

1.A.5.b - Other, Mobile (including Military)

Short description

In sub-category *1.A.5.b - Other, Mobile (including Military)* emissions from landbased, air- and waterborne military vehicles are reported.

NFR-Code	Name of Category								Method		AD	EF	Key Category Analysis				
1.A.5.b	Other, Mobile (including Military)								see sub-category details				see below				
1.A.5.b i	Land-based military transport and machinery								T1, T2		NS	CS, D		-			
1.A.5.b ii	Military Aviation								T1, T2		NS	CS, D		-			
1.A.5.b iii	Military Navigation								T1, T2, T3		NS, M	CS, D, M		-			
		NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	PB	Cd	Hg	Diox	PAH	HCB	
Key Category:		-/T	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	



For further information on sub-sector specific consumption data, emission factors and emissions as well as further information on emission trends, recalculations and planned improvements, please follow the links above.

Methodology

Activity data

Basically, all fuel deliveries to the military are included in the primary fuel delivery data provided by the National Energy Balances (NEB) ¹⁾. As the NEB does not provide specific data for military use, the following additional sources are used:

Military land-based vehicles and aviation:

For the years as of 1995, the official mineral-oil data of the Federal Republic of Germany (Amtliche Mineralölstatistik der Bundesrepublik Deutschland), prepared by the Federal Office of Economics and Export Control (BAFA), are used ²⁾. Provided in units of [1000 t], these amounts have to be converted into [TJ] on the basis of the relevant net calorific values given by ³⁾.

As the official mineral-oil data does not distinguish into fossil and biofuels but does provide amounts for inland deliveries of total diesel and gasoline fuels, no data on the consumption of biodiesel and bioethanol is available directly at the moment. Therefore, activity data for biofuels used in military vehicles are calculated by applying Germany's official annual biofuel shares to the named total deliveries (see also: info on EF).

As there is no consistent NEB data available for aviation gasoline, delivery data from BAFA is applied for the entire time series.

Military navigation:

Primarily, fuel deliveries to military navigation is included in the NEB data provided in NEB lines 6: 'International Deep-Sea Bunkers' and 64: 'Coastal and inland navigation' but cannot be derived directly. Therefore, starting with this submission, fuel use in military navigation is estimated within a specific model used for estimating emissions from German maritime activities ⁴⁾.

Table 1: Sources for consumption data in 1.A.5.b

Mode of Military Transport	Specific AD included in:	Sources for specific data	Relevant years
Military ground vehicles and mobile machinery, military aviation	NEB line 67 - 'Commerce, Trade, Services and other Consumers'	Special evaluation 1990-1994 carried out by AGE	1990 - 1994
		Official oil data, table 7j, column: 'An das Militär', ⁵⁾	as of 1995

Mode of Military Transport	Specific AD included in:	Sources for specific data	Relevant years
Military Navigation	NEB lines 6 - 'International Deep-Sea Bunkers' and 64 - 'Coastal and Inland Navigation'	AD estimated within ⁶⁾	as of 1990

Table 2: Annual over-all fuel consumption in military vehicles and mobile equipment, in terajoules

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
DIESEL OIL	15.417	8.264	1.592	3.377	1.863	1.820	1.293	1.141	1.127	763	1.104	791	787	734	719	571	412	445	328
GASOLINE	21.508	9.800	7.477	6.838	6.095	4.764	4.919	4.854	4.792	4.624	4.106	4.027	3.635	3.287	2.959	2.463	2.300	2.269	1.770
BIODIESEL	0	0	0	214	205	223	114	80,0	74,9	43,2	68,2	40,3	41,9	31,7	30,6	22,1	16,2	16,0	11,1
BIOGASOLINE	0	0	0	47,0	87,9	64,3	94,0	139	185	190	182	173	158	143	129	104	103	97,9	80,8
JET KEROSENE	38.385	16.143	9.862	2.200	2.441	2.554	3.597	4.396	3.286	4.114	1.171	2.049	3.060	3.726	3.845	1.507	1.025	3.746	2.904
AVGAS	15,2	6,35	1,09	0,26	2,48	14,8	0,00	0,04	0,17	0,00	0,00	0,00	0,00	0,00	0,13	0,00	0,17	0,04	0,00
HEAVY FUEL OIL	152	104	90,4	67,4	63,4	61,0	60,5	59,0	59,0	56,5	54,0	43,9	60,5	0,0	0,0	0,0	0,0	0,0	0,0
Σ 1.A.5.b	75.477	34.317	19.022	12.744	10.757	9.501	10.078	10.668	9.524	9.791	6.685	7.124	7.742	7.921	7.682	4.666	3.856	6.574	5.094

source: (BAFA, 2021) ⁷⁾: Amtliche Mineralöl-daten für die Bundesrepublik Deutschland, Table 7j: "an das Militär" ("to the military") and own estimates for blended biofuels

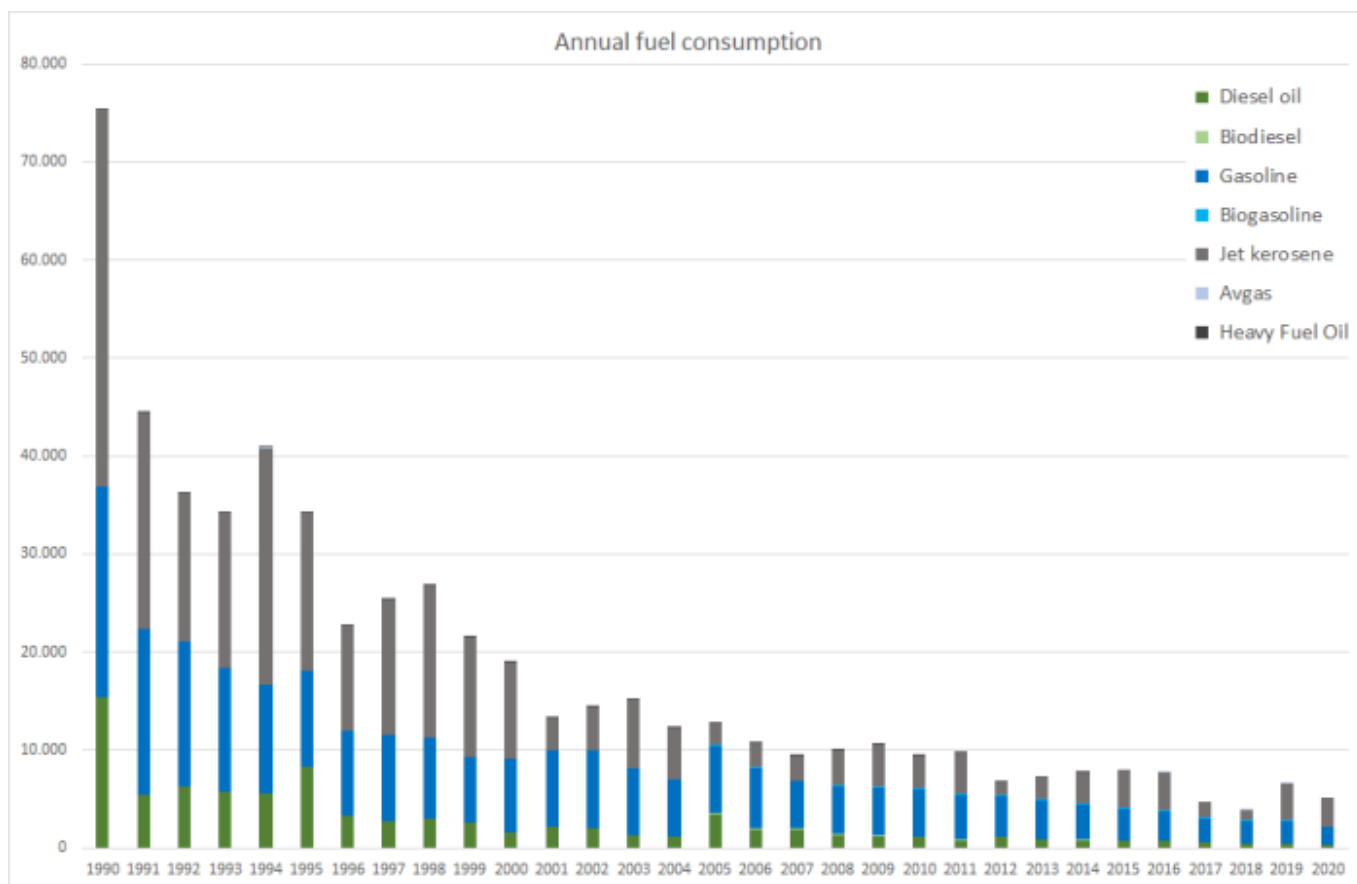


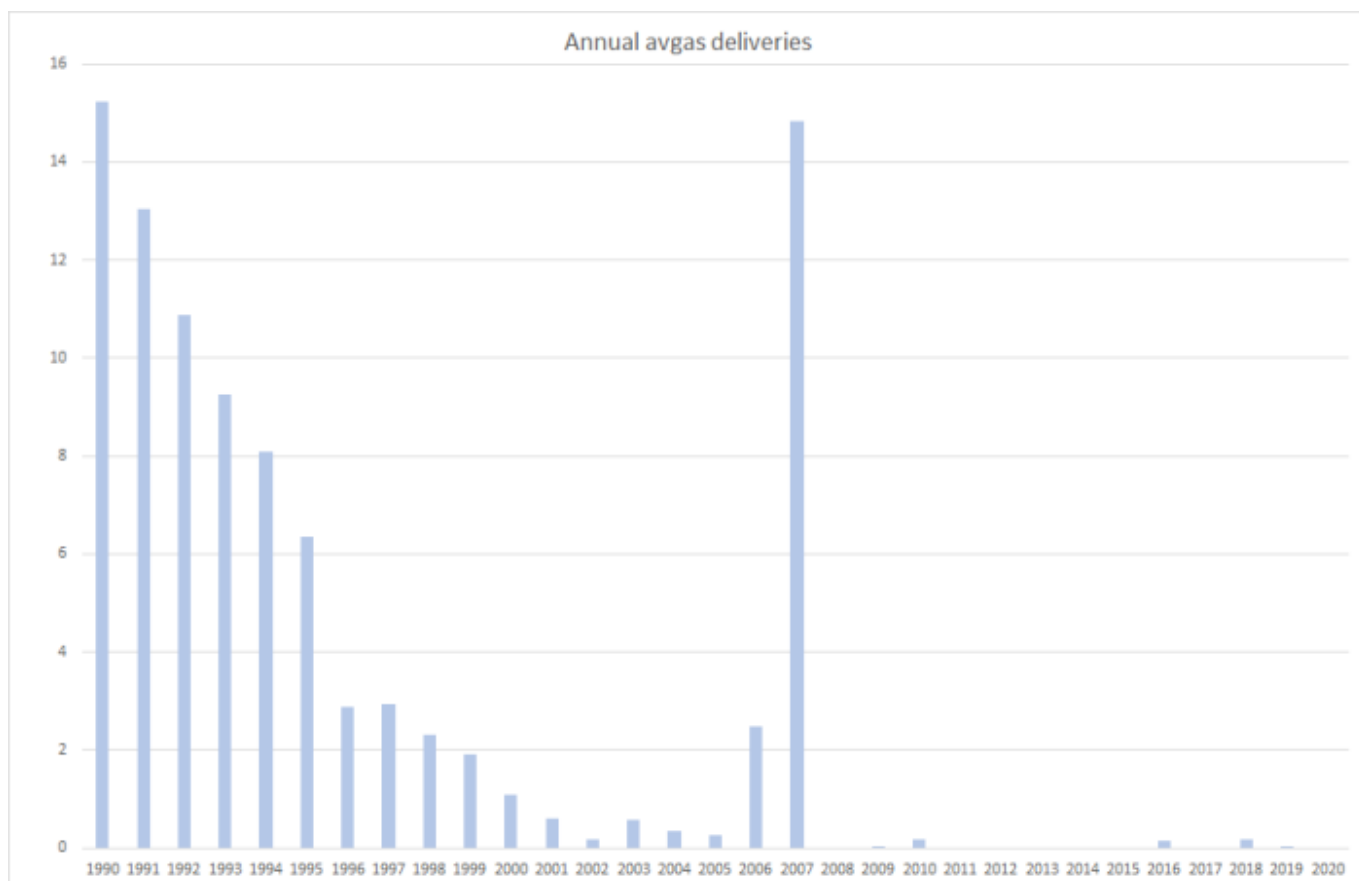
Table 2: Further break-down of annual military fuel consumption, in terajoules

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
used in military ground vehicles and machinery																			
Diesel Oil	15,037	8,001	1,364	3,206	1,701	1,664	1,139	990	977	620	966	680	683	580	577	415	279	281	133
Biodiesel	0	0	0	214	205	223	114	80	75	43	68	40	42	32	31	22	16	16	11
Gasoline	21,508	9,800	7,477	6,838	6,095	4,764	4,919	4,854	4,792	4,624	4,106	4,027	3,635	3,287	2,959	2,463	2,300	2,269	1,770
Biogasoline	0	0	0	47	88	64	94	139	185	190	182	173	158	143	129	104	103	98	81
used in military aircraft																			
Jet Kerosene	38,385	16,143	9,862	2,200	2,441	2,554	3,597	4,396	3,286	4,114	1,171	2,049	3,060	3,726	3,845	1,507	1,025	3,746	2,904
Aviation Gasoline	15	6	1	0	2	15	0	0	0	0	0	0	0	0	0	0	0	0	0
used in military navigation																			
Diesel Oil	380	263	228	171	161	155	154	150	150	144	138	111	104	154	141	156	133	164	195

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Heavy Fuel Oil	152	104	90	67	63	61	61	59	59	56	54	44	61	0	0	0	0	0	0
Σ 1.A.5.b																			
all types of fuels applied	75,477	34,317	19,022	12,744	10,757	9,501	10,078	10,668	9,524	9,791	6,685	7,124	7,742	7,921	7,682	4,666	3,856	6,574	5,094

source: (BAFA, 2021): Amtliche Mineralöl-daten für die Bundesrepublik Deutschland, Table 7j: "an das Militär" ("to the military"); Deichnik, 2020 (for fuel consumption in military navigation) and own estimates for blended biofuels

As the "consumption data" provided here originally represents fuel delivery data, some trends in "annual consumption" are influenced by stock-keeping activities. Here, a clear impact of storage effects can be observed for avgas, where a significantly high amount of 15 TJ was purchased in 2007 followed by zero or very small deliveries.



Furthermore, based upon expert information, no biodiesel or heavy fuel oil is used in national military navigation.

Emission factors



For further information on sub-sector specific emission factors, please refer to the sub-chapters on [ground-based](#), [airborne](#) and [naval](#) military activities.

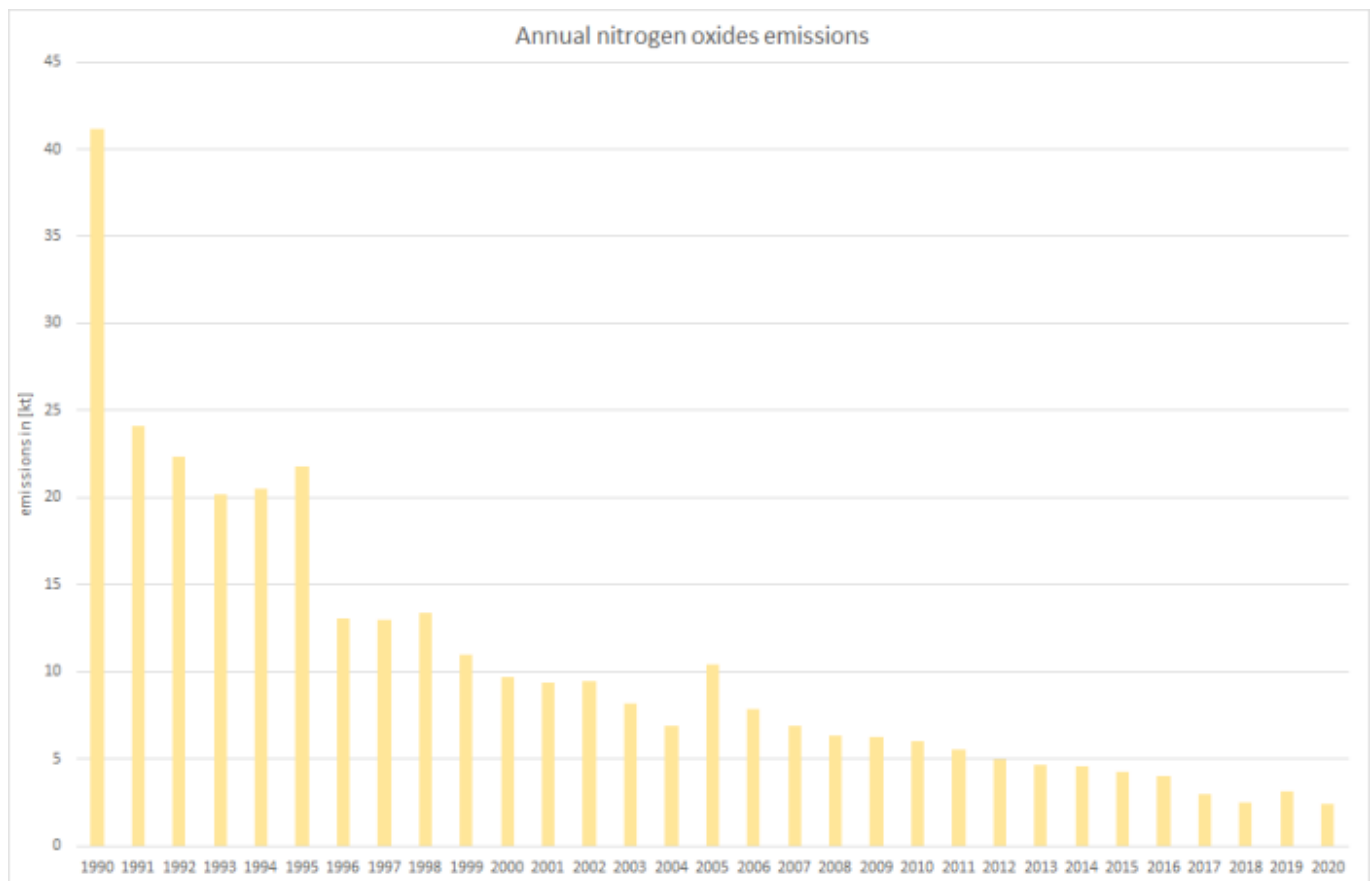
Discussion of emission trends

Table: Outcome of Key Category Analysis

for:	NO_x
by:	Trend

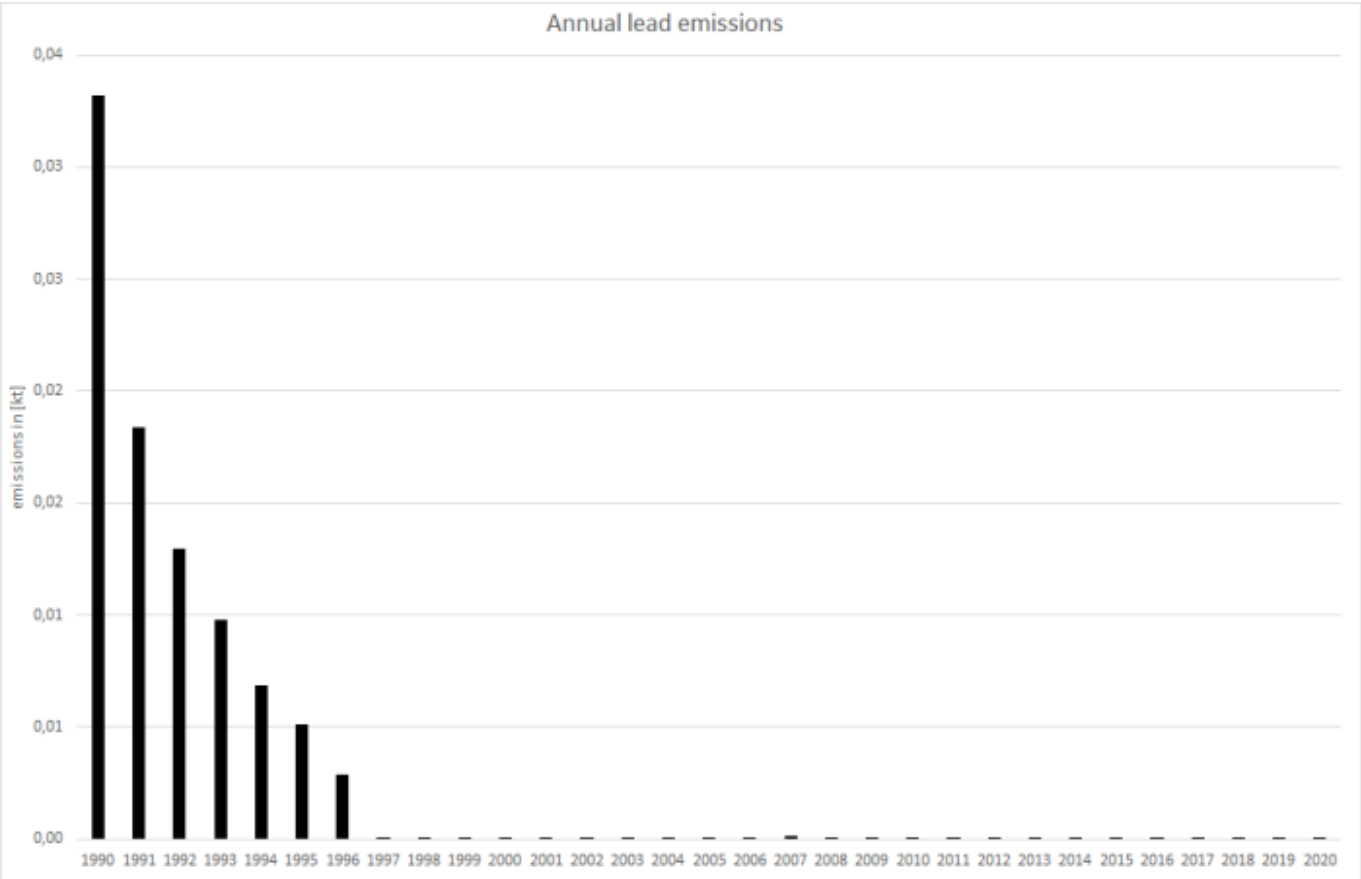
Here, due to the tier1 emission factors applied, annual emissions strongly correspond with activity data, therefore showing

strong decline after 1990 and an ongoing downward trend.

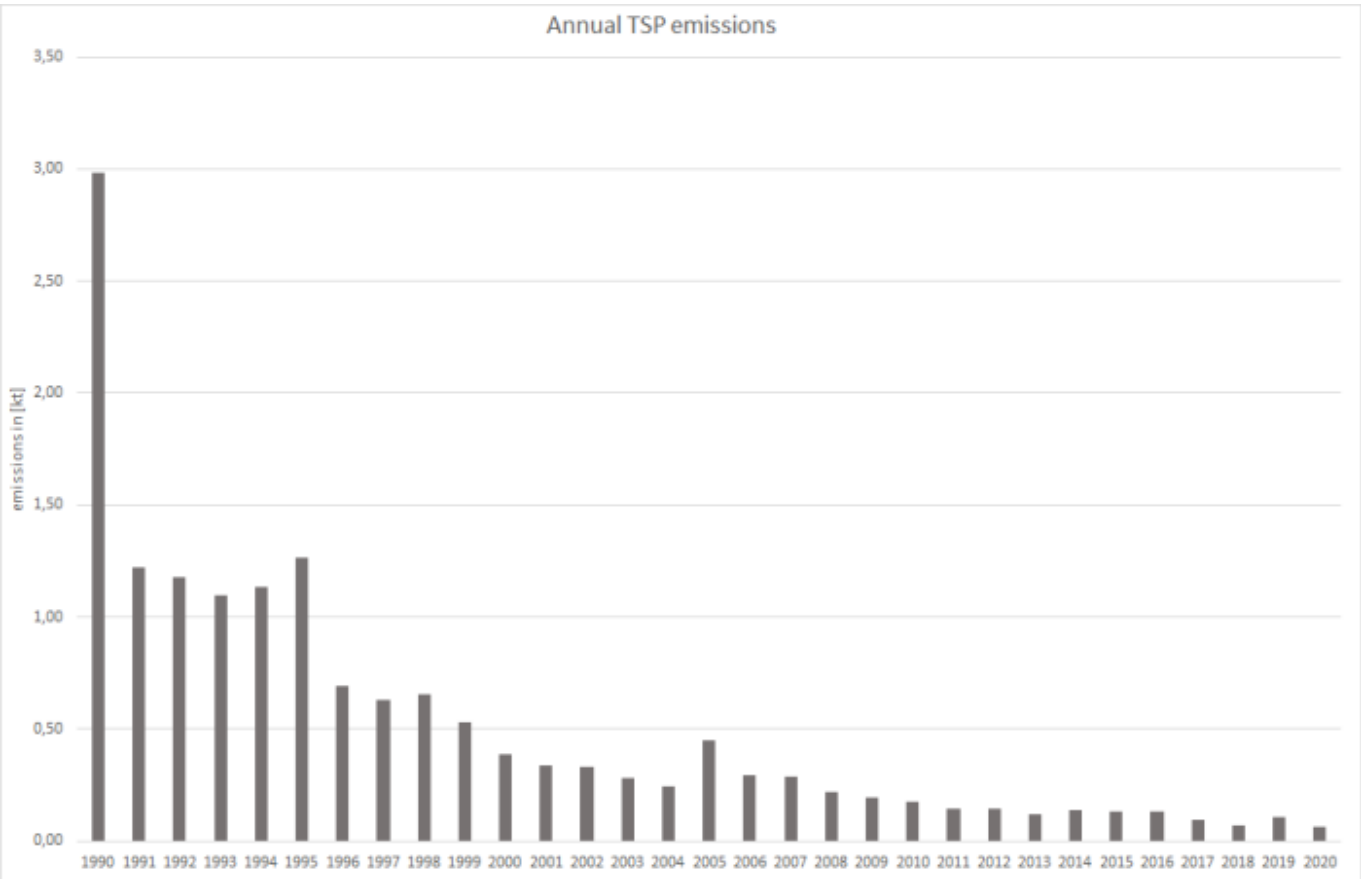


Furthermore, this NFR category shows interesting trends for emissions of **Lead (Pb)** from leaded gasoline (until 1997) and aviation gasoline:

Until 1997, lead emissions were dominated by the combustion of leaded gasoline in military ground-based vehicles. Therefore, the over-all trend for lead emissions from military vehicles and aircraft is driven mostly by the abolition of leaded gasoline in 1997. Towards this date, the amount of leaded gasoline decreased significantly. After 1997, the only source for lead from mobile fuel combustion is avgas used in military aircraft. As for avgas, the trend of consumption is more or less decreasing steadily until 2005 but then shows a strong increase for 2006 and '07 (!), followed by no or very small deliveries. As mentioned above, there are no real consumption data available: AD is based on fuel deliveries to the military only. Thus, especially the trends for the use of aviation gasoline and the resulting emissions show this significant jumps in 2006 and 07. The party is aware of this issue and will try to solve it as soon as data allows. (see also: FAQ)



The trend for **TSP** emissions reflects the impact of leaded gasoline at least for 1990 to 1997. For all other years, **particulate matter** emissions simply follow the trend in over-all fuel consumption.



Regarding **sulphur dioxide**, emissions not only reflect the trend of fuel consumption but also the impact of fuel-sulphur legislation.



For all other reported pollutants, due to the application of tier1 emission factors, emission trends reported for this sub-category only reflect the trend in fuel deliveries.

Recalculations

All recalculations result from the revision of underlying **activity data**.

Here, the TJ-amounts of gasoline were re-estimated based on corrected annual NCVs for recent years and the consumption of heavy-fuel oil in military navigation has been taken into account for the first time.

Table 4: Revised over-all activity data, in terajoules

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
current submission	75.477	34.317	19.022	12.744	10.757	9.501	10.078	10.668	9.524	9.791	6.685	7.124	7.742	7.921	7.682	4.666	3.856	6.574
previous submission	75.928	34.615	19.267	12.934	10.949	9.676	10.260	10.863	9.735	9.995	6.879	7.339	7.972	8.098	7.952	5.041	4.202	6.968
absolute change	-451	-298	-245	-189	-193	-175	-183	-194	-210	-204	-194	-214	-230	-177	-270	-375	-345	-394
relative change	-0,59%	-0,86%	-1,27%	-1,46%	-1,76%	-1,81%	-1,78%	-1,79%	-2,16%	-2,04%	-2,81%	-2,92%	-2,89%	-2,18%	-3,40%	-7,44%	-8,22%	-5,66%

For information on revised or newly implemented **emission factors**, please refer to the three sub-chapters linked above.



For **pollutant-specific information on recalculated emission estimates for Base Year and 2019**, please see the recalculation tables following chapter [8.1 - Recalculations](#).

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)⁸⁾.

Uncertainty estimates for **emission factors** were compiled during the PAREST research project. Here, the final report has not yet been published.

Planned improvements

With respect to NFR 1.A.5.b as such, no overarching improvements are planned. For further information on possible sub-sector specific improvements, please follow the links above.

^{1), 3)} AGEb, 2021: Working Group on Energy Balances (Arbeitsgemeinschaft Energiebilanzen (Hrsg.), AGEb): Energiebilanz für die Bundesrepublik Deutschland; URL: <http://www.ag-energiebilanzen.de/7-0-Bilanzen-1990-2018.html>, (Aufruf: 25.11.2021), Köln & Berlin, 2021

^{2), 7)} BAFA, 2021: Federal Office of Economics and Export Control (Bundesamt für Wirtschaft und Ausfuhrkontrolle, BAFA): Amtliche Mineralöl-daten für die Bundesrepublik Deutschland; URL: https://www.bafa.de/SharedDocs/Downloads/DE/Energie/Mineraloel/moel_amtliche_daten_2019_dezember.html, Eschborn, 2021.

⁴⁾ Deichnik, 2021: Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie (BSH): Pflege und Aktualisierung des Modells zur Berechnung der Energieeinsätze und Emissionen des von deutschen Häfen ausgehenden Seeverkehrs, im Auftrag des Umweltbundesamtes, Hamburg, 2021.

⁸⁾ 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.