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
Emissions from Fuel Combustion in Road Vehicles	
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
Fugitive Emissions from Road Vehicles	
1.A.3.b v	Gasoline Evaporation
Emissions from Tyre and Brake Wear & Road Abrasion	
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_x, CO, NMVOC and SO_2 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”) from (Knörr, W. et al. (2022a)) [1)].

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) [2)]. 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.

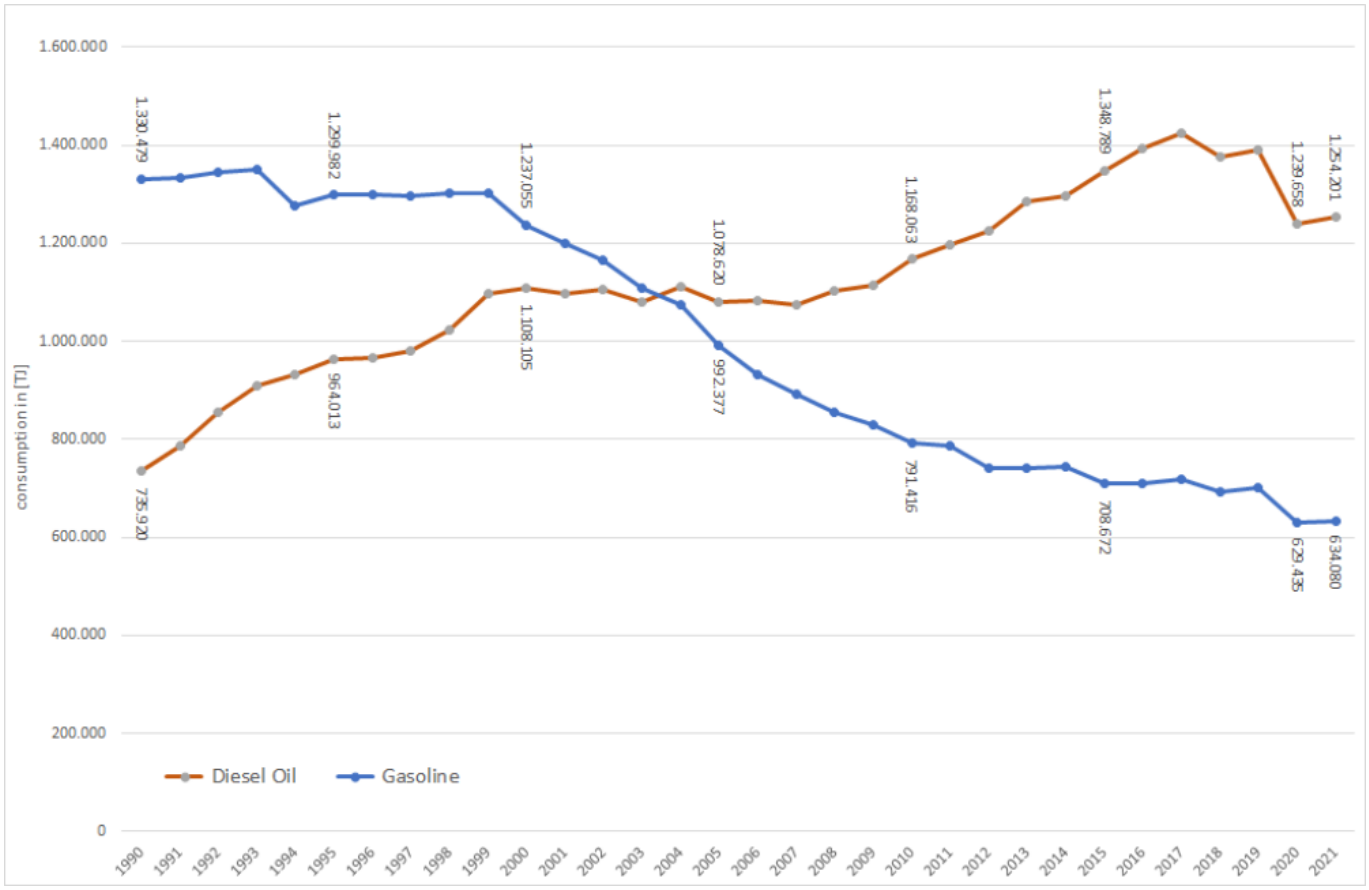
Table 1: Fuel consumption in German road transport, in terajoules

	Diesel oil	Gasoline	LPG	CNG	LNG	Petroleum[1]	Biodiesel	Biogasoline	Biogas	Lubricants[2]	TOTAL
1990	735,920	1,330,479	138							2,543	2,069,080
1991	785,174	1,332,285	137							1,702	2,119,298
1992	853,502	1,344,129	229							1,299	2,199,159
1993	907,787	1,350,617	184			473				872	2,259,933
1994	932,060	1,276,637	184			559				596	2,210,036
1995	964,013	1,299,982	138			610	1,504			455	2,266,702
1996	964,580	1,299,879	115			638	2,046			372	2,267,630
1997	979,586	1,297,487	106			357	3,652			266	2,281,454
1998	1,022,794	1,300,463	106			637	4,081			206	2,328,287
1999	1,097,036	1,300,602	100			637	5,370			116	2,403,861
2000	1,108,105	1,237,055	94			414	12,276			83	2,358,027
2001	1,097,416	1,199,318	98			471	16,740			74	2,314,117
2002	1,105,842	1,166,381	607			472	20,460			77	2,293,839
2003	1,078,352	1,108,989	694			0	29,948			73	2,218,056
2004	1,110,931	1,072,720	1,887			0	38,898	1,144		75	2,225,655
2005	1,078,620	992,377	2,357	3,127		0	72,080	6,817		78	2,155,457
2006	1,082,042	930,834	4,605	4,446		0	130,463	13,418		77	2,165,884
2007	1,073,987	892,982	8,942	5,845		0	143,691	12,061		80	2,137,589
2008	1,102,624	854,002	15,652	7,144		0	109,853	16,328		81	2,105,684
2009	1,114,939	829,227	23,842	8,443		0	90,074	23,691		87	2,090,304
2010	1,168,063	791,416	21,823	8,768		0	89,552	30,577		83	2,110,282
2011	1,197,252	787,803	23,613	8,771		0	83,536	32,292		81	2,133,348
2012	1,223,719	742,000	23,532	8,869	36	0	86,365	32,882	1,267	77	2,118,745
2013	1,283,637	741,150	23,077	7,389	41	0	76,126	31,770	1,462	78	2,164,730
2014	1,296,828	744,661	21,464	7,472	47	0	79,691	32,383	1,883	78	2,184,507
2015	1,348,789	708,672	18,963	7,407	52	0	73,779	30,736	1,249	78	2,189,725
2016	1,393,481	709,179	16,799	5,848	63	0	73,875	30,804	1,375	78	2,231,502
2017	1,425,424	719,580	15,377	5,848	104	0	76,096	30,337	1,616	77	2,274,459
2018	1,377,104	692,694	16,153	5,198	192	0	80,049	31,146	1,399	76	2,204,011
2019	1,390,837	699,835	14,602	5,848	830	0	79,219	30,184	2,378	77	2,223,810
2020	1,239,658	629,435	9,551	5,912	2,511	0	102,973	28,737	3,181	80	2,022,040
2021	1,254,201	634,080	9,500	6,657	5,045	0	87,131	30,165	3,181	73	2,030,033

[1]: applied only from 1993 to 2002 in a small number of buses (se chapter on NFR 1.A.3.b iii)

[2]: amounts of lubricants unintentionally co-incinerated in road vehicles (lubricants intentionally co-incinerated in 2-stroke road vehicles are taken into account in NFR 2.D.3.i Mobile Use of Lubricants

The following chart illustrates the (ongoing) trend to diesel vehicles operated in Germany, the so-called “Dieselization” with the amounts of fossil diesel oil exceeing those of fossil gasoline fuels from 2004 onwards.



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)) [3)].

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 revsisions of the underlying TREMOD model (recent years or entire time series, depending on outline of revision).

For more details please refer to the related sub-chapters as linked above.

Planned improvements

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

[1)] Knörr et al. (2022a): 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, 2022.
[2)] AGEB, 2022: Working Group on Energy Balances (Arbeitsgemeinschaft Energiebilanzen (Hrsg.), AGEB): Energiebilanz für die Bundesrepublik Deutschland; https://ag-energiebilanzen.de/daten-und-fakten/bilanzen-1990-bis-2020/?wpv-jahresbereich-bilanz=2011-2020, (Aufruf: 23.11.2022), Köln & Berlin, 2022
[3)] 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.