

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	NM VOC	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
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/EEA Emission Inventory Guidebook - 2019, 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 (or surveys)
M	Model / Modelled
C	Confidential

EF - Emission Factors

D	Default (EMEP Guidebook)
C	Confidential
CS	Country Specific
PS	Plant Specific data
M	Model / Modelled

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.



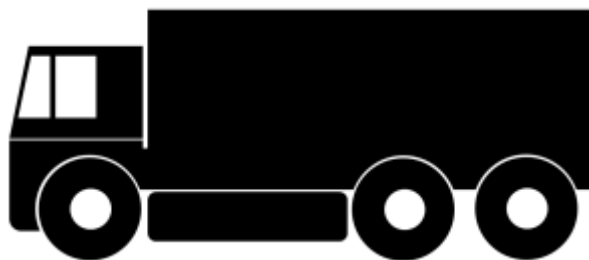


Table 1: Annual fuel consumption of trucks and lorries, in terajoules

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
HDVs: Buses																			
Diesel oil	57,322	49,060	49,204	39,890	39,400	37,316	38,776	42,093	44,448	44,080	47,336	48,611	46,147	49,428	51,353	50,519	48,606	50,088	38,954
Biodiesel	0	77	545	2,666	4,750	4,993	3,863	3,401	3,408	3,076	3,341	2,883	2,836	2,704	2,722	2,697	2,825	2,853	3,236
CNG	0	0	0	1,183	1,682	1,965	2,072	2,255	2,200	2,011	2,157	1,720	1,663	1,591	1,213	1,150	955	1,004	1,152
Biogas	0	0	0	0	0	0	0	0	0	0	308	340	419	268	285	318	257	408	529
Petroleum	0	610	414	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Σ Buses	57,322	49,137	49,750	43,739	45,832	44,274	44,711	47,748	50,056	49,167	53,142	53,555	51,065	53,991	55,574	54,684	52,644	54,353	43,871
HDVs: Trucks & Lorries																			
Diesel oil	401,801	541,198	631,094	486,181	508,342	492,112	496,382	483,129	526,568	527,325	550,954	566,780	539,718	559,069	564,622	568,615	553,447	562,904	537,774
Biodiesel	0	844	6,991	32,490	61,291	65,841	49,454	39,031	40,370	36,793	38,884	33,613	33,166	30,581	29,933	30,355	32,171	32,062	44,671
CNG	0	0	0	0	0	0	0	0	0	0	395	338	316	275	194	187	170	222	348
Biogas	0	0	0	0	0	0	0	0	0	0	56	67	80	46	46	52	46	90	160
Σ Trucks & Lorries	401,801	542,043	638,086	518,670	569,633	557,953	545,836	522,160	566,938	564,118	590,290	600,798	573,279	589,972	594,796	599,209	585,834	595,278	582,953
HDVs over all																			
Diesel oil	459,124	590,259	680,299	526,071	547,742	529,429	535,158	525,222	571,016	571,405	598,290	615,392	585,865	608,497	615,976	619,134	602,053	612,992	576,728
Biodiesel	0	921	7,537	35,155	66,042	70,833	53,317	42,432	43,778	39,869	42,225	36,496	36,002	33,285	32,656	33,052	34,996	34,915	47,907
CNG	0	0	0	1,183	1,682	1,965	2,072	2,255	2,200	2,011	2,552	2,058	1,979	1,866	1,407	1,337	1,125	1,226	1,500
Biogas	0	0	0	0	0	0	0	0	0	0	365	407	499	315	331	370	303	498	688
Petroleum	0	610	414	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Σ I.A.3.b iii	459,124	591,179	687,835	562,409	615,465	602,227	590,547	569,908	616,994	613,284	643,432	654,353	624,344	643,963	650,370	653,893	638,477	649,631	626,824

source: TREMOD 6.02 ²⁾



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 comprehensible 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 than 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

[illegible]

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

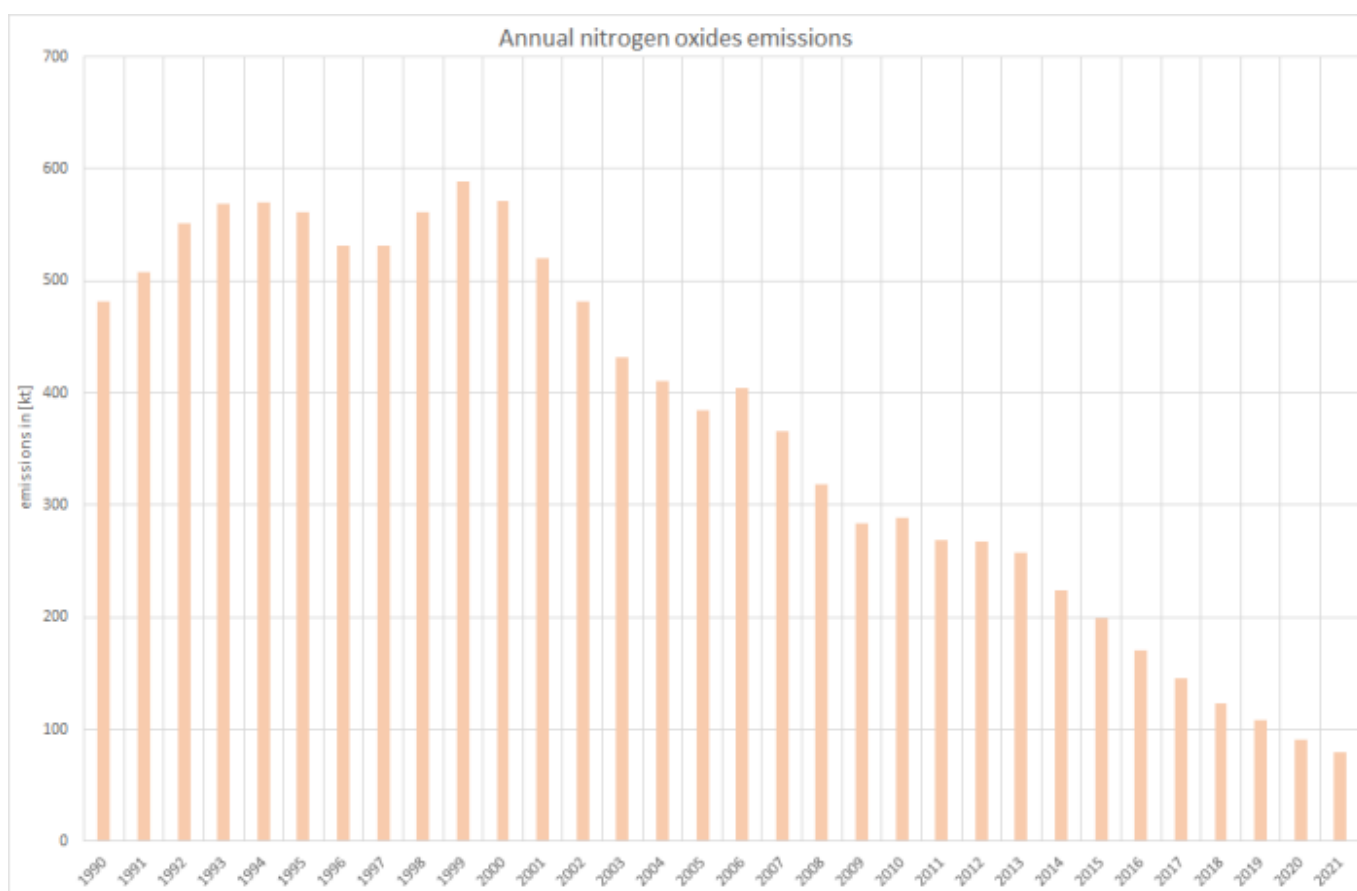
Discussion of emission trends

Outcome of Key Category Analysis

for:	NO_x	BC	PM₁₀	PM_{2.5}
by:	L/T	L/T	L/T	L/T

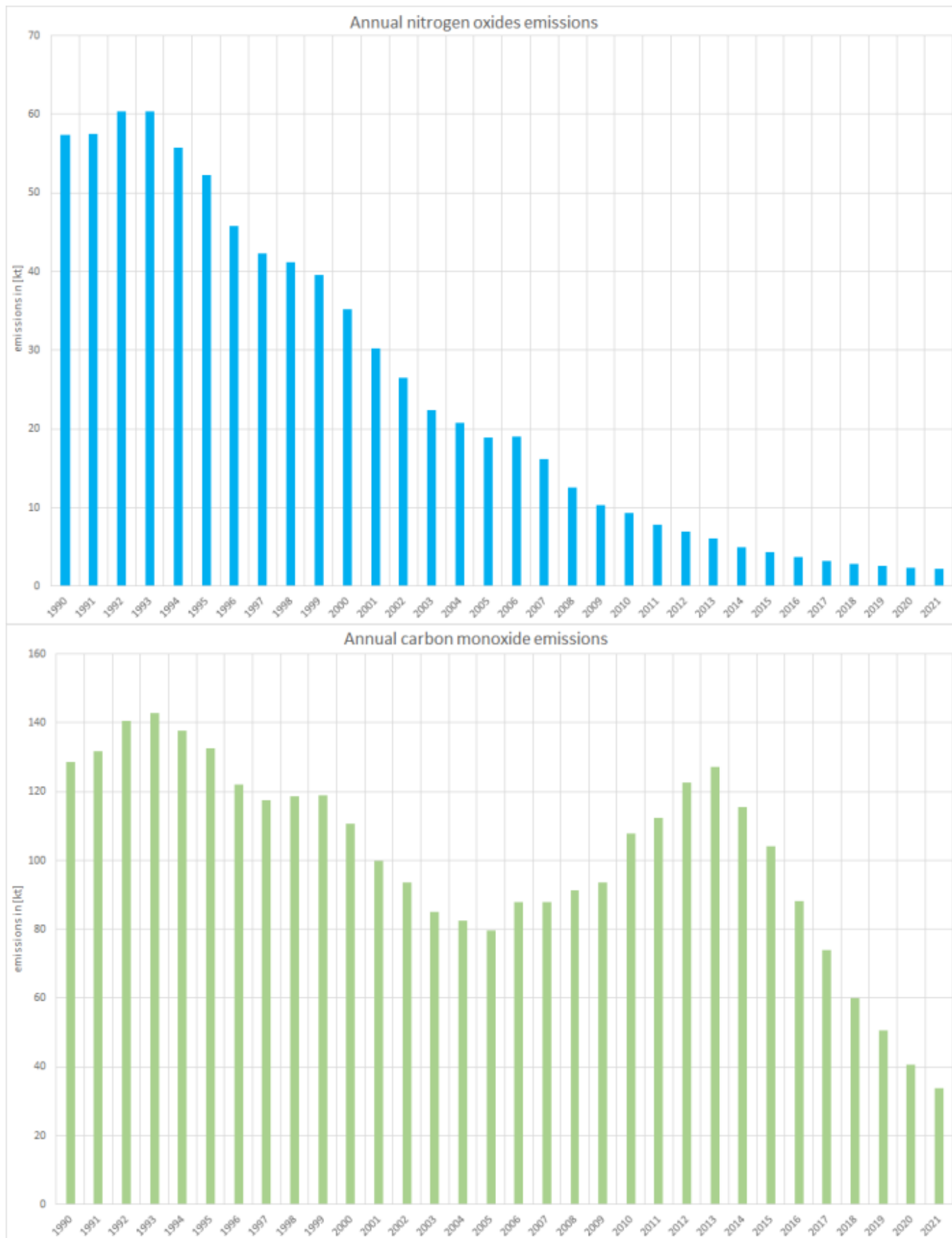
Nitrogen oxides

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.



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

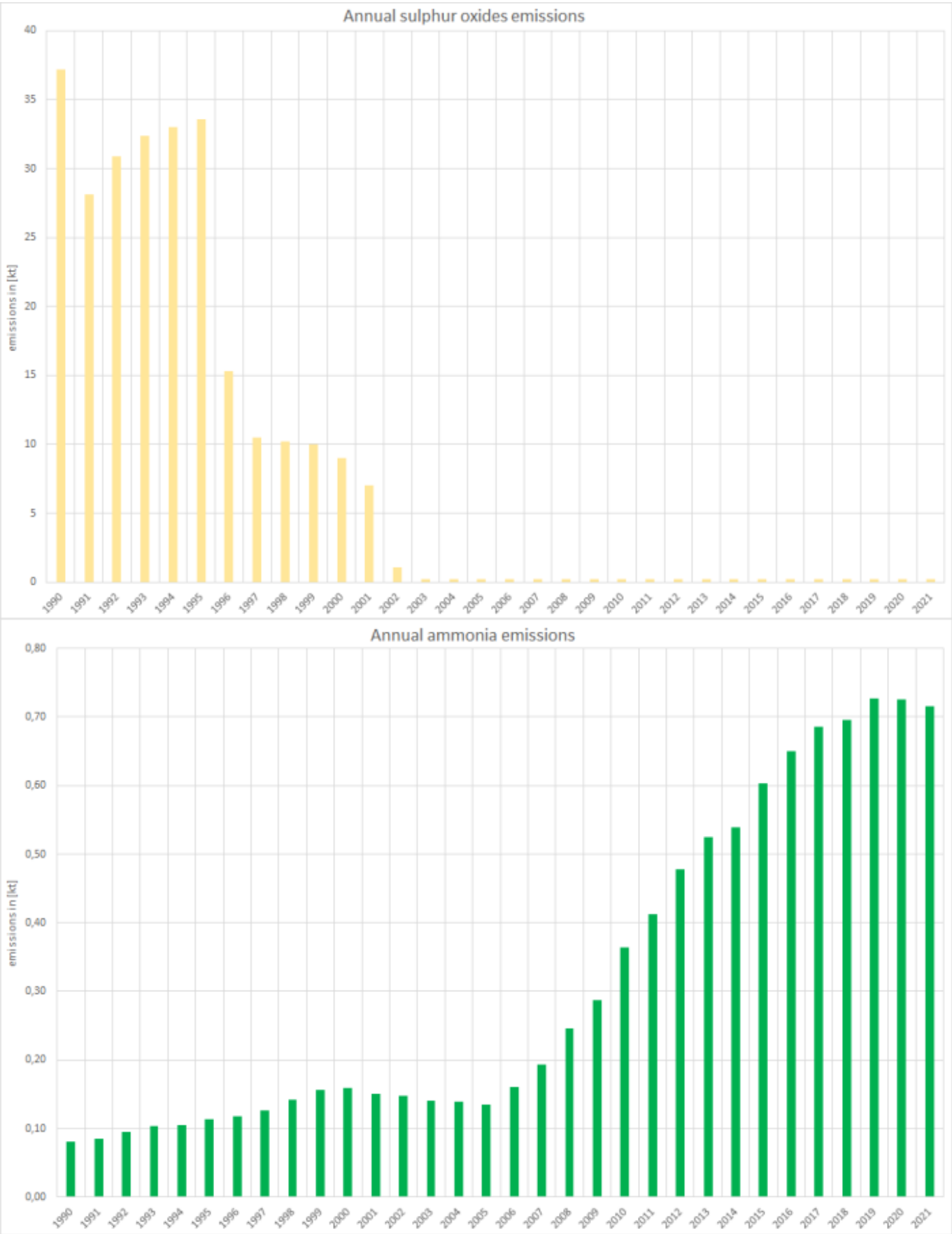
Since 1990, exhaust emissions of **NMVOC** and **carbon monoxide** have decreased sharply due to catalytic-converter use and engine improvements resulting from ongoing tightening of emissions laws and improved fuel quality.



Ammonia and sulphur dioxide

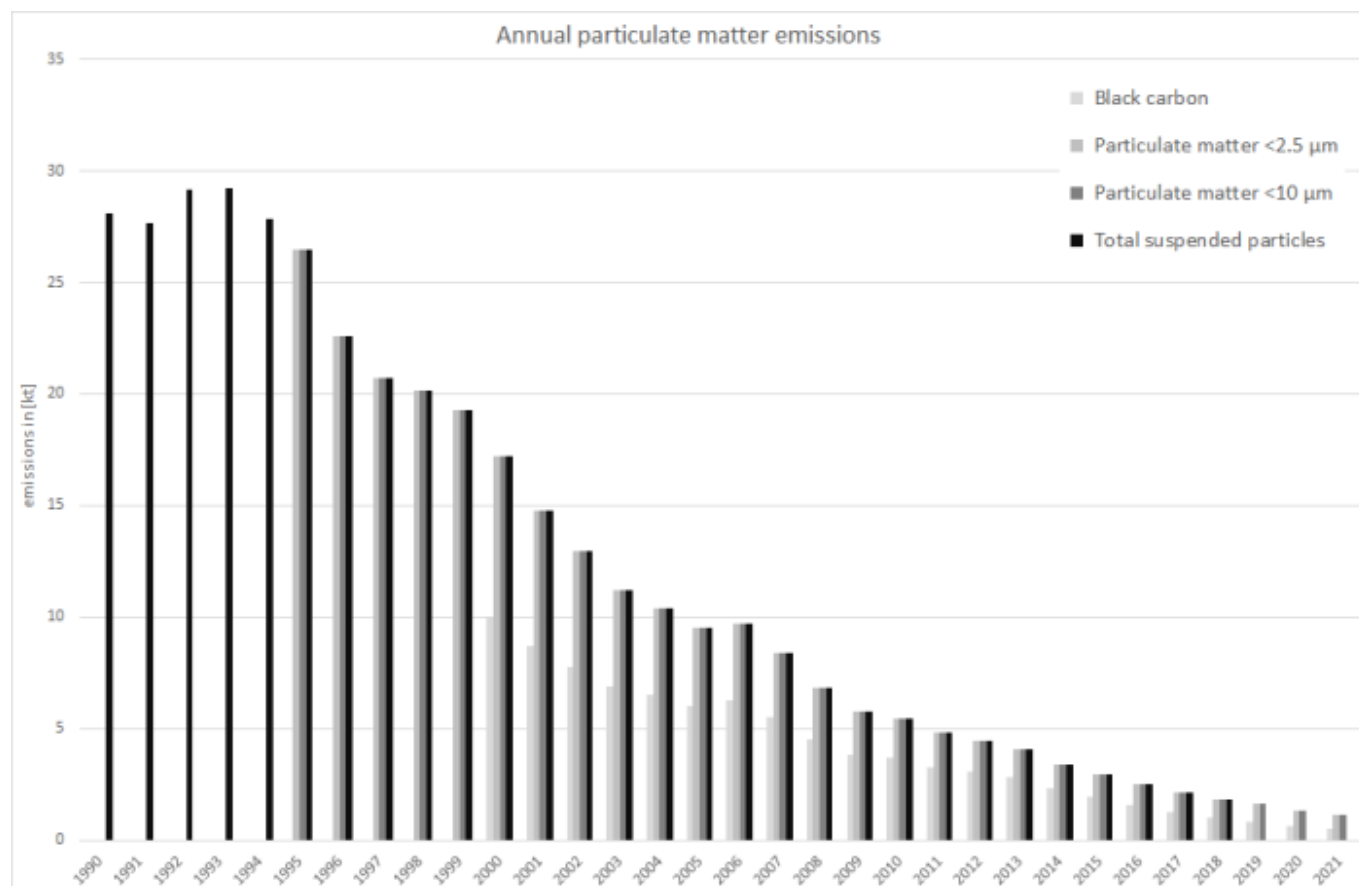
As for the entire road transport sector, the trends for **sulphur dioxide** (SO₂) and **ammonia** (NH₃) exhaust emissions from heavy duty vehicles show characteristics different from those shown above: Here, the strong dependence on increasing fuel qualities (sulphur content) leads to a cascaded downward trend of SO₂ 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.



Particulate matter & Black carbon

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}, PM₁₀, and TSP.



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 consumption 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	NO	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	NO	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		32	152	787	1.165	1.217	812	754	664	630	581	489	165	-799	-891	-960	-972
relative change		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	NO	NO	NO	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	NO	NO	NO	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				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				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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	365	407	496	311	327	365	297
Submission 2020	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	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	NO	610	414	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Submission 2020	NO	610	414	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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 comprehensible way.



For more information on recalculated emission estimates reported for Base Year and 2019, 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

^{1), 2), 4)} Knörr et al. (2020a): 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 1960-2035, sowie TREMOD, im Auftrag des Umweltbundesamtes, Heidelberg & Berlin, 2020.

³⁾ Keller et al. (2017): 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.

⁵⁾ 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.

⁶⁾ 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>

¹⁾

During test-bench measurements, temperatures are likely to be significantly higher than under real-world conditions, thus reducing condensation. On the contrary, smaller dilution (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.