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.

Category Code	Method					AD					EF				
1.A.3.b iii	T1, T3					NS, M					CS, M, D				
Key Category	**SO_2**	**NO_x**	**NH_3**	**NMVOC**	**CO**	**BC**	**Pb**	**Hg**	**Cd**	**Diox**	**PAH**	**HCB**	**TSP**	**PM_{10}**	**$PM_{2.5}$**
1.A.3.b iii	-/-	L/T	-/-	-/-	-/-	L/T	-/-	-/-	-/-	-/-	-/-	-	-/-	L/T	L/T

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.

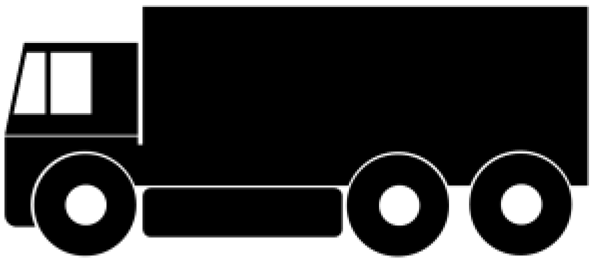

Table 1: Annual fuel consumption of trucks and lorries, in terajoules

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
HDVs: Buses																		
Diesel oil	57.433	49.083	49.344	39.968	39.501	37.437	38.906	42.223	44.623	44.276	47.546	48.820	46.298	49.575	51.430	50.676	48.797	50.087
Biodiesel	0	77	547	2.671	4.763	5.009	3.876	3.411	3.421	3.089	3.356	2.895	2.845	2.712	2.727	2.705	2.836	2.852
CNG	0	0	0	1.183	1.682	1.965	2.072	2.255	2.200	2.011	2.157	1.719	1.653	1.574	1.198	1.009	937	866
Biogas	0	0	0	0	0	0	0	0	0	0	308	340	417	265	282	314	252	396
Petroleum	0	610	414	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Σ Buses	**57.433**	**49.159**	**49.891**	**43.822**	**45.946**	**44.411**	**44.854**	**47.889**	**50.244**	**49.376**	**53.366**	**53.775**	**51.213**	**54.127**	**55.637**	**54.704**	**52.822**	**54.201**
HDVs: Trucks & Lorries																		
Diesel oil	401.691	541.176	630.955	486.102	508.241	491.992	496.253	482.997	526.385	527.113	550.718	566.541	539.595	558.842	564.107	567.943	553.039	563.811
Biodiesel	0	844	6.990	32.484	61.279	65.825	49.441	39.020	40.356	36.778	38.867	33.599	33.159	30.569	29.906	30.319	32.147	32.102
CNG	0	0	0	0	0	0	0	0	0	0	395	338	314	272	192	164	167	194
Biogas	0	0	0	0	0	0	0	0	0	0	56	67	79	46	45	51	45	89
Σ Trucks & Lorries	**401.691**	**542.020**	**637.944**	**518.587**	**569.520**	**557.816**	**545.694**	**522.017**	**566.741**	**563.891**	**590.037**	**600.544**	**573.147**	**589.729**	**594.250**	**598.477**	**585.398**	**596.196**
HDVs over all																		
Diesel oil	459.124	590.259	680.299	526.071	547.742	529.429	535.158	525.220	571.008	571.389	598.264	615.361	585.893	608.417	615.537	618.619	601.836	613.898
Biodiesel	0	921	7.537	35.155	66.042	70.833	53.317	42.432	43.777	39.867	42.223	36.494	36.004	33.281	32.633	33.025	34.984	34.954
CNG	0	0	0	1.183	1.682	1.965	2.072	2.255	2.200	2.011	2.552	2.057	1.967	1.846	1.390	1.173	1.104	1.060
Biogas	0	0	0	0	0	0	0	0	0	0	365	407	496	311	327	365	297	485
Petroleum	0	610	414	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Σ 1.A.3.b iii	**459.124**	**591.179**	**687.835**	**562.409**	**615.465**	**602.227**	**590.547**	**569.906**	**616.985**	**613.267**	**643.403**	**654.319**	**624.360**	**643.855**	**649.887**	**653.181**	**638.221**	**650.396**

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.

gallery size="medium" : 1A3biii_EM_NMVOC.png : 1A3biii_EM_CO.png gallery

++ 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	459.124	590.259	680.299	526.071	547.742	529.429	535.158	525.220	571.008	571.389	598.264	615.361	585.893	608.417	615.537	618.619	601.836
Submission 2020	440.876	569.761	666.542	516.135	539.313	521.986	529.223	519.922	566.561	567.290	594.728	612.117	588.197	628.668	636.985	640.779	622.937
absolute change	18.248	20.497	13.757	9.936	8.429	7.443	5.935	5.298	4.447	4.099	3.536	3.244	-2.304	-20.251	-21.448	-22.159	-21.101
relative change	4,14%	3,60%	2,06%	1,93%	1,56%	1,43%	1,12%	1,02%	0,78%	0,72%	0,59%	0,53%	-0,39%	-3,22%	-3,37%	-3,46%	-3,39%
BIODIESEL																	
Submission 2021	0	921	7.537	35.155	66.042	70.833	53.317	42.432	43.777	39.867	42.223	36.494	36.004	33.281	32.633	33.025	34.984

Submission 2020	0	889	7.384	34.369	64.877	69.616	52.505	41.677	43.114	39.238	41.642	36.005	35.838	34.079	33.524	33.985	35.955
absolute change	0	32	152	787	1.165	1.217	812	754	664	630	581	489	165	-799	-891	-960	-972
relative change	#DIV/0!	3,60%	2,06%	2,29%	1,80%	1,75%	1,55%	1,81%	1,54%	1,60%	1,39%	1,36%	0,46%	-2,34%	-2,66%	-2,82%	-2,70%
CNG																	
Submission 2021	0	0	0	1.183	1.682	1.965	2.072	2.255	2.200	2.011	2.552	2.057	1.967	1.846	1.390	1.173	1.104
Submission 2020	0	0	0	1.178	1.675	1.956	2.061	2.243	2.188	1.999	2.539	2.047	1.972	1.842	1.388	1.170	1.292
absolute change	0,00	0,00	0,00	5,06	7,19	9,39	10,63	11,33	11,61	11,95	12,64	9,98	-4,96	4,13	2,79	2,18	-188
relative change	#DIV/0!	#DIV/0!	#DIV/0!	0,43%	0,43%	0,48%	0,52%	0,51%	0,53%	0,60%	0,50%	0,49%	-0,25%	0,22%	0,20%	0,19%	-14,6%
BIOGAS																	
Submission 2021											365	407	496	311	327	365	297
Submission 2020											363	405	497	311	326	364	302
absolute change											1,81	1,98	-1,25	0,70	0,66	0,68	-4,99
relative change											0,50%	0,49%	-0,25%	0,22%	0,20%	0,19%	-1,65%
PETROLEUM																	
Submission 2021		610	414														
Submission 2020		610	414														
absolute change		0,00	0,00														
relative change		0,00%	0,00%														
TOTAL FUEL CONSUMPTION																	
Submission 2021	459.124	591.789	688.249	562.409	615.465	602.227	590.547	569.906	616.985	613.267	643.513	654.436	624.485	643.994	650.046	653.386	638.520
Submission 2020	440.876	571.260	674.340	551.681	605.865	593.558	583.789	563.842	611.862	608.527	639.272	650.574	626.504	664.900	672.222	676.297	660.487
absolute change	18.248	20.529	13.909	10.728	9.600	8.669	6.758	6.064	5.122	4.740	4.241	3.862	-2.019	-20.906	-22.176	-22.912	-21.966
relative change	4,14%	3,59%	2,06%	1,94%	1,58%	1,46%	1,16%	1,08%	0,84%	0,78%	0,66%	0,59%	-0,32%	-3,14%	-3,30%	-3,39%	-3,33%

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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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.