1.A.3.b iii - Transport: Road Transport: Heavy Duty Vehicles and Buses

Short description

In sub-category *1.A.3.b iii - Road Transport: Heavy Duty Vehicles and Buses* emissions from fuel combustion in trucks, lorries, buses etc. are reported.

Method	AD	EF	Key Category Analysis
T1, T3	NS, M	CS, M, D	**L&** : NO,,x,,, PM,,2.5,,, PM,,10,,, BC

T = key source by Trend **L** = key source by Level

Methods	
D	Default
RA	Reference Approach
T1	Tier 1 / Simple Methodology *
T2	Tier 2*
T3	Tier 3 / Detailed Methodology *
C	CORINAIR
CS	Country Specific
M	Model
* as described in the EMEP/CORINAIR Emission Inventory Guidebook - 2007, in the group specific chapters.	

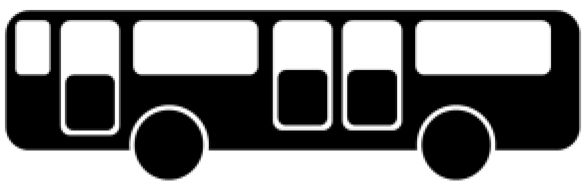
AD - Data Source for Activity Data	
NS	National Statistics
RS	Regional Statistics
IS	International Statistics
PS	Plant Specific data
AS	Associations, business organisations
Q	specific questionnaires, surveys

EF - Emission Factors	
D	Default (EMEP Guidebook)
C	Confidential
CS	Country Specific
PS	Plant Specific data

Methodology

Activity data

Specific consumption data for heavy-duty vehicles (trucks and lorries) and buses are generated within TREMOD [1)]. - The following tables provide an overview of annual amounts of fuels consumed by these vehicles in Germany.



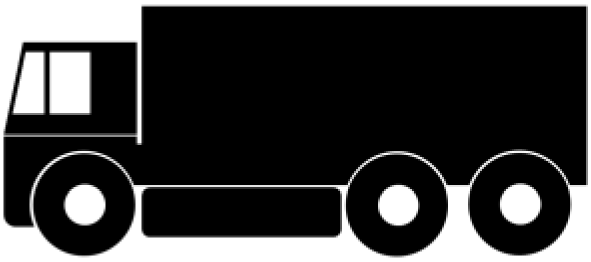


Table 1: Annual fuel consumption of trucks and lorries, in terajoules

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
HDVs: BUSES														
Diesel oil	55,150	47,931	47,854	38,966	42,435	41,389	43,823	45,779	45,332	48,707	49,184	47,804	45,803	
Biodiesel	0	75	530	2,595	3,229	2,863	3,068	2,693	2,762	2,640	2,588	2,535	2,644	
CNG	0	0	0	1,178	2,188	1,999	2,142	1,708	1,655	1,569	1,194	1,005	1,091	
Biogas	0	0	0	0	0	0	306	338	417	265	281	312	255	
Petroleum	0	610	414	0	0	0	0	0	0	0	0	0	0	
Σ Buses	**55,150**	**48,006**	**48,385**	**42,739**	**47,852**	**46,250**	**49,340**	**50,517**	**50,166**	**53,181**	**53,247**	**51,657**	**49,792**	
HDVs: TRUCKS & LORRIES														
Diesel oil	385,726	521,830	618,687	477,169	524,126	525,901	550,904	566,338	542,865	579,961	587,801	592,974	577,135	
Biodiesel	0	814	6,854	31,774	39,884	36,375	38,574	33,312	33,076	31,439	30,935	31,449	33,312	
CNG	0	0	0	0	0	0	397	340	317	273	194	166	201	
Biogas	0	0	0	0	0	0	57	67	80	46	46	52	47	
Σ Trucks & Lorries	**385,726**	**522,644**	**625,541**	**508,943**	**564,010**	**562,276**	**589,932**	**600,057**	**576,338**	**611,719**	**618,975**	**624,641**	**610,695**	
HDVs OVER-ALL														
Diesel oil	440,876	569,761	666,542	516,135	566,561	567,290	594,728	612,117	588,197	628,668	636,985	640,779	622,937	
Biodiesel	0	889	7,384	34,369	43,114	39,238	41,642	36,005	35,838	34,079	33,524	33,985	35,955	
CNG	0	0	0	1,178	2,188	1,999	2,539	2,047	1,972	1,842	1,388	1,170	1,292	
Biogas	0	0	0	0	0	0	363	405	497	311	326	364	302	
Petroleum	0	610	414	0	0	0	0	0	0	0	0	0	0	
Σ 1.A.3.b iii	**440,876**	**570,650**	**673,926**	**551,681**	**611,862**	**608,527**	**639,272**	**650,574**	**626,504**	**664,900**	**672,222**	**676,297**	**660,487**	

source: TREMOD 6.02 [2)]

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For information on mileage, please refer to sub-chapters on emissions from tyre & brake wear and road abrasion.

Emission factors

The majority of emission factors for exhaust emissions from road transport are taken from the 'Handbook Emission Factors for Road Transport' (HBEFA, version 4.1) [3)] where they are provided on a tier3 level mostly and processed within the TREMOD software used by the party [4)].

However, it is not possible to present these tier3 values in a comprehendible way here.

With respect to the country-specific emission factors applied for particulate matter, given the circumstances during test-bench measurements, condensables are most likely included at least partly. [1]

For heavy-metal (other then lead from leaded gasoline) and PAH exhaust-emissions, default emission factors from the 2019 EMEP Guidebook (EMEP/EEA, 2019) [5] have been applied. Regarding PCDD/F, tier1 EF from (Rentz et al., 2008) [6] are used instead.

Table 2: tier1 EF derived from default values

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	B[a]P	B[b]F	B[k]F	I[...]P	PAH 1-4	PCDD/F
	[g/TJ]									[mg/TJ]					[µg/km]
Diesel oil	0.012	0.001	0.123	0.002	0.198	0.133	0.005	0.002	0.419	498	521	275	493	1,788	
Biodiesel	0.013	0.001	0.142	0.003	0.228	0.153	0.005	0.003	0.483	575	601	317	569	2,062	
CNG & Biogas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
Petroleum	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
all fuels: buses															0.000019
all fuels: trucks & lorries															0.000016

Discussion of emission trends

> **NFR 1.A.3.b iii** is key category for **NO,,x,,**, **PM,,2.5,,**, **PM,,10,,** and **BC**.

++ Nitrogen oxides (NO,,x,,)

Until 2005, NO,,x,, emissions followed mileage and fuel consumption. Since 2006, in contrast to nearly unchanged fuel consumption, emissions have decreased due to controlled catalytic-converter use and engine improvements resulting from continual tightening of emissions laws.

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++ Non-methane volatile organic compounds (NMVOC) and carbon monoxide (CO)

Since the early 1990s, exhaust emissions of **NMVOC** and **carbon monoxide** have decreased due to catalytic-converter use and engine improvements resulting from ongoing tightening of emissions laws and improved fuel quality.

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++ Ammonia (NH,,3,,) and sulphur dioxide (SO,,2,,)

As for the entire road transport sector, the trends for **sulphur dioxide** (SO,,2,,) and **ammonia** (NH,,3,,) exhaust emissions from heavy duty vehicles show charcteristics different from those shown above: Here, the strong dependence on increasing fuel qualities (sulphur content) leads to an cascaded downward trend of SO,,2,, emissions , influenced only slightly by increases in fuel consumption and mileage. For **ammonia** emissions the increasing use of catalytic converters in gasoline driven cars in the 1990s lead to a steep increase whereas both the technical development of the converters and the ongoing shift from gasoline to diesel cars resulted in decreasing emissions in the following years.

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++ Particulate matter (BC, PM,,2.5,,, PM,,10,,, and TSP)

As for all reported exhaust PM emissions from mobile diesel vehicles the Party assumes that nearly all particles emitted are within the PM,,2.5,, range, resulting in similar emission values for PM,,2.5,,, PM,,10,,, and TSP.

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Recalculations

Compared to submission 2020, recalculations were carried out due to a routine revision of the TREMOD software and the revision of several National Energy Balances (NEB).

Here, **activity data** were revised within TREMOD due to the provision of the final NEB 2018.

Furthermore, significant re-allocations of consumption shares between the different vehicle types and classes were conducted, effecting the entire time series but with the 1.A.3.b consumptipon totals remaining unaltered.

Table 4: Revised fuel consumption data, in terajoules

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
DIESEL OIL																	
Submission 2021	23,131	19,972	24,124	23,030	21,811	21,678	20,902	20,202	19,039	18,591	17,555	17,548	17,996	17,777	18,080	18,456	
Submission 2020	22,049	16,628	19,184	20,151	20,306	17,167	17,492	17,657	17,384	18,033	17,840	18,540	19,289	18,641	18,609	18,809	
absolute change	1,082	3,344	4,940	2,878	1,505	4,511	3,410	2,544	1,655	558	-285	-992	-1,293	-863	-529	-352	
relative change	4,91%	20,1%	25,8%	14,3%	7,41%	26,3%	19,5%	14,4%	9,52%	3,09%	-1,60%	-5,35%	-6,71%	-4,63%	-2,84%	-1,87%	
BIODIESEL																	
Submission 2021	0	0	0	158	314	293	400	577	736	762	778	752	783	771	785	778	
Submission 2020	0	0	0	138	293	232	334	504	672	739	791	795	839	808	808	801	
absolute change	0	0	0	20	22	61	65	73	64	23	-13	-43	-56	-37	-23	-23	
relative change	0.00	0.00	0.00	14,3%	7,41%	26,3%	19,5%	14,4%	9,52%	3,09%	-1,60%	-5,35%	-6,71%	-4,63%	-2,84%	-2,82%	
CNG																	
Submission 2021	23,131	19,972	24,124	23,030	21,811	21,678	20,902	20,202	19,039	18,591	17,555	17,548	17,996	17,777	18,080	18,456	
Submission 2020	22,049	16,628	19,184	20,151	20,306	17,167	17,492	17,657	17,384	18,033	17,840	18,540	19,289	18,641	18,609	18,809	
absolute change	1,082	3,344	4,940	2,878	1,505	4,511	3,410	2,544	1,655	558	-285	-992	-1,293	-863	-529	-352	
relative change	4,91%	20,1%	25,8%	14,3%	7,41%	26,3%	19,5%	14,4%	9,52%	3,09%	-1,60%	-5,35%	-6,71%	-4,63%	-2,84%	-1,87%	
BIOGAS																	
Submission 2021	23,131	19,972	24,124	23,030	21,811	21,678	20,902	20,202	19,039	18,591	17,555	17,548	17,996	17,777	18,080	18,456	
Submission 2020	22,049	16,628	19,184	20,151	20,306	17,167	17,492	17,657	17,384	18,033	17,840	18,540	19,289	18,641	18,609	18,809	
absolute change	1,082	3,344	4,940	2,878	1,505	4,511	3,410	2,544	1,655	558	-285	-992	-1,293	-863	-529	-352	
relative change	4,91%	20,1%	25,8%	14,3%	7,41%	26,3%	19,5%	14,4%	9,52%	3,09%	-1,60%	-5,35%	-6,71%	-4,63%	-2,84%	-1,87%	
TOTAL FUEL CONSUMPTION																	
Submission 2021	23,131	19,972	24,124	23,188	22,125	21,971	21,302	20,779	19,775	19,354	18,336	18,304	18,783	18,554	18,871	19,242	
Submission 2020	22,049	16,628	19,184	20,290	20,598	17,399	17,827	18,162	18,056	18,773	18,631	19,335	20,128	19,449	19,417	19,609	
absolute change	1,082	3,344	4,940	2,898	1,527	4,572	3,475	2,617	1,719	581	-295	-1,030	-1,345	-895	-545	-368	
relative change	4.91%	20.1%	25.8%	14.3%	7.41%	26.3%	19.5%	14.4%	9.52%	3.09%	-1.58%	-5.33%	-6.68%	-4.60%	-2.81%	-1.88%	

Due to the variety of highly specific tier3 **emission factors** applied, it is not possible to display any changes in these data sets in a comprehendible way.

For more information on recalculated emission estimates reported for Base Year and 2018, please see the pollutant-specific recalculation tables following chapter 8.1 - Recalculations.

Planned improvements

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

FAQs

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bibliography : 1 : Knörr et al. (2019a): Knörr, W., Heidt, C., Gores, S., & Bergk, F.: ifeu Institute for Energy and Environmental Research (Institut für Energie- und Umweltforschung Heidelberg gGmbH, ifeu): Fortschreibung des Daten- und Rechenmodells: Energieverbrauch und Schadstoffemissionen des motorisierten Verkehrs in Deutschland 1960-2030, sowie TREMOD, im Auftrag des Umweltbundesamtes, Heidelberg & Berlin, 2019. : 2 : Keller et al. (2007): Keller, M., Hausberger, S., Matzer, C., Wüthrich, P., & Notter, B.: Handbook Emission Factors for Road Transport, version 4.1 (Handbuch Emissionsfaktoren des Straßenverkehrs 4.1) URL: http://www.hbefa.net/e/index.html - Dokumentation, Bern, 2017. : 3 : EMEP/EEA, 2019: EMEP/EEA air pollutant emission inventory guidebook 2019; 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; Copenhagen, 2019. : 4 : Rentz et al., 2008: Nationaler Durchführungsplan unter dem Stockholmer Abkommen zu persistenten organischen Schadstoffen (POPs), im Auftrag des Umweltbundesamtes, FKZ 205 67 444, UBA Texte | 01/2008, January 2008 - URL: http://www.umweltbundesamt.de/en/publikationen/nationaler-durchfuehrungsplan-unter-stockholmer bibliography

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[1] (bibcite 1)
[2] (bibcite 1)
[3] (bibcite 2)
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[5] (bibcite 3)
[6] (bibcite 4)
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During test-bench measurements, temperatures are likely to be significantly higher than under real-world conditions, thus reducing condensation. On the contrary, smaller dillution (higher number of primary particles acting as condensation germs) together with higher pressures increase the likeliness of condensation. So over-all condensables are very likely to occur but different to real-world conditions.