29.4.2022

Improving the allocation of road transport emissions in AEA module and coherence between AEA and PEFA modules

Deliverable 1.1: Methodology for allocation of road transport emissions

101022801 (2020-SK-ENVACC)ESTAT-AG
Call: ESTAT-2020-PA8-E-ENVACC
Topic: B5453-2020-ENVACC

Content

1. PROJECT GRANT BACKGROUND

On July 6th, 2011, the Regulation (EU) No 691/2011 of the European Parliament and the Council on European Environmental Economic Accounts was adopted, encompassing three modules: Air Emission Accounts (AEA), Environmental Taxes (ET) and Material Flow Accounts (EW-MFA). On April 16, 2014, Regulation (EU) No 538/2014 amended Regulation (EU) No 691/2011 with three new modules:

- Environment Protection Expenditure Accounts (EPEA);
- Environmental Goods and Services Sector Accounts (EGSS);
- Physical Energy Flow Accounts (PEFA).

Improving the methodology for allocating emissions from road transport has a significant impact on the quality of air emissions accounts reporting (AEA) under the EUROSTAT Regulation. Emissions from road transport, when allocated into the NACE rev.2 categories, make it possible to analyse the NACE rev.2 categories, which emit the largest amounts of emissions into the atmosphere. This could improve the policies focused on the relevant economic sectors at the Slovak level as well as at the EU level. PEFA enables recording energy flows from the environment to the economy (natural inputs), within the economy (products) and from the economy back to the environment (residues). PEFA enables integrated analyses of environmental, energy and economic issues.

The Department of Emissions and Biofuels (OEaB) is interested in the continual improvement of the AEA accounts (emissions); mostly focusing on the activities for extending the scope beyond what is required, methodological developments and improving the quality of data.

These goals were declared and fulfilled during two previous grants, which were successfully delivered in the previous years. In 2016, the working group on Environmental Accounts (WG) emphasized the need to improve methodology in the area of allocation of road transport emissions and energy use to NACE rev. 2/household categories. A road map for improvement was agreed upon.

In May 2017, the WG endorsed the classification of methodological elements developed by the Task Force and the timing of the next steps:

(i) Countries should complete the inventory of methods by end of July 2018,

(ii) Countries should provide self-assessments by end of October 2018.

The self-assessment process of Slovakia undergone in 2018, identified insufficiencies in the current national methodology of road transport reporting in the AEA. These lower quality elements are connected with the allocation of road transport based on employment or gross value added to the NACE rev. 2/household categories and secondly with the issue of allocation of some types of vehicles (motorcycles) to NACE 49 category.

These issues were the results of a lack or missing data/information and sources on the usage of company vehicles (vehicles used for business) in Slovakia. Both identified elements have a common issue and are interlinked. Slovakia prepared the National Action Plan (NAP) for improving the quality of the reporting. NAP is necessary to implement by the end of 2022.

Therefore, the main intention of this grant project is to help with the successful implementation of the action plan. The current project directly builds on the previously successful delivered grant projects in the area of the AEA. The aim and grant project contribution are to continuously improve the quality, accuracy, consistency, coherency and time series of the legal requirements under Regulation (EU) No 691/2011 as amended.

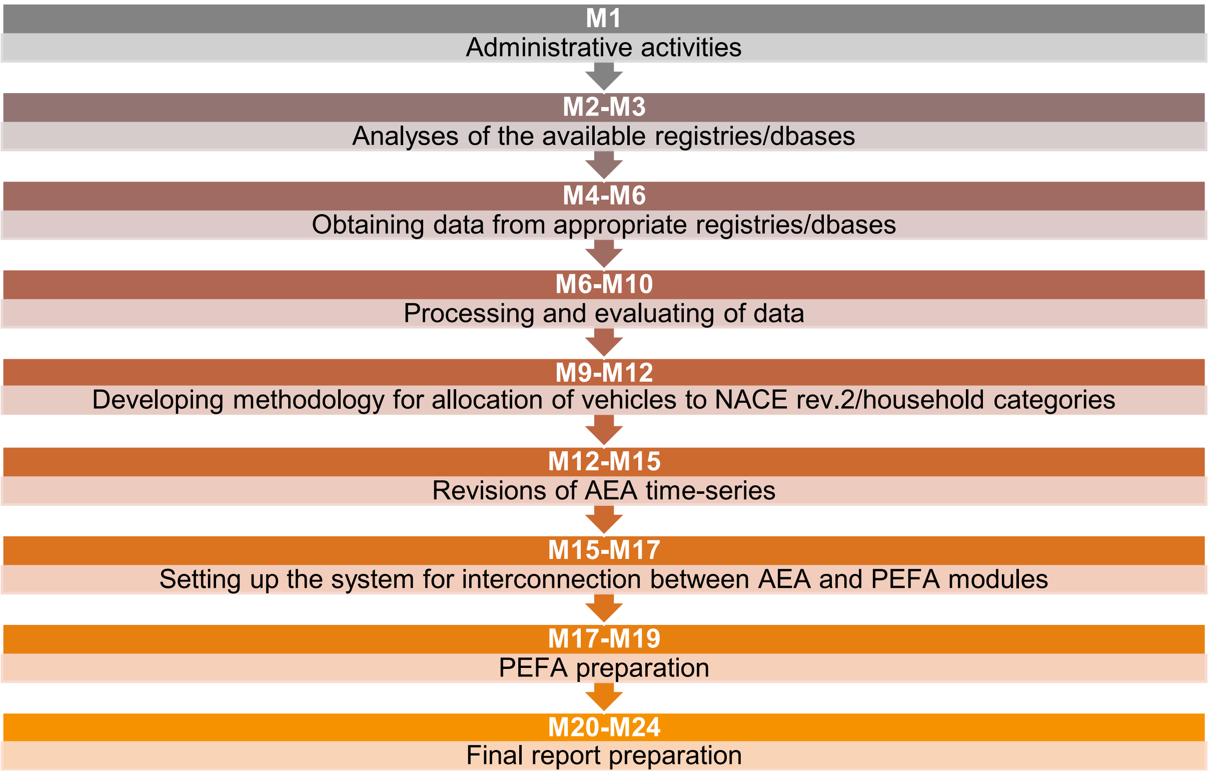
2. OBJECTIVES OF THE PROJECT GRANT AND TIME SCHEDULE

Eurostat grant project *"Improving the allocation of road transport emissions in AEA module and coherence between AEA and PEFA modules"* (Grant) has two main objectives, which result from the obligation of the Slovak Republic statistical reporting issues towards the Eurostat.

The first objective is an improvement of the allocation of road transport emissions in the AEA module to NACE rev. 2/household categories. The focus of this objective is the improvement of the methodology for assigning emissions from road transport to NACE rev. 2/household categories. New data, which will be obtained and processed within the Grant, are necessary to fulfil the obligations of the Slovak Republic arising from the NAP.

The second objective of the Grant is an improvement of coherence between AEA and PEFA modules in road transport fuels. This objective is focusing on the improvement of the coherence between AEA and PEFA modules in the proper allocation of road transport fuels to NACE rev. 2/household categories using results and methodology developed in the first objective of this Grant. The Grant started on February 1st 2021 and is planned to end on January 31st 2023. It is divided into several steps, which will follow in the order as is shown in *Fig.1*.

Fig. 1: Time schedule and Milestones of the Grant



3. METHODOLOGY FOR ALLOCATION OF ROAD TRANSPORT EMISSIONS INTO NACE REV.2 CATEGORIES

3.1 Data collection, analysis and processing

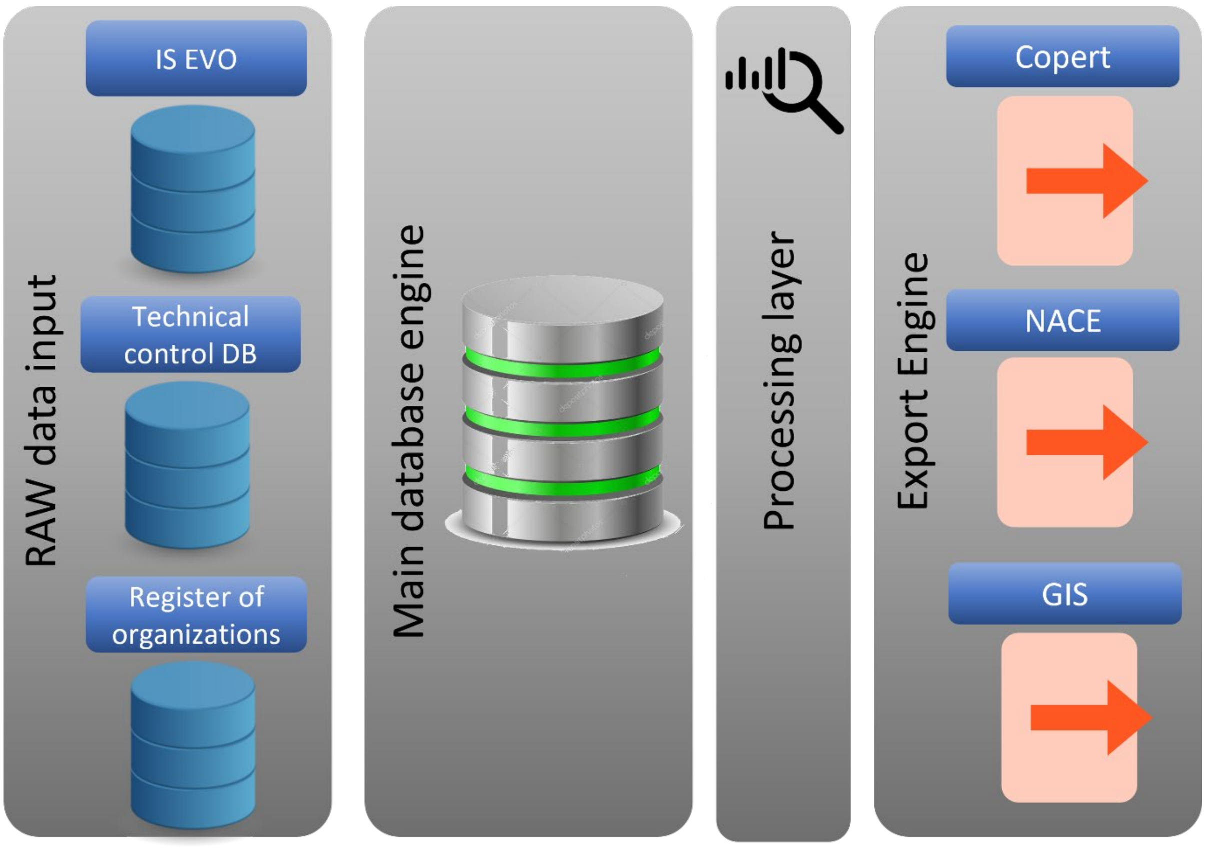
Based on an analysis of available sources, a prototype of a database system was developed and a Software Tool programmed for the data store (warehouse) and processing (including verification steps).

In the first stage of the Grant, the Software Tool includes data from the following sources:

- IS EVO (Vehicle Database)
- Technical Control Database
- Register of Organisations

These data sources provide raw data input for the database engine (depicted in *Fig. 2*). The collection of available data from the sources mentioned above was a preliminary stage of the processing.

Fig. 2: Simplified structure of prepared Software Tool



3.1.1 IS EVO

IS EVO is a vehicle registration information system used for the collection, recording and storage of information about registered vehicles in the Slovak Republic. It collects information about the car owners, car registration numbers and other relevant data. The operator of the IS EVO is the Ministry of Interior of the Slovak Republic via the Central Body of State Administration. The most important information from the IS EVO used in the prepared tool is the VIN number, vehicle registration number, type of fuel, engine capacity, gross vehicle weight, maximum combined weight, emission standards according to EU Directives, date of first registration and date of first registration in the Slovak Republic.

3.1.2 Technical Control Database

Technical Control Database is operated by the Ministry of Transport of the Slovak Republic. Information imported from this database into the prepared Software Tool is the VIN number, vehicle registration number, date of technical control, category of vehicle and total millage. Information about total mileage and the date of control is used for the estimation of the annual mileage of each individual vehicle. The VIN number and registration number are used for linking (cross-check) the data from the IS EVO and Technical Control Database.

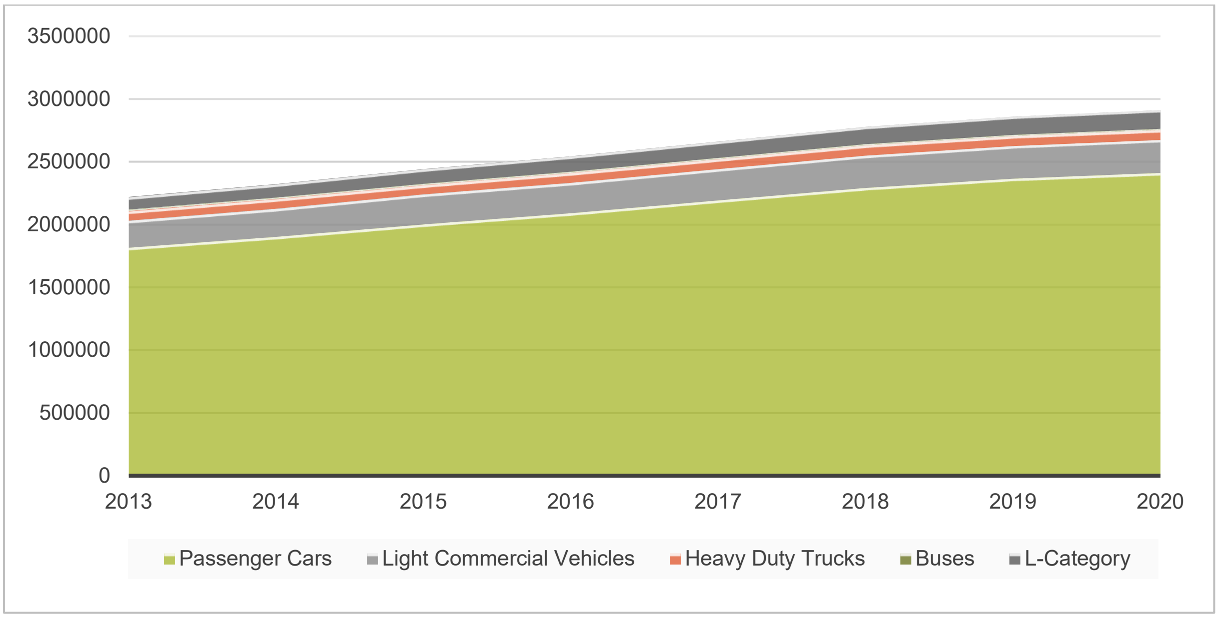
During the processing of input data and quality insurance cross-checks, some discrepancies were identified. These discrepancies probably arose during the manual entry of primary data into the databases. Therefore, in some cases, it was not possible to link data from the IS EVO and the Technical Control Database. Therefore, several flexible tools (processes) were developed to identify these discrepancies and correct information in both databases. The processing layer of the developed Software Tool is also responsible for the estimation of vehicle mileage.

For each car, the information from technical controls (with a periodicity of two years for every car older than four years) is collected and stored in a temporary list on the Technical Control Database. Based on generated pairs: date of control – total millage an approximate mileage at the beginning and end of the year is interpolated. The annual mileage of the car is estimated as the difference between millage at the beginning and end of the year/years.

To validate compiled data, it is important to perform a timeline consistency check of aggregated results. As an example of such a timeline, the next picture (*Fig. 3*) shows the total number of registered cars in the Slovak Republic, distinguished into five categories (based on the COPERT model system structure).

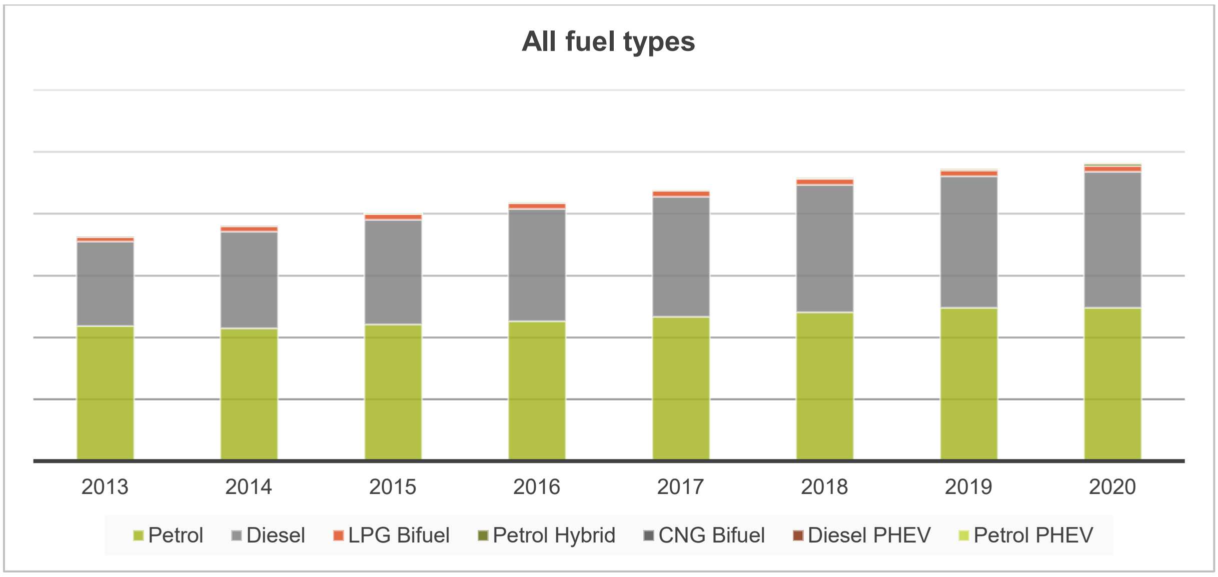
From *Fig. 3* it is clear, that the total number of registered vehicles has a growing tendency. Passenger cars have the largest share of the total number of vehicles. The inter-annual growth rate of passenger cars is at a level of 5%. The year 2020 is an exception, where the growth rate was below 2% (probably due to COVID-19). A very similar trend can be observed in the case of Light Commercial Vehicles and in L-Category (mopeds, motorcycles, ATVs, and micro-cars). On the other hand, the total number of Heavy-Duty Trucks and Buses is practically constant (the year 2020 is an exception, where both categories decreased sharply).

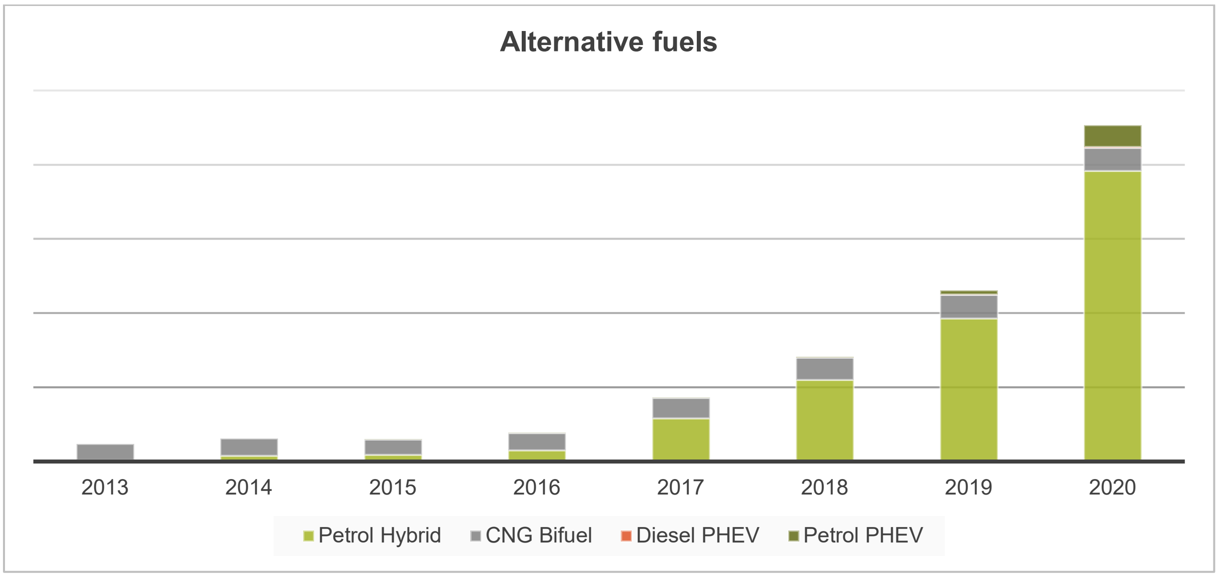
Fig. 3: Total number of registered cars (breakdown by vehicle type) since 2013



Very important input information for the inputs to the COPERT model system, in addition to mentioned above, is fuel type. The next pictures (*Fig. 4*) compare the share of individual fuels used in passenger cars. Particular disaggregation of alternative fuels is provided in the second figure.

Fig. 4: Share of fuel types in the Slovak Republic – passenger cars





The main trend, like in other EU countries, is that more than half of cars in the Slovak Republic use petrol as fuel. The dominance of petrol is continuously reduced by diesel. The diesel/petrol ratio was 38% in 2013 but the ratio increased to almost 47% in 2020. A positive trend is visible in the increase of alternative fuels. In the last five years, the increase of hybrid cars is practically exponential. There is also a significant increase in electric passenger cars in the last two years (*Fig. 4*).

For a correct estimate of the non-CO_2 emissions, it is important to include information about European emission standards (EURO standards) on each vehicle. This information is also necessary for COPERT model system. For illustration, the share of EURO standards of passenger cars, which contribute to 60% of non-CO_2 emissions, is depicted in *Fig. 5*.

Fig. 5: Share of EURO emissions standards in the Slovak Republic – passenger cars

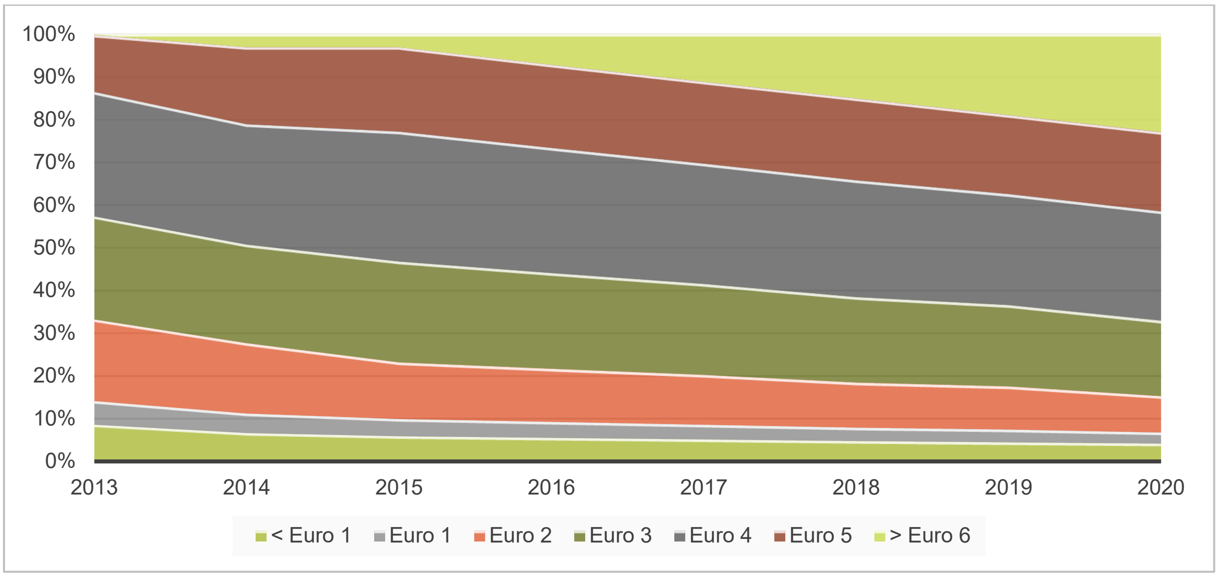


Fig. 5 depicted conventional, pre-ECE and ECE standards for passenger cars together in category <EURO 1. The EURO 6 covers all EURO 6 emissions standards (EURO 6 a/b/c, EURO 6d-Temp and EURO 6d). There is a continual increase of cars with EURO 5 and all EURO 6 emissions standards. The share of cars with EURO 6 standards is almost 23% of all cars in 2020 (in the year 2013 it was less than 0.2%). The number of cars with EURO 4 standards remains practically constant. Cars with emissions standards less than EURO 3 are continuously decreasing in the monitored range. The reduction in the number of cars in the EURO 3 category is 41% in comparison with the year 2013.

All information mentioned earlier is used as the background for the emissions estimation.

The export engine of the prepared Software Tool is used for preparation the background for vehicle analysis and to generate input data for other systems. As the primary objective of the prepared system is to estimate emissions in transport, the main exporting format is the input file of the COPERT model.

3.1.3 Register of Organisations

Statistical Office of the Slovak Republic is providing to the Slovak Hydrometeorological Institute, particularly to the OEaB on a regular basis (annually) the complete Register of the Organisation. This information can be used for the AEA and similar reporting obligations.

3.2 COPERT model and emissions estimation

The COPERT model is software for GHG emissions and air pollutants estimation in road transport calculation. It is partly financed by the European Environment Agency (EEA), in the framework of the activities of the European Topic Centre on Air and Climate Change. It contains default emission factors and emissions for all major pollutants, heavy metals, and particulate matters. The COPERT model requires inputs about vehicle type, vehicle segment, fuel used and EURO emission standards. For each combination of these four parameters, it is necessary to estimate the number of cars (STOCK), annual mileage (MEAN_ACTIVITY) and lifetime millage (LIFETIME_CUMULATIVE_ACTIVITY). These data are prepared and processed by the processing layer and compiled by the Export engine of the prepared Software Tool (*Fig. 2*).

The model distinguishes vehicle categories and default emission factors reflecting the recent development and research. Emission factors (EFs) are then modified for each country based on particular variables. The methodology is often referred to by the name of the program (methodology “COPERT”). The model is based on the fuels approach, which is used for the estimation of CO_2 emissions. The fuel consumption and other variables such as H/C and O/C ratio and carbon content in fuels is used in this approach. Also, country specific H/C ratio and NCVs are used in model calculation.

Slovakia is analysing the composition of fuels sold by most companies on the market, representing 3 different regional refineries on regular basis (Orlen Unipetrol from Czechia, OMV from Austria and Slovnaft from Slovakia). Delivering updated and most recent data on fuels' composition is crucial for correct country-specific EFs estimation. The H/C and O/C ratio of the fuels is regularly analysed by the Research Institute for Crude Oil and Hydrocarbon Gases (VÚRUP) operating certified laboratories.

The COPERT model works with five basic vehicle categories and 375 subcategories. Further disaggregation was applied according to the operation of road vehicles in the agglomeration, road, and highway traffic mode. In the COPERT model, buses were divided into two subcategories (urban and coaches) and seven weight categories. Heavy-duty vehicles are divided into two basic categories (rigid and articulated). Rigid vehicles are further divided by weight into eight and articulated into six subcategories. EMEP/EEA[1] methodology used technical parameters of different vehicle types and country-specific characteristics, such as the composition of the car fleet, the age, operation and fuels or climate conditions.

In conclusion, the model estimates country-specific emissions from the following input data:

- total fuel consumption,
- composition of vehicles fleet,
- driving mode,
- driving speed,
- emission factors,
- annual mileage.

The EFs for CH_4, N_2O and most of the air pollutants in the COPERT model are defined separately for the different types of fuels, types of vehicles, different technological levels of vehicles, driving modes and seasons as these emissions are dependent on ambient and vehicle temperature. EFs are then calculated automatically by the model, based on the input parameters such as the average speed, the quality of fuels, the age of vehicles, the weight of vehicles and the volume of cylinders.

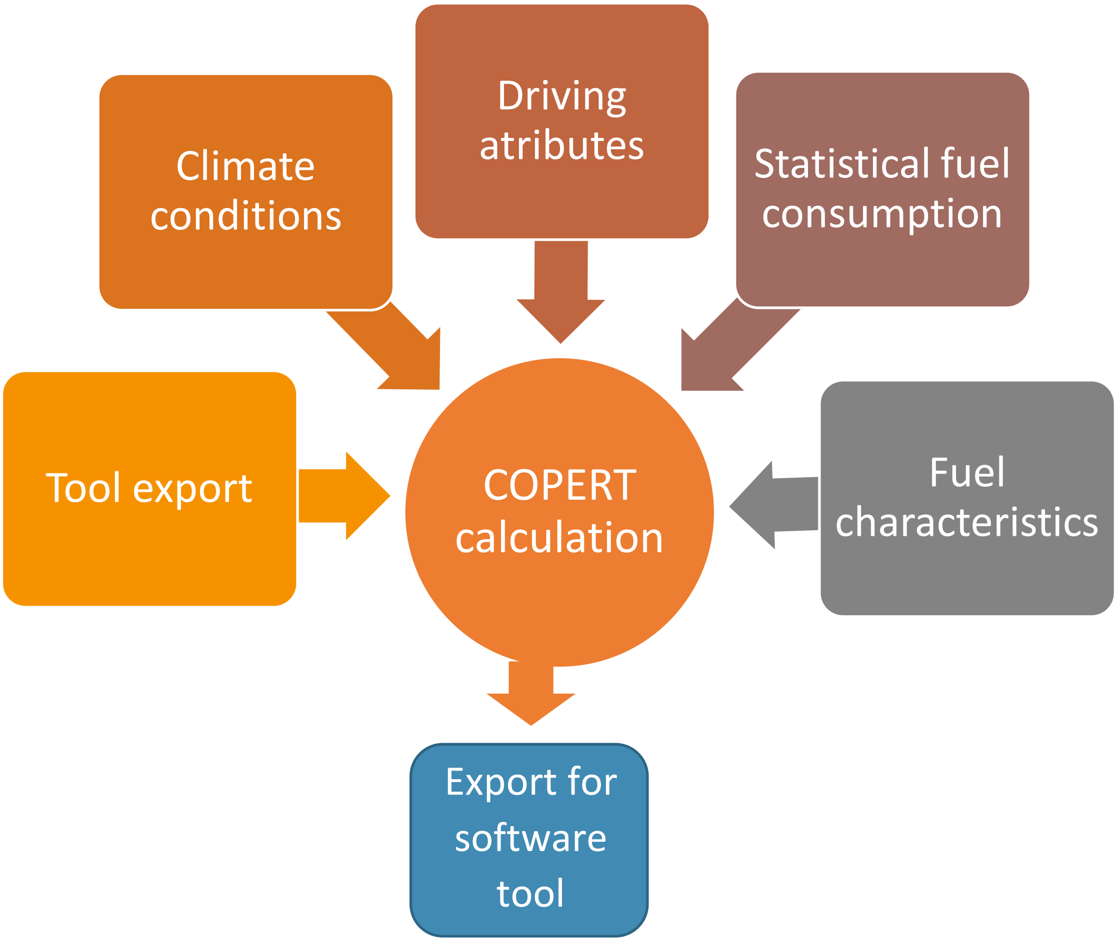
The average annual mileages including consistency with fuel consumption were also used for identifying the distribution of vehicles to their appropriate the COPERT category. The Traffic Census of Slovakia[2] conducted every five years (2000, 2005, 2010 and 2015) was the main source for intensity on urban, rural and highways.

More information on the COPERT model structure is given in *Fig. 6*.

[1] EMEP/EEA Guidebook for Road transport: https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-b-i/view

[2] https://www.ssc.sk/sk/cinnosti/rozvoj-cestnej-siete/dopravne-inzinierstvo.ssc

Fig. 6: Scheme of the COPERT model inputs and outputs



3.3 Emissions matrix preparation

As mentioned, one of the Grant tasks was to distinguish the estimated emissions into NACE rev.2 categories. The first part of this task was done on the database layer of the prepared Software Tool (see Chapter 3.1).

The aim of the first step was to separate individual vehicles and allocate them to the households sector or economic activities. The allocation and distribution key was based on the cross-checking data available in the IS EVO and the Register of Organisations. The IS EVO contains information about company registration numbers for individual vehicles used for economic activities. The database layer of the Software Tool used information exported from the Register of Organisations. From this register, a combination of the company registration number and NACE rev.2 classification of the owner (company) is used for adding the individual vehicle to the appropriate NACE rev.2 categories. The export engine of the Software Tool can generate an allocation (distribution) matrix where rows represent vehicle categories and subcategories identified by the COPERT model (i.e., a combination of vehicle type, vehicle segment, fuels, and EURO standards). The columns of the allocation matrix are NACE rev.2

classification codes. Individual matrix elements represent the number of vehicles in the corresponding category.

The second step of the matrix preparation was based on the outcomes of the COPERT model. The results from the model are structured in the same way that was needed to feed the matrix from the Software Tool (this was prepared to be in line with this structure). To establish a definitive matrix combination, data from the first part of the process (number of vehicles in each NACE rev.2 category) and data from the second part of the process (number of annual mileages and emissions) were needed to combine. By dividing the total mileage for each vehicle category and fuel, a ratio was obtained:

$$KM_x \div V_x = km_x \ (eq.1)$$

$$km_x \times V_{NACE} = km_{NACE} \ (eq.2)$$

$$km_{NACE} \div KM_x = R \ (eq.3)$$

Where:

KM_x – total mileage in designated vehicle and fuel category

V_x – total vehicles in designated category and fuel

km_x – average km of a vehicle in designated category and fuel

V_{NACE} – vehicles of designated category and fuel in NACE rev.2 category

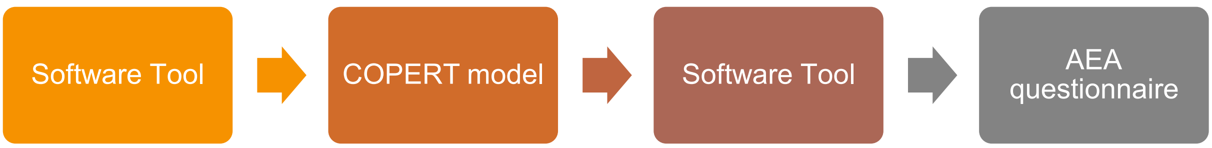
km_{NACE} – total mileage of the NACE rev.2 category for each vehicle category and fuel

R – ratio for matrix

This ratio was afterwards added to the matrix from the first step. After the combination of these two steps, a definitive matrix was obtained.

The generated matrix has in rows the ratio of emission from each economic activity based on NACE rev.2 classification and each column represents a vehicle category with a specific fuel. So, it contains the detailed structure of the vehicle fleet for a particular year, so as the detailed disaggregated information to each NACE rev.2 category. This matrix is a part of the Software Tool and after feeding the software with estimated individual GHG emissions and air pollutants, the result can be exported to the EUROSTAT AEA questionnaire.

Fig. 6: Scheme of all processes for the AEA questionnaire preparation



In the next phase of the Grant, it will be added to the matrix also the annual transported volume by freight transport. The volume of transported goods directly affects fuel consumption; thus, the energy flow (PEFA) is not necessarily the same as the emissions.

The presented approach allows the preparation of the background data for individual GHG emissions and air pollutants national inventory reports. The harmonisation of data from different databases (and their subsequent adjustment) allows for improving the time series of the emissions from transport in Slovakia and subsequently the AEA and PEFA reporting. These emissions are now possible to disaggregate more precisely into NACE rev.2 categories. In future, there is a plan to develop a software layer for communication with geographic information systems and to split emissions into defined geographical regions.

4. RESULTS AND CONCLUSIONS INCLUDING IMPACT ON DISAGGREGATION OF EMISSIONS FROM ROAD TRANSPORT

Presented results as summarised in the following tables (*Tab. 1*). The resulting change in allocations of reported air pollutants is significant. Emissions assigned for the households transport increased significantly. The most significant decrease was recorded for category H, due to disaggregation of the emissions into various services subcategories.

Using the new methodology, emissions from road transport are no longer allocated according to the GVA, which means that the Grant is able to secure the fulfilment of the obligation of the Slovak Republic to level up the methodology for two low-quality elements as was identified in the self-assessment of the road transport methodology in 2018.

The proposed methodology disaggregates emissions in high detail and provides higher accuracy using various databases which were obtained and cross-checked to achieve the goals of this Grant.

In addition, the new methodology described here is fully consistent with the methodological approach used in energy and industry sectors in the emission inventory. The individual vehicle is allocated with the same approach (according to the individual NACE rev.2 classification) as it is in the pollution sources (operators) in the energy or industry sectors. Therefore, the second task of the Grant (PEFA) will be more easily fulfilled to reach consistency and improvements in reporting.

Tab. 1: Comparison of allocation of emissions from road transport in the main NACE rev.2 categories using the previous and new methodology

NACE	CO_2 in Gg					
	2013	2014	2015	2016	2017	2018
A	-15.921	-49.003	0.112	-26.669	-10.869	14.166
B	-8.227	-5.886	-7.405	-1.696	-1.670	-0.657
C	-144.133	-191.542	-134.643	-146.209	-122.891	-73.836
D	-43.087	-34.826	-34.694	-32.348	-30.130	-13.266
E	16.434	11.491	21.395	19.304	19.077	21.179
F	54.982	49.946	122.276	123.935	124.989	147.897
G	112.319	134.117	278.981	301.011	308.274	327.151
H	-1 608.042	-2 016.840	-2 051.032	-1 857.180	-1 837.094	-1 785.745
I	16.121	14.960	28.756	27.509	28.809	28.622
J	-19.808	-13.884	-1.408	-3.282	-1.824	-1.492
K	-28.604	-34.491	-31.326	-20.056	-10.267	-3.946
L	-52.731	-29.761	-10.203	-11.780	-11.431	-40.012
M	60.649	53.301	100.763	101.736	110.154	110.757
N	86.130	65.943	106.677	130.398	153.232	171.339
O	-48.771	-52.264	-42.695	-54.644	-55.178	-54.342
P	-22.357	-20.656	-12.116	-15.240	-14.959	-21.165

NACE	CO_2 in Gg					
	2013	2014	2015	2016	2017	2018
Q	-16.962	-11.607	-3.072	-7.227	-2.666	-4.031
R	-12.484	-12.516	-6.916	5.444	-4.040	7.910
S	5.179	5.456	11.542	11.217	12.213	13.475
T	0.000	0.000	0.000	0.000	0.000	-0.475
U	0.194	0.208	0.310	0.317	0.287	0.333
HH trans.	1 669.118	2 137.853	1 664.698	1 455.461	1 345.984	1 156.139

NACE	Biomass CO_2 in Gg						CH_4 in tons					
	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018
A	-0.3	-2.4	0.4	-1.0	-0.3	1.3	-3.2	-4.3	-1.5	-1.4	-1.6	-0.2
B	-0.4	-0.3	-0.4	-0.1	-0.1	0.0	-0.6	-0.4	-0.4	-0.1	-0.2	-0.1
C	-5.8	-9.5	-6.0	-7.3	-6.7	-3.8	-15.7	-16.2	-12.4	-8.7	-11.6	-5.2
D	-2.0	-1.8	-1.8	-1.9	-1.9	-0.8	-3.0	-2.2	-1.8	-1.2	-1.5	-0.5
E	1.0	0.7	1.3	1.4	1.5	1.6	0.1	0.0	0.5	0.5	0.3	0.4
F	3.7	3.3	7.6	9.1	9.4	11.0	-3.2	-2.9	-0.1	0.7	-0.2	1.1
G	7.2	8.1	16.6	21.0	22.2	23.7	-4.4	-2.0	2.9	3.5	3.5	3.9
H	-69.0	-104.2	-101.8	-101.1	-109.4	-110.3	-78.0	-83.5	-59.5	-32.7	-53.6	-29.0
I	0.9	0.8	1.6	1.8	2.0	2.0	0.1	0.1	0.5	0.3	0.5	0.3
J	-0.9	-0.7	0.0	-0.1	-0.1	-0.1	-2.2	-1.5	-1.0	-0.7	-0.9	-0.6
K	-1.3	-1.8	-1.6	-1.1	-0.6	-0.2	-2.4	-2.2	-2.0	-1.1	-1.2	-0.6
L	-2.3	-1.5	-0.4	-0.5	-0.5	-2.5	-4.9	-2.7	-1.9	-1.4	-1.9	-2.1
M	3.3	3.0	5.7	6.6	7.5	7.7	0.4	0.3	1.7	1.3	1.9	1.5
N	4.7	3.8	6.1	8.7	10.7	12.1	1.5	1.1	2.0	2.0	2.5	2.4
O	-2.2	-2.8	-2.3	-3.3	-3.6	-3.6	-3.7	-3.1	-2.4	-2.1	-2.8	-1.8
P	-1.0	-1.1	-0.6	-0.9	-1.0	-1.4	-1.7	-1.3	-0.9	-0.7	-0.9	-0.8
Q	-0.8	-0.6	-0.2	-0.5	-0.2	-0.3	-1.5	-1.0	-0.7	-0.6	-0.5	-0.4
R	-0.5	-0.6	-0.3	0.4	-0.2	0.6	-1.2	-1.0	-0.8	-0.1	-0.6	0.0
S	0.3	0.3	0.6	0.7	0.8	0.9	-0.1	0.0	0.2	0.1	0.2	0.2
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
U	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HH trans.	65.6	107.3	75.2	68.0	70.3	62.3	123.7	123.1	77.9	42.3	68.6	31.5

NACE	N_2O in tons						NOx in tons					
	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018
A	-0.17	-1.30	0.42	-0.57	-0.07	0.95	-0.01	-0.15	0.07	-0.04	0.00	0.08
B	-0.23	-0.17	-0.22	-0.01	-0.01	0.03	-0.03	-0.02	-0.02	0.00	0.00	0.00
C	-3.68	-5.43	-2.76	-2.93	-2.11	-0.93	-0.44	-0.58	-0.32	-0.34	-0.27	-0.10
D	-1.33	-1.10	-1.07	-0.97	-0.95	-0.33	-0.15	-0.10	-0.10	-0.09	-0.08	-0.06
E	0.48	0.41	0.75	0.69	0.73	0.84	0.15	0.09	0.15	0.13	0.11	0.12
F	2.05	2.07	4.82	4.89	5.07	5.79	0.40	0.32	0.65	0.62	0.57	0.64
G	5.45	6.16	12.68	14.12	14.45	15.28	0.67	0.63	1.11	1.08	1.01	1.02
H	-52.96	-80.80	-86.16	-72.61	-76.04	-71.34	-5.92	-7.40	-5.87	-5.35	-4.87	-4.89
I	0.54	0.52	1.07	1.01	1.09	1.05	0.08	0.06	0.11	0.10	0.10	0.10
J	-0.53	-0.41	0.17	0.08	0.16	0.18	-0.04	-0.03	0.00	-0.01	0.00	0.00
K	-0.81	-1.05	-0.73	-0.37	0.02	0.13	-0.07	-0.10	-0.11	-0.06	-0.03	0.00

NACE	N_2O in tons						NOx in tons					
	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018
L	-1.41	-0.79	0.22	0.25	0.25	-0.51	-0.10	-0.06	-0.02	-0.03	-0.03	-0.12
M	2.48	2.12	4.28	4.41	4.86	4.81	0.31	0.21	0.33	0.31	0.31	0.30
N	3.29	2.62	4.51	5.68	6.77	7.34	0.46	0.29	0.41	0.46	0.50	0.53
O	-1.56	-1.66	-1.13	-1.49	-1.56	-1.52	-0.09	-0.15	-0.14	-0.17	-0.17	-0.16
P	-0.68	-0.66	-0.27	-0.37	-0.35	-0.51	-0.05	-0.05	-0.03	-0.04	-0.04	-0.06
Q	-0.52	-0.38	0.01	-0.15	-0.03	-0.09	-0.05	-0.04	-0.02	-0.03	-0.02	-0.02
R	-0.39	-0.40	-0.12	0.20	-0.05	0.29	-0.02	-0.03	-0.01	0.03	0.00	0.03
S	0.16	0.18	0.41	0.39	0.44	0.46	0.03	0.03	0.05	0.04	0.04	0.05
T	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
HH trans.	49.83	80.08	63.11	47.74	47.30	38.07	4.85	7.09	3.78	3.37	2.87	2.54

NACE	NMVOC in tons						SOx in tons					
	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018
A	-0.044	-0.046	-0.023	-1.299	-0.023	-0.010	0.000	0.000	0.000	0.000	0.000	0.000
B	-0.008	-0.006	-0.006	0.001	-0.004	-0.003	0.000	0.000	0.000	0.000	0.000	0.000
C	-0.273	-0.255	-0.240	0.057	-0.262	-0.148	-0.001	-0.001	-0.001	-0.001	-0.001	0.000
D	-0.054	-0.045	-0.035	-0.004	-0.031	-0.018	0.000	0.000	0.000	0.000	0.000	0.000
E	-0.005	-0.003	0.002	-0.018	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
F	-0.063	-0.044	-0.014	0.065	-0.018	-0.004	0.000	0.000	0.001	0.001	0.001	0.001
G	-0.096	-0.049	0.004	0.039	0.022	0.018	0.000	0.001	0.001	0.001	0.002	0.002
H	-0.408	-0.398	-0.374	0.082	-0.292	-0.234	-0.005	-0.008	-0.006	-0.006	-0.006	-0.006
I	-0.006	-0.002	0.003	0.009	0.003	0.002	0.000	0.000	0.000	0.000	0.000	0.000
J	-0.057	-0.038	-0.029	0.003	-0.029	-0.023	0.000	0.000	0.000	0.000	0.000	0.000
K	-0.059	-0.051	-0.049	-0.015	-0.032	-0.019	0.000	0.000	0.000	0.000	0.000	0.000
L	-0.127	-0.069	-0.056	0.009	-0.055	-0.070	0.000	0.000	0.000	0.000	0.000	0.000
M	-0.024	-0.016	0.004	-0.004	0.007	0.003	0.000	0.000	0.000	0.000	0.001	0.000
N	-0.004	0.003	0.013	0.035	0.023	0.026	0.000	0.000	0.000	0.001	0.001	0.001
O	-0.095	-0.071	-0.059	-0.009	-0.066	-0.050	0.000	0.000	0.000	0.000	0.000	0.000
P	-0.045	-0.033	-0.026	-0.051	-0.027	-0.026	0.000	0.000	0.000	0.000	0.000	0.000
Q	-0.039	-0.027	-0.021	-0.014	-0.018	-0.016	0.000	0.000	0.000	0.000	0.000	0.000
R	-0.031	-0.025	-0.023	0.001	-0.016	-0.002	0.000	0.000	0.000	0.000	0.000	0.000
S	-0.007	-0.004	-0.001	0.006	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
T	0.000	0.000	0.000	-0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HH trans.	1.446	1.175	0.925	0.718	0.814	0.569	0.006	0.009	0.005	0.004	0.004	0.003

NACE	NH_3 in tons						CO in tons					
	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018
A	-0.004	-0.004	-0.002	-0.003	-0.002	-0.001	-0.281	-0.289	-0.120	-0.113	-0.128	-0.025
B	-0.001	0.000	0.000	0.000	0.000	0.000	-0.056	-0.036	-0.034	-0.014	-0.022	-0.009
C	-0.022	-0.020	-0.017	-0.022	-0.018	-0.013	-1.647	-1.458	-1.217	-0.854	-1.305	-0.493
D	-0.004	-0.004	-0.002	-0.003	-0.002	-0.002	-0.332	-0.255	-0.187	-0.121	-0.163	-0.068
E	-0.001	0.000	0.000	0.000	0.000	0.000	-0.026	-0.014	0.016	0.023	0.008	0.018
F	-0.007	-0.004	-0.002	-0.002	-0.001	0.000	-0.355	-0.230	-0.017	0.026	-0.046	0.074

NACE	NH_3 in tons						CO in tons					
	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018
G	-0.009	-0.004	0.001	0.001	0.004	0.004	-0.473	-0.178	0.190	0.200	0.238	0.241
H	-0.025	-0.032	-0.024	-0.026	-0.024	-0.026	-3.813	-3.753	-3.298	-2.340	-2.559	-1.893
I	-0.001	0.000	0.000	0.000	0.000	0.000	-0.004	0.006	0.044	0.032	0.036	0.030
J	-0.005	-0.003	-0.002	-0.002	-0.002	-0.002	-0.318	-0.198	-0.129	-0.082	-0.130	-0.066
K	-0.005	-0.004	-0.003	-0.003	-0.002	-0.002	-0.337	-0.284	-0.250	-0.119	-0.157	-0.061
L	-0.010	-0.005	-0.004	-0.004	-0.004	-0.006	-0.716	-0.369	-0.263	-0.166	-0.265	-0.233
M	-0.002	-0.001	0.001	0.001	0.002	0.002	-0.065	-0.040	0.097	0.076	0.098	0.086
N	-0.001	0.000	0.001	0.002	0.002	0.004	0.051	0.055	0.128	0.129	0.175	0.177
O	-0.008	-0.006	-0.004	-0.006	-0.005	-0.005	-0.551	-0.393	-0.298	-0.225	-0.336	-0.181
P	-0.004	-0.003	-0.002	-0.002	-0.002	-0.002	-0.258	-0.183	-0.127	-0.084	-0.130	-0.088
Q	-0.003	-0.002	-0.001	-0.002	-0.001	-0.001	-0.222	-0.142	-0.095	-0.070	-0.080	-0.045
R	-0.002	-0.002	-0.002	0.000	-0.001	0.000	-0.175	-0.139	-0.110	-0.010	-0.078	0.000
S	-0.001	0.000	0.000	0.000	0.000	0.000	-0.030	-0.014	0.007	0.009	0.011	0.015
T	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.002
U	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001
HH trans.	0.113	0.095	0.062	0.071	0.056	0.050	9.607	7.913	5.662	3.701	4.832	2.523

NACE	$PM_{2.5}$ in tons						PM_{10} in tons					
	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018
A	-0.004	-0.010	-0.002	-0.005	-0.003	0.000	-0.006	-0.015	-0.004	-0.008	-0.005	-0.001
B	-0.002	-0.001	-0.002	-0.001	-0.001	-0.001	-0.003	-0.002	-0.002	-0.002	-0.002	-0.001
C	-0.046	-0.057	-0.059	-0.066	-0.067	-0.050	-0.072	-0.091	-0.099	-0.113	-0.115	-0.090
D	-0.013	-0.012	-0.011	-0.011	-0.010	-0.008	-0.019	-0.019	-0.017	-0.017	-0.016	-0.012
E	0.004	0.002	0.004	0.004	0.004	0.003	0.004	0.002	0.005	0.006	0.005	0.004
F	0.012	0.008	0.021	0.016	0.017	0.016	0.010	0.004	0.021	0.016	0.016	0.017
G	0.018	0.016	0.040	0.035	0.041	0.032	0.018	0.013	0.045	0.042	0.051	0.039
H	-0.134	-0.156	-0.131	-0.068	-0.065	-0.030	-0.070	-0.125	-0.073	0.002	0.008	0.049
I	0.002	0.002	0.004	0.002	0.003	0.001	0.001	0.001	0.003	0.002	0.002	0.000
J	-0.011	-0.009	-0.008	-0.009	-0.009	-0.011	-0.019	-0.016	-0.015	-0.016	-0.017	-0.020
K	-0.013	-0.014	-0.016	-0.011	-0.009	-0.008	-0.020	-0.022	-0.026	-0.019	-0.016	-0.015
L	-0.026	-0.016	-0.015	-0.015	-0.016	-0.029	-0.041	-0.027	-0.026	-0.027	-0.027	-0.050
M	0.005	0.001	0.008	0.004	0.006	0.001	0.003	-0.003	0.005	0.001	0.002	-0.005
N	0.015	0.009	0.015	0.017	0.021	0.020	0.017	0.010	0.018	0.022	0.026	0.025
O	-0.021	-0.020	-0.020	-0.023	-0.023	-0.023	-0.032	-0.032	-0.033	-0.037	-0.037	-0.039
P	-0.010	-0.009	-0.009	-0.009	-0.009	-0.013	-0.016	-0.015	-0.015	-0.016	-0.016	-0.021
Q	-0.009	-0.008	-0.008	-0.009	-0.008	-0.009	-0.014	-0.013	-0.014	-0.016	-0.014	-0.017
R	-0.006	-0.006	-0.007	-0.001	-0.005	-0.001	-0.010	-0.010	-0.011	-0.002	-0.008	-0.002
S	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	-0.001	0.000	-0.001	0.000	-0.001
T	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HH trans.	0.239	0.282	0.196	0.149	0.135	0.109	0.269	0.362	0.237	0.183	0.161	0.139