

NMVOC	13,3	8,96	5,98	5,27	5,15	5,02	4,89	4,77	4,66	4,53	4,39	4,39	4,71	4,35	4,17	4,23	4,32	4,25
NO_x	313	317	329	338	338	342	343	346	352	354	360	362	362	366	370	372	373	375
SO_x	19,7	19,5	19,5	19,6	19,6	19,6	19,6	19,6	19,6	19,6	19,6	19,6	19,6	19,6	19,6	19,6	19,6	19,6
PM¹	1,89	1,96	2,03	1,93	1,91	1,89	1,85	1,83	1,81	1,80	1,79	1,77	1,74	1,73	1,73	1,74	1,75	1,75
BC²	3,94	4,08	4,23	4,02	3,98	3,93	3,86	3,81	3,77	3,74	3,72	3,69	3,62	3,59	3,61	3,62	3,64	3,65
CO	73,8	61,6	47,7	42,4	41,5	40,6	39,7	38,6	37,8	37,3	37,0	36,8	40,1	36,2	34,2	34,2	34,7	34,6
AVGAS																		
NH₃	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	468	498	477	462	452	451	461	470	460	523	519	518	506	515	430	437	449	467
NO_x	103	109	103	100	98	97	99	100	97	111	109	110	104	108	68,7	69,8	73,7	82,2
SO_x	0,46	0,46	0,46	0,46	0,46	0,46	0,46	0,46	0,46	0,46	0,46	0,46	0,46	0,46	0,46	0,46	0,46	0,46
BC	0,40	0,42	0,41	0,40	0,40	0,40	0,41	0,41	0,41	0,44	0,44	0,44	0,45	0,44	0,47	0,47	0,47	0,46
PM_{2,5}	2,69	2,80	2,74	2,68	2,65	2,67	2,70	2,76	2,74	2,96	2,96	2,93	2,97	2,95	3,11	3,14	3,13	3,08
PM₁₀	2,69	2,80	2,74	2,68	2,65	2,67	2,70	2,76	2,74	2,96	2,96	2,93	2,97	2,95	3,11	3,14	3,13	3,08
TSP	17,9	18,0	17,9	17,9	17,8	17,8	17,9	17,9	17,9	18,1	18,1	18,1	18,1	18,1	18,3	18,3	18,3	18,2
CO	20.915	22.610	21.827	21.055	20.659	21.024	21.402	22.335	22.225	25.229	25.303	24.882	25.753	25.200	29.832	30.337	30.216	29.108

¹ EF(TSP) also applied for PM₁₀ and PM_{2,5} (assumption: > 99% of TSP consists of PM_{2,5})

² estimated via a f-BC of 0.48 as provided in ⁵⁾, Chapter: 1.A.3.a, 1.A.5.b Aviation, page 49: "Conclusion".



For the country-specific emission factors applied for particulate matter, no clear indication is available, whether or not condensables are included.

Trend discussion for Key Sources

NFR 1.A.3.a i (ii) - International Civil Aviation - Cruise is **not included in the national emission totals** and hence **not included in the key category analysis**.

Recalculations

Activity data have been revised for all years within TREMOD AV to keep in line with information available from the 2019 EMEP/EEA Guidebook ⁶⁾ and Eurocontrol's AEM model ⁷⁾.

Table 3: Revised kerosene usage in 1.A.3.a i (ii), in terajoules

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
JET KEROSENE																	
Submission 2021	149.007	189.185	240.680	285.709	301.032	312.607	316.629	307.916	304.544	292.898	314.325	319.548	308.755	307.982	331.809	363.932	374.434
Submission 2020	150.852	187.855	243.544	288.819	304.276	315.598	319.033	310.713	305.632	291.248	314.638	320.599	307.487	306.766	331.644	365.499	376.210
absolute change	-1.845	1.330	-2.863	-3.110	-3.244	-2.991	-2.405	-2.797	-1.088	1.650	-313	-1.051	1.268	1.216	165	-1.567	-1.776
relative change	-1,22%	0,71%	-1,18%	-1,08%	-1,07%	-0,95%	-0,75%	-0,90%	-0,36%	0,57%	-0,10%	-0,33%	0,41%	0,40%	0,05%	-0,43%	-0,47%
AVGAS																	
Submission 2021	464	161	173	91,6	87,2	76,8	82,5	75,8	76,8	68,1	60,4	48,6	40,0	58,5	16,2	16,2	12,1
Submission 2020	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
absolute change	464	161	173	91,6	87,2	76,8	82,5	75,8	76,8	68,1	60,4	48,6	40,0	58,5	16,2	16,2	12,1

In parallel, the majority of **country-specific emission factors** has been revised within TREMOD AV

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

Uncertainties

For uncertainties information, please see [main chapter](#) on civil aviation.

Planned improvements

For information on planned improvements, please see [main chapter](#) on civil aviation.

FAQs

[bibliography](#)

: 1 : Knörr, W., Schacht, A., & Gores, S. (2010): Entwicklung eines eigenständigen Modells zur Berechnung des Flugverkehrs (TREMOT-AV) : Endbericht. Endbericht zum F+E-Vorhaben 360 16 029, URL: <https://www.umweltbundesamt.de/publikationen/entwicklung-eines-modells-zur-berechnung>; Berlin & Heidelberg, 2012. : 2 : Knörr et al. (2019c): Knörr, W., Schacht, A., & Gores, S.: TREMOD Aviation (TREMOT AV) 2019 - Revision des Modells zur Berechnung des Flugverkehrs (TREMOT-AV). Heidelberg, Berlin: Ifeu Institut für Energie- und Umweltforschung Heidelberg GmbH & Öko-Institut e.V., Berlin & Heidelberg, 2019. : 3 : Gores (2019): Inventartool zum deutschen Flugverkehrsinventar 1990-2018, im Rahmen der Aktualisierung des Moduls TREMOD-AV im Transportemissionsmodell TREMOD, Berlin, 2019. : 4 : EMEP/EEA, 2019: EMEP/EEA air pollutant emission inventory guidebook 2019 - Copenhagen, 2019 : 5 : Eurocontrol (2019): Advanced emission model (AEM); <https://www.eurocontrol.int/model/advanced-emission-model>; 2019 [bibliography](#)

¹⁾ (bible 2)

²⁾ (bible 3)

³⁾ (bible 1)

⁴⁾ (bible 2)

⁵⁾ (bible 4)

⁶⁾ (bible 4)

⁷⁾ (bible 5)

⁸⁾ (bible 4)

⁹⁾ (bible 5)

