

1.A.3.b v - Gasoline Evaporation

Short description

In category *1.A.3.b v - Road Transport: Gasoline evaporation* fugitive emissions from the evaporation of gasoline from road vehicles are reported.

Method	AD	EF	Key Category
T2	NS, M	CS, M	L & T: NMVOC

Methodology

Activity data

Specific data for gasoline evaporation from road vehicles are generated within TREMOD ¹⁾. - The following table provides an overview of annual amounts of gasoline evaporated from road vehicles in Germany.

Table 1: Annual amount of gasoline evaporated from road vehicles, in kilotonnes

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
PCs	10,906	9,235	8,553	7,520	7,080	6,695	6,385	6,331	6,176	6,088	5,780	5,732	5,715	5,502	5,482	5,501	5,145	
LDVs	202	193	169	112	95	85	72	65	60	55	50	47	47	49	50	52	54	
Mopeds	52	34	38	44	45	49	52	60	57	56	54	56	57	59	59	59	57	
Motorcycles	108	99	204	219	203	200	186	169	155	143	131	124	130	136	138	140	137	
Σ 1.A.3.b v	11,283	9,561	8,964	7,895	7,424	7,030	6,695	6,625	6,447	6,342	6,015	5,959	5,948	5,747	5,730	5,752	5,392	

source: TREMOD 6.02 ²⁾

(Implied) Emission factors

Tier3 emission factors representing the effect of mitigation technologies are derived from TREMOD (Knörr et al., 2019a) ³⁾.

Table 2: Overview of implied emission factors per vehicle type, in kg/t

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
~ PCs	> 18.8	> 12.4	> 5.63	> 3.15	> 2.98	> 2.95	> 2.68	> 2.58	> 2.56	> 2.63	> 2.66	> 2.73	> 2.80	> 2.78	> 2.84	> 2.91	> 3.03
~ LDVs	> 24.9	> 20.0	> 13.9	> 10.3	> 9.64	> 9.27	> 7.86	> 7.47	> 7.13	> 7.11	> 6.65	> 6.69	> 6.49	> 6.01	> 5.92	> 5.74	> 5.29
~ Mopeds	> 37.4	> 23.7	> 21.1	> 17.6	> 17.1	> 16.4	> 15.9	> 15.1	> 15.0	> 14.9	> 14.8	> 14.6	> 14.4	> 13.8	> 13.9	> 14.0	> 14.3
~ Motorcycles	> 23.3	> 24.8	> 16.2	> 15.8	> 16.5	> 16.5	> 16.1	> 17.4	> 18.8	> 20.5	> 21.8	> 23.6	> 23.3	> 21.8	> 22.2	> 22.4	> 22.4

+ Discussion of emission trends

NFR 1.A.3.b v - Gasoline evaporation is key category for emissions of **NMVOC** regarding the emissions' level and declining trend.

++ Non-Methane Volatile Organic Compounds - NMVOC (*fugitive emissions only; no NMVOC emissions from fuel combustion included*)

[gallery size="medium" : 1A3bv_AD.png : 1A3bv_EM_NMVOC.PNG gallery](#)

Since its maximum level of over 11,000 kilotonnes in 1990, the amount of evaporated gasoline is decreasing - and so are the related NMVOC emissions. The amounts of evaporated gasoline are connected directly with those of gasoline consumed. Here, the decrease becomes sharper from 2000 onwards following a growing switch from gasoline to diesel oil especially in passenger cars. Here, the annual amounts of NMVOC emissions from evaporation not only depend directly on the amount of evaporated gasoline but also on the number of vehicles equipped with mitigation technologies. Thus, the decrease is sharpest straight after 1990 and since then slowing down.

NOTE: Due to defectively revised emission factors, the **emission estimates** provided in the NFR tables **are incorrect until 1993**. Here, the EFs for 1990 to 1993 have not been adapted to the revised values for all years as of 1994. As it is not possible to provide an artificially corrected chart for the *emission estimates*, the chart from submission 2014 is included to at least display the correct trend in emissions. - **However, the described erroneous EFs will be corrected with the next TREMOD routine revision and the NEC and CLRTAP submissions 2018.**

+ Recalculations

Due to a broad revision of the TREMOD model carried out to keep in line with the new HBEFA 4.1, **activity data** and **emission factors** have been checked and **revised for all years**.

Table 3: Revised annual amounts of evaporated gasoline, in kilotonnes

	= 1990	= 1995	= 2000	= 2005	= 2006	= 2007	= 2008	= 2009	= 2010	= 2011	= 2012	= 2013	= 2014	= 2015	= 2016	= 2017
~ Submission 2020	> 11,267	> 9,561	> 8,964	> 7,895	> 7,424	> 7,030	> 6,695	> 6,625	> 6,447	> 6,342	> 6,015	> 5,959	> 5,948	> 5,747	> 5,730	> 5,752
~ Submission 2019	> 11,283	> 9,951	> 9,480	> 8,419	> 7,944	> 7,573	> 7,340	> 7,307	> 7,196	> 7,134	> 6,817	> 6,909	> 6,973	> 6,888	> 6,670	> 6,634
~ absolute change	> -16.1	> -389	> -516	> -524	> -520	> -543	> -645	> -682	> -748	> -792	> -803	> -949	> -1,025	> -1,141	> -940	> -881
~ relative change	> -0.14%	> -3.91%	> -5.45%	> -6.23%	> -6.55%	> -7.17%	> -8.79%	> -9.34%	> -10.4%	> -11.1%	> -11.8%	> -13.7%	> -14.7%	> -16.6%	> -14.1%	> -13.3%

In addition, the NMVOC **emission factors** applied were revised for all years. However, this revision can only be displayed for the implied emission factors:

Table 4: Revised implied emission factors for NMVOC emissions from evaporated gasoline, in kg/t

	= 1990	= 1995	= 2000	= 2005	= 2006	= 2007	= 2008	= 2009	= 2010	= 2011	= 2012	= 2013	= 2014	= 2015	= 2016	= 2017
																< Passenger Cars
~ Submission 2020	> 19	> 12	> 5.6	> 3.1	> 3.0	> 3.0	> 2.7	> 2.6	> 2.6	> 2.6	> 2.7	> 2.7	> 2.8	> 2.8	> 2.8	> 2.9

~ Submission 2019	> 9.2	> 8.6	> 3.1	> 1.2	> 2.1	> 1.9	> 1.6	> 1.5	> 1.4	> 1.4	> 1.4	> 1.4	> 1.4	> 1.4	> 1.5	> 1.5
~ absolute change	> 9.6	> 3.8	> 2.6	> 2.0	> 0.9	> 1.0	> 1.1	> 1.1	> 1.2	> 1.2	> 1.3	> 1.3	> 1.4	> 1.4	> 1.4	> 1.4
~ relative change	> 105%	> 45%	> 83%	> 170%	> 44%	> 54%	> 71%	> 75%	> 82%	> 87%	> 90%	> 97%	> 100%	> 102%	> 95%	> 94%
< Light-duty vehicles																
~ Submission 2020	> 24.9	> 20.0	> 13.9	> 10.3	> 9.64	> 9.27	> 7.86	> 7.47	> 7.13	> 7.11	> 6.65	> 6.69	> 6.49	> 6.01	> 5.92	> 5.74
~ Submission 2019	> 14.5	> 18.4	> 10.3	> 6.56	> 12.6	> 11.4	> 8.82	> 7.73	> 6.80	> 6.13	> 5.65	> 5.36	> 5.21	> 4.94	> 5.12	> 5.07
~ absolute change	> 10.5	> 1.66	> 3.61	> 3.77	> -2.93	> -2.09	> -0.96	> -0.26	> 0.34	> 0.98	> 1.00	> 1.33	> 1.28	> 1.08	> 0.80	> 0.67
~ relative change	> 72.3%	> 9.1%	> 35.1%	> 57.4%	> -23.3%	> -18.4%	> -10.9%	> -3.4%	> 5.0%	> 16.0%	> 17.7%	> 24.7%	> 24.6%	> 21.8%	> 15.6%	> 13.2%
< Mopeds																
~ Submission 2020	> 37.4	> 23.7	> 21.1	> 17.6	> 17.1	> 16.4	> 15.9	> 15.1	> 15.0	> 14.9	> 14.8	> 14.6	> 14.4	> 13.8	> 13.9	> 14.0
~ Submission 2019	> 3.27	> 3.16	> 3.32	> 3.30	> 6.48	> 6.71	> 6.71	> 6.95	> 6.89	> 6.71	> 6.64	> 6.70	> 6.64	> 6.56	> 6.55	> 6.49
~ absolute change	> 34.1	> 20.5	> 17.8	> 14.3	> 10.6	> 9.64	> 9.17	> 8.10	> 8.13	> 8.23	> 8.18	> 7.87	> 7.78	> 7.27	> 7.35	> 7.52
~ relative change	> 1043%	> 650%	> 537%	> 434%	> 164%	> 144%	> 137%	> 117%	> 118%	> 123%	> 123%	> 117%	> 117%	> 111%	> 112%	> 116%
< Motorcycles																
~ Submission 2020	> 23.3	> 24.8	> 16.2	> 15.8	> 16.5	> 16.5	> 16.1	> 17.4	> 18.8	> 20.5	> 21.8	> 23.6	> 23.3	> 21.8	> 22.2	> 22.4
~ Submission 2019	> 8.76	> 23.1	> 11.3	> 6.37	> 11.62	> 16.05	> 13.49	> 12.09	> 10.91	> 10.16	> 9.24	> 8.41	> 7.81	> 7.55	> 7.18	> 6.86
~ absolute change	> 14.6	> 1.66	> 4.94	> 9.47	> 4.90	> 0.49	> 2.60	> 5.36	> 7.84	> 10.3	> 12.6	> 15.2	> 15.5	> 14.3	> 15.0	> 15.6
~ relative change	> 166%	> 7.16%	> 44%	> 149%	> 42%	> 3.07%	> 19.3%	> 44.4%	> 71.8%	> 101%	> 136%	> 181%	> 198%	> 189%	> 209%	> 227%

As a result, **NM VOC emissions from gasoline evaporation** were re-estimated as follows:

Table 6: Re-estimated NM VOC emissions, in kilotonnes

	= 1990	= 1995	= 2000	= 2005	= 2006	= 2007	= 2008	= 2009	= 2010	= 2011	= 2012	= 2013	= 2014	= 2015	= 2016	= 2017
~ Submission 2020	> 215	> 122	> 54.6	> 29.1	> 26.1	> 24.7	> 21.5	> 20.7	> 20.0	> 20.1	> 19.3	> 19.7	> 20.1	> 19.4	> 19.7	> 20.3
~ Submission 2019	> 104	> 87.2	> 31.2	> 11.8	> 20.3	> 17.9	> 14.5	> 13.7	> 13.0	> 12.9	> 12.3	> 12.4	> 12.6	> 12.2	> 12.4	> 12.6
~ absolute change	> 110	> 34.9	> 23.4	> 17.3	> 5.83	> 6.82	> 6.95	> 6.95	> 7.00	> 7.29	> 7.07	> 7.32	> 7.54	> 7.19	> 7.35	> 7.61
~ relative change	> 106%	> 40.0%	> 75.2%	> 146%	> 28.7%	> 38.2%	> 47.8%	> 50.6%	> 53.9%	> 56.7%	> 57.6%	> 59.1%	> 59.9%	> 59.0%	> 59.3%	> 60.2%

For specific **information on recalculated emission estimates for Base Year and 2018**, please see the pollutant specific recalculation tables following chapter [8.1 - Recalculations](#)].

Planned improvements

[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. [bibliography](#)

¹⁾ (bibtex 1)

²⁾ (bibtex 1)

³⁾ (bibtex 1)