | Road transport: Passenger cars | | 10.84702013 | 2.74525 | 0.03961 | 0.49051 | 0.631745 | 0.631745 | 0.631745 | 0.45207263 |
| F_RoadTransport | 1A3bii | Road transport: Light duty vehicles | | 2.392562494 | 0.18626 | 0.00956 | 0.00856 | 0.181869 | 0.181869 | 0.181869 | 0.13207693 |
| F_RoadTransport | 1A3biii | Road transport: Heavy duty vehicles and buses | | 8.925496091 | 0.42481 | 0.01694 | 0.00845 | 0.191824 | 0.191824 | 0.191824 | 0.11998006 |
| F_RoadTransport | 1A3biv | Road transport: Mopeds & motorcycles | | 0.166286151 | 1.82251 | 0.00045 | 0.00146 | 0.028679 | 0.028679 | 0.028679 | 0.00435869 |
| F_RoadTransport | 1A3bv | Road transport: Gasoline evaporation | | NA | 1.08 | NA | NA | NA | NA | NA | NA |
| F_RoadTransport | 1A3bvi | Road transport: Automobile tyre and brake wear | | NA | NA | NA | NA | 0.300078 | 0.564212 | 0.564212 | 0 |
| F_RoadTransport | 1A3bvii | Road transport: Automobile road abrasion | | NA | NA | NA | NA | 0.132779 | 0.243699 | 0.487397 | NE |
| I_Offroad | 1A3c | Railways | | 0.95892082 | 0.08509 | 0.00023 | 0.00013 | 0.025074 | 0.026355 | 0.027817 | 0.00016413 |
| G_Shipping | 1A3di(ii) | International inland waterways | | IE | IE | IE | IE | IE | IE | IE | IE |
| G_Shipping | 1A3dii | National navigation (shipping) | | 1.605125597 | 0.31141 | 0.00054 | 0.00029 | 0.192274 | 0.192274 | 0.192274 | 0.00105331 |
| I_Offroad | 1A3ei | Pipeline transport | | NO | NO | NO | NO | NO | NO | NO | NO |
| I_Offroad | 1A3eii | Other (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| C_OtherStationaryComb | 1A4ai | Commercial/institutional: Stationary | | 1.631611927 | 0.29276 | 0.10943 | 0.00781 | 0.070465 | 0.071011 | 0.072261 | 0.02907115 |
| I_Offroad | 1A4aii | Commercial/institutional: Mobile | | IE | IE | IE | IE | IE | IE | IE | IE |

| **HR: 29.01.2018: 2016** | ***NFR sectors to be reported*** | | | **Main Pollutants** (from 1990) | | | | **Particulate Matter** (from 2000) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx (as $NO_2$) | NMVOC | SOx (as $SO_2$) | $NH_3$ | $PM_{2.5}$ | $PM_{10}$ | TSP | BC |
| **NFR Aggregation for Gridding and LPS (GNFR)** | **NFR Code** | **Longname** | **Notes** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** | **kt** |
| C_OtherStationaryComb | 1A4bi | Residential: Stationary | | 5.212766807 | 16.0663 | 0.9086 | 2.23317 | 13.33772 | 13.66599 | 14.35799 | 1.87151061 |
| I_Offroad | 1A4bii | Residential: Household and gardening (mobile) | | 0.041748473 | 0.3013 | 0.00007 | 2.9E-05 | 0.008823 | 0.008823 | 0.008823 | 0.00044157 |
| C_OtherStationaryComb | 1A4ci | Agriculture/Forestry/Fishing: Stationary | | 0.354782796 | 0.03833 | 0.04045 | 0.00017 | 0.011548 | 0.011548 | 0.011548 | 0.00602721 |
| I_Offroad | 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | | 2.82 | 0.26 | 0.00217 | 0.00 | 0.12 | 0.12 | 0.12 | 0.07 |
| I_Offroad | 1A4ciii | Agriculture/Forestry/Fishing: National fishing | | IE | IE | IE | IE | IE | IE | IE | IE |
| C_OtherStationaryComb | 1A5a | Other stationary (including military) | | IE | IE | IE | IE | IE | IE | IE | IE |
| I_Offroad | 1A5b | Other, Mobile (including military, land based and recreational boats) | | IE | IE | IE | IE | IE | IE | IE | IE |
| D_Fugitive | 1B1a | Fugitive emission from solid fuels: Coal mining and handling | | NA | NO | NA | NA | NO | NO | NO | NO |
| D_Fugitive | 1B1b | Fugitive emission from solid fuels: Solid fuel transformation | | NO | NO | NO | NO | NO | NO | NO | NO |
| D_Fugitive | 1B1c | Other fugitive emissions from solid fuels | | NO | NO | NO | NO | NO | NO | NO | NO |
| D_Fugitive | 1B2ai | Fugitive emissions oil: Exploration, production, transport | | NA | 0.07002 | NE | NA | NA | NA | NA | NA |
| D_Fugitive | 1B2aiv | Fugitive emissions oil: Refining / storage | | 0.1047442 | 0.9829 | 3.77268 | 0.0838 | 0.146152 | 0.335783 | 0.459599 | 0.0001634 |
| D_Fugitive | 1B2av | Distribution of oil products | | NA | 2.24962 | NE | NA | NA | NA | NA | NA |
| D_Fugitive | 1B2b | Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) | | NA | 0.19522 | NE | NA | NA | NA | NA | NA |
| D_Fugitive | 1B2c | Venting and flaring (oil, gas, combined oil and gas) | | 0.055616711 | 0.02374 | 0.29117 | NE | 0.024566 | 0.024566 | 0.024566 | 0.00561038 |
| D_Fugitive | 1B2d | Other fugitive emissions from energy production | (a) | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2A1 | Cement production | | IE | IE | IE | IE | 0.160578 | 0.317943 | 0.037468 | 0.00802888 |
| B_Industry | 2A2 | Lime production | | IE | IE | IE | IE | 0.003752 | 0.025016 | 0.050033 | 1.7261E-05 |
| B_Industry | 2A3 | Glass production | | IE | 0.03572 | IE | 0.06661 | 0.11954 | 0.134983 | 0.151496 | 0.00110352 |
| B_Industry | 2A5a | Quarrying and mining of minerals other than coal | | NA | NA | NA | NA | 0.11496 | 1.149601 | 2.345185 | NA |
| B_Industry | 2A5b | Construction and demolition | | NA | NA | NA | NA | 0.015052 | 0.150516 | 0.300291 | NA |
| B_Industry | 2A5c | Storage, handling and transport of mineral products | | IE | IE | IE | IE | IE | IE | IE | IE |
| B_Industry | 2A6 | Other mineral products (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B1 | Ammonia production | | 0.741116365 | NE | NE | 0.0042 | NE | NA | NA | NA |
| B_Industry | 2B2 | Nitric acid production | | 0.1788886 | NA | NA | NE | NE | NA | NA | NA |
| B_Industry | 2B3 | Adipic acid production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B5 | Carbide production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B6 | Titanium dioxide production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B7 | Soda ash production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B10a | Chemical industry: Other (please specify in the IIR) | | 0.021436046 | 1.4E-05 | 0.20031 | 2.07468 | 0.35419 | 0.472253 | 0.692733 | 0.00637542 |
| B_Industry | 2B10b | Storage, handling and transport of chemical products (please specify in the IIR) | | NA | NA | NA | NA | IE | IE | IE | IE |
| B_Industry | 2C1 | Iron and steel production | | 0.003070643 | 0.00118 | 0.00142 | IE | 0.000496 | 0.000567 | 0.000826 | 1.7857E-06 |
| B_Industry | 2C2 | Ferroalloys production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C3 | Aluminium production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C4 | Magnesium production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C5 | Lead production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C6 | Zinc production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C7a | Copper production | | NO | NO | NO | NO | NO | NO | NO | NO |

| HR: 29.01.2018: 2016 | NFR sectors to be reported | | | Main Pollutants (from 1990) | | | | Particulate Matter (from 2000) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx (as $NO_2$) | NMVOC | SOx (as $SO_2$) | $NH_3$ | $PM_{2.5}$ | $PM_{10}$ | TSP | BC |
| NFR Aggregation for Gridding and LPS (GNFR) | NFR Code | Longname | Notes | kt | kt | kt | kt | kt | kt | kt | kt |
| B_Industry | 2C7b | Nickel production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C7c | Other metal production (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C7d | Storage, handling and transport of metal products (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| E_Solvents | 2D3a | Domestic solvent use including fungicides | | NA | 2.11786 | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3b | Road paving with asphalt | | NE | 0.01199 | NE | NA | 0.29986 | 2.24895 | 10.4951 | 0.01709202 |
| B_Industry | 2D3c | Asphalt roofing | | NE | 0.00225 | NA | NA | 0.001387 | 0.006936 | 0.027742 | 1.8033E-07 |
| B_Industry | 2D3d | Coating applications | | NA | 12.2765 | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3e | Degreasing | | NA | 2.96133 | NA | NA | NE | NA | NA | NA |
| E_Solvents | 2D3f | Dry cleaning | | NA | 0.04904 | NA | NA | NE | NA | NA | NA |
| E_Solvents | 2D3g | Chemical products | | NE | 1.16656 | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3h | Printing | | NA | 2.34836 | NA | NA | NE | NA | NA | NE |
| E_Solvents | 2D3i | Other solvent use (please specify in the IIR) | | NE | 3.43158 | NE | NE | 0.028302 | 0.042453 | 0.051887 | NE |
| E_Solvents | 2G | Other product use (please specify in the IIR) | | 0.01502388 | 0.89 | 0.00 | 0.03 | 0.29 | 0.35 | 0.36 | 0.10 |
| B_Industry | 2H1 | Pulp and paper industry | | NE | 0.00168 | NE | NE | NE | NE | NE | NE |
| B_Industry | 2H2 | Food and beverages industry | | NA | 5.38226 | NA | NA | NE | NE | NE | NE |
| B_Industry | 2H3 | Other industrial processes (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2I | Wood processing | | NE | NE | NE | NE | NE | NE | 0.087228 | NE |
| B_Industry | 2J | Production of POPs | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2K | Consumption of POPs and heavy metals (e.g. electrical and scientific equipment) | | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2L | Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| K_AgriLivestock | 3B1a | Manure management - Dairy cattle | | 0.017232158 | 2.69177 | NA | 4.59678 | 0.068727 | 0.105606 | 0.231327 | NA |
| K_AgriLivestock | 3B1b | Manure management - Non-dairy cattle | | 0.03 | 2.32276 | NA | 4.53271 | 0.037353 | 0.058467 | 0.125415 | NA |
| K_AgriLivestock | 3B2 | Manure management - Sheep | | 0.00 | 0.10527 | NA | 0.08601 | 0.010336 | 0.034411 | 0.086027 | NA |
| K_AgriLivestock | 3B3 | Manure management - Swine | | 0.015429174 | 0.83344 | NA | 8.13938 | 0.080753 | 0.459126 | 1.013989 | NA |
| K_AgriLivestock | 3B4a | Manure management - Buffalo | | NO | NO | NO | NO | NO | NO | NO | NO |
| K_AgriLivestock | 3B4d | Manure management - Goats | | 0.00 | 0.041 | NA | 0.02138 | 0.001261 | 0.004199 | 0.010499 | NA |
| K_AgriLivestock | 3B4e | Manure management - Horses | | 0.00 | 0.09736 | NA | 0.09547 | 0.003189 | 0.005011 | 0.010932 | NA |
| K_AgriLivestock | 3B4f | Manure management - Mules and asses | | 0.00 | 0.00421 | NA | 0.012 | 0.000286 | 0.000458 | 0.000973 | NA |
| K_AgriLivestock | 3B4gi | Manure mangement - Laying hens | | 0.01 | 0.5775 | NA | 1.36517 | 0.0805 | 0.4165 | 0.4165 | NA |
| K_AgriLivestock | 3B4gii | Manure mangement - Broilers | | 0.04 | 0.57911 | NA | 1.38646 | 0.048259 | 0.369985 | 0.369985 | NA |
| K_AgriLivestock | 3B4giii | Manure mangement - Turkeys | | 0.00 | 0.25029 | NA | 0.50378 | 0.035829 | 0.266159 | 0.266159 | NA |
| K_AgriLivestock | 3B4giv | Manure management - Other poultry | | 0.00 | 0.23589 | NA | 0.32116 | 0.013557 | 0.106624 | 0.106624 | NA |
| K_AgriLivestock | 3B4h | Manure management - Other animals (please specify in IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| L_AgriOther | 3Da1 | Inorganic N-fertilizers (includes also urea application) | | 2.431199992 | 0.62871 | NA | 7.15989 | 0.043863 | 1.14045 | 1.14045 | NA |
| L_AgriOther | 3Da2a | Animal manure applied to soils | | IE | NA | NA | IE | NA | NA | NA | NA |
| L_AgriOther | 3Da2b | Sewage sludge applied to soils | | 0.003943208 | NA | NA | 0.01 | NA | NA | NA | NA |
| L_AgriOther | 3Da2c | Other organic fertilisers applied to soils (including compost) | | NO | NO | NO | NO | NO | NO | NO | NO |
| L_AgriOther | 3Da3 | Urine and dung deposited by grazing animals | | NA | NA | NA | 1.12 | NA | NA | NA | NA |
| L_AgriOther | 3Da4 | Crop residues applied to soils | | NA | NA | NA | NA | NA | IE | IE | NA |
| L_AgriOther | 3Db | Indirect emissions from managed soils | | NA | NA | NA | NA | NA | IE | IE | NA |

| HR: 29.01.2018: 2016 | NFR sectors to be reported | | | Main Pollutants (from 1990) | | | | Particulate Matter (from 2000) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx (as $NO_2$) | NMVOC | SOx (as $SO_2$) | $NH_3$ | $PM_{2.5}$ | $PM_{10}$ | TSP | BC |
| NFR Aggregation for Gridding and LPS (GNFR) | NFR Code | Longname | Notes | kt | kt | kt | kt | kt | kt | kt | kt |
| L_AgriOther | 3Dc | Farm-level agricultural operations including storage, handling and transport of agricultural products | | NA | NA | NA | NA | IE | IE | IE | NA |
| L_AgriOther | 3Dd | Off-farm storage, handling and transport of bulk agricultural products | | NA | NA | NA | NA | IE | IE | IE | NA |
| L_AgriOther | 3De | Cultivated crops | (b) | IE | IE | NA | IE | IE | IE | IE | NA |
| L_AgriOther | 3Df | Use of pesticides | | NA | NA | NA | NO | NA | NA | NA | NA |
| L_AgriOther | 3F | Field burning of agricultural residues | | NE | NE | NE | NE | NE | NO | NO | NO |
| L_AgriOther | 3I | Agriculture other (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5A | Biological treatment of waste - Solid waste disposal on land | | NA | 2.05312 | NA | NA | 4.34E-05 | 0.000288 | 0.000609 | NA |
| J_Waste | 5B1 | Biological treatment of waste - Composting | | NE | NE | NE | 0.01 | NE | NE | NE | NE |
| J_Waste | 5B2 | Biological treatment of waste - Anaerobic digestion at biogas facilities | | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5C1a | Municipal waste incineration | (c) | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5C1bi | Industrial waste incineration | (c) | IE | IE | IE | IE | IE | IE | IE | IE |
| J_Waste | 5C1bii | Hazardous waste incineration | (c) | IE | IE | IE | IE | IE | IE | IE | IE |
| J_Waste | 5C1biii | Clinical waste incineration | (c) | 1.28E-04 | 3.9E-05 | 3E-05 | NE | NE | NE | 0.000947 | 2.1771E-05 |
| J_Waste | 5C1biv | Sewage sludge incineration | (c) | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5C1bv | Cremation | (c) | 0.0042306 | 6.7E-05 | 0.00058 | NA | 0.000178 | 0.000178 | 0.000198 | NE |
| J_Waste | 5C1bvi | Other waste incineration (please specify in the IIR) | (c) | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5C2 | Open burning of waste | | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5D1 | Domestic wastewater handling | | NA | 4.02E-03 | NA | NA | NA | NA | NA | NA |
| J_Waste | 5D2 | Industrial wastewater handling | | NA | 0.00018 | NA | NA | NA | NA | NA | NA |
| J_Waste | 5D3 | Other wastewater handling | | NA | NA | NA | 0.60086 | NA | NA | NA | NA |
| J_Waste | 5E | Other waste (please specify in IIR) | (d) | NE | NE | NE | NE | 0.149875 | 0.149875 | 0.149875 | NE |
| M_Other | 6A | Other (included in national total for entire territory) (please specify in IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| | NATIONAL TOTAL | National total for the entire territory (based on fuel sold) | | 52.372 | 69.871 | 14.714 | 35.014 | 18.411 | 25.604 | 37.501 | 2.964 |
| | | | | | | | | | | | |
| | ADJUSTMENTS (Net total) | Sum of adjustments (negative value) from Annex VII | | | | | | | | | |
| | NATIONAL TOTAL FOR COMPLIANCE | National total for compliance assessment (please specify all details in the IIR) | (e) | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 'MEMO' ITEMS - NOT TO BE INCLUDED IN NATIONAL TOTALS | | | | | | | | | | | |
| O_AviCruise | 1A3ai(ii) | International aviation cruise (civil) | | 1.258492062 | 0.04914 | 0.24801 | NE | 0.019666 | 0.019666 | 0.019666 | 0.00942237 |
| O_AviCruise | 1A3aii(ii) | Domestic aviation cruise (civil) | | 0.071445568 | 0.00069 | 0.0175 | NE | 0.001387 | 0.001387 | 0.001387 | 0.00066475 |
| P_IntShipping | 1A3di(i) | International maritime navigation | | 0.21195034 | 0.00756 | 0.0054 | 1.9E-05 | 0.00378 | 0.00405 | 0.00405 | 1.1762E-05 |
| z_Memo | 1A5c | Multilateral operations | | NA | NA | NA | NA | NA | NA | NA | NA |
| z_Memo | 1A3 | Transport (fuel used) | | NE | NE | NE | NE | NE | NE | NE | NE |
| z_Memo | 6B | Other not included in national total of the entire territory (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| N_Natural | 11A | Volcanoes | | NO | NO | NO | NO | NO | NO | NO | NO |
| N_Natural | 11B | Forest fires | | 0.6733 | 2.0199 | 0.13466 | 0.13466 | NE | NE | NE | NE |
| N_Natural | 11C | Other natural emissions (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |

| HR: 29.01.2018: 2016 | NFR sectors to be reported | | | Other (from 1990) | Priority Heavy Metals (from 1990) | | | Additional Heavy Metals (from 1990, voluntary reporting) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CO | Pb | Cd | Hg | As | Cr | Cu | Ni | Se | Zn |
| **NFR Aggregation for Gridding and LPS (GNFR)** | **NFR Code** | **Longname** | **Notes** | **kt** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| A_PublicPower | 1A1a | Public electricity and heat production | | 0.65852 | 0.29815 | 0.01645 | 0.19953 | 0.09539 | 0.09236 | 0.18342 | 0.31766 | 0.01158 | 0.9324 |
| B_Industry | 1A1b | Petroleum refining | | 0.48773 | 0.04125 | 0.01238 | 0.00282 | 0.02811 | 0.11274 | 0.09076 | 6.6082 | 0.01624 | 0.48386 |
| B_Industry | 1A1c | Manufacture of solid fuels and other energy industries | | 0.10385 | 3.9E-05 | 0.00645 | 0.00193 | 0.00036 | 4.7E-05 | 9.3E-06 | 4.7E-05 | 0.00021 | 0.00261 |
| B_Industry | 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | | 0.03159 | 0.00051 | 7.7E-05 | 0.00037 | 0.00019 | 0.00032 | 0.00028 | 0.00025 | 9.5E-05 | 0.00602 |
| B_Industry | 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | | 0.00879 | 0.00028 | 6.6E-05 | 0.00027 | 0.00021 | 0.00023 | 0.00012 | 0.00019 | 9.3E-05 | 0.00241 |
| B_Industry | 1A2c | Stationary combustion in manufacturing industries and construction: Chemicals | | 0.03624 | 0.00064 | 6.6E-05 | 0.00396 | 0.00076 | 0.00051 | 0.00033 | 0.00064 | 0.00034 | 0.00225 |
| B_Industry | 1A2d | Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print | | 0.06063 | 6.7E-05 | 1.8E-05 | 0.00089 | 0.00017 | 9E-05 | 5.7E-05 | 2.5E-05 | 0.00012 | 0.00784 |
| B_Industry | 1A2e | Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco | | 0.98465 | 0.02574 | 0.00286 | 0.0042 | 0.00497 | 0.01426 | 0.01546 | 0.01195 | 0.00235 | 0.23148 |
| B_Industry | 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | | 7.126 | 0.29238 | 0.02743 | 0.10836 | 0.05967 | 0.11355 | 0.15337 | 0.11483 | 0.05467 | 1.42726 |
| I_Offroad | 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | | 3.82 | 0.02 | 0.00091 | NE | NE | 0.00 | 0.16 | 0.01 | 0.00 | 0.09 |
| B_Industry | 1A2gviii | Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR) | | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| H_Aviation | 1A3ai(i) | International aviation LTO (civil) | | 0.27861 | 6.9E-05 | 5.1E-06 | 0.0001 | 2.6E-05 | 0.00017 | 0.00019 | 6.9E-06 | 9.4E-05 | 0.02483 |
| H_Aviation | 1A3aii(i) | Domestic aviation LTO (civil) | | 0.63666 | 0.13692 | 6.8E-06 | 1.4E-05 | 3.4E-06 | 9E-05 | 0.00137 | 1.8E-05 | 1.4E-05 | 0.00486 |
| F_RoadTransport | 1A3bi | Road transport: Passenger cars | | 26.7123 | 3.14507 | 0.0122 | 0.00801 | 0.00022 | 0.02968 | 0.03813 | 0.01336 | 0.00017 | 2.44132 |
| F_RoadTransport | 1A3bii | Road transport: Light duty vehicles | | 1.38145 | 0.05556 | 0.00188 | 0.00116 | 0.00002 | 0.00629 | 0.00471 | 0.00192 | 2.2E-05 | 0.37544 |
| F_RoadTransport | 1A3biii | Road transport: Heavy duty vehicles and buses | | 2.06593 | 0.00226 | 0.00324 | 0.00195 | 0.00004 | 0.01107 | 0.00792 | 0.00327 | 3.7E-05 | 0.64646 |
| F_RoadTransport | 1A3biv | Road transport: Mopeds & motorcycles | | 4.68996 | 0.11366 | 0.00025 | 0.00020 | 0.00001 | 0.00036 | 0.00095 | 0.0003 | 4.5E-06 | 0.04919 |
| F_RoadTransport | 1A3bv | Road transport: Gasoline evaporation | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| F_RoadTransport | 1A3bvi | Road transport: Automobile tyre and brake wear | | NA | 0.78981 | 0.00362 | NE | NE | 0.29304 | 6.4194 | 0.04611 | 0.006 | 2.38603 |
| F_RoadTransport | 1A3bvii | Road transport: Automobile road abrasion | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| I_Offroad | 1A3c | Railways | | 0.19581 | 6.3E-05 | 0.00018 | 9.4E-05 | 2.3E-05 | 0.00091 | 0.03111 | 0.00128 | 0.00018 | 0.0183 |
| G_Shipping | 1A3di(ii) | International inland waterways | | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| G_Shipping | 1A3dii | National navigation (shipping) | | 0.82764 | 0.00543 | 0.00042 | 0.00125 | 0.00168 | 0.00209 | 0.03887 | 0.03943 | 0.00395 | 0.04965 |
| I_Offroad | 1A3ei | Pipeline transport | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| I_Offroad | 1A3eii | Other (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| C_OtherStationaryComb | 1A4ai | Commercial/institutional: Stationary | | 0.47176 | 0.00525 | 0.01724 | 0.00482 | 0.00093 | 0.00459 | 0.00154 | 0.0005 | 0.00079 | 0.15358 |
| I_Offroad | 1A4aii | Commercial/institutional: Mobile | | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| C_OtherStationaryComb | 1A4bi | Residential: Stationary | | 123.526 | 1.28938 | 0.61411 | 0.04224 | 0.0119 | 1.08804 | 0.28621 | 0.09591 | 0.02405 | 24.2027 |
| I_Offroad | 1A4bii | Residential: Household and gardening (mobile) | | 5.74332 | 0.02775 | 7.4E-05 | NE | NE | 0.00037 | 0.01258 | 0.00052 | 7.4E-05 | 0.0074 |
| C_OtherStationaryComb | 1A4ci | Agriculture/Forestry/Fishing: Stationary | | 0.06677 | 5.5E-05 | 0.00196 | 0.00065 | 0.00012 | 0.00012 | 0.00012 | 1.8E-05 | 0.00012 | 0.01631 |
| I_Offroad | 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | | 1.27 | NA | 0.00 | NE | NE | 0.01 | 0.29 | 0.01 | 0.00 | 0.17 |
| I_Offroad | 1A4ciii | Agriculture/Forestry/Fishing: National fishing | | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| C_OtherStationaryComb | 1A5a | Other stationary (including military) | | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| I_Offroad | 1A5b | Other, Mobile (including military, land based and recreational boats) | | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| D_Fugitive | 1B1a | Fugitive emission from solid fuels: Coal mining and handling | | NA | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| D_Fugitive | 1B1b | Fugitive emission from solid fuels: Solid fuel transformation | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| D_Fugitive | 1B1c | Other fugitive emissions from solid fuels | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| D_Fugitive | 1B2ai | Fugitive emissions oil: Exploration, production, transport | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| D_Fugitive | 1B2aiv | Fugitive emissions oil: Refining / storage | | 20.4553 | 0.17038 | 0.03299 | 0.03852 | 0.14372 | 0.17283 | 0.07425 | 0.35481 | 0.00919 | 0.06564 |
| D_Fugitive | 1B2av | Distribution of oil products | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

| HR: 29.01.2018: 2016 | NFR sectors to be reported | | | Other (from 1990) | Priority Heavy Metals (from 1990) | | | Additional Heavy Metals (from 1990, voluntary reporting) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CO | Pb | Cd | Hg | As | Cr | Cu | Ni | Se | Zn |
| NFR Aggregation for Gridding and LPS (GNFR) | NFR Code | Longname | Notes | kt | t | t | t | t | t | t | t | t | t |
| D_Fugitive | 1B2b | Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) | | NA | NA | NA | 4.1E-05 | NA | NA | NA | NA | NA | NA |
| D_Fugitive | 1B2c | Venting and flaring (oil, gas, combined oil and gas) | | 0.29317 | 0.00272 | 0.00112 | 0.00016 | 0.00044 | 0.00402 | 0.00269 | 0.00569 | 3.9E-06 | 0.03942 |
| D_Fugitive | 1B2d | Other fugitive emissions from energy production | (a) | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2A1 | Cement production | | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| B_Industry | 2A2 | Lime production | | IE | IE | IE | IE | NA | NA | NA | NA | NA | NA |
| B_Industry | 2A3 | Glass production | | IE | 0.47048 | 0.03598 | 0.00083 | 0.05258 | 0.06365 | 0.00194 | 0.13561 | 0.2214 | 0.1024 |
| B_Industry | 2A5a | Quarrying and mining of minerals other than coal | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2A5b | Construction and demolition | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2A5c | Storage, handling and transport of mineral products | | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| B_Industry | 2A6 | Other mineral products (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B1 | Ammonia production | | 0.00336 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2B2 | Nitric acid production | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2B3 | Adipic acid production | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B5 | Carbide production | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B6 | Titanium dioxide production | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B7 | Soda ash production | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B10a | Chemical industry: Other (please specify in the IIR) | | 2.4E-05 | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| B_Industry | 2B10b | Storage, handling and transport of chemical products (please specify in the IIR) | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2C1 | Iron and steel production | | 0.04015 | 0.06141 | 0.00472 | 0.00118 | 0.00035 | 0.00236 | 0.00047 | 0.01653 | IE | 0.08503 |
| B_Industry | 2C2 | Ferroalloys production | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C3 | Aluminium production | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C4 | Magnesium production | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C5 | Lead production | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C6 | Zinc production | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C7a | Copper production | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C7b | Nickel production | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C7c | Other metal production (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C7d | Storage, handling and transport of metal products (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| E_Solvents | 2D3a | Domestic solvent use including fungicides | | NA | NA | NA | 0.02338 | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3b | Road paving with asphalt | | NE | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2D3c | Asphalt roofing | | 0.00016 | NE | NE | NE | NA | NA | NA | NA | NA | NA |
| B_Industry | 2D3d | Coating applications | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3e | Degreasing | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3f | Dry cleaning | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3g | Chemical products | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3h | Printing | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3i | Other solvent use (please specify in the IIR) | | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| E_Solvents | 2G | Other product use (please specify in the IIR) | | 0.46 | 1.00 | 0.05 | 0.00 | 0.00 | 0.02 | 0.61 | 0.06 | NE | 0.35 |
| B_Industry | 2H1 | Pulp and paper industry | | NE | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2H2 | Food and beverages industry | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2H3 | Other industrial processes (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| HR: 29.01.2018: 2016 | NFR sectors to be reported | | | Other (from 1990) | Priority Heavy Metals (from 1990) | | | Additional Heavy Metals (from 1990, voluntary reporting) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CO | Pb | Cd | Hg | As | Cr | Cu | Ni | Se | Zn |
| NFR Aggregation for Gridding and LPS (GNFR) | NFR Code | Longname | Notes | kt | t | t | t | t | t | t | t | t | t |
| B_Industry | 2I | Wood processing | | NE | NA | NA | NA | NE | NA | NE | NA | NA | NA |
| B_Industry | 2J | Production of POPs | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2K | Consumption of POPs and heavy metals (e.g. electrical and scientific equipment) | | NA | NE | NE | 0.04174 | NE | NE | NE | NE | NE | NE |
| B_Industry | 2L | Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| K_AgriLivestock | 3B1a | Manure management - Dairy cattle | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B1b | Manure management - Non-dairy cattle | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B2 | Manure management - Sheep | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B3 | Manure management - Swine | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4a | Manure management - Buffalo | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| K_AgriLivestock | 3B4d | Manure management - Goats | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4e | Manure management - Horses | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4f | Manure management - Mules and asses | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4gi | Manure mangement - Laying hens | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4gii | Manure mangement - Broilers | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4giii | Manure mangement - Turkeys | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4giv | Manure management - Other poultry | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4h | Manure management - Other animals (please specify in IIR) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| L_AgriOther | 3Da1 | Inorganic N-fertilizers (includes also urea application) | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Da2a | Animal manure applied to soils | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Da2b | Sewage sludge applied to soils | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Da2c | Other organic fertilisers applied to soils (including compost) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| L_AgriOther | 3Da3 | Urine and dung deposited by grazing animals | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Da4 | Crop residues applied to soils | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Db | Indirect emissions from managed soils | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Dc | Farm-level agricultural operations including storage, handling and transport of agricultural products | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Dd | Off-farm storage, handling and transport of bulk agricultural products | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3De | Cultivated crops | (b) | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Df | Use of pesticides | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3F | Field burning of agricultural residues | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| L_AgriOther | 3I | Agriculture other (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5A | Biological treatment of waste - Solid waste disposal on land | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5B1 | Biological treatment of waste - Composting | | NE | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5B2 | Biological treatment of waste - Anaerobic digestion at biogas facilities | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5C1a | Municipal waste incineration | (c) | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5C1bi | Industrial waste incineration | (c) | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| J_Waste | 5C1bii | Hazardous waste incineration | (c) | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| J_Waste | 5C1biii | Clinical waste incineration | (c) | 1.1E-05 | 0.00345 | 0.00045 | 0.00239 | 1.1E-05 | 0.00011 | 0.00546 | 0.00011 | NE | NE |
| J_Waste | 5C1biv | Sewage sludge incineration | (c) | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5C1bv | Cremation | (c) | 0.00072 | 0.00015 | 2.6E-05 | 0.00764 | 7E-05 | 7E-05 | 6.4E-05 | 8.9E-05 | 0.0001 | 0.00082 |
| J_Waste | 5C1bvi | Other waste incineration (please specify in the IIR) | (c) | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| HR: 29.01.2018: 2016 | *NFR sectors to be reported* | | | Other (from 1990) | Priority Heavy Metals (from 1990) | | | Additional Heavy Metals (from 1990, voluntary reporting) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CO | Pb | Cd | Hg | As | Cr | Cu | Ni | Se | Zn |
| **NFR Aggregation for Gridding and LPS (GNFR)** | **NFR Code** | **Longname** | **Notes** | **kt** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** | **t** |
| J_Waste | 5C2 | Open burning of waste | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5D1 | Domestic wastewater handling | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5D2 | Industrial wastewater handling | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5D3 | Other wastewater handling | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5E | Other waste (please specify in IIR) | (d) | NE | 0.00044 | 0.00088 | 0.00088 | 0.00139 | 0.00133 | 0.0031 | NE | NE | NE |
| M_Other | 6A | Other (included in national total for entire territory) (please specify in IIR) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | **NATIONAL TOTAL** | **National total for the entire territory (based on fuel sold)** | | 202.435 | 7.957 | 0.846 | 0.500 | 0.405 | 2.048 | 8.430 | 7.848 | 0.355 | 34.381 |
| | ADJUSTMENTS (Net total) | Sum of adjustments (negative value) from Annex VII | | | | | | | | | | | |
| | **NATIONAL TOTAL FOR COMPLIANCE** | **National total for compliance assessment (please specify all details in the IIR)** | (e) | | | | | | | | | | |
| *'MEMO' ITEMS - NOT TO BE INCLUDED IN NATIONAL TOTALS* | | | | | | | | | | | | | |
| O_AviCruise | 1A3ai(ii) | International aviation cruise (civil) | | 0.10814 | 0.00035 | 2.6E-05 | 0.00052 | 0.00013 | 0.00086 | 0.00095 | 3.5E-05 | 0.00048 | 0.12534 |
| O_AviCruise | 1A3aii(ii) | Domestic aviation cruise (civil) | | 0.01387 | 2.4E-05 | 1.8E-06 | 3.7E-05 | 9.1E-06 | 6.1E-05 | 6.7E-05 | 2.4E-06 | 3.4E-05 | 0.00884 |
| P_IntShipping | 1A3di(i) | International maritime navigation | | 0.01998 | 0.00035 | 2.7E-05 | 8.1E-05 | 0.00011 | 0.00014 | 0.00238 | 0.0027 | 0.00027 | 0.00324 |
| z_Memo | 1A5c | Multilateral operations | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| z_Memo | 1A3 | Transport (fuel used) | | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| z_Memo | 6B | Other not included in national total of the entire territory (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| N_Natural | 11A | Volcanoes | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| N_Natural | 11B | Forest fires | | 20.199 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| N_Natural | 11C | Other natural emissions (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| HR: 29.01.2018: 2016 | NFR sectors to be reported | | | POPs [1] (from 1990) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | PCDD/ PCDF (dioxins/ furans) | PAHs | | | | | HCB | PCBs |
| | | | | | benzo(a) pyrene | benzo(b) fluoranthene | benzo(k) fluoranthene | Indeno (1,2,3-cd) pyrene | Total 1-4 | | |
| **NFR Aggregation for Gridding and LPS (GNFR)** | **NFR Code** | **Longname** | **Notes** | **g I-TEQ** | **t** | **t** | **t** | **t** | **t** | **kg** | **kg** |
| A_PublicPower | 1A1a | Public electricity and heat production | | 0.43841 | 0.00424 | 0.00039 | 0.00012 | 0.00024 | 0.00498 | 0.03358 | 4.10691 |
| B_Industry | 1A1b | Petroleum refining | | 0.01766 | 1E-05 | 3.4E-05 | 8.3E-06 | 1.5E-05 | 6.8E-05 | NE | NE |
| B_Industry | 1A1c | Manufacture of solid fuels and other energy industries | | 0.00186 | 2.6E-06 | 1E-05 | 3.9E-06 | 3.9E-06 | 2.1E-05 | NE | NE |
| B_Industry | 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | | 0.00325 | 0.00101 | 0.00285 | 0.00094 | 0.00085 | 0.00563 | 3.9E-05 | 0.00562 |
| B_Industry | 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | | 0.00085 | 0.00012 | 0.00045 | 0.0002 | 0.00018 | 0.00095 | 4.7E-05 | 0.00799 |
| B_Industry | 1A2c | Stationary combustion in manufacturing industries and construction: Chemicals | | 0.00201 | 0.00056 | 0.00244 | 0.00105 | 0.00099 | 0.00504 | 0.0001 | 0.02761 |
| B_Industry | 1A2d | Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print | | 0.00124 | 0.00156 | 0.00777 | 0.00211 | 0.00204 | 0.01347 | 6E-06 | 7.2E-08 |
| B_Industry | 1A2e | Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco | | 0.17954 | 0.04172 | 0.06882 | 0.02551 | 0.02093 | 0.15698 | 0.00118 | 0.189 |
| B_Industry | 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | | 0.26539 | 0.05154 | 0.08158 | 0.03061 | 0.02498 | 0.1887 | 0.01371 | 0.4065 |
| I_Offroad | 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | | NE | 0.00 | 0.00 | NE | NE | 0.01 | NE | NE |
| B_Industry | 1A2gviii | Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR) | | IE | IE | IE | IE | IE | IE | IE | IE |
| H_Aviation | 1A3ai(i) | International aviation LTO (civil) | | 0.0012 | 0.00163 | 0.01284 | 0.00146 | 0.00128 | 0.01721 | NA | NA |
| H_Aviation | 1A3aii(i) | Domestic aviation LTO (civil) | | 0.00029 | 0.00022 | 0.0017 | 0.00019 | 0.00017 | 0.00228 | NA | NA |
| F_RoadTransport | 1A3bi | Road transport: Passenger cars | | 0.74921 | 0.02484 | 0.028 | 0.02162 | 0.02414 | 0.09861 | NE | NE |
| F_RoadTransport | 1A3bii | Road transport: Light duty vehicles | | 0.11469 | 0.00463 | 0.00519 | 0.00407 | 0.00432 | 0.0182 | NE | NE |
| F_RoadTransport | 1A3biii | Road transport: Heavy duty vehicles and buses | | 0.11814 | 0.00206 | 0.01245 | 0.01392 | 0.0032 | 0.03163 | NE | NE |
| F_RoadTransport | 1A3biv | Road transport: Mopeds & motorcycles | | 0.01045 | 0.00019 | 0.00023 | 0.00015 | 0.00025 | 0.00081 | NE | NE |
| F_RoadTransport | 1A3bv | Road transport: Gasoline evaporation | | NA | NA | NA | NA | NA | NA | NA | NA |
| F_RoadTransport | 1A3bvi | Road transport: Automobile tyre and brake wear | | NE | NE | NE | NE | NE | NE | NE | NE |
| F_RoadTransport | 1A3bvii | Road transport: Automobile road abrasion | | NE | NE | NE | NE | NE | NE | NE | NE |
| I_Offroad | 1A3c | Railways | | 0.00109 | 0.00055 | 0.00091 | 1.3E-06 | 1.2E-06 | 0.00146 | NE | NE |
| G_Shipping | 1A3di(ii) | International inland waterways | | IE | IE | IE | IE | IE | IE | IE | IE |
| G_Shipping | 1A3dii | National navigation (shipping) | | 0.33561 | 7.6E-05 | 0.00013 | NE | NE | 0.0002 | 0.00334 | 0.00246 |
| I_Offroad | 1A3ei | Pipeline transport | | NO | NO | NO | NO | NO | NO | NO | NO |
| I_Offroad | 1A3eii | Other (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| C_OtherStationaryComb | 1A4ai | Commercial/institutional: Stationary | | 0.02508 | 0.00186 | 0.00298 | 0.00094 | 0.00075 | 0.00653 | 0.00089 | 0.0003 |
| I_Offroad | 1A4aii | Commercial/institutional: Mobile | | IE | IE | IE | IE | IE | IE | IE | IE |
| C_OtherStationaryComb | 1A4bi | Residential: Stationary | | 14.3849 | 2.13976 | 2.20092 | 0.81024 | 1.20183 | 6.35276 | 0.23616 | 0.01768 |
| I_Offroad | 1A4bii | Residential: Household and gardening (mobile) | | NE | 0.0003 | 0.0003 | NE | NE | 0.00059 | NE | NE |
| C_OtherStationaryComb | 1A4ci | Agriculture/Forestry/Fishing: Stationary | | 0.00131 | 1.8E-06 | 1.1E-05 | 2.1E-06 | 2E-06 | 1.7E-05 | NE | NE |
| I_Offroad | 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | | NE | 0.01 | 0.01 | NE | NE | 0.01 | NE | NE |
| I_Offroad | 1A4ciii | Agriculture/Forestry/Fishing: National fishing | | IE | IE | IE | IE | IE | IE | IE | IE |
| C_OtherStationaryComb | 1A5a | Other stationary (including military) | | IE | IE | IE | IE | IE | IE | IE | IE |
| I_Offroad | 1A5b | Other, Mobile (including military, land based and recreational boats) | | IE | IE | IE | IE | IE | IE | IE | IE |
| D_Fugitive | 1B1a | Fugitive emission from solid fuels: Coal mining and handling | | NA | NA | NA | NA | NA | NA | NA | NA |
| D_Fugitive | 1B1b | Fugitive emission from solid fuels: Solid fuel transformation | | NO | NO | NO | NO | NO | NO | NO | NO |
| D_Fugitive | 1B1c | Other fugitive emissions from solid fuels | | NO | NO | NO | NO | NO | NO | NO | NO |

| HR: 29.01.2018: 2016 | NFR sectors to be reported | | | POPs (1) (from 1990) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | PCDD/ PCDF (dioxins/ furans) | PAHs | | | | | HCB | PCBs |
| | | | | | benzo(a) pyrene | benzo(b) fluoranthene | benzo(k) fluoranthene | Indeno (1,2,3-cd) pyrene | Total 1-4 | | |
| NFR Aggregation for Gridding and LPS (GNFR) | NFR Code | Longname | Notes | g I-TEQ | t | t | t | t | t | kg | kg |
| D_Fugitive | 1B2ai | Fugitive emissions oil: Exploration, production, transport | | NE | NA | NA | NA | NA | NA | NA | NA |
| D_Fugitive | 1B2aiv | Fugitive emissions oil: Refining / storage | | 0.00995 | 0.00037 | 0.00063 | 0.00043 | 0.00032 | 0.00175 | NA | NA |
| D_Fugitive | 1B2av | Distribution of oil products | | NE | NA | NA | NA | NA | NA | NA | NA |
| D_Fugitive | 1B2b | Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) | | NE | NA | NA | NA | NA | NA | NA | NA |
| D_Fugitive | 1B2c | Venting and flaring (oil, gas, combined oil and gas) | | NE | 9E-07 | 1.5E-06 | 8.4E-07 | 8.4E-07 | 4.1E-06 | NA | NA |
| D_Fugitive | 1B2d | Other fugitive emissions from energy production | (a) | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2A1 | Cement production | | IE | IE | IE | IE | IE | IE | IE | IE |
| B_Industry | 2A2 | Lime production | | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2A3 | Glass production | | IE | IE | IE | IE | IE | IE | IE | IE |
| B_Industry | 2A5a | Quarrying and mining of minerals other than coal | | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2A5b | Construction and demolition | | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2A5c | Storage, handling and transport of mineral products | | IE | IE | IE | IE | IE | IE | IE | IE |
| B_Industry | 2A6 | Other mineral products (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B1 | Ammonia production | | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2B2 | Nitric acid production | | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2B3 | Adipic acid production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B5 | Carbide production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B6 | Titanium dioxide production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B7 | Soda ash production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2B10a | Chemical industry: Other (please specify in the IIR) | | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2B10b | Storage, handling and transport of chemical products (please specify in the IIR) | | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2C1 | Iron and steel production | | 0.07086 | IE | IE | IE | IE | 0.01134 | IE | 0.05905 |
| B_Industry | 2C2 | Ferroalloys production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C3 | Aluminium production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C4 | Magnesium production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C5 | Lead production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C6 | Zinc production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C7a | Copper production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C7b | Nickel production | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C7c | Other metal production (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2C7d | Storage, handling and transport of metal products (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| E_Solvents | 2D3a | Domestic solvent use including fungicides | | NA | NA | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3b | Road paving with asphalt | | NE | NE | NE | NE | NE | NE | NE | NA |
| B_Industry | 2D3c | Asphalt roofing | | NE | NE | NE | NE | NE | NE | NE | NA |
| B_Industry | 2D3d | Coating applications | | NA | NA | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3e | Degreasing | | NA | NA | NA | NA | NA | NA | NA | NA |

| HR: 29.01.2018: 2016 | NFR sectors to be reported | | | POPs [(1)] (from 1990) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | PCDD/ PCDF (dioxins/ furans) | PAHs | | | | | HCB | PCBs |
| | | | | | benzo(a) pyrene | benzo(b) fluoranth ene | benzo(k) fluoranth ene | Indeno (1,2,3-cd) pyrene | Total 1-4 | | |
| **NFR Aggregation for Gridding and LPS (GNFR)** | **NFR Code** | **Longname** | **Notes** | **g I-TEQ** | **t** | **t** | **t** | **t** | **t** | **kg** | **kg** |
| E_Solvents | 2D3f | Dry cleaning | | NA | NA | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3g | Chemical products | | NA | NA | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3h | Printing | | NA | NA | NA | NA | NA | NA | NA | NA |
| E_Solvents | 2D3i | Other solvent use (please specify in the IIR) | | NE | 0.0003 | 0.00015 | 0.00015 | 0.00015 | 0.00077 | NE | NE |
| E_Solvents | 2G | Other product use (please specify in the IIR) | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NE | NE |
| B_Industry | 2H1 | Pulp and paper industry | | NA | NA | NE | NE | NE | NE | NE | NA |
| B_Industry | 2H2 | Food and beverages industry | | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2H3 | Other industrial processes (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2I | Wood processing | | NA | NA | NA | NA | NA | NA | NA | NA |
| B_Industry | 2J | Production of POPs | | NO | NO | NO | NO | NO | NO | NO | NO |
| B_Industry | 2K | Consumption of POPs and heavy metals (e.g. electrical and scientific equipment) | | NA | NA | NA | NA | NA | NA | NE | 417.435 |
| B_Industry | 2L | Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| K_AgriLivestock | 3B1a | Manure management - Dairy cattle | | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B1b | Manure management - Non-dairy cattle | | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B2 | Manure management - Sheep | | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B3 | Manure management - Swine | | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4a | Manure management - Buffalo | | NO | NO | NO | NO | NO | NO | NO | NO |
| K_AgriLivestock | 3B4d | Manure management - Goats | | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4e | Manure management - Horses | | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4f | Manure management - Mules and asses | | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4gi | Manure mangement - Laying hens | | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4gii | Manure mangement - Broilers | | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4giii | Manure mangement - Turkeys | | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4giv | Manure management - Other poultry | | NA | NA | NA | NA | NA | NA | NA | NA |
| K_AgriLivestock | 3B4h | Manure management - Other animals (please specify in IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| L_AgriOther | 3Da1 | Inorganic N-fertilizers (includes also urea application) | | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Da2a | Animal manure applied to soils | | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Da2b | Sewage sludge applied to soils | | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Da2c | Other organic fertilisers applied to soils (including compost) | | NO | NO | NO | NO | NO | NO | NO | NO |
| L_AgriOther | 3Da3 | Urine and dung deposited by grazing animals | | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Da4 | Crop residues applied to soils | | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Db | Indirect emissions from managed soils | | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Dc | Farm-level agricultural operations including storage, handling and transport of agricultural products | | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Dd | Off-farm storage, handling and transport of bulk agricultural products | | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3De | Cultivated crops | (b) | NA | NA | NA | NA | NA | NA | NA | NA |
| L_AgriOther | 3Df | Use of pesticides | | NA | NA | NA | NA | NA | NA | NO | NA |
| L_AgriOther | 3F | Field burning of agricultural residues | | NO | NO | NO | NO | NO | NO | NO | NO |
| L_AgriOther | 3I | Agriculture other (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |

| HR: 29.01.2018: 2016 | *NFR sectors to be reported* | | | POPs (1) (from 1990) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | PCDD/ PCDF (dioxins/ furans) | PAHs | | | | | HCB | PCBs |
| | | | | | benzo(a) pyrene | benzo(b) fluoranthene | benzo(k) fluoranthene | Indeno (1,2,3-cd) pyrene | Total 1-4 | | |
| **NFR Aggregation for Gridding and LPS (GNFR)** | **NFR Code** | **Longname** | **Notes** | **g I-TEQ** | **t** | **t** | **t** | **t** | **t** | **kg** | **kg** |
| J_Waste | 5A | Biological treatment of waste - Solid waste disposal on land | | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5B1 | Biological treatment of waste - Composting | | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5B2 | Biological treatment of waste - Anaerobic digestion at biogas facilities | | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5C1a | Municipal waste incineration | (c) | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5C1bi | Industrial waste incineration | (c) | IE | IE | IE | IE | IE | IE | IE | IE |
| J_Waste | 5C1bii | Hazardous waste incineration | (c) | IE | IE | IE | IE | IE | IE | IE | IE |
| J_Waste | 5C1biii | Clinical waste incineration | (c) | 2.2272 | IE | IE | IE | IE | 2.23E-09 | 0.00557 | 0.00111 |
| J_Waste | 5C1biv | Sewage sludge incineration | (c) | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5C1bv | Cremation | (c) | 0.00014 | 6.77E-08 | 3.70E-08 | 3.30E-08 | 3.58E-08 | ####### | 0.00077 | 0.0021 |
| J_Waste | 5C1bvi | Other waste incineration (please specify in the IIR) | (c) | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5C2 | Open burning of waste | | NO | NO | NO | NO | NO | NO | NO | NO |
| J_Waste | 5D1 | Domestic wastewater handling | | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5D2 | Industrial wastewater handling | | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5D3 | Other wastewater handling | | NA | NA | NA | NA | NA | NA | NA | NA |
| J_Waste | 5E | Other waste (please specify in IIR) | (d) | 1.51008 | NE | NE | NE | NE | NE | NE | NE |
| M_Other | 6A | Other (included in national total for entire territory) (please specify in IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| | NATIONAL TOTAL | National total for the entire territory (based on fuel sold) | | 20.471 | 2.286 | 2.444 | 0.914 | 1.287 | 6.943 | 0.295 | 422.261 |
| | | | | | | | | | | | |
| | ADJUSTMENTS (Net total) | Sum of adjustments (negative value) from Annex VII | | | | | | | | | |
| | NATIONAL TOTAL FOR COMPLIANCE | National total for compliance assessment (please specify all details in the IIR) | (e) | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 'MEMO' ITEMS - NOT TO BE INCLUDED IN NATIONAL TOTALS | | | | | | | | | | | |
| O_AviCruise | 1A3ai(ii) | International aviation cruise (civil) | | 0.00605 | 0.00821 | 0.06483 | 0.00735 | 0.00648 | 0.08688 | NE | NE |
| O_AviCruise | 1A3aii(ii) | Domestic aviation cruise (civil) | | 0.00043 | 0.00058 | 0.00457 | 0.00052 | 0.00046 | 0.00613 | NE | NE |
| P_IntShipping | 1A3di(i) | International maritime navigation | | 0.00035 | 8.1E-05 | 0.00013 | NE | NE | 0.00022 | 0.00022 | 0.0001 |
| z_Memo | 1A5c | Multilateral operations | | NA | NA | NA | NA | NA | NA | NA | NA |
| z_Memo | 1A3 | Transport (fuel used) | | NE | NE | NE | NE | NE | NE | NE | NE |
| z_Memo | 6B | Other not included in national total of the entire territory (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |
| N_Natural | 11A | Volcanoes | | NO | NO | NO | NO | NO | NO | NO | NO |
| N_Natural | 11B | Forest fires | | NA | NA | NA | NA | NA | NA | NA | NA |
| N_Natural | 11C | Other natural emissions (please specify in the IIR) | | NO | NO | NO | NO | NO | NO | NO | NO |

| HR: 29.01.2018: 2016 | NFR sectors to be reported | | Activity Data (from 1990) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels | *Other activity (specified)* | *Other Activity Units* |
| NFR Aggregation for Gridding and LPS (GNFR) | NFR Code | Longname | TJ NCV | TJ NCV | TJ NCV | TJ NCV | TJ NCV | | |
| A_PublicPower | 1A1a | Public electricity and heat production | 696 | 24081 | 19359 | 3730 | NO | *NA* | *TJ NCV* |
| B_Industry | 1A1b | Petroleum refining | 13008 | NA | 3355 | NO | NO | *NA* | *TJ NCV* |
| B_Industry | 1A1c | Manufacture of solid fuels and other energy industries | NO | NO | 3581 | NO | NO | *NA* | *TJ NCV* |
| B_Industry | 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | 65 | 12 | 490 | 4 | NO | *NA* | *TJ NCV* |
| B_Industry | 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | 47 | NO | 114 | 4 | NO | *NA* | *TJ NCV* |
| B_Industry | 1A2c | Stationary combustion in manufacturing industries and construction: Chemicals | 162 | NO | 5413 | NO | NO | *NA* | *TJ NCV* |
| B_Industry | 1A2d | Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print | 209 | NO | 1592 | 1 | NO | *NA* | *TJ NCV* |
| B_Industry | 1A2e | Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco | 761 | 808 | 4264 | 98 | NO | *NA* | *TJ NCV* |
| B_Industry | 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | 5957 | 2023 | 4720 | 709 | 159 | *NA* | *TJ NCV* |
| I_Offroad | 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | 3911 | NO | NO | NO | NO | *NA* | *TJ NCV* |
| B_Industry | 1A2gviii | Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR) | IE | IE | IE | IE | NO | *NA* | *TJ NCV* |
| H_Aviation | 1A3ai(i) | International aviation LTO (civil) | 135 | NA | NO | NO | NA | *NA* | *TJ NCV* |
| H_Aviation | 1A3aii(i) | Domestic aviation LTO (civil) | 856 | NA | NO | NO | NA | *NA* | *TJ NCV* |
| F_RoadTransport | 1A3bi | Road transport: Passenger cars | 54952.35 | NO | 12.41 | 35.00 | NO | NA | *TJ NCV* |
| F_RoadTransport | 1A3bii | Road transport: Light duty vehicles | 9141.03 | NO | NO | 9.68 | NO | NA | *TJ NCV* |
| F_RoadTransport | 1A3biii | Road transport: Heavy duty vehicles and buses | 15732.99 | NO | NO | NO | NO | NA | *TJ NCV* |
| F_RoadTransport | 1A3biv | Road transport: Mopeds & motorcycles | 995.12 | NO | NO | NO | NO | NA | *TJ NCV* |
| F_RoadTransport | 1A3bv | Road transport: Gasoline evaporation | IE | NA | NA | NA | NA | NA | *TJ NCV* |
| F_RoadTransport | 1A3bvi | Road transport: Automobile tyre and brake wear | NA | NA | NA | NA | NA | 26702 | *10^6 km* |
| F_RoadTransport | 1A3bvii | Road transport: Automobile road abrasion | NA | NA | NA | NA | NA | 26702 | *10^6 km* |
| I_Offroad | 1A3c | Railways | 782 | NO | NO | NO | NA | *NA* | *TJ NCV* |
| G_Shipping | 1A3di(ii) | International inland waterways | IE | NO | NO | NO | NA | *NA* | *TJ NCV* |
| G_Shipping | 1A3dii | National navigation (shipping) | 1785 | NO | NO | NO | NA | *NA* | *TJ NCV* |
| I_Offroad | 1A3ei | Pipeline transport | NO | NA | NA | NA | NA | *NA* | *TJ NCV* |
| I_Offroad | 1A3eii | Other (please specify in the IIR) | NO | NO | NO | NO | NO | NO | *TJ NCV* |
| C_OtherStationaryComb | 1A4ai | Commercial/institutional: Stationary | 2543 | 2 | 7702 | 177 | NO | *NA* | *TJ NCV* |
| I_Offroad | 1A4aii | Commercial/institutional: Mobile | IE | IE | IE | IE | IE | IE | *TJ NCV* |
| C_OtherStationaryComb | 1A4bi | Residential: Stationary | 5972 | 97 | 19505 | 47221 | NO | *NA* | *TJ NCV* |
| I_Offroad | 1A4bii | Residential: Household and gardening (mobile) | 330 | NA | NO | NO | NA | *NA* | *TJ NCV* |
| C_OtherStationaryComb | 1A4ci | Agriculture/Forestry/Fishing: Stationary | 652 | NO | 967 | NO | NO | *NA* | *TJ NCV* |
| I_Offroad | 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | 7239 | NA | NO | NO | NA | *NA* | *TJ NCV* |
| I_Offroad | 1A4ciii | Agriculture/Forestry/Fishing: National fishing | IE | IE | IE | IE | IE | *NA* | *TJ NCV* |
| C_OtherStationaryComb | 1A5a | Other stationary (including military) | IE | IE | IE | IE | NA | *NA* | *TJ NCV* |
| I_Offroad | 1A5b | Other, Mobile (including military, land based and recreational boats) | IE | IE | IE | IE | NA | *NA* | *TJ NCV* |
| D_Fugitive | 1B1a | Fugitive emission from solid fuels: Coal mining and handling | NA | NA | NA | NA | NA | *NO* | *Coal produced [Mt]* |
| D_Fugitive | 1B1b | Fugitive emission from solid fuels: Solid fuel transformation | NA | NA | NA | NA | NA | *NO* | *Coal used for transformation [Mt]* |
| D_Fugitive | 1B1c | Other fugitive emissions from solid fuels | NA | NA | NA | NA | NA | *NA* | *Please specify* |

| HR: 29.01.2018: 2016 | NFR sectors to be reported | | Activity Data (from 1990) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels | Other activity (specified) | Other Activity Units |
| NFR Aggregation for Gridding and LPS (GNFR) | NFR Code | Longname | TJ NCV | TJ NCV | TJ NCV | TJ NCV | TJ NCV | | |
| D_Fugitive | 1B2ai | Fugitive emissions oil: Exploration, production, transport | NA | NA | NA | NA | NA | 737.1 | Crude oil produced [Mt] |
| D_Fugitive | 1B2aiv | Fugitive emissions oil: Refining / storage | NA | NA | NA | NA | NA | 3250.5 | Crude oil refined [Mt] |
| D_Fugitive | 1B2av | Distribution of oil products | NA | NA | NA | NA | NA | 6297.3 | Oil consumed [Mt] |
| D_Fugitive | 1B2b | Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) | NA | NA | NA | NA | NA | 1.65E+09 | Gas throughput [Mn3] |
| D_Fugitive | 1B2c | Venting and flaring (oil, gas, combined oil and gas) | NA | NA | NA | NA | NA | 440327.52 | Gas vented flared [TJ] |
| D_Fugitive | 1B2d | Other fugitive emissions from energy production | NA | NA | NA | NA | NA | NO | |
| B_Industry | 2A1 | Cement production | NA | NA | NA | NA | NA | 2058.686 | Clinker produced [kt] |
| B_Industry | 2A2 | Lime production | NA | NA | NA | NA | NA | 125.08233 | Lime produced [kt] |
| B_Industry | 2A3 | Glass production | NA | NA | NA | NA | NA | 378.08 | Glass produced [t] |
| B_Industry | 2A5a | Quarrying and mining of minerals other than coal | NA | NA | NA | NA | NA | 22.99 | Material quarried [Mt] |
| B_Industry | 2A5b | Construction and demolition | NA | NA | NA | NA | NA | 1853646 | floor space constructed/demolished [M3 ] |
| B_Industry | 2A5c | Storage, handling and transport of mineral products | NA | NA | NA | NA | NA | IE | Amount [Mt] |
| B_Industry | 2A6 | Other mineral products (please specify in the IIR) | NA | NA | NA | NA | NA | NO | Please specify |
| B_Industry | 2B1 | Ammonia production | NA | NA | NA | NA | NA | 420.3723 | Ammonia produced [kt] |
| B_Industry | 2B2 | Nitric acid production | NA | NA | NA | NA | NA | 293.26 | Nitric acid produced [kt] |
| B_Industry | 2B3 | Adipic acid production | NA | NA | NA | NA | NA | NO | Adipic acid produced [kt] |
| B_Industry | 2B5 | Carbide production | NA | NA | NA | NA | NA | NO | Carbide produced [kt] |
| B_Industry | 2B6 | Titanium dioxide production | NA | NA | NA | NA | NA | NO | Titanium dioxide produced [kt] |
| B_Industry | 2B7 | Soda ash production | NA | NA | NA | NA | NA | NO | Soda ash produced [kt] |
| B_Industry | 2B10a | Chemical industry: Other (please specify in the IIR) | NA | NA | NA | NA | NA | 695.51644 | Please specify |
| B_Industry | 2B10b | Storage, handling and transport of chemical products (please specify in the IIR) | NA | NA | NA | NA | NA | IE | Please specify |
| B_Industry | 2C1 | Iron and steel production | NA | NA | NA | NA | NA | 23.620332 | Steel produced [kt] |
| B_Industry | 2C2 | Ferroalloys production | NA | NA | NA | NA | NA | NO | Ferroalloys produced [kt] |
| B_Industry | 2C3 | Aluminium production | NA | NA | NA | NA | NA | NO | Aluminium produced [kt] |
| B_Industry | 2C4 | Magnesium production | NA | NA | NA | NA | NA | NO | Magnesium produced [kt] |
| B_Industry | 2C5 | Lead production | NA | NA | NA | NA | NA | NO | Lead produced [kt] |
| B_Industry | 2C6 | Zinc production | NA | NA | NA | NA | NA | NO | Zinc produced [kt] |
| B_Industry | 2C7a | Copper production | NA | NA | NA | NA | NA | NO | Copper produced [kt] |
| B_Industry | 2C7b | Nickel production | NA | NA | NA | NA | NA | NO | Nickel produced [kt] |
| B_Industry | 2C7c | Other metal production (please specify in the IIR) | NA | NA | NA | NA | NA | NO | Please specify |
| B_Industry | 2C7d | Storage, handling and transport of metal products (please specify in the IIR) | NA | NA | NA | NA | NA | 33.60 | Amount (kt) |
| E_Solvents | 2D3a | Domestic solvent use including fungicides | NA | NA | NA | NA | NA | NA | |
| E_Solvents | 2D3b | Road paving with asphalt | NA | NA | NA | NA | NA | NA | |
| B_Industry | 2D3c | Asphalt roofing | NA | NA | NA | NA | NA | NA | |
| B_Industry | 2D3d | Coating applications | NA | NA | NA | NA | NA | 49.1061 | Paint applied [kt] |
| E_Solvents | 2D3e | Degreasing | NA | NA | NA | NA | NA | NA | Solvents used [kt] |
| E_Solvents | 2D3f | Dry cleaning | NA | NA | NA | NA | NA | NA | Solvents used [kt] |
| E_Solvents | 2D3g | Chemical products | NA | NA | NA | NA | NA | NA | NA |

| **HR: 29.01.2018: 2016** | ***NFR sectors to be reported*** | | **Activity Data** (from 1990) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels | *Other activity (specified)* | *Other Activity Units* |
| **NFR Aggregation for Gridding and LPS (GNFR)** | **NFR Code** | **Longname** | **TJ NCV** | **TJ NCV** | **TJ NCV** | **TJ NCV** | **TJ NCV** | | |
| E_Solvents | 2D3h | Printing | NA | NA | NA | NA | NA | *NA* | *NA* |
| E_Solvents | 2D3i | Other solvent use (please specify in the IIR) | NA | NA | NA | NA | NA | *NA* | |
| E_Solvents | 2G | Other product use (please specify in the IIR) | NA | NA | NA | NA | NA | IE | *Please specify* |
| B_Industry | 2H1 | Pulp and paper industry | NA | NA | NA | NA | NA | *33.596462* | *Pulp production [kt]* |
| B_Industry | 2H2 | Food and beverages industry | NA | NA | NA | NA | NA | *1422.777* | *Bread, Wine, Beer, Spirits production [kt]* |
| B_Industry | 2H3 | Other industrial processes (please specify in the IIR) | NA | NA | NA | NA | NA | NO | |
| B_Industry | 2I | Wood processing | NA | NA | NA | NA | NA | *87.23* | *Please specify* |
| B_Industry | 2J | Production of POPs | NA | NA | NA | NA | NA | *NA* | *NA* |
| B_Industry | 2K | Consumption of POPs and heavy metals (e.g. electrical and scientific equipment) | NA | NA | NA | NA | NA | *NA* | *NA* |
| B_Industry | 2L | Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR) | NA | NA | NA | NA | NA | *NA* | *NA* |
| K_AgriLivestock | 3B1a | Manure management - Dairy cattle | NA | NA | NA | NA | NA | *167.63* | *Population size (1000 head)* |
| K_AgriLivestock | 3B1b | Manure management - Non-dairy cattle | NA | NA | NA | NA | NA | *315.85* | *Population size (1000 head)* |
| K_AgriLivestock | 3B2 | Manure management - Sheep | NA | NA | NA | NA | NA | *618.90* | *Population size (1000 head)* |
| K_AgriLivestock | 3B3 | Manure management - Swine | NA | NA | NA | NA | NA | *1193.29* | *Population size (1000 head)* |
| K_AgriLivestock | 3B4a | Manure management - Buffalo | NA | NA | NA | NA | NA | *NO* | *Population size (1000 head)* |
| K_AgriLivestock | 3B4d | Manure management - Goats | NA | NA | NA | NA | NA | *75.53* | *Population size (1000 head)* |
| K_AgriLivestock | 3B4e | Manure management - Horses | NA | NA | NA | NA | NA | *22.78* | *Population size (1000 head)* |
| K_AgriLivestock | 3B4f | Manure management - Mules and asses | NA | NA | NA | NA | NA | *2.86* | *Population size (1000 head)* |
| K_AgriLivestock | 3B4gi | Manure mangement - Laying hens | NA | NA | NA | NA | NA | *3500.00* | *Population size (1000 head)* |
| K_AgriLivestock | 3B4gii | Manure mangement - Broilers | NA | NA | NA | NA | NA | *5362.10* | *Population size (1000 head)* |
| K_AgriLivestock | 3B4giii | Manure mangement - Turkeys | NA | NA | NA | NA | NA | *511.84* | *Population size (1000 head)* |
| K_AgriLivestock | 3B4giv | Manure management - Other poultry | NA | NA | NA | NA | NA | *482.40* | *Population size (1000 head)* |
| K_AgriLivestock | 3B4h | Manure management - Other animals (please specify in IIR) | NA | NA | NA | NA | NA | *NO* | *Population size (1000 head)* |
| L_AgriOther | 3Da1 | Inorganic N-fertilizers (includes also urea application) | NA | NA | NA | NA | NA | *93507692* | *Use of inorganic fertilizers (kg N/yr)* |
| L_AgriOther | 3Da2a | Animal manure applied to soils | NA | NA | NA | NA | NA | NA | |
| L_AgriOther | 3Da2b | Sewage sludge applied to soils | NA | NA | NA | NA | NA | NA | |
| L_AgriOther | 3Da2c | Other organic fertilisers applied to soils (including compost) | NA | NA | NA | NA | NA | NO | |
| L_AgriOther | 3Da3 | Urine and dung deposited by grazing animals | NA | NA | NA | NA | NA | NA | |
| L_AgriOther | 3Da4 | Crop residues applied to soils | NA | NA | NA | NA | NA | NA | |
| L_AgriOther | 3Db | Indirect emissions from managed soils | NA | NA | NA | NA | NA | NA | |
| L_AgriOther | 3Dc | Farm-level agricultural operations including storage, handling and transport of agricultural products | NA | NA | NA | NA | NA | NA | |
| L_AgriOther | 3Dd | Off-farm storage, handling and transport of bulk agricultural products | NA | NA | NA | NA | NA | NA | |
| L_AgriOther | 3De | Cultivated crops | NA | NA | NA | NA | NA | NA | |
| L_AgriOther | 3Df | Use of pesticides | NA | NA | NA | NA | NA | NA | |
| L_AgriOther | 3F | Field burning of agricultural residues | NA | NA | NA | NA | NA | NE | *Area burned [k ha/yr]* |
| L_AgriOther | 3I | Agriculture other (please specify in the IIR) | NA | NA | NA | NA | NA | NO | *NA* |
| J_Waste | 5A | Biological treatment of waste - Solid waste disposal on land | NA | NA | NA | NA | NA | *1316.10* | *Annual deposition of MSW at the SWDS [kt]* |
| J_Waste | 5B1 | Biological treatment of waste - Composting | NA | NA | NA | NA | NA | NA | |
| J_Waste | 5B2 | Biological treatment of waste - Anaerobic digestion at biogas facilities | NA | NA | NA | NA | NA | NA | |

| **HR: 29.01.2018: 2016** | ***NFR sectors to be reported*** | | **Activity Data** (from 1990) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels | *Other activity (specified)* | *Other Activity Units* |
| **NFR Aggregation for Gridding and LPS (GNFR)** | **NFR Code** | **Longname** | **TJ NCV** | **TJ NCV** | **TJ NCV** | **TJ NCV** | **TJ NCV** | | |
| J_Waste | 5C1a | Municipal waste incineration | NA | NA | NA | NA | NA | NO | *MSW incinerated [kt]* |
| J_Waste | 5C1bi | Industrial waste incineration | NA | NA | NA | NA | NA | *NO* | *Waste incinerated [kt]* |
| J_Waste | 5C1bii | Hazardous waste incineration | NA | NA | NA | NA | NA | IE | *Waste incinerated [kt]* |
| J_Waste | 5C1biii | Clinical waste incineration | NA | NA | NA | NA | NA | *0.06* | *Waste incinerated [kt]* |
| J_Waste | 5C1biv | Sewage sludge incineration | NA | NA | NA | NA | NA | NO | |
| J_Waste | 5C1bv | Cremation | NA | NA | NA | NA | NA | *5128* | *Incineration of corpses [Number]* |
| J_Waste | 5C1bvi | Other waste incineration (please specify in the IIR) | NA | NA | NA | NA | NA | NO | |
| J_Waste | 5C2 | Open burning of waste | NA | NA | NA | NA | NA | NO | |
| J_Waste | 5D1 | Domestic wastewater handling | NA | NA | NA | NA | NA | *NE* | *Total organic product [Gg DC/yr]* |
| J_Waste | 5D2 | Industrial wastewater handling | NA | NA | NA | NA | NA | *NE* | *Total organic product [Gg DC/yr]* |
| J_Waste | 5D3 | Other wastewater handling | NA | NA | NA | NA | NA | *NE* | *Total organic product [Gg DC/yr]* |
| J_Waste | 5E | Other waste (please specify in IIR) | NA | NA | NA | NA | NA | NA | *Please specify* |
| M_Other | 6A | Other (included in national total for entire territory) (please specify in IIR) | NA | NA | NA | NA | NA | NO | *NA* |
| | **NATIONAL TOTAL** | **National total for the entire territory (based on fuel sold)** | ####### | 27024.20 | 71073.41 | 51988.48 | 159.16 | NA | *NA* |
| | | | | | | | | | |
| | ADJUSTMENTS (Net total) | Sum of adjustments (negative value) from Annex VII | | | | | | | *NA* |
| | **NATIONAL TOTAL FOR COMPLIANCE** | **National total for compliance assessment (please specify all details in the IIR)** | | | | | | | *NA* |
| | | | | | | | | | |
| | | | | | | | | | |
| *'MEMO' ITEMS - NOT TO BE INCLUDED IN NATIONAL TOTALS* | | | | | | | | | |
| O_AviCruise | 1A3ai(ii) | International aviation cruise (civil) | 4117 | NO | NO | NO | NO | NA | *TJ NCV* |
| O_AviCruise | 1A3aii(ii) | Domestic aviation cruise (civil) | 305 | NO | NO | NO | NO | NA | *TJ NCV* |
| P_IntShipping | 1A3di(i) | International maritime navigation | 72 | NO | NO | NO | NO | NA | *TJ NCV* |
| z_Memo | 1A5c | Multilateral operations | NA | NA | NA | NA | NA | NA | |
| z_Memo | 1A3 | Transport (fuel used) | NE | NE | NE | NE | NE | NA | |
| z_Memo | 6B | Other not included in national total of the entire territory (please specify in the IIR) | NA | NA | NA | NA | NA | NO | *NA* |
| N_Natural | 11A | Volcanoes | NA | NA | NA | NA | NA | NO | *Please specify* |
| N_Natural | 11B | Forest fires | NA | NA | NA | NA | NA | *6733* | *Area of forest burned [ha]* |
| N_Natural | 11C | Other natural emissions (please specify in the IIR) | NA | NA | NA | NA | NA | NO | |

# APPENDIX 7. UNCERTAINTY ANALYSIS

| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
| | | kt | kt | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | SO2 | 99.23 | 6.35 | 3.0 | 10.0 | 10.44 | 4.50583 | -0.01299 | 0.03728 | -0.12989 | 0.15819 | 0.20468 |
| 1 A 2 Manufacturing Industries and Construction | SO2 | 37.02 | 2.91 | 3.0 | 10.0 | 10.44 | 2.06645 | -0.00168 | 0.01710 | -0.01680 | 0.07255 | 0.07447 |
| 1 A 3 b Road Transport | SO2 | 4.42 | 0.07 | 3.0 | 20.0 | 20.22 | 0.09152 | -0.00185 | 0.00039 | -0.03702 | 0.00166 | 0.03706 |
| 1 A 3 Other mobile source and machinery | SO2 | 1.27 | 0.06 | 3.0 | 20.0 | 20.22 | 0.07751 | -0.00032 | 0.00033 | -0.00631 | 0.00140 | 0.00647 |
| 1 A 4 a Commercial, institutional combustion | SO2 | 6.88 | 0.11 | 5.0 | 20.0 | 20.62 | 0.15336 | -0.00285 | 0.00064 | -0.05698 | 0.00454 | 0.05716 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | SO2 | 17.82 | 0.95 | 3.0 | 20.0 | 20.22 | 1.30787 | -0.00345 | 0.00559 | -0.06904 | 0.02370 | 0.07299 |
| 1 B Extraction and distribution of fossil fuels | SO2 | 6.1E-01 | 2.9E-01 | 10.0 | 50.0 | 50.99 | 1.00930 | 0.00140 | 0.00171 | 0.06990 | 0.02418 | 0.07396 |
| 1 B 2 a iv Refining / storage | SO2 | 1.80 | 3.77 | 3.0 | 50.0 | 50.09 | 12.84676 | 0.02124 | 0.02216 | 1.06207 | 0.09401 | 1.06623 |
| 2 B 10 a, 2 H Chemical industry: Other, Pulp and Paper industry | SO2 | 0.75 | 0.20 | 3.0 | 20.0 | 20.22 | 0.27539 | 0.00080 | 0.00118 | 0.01596 | 0.00499 | 0.01672 |
| 2 C Metal production | SO2 | 0.46 | 1.4E-03 | 7.5 | 20.0 | 21.36 | 0.00206 | -0.00022 | 0.00001 | -0.00446 | 0.00009 | 0.00446 |
| 5 C Waste incineration | SO2 | 8.7E-05 | 3.0E-05 | 5.0 | 20.0 | 20.62 | 0.00004 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 5 C 1 b v Cremation | SO2 | 1.7E-04 | 5.8E-04 | 5.0 | 20.0 | 20.62 | 0.00081 | 0.00000 | 0.00000 | 0.00007 | 0.00002 | 0.00007 |
| TOTAL | | 170.27 | 14.71 | % Uncertainty in total inventory | | | **13.87** | | | Trend uncertainty: | | **1.10** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kt | kt | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | NO2 | 18.03 | 6.93 | 3.0 | 20.0 | 20.22 | 2.67876 | -0.01878 | 0.06555 | -0.37557 | 0.27812 | 0.46733 |
| 1 A 2 Manufacturing Industries and Construction | NO2 | 23.53 | 6.58 | 3.0 | 20.0 | 20.22 | 2.54148 | -0.04780 | 0.06219 | -0.95604 | 0.26386 | 0.99178 |
| 1 A 3 b Road Transport | NO2 | 37.13 | 22.33 | 3.0 | 20.0 | 20.22 | 8.62961 | 0.03727 | 0.21118 | 0.74530 | 0.89595 | 1.16542 |
| 1 A 3 Other mobile source and machinery | NO2 | 3.93 | 2.79 | 3.0 | 100.0 | 100.04 | 5.32933 | 0.00795 | 0.02636 | 0.79471 | 0.11185 | 0.80254 |
| 1 A 4 a Commercial, institutional combustion | NO2 | 3.90 | 1.63 | 5.0 | 50.0 | 50.25 | 1.56661 | -0.00282 | 0.01543 | -0.14096 | 0.10910 | 0.17825 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | NO2 | 13.11 | 8.43 | 3.0 | 50.0 | 50.09 | 8.06597 | 0.01831 | 0.07969 | 0.91527 | 0.33811 | 0.97573 |
| 1 B Extraction and distribution of fossil fuels | NO2 | 0.08 | 0.06 | 10.0 | 50.0 | 50.99 | 0.05419 | 0.00017 | 0.00053 | 0.00859 | 0.00744 | 0.01136 |
| 1 B 2 a iv Refining / storage | NO2 | 0.26 | 0.10 | 3.0 | 50.0 | 50.09 | 0.10025 | -0.00021 | 0.00099 | -0.01044 | 0.00420 | 0.01126 |
| 2 B 10 a, 2 H Chemical industry: Other, Pulp and Paper industry | NO2 | 0.53 | 0.02 | 3.0 | 50.0 | 50.09 | 0.02052 | -0.00226 | 0.00020 | -0.11325 | 0.00086 | 0.11325 |
| 2 B 1, 2 B 2 Ammonia and Nitric acid production | NO2 | 2.09 | 0.92 | 3.0 | 50.0 | 50.09 | 0.88055 | -0.00109 | 0.00870 | -0.05429 | 0.03691 | 0.06565 |
| 2 C Metal production | NO2 | 0.10 | 0.00 | 7.5 | 50.0 | 50.56 | 0.00297 | -0.00042 | 0.00003 | -0.02113 | 0.00031 | 0.02113 |
| 2 G Other product use | NO2 | 0.02 | 0.02 | 10.0 | 31.0 | 32.57 | 0.00935 | 0.00004 | 0.00014 | 0.00122 | 0.00201 | 0.00235 |
| 3 D | NO2 | 2.80 | 2.44 | 5.0 | 100.0 | 100.12 | 4.65888 | 0.00994 | 0.02303 | 0.99373 | 0.16283 | 1.00698 |
| 3B1, 3B2, 3B4d, 3B4e, 3B4f, | NO2 | 0.09 | 1.72E-02 | 10.0 | 100.0 | 100.50 | 0.03309 | -0.00027 | 0.00016 | -0.02728 | 0.00230 | 0.02738 |
| 3B3, 3B4g | NO2 | 0.16 | 7.07E-02 | 50.0 | 100.0 | 111.80 | 0.15099 | -0.00006 | 0.00067 | -0.00641 | 0.04726 | 0.04769 |
| 5 C 1 b v Cremation | NO2 | 1.2E-03 | 4.2E-03 | 5.0 | 20.0 | 20.62 | 0.00167 | 0.00003 | 0.00004 | 0.00069 | 0.00028 | 0.00074 |
| 5 C Waste incineration | NO2 | 5.4E-04 | 1.3E-04 | 30.0 | 20.0 | 36.06 | 0.00009 | 0.00000 | 0.00000 | -0.00003 | 0.00005 | 0.00006 |
| TOTAL | | 105.75 | 52.33 | % Uncertainty in total inventory | | | **14.37** | | | Trend uncertainty: | | **2.29** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kt | kt | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | NMVOC | 0.99 | 0.36 | 3.0 | 50.0 | 50.09 | 0.25487 | -0.00024 | 0.00203 | -0.01186 | 0.00862 | 0.01466 |
| 1 A 2 Manufacturing Industries and Construction | NMVOC | 4.59 | 1.26 | 3.0 | 50.0 | 50.09 | 0.90212 | -0.00329 | 0.00719 | -0.16438 | 0.03051 | 0.16718 |
| 1 A 3 b Road Transport | NMVOC | 34.64 | 6.26 | 3.0 | 20.0 | 20.22 | 1.81222 | -0.04319 | 0.03578 | -0.86377 | 0.15181 | 0.87701 |
| 1 A 3 Other mobile source and machinery | NMVOC | 0.54 | 0.42 | 3.0 | 100.0 | 100.04 | 0.60047 | 0.00116 | 0.00240 | 0.11579 | 0.01017 | 0.11624 |
| 1 A 4 a Commercial, institutional combustion | NMVOC | 0.32 | 0.29 | 5.0 | 50.0 | 50.25 | 0.21055 | 0.00094 | 0.00167 | 0.04698 | 0.01183 | 0.04845 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | NMVOC | 24.70 | 16.66 | 3.0 | 50.0 | 50.09 | 11.94474 | 0.03879 | 0.09522 | 1.93946 | 0.40400 | 1.98109 |
| 1 B Extraction and distribution of fossil fuels | NMVOC | 4.27 | 2.54 | 10.0 | 50.0 | 50.99 | 1.85262 | 0.00477 | 0.01451 | 0.23844 | 0.20518 | 0.31456 |
| 1 B 2 a iv Refining / storage | NMVOC | 2.18 | 0.98 | 3.0 | 50.0 | 50.09 | 0.70463 | 0.00064 | 0.00562 | 0.03218 | 0.02383 | 0.04004 |
| 2 B 10 a, 2 H 1, 2 H 2 Chemical industry: Other, Pulp and Paper industry, Food and beverages industry | NMVOC | 23.4 | 5.38 | 3.0 | 50.0 | 50.09 | 3.85973 | -0.02253 | 0.03077 | -1.12654 | 0.13055 | 1.13408 |
| 2 A 1, 2 A 2, 2 A 3 Cement, Lime and glass production | NMVOC | 0 | 0.04 | 3.0 | 20.0 | 20.22 | 0.01034 | 0.00020 | 0.00020 | 0.00408 | 0.00087 | 0.00417 |
| 2 C Metal production | NMVOC | 9.6E-03 | 0.00 | 7.5 | 50.0 | 50.56 | 0.00085 | -0.00002 | 0.00001 | -0.00076 | 0.00007 | 0.00077 |
| 2D3b, 2D3c, 2D3g, 2D3h | NMVOC | 7.18 | 3.53 | 30 | 20.0 | 36.06 | 1.82116 | 0.00378 | 0.02017 | 0.07558 | 0.85572 | 0.85905 |
| 2D3a, 2D3i, 2G, 2D3e, 2D3f, 2D3d | NMVOC | 58.09 | 21.73 | 10 | 20.0 | 22.36 | 6.95284 | -0.00837 | 0.12416 | -0.16733 | 1.75595 | 1.76390 |
| 3B | NMVOC | 12.10 | 7.74 | 10.0 | 100 | 100.50 | 11.13086 | 0.01660 | 0.04423 | 1.65987 | 0.62546 | 1.77380 |
| 3D1a | NMVOC | 1.06 | 0.63 | 5 | 100.0 | 100.12 | 0.90094 | 0.00117 | 0.00359 | 0.11721 | 0.02541 | 0.11993 |
| 5 A Biological treatment of waste - Solid waste disposal on land | NMVOC | 0.92 | 2.05 | 5 | 50 | 50.25 | 1.47656 | 0.00963 | 0.01173 | 0.48164 | 0.08297 | 0.48873 |
| 5 C 1 b v Cremation | NMVOC | 1.9E-05 | 6.67E-05 | 5.0 | 50 | 50.25 | 0.00005 | 0.00000 | 0.00000 | 0.00002 | 0.00000 | 0.00002 |
| 5 C Waste incineration | NMVOC | 1.9E-03 | 3.90E-05 | 30.0 | 50 | 58.31 | 0.00003 | 0.00000 | 0.00000 | -0.00021 | 0.00001 | 0.00021 |
| 5D1, 5D2 | NMVOC | 2.4E-03 | 4.20E-03 | 30.0 | 50 | 58.31 | 0.00350 | 0.00002 | 0.00002 | 0.00093 | 0.00102 | 0.00138 |
| TOTAL | | 174.97 | 69.87 | % Uncertainty in total inventory | | | **18.56** | | | Trend uncertainty: | | **3.66** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kt | kt | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | CO | 3.02 | 1.25 | 3.0 | 20.0 | 20.22 | 0.12489 | 0.00027 | 0.00224 | 0.00549 | 0.00952 | 0.01099 |
| 1 A 2 Manufacturing Industries and | CO | 23.61 | 12.07 | 3.0 | 20.0 | 20.22 | 1.20584 | 0.00627 | 0.02166 | 0.12540 | 0.09188 | 0.15545 |
| 1 A 3 b Road Transport | CO | 236.59 | 34.85 | 3.0 | 20.0 | 20.22 | 3.48157 | -0.09125 | 0.06252 | -1.82501 | 0.26527 | 1.84419 |
| 1 A 3 Other mobile source and machinery | CO | 3.22 | 1.94 | 3.0 | 100.0 | 100.04 | 0.95813 | 0.00138 | 0.00348 | 0.13771 | 0.01476 | 0.13850 |
| 1 A 4 a Commercial, institutional combustion | CO | 1.37 | 0.47 | 5.0 | 50.0 | 50.25 | 0.11710 | -0.00005 | 0.00085 | -0.00246 | 0.00598 | 0.00647 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | CO | 198.30 | 130.60 | 3.0 | 50.0 | 50.09 | 32.31594 | 0.10473 | 0.23431 | 5.23658 | 0.99411 | 5.33011 |
| 1 B Extraction and distribution of fossil fuels | CO | 0.65 | 2.9E-01 | 10.0 | 50.0 | 50.99 | 0.07385 | 0.00010 | 0.00053 | 0.00525 | 0.00744 | 0.00910 |
| 1 B 2 a iv Refining / storage | CO | 50.04 | 20.46 | 3.0 | 50.0 | 50.09 | 5.06141 | 0.00409 | 0.03670 | 0.20442 | 0.15570 | 0.25696 |
| 2 B 10 a, 2 H Chemical industry: Other, Pulp and Paper industry, 2 B 1 Ammonia production | CO | 30.71 | 3.4E-03 | 3.0 | 50.0 | 50.09 | 0.00084 | -0.01999 | 0.00001 | -0.99959 | 0.00003 | 0.99959 |
| 2 C Metal production | CO | 9.20 | 0.04 | 7.5 | 50.0 | 50.56 | 0.01003 | -0.00592 | 0.00007 | -0.29611 | 0.00076 | 0.29611 |
| 2D3b, 2D3c, 2D3d, 2D3g, 2D3h | CO | 2.3E-04 | 1.6E-04 | 30 | 100.0 | 104.40 | 0.00008 | 0.00000 | 0.00000 | 0.00001 | 0.00001 | 0.00002 |
| 2 G Other product use | CO | 0.67 | 0.46 | 5 | 100.0 | 100.12 | 0.22696 | 0.00039 | 0.00082 | 0.03858 | 0.00582 | 0.03902 |
| 5 C Waste incineration | CO | 4.4E-05 | 1.1E-05 | 5.0 | 100.0 | 100.12 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 5 C 1 b v Cremation | CO | 2.0E-04 | 7.2E-04 | 5.0 | 50.0 | 50.25 | 0.00018 | 0.00000 | 0.00000 | 0.00006 | 0.00001 | 0.00006 |
| TOTAL | | 557.38 | 202.43 | % Uncertainty in total inventory | | | **32.93** | | | Trend uncertainty: | | **5.75** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kt | kt | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | NH3 | 9.0E-03 | 1.1E-02 | 3.0 | 1.000 | 1000.00 | 0.31174 | 0.00009 | 0.00020 | 0.09419 | 0.00086 | 0.09420 |
| 1 A 2 Manufacturing Industries and | NH3 | 0.13 | 0.03 | 3.0 | 1.000 | 1000.00 | 0.88936 | -0.00105 | 0.00058 | -1.05145 | 0.00246 | 1.05145 |
| 1 A 3 b Road Transport | NH3 | 0.03 | 0.51 | 3.0 | 400 | 400.01 | 5.81589 | 0.00912 | 0.00949 | 3.64703 | 0.04024 | 3.64725 |
| 1 A 3 Other mobile source and machinery | NH3 | 9.8E-04 | 5.7E-04 | 3.0 | 1.000 | 1000.00 | 0.01642 | 0.00000 | 0.00001 | -0.00122 | 0.00005 | 0.00122 |
| 1 A 4 a Commercial, institutional combustion | NH3 | 8.0E-04 | 7.8E-03 | 5.0 | 1.000 | 1000.01 | 0.22308 | 0.00014 | 0.00015 | 0.13584 | 0.00103 | 0.13585 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | NH3 | 3.03 | 2.23 | 3.0 | 1.000 | 1000.00 | 63.83584 | 0.00482 | 0.04165 | 4.81603 | 0.17669 | 4.81927 |
| 1 B Extraction and distribution of fossil fuels | NH3 | 2.1E-03 | 0 | 10.0 | 1.000 | 1000.05 | 0.00000 | -0.00003 | 0.00000 | -0.02501 | 0.00000 | 0.02501 |
| 1 B 2 a iv Refining / storage | NH3 | 0.21 | 0.08 | 3.0 | 1.000 | 1000.00 | 2.39366 | -0.00093 | 0.00156 | -0.93103 | 0.00663 | 0.93105 |
| 2 B 10 a Chemical industry: Other, 2 H 1 Pulp and Paper industry, 2 H 2 Food and beverages industry | NH3 | 3.48 | 2.07 | 3.0 | 400 | 400.01 | 23.70635 | -0.00368 | 0.03866 | -1.47318 | 0.16404 | 1.48228 |
| 2 A 3 Glass production, 2 B 1 Ammonia production | NH3 | 3.4E-03 | 0.07 | 3.0 | 400 | 400.01 | 0.80915 | 0.00128 | 0.00132 | 0.51110 | 0.00560 | 0.51113 |
| 2D3a, 2D3i, 2G | NH3 | 0.05 | 0.03 | 10 | 400 | 400.12 | 0.38715 | 0.00002 | 0.00063 | 0.00847 | 0.00893 | 0.01231 |
| 3B1, 3B2, 3B4d, 3B4e, 3B4f | NH3 | 17.17 | 9.34 | 10.0 | 100 | 100.50 | 26.82571 | -0.03447 | 0.17414 | -3.44730 | 2.46274 | 4.23662 |
| 3B3, 3B4g | NH3 | 20.51 | 11.72 | 50.0 | 100 | 111.80 | 37.41740 | -0.03094 | 0.21834 | -3.09430 | 15.43889 | 15.74592 |
| 3D | NH3 | 8.34 | 8.29 | 5 | 100 | 100.12 | 23.70711 | 0.05302 | 0.15447 | 5.30224 | 1.09228 | 5.41358 |
| 5D3 Other wastewater handling | NH3 | 0.69 | 0.60 | 30.0 | 1.000 | 1000.45 | 17.17154 | 0.00277 | 0.01120 | 2.76821 | 0.47508 | 2.80868 |
| TOTAL | | 53.66 | 35.01 | % Uncertainty in total inventory | | | **87.49** | | | Trend uncertainty: | | **18.55** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kt | kt | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | BC | 0.11 | 0.03 | 3.0 | 50.0 | 50.09 | 0.44836 | -0.00640 | 0.00486 | -0.31980 | 0.02061 | 0.32046 |
| 1 A 2 Manufacturing Industries and Construction | BC | 0.78 | 0.11 | 3.0 | 50.0 | 50.09 | 1.83984 | -0.05749 | 0.01993 | -2.87450 | 0.08457 | 2.87575 |
| 1 A 3 b Road Transport | BC | 0.58 | 0.71 | 3.0 | 100.0 | 100.04 | 23.91468 | 0.07248 | 0.12973 | 7.24825 | 0.55039 | 7.26912 |
| 1 A 3 Other mobile source and machinery | BC | 4.10E-03 | 2.13E-03 | 3.0 | 500.0 | 500.01 | 0.35945 | -0.00002 | 0.00039 | -0.00857 | 0.00166 | 0.00873 |
| 1 A 4 a Commercial, institutional combustion | BC | 8.31E-02 | 2.91E-02 | 5.0 | 78.0 | 78.16 | 0.76663 | -0.00293 | 0.00532 | -0.22871 | 0.03764 | 0.23179 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | BC | 3.70 | 1.95 | 3.0 | 76.0 | 76.06 | 50.07277 | -0.01033 | 0.35728 | -0.78473 | 1.51582 | 1.70690 |
| 1 B Extraction and distribution of fossil fuels | BC | 2.68E-02 | 0.00561 | 10.0 | 50.0 | 50.99 | 0.09652 | -0.00164 | 0.00103 | -0.08177 | 0.01453 | 0.08305 |
| 1 B 2 a iv Refining / storage | BC | 4.00E-04 | 1.63E-04 | 3.0 | 50.0 | 50.09 | 0.00276 | -0.00001 | 0.00003 | -0.00049 | 0.00013 | 0.00051 |
| 2 B 10 a, 2 H 1, 2 H 2 Chemical industry: Other, Pulp and Paper industry, Food and beverages industry | BC | 6.22E-03 | 6.38E-03 | 3.0 | 50.0 | 50.09 | 0.10774 | 0.00055 | 0.00117 | 0.02747 | 0.00495 | 0.02791 |
| 2 A 1, 2 A 2, 2 A 3 Cement, Lime and glass production | BC | 7.44E-03 | 9.15E-03 | 3.0 | 50.0 | 50.09 | 0.15463 | 0.00094 | 0.00168 | 0.04682 | 0.00711 | 0.04735 |
| 2 C Metal production | BC | 0.01 | 1.8E-06 | 7.5 | 50.0 | 50.56 | 0.00003 | -0.00132 | 0.00000 | -0.06601 | 0.00000 | 0.06601 |
| 2D3b, 2D3c, 2D3d, 2D3g, 2D3h | BC | 4.57E-03 | 1.71E-02 | 30 | 50.0 | 58.31 | 0.33626 | 0.00268 | 0.00313 | 0.13378 | 0.13278 | 0.18848 |
| 2D3a, 2D3i, 2G | BC | 0.15 | 0.10 | 10 | 100.0 | 100.50 | 3.36256 | 0.00356 | 0.01816 | 0.35590 | 0.25679 | 0.43887 |
| 5 C Waste incineration | BC | 3.5E-08 | 0 | 30.0 | 50.0 | 58.31 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| TOTAL | | 5.46 | 2.96 | % Uncertainty in total inventory | | | **55.63** | | | Trend uncertainty: | | **8.03** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kt | kt | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | PM2.5 | 0.91 | 0.66 | 3.0 | 50.0 | 50.09 | 1.79957 | 0.00579 | 0.01743 | 0.28935 | 0.07395 | 0.29865 |
| 1 A 2 Manufacturing Industries and Construction | PM2.5 | 2.94 | 0.39 | 3.0 | 50.0 | 50.09 | 1.06235 | -0.02731 | 0.01029 | -1.36525 | 0.04366 | 1.36595 |
| 1 A 3 b Road Transport | PM2.5 | 1.30 | 1.47 | 3.0 | 100.0 | 100.04 | 7.97131 | 0.02207 | 0.03866 | 2.20667 | 0.16401 | 2.21276 |
| 1 A 3 Other mobile source and machinery | PM2.5 | 0.27 | 0.22 | 3.0 | 500.0 | 500.01 | 5.95561 | 0.00236 | 0.00578 | 1.17870 | 0.02452 | 1.17896 |
| 1 A 4 a Commercial, institutional combustion | PM2.5 | 0.24 | 0.07 | 5.0 | 78.0 | 78.16 | 0.29914 | -0.00116 | 0.00186 | -0.09067 | 0.01313 | 0.09162 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | PM2.5 | 29.30 | 13.47 | 3.0 | 76.0 | 76.06 | 55.65873 | -0.01939 | 0.35505 | -1.47385 | 1.50635 | 2.10744 |
| 1 B Extraction and distribution of fossil fuels | PM2.5 | 0.08 | 0.024566 | 10.0 | 50.0 | 50.99 | 0.06803 | -0.00036 | 0.00065 | -0.01790 | 0.00916 | 0.02011 |
| 1 B 2 a iv Refining / storage | PM2.5 | 0.31 | 0.15 | 3.0 | 50.0 | 50.09 | 0.39762 | -0.00008 | 0.00385 | -0.00403 | 0.01634 | 0.01683 |
| 2 B 10 a, 2 H 1, 2 H 2 Chemical industry: Other, Pulp and Paper industry, Food and beverages industry | PM2.5 | 0.29 | 0.35 | 3.0 | 50.0 | 50.09 | 0.96360 | 0.00568 | 0.00933 | 0.28423 | 0.03960 | 0.28698 |
| 2 A 1, 2 A 2, 2 A 3 Cement, Lime and glass production | PM2.5 | 0.22 | 0.28 | 3.0 | 50.0 | 50.09 | 0.77229 | 0.00466 | 0.00748 | 0.23315 | 0.03174 | 0.23530 |
| 2 A 5 a, 2 A 5 b Quarrying and mining of mineral products, Construction and demolition | PM2.5 | 0.16 | 0.13 | 5.0 | 50.0 | 50.25 | 0.35483 | 0.00141 | 0.00343 | 0.07027 | 0.02423 | 0.07432 |
| 2 C Metal production | PM2.5 | 0.31 | 5.0E-04 | 7.5 | 50.0 | 50.56 | 0.00136 | -0.00399 | 0.00001 | -0.19939 | 0.00014 | 0.19939 |
| 2D3b, 2D3c, 2D3d, 2D3g, 2D3h | PM2.5 | 0.08 | 0.30 | 30 | 50.0 | 58.31 | 0.95406 | 0.00689 | 0.00794 | 0.34442 | 0.33681 | 0.48173 |
| 2D3a, 2D3i, 2G | PM2.5 | 0.44 | 0.32 | 10 | 100.0 | 100.50 | 1.71973 | 0.00273 | 0.00830 | 0.27278 | 0.11741 | 0.29698 |
| 3B1, 3B2, 3B4d, 3B4e, 3B4f, | PM2.5 | 0.26 | 0.12 | 10.0 | 100.0 | 100.50 | 0.66131 | -0.00016 | 0.00319 | -0.01645 | 0.04515 | 0.04805 |
| 3B3, 3B4g | PM2.5 | 0.51 | 0.26 | 50.0 | 100.0 | 111.80 | 1.57216 | 0.00037 | 0.00682 | 0.03650 | 0.48243 | 0.48381 |
| 3D1a | PM2.5 | 0.07 | 0.04 | 5 | 50.0 | 50.25 | 0.11971 | 0.00021 | 0.00116 | 0.01048 | 0.00817 | 0.01329 |
| 5 A Biological treatment of waste - Solid waste disposal on land | PM2.5 | 1.95E-05 | 4.34E-05 | 5 | 100.0 | 100.12 | 0.00024 | 0.00000 | 0.00000 | 0.00009 | 0.00001 | 0.00009 |
| 5 C 1 b v Cremation | PM2.5 | 5.1E-05 | 1.8E-04 | 5.0 | 80.0 | 80.16 | 0.00077 | 0.00000 | 0.00000 | 0.00032 | 0.00003 | 0.00032 |
| 5 C Waste incineration | PM2.5 | 1.0E-06 | 0 | 30.0 | 50.0 | 58.31 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 5 E Other waste (Building and car fires) | PM2.5 | 2.7E-01 | 1.5E-01 | 10.0 | 700.0 | 700.07 | 5.69880 | 0.00045 | 0.00395 | 0.31659 | 0.05586 | 0.32148 |
| TOTAL | | 37.95 | 18.41 | % Uncertainty in total inventory | | | **56.94** | | | Trend uncertainty: | | **3.68** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kt | kt | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | PM10 | 1.48 | 0.87 | 3.0 | 50.0 | 50.09 | 1.69867 | 0.00138 | 0.01839 | 0.06909 | 0.07802 | 0.10421 |
| 1 A 2 Manufacturing Industries and Construction | PM10 | 3.07 | 0.42 | 3.0 | 50.0 | 50.09 | 0.82816 | -0.02623 | 0.00897 | -1.31172 | 0.03804 | 1.31227 |
| 1 A 3 b Road Transport | PM10 | 1.54 | 1.84 | 3.0 | 100.0 | 100.04 | 7.18367 | 0.02131 | 0.03894 | 2.13073 | 0.16520 | 2.13712 |
| 1 A 3 Other mobile source and machinery | PM10 | 0.27 | 0.22 | 3.0 | 500.0 | 500.01 | 4.30040 | 0.00153 | 0.00466 | 0.76423 | 0.01979 | 0.76448 |
| 1 A 4 a Commercial, institutional combustion | PM10 | 0.24 | 0.07 | 5.0 | 78.0 | 78.16 | 0.21635 | -0.00130 | 0.00150 | -0.10126 | 0.01061 | 0.10181 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | PM10 | 30.02 | 13.80 | 3.0 | 76.0 | 76.06 | 40.91951 | -0.05208 | 0.29174 | -3.95818 | 1.23773 | 4.14719 |
| 1 B Extraction and distribution of fossil fuels | PM10 | 0.13 | 0.0245659 | 10.0 | 50.0 | 50.99 | 0.04883 | -0.00100 | 0.00052 | -0.04987 | 0.00734 | 0.05041 |
| 1 B 2 a iv Refining / storage | PM10 | 0.70 | 0.34 | 3.0 | 50.0 | 50.09 | 0.65564 | -0.00098 | 0.00710 | -0.04902 | 0.03011 | 0.05753 |
| 2 B 10 a, 2 H 1, 2 H 2 Chemical industry: Other, Pulp and | PM10 | 0.39 | 0.47 | 3.0 | 50.0 | 50.09 | 0.92210 | 0.00553 | 0.00998 | 0.27632 | 0.04235 | 0.27954 |
| 2 A 1, 2 A 2, 2 A 3 Cement, Lime and glass production | PM10 | 0.41 | 0.48 | 3.0 | 50.0 | 50.09 | 0.93321 | 0.00537 | 0.01010 | 0.26874 | 0.04286 | 0.27213 |
| 2 A 5 a, 2 A 5 b Quarrying and mining of mineral products, Construction and demolition | PM10 | 1.58 | 1.30 | 5.0 | 50.0 | 50.25 | 2.54664 | 0.00936 | 0.02748 | 0.46815 | 0.19433 | 0.50688 |
| 2 C Metal production | PM10 | 0.47 | 5.7E-04 | 7.5 | 50.0 | 50.56 | 0.00112 | -0.00542 | 0.00001 | -0.27101 | 0.00013 | 0.27101 |
| 2D3b, 2D3c, 2D3d, 2D3g, 2D3h | PM10 | 0.61 | 2.26 | 30 | 50.0 | 58.31 | 5.12757 | 0.04068 | 0.04769 | 2.03377 | 2.02310 | 2.86866 |
| 2D3a, 2D3i, 2G | PM10 | 0.51 | 0.44 | 10 | 100.0 | 100.50 | 1.72276 | 0.00349 | 0.00930 | 0.34913 | 0.13146 | 0.37306 |
| 3B1, 3B2, 3B4d, 3B4e, 3B4f, | PM10 | 0.43 | 0.21 | 10.0 | 100.0 | 100.50 | 0.81545 | -0.00056 | 0.00440 | -0.05641 | 0.06222 | 0.08399 |
| 3B3, 3B4g | PM10 | 3.23 | 1.62 | 50.0 | 100.0 | 111.80 | 7.05333 | -0.00283 | 0.03421 | -0.28295 | 2.41899 | 2.43548 |
| 3D1a | PM10 | 1.92 | 1.14 | 5 | 50.0 | 50.25 | 2.23389 | 0.00205 | 0.02411 | 0.10246 | 0.17046 | 0.19889 |
| 5 A Biological treatment of waste - Solid waste disposal on land | PM10 | 1.29E-04 | 2.9E-04 | 5 | 100.0 | 100.12 | 0.00112 | 0.00000 | 0.00001 | 0.00046 | 0.00004 | 0.00046 |
| 5 C 1 b v Cremation | PM10 | 5.1E-05 | 1.8E-04 | 5.0 | 80.0 | 80.16 | 0.00056 | 0.00000 | 0.00000 | 0.00025 | 0.00003 | 0.00026 |
| 5 C Waste incineration | PM10 | 1.8E-06 | 0 | 30.0 | 50.0 | 58.31 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 5 E Other waste (Building and car fires) | PM10 | 2.7E-01 | 1.5E-01 | 10.0 | 700.0 | 700.07 | 4.09002 | 0.00003 | 0.00317 | 0.02296 | 0.04480 | 0.05034 |
| TOTAL | | 47.31 | 25.65 | % Uncertainty in total inventory | | | **43.11** | | | Trend uncertainty: | | **6.24** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kt | kt | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | TSP | 2.52 | 1.14 | 3.0 | 50.0 | 50.09 | 1.52324 | -0.00969 | 0.02035 | -0.48452 | 0.08632 | 0.49215 |
| 1 A 2 Manufacturing Industries and Construction | TSP | 3.19 | 0.47 | 3.0 | 50.0 | 50.09 | 0.62765 | -0.02965 | 0.00838 | -1.48234 | 0.03557 | 1.48277 |
| 1 A 3 b Road Transport | TSP | 1.71 | 2.09 | 3.0 | 100.0 | 100.04 | 5.55890 | 0.01675 | 0.03718 | 1.67465 | 0.15772 | 1.68206 |
| 1 A 3 Other mobile source and machinery | TSP | 0.28 | 0.22 | 3.0 | 500.0 | 500.01 | 2.95841 | 0.00064 | 0.00396 | 0.32173 | 0.01679 | 0.32217 |
| 1 A 4 a Commercial, institutional combustion | TSP | 0.25 | 0.07 | 5.0 | 78.0 | 78.16 | 0.15046 | -0.00170 | 0.00129 | -0.13251 | 0.00911 | 0.13282 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | TSP | 31.57 | 14.49 | 3.0 | 76.0 | 76.06 | 29.36697 | -0.11750 | 0.25832 | -8.93011 | 1.09598 | 8.99712 |
| 1 B Extraction and distribution of fossil fuels | TSP | 0.25 | 0 | 10.0 | 50.0 | 50.99 | 0.03337 | -0.00257 | 0.00044 | -0.12850 | 0.00619 | 0.12865 |
| 1 B 2 a iv Refining / storage | TSP | 0.90 | 0.46 | 3.0 | 50.0 | 50.09 | 0.61329 | -0.00250 | 0.00819 | -0.12521 | 0.03475 | 0.12994 |
| 2 B 10 a, 2 H 1, 2 H 2, 2 I Chemical industry: Other, Pulp and Paper industry, Food and beverages industry, Wood processing | TSP | 0.84 | 0.78 | 3.0 | 50.0 | 50.09 | 1.04078 | 0.00394 | 0.01390 | 0.19690 | 0.05898 | 0.20555 |
| 2 A 1, 2 A 2, 2 A 3 Cement, Lime and glass production | TSP | 0.21 | 0.24 | 3.0 | 50.0 | 50.09 | 0.31892 | 0.00176 | 0.00426 | 0.08781 | 0.01807 | 0.08966 |
| 2 A 5 a, 2 A 5 b Quarrying and mining of mineral products, Construction and demolition | TSP | 3.21 | 2.65 | 5.0 | 50.0 | 50.25 | 3.54137 | 0.00882 | 0.04715 | 0.44111 | 0.33341 | 0.55294 |
| 2 C Metal production | TSP | 0.66 | 8.3E-04 | 7.5 | 50.0 | 50.56 | 0.00111 | -0.00787 | 0.00001 | -0.39341 | 0.00016 | 0.39341 |
| 2D3b, 2D3c, 2D3d, 2D3g, 2D3h | TSP | 2.85 | 10.52 | 30 | 50.0 | 58.31 | 16.34590 | 0.15355 | 0.18755 | 7.67746 | 7.95727 | 11.05720 |
| 2D3a, 2D3i, 2G | TSP | 0.53 | 0.45 | 10 | 100.0 | 100.50 | 1.20261 | 0.00168 | 0.00801 | 0.16789 | 0.11322 | 0.20250 |
| 3B1, 3B2, 3B4d, 3B4e, 3B4f | TSP | 0.96 | 0.47 | 10.0 | 100.0 | 100.50 | 1.24540 | -0.00317 | 0.00829 | -0.31671 | 0.11725 | 0.33772 |
| 3B3, 3B4g | TSP | 3.98 | 2.17 | 50.0 | 100.0 | 111.80 | 6.47296 | -0.00867 | 0.03874 | -0.86746 | 2.73900 | 2.87308 |
| 3D1a | TSP | 1.92 | 1.14 | 5 | 50.0 | 50.25 | 1.52666 | -0.00262 | 0.02033 | -0.13095 | 0.14373 | 0.19444 |
| 5 A Biological treatment of waste - Solid waste disposal on land | TSP | 2.7E-04 | 6.1E-04 | 5 | 100.0 | 100.12 | 0.00163 | 0.00001 | 0.00001 | 0.00076 | 0.00008 | 0.00076 |
| 5 C 1 b v Cremation | TSP | 5.6E-05 | 2.0E-04 | 5.0 | 80.0 | 80.16 | 0.00042 | 0.00000 | 0.00000 | 0.00023 | 0.00002 | 0.00023 |
| 5 C Waste incineration | TSP | 2.4E-03 | 9.5E-04 | 30.0 | 50.0 | 58.31 | 0.00147 | -0.00001 | 0.00002 | -0.00058 | 0.00072 | 0.00092 |
| 5 E Other waste (Building and car fires) | TSP | 2.7E-01 | 1.5E-01 | 10.0 | 700.0 | 700.07 | 2.79516 | -0.00059 | 0.00267 | -0.41330 | 0.03778 | 0.41502 |
| TOTAL | | 56.11 | 37.54 | % Uncertainty in total inventory | | | **35.23** | | | Trend uncertainty: | | **14.76** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t | t | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | PAH | 0.03 | 5.07E-03 | 3.0 | 100.0 | 100.04 | 0.07305 | -0.00010 | 0.00021 | -0.01047 | 0.00091 | 0.01051 |
| 1 A 2 Manufacturing Industries and Construction | PAH | 2.65 | 0.38 | 3.0 | 100.0 | 100.04 | 5.44813 | -0.01693 | 0.01599 | -1.69273 | 0.06783 | 1.69408 |
| 1 A 3 b Road Transport | PAH | 0.06 | 0.15 | 3.0 | 400.0 | 400.01 | 8.59815 | 0.00555 | 0.00631 | 2.21964 | 0.02677 | 2.21980 |
| 1 A 3 Other mobile source and machinery | PAH | 0.06 | 0.02 | 3.0 | 400.0 | 400.01 | 1.21915 | 0.00018 | 0.00089 | 0.07107 | 0.00380 | 0.07117 |
| 1 A 4 a Commercial, institutional combustion | PAH | 0.13 | 0.01 | 5.0 | 400.0 | 400.03 | 0.37613 | -0.00135 | 0.00028 | -0.54160 | 0.00195 | 0.54161 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | PAH | 18.25 | 6.37 | 3.0 | 400.0 | 400.01 | 366.82831 | 0.04234 | 0.26922 | 16.93702 | 1.14222 | 16.97549 |
| 1 B Extraction and distribution of fossil fuels | PAH | 0.29 | 0 | 10.0 | 400.0 | 400.12 | 0.00000 | -0.00366 | 0.00000 | -1.46306 | 0.00000 | 1.46306 |
| 1 B 2 a iv Refining / storage | PAH | 4.3E-03 | 1.8E-03 | 3.0 | 400.0 | 400.01 | 0.10108 | 0.00002 | 0.00007 | 0.00836 | 0.00031 | 0.00837 |
| 2 C Metal production | PAH | 2.17 | 0.01 | 7.5 | 400.0 | 400.07 | 0.65332 | -0.02640 | 0.00048 | -10.55965 | 0.00508 | 10.55965 |
| 2 D 3 i, 2G | PAH | 3.9E-03 | 2.8E-03 | 10 | 400.0 | 400.12 | 0.15984 | 0.00007 | 0.00012 | 0.02775 | 0.00166 | 0.02780 |
| 5 C Waste incineration | PAH | 5.0E-06 | 2.2E-09 | 5.0 | 100 | 100.12 | 0.00000 | 0.00000 | 0.00000 | -0.00001 | 0.00000 | 0.00001 |
| 5 C 1 b v Cremation | PAH | 5.0E-08 | 1.7E-07 | 5.0 | 100 | 100.12 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| TOTAL | | 23.65 | 6.94 | % Uncertainty in total inventory | | | **366.97** | | | Trend uncertainty: | | **20.25** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kg | kg | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | HCB | 0.004 | 0.03 | 3.0 | 100.0 | 100.04 | 11.37382 | 0.10792 | 0.12379 | 10.79186 | 0.52520 | 10.80463 |
| 1 A 2 Manufacturing Industries and Construction | HCB | 0.03 | 0.02 | 3.0 | 100.0 | 100.04 | 5.10695 | -0.08448 | 0.05558 | -8.44788 | 0.23582 | 8.45117 |
| 1 A 3 Other mobile source and machinery | HCB | 3.5E-03 | 3.3E-03 | 3.0 | 400.0 | 400.01 | 4.52096 | -0.00181 | 0.01231 | -0.72476 | 0.05221 | 0.72664 |
| 1 A 4 a Commercial, institutional combustion | HCB | 5.5E-04 | 8.9E-04 | 5.0 | 400.0 | 400.03 | 1.19928 | 0.00104 | 0.00326 | 0.41515 | 0.02308 | 0.41579 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | HCB | 0.21 | 0.24 | 3.0 | 400.0 | 400.01 | 319.81393 | 0.01305 | 0.87057 | 5.21890 | 3.69352 | 6.39367 |
| 5 C Waste incineration | HCB | 1.5E-02 | 5.6E-03 | 5.0 | 100 | 100.12 | 1.88735 | -0.03766 | 0.02053 | -3.76564 | 0.14514 | 3.76844 |
| 5 C 1 b v Cremation | HCB | 2.2E-04 | 7.7E-04 | 5.0 | 100 | 100.12 | 0.26073 | 0.00195 | 0.00284 | 0.19540 | 0.02005 | 0.19643 |
| TOTAL | | 0.27 | 0.30 | % Uncertainty in total inventory | | | **320.10** | | | Trend uncertainty: | | **15.62** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | g I-TEQ | g I-TEQ | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | PCDD/PCDF | 0.20 | 0.46 | 3.0 | 100.0 | 100.04 | 2.23795 | 0.00768 | 0.00946 | 0.76823 | 0.04016 | 0.76928 |
| 1 A 2 Manufacturing Industries and Construction | PCDD/PCDF | 3.11 | 0.45 | 3.0 | 100.0 | 100.04 | 2.21036 | -0.01782 | 0.00935 | -1.78161 | 0.03966 | 1.78205 |
| 1 A 3 b Road Transport | PCDD/PCDF | 0.41 | 0.99 | 3.0 | 400.0 | 400.01 | 19.39348 | 0.01693 | 0.02051 | 6.77065 | 0.08703 | 6.77121 |
| 1 A 3 Other mobile source and machinery | PCDD/PCDF | 0.36 | 0.34 | 3.0 | 400.0 | 400.01 | 6.60848 | 0.00385 | 0.00699 | 1.53874 | 0.02966 | 1.53902 |
| 1 A 4 a Commercial, institutional combustion | PCDD/PCDF | 0.19 | 0.03 | 5.0 | 400.0 | 400.03 | 0.49011 | -0.00117 | 0.00052 | -0.46712 | 0.00367 | 0.46713 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | PCDD/PCDF | 33.08 | 14.39 | 3.0 | 400.0 | 400.01 | 281.10853 | 0.00799 | 0.29735 | 3.19720 | 1.26153 | 3.43708 |
| 1 B Extraction and distribution of fossil fuels | PCDD/PCDF | 1.67 | 0 | 10.0 | 400.0 | 400.12 | 0.00000 | -0.01458 | 0.00000 | -5.83291 | 0.00000 | 5.83291 |
| 1 B 2 a iv Refining / storage | PCDD/PCDF | 0.02 | 0.01 | 3.0 | 400.0 | 400.01 | 0.19444 | -0.00001 | 0.00021 | -0.00290 | 0.00087 | 0.00303 |
| 2 C Metal production | PCDD/PCDF | 0.90 | 0.07 | 7.5 | 400.0 | 400.07 | 1.38484 | -0.00642 | 0.00146 | -2.56913 | 0.01553 | 2.56917 |
| 2 G Other product use | PCDD/PCDF | 1.2E-03 | 8.2E-04 | 10 | 400.0 | 400.12 | 0.01595 | 0.00001 | 0.00002 | 0.00252 | 0.00024 | 0.00253 |
| 5 C Waste incineration | PCDD/PCDF | 5.69 | 2.23 | 5.0 | 100 | 100.12 | 10.89327 | -0.00370 | 0.04603 | -0.37012 | 0.32551 | 0.49289 |
| 5 C 1 b v Cremation | PCDD/PCDF | 4.0E-05 | 1.4E-04 | 5.0 | 100 | 100.12 | 0.00068 | 0.00000 | 0.00000 | 0.00025 | 0.00002 | 0.00025 |
| 5 E Other waste (Building and car fires) | PCDD/PCDF | 2.7E+00 | 1.5E+00 | 5.0 | 100 | 100.12 | 7.38583 | 0.00720 | 0.03121 | 0.72012 | 0.22070 | 0.75318 |
| TOTAL | | 48.38 | 20.47 | % Uncertainty in total inventory | | | **282.18** | | | Trend uncertainty: | | **10.27** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t | t | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | Pb | 0.57 | 0.34 | 3.0 | 100.0 | 100.04 | 4.88486 | 0.00062 | 0.00063 | 0.06161 | 0.00267 | 0.06167 |
| 1 A 2 Manufacturing Industries and Construction | Pb | 0.77 | 0.33 | 3.0 | 100.0 | 100.04 | 4.82081 | 0.00060 | 0.00062 | 0.06031 | 0.00264 | 0.06037 |
| 1 A 3 b Road Transport | Pb | 456.13 | 4.11 | 3.0 | 200.0 | 200.02 | 118.14740 | -0.00327 | 0.00762 | -0.65403 | 0.03233 | 0.65483 |
| 1 A 3 Other mobile source and machinery | Pb | 0.36 | 0.14 | 3.0 | 400.0 | 400.01 | 8.19805 | 0.00026 | 0.00026 | 0.10227 | 0.00112 | 0.10228 |
| 1 A 4 a Commercial, institutional combustion | Pb | 0.12 | 5.25E-03 | 5.0 | 400.0 | 400.03 | 0.30218 | 0.00001 | 0.00001 | 0.00274 | 0.00007 | 0.00275 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | Pb | 3.50 | 1.3 | 3.0 | 400.0 | 400.01 | 75.78944 | 0.00236 | 0.00244 | 0.94403 | 0.01037 | 0.94408 |
| 1 B Extraction and distribution of fossil fuels | Pb | 0.21 | 0 | 10.0 | 400.0 | 400.12 | 0.00000 | -0.00001 | 0.00000 | -0.00202 | 0.00000 | 0.00202 |
| 1 B 2 a iv Refining / storage | Pb | 0.41 | 0.17 | 3.0 | 400.0 | 400.01 | 9.80350 | 0.00031 | 0.00032 | 0.12253 | 0.00134 | 0.12254 |
| 2 A 3 Glass production | Pb | 0.47 | 0.47 | 3.0 | | | | | | | | |
| 2 C Metal production | Pb | 76.4 | 0.06 | 7.5 | 400.0 | 400.07 | 3.53415 | -0.00171 | 0.00011 | -0.68481 | 0.00121 | 0.68482 |
| 5 C Waste incineration | Pb | 9.0E-03 | 3.5E-03 | 5.0 | 100 | 100.12 | 0.04972 | 0.00001 | 0.00001 | 0.00062 | 0.00005 | 0.00062 |
| 5 C 1 b v Cremation | Pb | 4.4E-05 | 1.5E-04 | 5.0 | 700 | 700.02 | 0.01551 | 0.00000 | 0.00000 | 0.00020 | 0.00000 | 0.00020 |
| 5 E Other waste (Building and car fires) | Pb | 8.0E-04 | 4.4E-04 | 5.0 | 700 | 700.02 | 0.04381 | 7.88E-07 | 8.07E-07 | 5.52E-04 | 5.71E-06 | 5.52E-04 |
| TOTAL | | 538.95 | 6.95 | % Uncertainty in total inventory | | | **141.16** | | | Trend uncertainty: | | **1.35** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t | t | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | Cd | 0.08 | 0.04 | 3.0 | 100.0 | 100.04 | 4.17828 | -0.02044 | 0.02985 | -2.04422 | 0.12665 | 2.04814 |
| Construction | Cd | 0.09 | 0.03 | 3.0 | 100.0 | 100.04 | 3.72312 | -0.02621 | 0.02660 | -2.62066 | 0.11285 | 2.62309 |
| 1 A 3 b Road Transport | Cd | 0.01 | 0.02 | 3.0 | 200.0 | 200.02 | 5.01686 | 0.00970 | 0.01793 | 1.94041 | 0.07606 | 1.94190 |
| 1 A 3 Other mobile source and machinery | Cd | 1.2E-03 | 6.1E-04 | 3.0 | 400.0 | 400.01 | 0.28866 | -0.00021 | 0.00052 | -0.08470 | 0.00219 | 0.08473 |
| 1 A 4 a Commercial, institutional combustion | Cd | 7.2E-03 | 0.02 | 5.0 | 400.0 | 400.03 | 8.16629 | 0.01025 | 0.01459 | 4.10079 | 0.10317 | 4.10208 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | Cd | 0.56 | 0.62 | 3.0 | 400.0 | 400.01 | 292.61819 | 0.18151 | 0.52285 | 72.60590 | 2.21828 | 72.63978 |
| 1 B Extraction and distribution of fossil fuels | Cd | 3.9E-03 | 0 | 10.0 | 400.0 | 400.12 | 0.00000 | -0.00235 | 0.00000 | -0.94162 | 0.00000 | 0.94162 |
| 1 B 2 a iv Refining / storage | Cd | 0.08 | 3.30E-02 | 3.0 | 400.0 | 400.01 | 15.62666 | -0.02089 | 0.02792 | -8.35711 | 0.11846 | 8.35795 |
| 2 A 3 Glass production | Cd | 0.04 | 0.04 | 3.0 | 400.0 | 400.01 | 17.03961 | 0.00878 | 0.03045 | 3.51264 | 0.12917 | 3.51501 |
| 2 C Metal production | Cd | 0.24 | 0.00 | 7.5 | 400.0 | 400.07 | 2.23772 | -0.13893 | 0.00400 | -55.57161 | 0.04240 | 55.57163 |
| 2 G Other product use | Cd | 0.07 | 0.05 | 10 | 400.0 | 400.12 | 21.77650 | -0.00123 | 0.03890 | -0.49074 | 0.55012 | 0.73720 |
| 5 C Waste incineration | Cd | 1.1E-03 | 4.5E-04 | 5.0 | 100 | 100.12 | 0.05281 | -0.00032 | 0.00038 | -0.03156 | 0.00267 | 0.03167 |
| 5 C 1 b v Cremation | Cd | 7.4E-06 | 2.6E-05 | 5.0 | 100 | 100.12 | 0.00306 | 0.00002 | 0.00002 | 0.00174 | 0.00015 | 0.00174 |
| 5 E Other waste (Building and car fires) | Cd | 1.6E-03 | 8.8E-04 | 5.0 | 700 | 700.02 | 0.72835 | -0.00023 | 0.00074 | -0.16155 | 0.00526 | 0.16163 |
| TOTAL | | 1.18 | 0.84 | % Uncertainty in total inventory | | | **294.56** | | | Trend uncertainty: | | **92.09** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t | t | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | Hg | 0.07 | 0.20 | 3.0 | 100 | 100.04 | 40.92080 | 0.14801 | 0.17523 | 14.80100 | 0.74345 | 14.81966 |
| 1 A 2 Manufacturing Industries and Construction | Hg | 0.12 | 0.12 | 3.0 | 100 | 100.04 | 23.64699 | 0.05679 | 0.10126 | 5.67874 | 0.42962 | 5.69497 |
| 1 A 3 b Road Transport | Hg | 8.5E-03 | 1.1E-02 | 3.0 | 200 | 200.02 | 4.53711 | 0.00658 | 0.00972 | 1.31530 | 0.04123 | 1.31594 |
| 1 A 3 Other mobile source and machinery | Hg | 3.2E-03 | 1.5E-03 | 3.0 | 400 | 400.01 | 1.16915 | 0.00007 | 0.00125 | 0.02727 | 0.00531 | 0.02779 |
| 1 A 4 a Commercial, institutional combustion | Hg | 9.5E-03 | 4.8E-03 | 5.0 | 400 | 400.03 | 3.86454 | 0.00063 | 0.00414 | 0.25209 | 0.02927 | 0.25379 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | Hg | 0.06 | 0.04 | 3.0 | 400 | 400.01 | 34.35018 | 0.01525 | 0.03679 | 6.09844 | 0.15609 | 6.10044 |
| 1 B Extraction and distribution of fossil fuels | Hg | 7.1E-01 | 4.1E-05 | 10.0 | 400 | 400.12 | 0.03285 | -0.25848 | 0.00004 | -103.39068 | 0.00050 | 103.39068 |
| 1 B 2 a iv Refining / storage | Hg | 0.09 | 0.04 | 3.0 | 400 | 400.01 | 30.85159 | 0.00008 | 0.03304 | 0.03169 | 0.14019 | 0.14373 |
| 2 A 3 Glass production | Hg | 8.26E-04 | 8.30E-04 | 3.0 | 400 | 400.01 | 0.66497 | 0.00041 | 0.00071 | 0.16339 | 0.00302 | 0.16341 |
| 2 C Metal production | Hg | 8.58E-03 | 1.18E-03 | 7.5 | 400 | 400.07 | 0.94604 | -0.00214 | 0.00101 | -0.85563 | 0.01075 | 0.85570 |
| 2K | Hg | 0.05 | 0.04 | 50 | 400 | 403.11 | 33.69229 | 0.01824 | 0.03581 | 7.29638 | 2.53196 | 7.72321 |
| 2D3a | Hg | 2.7E-02 | 2.3E-02 | 10 | 400 | 400.12 | 18.72783 | 0.01022 | 0.02005 | 4.08671 | 0.28358 | 4.09654 |
| 5 C Waste incineration | Hg | 6.0E-03 | 2.4E-03 | 5.0 | 100 | 100.12 | 0.47998 | -0.00016 | 0.00205 | -0.01637 | 0.01452 | 0.02188 |
| 5 C 1 b v Cremation | Hg | 2.2E-03 | 7.6E-03 | 5.0 | 100 | 100.12 | 1.53176 | 0.00575 | 0.00655 | 0.57524 | 0.04634 | 0.57711 |
| 5 E Other waste (Building and car fires) | Hg | 1.6E-03 | 8.8E-04 | 5.0 | 700 | 700.02 | 1.23170 | 0.00016 | 0.00075 | 0.11323 | 0.00533 | 0.11336 |
| TOTAL | | 1.17 | 0.50 | % Uncertainty in total inventory | | | **76.77** | | | Trend uncertainty: | | **105.16** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t | t | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | As | 0.78 | 0.12 | 3.0 | 100.0 | 100.04 | 30.75394 | 0.01017 | 0.01441 | 1.01689 | 0.06115 | 1.01873 |
| Construction | As | 0.11 | 0.07 | 3.0 | 100.0 | 100.04 | 16.37763 | 0.00709 | 0.00768 | 0.70884 | 0.03257 | 0.70959 |
| 1 A 3 b Road Transport | As | 2.6E-04 | 2.8E-04 | 3.0 | 200.0 | 200.02 | 0.14131 | 0.00003 | 0.00003 | 0.00634 | 0.00014 | 0.00634 |
| 1 A 3 Other mobile source and machinery | As | 3.9E-03 | 1.7E-03 | 3.0 | 400.0 | 400.01 | 1.71817 | 0.00018 | 0.00020 | 0.07200 | 0.00085 | 0.07201 |
| 1 A 4 a Commercial, institutional combustion | As | 4.1E-03 | 9.3E-04 | 5.0 | 400.0 | 400.03 | 0.92160 | 0.00009 | 0.00011 | 0.03428 | 0.00076 | 0.03429 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | As | 0.02 | 0.01 | 3.0 | 400.0 | 400.01 | 11.93931 | 0.00127 | 0.00140 | 0.50849 | 0.00594 | 0.50853 |
| 1 B Extraction and distribution of fossil fuels | As | 7.2E-03 | 0 | 10.0 | 400.0 | 400.12 | 0.00000 | -0.00004 | 0.00000 | -0.01578 | 0.00000 | 0.01578 |
| 1 B 2 a iv Refining / storage | As | 0.02 | 0.14 | 3.0 | 400.0 | 400.01 | 142.68441 | 0.01663 | 0.01673 | 6.65091 | 0.07096 | 6.65129 |
| 2 A 3 Glass production | As | 0.05 | 0.05 | 3.0 | 100 | 100.04 | 13.05620 | 0.00583 | 0.00612 | 0.58333 | 0.02596 | 0.58390 |
| 2 C Metal production | As | 7.60 | 3.54E-04 | 7.5 | 400 | 400.07 | 0.35180 | -0.04105 | 0.00004 | -16.42091 | 0.00044 | 16.42091 |
| 5 C Waste incineration | As | 3.2E-05 | 1.1E-05 | 5.0 | 100 | 100.12 | 0.00277 | 0.00000 | 0.00000 | 0.00011 | 0.00001 | 0.00011 |
| 5 C 1 b v Cremation | As | 2.0E-05 | 7.0E-05 | 5.0 | 100 | 100.12 | 0.01734 | 0.00001 | 0.00001 | 0.00080 | 0.00006 | 0.00080 |
| 5 E Other waste (Building and car fires) | As | 2.6E-03 | 1.4E-03 | 5.0 | 700 | 700.02 | 2.42115 | 0.00015 | 0.00016 | 0.10376 | 0.00115 | 0.10376 |
| TOTAL | | 8.59 | 0.40 | % Uncertainty in total inventory | | | **147.97** | | | Trend uncertainty: | | **17.78** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t | t | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | Cr | 2.03 | 0.21 | 3.0 | 100 | 100.04 | 10.13854 | -0.10665 | 0.03867 | -10.66546 | 0.16408 | 10.66672 |
| Construction | Cr | 0.35 | 0.13 | 3.0 | 100 | 100.04 | 6.59926 | -0.00006 | 0.02517 | -0.00571 | 0.10680 | 0.10695 |
| 1 A 3 b Road Transport | Cr | 0.20 | 0.34 | 3.0 | 200 | 200.02 | 33.63921 | 0.04947 | 0.06418 | 9.89474 | 0.27230 | 9.89849 |
| 1 A 3 Other mobile source and machinery | Cr | 8.6E-03 | 3.3E-03 | 3.0 | 400 | 400.01 | 0.64534 | 0.00000 | 0.00062 | -0.00112 | 0.00261 | 0.00284 |
| 1 A 4 a Commercial, institutional combustion | Cr | 1.3E-02 | 4.6E-03 | 5.0 | 400 | 400.03 | 0.90702 | -0.00011 | 0.00087 | -0.04208 | 0.00612 | 0.04252 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | Cr | 1.04 | 1.10 | 3.0 | 400 | 400.01 | 216.76868 | 0.13191 | 0.20681 | 52.76274 | 0.87741 | 52.77003 |
| 1 B Extraction and distribution of fossil fuels | Cr | 0.09 | 0 | 10.0 | 400 | 400.12 | 0.00000 | -0.00680 | 0.00000 | -2.71964 | 0.00000 | 2.71964 |
| 1 B 2 a iv Refining / storage | Cr | 0.42 | 0.17 | 3.0 | 400 | 400.01 | 34.15096 | 0.00216 | 0.03258 | 0.86291 | 0.13823 | 0.87391 |
| 2 A 3 Glass production | Cr | 0.06 | 0.06 | 3.0 | 400 | 400.01 | 12.57788 | 0.00744 | 0.01200 | 2.97615 | 0.05091 | 2.97659 |
| 2 C Metal production | Cr | 1.08 | 0.00 | 7.5 | 400 | 400.07 | 0.46681 | -0.07716 | 0.00045 | -30.86233 | 0.00472 | 30.86233 |
| 5 C Waste incineration | Cr | 3.6E-04 | 1.1E-04 | 5.0 | 100 | 100.12 | 0.00551 | 0.00000 | 0.00002 | -0.00045 | 0.00015 | 0.00048 |
| 5 C 1 b v Cremation | Cr | 2.0E-05 | 7.0E-05 | 5.0 | 100 | 100.12 | 0.00344 | 0.00001 | 0.00001 | 0.00117 | 0.00009 | 0.00117 |
| 5 E Other waste (Building and car fires) | Cr | 2.4E-03 | 1.3E-03 | 5.0 | 700 | 700.02 | 0.46060 | 0.00008 | 0.00025 | 0.05273 | 0.00178 | 0.05276 |
| TOTAL | | 5.30 | 2.02 | % Uncertainty in total inventory | | | **222.69** | | | Trend uncertainty: | | **62.98** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t | t | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | Cu | 0.95 | 0.27 | 3.0 | 100 | 100.04 | 3.25502 | -0.06855 | 0.03052 | -6.85515 | 0.12948 | 6.85637 |
| 1 A 2 Manufacturing Industries and Construction | Cu | 0.61 | 0.32 | 3.0 | 100 | 100.04 | 3.85808 | -0.02793 | 0.03617 | -2.79325 | 0.15347 | 2.79746 |
| 1 A 3 b Road Transport | Cu | 5.88 | 6.47 | 3.0 | 200 | 200.02 | 153.59388 | 0.10535 | 0.72030 | 21.07080 | 3.05599 | 21.29126 |
| 1 A 3 Other mobile source and machinery | Cu | 0.11 | 0.07 | 3.0 | 400 | 400.01 | 3.39585 | -0.00344 | 0.00796 | -1.37791 | 0.03379 | 1.37832 |
| 1 A 4 a Commercial, institutional combustion | Cu | 1.7E-02 | 1.5E-03 | 5.0 | 400 | 400.03 | 0.07321 | -0.00162 | 0.00017 | -0.64857 | 0.00121 | 0.64857 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | Cu | 0.72 | 0.59 | 3.0 | 400 | 400.01 | 27.86596 | -0.00983 | 0.06535 | -3.93102 | 0.27724 | 3.94078 |
| 1 B Extraction and distribution of fossil fuels | Cu | 2.7E-02 | 0 | 10.0 | 400 | 400.12 | 0.00000 | -0.00279 | 0.00000 | -1.11460 | 0.00000 | 1.11460 |
| 1 B 2 a iv Refining / storage | Cu | 0.18 | 0.07 | 3.0 | 400 | 400.01 | 3.52443 | -0.01046 | 0.00826 | -4.18567 | 0.03507 | 4.18582 |
| 2 A 3 Glass production | Cu | 1.93E-03 | 1.94E-03 | 3.0 | 400 | 400.01 | 0.09196 | 0.00001 | 0.00022 | 0.00571 | 0.00091 | 0.00579 |
| 2 C Metal production | Cu | 8.25E-02 | 4.72E-04 | 7.5 | 400 | 400.07 | 0.02243 | -0.00856 | 0.00005 | -3.42474 | 0.00056 | 3.42474 |
| 2 G Other product use | Cu | 0.38 | 0.61 | 10 | 400 | 400.12 | 29.03438 | 0.02837 | 0.06807 | 11.34755 | 0.96261 | 11.38831 |
| 5 C Waste incineration | Cu | 1.4E-02 | 5.5E-03 | 5.0 | 100 | 100.12 | 0.06483 | -0.00090 | 0.00061 | -0.09035 | 0.00429 | 0.09045 |
| 5 C 1 b v Cremation | Cu | 1.8E-05 | 6.4E-05 | 5.0 | 100 | 100.12 | 0.00076 | 0.00001 | 0.00001 | 0.00052 | 0.00005 | 0.00052 |
| 5 E Other waste (Building and car fires) | Cu | 5.7E-03 | 3.1E-03 | 5.0 | 700 | 700.02 | 0.25730 | -0.00025 | 0.00034 | -0.17341 | 0.00244 | 0.17342 |
| TOTAL | | 8.98 | 8.43 | % Uncertainty in total inventory | | | **158.93** | | | Trend uncertainty: | | **26.20** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t | t | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | Ni | 21.86 | 6.93 | 3.0 | 100 | 100.04 | 88.35533 | 0.01470 | 0.26414 | 1.47024 | 1.12067 | 1.84865 |
| Construction | Ni | 0.28 | 0.13 | 3.0 | 100 | 100.04 | 1.71316 | 0.00190 | 0.00512 | 0.18981 | 0.02173 | 0.19105 |
| 1 A 3 b Road Transport | Ni | 0.11 | 0.06 | 3.0 | 200 | 200.02 | 1.65670 | 0.00126 | 0.00248 | 0.25109 | 0.01051 | 0.25131 |
| 1 A 3 Other mobile source and machinery | Ni | 0.11 | 0.04 | 3.0 | 400 | 400.01 | 2.07803 | 0.00031 | 0.00155 | 0.12344 | 0.00659 | 0.12362 |
| 1 A 4 a Commercial, institutional combustion | Ni | 1.2E-02 | 5.0E-04 | 5.0 | 400 | 400.03 | 0.02547 | -0.00011 | 0.00002 | -0.04588 | 0.00013 | 0.04588 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | Ni | 0.16 | 0.11 | 3.0 | 400 | 400.01 | 5.52445 | 0.00226 | 0.00413 | 0.90509 | 0.01752 | 0.90526 |
| 1 B Extraction and distribution of fossil fuels | Ni | 6.7E-02 | 0 | 10.0 | 400 | 400.12 | 0.00000 | -0.00076 | 0.00000 | -0.30442 | 0.00000 | 0.30442 |
| 1 B 2 a iv Refining / storage | Ni | 0.78 | 0.35 | 3.0 | 400 | 400.01 | 18.09780 | 0.00461 | 0.01353 | 1.84572 | 0.05741 | 1.84662 |
| 2 A 3 Glass production | Ni | 1.35E-01 | 1.36E-01 | 3.0 | 400 | 400.01 | 6.91703 | 0.00363 | 0.00517 | 1.45276 | 0.02194 | 1.45293 |
| 2 C Metal production | Ni | 2.65 | 0.02 | 7.5 | 400 | 400.07 | 0.84349 | -0.02958 | 0.00063 | -11.83353 | 0.00669 | 11.83353 |
| 2 G Other product use | Ni | 0.05 | 0.06 | 10 | 400 | 400.12 | 3.08057 | 0.00169 | 0.00230 | 0.67506 | 0.03257 | 0.67585 |
| 5 C Waste incineration | Ni | 3.2E-04 | 1.1E-04 | 5.0 | 100 | 100.12 | 0.00142 | 0.00000 | 0.00000 | 0.00007 | 0.00003 | 0.00007 |
| 5 C 1 b v Cremation | Ni | 2.5E-05 | 8.9E-05 | 5.0 | 100 | 100.12 | 0.00113 | 0.00000 | 0.00000 | 0.00031 | 0.00002 | 0.00031 |
| TOTAL | | 26.22 | 7.84 | % Uncertainty in total inventory | | | **90.73** | | | Trend uncertainty: | | **12.27** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t | t | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | Se | 0.08 | 0.03 | 3.0 | 100 | 100.04 | 7.90987 | 0.07240 | 0.06084 | 7.23964 | 0.25814 | 7.24425 |
| Construction | Se | 0.08 | 0.06 | 3.0 | 100 | 100.04 | 16.53103 | 0.00442 | 0.12716 | 0.44203 | 0.53950 | 0.69746 |
| 1 A 3 b Road Transport | Se | 0.01 | 0.01 | 3.0 | 200 | 200.02 | 3.51745 | 0.01125 | 0.01353 | 2.24952 | 0.05742 | 2.25025 |
| 1 A 3 Other mobile source and machinery | Se | 0.00 | 0.00 | 3.0 | 400 | 400.01 | 4.78230 | 0.00088 | 0.00920 | 0.35080 | 0.03903 | 0.35296 |
| 1 A 4 a Commercial, institutional combustion | Se | 2.5E-03 | 7.9E-04 | 5.0 | 400 | 400.03 | 0.88836 | 0.00254 | 0.00171 | 1.01543 | 0.01208 | 1.01550 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | Se | 0.03 | 0.03 | 3.0 | 400 | 400.01 | 29.27361 | 0.00213 | 0.05632 | 0.85184 | 0.23894 | 0.88471 |
| 1 B Extraction and distribution of fossil fuels | Se | 8.9E-03 | 0 | 10.0 | 400 | 400.12 | 0.00000 | 0.01486 | 0.00000 | 5.94361 | 0.00000 | 5.94361 |
| 1 B 2 a iv Refining / storage | Se | 0.02 | 0.01 | 3.0 | 400 | 400.01 | 10.37199 | 0.01001 | 0.01995 | 4.00471 | 0.08466 | 4.00560 |
| 2 A 3 Glass production | Se | 0.22 | 0.22 | 3.0 | 400 | 400.01 | 249.82391 | 0.11190 | 0.48063 | 44.76076 | 2.03914 | 44.80719 |
| 5 C 1 b v Cremation | Se | 2.9E-05 | 1.0E-04 | 5.0 | 100 | 100.12 | 0.02865 | 0.00017 | 0.00022 | 0.01718 | 0.00156 | 0.01725 |
| TOTAL | | 0.46 | 0.35 | % Uncertainty in total inventory | | | **252.48** | | | Trend uncertainty: | | **46.03** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t | t | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | Zn | 2.26 | 1.42 | 3.0 | 100 | 100.04 | 4.13353 | 0.01496 | 0.03661 | 1.49595 | 0.15533 | 1.50399 |
| 1 A 2 Manufacturing industries and Construction | Zn | 6.02 | 1.77 | 3.0 | 100 | 100.04 | 5.15258 | 0.09193 | 0.04564 | 9.19346 | 0.19363 | 9.19550 |
| 1 A 3 b Road Transport | Zn | 3.71 | 5.90 | 3.0 | 200 | 200.02 | 34.35568 | 0.06738 | 0.15220 | 13.47641 | 0.64575 | 13.49188 |
| 1 A 3 Other mobile source and machinery | Zn | 0.17 | 0.10 | 3.0 | 400 | 400.01 | 1.13737 | 0.00128 | 0.00252 | 0.51139 | 0.01069 | 0.51150 |
| 1 A 4 a Commercial, institutional combustion | Zn | 0.38 | 0.15 | 5.0 | 400 | 400.03 | 1.78906 | 0.00473 | 0.00396 | 1.89051 | 0.02802 | 1.89072 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | Zn | 22.94 | 24.40 | 3.0 | 400 | 400.01 | 284.16613 | 0.10424 | 0.62951 | 41.69705 | 2.67080 | 41.78250 |
| 1 B Extraction and distribution of fossil fuels | Zn | 0.12 | 0 | 10.0 | 400 | 400.12 | 0.00000 | 0.00280 | 0.00000 | 1.11876 | 0.00000 | 1.11876 |
| 1 B 2 a iv Refining / storage | Zn | 0.15 | 0.07 | 3.0 | 400 | 400.01 | 0.76454 | 0.00182 | 0.00169 | 0.72892 | 0.00719 | 0.72895 |
| 2 A 3 Glass production | Zn | 0.10 | 0.10 | 3.0 | 400 | 400.01 | 1.19274 | 0.00031 | 0.00264 | 0.12460 | 0.01121 | 0.12510 |
| 2 C Metal production | Zn | 2.68 | 0.09 | 7.5 | 400 | 400.07 | 0.99062 | 0.05909 | 0.00219 | 23.63665 | 0.02327 | 23.63666 |
| 2 G Other product use | Zn | 0.22 | 0.35 | 10 | 400 | 400.12 | 4.12830 | 0.00418 | 0.00914 | 1.67238 | 0.12930 | 1.67738 |
| 5 C Waste incineration | Zn | 5.3E-04 | 0 | 5.0 | 100 | 100.12 | 0.00000 | 0.00001 | 0.00000 | 0.00120 | 0.00000 | 0.00120 |
| 5 C 1 b v Cremation | Zn | 2.3E-04 | 8.2E-04 | 5.0 | 100 | 100.12 | 0.00239 | 0.00002 | 0.00002 | 0.00158 | 0.00015 | 0.00159 |
| TOTAL | | 38.75 | 34.34 | % Uncertainty in total inventory | | | **286.35** | | | Trend uncertainty: | | **50.81** |

| NFR Source | Pollutant | Emissions 1990 | Emissions 2016 | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total emissions in year 2013 | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activity data uncertainty | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kg | kg | % | % | % | % | % | % | % | % | % |
| 1 A 1 Energy Industries | PCB | 1.083 | 4.11 | 3.0 | 100.0 | 100.04 | 0.97304 | 0.00654 | 0.00850 | 0.65409 | 0.03606 | 0.65508 |
| 1 A 2 Manufacturing Industries and Construction | PCB | 2.45 | 0.64 | 3.0 | 100.0 | 100.04 | 0.15086 | -0.00312 | 0.00132 | -0.31194 | 0.00559 | 0.31199 |
| 1 A 3 Other mobile source and machinery | PCB | 4.0E-02 | 2.5E-03 | 3.0 | 400.0 | 400.01 | 0.00233 | -0.00007 | 0.00001 | -0.02684 | 0.00002 | 0.02684 |
| 1 A 4 a Commercial, institutional combustion | PCB | 0.15 | 3.0E-04 | 5.0 | 400.0 | 400.03 | 0.00028 | -0.00027 | 0.00000 | -0.10981 | 0.00000 | 0.10981 |
| 1 A 4 b Residential combustion , 1 A 4 c Combustion in Agriculture/Forestry/ Fishing | PCB | 0.75 | 0.02 | 3.0 | 400.0 | 400.01 | 0.01675 | -0.00133 | 0.00004 | -0.53121 | 0.00016 | 0.53121 |
| 2 C Metal production | PCB | 0.85 | 0.06 | 7.5 | 400 | 400.07 | 0.05595 | -0.00141 | 0.00012 | -0.56361 | 0.00130 | 0.56362 |
| 2 K | PCB | 477.80 | 417.43 | 50 | 400 | 403.11 | 398.50542 | -0.00034 | 0.86402 | -0.13596 | 61.09528 | 61.09543 |
| 5 C Waste incineration | PCB | 2.8E-03 | 1.1E-03 | 5.0 | 100 | 100.12 | 0.00026 | 0.00000 | 0.00000 | -0.00028 | 0.00002 | 0.00028 |
| 5 C 1 b v Cremation | PCB | 6.0E-04 | 2.1E-03 | 5.0 | 100 | 100.12 | 0.00050 | 0.00000 | 0.00000 | 0.00033 | 0.00003 | 0.00033 |
| TOTAL | | 483.13 | 422.26 | % Uncertainty in total inventory | | | **398.51** | | | Trend uncertainty: | | **61.10** |

# APPENDIX 8. INFLUENCE OF RECALCULATIONS 1990 – 2015 IN RESPECT TO POLLUTANT AND SNAP97 SECTOR

| **Pollutant** | **SO2** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | -14% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.3%** |
| 1991 | 0% | 0% | 0% | -14% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.3%** |
| 1992 | 0% | 0% | 0% | -17% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.3%** |
| 1993 | 0% | 0% | 0% | -17% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.3%** |
| 1994 | 0% | 0% | 0% | -20% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.5%** |
| 1995 | 0% | 0% | 0% | -17% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.5%** |
| 1996 | 0% | 0% | 0% | -16% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.5%** |
| 1997 | 0% | 0% | 0% | -16% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.5%** |
| 1998 | 0% | 0% | 0% | -10% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.3%** |
| 1999 | 0% | 0% | 0% | -11% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.4%** |
| 2000 | 0% | 0% | 0% | -10% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.7%** |
| 2001 | 0% | 0% | 0% | -10% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.6%** |
| 2002 | 0% | 0% | 0% | -10% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.6%** |
| 2003 | 0% | 0% | 0% | -7% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.4%** |
| 2004 | 0% | 0% | 0% | -8% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.6%** |
| 2005 | 0% | 0% | 0% | -7% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.5%** |
| 2006 | 0% | 0% | 0% | -9% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.6%** |
| 2007 | 0% | 0% | 0% | -6% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.4%** |
| 2008 | 0% | 0% | 0% | -7% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **-0.5%** |
| 2009 | 0% | 0% | 0% | -5% | 0% | 0% | 0% | -1% | 0% | 0% | 0% | **-0.4%** |
| 2010 | 0% | 0% | 0% | -10% | 0% | 0% | 0% | -1% | 0% | 0% | 0% | **-0.8%** |
| 2011 | 0% | 0% | 0% | -8% | 0% | 0% | 0% | -2% | 0% | 0% | 0% | **-1.1%** |
| 2012 | 0% | 0% | 0% | -5% | 0% | 0% | 0% | -5% | 0% | 0% | 0% | **-0.9%** |
| 2013 | 0% | 0% | 0% | -6% | 0% | 0% | 0% | -8% | 0% | 0% | 0% | **-1.2%** |
| 2014 | 0% | 1% | 3% | -4% | 0% | 0% | 0% | -76% | 2% | 0% | 0% | **-1.8%** |
| 2015 | 12% | 1% | 2% | -5% | 0% | 0% | 34% | -77% | 25% | 0% | 0% | **4.4%** |

| **Pollutant** | **NOx** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | -2% | 0% | 1% | 0% | -1% | 0% | 10% | 0% | **0.1%** |
| 1991 | 0% | 0% | 0% | -1% | 0% | 1% | 0% | -1% | 0% | 9% | 0% | **0.2%** |
| 1992 | 0% | 0% | 0% | -1% | 0% | 1% | 0% | -1% | 0% | 6% | 0% | **0.2%** |
| 1993 | 0% | 0% | 0% | -1% | 0% | 1% | 0% | -1% | 0% | 9% | 0% | **0.2%** |
| 1994 | 0% | 0% | 0% | -2% | 0% | 2% | 0% | -1% | 0% | 8% | 0% | **0.1%** |
| 1995 | 0% | 0% | 0% | -1% | 0% | 1% | 0% | -1% | 0% | 7% | 0% | **0.1%** |
| 1996 | 0% | 0% | 0% | -1% | 0% | 2% | 0% | -1% | 0% | 6% | 0% | **0.1%** |
| 1997 | 0% | 0% | 0% | -1% | 0% | 2% | 0% | -1% | 0% | 5% | 0% | **0.1%** |
| 1998 | 0% | 0% | 0% | -1% | 0% | 1% | 0% | -1% | 0% | 6% | 0% | **0.0%** |
| 1999 | 0% | 0% | 0% | -1% | 0% | 1% | 0% | -1% | 0% | 6% | 0% | **0.0%** |
| 2000 | 0% | 0% | 0% | -2% | 0% | 1% | 0% | -2% | 0% | 5% | 0% | **-0.1%** |
| 2001 | 0% | 0% | 0% | -2% | 0% | 1% | 0% | -2% | 0% | 4% | 0% | **-0.2%** |
| 2002 | 0% | 0% | 0% | -2% | 0% | 7% | 0% | -1% | 0% | 5% | 0% | **-0.1%** |
| 2003 | 0% | 0% | 0% | -1% | 0% | 9% | 0% | -1% | 0% | 5% | 0% | **-0.1%** |
| 2004 | 0% | 0% | 0% | -1% | 0% | 6% | 0% | -1% | 0% | 5% | 0% | **-0.1%** |
| 2005 | 0% | 0% | 0% | -1% | 0% | 3% | 0% | -1% | 0% | 4% | 0% | **-0.2%** |
| 2006 | 0% | 0% | 0% | -1% | 0% | 2% | 0% | -1% | 0% | 4% | 0% | **0.0%** |
| 2007 | 0% | 0% | 0% | -1% | 0% | 1% | 0% | -1% | 0% | 4% | 0% | **0.0%** |
| 2008 | 0% | 0% | 0% | -1% | 0% | 1% | -6% | -1% | 0% | 4% | 0% | **-2.1%** |
| 2009 | 0% | 0% | 0% | -1% | 0% | 1% | 0% | -1% | 0% | 4% | 0% | **0.0%** |
| 2010 | 0% | 0% | 0% | -1% | 0% | 0% | 0% | -1% | 0% | 5% | 0% | **0.0%** |
| 2011 | 1% | 0% | 0% | -2% | 0% | 0% | 0% | -1% | 0% | 4% | 0% | **0.1%** |
| 2012 | 1% | 0% | 0% | -2% | 0% | 0% | 0% | -3% | 0% | 4% | 0% | **0.0%** |
| 2013 | 1% | 0% | 0% | -2% | 0% | 2% | 0% | 0% | 0% | 5% | 0% | **0.5%** |
| 2014 | 2% | -1% | 0% | -1% | 0% | 2% | 0% | 1% | 0% | 6% | 0% | **0.4%** |
| 2015 | 7% | 4% | -4% | -1% | 0% | 2% | 0% | 0% | 0% | 6% | 0% | **1.2%** |

| **Pollutant** | **NMVOC** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 1% | 53% | 0% | -2% | 0% | 9% | 0% | **15.6%** |
| 1991 | 0% | 0% | 0% | 0% | 2% | 50% | 0% | -7% | 0% | 9% | 0% | **12.0%** |
| 1992 | 0% | 0% | 0% | 0% | 1% | 43% | 0% | -3% | 0% | 8% | 0% | **9.2%** |
| 1993 | 0% | 0% | 0% | 0% | 1% | 37% | 0% | -4% | 0% | 8% | 0% | **8.3%** |
| 1994 | 0% | 0% | 0% | 0% | 1% | 36% | 0% | -1% | 0% | 9% | 0% | **8.5%** |
| 1995 | 0% | 0% | 0% | 0% | 1% | 98% | 0% | -1% | 0% | 9% | 0% | **20.6%** |
| 1996 | 0% | 0% | 0% | 0% | 1% | 76% | 0% | 0% | 0% | 9% | 0% | **16.1%** |
| 1997 | 0% | 0% | 0% | 0% | 1% | 39% | 0% | 0% | 0% | 9% | 0% | **9.1%** |
| 1998 | 0% | 0% | 0% | 0% | 1% | 42% | 0% | 1% | 0% | 8% | 0% | **9.3%** |
| 1999 | 0% | 0% | 0% | 0% | 1% | 46% | 0% | 2% | 0% | 9% | 0% | **9.1%** |
| 2000 | 0% | 0% | 0% | 0% | 1% | 46% | 0% | 1% | 0% | 10% | 0% | **9.5%** |
| 2001 | 0% | 0% | 0% | 0% | 1% | 41% | 0% | 1% | 0% | 9% | 0% | **9.1%** |
| 2002 | 0% | 0% | 0% | 0% | 1% | 38% | 0% | 0% | 0% | 10% | 0% | **10.2%** |
| 2003 | 0% | 0% | 0% | 0% | 1% | 41% | 0% | 1% | 0% | 11% | 0% | **10.7%** |
| 2004 | 0% | 0% | 0% | 0% | 1% | 40% | 0% | 0% | 0% | 10% | 0% | **11.9%** |
| 2005 | 0% | 0% | 0% | 0% | 1% | 40% | 6% | 0% | 0% | 8% | 0% | **13.1%** |
| 2006 | 0% | 0% | 0% | 0% | 1% | 40% | 0% | 0% | 0% | 9% | 0% | **13.6%** |
| 2007 | 0% | 0% | 0% | 0% | 1% | 30% | 0% | 0% | 0% | 9% | 0% | **11.5%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 37% | -1% | 0% | 0% | 8% | 0% | **13.7%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 43% | 0% | 0% | 0% | 10% | 0% | **13.2%** |
| 2010 | 0% | 0% | 0% | 0% | -1% | 45% | 0% | 0% | 0% | 11% | 0% | **13.3%** |
| 2011 | 1% | 0% | 0% | 0% | 1% | 49% | 0% | 0% | 0% | 13% | 0% | **14.3%** |
| 2012 | 2% | 0% | 0% | 0% | 1% | 52% | 0% | -2% | 0% | 13% | 0% | **15.3%** |
| 2013 | 2% | 0% | 0% | 0% | 2% | 44% | 0% | 0% | 0% | 12% | 0% | **13.7%** |
| 2014 | 4% | 0% | 0% | -0.03% | 4% | 48% | 0% | 1% | 0% | 13% | 0% | **14.7%** |
| 2015 | 7% | 0% | -1% | -0.02% | 2% | 45% | 0% | -1% | 0% | 13% | 0% | **13.9%** |

| **Pollutant** | **CO** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 4% | 0% | 0% | 0% | **0.1%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | -12% | 0% | 0% | 0% | **-0.5%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | -8% | 0% | 0% | 0% | **-0.3%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | -11% | 0% | 0% | 0% | **-0.4%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 2% | 0% | -6% | 0% | 0% | 0% | **-0.2%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | -6% | 0% | 0% | 0% | **-0.2%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 2% | 0% | -4% | 0% | 0% | 0% | **-0.2%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 2% | 0% | -3% | 0% | 0% | 0% | **-0.1%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | -1% | 0% | 0% | 0% | **0.0%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 5% | 0% | 0% | 0% | **0.2%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 6% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 8% | 0% | 6% | 0% | 0% | 0% | **0.3%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 6% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 2% | 2% | 0% | 0% | 0% | 0% | **0.6%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 2% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 1% | -1% | 0% | 0% | 0% | 0% | **-0.2%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 0% | 0% | 0% | **0.0%** |
| 2011 | 5% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 0% | 0% | 0% | **0.0%** |
| 2012 | 7% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 0% | 0% | 0% | **0.0%** |
| 2013 | 9% | 0% | 0% | 0% | 0% | 2% | 0% | -1% | 0% | 0% | 0% | **0.1%** |
| 2014 | 12% | 0% | 0% | 0% | 0% | 2% | 0% | 2% | 0% | 0% | 0% | **0.2%** |
| 2015 | 24% | 0% | 0% | 0% | 0% | 2% | 0% | 0% | 0% | 0% | 0% | **0.2%** |

| **Pollutant** | **NH3** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 12% | -3% | 15% | 0% | **12.8%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 7% | -3% | 16% | 0% | **13.1%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 12% | 0% | **9.6%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 14% | 0% | **11.7%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | -3% | 15% | 0% | **12.2%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 14% | 0% | **11.4%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 15% | 0% | **11.4%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 13% | 0% | **10.5%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 15% | 0% | **11.3%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 15% | -3% | 16% | 0% | **12.5%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 15% | 0% | **11.6%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 15% | 0% | **11.8%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 16% | 0% | **12.8%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 12% | -3% | 17% | 0% | **13.2%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 17% | 0% | **13.2%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 0% | -2% | 0% | -3% | 15% | 0% | **11.3%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 17% | 0% | **13.4%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 16% | 0% | **12.5%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 14% | 0% | **11.2%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 17% | 0% | **13.8%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 19% | 0% | **14.7%** |
| 2011 | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 0% | -3% | 20% | 0% | **15.5%** |
| 2012 | 0% | 0% | 0% | 0% | 0% | 0% | 2% | 0% | -2% | 20% | 0% | **15.8%** |
| 2013 | 0% | 0% | 0% | 0% | 0% | 0% | 2% | 0% | -2% | 21% | 0% | **16.4%** |
| 2014 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -2% | 23% | 0% | **18.3%** |
| 2015 | 0% | 0% | 1% | 0% | 0% | 0% | 0% | -1% | -1% | 22% | 0% | **17.1%** |

| **Pollutant** | **TSP** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 17% | 0% | 2% | 609% | 17% | 0% | **2.5%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 23% | 0% | 2% | 480% | 18% | 0% | **2.4%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 19% | 0% | 2% | 1172% | 18% | 0% | **2.6%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 22% | 0% | 2% | 520% | 18% | 0% | **2.2%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 37% | 0% | 4% | 769% | 19% | 0% | **2.4%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 33% | 0% | 3% | 1096% | 18% | 0% | **2.4%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 51% | 0% | 3% | 1178% | 19% | 0% | **2.3%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 43% | 0% | 3% | 934% | 19% | 0% | **2.2%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 27% | 0% | 4% | 1045% | 18% | 0% | **2.1%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 22% | 0% | 4% | 916% | 20% | 0% | **2.2%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 20% | 0% | 4% | 1031% | 22% | 0% | **2.4%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 36% | 0% | 3% | 815% | 21% | 0% | **2.5%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 137% | 0% | -1% | 734% | 23% | 0% | **3.6%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 185% | 0% | -1% | 807% | 24% | 0% | **3.6%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 139% | 0% | -1% | 676% | 23% | 0% | **2.6%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 57% | 1% | -1% | 675% | 20% | 0% | **1.9%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 43% | 0% | -1% | 573% | 21% | 0% | **2%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 32% | 0% | -1% | 519% | 22% | 0% | **2%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 22% | 0% | -1% | 531% | 20% | 0% | **1.6%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 13% | -20% | -1% | 556% | 23% | 0% | **0.9%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 812% | 26% | 0% | **2.0%** |
| 2011 | 21% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 730% | 30% | 0% | **2.5%** |
| 2012 | 28% | 0% | 0% | 0% | 0% | 0% | 0% | -4% | 914% | 29% | 0% | **2.7%** |
| 2013 | 62% | 0% | 0% | 0% | 0% | 54% | 0% | -1% | 864% | 28% | 0% | **3.3%** |
| 2014 | 50% | 0% | 0% | 0% | 0% | 41% | 0% | 0% | 430% | 31% | 0% | **3.5%** |
| 2015 | 89% | 0% | 21% | 0% | 0% | 40% | 0% | -1% | 561% | 31% | 0% | **4.2%** |

| **Pollutant** | **PM2.5** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 9% | 0% | 2% | 607% | 14% | 0% | **1.2%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 11% | 0% | 2% | 477% | 14% | 0% | **0.9%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 10% | 0% | 2% | 1175% | 13% | 0% | **1.4%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 11% | 0% | 2% | 517% | 14% | 0% | **0.9%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 21% | 0% | 4% | 769% | 15% | 0% | **1.2%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 17% | 0% | 3% | 1101% | 14% | 0% | **1.3%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 27% | 0% | 3% | 1185% | 15% | 0% | **1.2%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 24% | 0% | 3% | 939% | 15% | 0% | **1.2%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 15% | 0% | 4% | 1052% | 15% | 0% | **1.2%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 12% | 0% | 5% | 921% | 16% | 0% | **1.2%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 10% | 0% | 4% | 1038% | 17% | 0% | **1.3%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 18% | 0% | 3% | 819% | 17% | 0% | **1.3%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 73% | 0% | -1% | 736% | 19% | 0% | **2.2%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 98% | 0% | -1% | 811% | 19% | 0% | **2.5%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 73% | 0% | -1% | 678% | 18% | 0% | **1.7%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 31% | 1% | -1% | 677% | 16% | 0% | **1.2%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 23% | 0% | -1% | 574% | 17% | 0% | **1.2%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 17% | 0% | -1% | 519% | 17% | 0% | **1.1%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 11% | 0% | -1% | 534% | 16% | 0% | **1.1%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 7% | 0% | -1% | 560% | 19% | 0% | **1.0%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 2% | 0% | 0% | 831% | 22% | 0% | **1.0%** |
| 2011 | 45% | 0% | 0% | 0% | 0% | 2% | 0% | 0% | 743% | 26% | 0% | **1.6%** |
| 2012 | 64% | 0% | 0% | 0% | 0% | 0% | 0% | -4% | 931% | 26% | 0% | **1.6%** |
| 2013 | 27% | 0% | 0% | 0% | 0% | 27% | 0% | -1% | 885% | 25% | 0% | **2.2%** |
| 2014 | 14% | 0% | 0% | 0% | 0% | 21% | 0% | 0% | 436% | 28% | 0% | **2.3%** |
| 2015 | 204% | 0% | 4% | 0% | 0% | 21% | 0% | -1% | 571% | 29% | 0% | **3.1%** |

| **Pollutant** | **PM10** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 16% | 0% | 2% | 606% | 14% | 0% | **2.3%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 22% | 0% | 2% | 476% | 14% | 0% | **2.0%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 18% | 0% | 2% | 1170% | 15% | 0% | **2.3%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 21% | 0% | 2% | 516% | 15% | 0% | **1.9%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 36% | 0% | 4% | 766% | 15% | 0% | **2.2%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 31% | 0% | 3% | 1095% | 15% | 0% | **2.2%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 48% | 0% | 3% | 1178% | 15% | 0% | **2.2%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 42% | 0% | 3% | 934% | 15% | 0% | **2.2%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 26% | 0% | 4% | 1045% | 14% | 0% | **2.0%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 21% | 0% | 4% | 916% | 15% | 0% | **2.1%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 18% | 0% | 4% | 1032% | 18% | 0% | **2.3%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 33% | 0% | 3% | 814% | 17% | 0% | **2.3%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 130% | 0% | -1% | 732% | 19% | 0% | **3.8%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 176% | 0% | -1% | 806% | 20% | 0% | **4.1%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 132% | 0% | -1% | 674% | 18% | 0% | **2.9%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 55% | 1% | -1% | 673% | 16% | 0% | **2.0%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 41% | 0% | -1% | 571% | 16% | 0% | **2.1%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 30% | 0% | -1% | 516% | 17% | 0% | **2.0%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 20% | 0% | -1% | 530% | 15% | 0% | **1.8%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 12% | 0% | -1% | 555% | 18% | 0% | **2.0%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 822% | 22% | 0% | **2.0%** |
| 2011 | 31% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 736% | 26% | 0% | **2.8%** |
| 2012 | 43% | 0% | 0% | 0% | 0% | 0% | 0% | -4% | 921% | 25% | 0% | **2.9%** |
| 2013 | 89% | 0% | 0% | 0% | 0% | 50% | 0% | -1% | 875% | 24% | 0% | **3.6%** |
| 2014 | 77% | 0% | 0% | 0% | 0% | 39% | 0% | 0% | 432% | 28% | 0% | **4.0%** |
| 2015 | 138% | 0% | 11% | 0% | 0% | 38% | 0% | -1% | 565% | 28% | 0% | **4.9%** |

| Pollutant | Cd | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 2% | 0% | 0% | 61% | 0% | 0% | **0.2%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 2% | 0% | 0% | 50% | 0% | 0% | **0.2%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 2% | 0% | 0% | 96% | 0% | 0% | **0.4%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 2% | 0% | 0% | 49% | 0% | 0% | **0.2%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 62% | 0% | 0% | **0.3%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 3% | 0% | 0% | 70% | 0% | 0% | **0.4%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 75% | 0% | 0% | **0.5%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 67% | 0% | 0% | **0.5%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 3% | 0% | 0% | 66% | 0% | 0% | **0.4%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 2% | 0% | 0% | 65% | 0% | 0% | **0.3%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | 62% | 0% | 0% | **0.3%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 3% | 0% | 0% | 57% | 0% | 0% | **0.4%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 12% | 0% | 0% | 57% | 0% | 0% | **1.5%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 17% | 0% | 0% | 68% | 0% | 0% | **1.8%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 12% | 0% | 0% | 57% | 0% | 0% | **1.0%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 5% | 0% | 0% | 58% | 0% | 0% | **0.5%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 55% | 0% | 0% | **0.4%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 3% | 0% | 0% | 48% | 0% | 0% | **0.4%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 2% | 0% | 0% | 55% | 0% | 0% | **0.3%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | 47% | 0% | 0% | **0.2%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 113% | 0% | 0% | **0.2%** |
| 2011 | 3% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 105% | 0% | 0% | **0.3%** |
| 2012 | 5% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 81% | 0% | 0% | **0.3%** |
| 2013 | 7% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 99% | 0% | 0% | **0.6%** |
| 2014 | 7% | 0% | 0% | 0% | 0% | 3% | 0% | 0% | 60% | 0% | 0% | **0.5%** |
| 2015 | 22% | 0% | -6% | 0% | 0% | 3% | 0% | -1% | 61% | 0% | 0% | **0.9%** |

| **Pollutant** | **Hg** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 19% | 0% | 0% | **0.1%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 13% | 0% | 0% | **0.1%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 21% | 0% | 0% | **0.2%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 11% | 0% | 0% | **0.3%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 13% | 0% | 0% | **0.4%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 16% | 0% | 0% | **0.6%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 15% | 0% | 0% | **0.6%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 14% | 0% | 0% | **0.5%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 15% | 0% | 0% | **0.5%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 15% | 0% | 0% | **0.4%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 15% | 0% | 0% | **0.3%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 14% | 0% | 0% | **0.3%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | -1% | 13% | 0% | 0% | **0.4%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | -1% | 14% | 0% | 0% | **0.4%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | -1% | 11% | 0% | 0% | **0.3%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 11% | 0% | 0% | **0.3%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 11% | 0% | 0% | **0.3%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 9% | 0% | 0% | **0.2%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 10% | 0% | 0% | **0.2%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -2% | 9% | 0% | 0% | **0.2%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 14% | 0% | 0% | **0.2%** |
| 2011 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 15% | 0% | 0% | **0.3%** |
| 2012 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 12% | 0% | 0% | **0.4%** |
| 2013 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 13% | 0% | 0% | **0.4%** |
| 2014 | 0% | -1% | 0% | 0% | 0% | 0% | 0% | -2% | 8% | 0% | 0% | **0.3%** |
| 2015 | 1% | 1% | 4% | 0% | 0% | 0% | 2% | -2% | 8% | 0% | 0% | **1.7%** |

| **Pollutant** | **Pb** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 17% | 6% | 0% | 0% | **0.2%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 2% | 5% | 0% | 0% | **0.2%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 9% | 0% | 0% | **0.2%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 0% | 0% | **0.2%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 6% | 0% | 0% | **0.2%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 7% | 0% | 0% | **0.3%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 7% | 0% | 0% | **0.5%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 6% | 0% | 0% | **0.5%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 6% | 0% | 0% | **0.3%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 8% | 6% | 0% | 0% | **0.4%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 0% | 0% | **0.2%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | **0.5%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 0% | 0% | **4.3%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 72% | 6% | 0% | 0% | **14.1%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 0% | 0% | **8.3%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 0% | 2% | 0% | 5% | 0% | 0% | **5.8%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 0% | 0% | **19.2%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 0% | 0% | **13.3%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 0% | 5% | 0% | 0% | **9.1%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | **4.3%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 12% | 0% | 0% | **1.8%** |
| 2011 | 4% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 12% | 0% | 0% | **1.8%** |
| 2012 | 6% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 8% | 0% | 0% | **0.4%** |
| 2013 | 8% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 12% | 0% | 0% | **16.1%** |
| 2014 | 9% | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 7% | 0% | 0% | **11.8%** |
| 2015 | 20% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 7% | 0% | 0% | **11.8%** |

| **Pollutant** | **PCDD/PCDF** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 48% | 0% | 0% | **6.0%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 33% | 0% | 0% | **4.0%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 60% | 0% | 0% | **8.3%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 33% | 0% | 0% | **4.4%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 42% | 0% | 0% | **6.1%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 50% | 0% | 0% | **7.3%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 51% | 0% | 0% | **6.7%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 45% | 0% | 0% | **6.6%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 44% | 0% | 0% | **6.8%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 45% | 0% | 0% | **7.2%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 42% | 0% | 0% | **7.7%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 36% | 0% | 0% | **6.6%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 36% | 0% | 0% | **6.5%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 44% | 0% | 0% | **6.7%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 35% | 0% | 0% | **5.7%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 0% | 63% | 0% | 36% | 0% | 0% | **7.0%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 34% | 0% | 0% | **6.1%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 29% | 0% | 0% | **6.2%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 0% | 94% | 0% | 36% | 0% | 0% | **8.7%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 0% | -66% | 0% | 30% | 0% | 0% | **3.9%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 0% | -65% | 0% | 95% | 0% | 0% | **4.3%** |
| 2011 | 13% | 0% | 0% | 0% | 0% | 0% | -65% | 0% | 99% | 0% | 0% | **5.6%** |
| 2012 | 19% | 0% | 0% | 0% | 0% | 0% | -66% | 0% | 59% | 0% | 0% | **5.4%** |
| 2013 | 21% | 0% | 0% | 0% | 0% | 0% | -65% | 0% | 105% | 0% | 0% | **5.7%** |
| 2014 | 23% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 66% | 0% | 0% | **6.8%** |
| 2015 | 46% | 0% | 2% | 0% | 0% | 0% | 0% | 0% | 72% | 0% | 0% | **7.5%** |

| **Pollutant** | **PCB** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0%** |
| 2011 | 0% | 0% | 0% | 0% | 0% | 0.0% | 0% | 0% | 0% | 0% | 0% | **0.0006%** |
| 2012 | 0% | 0% | 0% | 0% | 0% | 0.0% | 0% | 0% | 0% | 0% | 0% | **0.0008%** |
| 2013 | 0% | 0% | 0% | 0% | 0% | 0.0% | 0% | 0% | 0% | 0% | 0% | **0.0009%** |
| 2014 | 0% | 2% | 0% | 0% | 0% | 0.0% | 0% | 0% | 0% | 0% | 0% | **0.0011%** |
| 2015 | 0% | 1% | 35% | 0% | 0% | 0.0% | 0% | 0% | 0% | 0% | 0% | **0.043%** |

| **Pollutant** | **PAHs** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | -90% | 0% | -4% | 0% | 0% | 0% | **-0.2%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | -81% | 0% | -2% | 0% | 0% | 0% | **-0.1%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | -88% | 0% | -2% | 0% | 0% | 0% | **-0.2%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | -87% | 0% | -10% | 0% | 0% | 0% | **-0.1%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | -95% | 0% | -6% | 0% | 0% | 0% | **-0.3%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | -91% | 0% | -6% | 0% | 0% | 0% | **-0.2%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | -92% | 0% | 1% | 0% | 0% | 0% | **-0.3%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | -92% | 0% | -5% | 0% | 0% | 0% | **-0.3%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | -91% | 0% | -5% | 0% | 0% | 0% | **-0.3%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | -91% | 0% | -7% | 0% | 0% | 0% | **-0.3%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | -86% | 0% | -4% | 0% | 0% | 0% | **-0.2%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | -83% | 0% | -4% | 0% | 0% | 0% | **-0.2%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | -87% | 0% | -4% | 0% | 0% | 0% | **-0.2%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | -94% | 0% | -5% | 0% | 0% | 0% | **-0.7%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | -96% | 0% | -4% | 0% | 0% | 0% | **-1.1%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | -95% | 0% | -5% | 0% | 0% | 0% | **-0.8%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | -94% | 0% | -5% | 0% | 0% | 0% | **-0.6%** |
| 2007 | 0% | 0% | 0.0% | 0% | 0% | -95% | 0% | -4% | 0% | 0% | 0% | **-1.0%** |
| 2008 | 0% | 0% | 0.0% | 0% | 0% | -95% | 5% | -5% | 0% | 0% | 0% | **-1.0%** |
| 2009 | 0% | 0% | 0.0% | 0% | 0% | -96% | 0% | -10% | 0% | 0% | 0% | **-1.4%** |
| 2010 | 0% | 0% | 0.0% | 0% | 0% | -96% | 0% | -13% | 0% | 0% | 0% | **-1.4%** |
| 2011 | 16% | 0% | 0.0% | 0% | 0% | -96% | 0% | -14% | 0% | 0% | 0% | **-1.2%** |
| 2012 | 28% | 0% | 0.0% | 0% | 0% | -96% | 0% | -14% | 0% | 0% | 0% | **-1.6%** |
| 2013 | 71% | 0% | 0.0% | 0% | 0% | -97% | 0% | -13% | 0% | 0% | 0% | **-2.7%** |
| 2014 | 115% | 0% | -0.1% | 0% | 0% | -93% | 0% | -12% | 0% | 0% | 0% | **-0.5%** |
| 2015 | 131% | 0% | -4.5% | 0% | 0% | -95% | 0% | -10% | 0% | 0% | 0% | **-1.0%** |

| Pollutant | As | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 423% | 0% | 0% | **0.0%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 388% | 0% | 0% | **0.1%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 760% | 0% | 0% | **0.5%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 361% | 0% | 0% | **0.3%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 457% | 0% | 0% | **0.2%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 474% | 0% | 0% | **0.4%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 523% | 0% | 0% | **0.5%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 479% | 0% | 0% | **0.4%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 477% | 0% | 0% | **0.3%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 461% | 0% | 0% | **0.3%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 445% | 0% | 0% | **0.3%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 434% | 0% | 0% | **0.4%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 446% | 0% | 0% | **1.1%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 516% | 0% | 0% | **1.2%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 453% | 0% | 0% | **1.0%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 468% | 0% | 0% | **0.5%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 460% | 0% | 0% | **0.4%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 404% | 0% | 0% | **0.4%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 430% | 0% | 0% | **0.4%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 370% | 0% | 0% | **0.3%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 651% | 0% | 0% | **0.3%** |
| 2011 | 3% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 589% | 0% | 0% | **1.7%** |
| 2012 | 5% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 517% | 0% | 0% | **2.0%** |
| 2013 | 9% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 505% | 0% | 0% | **3.3%** |
| 2014 | 11% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 310% | 0% | 0% | **4.1%** |
| 2015 | 24% | 1% | 2% | 0% | 0% | 0% | 2% | 0% | 295% | 0% | 0% | **7.1%** |

| **Pollutant** | **Cr** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 46% | 0% | 0% | **0.3%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 44% | 0% | 0% | **0.3%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 86% | 0% | 0% | **0.4%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 41% | 0% | 0% | **0.4%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 52% | 0% | 0% | **0.3%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 52% | 0% | 0% | **0.6%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 58% | 0% | 0% | **0.9%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 53% | 0% | 0% | **0.8%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 50% | 0% | 0% | **0.5%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 48% | 0% | 0% | **0.4%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 44% | 0% | 0% | **0.4%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 43% | 0% | 0% | **0.8%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 48% | 0% | 0% | **3.8%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 59% | 0% | 0% | **4.3%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 53% | 0% | 0% | **2.9%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 55% | 0% | 0% | **1.2%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 55% | 0% | 0% | **0.9%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 48% | 0% | 0% | **0.7%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 0% | -3% | 0% | 52% | 0% | 0% | **0.2%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 44% | 0% | 0% | **0.3%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 88% | 0% | 0% | **0.2%** |
| 2011 | 1% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 76% | 0% | 0% | **0.5%** |
| 2012 | 2% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 63% | 0% | 0% | **0.5%** |
| 2013 | 4% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 63% | 0% | 0% | **1.6%** |
| 2014 | 5% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 39% | 0% | 0% | **1.5%** |
| 2015 | 19% | 0% | -3% | 0% | 0% | 0% | 0% | -1% | 36% | 0% | 0% | **2.9%** |

| **Pollutant** | **Cu** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 482% | 0% | 0% | 32% | 0% | 0% | **3.7%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 519% | 0% | 0% | 23% | 0% | 0% | **6.3%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 469% | 0% | 0% | 43% | 0% | 0% | **6.7%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 517% | 0% | 0% | 23% | 0% | 0% | **6.4%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 1200% | 0% | 0% | 29% | 0% | 0% | **5.5%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 843% | 0% | 0% | 34% | 0% | 0% | **10.0%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 1297% | 0% | 0% | 35% | 0% | 0% | **14.2%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 1298% | 0% | 0% | 29% | 0% | 0% | **12.7%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 823% | 0% | 0% | 25% | 0% | 0% | **7.9%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 578% | 0% | 1% | 25% | 0% | 0% | **6.1%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 430% | 0% | 0% | 22% | 0% | 0% | **4.6%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 772% | 0% | 0% | 19% | 0% | 0% | **11.5%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 3715% | 0% | 0% | 21% | 0% | 0% | **53.9%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 4953% | 0% | 0% | 31% | 0% | 0% | **67.4%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 3576% | 0% | 0% | 25% | 0% | 0% | **37.5%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 1558% | 0% | 0% | 26% | 0% | 0% | **16.4%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 1190% | 0% | 0% | 24% | 0% | 0% | **11.5%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 829% | 0% | 0% | 22% | 0% | 0% | **7.7%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 547% | -3% | 0% | 26% | 0% | 0% | **2.8%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 331% | 0% | 0% | 22% | 0% | 0% | **2.5%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 112% | 0% | 0% | 64% | 0% | 0% | **1.1%** |
| 2011 | 4% | 0% | 0% | 0% | 0% | 110% | 0% | 0% | 64% | 0% | 0% | **1.2%** |
| 2012 | 7% | 0% | 0% | 0% | 0% | 8% | 0% | 0% | 41% | 0% | 0% | **0.4%** |
| 2013 | 11% | 0% | 0% | 0% | 0% | 1246% | 0% | 0% | 63% | 0% | 0% | **8.9%** |
| 2014 | 12% | 0% | 0% | 0% | 0% | 1017% | 0% | 0% | 40% | 0% | 0% | **6.7%** |
| 2015 | 33% | 0% | -1% | 0% | 0% | 1008% | 0% | -1% | 41% | 0% | 0% | **6.7%** |

| Pollutant | Ni | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 65% | 0% | 0% | 0% | 0% | 0% | **0.1%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 70% | 0% | 0% | 0% | 0% | 0% | **0.1%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 63% | 0% | 0% | 0% | 0% | 0% | **0.1%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 70% | 0% | 0% | 0% | 0% | 0% | **0.1%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 162% | 0% | 0% | 0% | 0% | 0% | **0.1%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 114% | 0% | 0% | 0% | 0% | 0% | **0.2%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 175% | 0% | 0% | 0% | 0% | 0% | **0.2%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 175% | 0% | 0% | 0% | 0% | 0% | **0.3%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 111% | 0% | 0% | 0% | 0% | 0% | **0.2%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 78% | 0% | 0% | 0% | 0% | 0% | **0.1%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 58% | 0% | 0% | 0% | 0% | 0% | **0.1%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 104% | 0% | 0% | 0% | 0% | 0% | **0.3%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 502% | 0% | 0% | 0% | 0% | 0% | **1.2%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 669% | 0% | 0% | 0% | 0% | 0% | **1.6%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 483% | 0% | 0% | 0% | 0% | 0% | **1.0%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 211% | 0% | 0% | 0% | 0% | 0% | **0.4%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 161% | 0% | 0% | 0% | 0% | 0% | **0.3%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 112% | 0% | 0% | 0% | 0% | 0% | **0.2%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 74% | -2% | 0% | 0% | 0% | 0% | **0.2%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 45% | 0% | 0% | 0% | 0% | 0% | **0.1%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 15% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2011 | 0% | 0% | 0% | 0% | 0% | 15% | 0% | 0% | 0% | 0% | 0% | **0.1%** |
| 2012 | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | 0% | 0% | 0% | **0.1%** |
| 2013 | 0% | 0% | 0% | 0% | 0% | 168% | 0% | 0% | 0% | 0% | 0% | **0.8%** |
| 2014 | 0% | 0% | 0% | 0% | 0% | 137% | 0% | 0% | 0% | 0% | 0% | **0.7%** |
| 2015 | 37% | 0% | -41% | 0% | 0% | 136% | 0% | 0% | 0% | 0% | 0% | **29.2%** |

| **Pollutant** | **Se** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 0% | -2% | 0% | 0% | 0% | 0% | **0.0%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2011 | 2% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 0% | 0% | 0% | **0.3%** |
| 2012 | 4% | 0% | 0% | 0% | 0% | 0% | 0% | -1% | 0% | 0% | 0% | **0.4%** |
| 2013 | 6% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.4%** |
| 2014 | 6% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.4%** |
| 2015 | 30% | 0% | 3% | 0% | 0% | 0% | 0% | -1% | 0% | 0% | 0% | **2.6%** |

| **Pollutant** | **Zn** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 565% | 0% | 0% | 0% | 0% | 0% | **0.5%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 608% | 0% | 0% | 0% | 0% | 0% | **0.5%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 549% | 0% | 0% | 0% | 0% | 0% | **0.6%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 606% | 0% | -2% | 0% | 0% | 0% | **0.6%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 1406% | 0% | -1% | 0% | 0% | 0% | **0.6%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 987% | 0% | -1% | 0% | 0% | 0% | **1.0%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 1519% | 0% | 0% | 0% | 0% | 0% | **1.3%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 1520% | 0% | -1% | 0% | 0% | 0% | **1.4%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 963% | 0% | -1% | 0% | 0% | 0% | **0.9%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 677% | 0% | 0% | 0% | 0% | 0% | **0.8%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 503% | 0% | -1% | 0% | 0% | 0% | **0.6%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 904% | 0% | -1% | 0% | 0% | 0% | **1.3%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 4351% | 0% | -1% | 0% | 0% | 0% | **6.8%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 5801% | 0% | 0% | 0% | 0% | 0% | **8.4%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 4189% | 0% | -1% | 0% | 0% | 0% | **4.6%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 1825% | 0% | -1% | 0% | 0% | 0% | **2.0%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 1394% | 0% | -1% | 0% | 0% | 0% | **1.5%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 971% | 0% | -1% | 0% | 0% | 0% | **1.1%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 640% | -1% | -1% | 0% | 0% | 0% | **0.6%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 387% | 0% | -2% | 0% | 0% | 0% | **0.3%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 131% | 0% | -2% | 0% | 0% | 0% | **0.1%** |
| 2011 | 12% | 0% | 0% | 0% | 0% | 129% | 0% | -2% | 0% | 0% | 0% | **0.5%** |
| 2012 | 17% | 0% | 0% | 0% | 0% | 9% | 0% | -2% | 0% | 0% | 0% | **0.5%** |
| 2013 | 27% | 0% | 0% | 0% | 0% | 1460% | 0% | -2% | 0% | 0% | 0% | **1.7%** |
| 2014 | 27% | 0% | 0% | 0% | 0% | 1191% | 0% | -2% | 0% | 0% | 0% | **1.5%** |
| 2015 | 68% | 0% | -1% | 0% | 0% | 1181% | 0% | -2% | 0% | 0% | 0% | **2.2%** |

| **Pollutant** | **HCB** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **TOTAL** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2009 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2010 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **0.0%** |
| 2011 | 27% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **1.4%** |
| 2012 | 38% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **1.7%** |
| 2013 | 40% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **2.0%** |
| 2014 | 42% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **2.4%** |
| 2015 | 81% | 0% | 4% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **4.1%** |

| **Pollutant** | **BC** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SNAP sector** | **01** | **02** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **total** |
| 1990 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 3% | 1% | 0% | 0% | **0.4%** |
| 1991 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 3% | 1% | 0% | 0% | **0.3%** |
| 1992 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 4% | 1% | 0% | 0% | **0.2%** |
| 1993 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 3% | 1% | 0% | 0% | **0.1%** |
| 1994 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 1% | 0% | 0% | **0.4%** |
| 1995 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 1% | 0% | 0% | **0.3%** |
| 1996 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 6% | 1% | 0% | 0% | **0.3%** |
| 1997 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 1% | 0% | 0% | **0.3%** |
| 1998 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 6% | 1% | 0% | 0% | **0.4%** |
| 1999 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 6% | 1% | 0% | 0% | **0.4%** |
| 2000 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 6% | 1% | 0% | 0% | **0.5%** |
| 2001 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 1% | 0% | 0% | **0.4%** |
| 2002 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | **0.0%** |
| 2003 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | **0.0%** |
| 2004 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | **0.0%** |
| 2005 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | **0.0%** |
| 2006 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | **0.0%** |
| 2007 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | **0.0%** |
| 2008 | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 1% | 0% | 0% | **0.3%** |
| 2009 | 0% | 0% | 0% | 1% | 0% | 0% | 0% | 1% | 1% | 0% | 0% | **0.1%** |
| 2010 | 0% | 0% | 0% | 1% | 0% | 0% | 0% | 2% | 0% | 0% | 0% | **0.1%** |
| 2011 | 15% | 0% | 0% | 1% | 0% | 0% | 0% | 2% | 0% | 0% | 0% | **0.2%** |
| 2012 | 25% | 0% | 0% | 1% | 0% | 0% | 0% | -2% | 1% | 0% | 0% | **0.0%** |
| 2013 | 51% | 0% | 0% | 2% | 0% | 0% | 0% | 3% | 0% | 0% | 0% | **0.3%** |
| 2014 | 56% | 0% | 0% | 1% | 0% | 0% | 0% | 3% | 0% | 0% | 0% | **0.4%** |
| 2015 | 107% | 0% | -15% | 2% | 0% | 0% | -11% | 3% | 0% | 0% | 0% | **-2.6%** |