

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

Short description

Method	AD	EF	Key Category for
T1, T2, T3	NS, M	CS, D, M	<i>not included in key category analysis</i>

In NFR category 1.A.3.a i (ii) - *International Civil Aviation: Cruise* emissions from international flights from 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

Activity Data

Specific jet kerosene consumption during LTO-stage is calculated within TREMOD AV as described in the [superordinate chapter](#) on civil aviation.

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

1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

gallery size="medium" : 1A3ai(ii)_AD.png [gallery](#)

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 [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																		
NM VOC																		
NO _x																		
SO _x																		
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 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
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 country-specific emission-factors, in [kg/TJ]

< NMVOC																	
~ Submission 2020	> 13.4	> 9.5	> 5.9	> 5.4	> 5.3	> 5.2	> 5.1	> 5.0	> 4.9	> 4.8	> 4.7	> 4.7	> 4.6	> 4.7	> 4.5	> 4.5	
~ Submission 2019	> 13.5	> 9.0	> 5.6	> 5.2	> 5.1	> 4.9	> 4.8	> 4.7	> 4.7	> 4.6	> 4.4	> 4.5	> 4.5	> 4.5	> 4.4	> 4.5	
~ absolute change	> -0.05	> 0.48	> 0.36	> 0.24	> 0.27	> 0.29	> 0.30	> 0.25	> 0.25	> 0.24	> 0.26	> 0.23	> 0.14	> 0.19	> 0.02	> 0.00	
~ relative change	> -0.39%	> 5.36%	> 6.42%	> 4.62%	> 5.31%	> 5.98%	> 6.26%	> 5.24%	> 5.37%	> 5.27%	> 5.75%	> 5.23%	> 3.18%	> 4.18%	> 0.39%	> 0.07%	
< NO_x																	
~ Submission 2020	> 308	> 313	> 319	> 330	> 331	> 334	> 335	> 339	> 346	> 349	> 354	> 354	> 354	> 354	> 359	> 361	
~ Submission 2019	> 313	> 317	> 329	> 335	> 336	> 339	> 341	> 344	> 350	> 352	> 359	> 364	> 368	> 374	> 378	> 380	
~ absolute change	> -5.05	> -3.50	> -9.68	> -5.31	> -5.00	> -5.19	> -5.11	> -4.91	> -4.69	> -3.15	> -5.07	> -10.16	> -13.33	> -19.30	> -19.11	> -19.37	
~ relative change	> -1.61%	> -1.10%	> -2.94%	> -1.58%	> -1.49%	> -1.53%	> -1.50%	> -1.43%	> -1.34%	> -0.89%	> -1.41%	> -2.79%	> -3.62%	> -5.17%	> -5.05%	> -5.09%	
< 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	> 1.91	> 2.01	> 2.08	> 1.97	> 1.95	> 1.93	> 1.90	> 1.88	> 1.86	> 1.84	> 1.83	> 1.82	> 1.78	> 1.79	> 1.79	> 1.80	

~ 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	> -0.32	> -0.22	> -0.15	> -0.26	> -0.28	> -0.30	> -0.33	> -0.36	> -0.37	> -0.39	> -0.40	> -0.42	> -0.45	> -0.44	> -0.44	> -0.44
~ relative change	> -14.3%	> -9.8%	> -6.8%	> -11.6%	> -12.5%	> -13.5%	> -15.0%	> -16.0%	> -16.7%	> -17.5%	> -18.0%	> -18.7%	> -20.1%	> -19.9%	> -19.7%	> -19.5%
< Particulate matter - PM																
~ Submission 2020	> 3.98	> 4.19	> 4.33	> 4.11	> 4.07	> 4.02	> 3.95	> 3.91	> 3.87	> 3.84	> 3.81	> 3.78	> 3.72	> 3.72	> 3.74	> 3.74
~ 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	> -0.67	> -0.46	> -0.32	> -0.54	> -0.58	> -0.63	> -0.70	> -0.74	> -0.78	> -0.81	> -0.84	> -0.87	> -0.93	> -0.93	> -0.91	> -0.91
~ relative change	> -14.3%	> -9.8%	> -6.8%	> -11.6%	> -12.5%	> -13.5%	> -15.0%	> -16.0%	> -16.7%	> -17.5%	> -18.0%	> -18.7%	> -20.1%	> -19.9%	> -19.7%	> -19.5%
< Carbon monoxide - CO																
~ Submission 2020	> 71.0	> 60.3	> 44.9	> 40.0	> 39.2	> 38.3	> 37.4	> 36.4	> 35.9	> 35.6	> 35.5	> 35.6	> 35.3	> 35.5	> 33.5	> 33.6
~ Submission 2019	> 72.0	> 59.8	> 44.3	> 40.2	> 39.2	> 38.2	> 37.1	> 36.8	> 36.4	> 36.2	> 35.8	> 35.6	> 35.1	> 35.1	> 35.1	> 35.5
~ absolute change	> -0.97	> 0.48	> 0.55	> -0.21	> 0.00	> 0.17	> 0.32	> -0.41	> -0.47	> -0.59	> -0.28	> -0.05	> 0.19	> 0.40	> -1.55	> -1.90
~ relative change	> -1.35%	> 0.81%	> 1.24%	> -0.53%	> 0.01%	> 0.44%	> 0.87%	> -1.11%	> -1.29%	> -1.63%	> -0.78%	> -0.14%	> 0.54%	> 1.15%	> -4.42%	> -5.35%



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⁾ (bibcite 2)

²⁾ (bibcite 3)

³⁾ (bibcite 1)

⁴⁾ (bibcite 2)

⁵⁾ (bibcite 4)

⁶⁾ (bibcite 4)

⁷⁾ (bibcite 5)

⁸⁾ (bibcite 4)

⁹⁾ (bibcite 5)