

1.A.3.b iv - Road Transport: Mopeds & Motorcycles

Short description

In sub-categories *1.A.3.b iv - Road Transport: Mopeds & Motorcycles* emissions from fuel combustion in motorised two-wheelers are reported.

Category Code	Method					AD					EF				
1.A.3.b iv	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 iv	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-/-	-/-	-/-

Methodology

Activity data

Specific consumption data for mopeds and motorcycles is generated within the TREMOD model (Knörr, 2021a) ¹⁾.

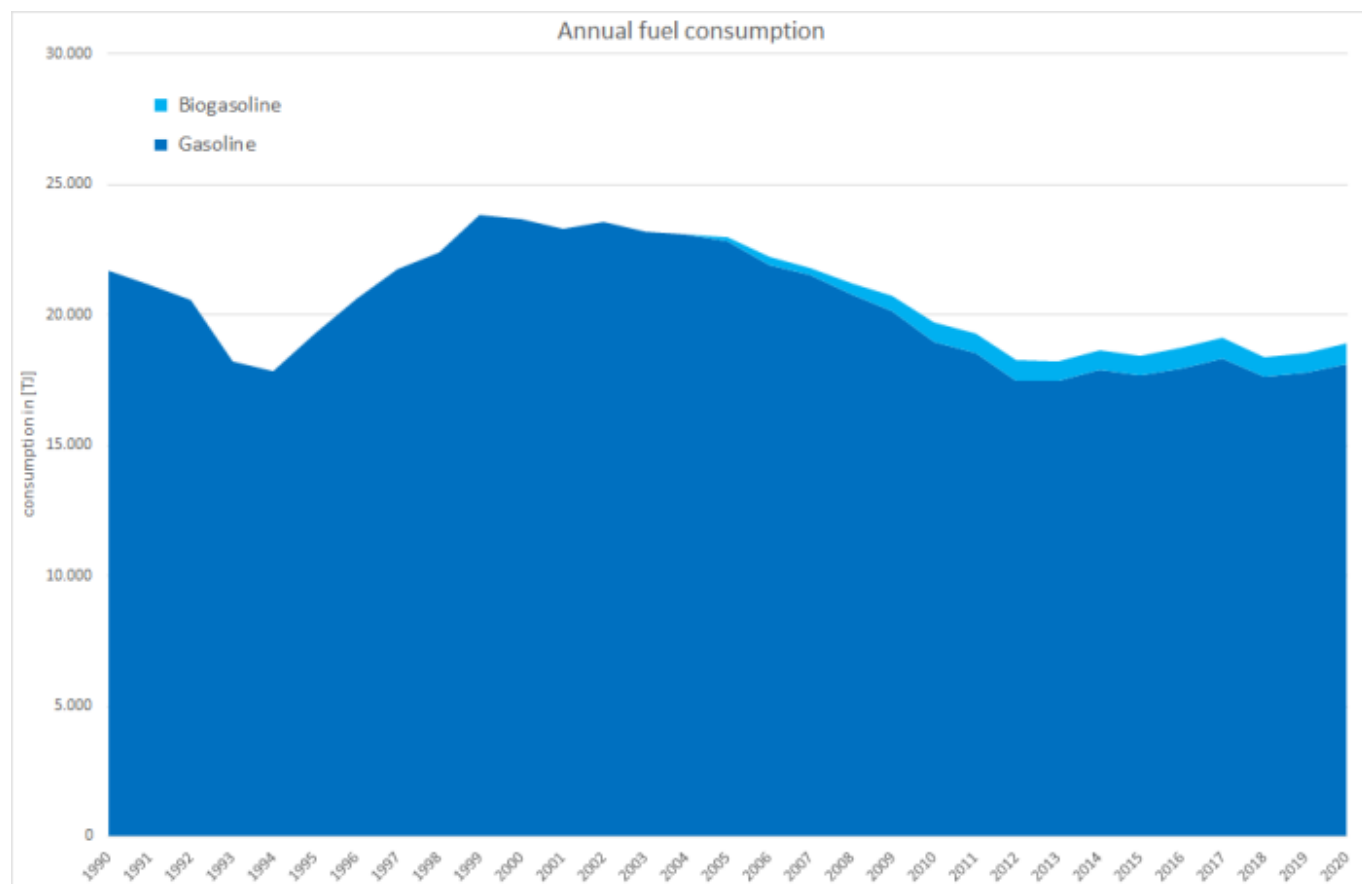


The following table provides an overview of annual amounts of gasoline fuels consumed by motorized two-wheelers in Germany.

Table 1: Annual fuel consumption of mopeds and motorcycles, in terajoules

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MOPEDS																			
Gasoline	4,953	3,102	3,133	3,056	3,021	3,169	3,240	3,517	3,298	3,235	3,067	3,152	3,155	3,173	3,186	3,181	3,119	3,160	3,230
Biogasoline	0	0	0	21	44	43	62	100	127	133	136	135	137	138	138	134	140	136	147
Σ Mopeds	4,953	3,102	3,133	3,077	3,065	3,212	3,302	3,617	3,426	3,368	3,203	3,287	3,293	3,310	3,324	3,315	3,259	3,296	3,377
MOTORCYCLES																			
Gasoline	16,747	16,206	20,514	19,740	18,888	18,352	17,563	16,613	15,680	15,294	14,426	14,326	14,731	14,502	14,786	15,152	14,483	14,618	14,875
Biogasoline	0	0	0	21	44	43	62	100	127	133	136	135	137	138	138	134	140	136	147
Σ Motorcycles	16,747	16,206	20,514	19,761	18,932	18,395	17,625	16,714	15,807	15,427	14,562	14,461	14,868	14,640	14,925	15,287	14,623	14,754	15,022
MOTORIZED 2-WHEELERS: Mopeds & Motorcycles																			
Gasoline	21,700	19,308	23,648	22,796	21,909	21,521	20,803	20,130	18,978	18,530	17,493	17,478	17,887	17,675	17,972	18,333	17,601	17,777	18,104
Biogasoline	0	0	0	157	316	291	398	575	733	760	775	749	778	767	781	773	791	767	827
Σ 1.A.3.b iv	21,700	19,308	23,648	22,953	22,225	21,812	21,201	20,705	19,712	19,289	18,268	18,227	18,665	18,441	18,753	19,106	18,393	18,544	18,931

source: TREMOD 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 TREMOD ⁴⁾.

However, it is not possible to present these highly specific 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.

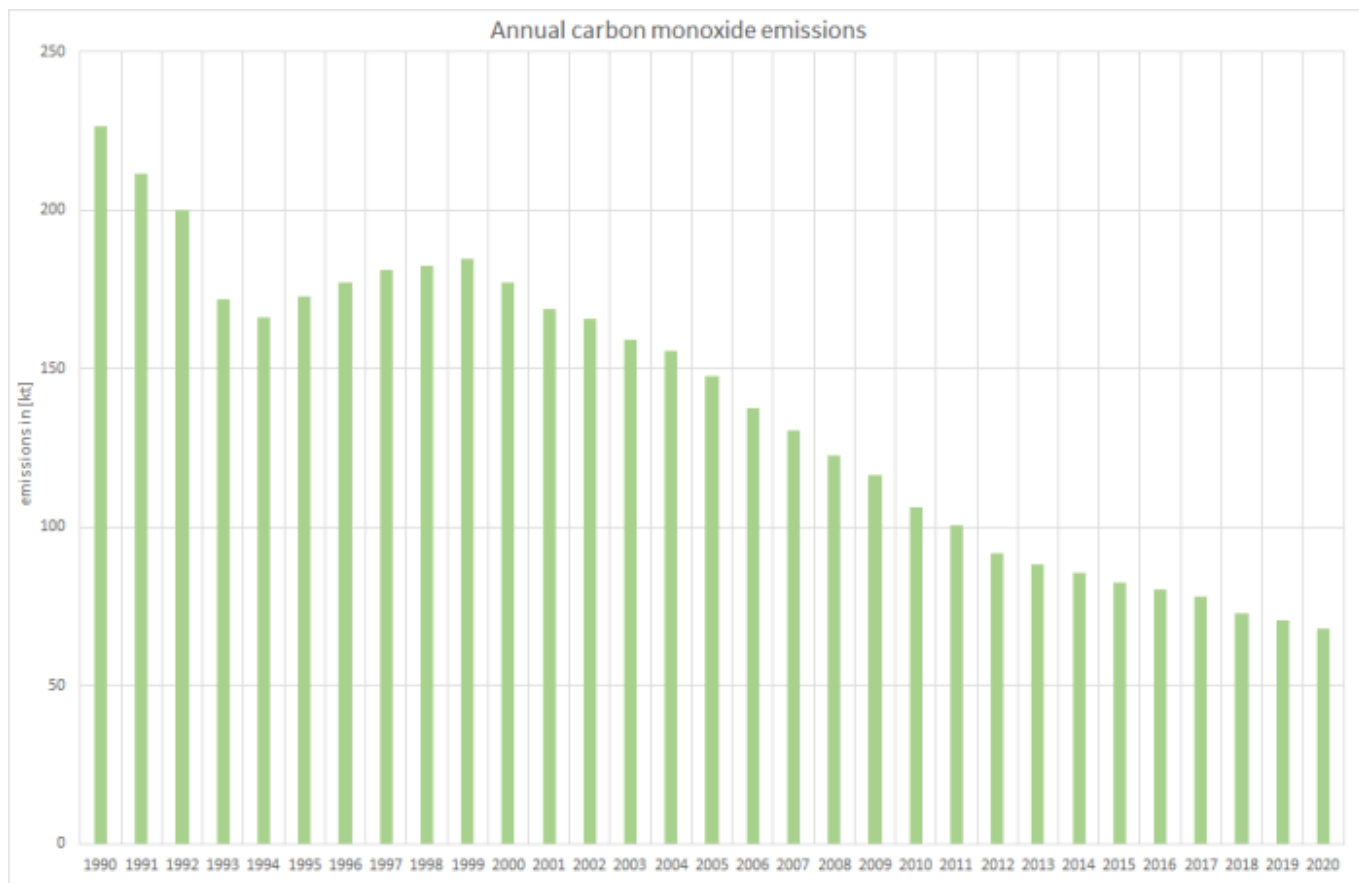
Table 3: Overview of applied EMEP/EEA defaults and other tier1 EF

As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	PCDD/F	B[a]P	B[b]F	B[k]F	I[...]P	PAH 1-4
[g/Tj]									[µg/km]		[mg/Tj]			
0.007	0.005	0.145	0.103	0.200	0.053	0.037	0.005	0.758	0.0000027	192.91	215.88	156.17	234.25	799.21

Discussion of emission trends

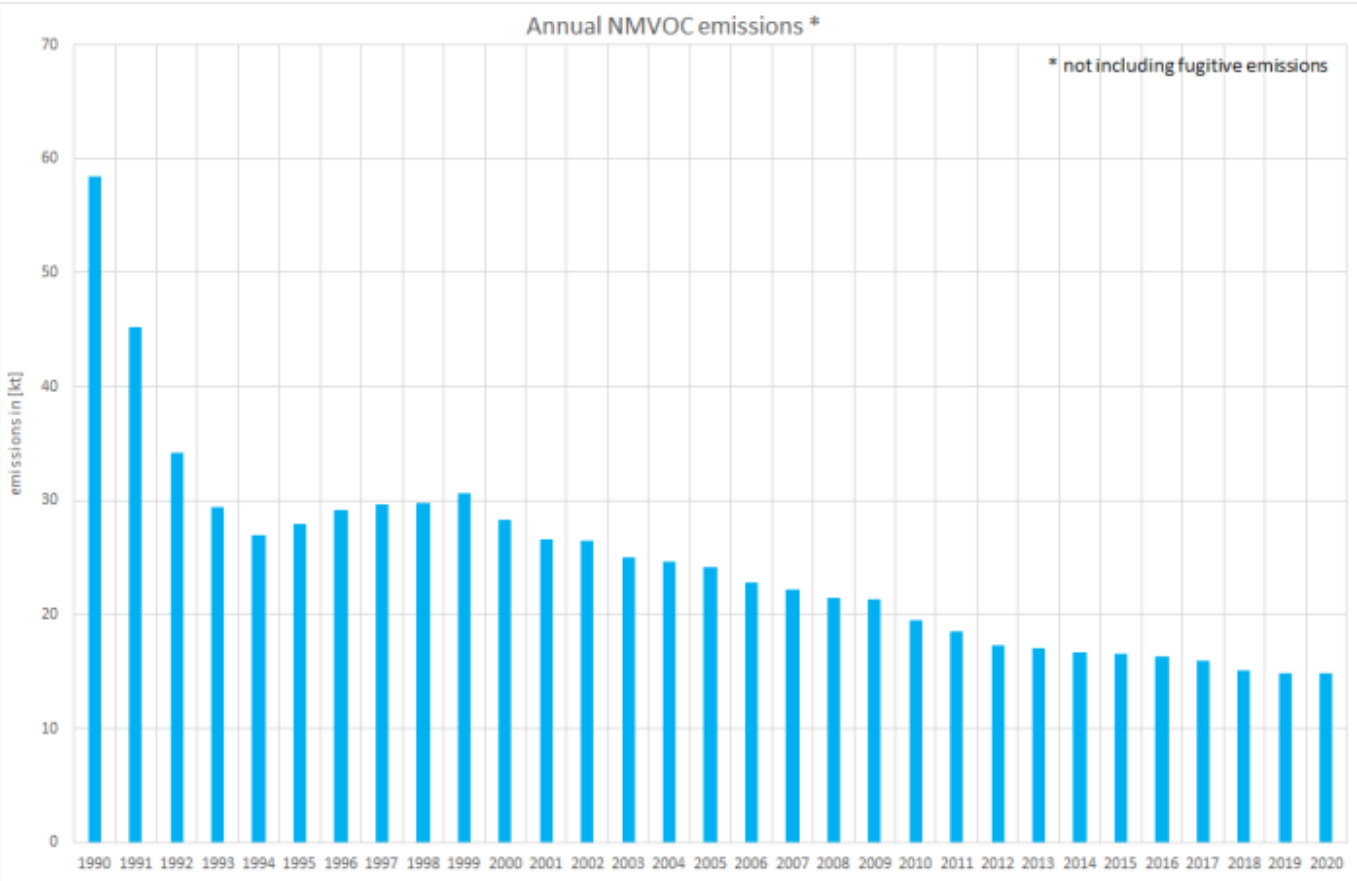
NFR 1.A.3.b iv is no key category.

Carbon monoxide

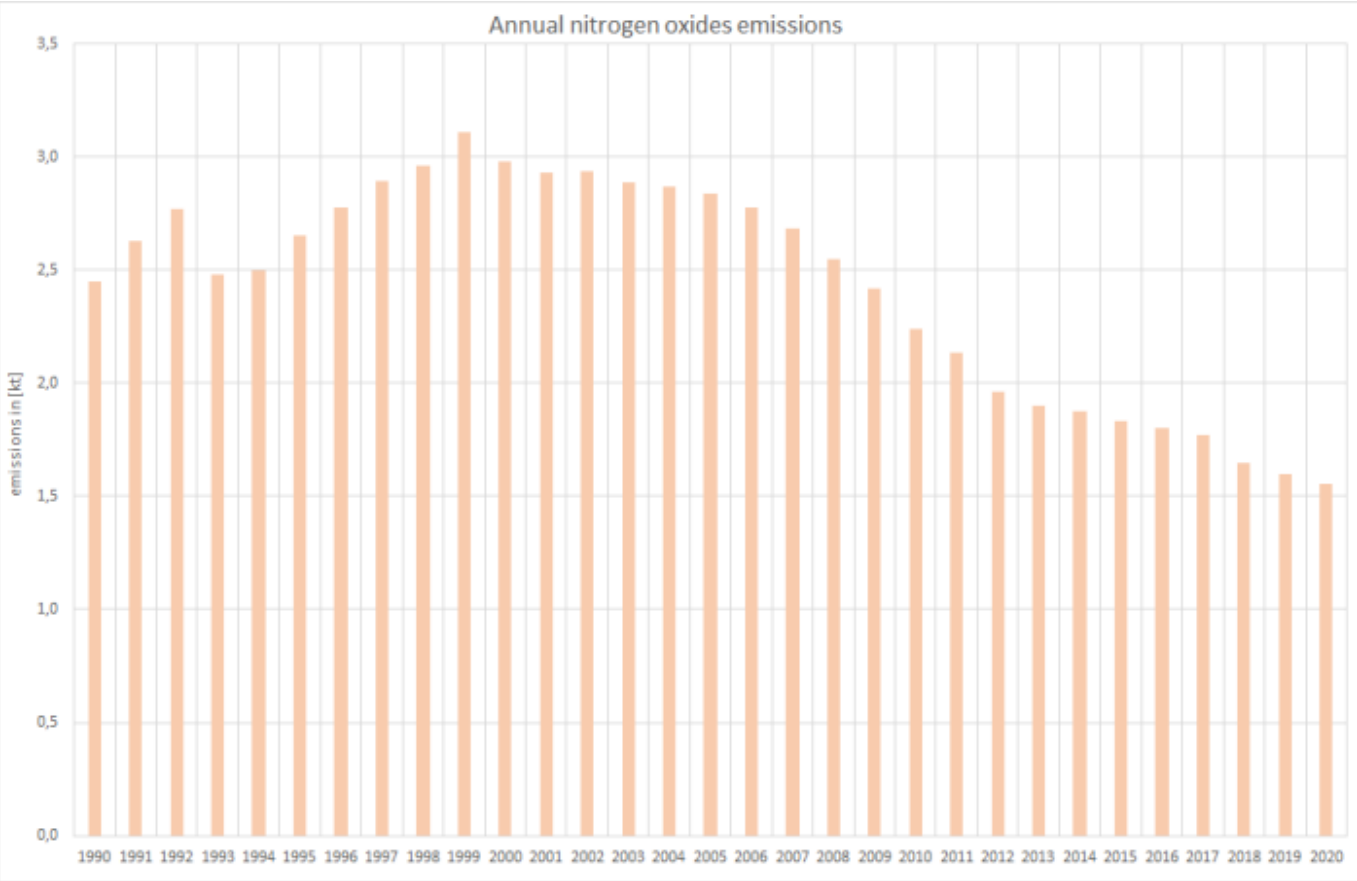


Non-methane volatile organic compounds

Since 1990, exhaust emissions of NMVOC have decreased due to technical improvements.

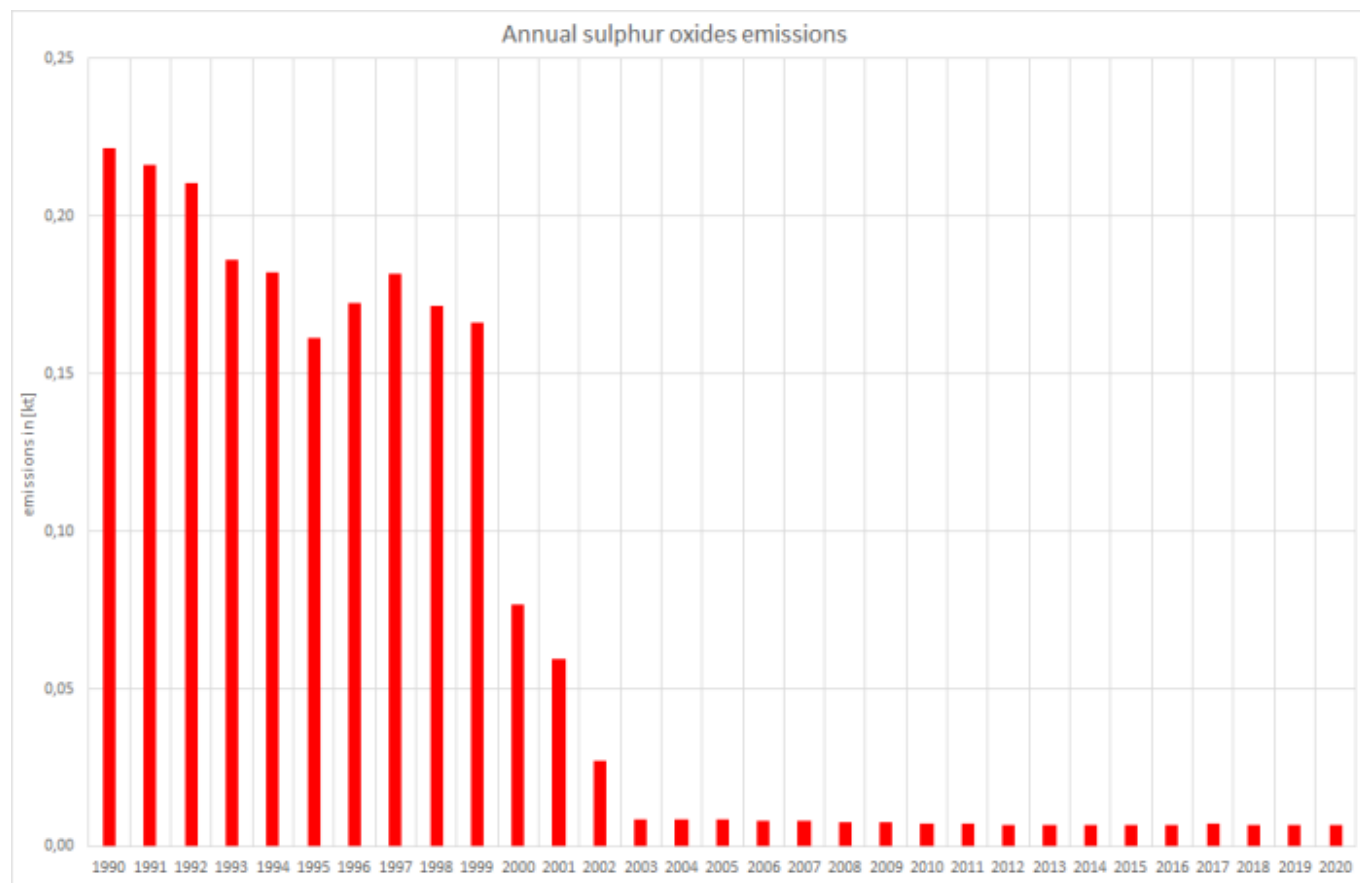


Nitrogen oxides



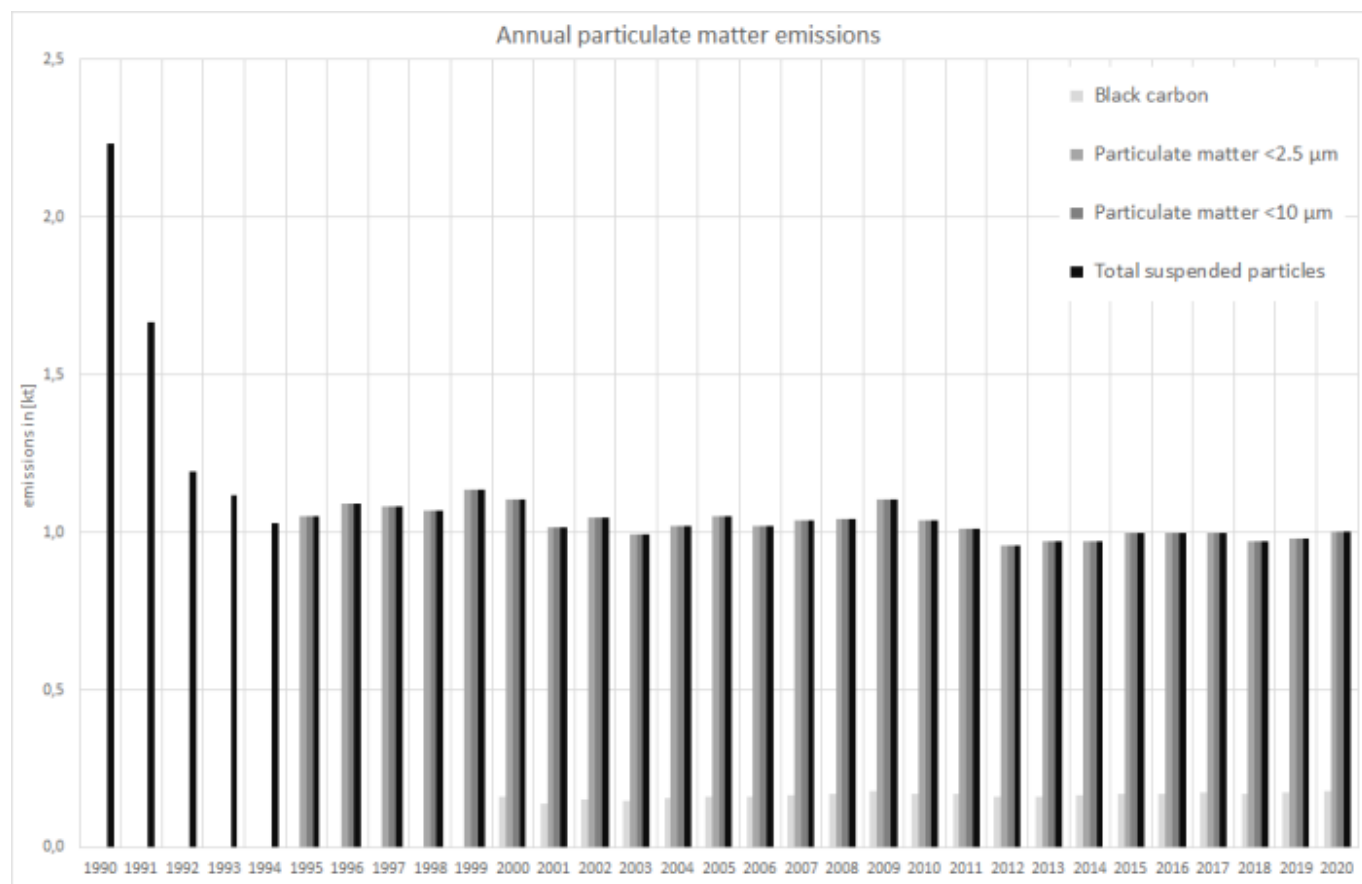
Sulphur dioxide

As for the entire road transport sector, the trends for **sulphur dioxide** exhaust emissions from two-wheelers shows characteristics very different from those shown above: Here, the strong dependence on increasing fuel qualities (sulphur content) leads to a cascaded downward trend of emissions, influenced only slightly by increases in fuel consumption and mileage.



Particulate matter & Black carbon

Particle emissions result from the combustion of gasoline and bioethanol. Here, due to the assumption that nearly all TSP emitted is formed by particles in the PM_{2.5} range, similar estimates are provided for all three fractions. (Exception: Until 1997, additional TSP emissions from use of leaded gasoline are included.)



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.

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
GASOLINE																	
Submission 2021	21.700	19.308	23.648	22.796	21.909	21.521	20.803	20.130	18.978	18.530	17.492	17.480	17.894	17.691	18.003	18.385	17.702
Submission 2020	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	17.915
absolute change	-1.431	-664	-476	-233	98,6	-157	-99,0	-71,5	-60,7	-61,7	-62,4	-68,3	-102	-86,0	-77,0	-71,3	-214
relative change	-6,18%	-3,3%	-2,0%	-1,0%	0,45%	-0,7%	-0,5%	-0,4%	-0,32%	-0,33%	-0,36%	-0,39%	-0,56%	-0,48%	-0,43%	-0,39%	-1,19%
BIOGASOLINE																	
Submission 2021	0	0	0	157	316	291	398	575	733	760	775	749	778	767	782	775	796
Submission 2020	0	0	0	158	314	293	400	577	736	762	778	752	783	771	785	778	806
absolute change	0	0	0	-1,60	1,42	-2,12	-1,89	-2,04	-2,35	-2,53	-2,77	-2,93	-4,42	-3,73	-3,35	-3,01	-9,62
relative change				-1,01%	0,45%	-0,72%	-0,47%	-0,35%	-0,32%	-0,33%	-0,36%	-0,39%	-0,56%	-0,48%	-0,43%	-0,39%	-1,19%
TOTAL FUEL CONSUMPTION																	
Submission 2021	21.700	19.308	23.648	22.953	22.225	21.812	21.201	20.705	19.712	19.289	18.270	18.233	18.677	18.464	18.791	19.167	18.505
Submission 2020	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	18.729
absolute change	-1.431	-664	-476	-235	100	-159	-101	-73,6	-63,1	-64,3	-65,2	-71,2	-106	-89,7	-80,4	-74,4	-223

relative change	-6,18%	-3,33%	-1,97%	-1,01%	0,45%	-0,72%	-0,47%	-0,35%	-0,32%	-0,33%	-0,36%	-0,39%	-0,56%	-0,48%	-0,43%	-0,39%	-1,19%
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Due to the variety of 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. (2021a): 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, 2021.

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.