1.A.3.a ii (ii) - Domestic Civil Aviation: Cruise

Short description

Category Code	Method					AD					EF				
1.A.3.a ii (ii)	T1, T2, T3					NS, M					CS, D, M				
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.a ii (ii)	*not included in key category analysis*														

In NFR category *1.A.3.a ii (ii) - Domestic Civil Aviation: Cruise* emissions from domestic flights between German airports during cruise stage (above 3,000 feet of altitude) are reported.

In the following, information on sub-category specific activity data, (implied) emission factors and emission estimates are provided.

Methodology

Actitvity Data

Specific jet kerosene consumption during LTO-stage is calculated within TREMOD AV as described in the superordinate chapter.

Table 1: annual jet kerosene consumption during cruise-stage, in terajoules

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Kerosene	21.690	19.937	25.301	24.071	24.736	25.337	25.111	24.048	22.503	20.552	21.026	19.762	19.038	19.195	20.067	20.793	21.067	21.573
Avgas	1.580	614	614	291	260	228	259	244	237	283	246	199	180	233	145	142	116	72

source: Knörr et al. (2019c) [1)] & Gores (2019) [2)]

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Emission factors

All country specific emission factors used for emission reporting were basically ascertained within UBA project FKZ 360 16 029 [3)] and have since then been compiled, revised and maintained in TREMOD AV [4)].

For more information, please see the superordinate chapter on civil aviation.

Table 2: Annual country-specific emission factors, in kg/TJ

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
NH_3																		
NMVOC																		
NO_x																		
SO_x																		
PM[1]																		
BC[2]																		
CO																		

[1] EF(TSP) also applied for PM_{10} 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

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Berechnung des Flugverkehrs (TREMOD-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

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