

# 1.A.3.b - Transport: Road Transport

## Short description

In category *1.A.3.b - Road Transport* emissions from fuel combustion activities as well as abrasive and fugitive emissions are reported within the following categories:

NFR-Code	Name of Category
<b>Emissions from Fuel Combustion in Road Vehicles</b>	
1.A.3.b i	Passenger Cars - PCs
1.A.3.b ii	Light Duty Vehicles - LDVs
1.A.3.b iii	Heavy Duty Vehicles - HDVs
1.A.3.b iv	Mopeds & Motorcycles - MPDs & MCs
<b>Fugitive Emissions from Road Vehicles</b>	
1.A.3.b v	Gasoline Evaporation
<b>Emissions from Tyre and Brake Wear &amp; Road Abrasion</b>	
1.A.3.b vi	Automobile Tyre and Brake Wear
1.A.3.b vii	Automobile Road Abrasion

Emissions from motorised road traffic in Germany are reported under this category. It includes traffic on public roads within Germany, except for agricultural and forestry transports and military transports. Calculations are made for the vehicle categories of passenger cars, motorcycles, light duty vehicles, heavy duty vehicles and buses. For calculation purposes, the vehicle categories are broken down into so-called vehicle layers with the same emissions behaviour. To this end, vehicle categories are also broken down by type of fuel used, vehicle size (trucks and buses by weight class; automobiles and motorcycles by engine displacement) and pollution control equipment used, as defined by EU directives for emissions control ("EURO norms"), and by regional traffic distribution (outside of cities, in cities and autobahn).

Since 1990, emissions of NO<sub>x</sub>, CO, NMVOC and SO<sub>2</sub> from road transports have decreased sharply, due to catalytic-converter use and engine improvements resulting from continual tightening of emissions laws, and due to improved fuel quality.

For buses and heavy duty vehicles (over 3.5 t total permissible vehicle weight), maximum permissible levels of hydrocarbon (HC, incl. NMVOC) emissions were lowered especially sharply (-40%) via the introduction of the EURO3 standard in 2000. Since EURO3 vehicles were very quick to reach the market as of 2000, the emission factor for hydrocarbon emissions from diesel fuel - and the relevant emissions themselves - decreased considerably after 2000.

## Methodology

Emissions are calculated with the aid of the TREMOD model ("Transport Emission Estimation Model" v6.02) from (Knörr, W. et al. (2021a)) <sup>1)</sup>.

This model adopts a "bottom-up" (tier3) approach whereby mileage of the individual vehicle layers is multiplied by region-specific emission factors. For passenger cars and light duty vehicles, a "cold start surplus" is also added. The total consumption calculated on the basis of fuel type is compared with the consumption according to the Energy Balance. The emissions are then corrected with the aid of factors obtained from this comparison process. For petrol-powered vehicles, the evaporation emissions of VOC are calculated in keeping with the pollution-control technology used. From the emissions and fuel consumption for the various vehicle layers, aggregated, fuelbased emission factors (kg of emissions per TJ of fuel consumption) are derived, and then the emission factors are forwarded to the CSE via a relevant interface. In keeping with the CORINAIR report structure, these factors are differentiated only by type of fuel, type of road (autobahn, rural road, city road) and, within the vehicle categories, by "without/with emissions-control equipment". The following emissions-control categories are differentiated:

For calculation with TREMOD, extensive basic data from generally accessible statistics and special surveys were used, co-ordinated, and supplemented. An overview of the principal sources and key assumptions is given below. Detailed descriptions of the databases, including information on the sources used, and the calculation methods used in TREMOD, are provided in the aforementioned IFEU report.

## Activity Data

The basis for CSE data collection for the road-transport sector consists of fuel consumption data provided by the Working Group on Energy Balances (AGEB) <sup>2)</sup>. For each year, the sum of the activity rates for the various individual structural elements must correspond to the Energy Balance data, in terajoule. The relevant basic Energy Balance data is shown in the table below.

Table 1: Fuel consumption in German road transport, in terajoules

	Gasoline	Diesel oil	Biofuels	CNG, LPG & LNG	Petroleum	Lubricant
1990	1,330,479	735,920	0	138	0	2,495
1991	1,332,285	785,174	0	137	0	1,668
1992	1,344,129	853,502	0	229	0	1,275
1993	1,350,617	907,787	0	184	473	857
1994	1,276,637	932,060	0	184	559	586
1995	1,299,982	964,013	1,504	138	610	447
1996	1,299,879	964,580	2,046	115	638	365
1997	1,297,487	979,586	3,652	106	357	261
1998	1,300,463	1,022,794	4,081	106	637	202
1999	1,300,602	1,097,036	5,370	100	637	113
2000	1,237,055	1,108,105	12,276	94	414	81
2001	1,199,318	1,097,416	16,740	98	471	73
2002	1,166,381	1,105,842	20,460	607	472	75
2003	1,108,989	1,078,352	29,948	694	0	71
2004	1,072,720	1,110,931	40,042	1,887	0	73
2005	992,377	1,078,620	78,897	5,484	0	77
2006	930,834	1,082,042	143,881	9,051	0	76
2007	892,982	1,073,987	155,752	14,787	0	79
2008	854,002	1,102,624	126,181	22,796	0	80
2009	829,227	1,114,939	113,765	32,285	0	86
2010	791,416	1,168,063	120,129	30,591	0	81
2011	787,803	1,197,252	115,828	32,384	0	80
2012	742,000	1,223,718	120,513	32,438	0	76
2013	741,150	1,283,637	109,358	30,508	0	77
2014	744,661	1,296,828	113,957	28,983	0	77
2015	708,672	1,348,789	105,764	26,420	0	77
2016	709,179	1,393,481	106,054	22,705	0	77
2017	719,580	1,425,424	108,049	21,316	0	77
2018	692,694	1,377,104	112,594	21,514	0	76
2019	699,835	1,390,837	111,781	21,147	0	76
2020	629,926	1,241,557	135,073	22,708	0	78

Source: Evaluation tables of the Energy Balances, "Mineralölzahlen" ("Petroleum Data") of the Association of the German Petroleum Industry (MWV) <sup>3)</sup> and "Amtliche Mineralölzahlen" ("Official Petroleum Data", BAFA); lubricant in 2-Stroke mix: TREMOD

For more information on the derivation of activity data and the emission factors applied, please refer to the sub-ordinate chapters as well as Appendix 2.2.

## Uncertainties

Uncertainty estimates for **activity data** of mobile sources derive from research project FKZ 360 16 023: "Ermittlung der Unsicherheiten der mit den Modellen TREMOD und TREMOD-MM berechneten Luftschadstoffemissionen des landgebundenen Verkehrs in Deutschland" by (Knörr et al. (2009)) <sup>4)</sup>.

Uncertainty estimates for **emission factors** for all 1.A.3.b sub-categories were compiled during the PAREST research project. Here, the final report has not yet been published.

## Recalculations



Basically, recalculations result from a) the revision of the National Energy Balance (for most recent years) and b) routine revisions of the underlying TREMOD model (recent years or entire time series, depending on outline of revision).

For more details please refer to chapter 1.A.3.b i-iv - Emissions from Fuel Combustion in Road Vehicles and the related sub-chapters as linked above.

## Planned improvements

Besides the routine revision of the TREMOD model, no specific improvements are planned.

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<sup>1)</sup> Knörr et al. (2021a): Knörr, W., Heidt, C., Gores, S., & Bergk, F.: Fortschreibung des Daten- und Rechenmodells: Energieverbrauch und Schadstoffemissionen des motorisierten Verkehrs in Deutschland 1960-2035, sowie TREMOD, im Auftrag des Umweltbundesamtes, Heidelberg [u.a.]: Ifeu Institut für Energie- und Umweltforschung Heidelberg GmbH, Heidelberg & Berlin, 2021.

<sup>2)</sup> AGEb (2021): Working Group on Energy Balances (Arbeitsgemeinschaft Energiebilanzen (Hrsg.), AGEb): Energiebilanz für die Bundesrepublik Deutschland; URL: <https://ag-energiebilanzen.de/7-0-Bilanzen-1990-2019.html>, Köln & Berlin, 2021.

<sup>3)</sup> MWV (2021): Association of the German Petroleum Industry (Mineralölwirtschaftsverband, MWV): Annual Report 2018, page 65, Table 'Sektoraler Verbrauch von Dieselmotorkraftstoff 2012-2019'; URL: [https://www.mwv.de/wp-content/uploads/2020/09/MWV\\_Mineraloelwirtschaftsverband-e.V.-Jahresbericht-2020-Webversion.pdf](https://www.mwv.de/wp-content/uploads/2020/09/MWV_Mineraloelwirtschaftsverband-e.V.-Jahresbericht-2020-Webversion.pdf), Berlin, 2021.

<sup>4)</sup> Knörr et al. (2009): Knörr, W., Heldstab, J., & Kasser, F.: Ermittlung der Unsicherheiten der mit den Modellen TREMOD und TREMOD-MM berechneten Luftschadstoffemissionen des landgebundenen Verkehrs in Deutschland; final report; URL: <https://www.umweltbundesamt.de/sites/default/files/medien/461/publikationen/3937.pdf>, FKZ 360 16 023, Heidelberg & Zürich, 2009.