Annex IV – Description of methodology for historical years of AEA

CONTENT

EUROSTAT GRANT FOR 2016: QUALITY IMPROVEMENTS OF AIR EMISSION ACCOUNTS AND EXTENSION OF PROVIDED TIME-SERIES

PART A.2
ENLARGEMENT OF PROVIDED DATA BEYOND THE LEGAL REQUIREMENTS

This part of the project granted by the EUROSTAT was focused on the providing consistent and more accurate time-series back to the base year (1990) for Air Emission Accounts in the area of air pollutants (*Chapter A.2-1*) and greenhouse gases (*Chapter A.2-2*). This approach is beyond the legal requirements of the Regulation (EU) No 691/2011 on European environmental economic accounts (AEA regulation).

Enlargement of the provided data was performed in line with the updated and improved methodology for CRF (NFR) to NACE Rev. 2 categories. The separate chapters describe mapping of the activity data in appropriate NACE Rev. 2 categories. Several references and remarks are included.

The Slovak Republic is using inventory-first approach for AEA reporting. Due to national circumstances, both inventories (air pollutants and GHG) are based on consistent background (activity data), used consistent databases and assumptions. These inventories are reported under international requirements and national reduction targets.

Emission inventories are prepared in the Department of Emissions and Biofuels, expert department at the Slovak Hydrometeorological Institute. At the same time, the same department is responsible for AEA reporting. This is basis for the consistent and harmonized reporting of the Slovak Republic in this area.

CHAPTER A.2-1

GENERAL METHODOLOGICAL IMPROVEMENT IN THE AREA OF AIR POLLUTANTS

Air emissions accounts (AEA) cover seven main air pollutants: NOx, SOx, NH_3, NMVOCs, CO, $PM_{2.5}$ and PM_{10}, which are generated by 64 categories of economic activities in NACE Rev. 2 classification and 3 household categories.

National inventory of air pollutants uses Nomenclature for Reporting (NFR) consisting of 127 categories, which are divided into several sectors and subsectors.

The main source of input emissions data is the NEIS database (National Emission Information System) that covers medium and large stationary sources of air pollution. Operators of large and medium air pollution sources are obliged annually report specific data on operation and obtained data are gathered in the NEIS database (more about NEIS in Slovak IIR 2018, III. ANNEX).

Emissions not covered by NEIS (agriculture, transport and waste), but which enter into the emission inventory are balanced within national inventory by international and national methodologies (EMEP/EEA Guidebook 2016) and they are included in national totals of the Slovak Republic.

To implement the Regulation (EU) No 691/2011 on European environmental economic accounts, development of methodology of distribution of NFR categories into NACE Rev. 2 divisions was necessary. This distribution is based on information on main economic activity of companies from the Statistical Register of Organisation. More information is available in the AEA grant project report (Eurostat grant No 50904.2010.004-2010.596).

Planned improvements directly connected with the focus of this new project supported by the EUROSTAT in the area of the AEA reporting on Air pollutants emissions are:

- To improve allocation and mapping of NFR and NACE Rev. 2;
- To develop matrix for the time-series;
- To complete time-series (1990 – 2007) and include the most recent year 2016;
- To strengthen cooperation with the ŠÚ SR;
- To apply this methodology in future submissions under the AEA regulation.

Correspondence matrix for air pollutants, which connects NFR categorization with NACE Rev. 2, was developed on base of recommendations from **Manual for air emissions account, edition 2015, and Chapter 7: *Assigning emissions and energy use to economic activities***. For the development of correspondence matrix for historical data were used different methods, because the Statistical Register of Organisation – specific distribution key for registered stationary sources of air pollution – is not available for historical years.

Inconsistence with methodology of correspondence matrices for GHGs was caused by different approach in compilation of both inventories. GHGs inventory use energy balances of fuels, which are also consistent with PEFA. For inventory of air pollutants, source specific

activity data for fuel consumption in NEIS are used, and allocation of sources and type of activity data are not fully consistent with approach used by PEFA and GHG inventory.

Several statistical data and allocation of sources according to NEIS database were used for categories, where clear identification cannot be performed and country specific allocation was required. Emissions for historical years were distributed according to developed matrix (described later), developed for this purpose.

Methodology for allocation of air pollutants emissions in transport, agriculture and waste sectors was improved in the period 2008 – 2016. For these sectors, special matrix was used to allocate emissions.

Distribution key for missing years was based on existing data from **supply tables** with using gross value added for their **extrapolation**. This parameter was used to identify development trend of the relevant the NACE Rev. 2 category. Data on gross value added is available only for the years 1995 – 2016; therefore, the data for 1990 – 1994 were linear extrapolated. Coefficient of annual trend were calculated and used as trend parameter to **extrapolate unavailable data**. Distribution keys were developed from available time-series. Similar **method was used to extrapolate missing data** (1990 – 2004) for allocation according to NEIS database. Each source in this database has specific NFR classification according to specific activity and NACE Rev. 2 classification according to main economic activity of source.

CHAPTER A.2-1-1
AIR POLLUTANTS EMISSIONS IN ENERGY

ENERGY INDUSTRIES

The category energy industries covers the following subcategories: **Public Electricity and Heat Production**, **Petroleum Refining** and **Manufacture of Solid Fuels and Other Energy Industries**. This subsector is main contributor to SOx and NOx emissions.

Distribution key used to disaggregate emissions from category 1.A.1.a was based on data from supply tables (source: ŠÚ SR) for the years 2008 – 2014. Distribution of product CPA_D across the NACE categories was used. This parameter was used to identify autoproducers of electricity and heat. Major part of emissions are allocated in category D for the entire time-series. Categories 1.A.1.b and 1.A.1.c could be clearly allocated to category C19. Overview of this distribution is shown in the *Table A.2-1.1*.

Historical data for the years 1990 – 2007 and for the years 2015 – 2016 were extrapolated using abovementioned method described in the *Chapter A.2-1*.

Table A.2-1.1: Allocation of NFR the categories and gases in Energy Industries into NACE Rev. 2 for 1990 – 2007

NFR	Description	NACE Rev. 2	Pollutant	Comments
1.A.1.a	Public electricity and heat production-allocated according to supply table into 56 NACE Rev. 2 categories, most substantially to D	A-U – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.A.1.b	Petroleum refining	C19 – 100% b)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.A.1.c	Manufacture of solid fuels and other energy industries	C19 – 100% b)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	

a) Allocation is variable in time-series for the categories due to using supply tables data.

b) Assigned using Manual for Air Emissions Accounts, edition 2015.

In the following tables, the abbreviation of notation keys for emission inventory reporting under the NECD / CLRTAP are used. The explanation of the meaning is presented below:

- Included elsewhere – IE;
- Not applicable – NA;
- Not occurring – NO;
- Not estimated – NE.

TRANSPORT

The correspondence matrix for allocation of the emissions from transport sector is identical as for greenhouse gases (*Chapter A.2-2-1*).

MANUFACTURING INDUSTRIES AND CONSTRUCTION

The category of manufacturing industries and construction is focused on the following combustion subcategories: **Iron and Steel, Non-ferrous Metals**, **Chemicals**, **Pulp, Paper and Print**, **Food Processing, Beverages, and Tobacco**, **Non-metallic Minerals** and **Other**. This subsector is one of the main contributors to NO_X emissions.

Allocation of emissions from category 1A2c and 1A2d was based on data from supply tables. According to split between products CPA_C20/CPA_C21 and CPA_C17/CPA_C18 across the NACE categories in a specific year, emissions were allocated to C20/C21 (1A2c) and C17/C18 (1A2d). Extrapolation for historical years and 2015 – 2016 was performed according to the method described in the *Chapter A.2-1*. Categories 1.A.2.a and 1.A.2.b could be clearly allocated to category C24 and 1.A.2.f with C23. Category 1.A.2.g.viii was distributed by using allocation of sources in the NEIS database (National Emission Information System). Emissions distribution per NACE category was used as a parameter. Data from NEIS database compiled in AEA are available from 2008 – 2016. Historical years were extrapolated by applying method described in the *Chapter A.2-1*. Overview of this distribution is shown in the *Table A.2-1.2*.

Table A.2-1.2: Allocation of the categories and gases in Manufacturing Industries and Construction into NACE Rev. 2 for 1990 – 2007

NFR	Description	NACE Rev. 2	Pollutant	Comments
1.A.2.a	Iron and steel	C24 – 100% [b)]	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.A.2.b	Non-ferrous metals	C24 – 100% [b)]	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.A.2.c	Chemicals – disaggregated to C20, C21 according to split of C20/C21 in supply tables	C20, C21 [a) d)]	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.A.2.d	Pulp, paper, and print - disaggregated to C17, C18 according to split of C17/C18 in supply tables	C17, C18 [a) e)]	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.A.2.e	Food processing, beverages, and tobacco	C10_12 – 100% [b)]	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.A.2.f	Non-metallic minerals	C23 – 100% [b)]	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.A.2.g.vii	*Mobile combustion*			*IE*
1.A.2.g.viii	Other – disaggregated into 27 NACE Rev. 2 categories, 99% in C division	A-S – 100% [c)]	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	

a) Allocation is variable in time-series for the categories due to using supply tables.

b) Assigned using Manual for Air Emissions Accounts, edition 2015.

c) Allocation is variable in time-series according to emissions allocation into NACE categories.

d) Split between C20 and C21 made using supply tables.

e) Split between C17 and C18 made using supply tables.

SMALL COMBUSTION AND OTHER STATIONARY

The subsector Small Combustion and Other Stationary covers following categories: **Commercial/institutional**, **Residential**, **Agriculture/forestry/fishing** and **Other Combustion**. This subsector substantial contributes to emissions of particulate matter.

Allocation of emissions from category 1.A.4.a.i and 1.A.4.c.i was based on employment in the relevant NACE categories. Employment statistics were used on base of assumption, that more employees per category means also more space to heat, and similar automation of these activities. NFR category 1.A.4.c.ii was 50/50 divided into A01 and A02 according to expert judgement. Category 1A5a was allocated using allocation of sources in NEIS database. Emissions distribution per NACE category was used as a parameter. Data from NEIS database compiled in AEA are available from 2008 – 2016. Historical years were extrapolated by applying method described in *Chapter A.2-1*.The overview of the distribution is shown in the *Table A.2-1.3*.

Table A.2-1.3: Allocation of NFR the categories and gases in Small Combustion and Other Stationary into NACE Rev. 2 for 1990 – 2007

NFR	Description	NACE Rev. 2	HH	Pollutant	Comments
1.A.4.a.i	Commercial/institutional: Stationary – distributed according to employment in commercial/institutional categories	G-S – 100% a)		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.A.4.a.ii	*Commercial/institutional: Mobile*				*IE*
1.A.4.b.i	Residential: Stationary		Heat. / Cool. – 100%	NO_X, SO_X, NMVOC, CO, $PM_{2,5}$, PM_{10}	NH_3 (NE)
1.A.4.b.ii	*Residential: Mobile*				*IE*
1.A.4.c.i	Agriculture/forestry/fishing: Stationary - allocated according to employment in agricultural categories	A01 - A03 – 100% a)		NO_X, SO_X, NMVOC, CO, $PM_{2,5}$, PM_{10}	NH_3 (NE)
1.A.4.c.ii	Agriculture/forestry/fishing: Off-road vehicles and other machinery	A01 – 50% A02 – 50%		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.A.4.c.iii	*Agriculture/forestry/fishing: National fishing*				*NO*
1.A.5.a	Other Stationary – disaggregated into 18 NACE Rev. 2 categories	A-G, J, L-N – 100% b)		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.A.5.b	Other Mobile	O – 100%		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	

a) Variable in time-series due to using employment in commercial sector.

b) Allocation is variable in time-series according to emissions allocation into NACE categories.

FUGITIVE EMISSIONS

The subsector Fugitive Emissions covers the following subcategories: **Fugitive Emission from Solid Fuels**, **Fugitive Emissions from Oil**, **Fugitive Emissions from Natural Gas**, **Venting and Flaring** and **Other Fugitive Emissions from Energy Production**.

NFR categories from this sector were allocated mostly in NACE category B (1.B.1.b, 1.B.2.a.i, 1.B.2.b), C19 (1.B.2.a.i) and C24 (1.B.1.b). Category 1.B.2.a.v was allocated using allocation of sources in NEIS database between G46/G47. Emissions distribution per NACE category was used as a parameter. Data from NEIS database compiled in AEA are available from 2008 – 2016. Historical years were extrapolated by applying method described in *Chapter A.2-1*. The overview of the distribution is shown in the *Table A.2-1.4*.

Table A.2-1.4: Allocation of NFR categories and gases in Fugitive Emissions into NACE Rev. 2 for 1990 – 2007

NFR	Description	NACE Rev. 2	Pollutant	Comments
1.B.1.a	Solid fuels: Coal mining and handling	B – 100% a)	NMVOC, $PM_{2,5}$, PM_{10}	NO_X, SO_X, NH_3, CO (NA)
1.B.1.b	Solid fuels: Solid fuel transformation	C24 – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
1.B.1.c	*Solid fuels: Other fugitive emissions from solid fuels*			*NO*
1.B.2.a.i	Oil: Exploration, production, transport	B – 100% a)	NMVOC	SO_X (NE); NO_X, NH_3, CO, $PM_{2,5}$, PM_{10} (NA)
1.B.2.a.iv	*Oil: Fugitive emissions oil: Refining / storage*			*NA*
1.B.2.a.v	Oil: Distribution of oil products	G46, G47 – 100% b)	NMVOC	SO_X (NE); NO_X, NH_3, CO, $PM_{2,5}$, PM_{10} (NA)
1.B.2.b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	B – 100% a)	NMVOC	SO_X (NE); NO_X, NH_3, CO, $PM_{2,5}$, PM_{10} (NA)
1.B.2.c	*Venting and flaring (oil, gas, combined oil and gas)*			*IE*
1.B.2.d	*Other fugitive emissions from energy production*			*NE*

a) Assigned using Manual for Air Emissions Accounts, edition 2015.

b) Allocation is variable in time-series according to emissions allocation into NACE categories.

CHAPTER A.2-1-2

AIR POLLUTANTS EMISSIONS IN INDUSTRIAL PROCESSES AND PRODUCT USE

MINERAL PRODUCTS

The subsector covers activities: **Cement Production**, **Lime Production**, **Glass Production**, **Quarrying and Mining of Minerals Other than Coal**, **Construction and Demolition**, **Storage, Handling and Transport of Mineral Products** and **Other Mineral Products**. Mineral production of the Slovak Republic is low and does not belong to significant world producer of mineral commodities. Mining and quarrying sector is not a significant contributor to the country's economy.

Emissions from mineral industry were mainly clearly allocated to NACE categories C23 (2.A.1, 2.A.2, 2.A.3), B (2.A.5.a) and F (2.A.5.b). Category 2.A.6 was allocated using the allocation of sources in NEIS database. Emissions distribution per NACE category was used as a parameter. Data from NEIS database compiled in AEA are available from 2008 – 2016. Historical years were extrapolated by applying method described in *Chapter A.2-1*. In the *Table A.2-1.5* is presented allocation matrix to NACE Rev. 2.

Table A.2-1.5: Allocation of NFR the categories and gases in Mineral Products into NACE Rev. 2 for 1990 – 2007

NFR	Description	NACE Rev. 2	Pollutants	Comments
2.A.1	Cement production	C23 – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.A.2	Lime production	C23 – 100% a)	NO_X, SO_X, NMVOC, CO, $PM_{2,5}$, PM_{10}	NH_3 (NA)
2.A.3	Glass production	C23 – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.A.5.a	Quarrying and mining of minerals other than coal	B – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.A.5.b	Construction and demolition	F – 100% a)	$PM_{2,5}$, PM_{10}	NO_X, SO_X, NMVOC, NH_3, CO (NA)
2.A.5.c	*Storage, handling and transport of mineral products*			*IE*
2.A.6	Other mineral products – disaggregated into 13 NACE Rev. 2 categories, most substantial to C23	A-C, E-H, L-M – 100% b)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	

a) Assigned using Manual for Air Emissions Accounts, edition 2015.

b) Allocation is variable in time-series according to emissions allocation into NACE categories.

CHEMICAL PRODUCTS

The subsector Chemical Products is focusing on following activities: **Ammonia Production**, **Nitric Acid Production**, **Adipic Acid Production**, **Carbide Production**, **Titanium Dioxide Production**, **Soda Ash Production**, **Chemical Industry: Other** and **Storage, Handling and Transport of Chemical Products**. All categories from chemical production were allocated to NACE Rev. 2 category C20.

Table A.2-1.6: Allocation of NFR categories and gases in Chemical Production into NACE Rev. 2 for 1990 – 2007

NFR	Description	NACE Rev. 2	Pollutants	Comments
2.B.1	*Ammonia production*			*NO*
2.B.1	*Nitric acid production*			*NO*
2.B.3	Adipic acid production	C20 – 100% a)	NOx, NH_3	SO_X, NMVOC, CO, $PM_{2,5}$, PM_{10} (NA)
2.B.5	Carbide production	C20 – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.B.6	*Titanium dioxide production*			*NO*
2.B.7	*Soda ash production*			*NO*
2.B.10.a	Chemical industry: Other	C20 – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.B.10.b	Storage, handling and transport of chemical products	C20 – 100% a)	NO_X, SO_X, NMVOC, CO, $PM_{2,5}$, PM_{10}	NH_3 (NO)

METAL PRODUCTS

In the subsector Metal Products are included: **Iron and Steel Production**, **Ferroalloys Production**, **Aluminium Production**, **Magnesium Production**, **Lead Production**, **Zinc Production**, **Copper Production**, **Nickel Production**, **Other Metal Production** and **Storage, Handling and Transport of Metal Products**. All categories from metal production were assigned to NACE Rev. 2 category C24.

Table A.2-1.7: Allocation of NFR the categories and gases in Metal Production into NACE Rev. 2 for 1990 – 2007

NFR	Description	NACE Rev. 2	Pollutants	Comments
2.C.1	Iron and steel production	C24 – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.C.2	Ferroalloys production	C24 – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.C.3	*Aluminium production*			*IE*
2.C.4	Magnesium production	C24 – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.C.5	Lead production	C24 – 100% a)	NO_X, SO_X, NMVOC, CO, $PM_{2,5}$, PM_{10}	NH_3 (NE)
2.C.6	*Zinc production*			*NO*
2.C.7.a	*Copper production*			*IE*
2.C.7.b	*Nickel production*			*NO*
2.C.7.c	Other metal production	C24 – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.C.7.d	*Storage, handling and transport of metal products*			*IE*

a) Assigned using Manual for Air Emissions Accounts, edition 2015.

SOLVENTS AND PRODUCT USE

Subsector Solvents and Product Use includes categories: **Domestic Solvent Use Including Fungicides**, **Road Paving with Asphalt**, **Asphalt Roofing**, **Coating Applications**, **Degreasing**, **Dry Cleaning**, **Chemical Products**, **Printing**, **Other Solvent Use** and **Other Product Use**

Categories 2.D.3.b, 2.D.3.d - 2.D.3.i were disaggregated using NMVOC emissions distribution to NACE according to NEIS database. Emissions of NMVOC per NACE category was used as distribution parameter. Category 2.D.3.a was clearly allocated to Households-Other. Category 2.D.3.c was allocated to C23 (only sources with this NACE Rev. 2 category operated in 2005 – 2016). Missing historical data were extrapolated by applying the method described in the *Chapter A.2-1*.

Table A.2-1.8: Allocation of the NFR categories and gases in Solvents sector into NACE for 1990 – 2007

NFR	Description	NACE Rev. 2	HH	Pollutant	Comments
2.D.3.a	Domestic solvent use including fungicides		Other – 100%	NMVOC	NO_X, SO_X, NH_3, CO, PM_{10} (NA); $PM_{2,5}$ (NE)
2.D.3.b	Road paving with asphalt	F – 100% a)		NMVOC, $PM_{2,5}$, PM_{10}	NO_X, SO_X, CO (NE); NH_3 (NA)
2.D.3.c	Asphalt roofing	C23 – 100%		NMVOC, $PM_{2,5}$, PM_{10}	NO_X, CO (NE); SO_X, NH_3 (NA)
2.D.3.d	Coating applications - disaggregated into 25 NACE Rev. 2 categories, most substantially C28	A, C, F-H, M-P – 100% a)		NMVOC	NO_X, SO_X, NH_3, CO, $PM_{2,5}$, PM_{10} (NA)
2.D.3.e	Degreasing - disaggregated into 11 NACE Rev. 2 categories, 99% in C25-33	C, D, G, H – 100% a)		NMVOC	NO_X, SO_X, NH_3, CO, PM_{10} (NA); $PM_{2,5}$ (NE)
2.D.3.f	Dry cleaning- disaggregated into 20 NACE Rev. 2 categories, most substantial to S96	A, C-L, N, O, Q, S – 100% a)		NMVOC	NO_X, SO_X, NH_3, CO, PM_{10} (NA); $PM_{2,5}$ (NE)
2.D.3.g	Chemical products - disaggregated into 20 NACE Rev. 2 categories	A, C, E, G, L – N – 100% a)		NMVOC	NO_X, SO_X, NH_3, CO $PM_{2,5}$, PM_{10}, (NE)
2.D.3.h	Printing - disaggregated into 12 NACE Rev. 2 categories, 99% in C division	C, G, J, M, N – 100% a)		NMVOC	NO_X, SO_X, NH_3, CO, PM_{10} (NA); $PM_{2,5}$ (NE)
2.D.3.i	Other solvent use - disaggregated into 11 NACE Rev. 2 categories, 99% in C division	C, G, H, L – 100% a)		NMVOC	NO_X, SO_X, NH_3, CO, PM_{10}, $PM_{2,5}$ (NE)
2.G	*Other product use*				*NE*

a) Allocation is variable in time-series according to emissions allocation into NACE categories.

OTHER PROCESSES AND PRODUCT USE

This category contains following categories: **Pulp and Paper Industry**, **Food and Beverages Industry**, **Other Industrial Processes**, **Wood Processing**, **Production of POPs**, **Consumption of POPs and Heavy Metals**, **Other Production, Consumption, Storage, Transportation or Handling of Bulk Products**.

Several NFR categories in this subsector were clearly allocated to NACE Rev. 2 divisions (2.H.1, 2.H.2, 2.I). Category 2.H.3 was allocated using sources allocation in NEIS database. Emissions distribution per NACE category was used as a parameter. Data from NEIS database compiled in AEA are available from 2008 – 2016. Historical years were extrapolated by applying of method described in the *Chapter A.2-1*. Category 2.K was allocated to Households due to methodology used in national inventory (only private consumption included).

Table A.2-1.9: Allocation of NFR categories and gases in Other Processes and Product Use into NACE for 1990 – 2007

NFR	Description	NACE Rev. 2	Pollutant	Comments
2.H.1	Pulp and paper industry	C17 – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.H.2	Food and beverages industry	C10-12 – 100% a)	NMVOC	NO_X, SO_X, NH_3, CO (NA); $PM_{2,5}$, PM_{10} (NE)
2.H.3	Other industrial processes - disaggregated into 16 NACE Rev. 2 categories	A, C, G, H, M – 100% b)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.I	Wood processing	C16 – 100% a)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
2.J	*Production of POPs*			*NO*
2.K	*Consumption of POPs and heavy metals*			*NA*
2.L	*Other production, consumption, storage, transportation or handling of bulk products*			*NO*

a) Assigned using Manual for Air Emissions Accounts, edition 2015.

b) Allocation is variable in time-series according to emissions allocation into NACE categories.

CHAPTER A.2-1-3
AIR POLLUTANTS EMISSIONS IN AGRICULTURE

The NH_3 emitted from agriculture is considered as the most important gases. The 2016 EMEP/EEA Guidebook was taken into consideration during NH_3, NMVOC, NO_x, $PM_{2.5}$ and PM_{10} calculations.

Agriculture produces about 95% of total NH_3, and 10% of NMVOC emissions in the Slovak Republic. Agriculture is dominant producer of NH_3 emissions in the Slovak Republic. Especially, intensive animal production is the most loading activity. Major emission sources are manure and slurry spreading into soils and manure storage.

Allocation of NFR agriculture categories to the NACE industries and households was suggested taking into consideration of national circumstances and based on the value added on the economic activities. In general, allocation of the emission categories of agriculture sector to NACE was done using specific characterization of activity in each category. The Agriculture emissions are dived into the two subcategories: emissions from manure management (NFR CRF 3.B) and emission from agricultural soils. The major emission NFRs were allocated into NACE A01 Crop and animal production, hunting and related service activities. The Food production has main activity in the agriculture sector. The agricultural sector produces raw products (milk, meat), which enters in the manufacturing food industry. The emissions from this activity were included in C10-12 NACE category Manufacture of food products, beverages and tobacco products. Breeding animals produce organic waste in form of slurry and manure. Slurry and manure need to be safely managed and disposed. The emissions from mentioned activity were allocated in E37_39 NACE category.

Table A.2-1.11: Allocation of NFR the categories and air pollutants in agriculture sector into NACE for 1990 – 2016[a)]

CRF	Description	NH_3 emissions	NO_x emissions	NMVOC emissions
3.B	Manure Management - Emissions from manure are allocated in 2 NACE Rev. 2 categories.	A01 – 90% E37_39 – 10%	A01 – 90% E37_39 – 10%	A01 – 90% E37_39 – 10%
3.D	Emissions from agricultural soils - emissions from agricultural using of soil, crop production and fertilizers.	A01 – 70% C10_12 – 20% E37_39 – 10%	A01 – 70% C10_12 – 20% E37_39 – 10%	A01 – 70% C10_12 – 20% E37_39 – 10%

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation in agriculture sector.

Table A.2-1.12: Allocation of NFR the categories and air pollutants in agriculture sector into NACE for 1990 – 2016[a)]

CRF	Description	PM_{10} emissions	$PM_{2.5}$ emissions	TSP
3.B	Manure Management - Emissions from manure are allocated in 2 NACE Rev. 2 categories.	A01 – 100%	A01 – 100%	A01 – 100%
3.D	Emissions from agricultural soils - emissions from agricultural using of soil, crop production and fertilizers.	A01 – 70% C10_12 – 30%	A01 – 70% C10_12 – 30%	A01 – 70% C10_12 – 30%

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation in agriculture sector.

CHAPTER A.2-1-4
AIR POLLUTANT EMISSIONS IN WASTE SECTOR

This sector is focusing on categories: **Biological Treatment of Waste**, **Waste Incineration**, **Wastewater Handling** and **Other Waste**.

Distribution key used to allocate emissions from category 5.A.a is based on data from supply tables (source: ŠÚ SR) for the years 2008 – 2014. Distribution of product CPA E37_39 across the NACE categories was used to allocate emissions to NACE categories, as solid waste disposal on land is the most used waste treatment method.

Categories 5.B.1, 5.B.2 and 5.C.1.a were clearly allocated to category E37_39. Category 5.C.1.b.i was allocated using sources allocation in NEIS database. Emissions distribution per NACE category was used as a parameter. Data from NEIS database compiled in AEA are available from 2008 – 2016. Historical years were extrapolated by applying of method described in the *Chapter A.2-1*. Categories 5.C.1.b.iii was allocated to NACE Q86 (only hospitals operate this type of incineration plant in the Slovak Republic) and 5.D.1 to NACE E36. Category 5.D.2 was allocated using sources allocation in NEIS database. Emissions distribution per NACE category was used as a parameter. Data from NEIS database compiled in AEA are available from 2008 – 2016. Category 5.D.3 was assigned to Households-Other due to activity data used in national inventory (only domestic use of latrines was included in national inventory). Category 5.E was allocated based on fire statistics (source: A Fire-Expertise Department of the Ministry of Interior: Fire Statistics). Aggregated data for divisions: agriculture, forestry, industry, construction, transport (only land transport), other sectors and households were only available. Disaggregation was provided according to equation*: percentage of fires per sector/number of sectoral subcategories*.

Table A.2-1.13: Allocation of the NFR categories and gases in Waste sector into NACE for 1990 – 2016

NFR	Description	NACE Rev. 2	HH	Pollutant	Comments
5.A	Solid waste disposal on land - allocated according to supply table into 56 NACE Rev. 2 categories	A-U – 100%) a)		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
5.B.1	Composting	E37_39 – 100%)		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
5.B.2	Anaerobic digestion at biogas facilities	E37_39 – 100%)		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
5.C.1.a	Municipal waste incineration	E37_39 – 100%)		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
5.C.1.b.i	Industrial waste incineration - disaggregated into 4 NACE Rev. 2 categories: C19-20, D, E37_39	C, D, E – 100% b)		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
5.C.1.b.ii	*Hazardous waste incineration*				*IE*
5.C.1.b.iii	Clinical waste incineration	Q86 – 100%		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
5.C.1.b.iv	*Sewage sludge incineration*				*IE*
5.C.1.b.v	Cremation	S96 – 100%		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
5.C.1.b.vi	*Other waste incineration*				*NO*
5.C.2	*Open burning of waste*				*NO*

NFR	Description	NACE Rev. 2	HH	Pollutant	Comments
5.D.1	Domestic wastewater handling	E36 – 100%		NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
5.D.2	Industrial wastewater handling - disaggregated into 7 NACE Rev. 2 categories	C, G – 100% c)		$PM_{2,5}$, PM_{10}	NO_X, SO_X, NMVOC, CO (NE) NH_3,(NA)
5.D.3	Other wastewater handling		Other – 100%	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	
5.E	Other waste - disaggregated into 56 NACE Rev. 2 categories	A-C,F-U c)	Other c)	NO_X, SO_X, NMVOC, NH_3, CO, $PM_{2,5}$, PM_{10}	

a) Allocation is variable in time-series for the categories due to using supply tables.

b) Allocation is variable in time-series according to emissions allocation into NACE categories.

c) Allocation variable in time-series for the categories due to using fire statistics.

CHAPTER A.2-2

GENERAL METHODOLOGICAL IMPROVEMENT IN THE AREA OF GREENHOUSE GASES

Air emissions accounts (AEA) present emissions of 14 different gases including seven greenhouse gases (GHG) - (CO_2, bio-CO_2, CH_4, N_2O, PFCs, HFCs, SF_6 and NF_3[11]) originating from 64 industries NACE Rev. 2 categories and from households.

Reporting of GHG emissions is fulfilling IPCC methodology[12] and emissions are allocated into several CRF categories in line with the IPCC 2006 Guidelines. This approach is maintained since the base year 1990.

Main challenge for the expert team of the SHMÚ[13] engaged in the implementation of the Regulation (EU) No 691/2011 on European environmental economic accounts (AEA regulation) was to developed methodology for distributing emissions allocated in the CRF categories to NACE Rev. 2 categories.

This task was subject of the previous grant project supported by the EUROSTAT[14] in the years 2011 – 2013. Methodology developed in terms of reference was applied since the first year of reporting under the AEA regulation (2013). This methodology is using the inventory first approach in a compilation of the air emissions accounts for GHG emissions. For more information on previously used methodology, please see Final Report of the EUROSTAT Grant project published on July 2013. Since that time, methodology and description were several times updated and reported in annual submissions to the EUROSTAT taking into consideration recommendations of the EUROSTAT from previous reports. This methodological approach is described also in the regular quality reports included in the AEA submission annually.

In the 2017 AEA submission (September 21, 2017), the Slovak Republic transmitted data to the Eurostat covering the years 2008 – 2015 based on the advanced methodological approach (described in the accompanied Quality Report). Besides implemented improvements, several issues remained unsolved. During years, inconsistencies were discovered in the mapping of the CRF categories and NACE Rev. 2 categories. Different allocation of sources and emissions caused inconsistencies and trend fluctuations.

Planned improvements directly connected with the focus of this new project grant supported by the EUROSTAT in the area of the AEA reporting on GHG emissions are:

- To improve allocation and mapping CRF and NACE Rev. 2;
- To develop matrix for the time-series;
- To complete time-series (1990 – 2007) and include the most recent year 2016;
- To harmonise allocation of emissions with the PEFA accounts;

[11] NF_3 emissions are not occurring in the Slovak Republic
[12] https://www.ipcc-nggip.iges.or.jp/public/2006gl/
[13] Slovak Hydrometeorological Institute is included into the List of National Statistical Institutes (NSI) and other national authorities responsible for the development, production and dissemination of European statistics (7. June 2010)
[14] Grant agreement No 50904.2010.004-2010.596

- To strengthen cooperation with the ŠÚ SR;
- To apply this methodology in future submissions under the AEA regulation.

The preparation process of the GHG emissions inventory is divided into several sectors related to the different sources of primary data. For better results and more accurate emission inventory, sophisticated methodology for sources allocation into CRF categories was developed inside the Slovak National Inventory System for GHG emissions (NIS SR for GHG)[15] in previous years. To provide the most appropriate emissions distribution for particular sector and for historical years, this methodology is updated regularly. Methodological approaches and other relevant information on allocation into CRF categories in different sectors are available in the National Inventory Reports (most recent is the May 15, 2018 submission).[2,16]

[15] http://ghg-inventory.shmu.sk
[16] https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/national-inventory-submissions-2018

CHAPTER A.2-2-1

GHG EMISSIONS IN ENERGY

In the year 2016, the ŠÚ SR compiled and submitted to Eurostat the PEFA questionnaire, which consisted of:

- Table A - Physical supply table for energy flows;
- Table B - Physical use table for energy flows.

The NIS SR for GHG is cooperating with the ŠÚ SR in the PEFA questionnaire compilation, specifically in energy feedstock and carbon stored estimation.[17]

Annual energy balance based on ENERG questionnaires in the Slovak Republic is the most important data sources for compilation of PEFA questionnaire. This approach is described in the Technical Manual for PEFA accounts preparation.

During the project, methodological approach for PEFA accounts compiled by the ŠÚ SR was analysed for the years 2014 and 2015. In addition, preliminary data for PEFA 2016 was used, too. Therefore, the timeline 2014 – 2016 for PEFA accounts was analysed and compared with the national GHG inventory. **It can be confirmed, that the approach is consistent with the approach used for preparation of the emission balance of GHGs for combustion of fuels in energy and industry sectors.** Methodology used for GHG emissions inventory is described in detail in the National Inventory Report of the Slovak Republic 2018, Chapter 3.2.[3]

In general, both methodologies are based on fuel balance published in the annual energy balance based on ENERG prepared by the ŠÚ SR. Fuels are allocated in the CRF categories 1.A.1, 1.A.2, 1.A.4 and 1.A.5 (energy sector) on plant specific level (tier 3 method). The SHMÚ[18] obtains data on fuels disaggregated on plant level (with information on main NACE activity) from the ŠÚ SR based on bilateral agreement, annually. This data are processed in line with the methodology approved among the NIS SR for GHG. Data on fuels is verified and compared with the data obtained from the EU Emission Trading System (EU ETS) and from the National Emissions Information System (NEIS).[19] Based on the data from the EU ETS, also industrial sources with technological fuels consumption are completed into GHG emissions inventory (2.A-2.D categories). Complex operators with several fuel streams such as petroleum refinery or steel producer are modelled separately in line with the IPCC methodology.

As it was already mentioned above; the SHMÚ is cooperating with the ŠÚ SR in the preparation of the PEFA accounts in part of feedstock, households and carbon stored. Except of transport emissions, complete fuel balance in country is prepared in one model, this approach used in GHG emission inventory preparation was also introduced in AEA methodology. Therefore, it is ensured, that the AEA and PEFA data sources are consistent and harmonised on a high level of disaggregation.

[17] Carbon stored = Final Non-Energy Consumption
[18] NIS SR for GHG is situated in the SHMÚ, Department of Emissions and Biofuels http://www.shmu.sk/en/?page=992
[19] for more information on NEIS, please see chapter for air pollutants inventory of this report

However, several inconsistencies occurred during analysis PEFA accounts in terms of this project:

- General inconsistencies in calorific values used in national inventory and in national statistics;
- Inconsistencies in C24 (C19) on a level of approximately 60 000 TJ of fuels caused by including of coke and coking coal, which shall be excluded from PEFA. It is also written in methodological report to PEFA: *"**PEFA Table C:** Emission-relevant use of energy flows presented in table C was calculated by **excluding** the following use of energy flows: use of energy flows as intake for production of another energy products (e.g. coking coal used for production of coke)";*
- Inconsistencies in C23 on a level of approximately 3 000 TJ of fuels caused by the quantification of waste in national statistics. (inventory used data on waste incineration in industry directly from operators in EU ETS);
- Inconsistencies in D with the higher national gas and biomass consumption in PEFA, the reason is unknown at the moment;
- Inconsistencies in military aviation, this consumption of fuels is not included in PEFA accounts, only negligible fuel consumption from this category is included in transport sector.

Following *Table A.2-2.1 – Table A.2-2.4* show percentage[20] of disaggregation CRF categories in energy and industry into appropriate NACE Rev. 2 categories for separate gases and considering PEFA and national GHG inventory methodologies.

Table A.2-2.1: Percentage (%) of allocation of energy (fuels) and GHG emissions from the CRF category 1.A.1

NACE Rev. 2	ENERGY (fuels)	CO_2 emissions	CH_4 emissions	N_2O emissions
B05-B09	0.60	0.47	0.14	0.08
C19	**20.48**	**18.60**	8.07	3.10
C24	6.84	**17.59**	1.56	0.67
D35	**72.08**	**63.34**	**90.23**	**96.15**

Table A.2-2.2: Percentage (%) of allocation of energy (fuels) and GHG emissions from the CRF category 1.A.2

NACE Rev. 2	ENERGY (fuels)	CO_2 emissions	CH_4 emissions	N_2O emissions
B05-B09	0.16	0.13	0.05	0.03
C10-C12	4.13	3.41	0.83	0.47
C13-C15	0.76	0.63	0.15	0.09
C16	2.19	0.81	**10.96**	**7.98**
C17	**21.78**	1.70	**28.61**	**46.07**
C18	0.19	0.16	0.06	0.03
C19	0.00	0.00	0.00	0.00
C20	4.42	3.67	0.92	0.55
C21	0.64	0.52	0.11	0.06
C22	1.81	1.48	0.33	0.18
C23	**14.67**	**17.58**	**16.32**	**12.85**

[20] Three-years average (2014 – 2016)

NACE Rev. 2	ENERGY (fuels)	CO_2 emissions	CH_4 emissions	N_2O emissions
C24	**33.08**	**53.99**	**22.59**	**17.25**
C25	1.49	1.30	0.72	0.47
C26	0.20	0.16	0.04	0.02
C27	0.63	0.52	0.12	0.07
C28	1.55	1.39	1.03	0.70
C29	2.60	2.14	0.49	0.27
C30	0.27	0.26	0.14	0.11
C31-C32	0.63	0.82	2.04	1.48
C33	0.30	0.25	0.06	0.04
D35	**7.79**	**8.44**	**14.14**	**11.10**
E36	0.00	0.00	0.00	0.00
E37-E39	0.00	0.00	0.00	0.00
F41-F43	0.72	0.63	0.30	0.19

Table A.2-2.3: Percentage (%) of allocation of energy (fuels) and GHG emissions from the CRF category 1.A.4

NACE Rev. 2	ENERGY (fuels)	CO_2 emissions	CH_4 emissions	N_2O emissions
A01	1.82	1.82	1.82	1.82
A02	0.12	0.12	0.12	0.12
A03	0.00	0.00	0.00	0.00
D35	1.55	1.55	1.55	1.55
H49	1.09	1.09	1.09	1.09
H52	2.52	2.52	2.52	2.52
I	2.14	2.14	2.14	2.14
L	3.46	3.46	3.46	3.46
M	6.66	6.66	6.66	6.66
N	2.31	2.31	2.31	2.31
O	4.99	4.99	4.99	4.99
P	1.54	1.54	1.54	1.54
Q	2.48	2.48	2.48	2.48
R	1.89	1.89	1.89	1.89
S	2.10	2.10	2.10	2.10
Households	**59.47**	**59.47**	**59.47**	**59.47**
Off-road	5.85	5.85	5.85	5.85

Table A.2-2.4: Percentage (%) of allocation of energy (fuels) and GHG emissions from the CRF category 1.A.5

NACE Rev. 2	ENERGY (fuels)	CO_2 emissions	CH_4 emissions	N_2O emissions
E36	30.46	25.29	11.38	13.45
E37-E39	**56.16**	**50.34**	**83.33**	**76.99**
Mobile-Military	13.38	24.36	5.29	9.56

Methodological approach and disaggregation of energy and emissions from categories 1.A1, 1.A.2, 1.A.4 and 1.A.5 described above was used for the time-series 2008 – 2016. During this period, minimal changes in allocation of fuels was observed. Consistent time-series for 2008 – 2016 is available from the EU ETS data (II. and III. phases) and energy statistics.

The share of GHGs in NACE Rev. 2 categories is not constant. This is influenced by the emission factors and by the used combustion technology.

One of the project objectives was to complete reporting years back to the base year (1990). After the base year 1990, several extensive economical, energetic and socioeconomic changes occurred in the Slovak Republic. These changes and their impact on fuel diversification, fuel mix change and emissions (both the GHG and air pollutants) were already described in several official reports of the Slovak Republic.[21]

Therefore, the time variable parameters for CRF-NACE categorisation share were introduced in time-series 1990 – 2007 for CO_2 emissions. Due to the national circumstances, CO_2 emissions represent more than 90% share in total emissions and therefore dynamic share applied only on CO_2 emissions. The most energy intensive sectors or categories 1.A1 and 1.A.2 dominated in the 90-ties. Therefore, the share of GHG emissions allocation in time-series 1990 – 2007 shows decreasing trend in the following NACE Rev. 2 categories with high energy intensive industry:

- C16 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials;
- C17 Manufacture of paper and paper products;
- C19 Manufacture of coke and refined petroleum products;
- C20 Manufacture of chemicals and chemical products;
- C21 Manufacture of basic pharmaceutical products and preparations;
- C23 Manufacture of other non-metallic mineral products
- C24 Manufacture of basic metals;
- C25 Manufacture of fabricated metal products, except machinery and equipment.

On the other hand, the share of GHG emissions allocation in time-series 1990 – 2007 shows increasing trend in the following NACE Rev. 2 categories:

- C18 Printing and reproduction of recorded media;
- C29 Manufacture of motor vehicles, trailers and semi-trailers;
- C30 Manufacture of other transport equipment;
- D Electricity, gas, steam and air conditioning supply;
- F Construction.

These are more developed and started to grow after the economic crises occurred in 2009. More information is available in the *Tables A.2-2.5* and *Table A.2-2.6*.

Table A.2-2.5: Share (%) of GHG emissions allocation in category 1.A.1 in time-series 1990 – 2016

NACE Rev. 2	1990-1995	1996-2000	2001-2006	2007-2016
CO_2 emissions				
C19	21.6	20.6	19.6	18.60
C24	20.6	19.6	18.6	17.59
D35	**57.33**	**59.33**	**61.33**	**63.34**

Figures in Table represent share of emissions allocation share provided in the *Table A.2-2.1*.

[21] see for example Chapter National Circumstances from the Seventh National Communication of the Slovak Republic to the UNFCCC https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/national-communications-and-biennial-reports-annex-i-parties/seventh-national-communications-annex-i

Table A.2-2.6: Share (%) of GHG emissions allocation in category 1.A.2 in time-series 1990 – 2016

NACE Rev. 2	1990-1995	1996-2000	2001-2006	2007-2016
		CO_2 emissions		
C16	1.10	1.00	0.90	0.81
C17	2.00	1.90	1.80	1.70
C19	0.30	0.20	0.10	0.00
C20	3.85	3.80	3.75	3.67
C21	0.80	0.70	0.60	0.52
C23	20.58	19.58	18.58	17.58
C24	56.99	55.99	54.99	53.99
C25	1.60	1.50	1.40	1.30
C18	0.00	0.00	0.00	0.16
C29	0.00	0.00	0.00	2.14
D35	3.72	6.27	8.82	8.44
F41-43	0.00	0.00	0.00	0.63

Figures in Table represent share of emissions allocation share provided in the *Table A.2-2.2.*

Allocation is constant in time-series for the categories 1.A.4, 1.A.5 and 1.B due to using consistent methodological approach for GHG emissions estimation in industry sector.

Detailed information is described in separate chapters of this report.

Transport sector was prepared with the different methodology individually, due to different approach of the GHG and air pollutants emissions balance in this sector.

EMISSIONS FROM FUEL COMBUSTION AND FUGITIVE EMISSIONS (CRF 1.A.1, 1.A.2, 1.A.4, 1.A.5 AND 1.B)

Energy sector covers emissions from fossil fuels combustion (CRF 1.AA) and fugitive emissions from mines, oil and natural gas (CRF 1.B). The inventory of emissions from fuel combustion includes direct GHG emissions (CO_2, CH_4, N_2O) and indirect GHG emissions (NOx, CO, NMVOCs), as well SO_2 emissions. Point sources, transport and other fuel combustion are included, too. The inventory of fugitive emissions from mines, oil and natural gas includes CO_2, CH_4, N_2O and NMVOCs emissions from brown coal mining, oil and natural gas refining and storage, the emissions from venting and flaring at oil refineries, the emissions from natural gas transmission and distribution. The emissions from international bunkers (CO_2, CH_4, N_2O, SO_2 and indirect gases) and CO_2 emissions from biomass are included in memo items and not calculated into national total.

Fossil fuels combustion for energy and heat production (including transport) is the most important source of GHG emissions in the Slovak Republic. The GHG emissions in this sector represent more than 63% share of total GHGs emissions in CO_2 equivalents. It is especially category of public energy production for power and heat supply, industrial energy production for electricity and heat supply for technological processes, road transportation and district heating – heat supply for residential sector (block of flats and dwellings), public and services buildings and other objects of non-productive sector.

Fugitive emissions from the categories 1.B.1 Solid Fuel and 1.B.2 Oil and Natural Gas, as key categories, are important sources of methane emissions in the national GHGs inventory.

Fugitive methane emissions from charcoal production and NMVOC emissions from coke production are included in the category 1.B.1.b Solid Fuel Transformation. Charcoal emissions were estimated since the base year and reported firstly in 2015 submission.

Allocation of CRF energy categories into the NACE industries and households' categories was based on methodology used for national energy balance of fuels (ENERG, PEFA accounts, EU ETS reports, NEIS). In general, allocation of the emission categories of industry sector into NACE Rev. 2 was done using specific characterization of activity in each category.

Tables A.2-2.1-A.2-2.4 present allocation of GHG emissions included in the CRF categories 1.A.1, 1.A.2, 1.A.4 and 1.A.5. *Table A.2-2.7* presents allocation of GHG emissions included in the CRF categories 1.B.1 and 1.B.2.

Table A.2-2.7: Percentage (%) of allocation of GHG emissions from the CRF category 1.B.1&1.B.2

NACE Rev. 2	CO_2 emissions	CH_4 emissions	N_2O emissions
1.B.1			
B	75	75	NO
C19	25	25	NO
1.B.2			
B	20	20	20
C19	10	10	10
D	50	50	50
H49	20	20	20

The allocation is constant in time-series for the categories 1.B.1 and 1.B.2 due to using consistent methodological approach for GHG emissions estimation in the entire time-series and minor changes in development of these categories since the base year.

EMISSIONS FROM TRANSPORTATION (CRF and NFR 1.A.3.)

The basis for calculation of greenhouse gases and air pollutants emissions in the transport sector and particularly in road transportation is fuel consumption. Fuel consumption in transportation is based on official statistical data (ŠÚ SR). Road transportation emissions are calculated in COPERT model. These emissions are broken down to the specific vehicle type (e.g. passenger car – petrol – small /800 – 1200 cm3/ - EURO 4) through average annual mileage driven. The split by fuel types is treated directly in the inventory – for more information see annexed SVK NIR methodology (chapter 3, 3.2.8)[22] and IIR Slovakia chapter 3.4.[23]

As it was mentioned in the previous paragraph emission estimation is based on sector specific fuel consumption (according to statistical data from ŠÚ SR and data obtained from companies), thus the emissions cannot be fully linked with PEFA and allocated in line with PEFA. Energy (fuel consumption) allocation in PEFA is based on the main NACE category of the company, not on the category, where is the fuel used (e.g. hard coal for heating in NACE category H51). Statistical energy flow is not part of the emission inventories and emission statistics as it would affect categorisation of the sources of emissions.

[22] NIR Slovakia: http://ghg-inventory.shmu.sk/main.php?lang=2
[23] IIR Slovakia: http://cdr.eionet.europa.eu/sk

Emissions from road transportation (CRF and NFR 1.A.3.b)

Road transportation is the most important and key category within transport with the highest share of emissions and continually increasing trend in fuel consumption. Allocation of CRF and NFR subcategories into the NACE industrial categories and households´ categories is based on the annual gross value added and income (GVA) (1) and performance in public and non-public road transportation (tkm) parameters (2).

$$R_{NACE} = \frac{N_y}{NACE} \quad (1)$$

$$P_y = \frac{p_y}{P} \quad (2)$$

Where:
R_{NACE} – GVA ratio of specific NACE category; N_y – GVA of the specific NACE category; NACE – total GVA of the Slovak Republic in a particular year; P_y – ratio of performance in a specific NACE category; p_y – performance in a specific NACE category; P – total performance in non-public road transport.

Table A.2-2.8: Allocation of subcategories within 1.A.3.b to NACE Rev. 2 categories and households

Year	NACE category	Household	Gases	Description (if needed)
1.1 PASSENGER CARS				
1990-2008	A – U (36%)	64%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	Data are mostly estimates based on data from 2009 onwards
2009	A – U (36%)	64%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	Different disaggregation in the NACE A – U as in the previous years
2010	A – U (34%)	66%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	Ratio towards household is probably affected by global financial crisis from 2008 and end of business for some companies
2011	A – U (33%)	67%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	-
2012	A – U (32%)	68%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	-
2013	A – U (32%)	68%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	-
2014	A – U (30%)	70%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	-
2015	A – U (26%)	74%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	-
2016	A – U (27%)	73%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	-

1.2 LIGHT COMMERCIAL VEHICLES (LCV)				
1990-2016	A – U (85%)	15%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	-
1.3 HEAVY-DUTY VEHICLES AND BUSSES				
1990-2016	A – U (100%)	0%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	Emissions are allocated between H49 and other categories based on the fact, if it is public transport or non-public transport
1.4 MOTORCYCLES AN MOPEDS				
1990-2016	A – U (0%)	100%	GHGs, NO_X, SO_X,NMVOC, $PM_{2.5}$, PM_{10}, NH_3, CO	-
1.5 GASOLINE EVAPORATION				
1990 – 2016	A – U (31%-41%)	59%-69%	NMVOC	See chapter “Gasoline evaporation”
1.6 TYRE AND BREAK WEAR				
1990 – 2016	A – U (41%-54%)	46%-59%	$PM_{2.5}$, PM_{10}	See chapter “Tyre, break wear and road abrasion”
1.7 ROAD ABRASION				
1990 – 2016	A – U (41%-54%)	46%-59%	$PM_{2.5}$, PM_{10}	See chapter “Tyre, break wear and road abrasion”

Passenger cars (PC)

The emissions originated from passenger cars belonging to the NACE industries represent around 30% (depending on the year) of all emissions from passenger cars. Share of NACE industrial categories and household varied inter-annually (*Table A.2-2.8*).

Emissions from the passenger cars, as the most common transport vehicle, were divided in all NACE industrial subcategories that produced any gross value added (1). Portion of the emissions should rise with the portion of gross value created by each NACE category.

$$R_{ind} = \frac{(SE_y + C_y) * 2}{APC_y} \quad (3)$$

$$R_{HH} = 1 - R_{ind} \quad (4)$$

Where:
R_{ind} – proportion of NACE usage of passenger cars; SE_y – number of self-employed for year y; C_y – number of companies in year y; APC_y – number of all passenger cars in year y; R_{HH} – proportion of household usage of passenger cars.

The ratio (3, 4) between industry and household NACE categories is based on sum of self-employed and companies in each NACE category. This sum was multiplied by 2 as an expert judgment of average number of PC per company/self-employed. This approach will need further specification on the number of PC used in industry. This data should be available in the Financial Administration of the Slovak Republic.

Light commercial vehicles (LCV)

Light commercial vehicles are mainly used in industry for transportation and delivery of small quantity of goods. Older LCVs can be also used for personal transport and use, so part of the emissions should be identified as household emissions.

Emissions from light commercial vehicles were divided between household and industry on the base of expert judgment. The ratio is 15:85 (HH:IND). Expert judgement was used due to lack of information on the usage of light commercial vehicles. Allocation of CRF and NFR subcategories into the NACE categories is based on the annual GVA and performances in the corresponding NACE category (*Table A.2-2.8)*.

$$E_{LCV} = R_{NACE} * P_y * 0.85 * LCV \qquad (5)$$

Where:
E_{LCV} – proportion of emissions of light commercial vehicles in the specific NACE category;
0.85 – ratio of industry;
LCV – total emissions in light commercial vehicles category according to NIR/IIR.

Heavy-duty vehicles and buses

Heavy-duty vehicles are used exclusively in NACE industrial categories (no households) (*Table A.2-2.8*). Therefore, 100% of emissions were divided into NACE industrial categories and subcategories. According to official statistics, there are two types of freight transport: public transport and non-public transport. Public transport includes enterprises with transport as prevailing activity carrying out the inland or international transport of goods. Non-public transport includes all in-company transport of goods. Performance of these types of transportation is used in the methodology. Emissions in the category H49 Land transport and via pipelines all originate in public transport or transport via pipelines (natural gas) and non-public emissions are allocated among all NACE categories including NACE H. The allocation of freight transport has two levels. The first level is dividing the emissions between public and non-public transport according to inter-annual ratio of performance of these two categories. The second level is the same as in the LCV category (the difference is in ratio, which is 1).

Mopeds and motorcycles

All emissions from these two categories (in the NFR and CRF categorisation are together) are included in household emissions (*Table A.2-2.8*).

Gasoline evaporation

Emissions from gasoline evaporation are NMVOC. Emissions from this category are divided between passenger cars, LCV and motorcycles and mopeds, all fuelled by gasoline. As the emissions in this category are not related to vehicle but to fuel, the approach is based on ratio between total consumption of gasoline (5) in each vehicle category separately. Vehicle specific coefficient is afterward multiplied by the specific ratio for NACE industry or households (6).

$$R_{evap.} = \frac{F_g}{F} \qquad (5)$$

$$E_{ind/HH} = R_{evap.} * R_{ind/HH} \qquad (6)$$

Where:

$R_{evap.}$ – ratio between category specific gasoline consumption and total gasoline consumption, F_g – gasoline consumption in the specific category, F – total gasoline consumption, $E_{ind/HH}$ – proportion of emissions in the appropriate category NACE industry or households, $R_{ind/HH}$ – proportion of households/NACE industry usage of appropriate vehicles (3, 4).

Tyre, break wear and road abrasion

Emissions from tyre, break wear and road abrasion are PMs (2.5; 10). Emissions from this category are divided between vehicles based on vehiclekilometer (vehkm) passed altogether by the specific category (passenger cars, LCV, HDV, buses, mopeds and motorcycles). The calculation is based on the ratio of vehkm passed in specific SNAP category and total vehkm passed in road transport (7). SNAP category specific coefficient is afterward multiplied by the specific ratio for NACE industry or households (8).

$$R_x = \frac{V_x}{\sum V} \quad (7)$$

$$PM_{ind/HH} = R_x * R_{ind/HH} \quad (8)$$

Where,

R_x – ratio between vehkm of specific SNAP category and total vehkm passed, V_x – vehkm passed in the specific SNAP category, $\sum V$ – sum of vehkm in all SNAP categories, $PM_{ind/HH}$ – proportion of PM emissions in the appropriate category NACE industry or households, $R_{ind/HH}$ – proportion of households/NACE industry usage of appropriate vehicles (3, 4).

EMISSIONS FROM NON-ROAD TRANSPORTATION (CRF and NFR 1.A.3.a, .c, .d, .e and 1.A.4.c.ii)

Non-road emissions include railways, air transport, water transport and off-road vehicle and machinery (CRF and NFR category 1A.4.c.ii). These emissions are divided in the respective NACE category as in *Table A.2-2.9*.

EMISSIONS FROM BIOMASS BURNING

Biomass is combusted only in energy sector – stationary combustion and road transportation (due to biofuel policy).

Allocation of CRF energy categories into the NACE industries and households was suggested taking into consideration of national circumstances and based on the energy statistics and PEFA questionnaire. In general, allocation of the emission categories to NACE Rev. 2 was done using specific characterization of activity in each category. Information is included in the *Tables A.2-2.1* and the *Table A.2-2.4*.

Table A.2-2.9: Allocation of non-road transport categories into NACE

CRF/NFR category	Year	Description	Emissions into NACE
1A.3.a.i(i) International aviation (LTO)	1990 – 2015	Non-residential flights from Slovak airports	Bridging items – 100%
1.A.3.a.ii(i) Civil Aviation (Domestic, LTO)	1990 – 2015	Residential flights	H51 – 100%
1.A.3.c Railways	1990 – 2015	Residential railway transport of passengers and goods	H49 – 100%
1.A.3.d.i(ii) International inland waterways	1990 – 2015	Non-residential ships passing Slovak section of Danube	Bridging items – 100%
1.A.3.d.ii National navigation (Shipping)	1990 – 2015	Residential shipping mainly on lakes and in country waterways	H50 – 100%
1.A.3.e Other Transportation (pipelines)	1990 – 2017	Pipeline transportation	H49 – 100%
1.A.4.c.ii Off-road Vehicles and Other Machinery	1990 – 2015	Emissions from off-road mechanism belonging into agriculture	A01 – 50% A02 – 50%

CHAPTER A.2-2-2
GHG EMISSIONS IN INDUSTRY

CO_2, CH_4 AND N_2O EMISSIONS IN INDUSTRY
(CRF AND NFR 2.A, 2.B, 2.C AND 2.D)

Industrial processes and product use sector includes all GHG emissions generated from the technological processes producing raw materials and products. Within the preparation of the GHG emissions balance in the Slovak Republic, consistent methodology of individual technological processes was use and disaggregation between the fuel combustion emissions (in heat and energy production) and emissions from the technological processes and industrial production.

The industry sector covers emissions from the technological processes in mineral products industry (CRF 2.A), in chemical industry (CRF 2.B), in metal production (CRF 2.C),[24] in non-energy products from fuels and solvent use (CRF 2.D), in electronics industry (CRF 2.E),[25] in product uses as substitutes for ODS (CRF 2.F)[26] and in other product manufacture (CRF 2.G).[27] The emissions inventory of technological processes includes direct greenhouse gas emissions (CO_2, CH_4, N_2O, halocarbons and SF_6) and indirect greenhouse gas emissions (NO_x, CO, NMVOCs).

Allocation of CRF industrial categories into the NACE industries and households was suggested taking into consideration of national circumstances and based on the energy statistics and PEFA questionnaire. In general, allocation of the emission categories of industry sector into NACE Rev. 2 was done using specific characterization of activity in each category. More information is available in the Chapter A.2-1 of this Report.

Table A.2-2.10: Percentage (%) of allocation of GHG emissions from the CRF categories 2.A, 2.B, 2.C, 2.D and 2.F for 1990 – 2016[a)]

CRF	Description	CO_2 emissions	CH_4 emissions	N_2O emissions
2.A	Mineral Production – mostly allocated in the NACE category F - Construction	C23 – 20% F – 80%	NO	NO
2.B	Chemical Industry – mostly allocated in the NACE category C – chemical products and plastics	C20 – 60% C22 – 40%	C20 – 60% C22 – 40%	C20 – 60% C22 – 40%
2.C	Metal Industry – CH_4 emissions since 1998, mostly allocated in the NACE category C – basic and fabricated metals	C24 – 60% C25 – 40%	C24 – 60% C25 – 40%	not occurring
2.D	Non-energy Products from Fuels and Solvent Use – lubricants and paraffin use in industry and transport	C19 – 10% C29 – 30% C30 – 10% G45 – 20% H49 – 20% H52 – 10%	NO	NO
2.G	Other Product Manufacture and Use – value added in industry was used	NO	NO	A-U – 95%[b)] Household – 5%

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation in industry sector;
b) Detailed allocation is based on the document EEEA/2017/01 (European Environmental Economic Accounts - Allocating emissions of fluorinated gases to NACE industries in air emissions accounts).

[24] See also Chapter B.3
[25] Not occurring in the Slovak Republic
[26] See Chapter B.2
[27] See Chapter B.4

HFCs EMISSIONS IN INDUSTRY

HFCs emissions from CRF 2.F.1 – Refrigeration and Air Conditioning

The emissions originating from refrigeration and AC equipment represent more than 95% of emissions from the 2.F category in the year 2016. Therefore, these emissions are significant source in recent years.

Allocation of CRF sub-categories into the NACE industries and households was suggested taking into consideration of national circumstances and based on the document EEEA/2017/01 (European Environmental Economic Accounts - Allocating emissions of fluorinated gases to NACE industries in air emissions accounts).

Table A.2-2.11: Percentage (%) of allocation of GHG emissions from the CRF category 2.F.1 for 1995 – 2016[a)]

CRF sub-category	Description	Emissions from manufacturing	Emissions from stocks	Emissions from disposal and recovery)[b)]
2.F.1.a Commercial refrigeration	Different types of equipment, from vending machines to centralized refrigeration systems in supermarkets.	C28 – 100%	G46 – 20% G47 – 30% I56 – 30% R93 – 20% (Norway approach)	E38 – 100%
2.F.1.b Domestic refrigeration	Household refrigeration	C27 – 100%	Household, Other – 100%	E38 – 100%
2.F.1.c Industrial refrigeration	Industrial processes including chillers, cold storage, and industrial heat pumps used in the food, petrochemical and other industries	C28 – 100%	A03 – 10% C10-12 – 40% C20 – 50% (Norway approach)	E38 – 100%
2.F.1.d Transport refrigeration	Equipment and systems used in refrigerated trucks, containers, reefers, and wagons	C28 – 100%	H49 – 50% H50 – 50%	E38 – 100%
2.F.1.e Mobile air-conditioning	Mobile air-conditioning systems used in passenger cars, truck cabins, buses, and trains. The sub-application of mobile air conditioning systems is likely to represent the largest share of HFC emissions within the Refrigeration and Air Conditioning application for many countries.	C25 – 30% C28 – 70%[e)]	Household, Other – 100%	E38 – 100%
2.F.1.f Stationary air-conditioning	Air-to-air systems, heat pumps, and chillers for building and residential applications. Comfort air conditioning in large commercial buildings (including hotels, offices, hospitals, universities, etc.) is commonly provided by water chillers coupled with an air handling and distribution system.	C25 – 30% C28 – 70%[e)]	I – 12.5% L – 12.5% O – 12.5% P – 12.5% Q86 – 12.5% Q87-88 – 12.5% Households, Other – 25%	E38 – 100%

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation.

HFCs Emissions from CRF 2.F.2 – Foam Blowing Agents

HFCs are being used as replacements for CFCs and HCFCs in foams and particularly in insulation applications. The division of foams into open-cell or closed-cell relates to the way in which blowing agent is lost from the products.

For open-cell foam, emissions of HFCs used as blowing agents are likely to occur during the manufacturing process and shortly thereafter. Open-celled foams are used for applications such as household furniture cushioning, mattresses, automotive seating and for moulded products such as car steering wheels and office furniture.

In closed-cell foam, only a minority of emissions occur during the manufacturing phase. This category is not significant and includes F-gases used in industry as follow:

- PU foam appliances (transferred from blowing agent R141b directly to cyclopentane in 1998);
- Injected PU foams in commercial cooling (started in 1999 and transferred from blowing agent R134a to water in 2007);
- Sprayed PU foams for roofs (transferred directly from ODS to HFC245fa and 365mfc in 2002);
- PU panels for containers, store rooms, *etc.*

Big importers imported only panels with hydrocarbons, water blowing agents; smaller importers (in opened market) imported panels with R134a from 1999 up to 2007. In the main application areas of PU hard foam (rigid foam insulating panels, flexibly coated; rigidly faced sandwich panels), hydrocarbons and CO_2 are usually used as blowing agent. In the area of PU insulating foam for pipes HFC-245fa and HFC-365mfc cover a small share of the market whilst CO_2 and pentane are dominating.

Allocation of CRF sub-categories to the NACE industries and households was suggested taking into consideration of national circumstances and based on the document EEEA/2017/01 (European Environmental Economic Accounts - Allocating emissions of fluorinated gases to NACE industries in air emissions accounts).

Table A.2-2.12: Percentage (%) of allocation of GHG emissions from the CRF category 2.F.2 for 1995 – 2016[a)]

CRF sub-category	Description	Emissions from manufacturing	Emissions from stocks	Emissions from disposal and recovery)
2.F.2.a Foam – Closed cells	Furniture, mattresses etc.	C22 – 100%	C10-12 – 5% G47 – 10% H49 - 20 H50 – 10% I – 25% L – 5% Households, Other – 25%	NO
2.F.2.b Foam – Open cells	Automotive seating, steering wheels etc.	NO	NO	NO

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation in industry sector.

HFCs Emissions from CRF 2.F.3 – Fire Protection

There are two general types of fire protection (fire suppression) equipment that use HFCs and/or PFCs as partial replacements for halons: portable (streaming) equipment, and fixed (flooding) equipment. While actual emissions from the fire protection sub-sector are expected to be quite small, the use is normally non-emissive in provision of stand-by fire protection and is growing. This results in an accumulating bank of future potential emissions.

This category is not significant in the Slovak Republic and includes F-gases used in the following industry:

- HFC134a used as fluid in operating systems since 1994 in very little amount;
- HFC227ea (*FM 200*) is used as extinguishing media and suitable alternative for halon H1301 in fixed extinguishing systems since 2004. After 1993, halons are not imported into the Slovak Republic;
- HFC 236fa (*FE36*) started to be used for portable extinguishing systems since the year 2000;
- PFCs extinguishing media are not imported into the Slovak Republic. PFC 410 and PFC 614 have been never used in stabile extinguishing equipment.

Prices of new extinguishing medias are quite high (approx. 40 Euro/kg), so the consumption and emissions are minimal. Stationary fire protection systems for flooding indoor spaces mainly use inert gases at the present. Formerly used ozone layer depleting halons have been replaced in some cases by HFCs. HFC-227ea in the fire extinguishers was firstly introduced on the Slovak market in 1994. F-gases for firefighting are imported in cylinders and filled in fixed installed systems.

Allocation of CRF sub-categories to the NACE industries and households was suggested taking into consideration of national circumstances and based on the document EEEA/2017/01 (European Environmental Economic Accounts - Allocating emissions of fluorinated gases to NACE industries in air emissions accounts).

Table A.2-2.13: Percentage (%) of allocation of GHG emissions from the CRF category 2.F.3 for 1995 – 2016[a)]

CRF sub-category	Description	Emissions from manufacturing	Emissions from stocks	Emissions from disposal and recovery
2.F.3 Fire Protection agents and fire protection equipment	Use and servicing of fire protection equipment is relevant for the Slovak Republic	C28 – 100%	C33 – 50% O – 50%	NO

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation in industry sector.

HFCs Emissions from CRF 2.F.4 – Aerosols

Most aerosol packages contain hydrocarbon (HC) as propellants but, in a small fraction of the total, HFCs and PFCs may be used as propellants or solvents. Emissions from aerosols usually occur shortly after production, on average six months after sale. However, the period between manufacture and sale could vary significantly depending on the sub-application involved. During the use of aerosols, 100 percent of the chemical is emitted.

The producers of aerosols in the Slovak Republic changed directly from ODS to mechanical principles and use of hydrocarbons and dimethyl ether in 1990. The group of aerosols gases includes medical aerosols, i.e. Metered Dose Inhalers (MDIs), only. The HFC-134a and HFC227ea are used as propellant for such aerosols in the Slovak Republic.

Allocation of CRF sub-categories to the NACE industries and households was suggested taking into consideration of national circumstances and based on the document EEEA/2017/01 (European Environmental Economic Accounts - Allocating emissions of fluorinated gases to NACE industries in air emissions accounts).

Table A.2-2.14: Percentage (%) of allocation of GHG emissions from the CRF category 2.F.4 for 1995 – 2016[a)]

CRF sub-category	Description	Emissions from manufacturing	Emissions from stocks	Emissions from disposal and recovery
Metered dose inhalers	C21	NO	Household – Other – 100%	NO

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation in industry sector.

PFCs EMISSIONS IN INDUSTRY

PFCs Emissions from CRF 2.C.3 – Aluminium Production

In metal industry (CRF 2.C), perfluorocarbons (PFCs) emissions occur during anode effects in primary aluminium production. During electrolysis, alumina (Al_2O_3) is dissolved in a fluoride melt comprising about 80 weight percent cryolite (Na_3AlF_6). Perfluorocarbons (CF_4 and C_2F_6 collectively referred to as PFCs) are formed from the reaction of the carbon anode with the cryolite melt during a process upset condition known as an ‘anode effect’. An anode effect occurs when the concentration of alumina in the electrolyte is too low to support the standard anode reaction.

Aluminium is produced by the electrolysis of alumina dissolved in cryolite-based melt (t = 950°C) in the Slovak Republic. The main additives to cryolite (Na_3AlF_6) are aluminium fluoride (AlF_3) and CaF_2. In the Slovak Republic, the plants for aluminium production use a modern technology where the majority of HF and other fluorides escaped from the electrolytic cells is absorbed and adsorbed on alumina. Alumina is used subsequently in the electrolytic process. The anodes are made from graphite. So-called pre-baked anodes for aluminium production are made in separate plants. Due to this technology, emissions are much lower than in the Søderberg process. The release of CF_4 and C_2F_6 emissions can occur at a special technological disturbance (the anode effect). Because of the progress in process control, this irregularity occurs only 1-2 times in a month.

Allocation of CRF sub-categories to the NACE industries and households was suggested taking into consideration of national circumstances and based on the document EEEA/2017/01 (European Environmental Economic Accounts - Allocating emissions of fluorinated gases to NACE industries in air emissions accounts).

Table A.2-2.15: Percentage (%) of allocation of GHG emissions from the CRF category 2.C.3 for 1990 – 2016[a)]

CRF sub-category	Description	Emissions from manufacturin	Emissions from stocks	Emissions from disposal and recovery
2.C.3	Aluminium Production	C24 – 100%	C24 – 100%	C24 – 100%

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation in industry sector.

PFCs Emissions from CRF 2.F.5 – Solvent

HFCs are used in solvent applications to a low extent and PFCs are still only very rarely used. HFC/PFC solvent uses occur mainly in precision cleaning, electronics cleaning, metal cleaning and deposition applications. HFCs are typically used in the form of an azeotrope or other blend for solvent cleaning.

In general, PFCs have little use in cleaning, as they are essentially inert, have very high GWPs and have very little power to dissolve oils - except for fluoro-oils and fluoro-greases for even deposition of these materials as lubricants in disk drive manufacture.

The HFCs emissions are not occurring in this category, recently. There is no import of F-solvents to the Slovak Republic because they are rather expensive. SP-255, which contains distilled oil and methyl acetate, is used as a flushing material. The solvents L113 and S316 used in the Slovak Republic, but are not reported in the emissions inventory. The solvents with HFCs are not used in cleaning machines for flushing refrigeration circuits.

Allocation of CRF sub-categories to the NACE industries and households was suggested taking into consideration of national circumstances and based on the document EEEA/2017/01 (European Environmental Economic Accounts - Allocating emissions of fluorinated gases to NACE industries in air emissions accounts).

PFC14 emissions from the solvents use are reported for the period 1997 – 2006.

Table A.2-2.16: Percentage (%) of allocation of GHG emissions from the CRF category 2.F.5 for 1990 – 2016[a)]

CRF sub-category	Description	Emissions from manufacturing	Emissions from stocks	Emissions from disposal and recovery
Solvent Cleaning	Manufacture of computer, electronic and optical products Manufacture of electrical equipment	NO	C26 – 50% C27 – 50%	NO

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation in industry sector.

SF_6 EMISSIONS IN INDUSTRY

SF_6 Emissions from CRF 2.G.1 – Electrical Equipment

Sulphur hexafluoride (SF_6) is used for electrical insulation and current interruption in equipment used in the transmission and distribution of electricity. Emissions occur at each phase of the equipment life cycle, including manufacturing, installation, use, servicing, and disposal. Most of the SF_6 used in electrical equipment is used in gas insulated switchgear and substations

(GIS) and in gas circuit breakers (GCB), though some SF_6 is used in high voltage gas-insulated lines (GIL), outdoor gas- insulated instrument transformers and other equipment. Both categories of equipment have lifetimes of more than 30 to 40 years. Electrical equipment is the largest consumer and most important use of SF_6, globally. It significantly contributes to worldwide SF_6 emissions. However, the importance of this source varies considerably from region to region and from country to country. The emissions from this category depend not only on the installed (banked) or consumed quantities of SF_6, but also very much on the tightness of the products and the handling processes applied. Regional average emission rates presently vary between far less than 1 percent to more than 10 percent.

In the Slovak Republic, emissions of SF_6 from the thermal insulation of windows and from the high voltage switchgears are reported in this category. The Nitrasklo Ltd. company for windows used SF_6 since 1994 for anti-noise and thermal isolation. It was mixed with argon in the ratio 30:70. Due the more effective production, consumption decreased. It was filled in close cycles without emissions from production. Consumption of SF_6 in Nitrasklo Ltd. continually decreased and was phased out in the year 2002. Amount of stored gas annually in windows in the Slovak Republic was 10 kg from 80 kg filled into windows annually (70 kg were exported in windows). For the stock of gas remaining inside, an annual leakage rate is 1%. SF_6 emissions from window insulation are very negligible when compared to the emissions from electrical equipment (approx. 0.09% of total SF_6 emissions). Since the production of windows ceased in 2002, we considered it unfeasible to report disaggregated emissions. Data on windows are reported together with the emissions from isolating gas in high voltage switchers.

Most of the SF_6 is used as insulation media in high and low voltage electric equipment because of higher safety level and enable to reduce dimension of equipment. SF_6 is used as an arc quenching and insulating gas in high-voltage (>36 kV [110–380 kV]) and medium-voltage (1–36 kV) switchgear and control gear. The equipment – mainly Gas-Insulates Systems, GIS – has not been manufactured during the reference period in the Slovak Republic, but has been completely imported. High-voltage GIS (HV GIS) operate with a high operating pressure (up to 7 bar) and large gas quantities. They are imported with a transport filling and are filled up on site. The systems are “closed for life” and have to be replenished in their lifetime. Emissions from operating HV systems are higher than emissions from the medium-voltage GIS (MV GIS). These operate with lower overpressure and small gas quantities of only some kg per system. They are already charged with SF_6 when imported and are hermetically closed (“sealed for life”).

Allocation of CRF sub-categories to the NACE industries and households was suggested taking into consideration of national circumstances and based on the document EEEA/2017/01 (European Environmental Economic Accounts - Allocating emissions of fluorinated gases to NACE industries in air emissions accounts).

Table A.2-2.17: Percentage (%) of allocation of GHG emissions from the CRF category 2.G.1 for 1990 – 2016[a)]

CRF sub-category	Description	Emissions from manufacturing	Emissions from stocks	Emissions from disposal and recovery)
2.G.1	Transmission and distribution of electricity	E27 – 100%	D – 100%	E38 – 100%

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation in industry sector.

CHAPTER A.2-2-3
GHG EMISSIONS IN AGRICULTURE

Despite of the fact that water vapour and CO_2 are the gases with the highest share to greenhouse effect of the atmosphere, N_2O and CH_4 emitted from agriculture are considered as the most important gases from the point of view of planning adaptive measures to reduce their influence on environment.

The sources of N_2O and CH_4 emissions are analysed according to the IPCC 2006 Guidelines methodologies and principles of good practice in GHGs inventory in agriculture were taken into account. Agriculture produces about 26% of total methane and more than 77% of total nitrous oxide emissions in the Slovak Republic.

The share of agriculture and food industry in the macro-economic indicators of the national economy has decreased in most indicators in 2016 (income, cost, sales from own products). The result of this development was a consequence of the stagnation in the agriculture and food sector in the Slovak economy and a continuing dampening of agriculture and food industry production with negative impact on the total economic income and social benefits generated by these sectors. The subsidies from EU funds has improved economic results and without them most businesses would be in a loss.

The gross value added in agriculture upsurges as a result of the increase in gross agricultural output, more so in crops than in animals, with a concurrent in intermediate consumption and a significant upsurge in product subsidies. The biggest fall in prices of all agricultural products was in raw cow's milk (-10.7%) and slaughter pigs (-10.5%).The decline in yields of most commodity crop production (excluding wheat, legumes, fruit), caused also further declining of emissions of nitrogen.

Lower-mass production of almost all groups of crucial slaughter animals, in particular pigs (9.7%), sheep (30.7%) and goats (1.3%), in addition to the slaughter of cattle and poultry (9.5% and 15.1%) (based on references published in the Green Report 2016) caused degrease in emissions.

The allocation of CRF agriculture categories to the classification of the NACE industries and households was suggested taking into consideration of national circumstances and based on the value added on the economic activities. In general, allocation of the emission categories of agriculture sector into NACE Rev. 2 was done using specific characterization of activity in each category.

The percentage share of assigned emissions into particular categories is presented in the following *Table A.2-2.18*.

Table A.2-2.18: Percentage (%) of allocation of GHG emissions from the agriculture sector into NACE for 1990 – 2016[a)]

CRF category	Description	CO_2 emissions	CH_4 emissions	N_2O emissions
3.A	Enteric Fermentation – only emissions of methane are relevant for this category. Emissions from animal production in agriculture are allocated in 2 NACE Rev. 2 categories.	NO	A01 – 80% C10_12 – 20%	NO
3.B	Manure Management – only emissions of methane and N_2O are relevant for this category. Emissions from manure are allocated in 2 NACE Rev. 2 categories.	NO	A01 – 90% E37_39 – 10%	A01 – 90% E37_39 – 10%
3.D.1	Direct N_2O Emissions from Soils – emissions from agricultural using of soil, crop production and fertilizers.	NO	NO	A01 – 70% C10_12 – 20% E37_39 – 10%
3.D.2	Indirect N_2O Emissions from Soils – emissions from agricultural using of soil, crop production and fertilizers, emissions produced by leaching and run-off of nitrogen in soil.	NO	NO	A01 – 70% C10_12 – 20% E37_39 – 10%
3.G	Liming – CO_2 emissions from using dolomite and limestone in agriculture.	A01 – 90% B – 10%	NO	NO
3.H	Urea Application – CO_2 emissions from using urea in agriculture	A01 – 90% B – 10%	NO	NO

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation in agriculture sector;

CHAPTER A.2-2-4
GHG EMISSIONS IN WASTE

Inventory of emissions from waste sector includes direct (CH_4, CO_2, N_2O) and indirect (NMVOCs) greenhouse gas emissions. Methane is generated from solid waste disposal sites, biological treatment of waste, waste incineration and wastewater treatment. Main source of CO_2 is waste incineration. N_2O is generated from biological treatment of waste and from wastewater treatment. Estimation of the following emission categories is presented in this chapter:

- 5.A Solid waste disposal;
- 5.B Biological treatment of solid waste;
- 5.C Incineration and open burning of waste;
- 5.D Wastewater treatment and discharge.

Allocation of CRF waste categories to the NACE industries and households was suggested taking into consideration of national circumstances and based on the value added on the economic activities. In general, allocation of the emission categories of waste sector to NACE Rev. 2 was done using specific waste classification.

European Waste Classification - The division of waste to Waste Groups defined in the European System of Waste Classification (Commission Decision 2000/532/EC) is used for estimating emissions. This classification divides waste to 20 waste groups and covers all waste types for which emission estimations are required by the IPCC 2006 Guidelines.

- Municipal solid waste – Waste Group 20;
- Industrial solid waste – Waste Group 1 – 16;
- Agricultural waste – Waste Group 2;
- Hazardous waste – Waste Groups 1 – 19;
- Clinical waste – Waste Group 18;
- Waste water treatment sludge – Waste Group 19;
- Fossil liquid waste – Waste Group 13.

Table A.2-2.19: Percentage (%) of allocation of GHG emissions from the waste sector into NACE for 1990 – 2016[a)]

CRF category	Description	CO_2 emissions	CH_4 emissions	N_2O emissions
5.A.1	Managed Waste Disposal Sites – only emissions of methane are relevant for this category since 1995. Large managed sites are allocated in one NACE.	NO	E37_39 – 100%	NO
5.A.2	Unmanaged Waste Disposal Sites – only emissions of methane are relevant for this category since 1990. Large unmanaged sites are allocated in one NACE.	NO	E37_39 – 100%	NO
5.A.3	Uncategorized Waste Disposal Sites – no emissions are relevant for this category	NO	NO	NO
5.B.1	Composting – allocation of CH_4 and N_2O emissions between agriculture, wastewater management and households	NO	A – 50% E – 30% Household – Other – 20%	A – 50% E – 30% Household – Other – 20%
5.B.2	Anaerobic Digestion at Biogas Facilities – no emissions are relevant for this category	NO	NO	NO
5.C.1	Waste Incineration – industrial waste incineration only allocated in this category. Other waste incineration is allocated in energy sector.	A-S – 100%[b)]	A-S – 100% [b)]	A-S – 100% [b)]
5.C.2	Open Burning of Waste – no emissions are relevant for this category	NO	NO	NO
5.D.1	Domestic Wastewater	NO	E – more than 95% Households – less than 3% D and F – 2% [b)]	E – more than 95% Households – less than 3% D and F – 2% [b)]
5.D.2	Industrial Wastewater	NO	C-F – 100%	C-F – 100%

a) Allocation is constant in time-series due to using consistent methodological approach for GHG emissions estimation in waste sector.

b) Emissions from waste incineration in industry, hazardous and other waste is disaggregated according to the value added, based on technological approach, consistent allocation is used for all gases.