

PM ¹																		
BC ²																		
CO																		

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 ii (ii) - Domestic 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 consumption in 1.A.3.a ii (ii), in terajoules

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Submission 2021																	
Submission 2020																	
absolute change																	
relative change																	

In parallel, the majority of **country-specific emission factors** has been revised within TREMOD AV based on information available from the 2019 EMEP/EEA Guidebook ⁸⁾ and Eurocontrol's AEM model ⁹⁾.

Table 4: Revised emission-factor values, in [kg/TJ]

< NMVOC																	
~ Submission 2020	> 15.1	> 17.0	> 17.2	> 19.9	> 20.9	> 21.5	> 21.7	> 21.6	> 21.3	> 21.4	> 21.7	> 23.3	> 23.6	> 23.8	> 19.1	> 19.5	
~ Submission 2019	> 9.3	> 11.6	> 10.5	> 12.1	> 13.2	> 13.3	> 13.0	> 13.1	> 13.1	> 13.3	> 13.2	> 13.7	> 14.1	> 13.5	> 13.4	> 13.6	
~ absolute change	> 5.84	> 5.46	> 6.68	> 7.76	> 7.69	> 8.21	> 8.69	> 8.49	> 8.24	> 8.10	> 8.48	> 9.68	> 9.48	> 10.28	> 5.66	> 5.83	
~ relative change	> 63.0%	> 47.2%	> 63.8%	> 64.0%	> 58.1%	> 61.7%	> 66.7%	> 64.8%	> 63.1%	> 61.1%	> 64.0%	> 70.9%	> 67.1%	> 75.9%	> 42.2%	> 42.7%	

< Nitrogen oxides - NO_x																
~ Submission 2020	> 330	> 367	> 332	> 319	> 317	> 320	> 333	> 346	> 354	> 356	> 360	> 359	> 366	> 365	> 379	> 380
~ Submission 2019	> 342	> 381	> 351	> 338	> 339	> 346	> 358	> 366	> 372	> 375	> 380	> 385	> 384	> 388	> 396	> 402
~ absolute change	> -12.51	> -14.42	> -18.74	> -19.36	> -21.48	> -26.16	> -25.15	> -20.71	> -18.06	> -19.21	> -20.09	> -26.37	> -17.21	> -22.82	> -17.11	> -21.59
~ relative change	> -3.65%	> -3.79%	> -5.34%	> -5.72%	> -6.34%	> -7.55%	> -7.02%	> -5.65%	> -4.86%	> -5.13%	> -5.29%	> -6.85%	> -4.48%	> -5.88%	> -4.33%	> -5.38%
< Sulphur oxides - SO_x																
~ Submission 2020	> 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
~ Submission 2019	> 25.1	> 15.2	> 8.5	> 6.3	> 5.9	> 5.5	> 5.1	> 4.7	> 4.7	> 4.7	> 4.7	> 4.7	> 4.7	> 4.7	> 4.7	> 4.7
~ absolute change	> -5.45	> 4.30	> 11.08	> 13.28	> 13.71	> 14.13	> 14.55	> 14.98	> 14.98	> 14.98	> 14.98	> 14.98	> 14.98	> 14.98	> 14.98	> 14.98
~ relative change	> -21.7%	> 28.2%	> 131%	> 209%	> 232%	> 257%	> 287%	> 322%	> 322%	> 322%	> 322%	> 322%	> 322%	> 322%	> 322%	> 322%
< Black carbon - BC																
~ Submission 2020	> 2.02	> 2.49	> 2.44	> 2.53	> 2.56	> 2.47	> 2.20	> 2.22	> 2.28	> 2.25	> 2.26	> 2.27	> 2.38	> 2.40	> 2.24	> 2.21
~ Submission 2019	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23
~ absolute change	> -0.21	> 0.26	> 0.21	> 0.30	> 0.32	> 0.24	> -0.03	> -0.01	> 0.05	> 0.02	> 0.03	> 0.03	> 0.15	> 0.17	> 0.01	> -0.02
~ relative change	> -9.52%	> 11.61%	> 9.50%	> 13.39%	> 14.49%	> 10.85%	> -1.42%	> -0.49%	> 2.32%	> 0.82%	> 1.34%	> 1.55%	> 6.53%	> 7.57%	> 0.29%	> -0.95%
< Particulate matter - PM																
~ Submission 2020	> 4.21	> 5.19	> 5.09	> 5.27	> 5.33	> 5.16	> 4.58	> 4.63	> 4.76	> 4.69	> 4.71	> 4.72	> 4.95	> 5.00	> 4.66	> 4.61
~ Submission 2019	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65
~ absolute change	> -0.44	> 0.54	> 0.44	> 0.62	> 0.67	> 0.50	> -0.07	> -0.02	> 0.11	> 0.04	> 0.06	> 0.07	> 0.30	> 0.35	> 0.01	> -0.04
~ relative change	> -9.52%	> 11.6%	> 9.50%	> 13.4%	> 14.5%	> 10.8%	> -1.42%	> -0.49%	> 2.32%	> 0.82%	> 1.34%	> 1.55%	> 6.53%	> 7.57%	> 0.29%	> -0.95%
< Carbon monoxide - CO																
~ Submission 2020	> 144.5	> 145.2	> 179.0	> 195.3	> 194.5	> 193.3	> 195.1	> 194.2	> 190.2	> 190.0	> 194.1	> 205.0	> 206.2	> 208.5	> 149.0	> 145.3
~ Submission 2019	> 85.5	> 88.2	> 111.7	> 111.0	> 111.0	> 105.2	> 102.4	> 104.8	> 105.8	> 105.2	> 102.1	> 98.7	> 100.4	> 104.3	> 98.2	> 91.7
~ absolute change	> 58.93	> 56.97	> 67.33	> 84.30	> 83.50	> 88.08	> 92.71	> 89.41	> 84.38	> 84.77	> 91.96	> 106.30	> 105.85	> 104.16	> 50.81	> 53.62
~ relative change	> 68.9%	> 64.6%	> 60.3%	> 75.9%	> 75.2%	> 83.7%	> 90.5%	> 85.3%	> 79.7%	> 80.6%	> 90.1%	> 108%	> 105.4%	> 99.9%	> 51.7%	> 58.5%



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 (2018): 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,

<https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-a-aviation/view>; 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)