1.A.3.a i (i) - Internatinal Civil Aviation: LTO

Short description

In NFR category *1.A.3.a i (i) - Internatinal Civil Aviation: LTO* emissions during LTO stage (Landing/Take-off: 0-3,000 feet) are reported. In the following, information on sub-category specific AD, (implied) emission factors and emission estimates are provided.

Method	AD	EF	Key Category
T1, T2, T3	NS, M	CS, D, M	*no key category*

T = key source by Trend **L** = key source by Level

Methods	
D	Default
RA	Reference Approach
T1	Tier 1 / Simple Methodology *
T2	Tier 2*
T3	Tier 3 / Detailed Methodology *
C	CORINAIR
CS	Country Specific
M	Model
* as described in the EMEP/CORINAIR Emission Inventory Guidebook - 2007, in the group specific chapters.	

AD - Data Source for Activity Data	
NS	National Statistics
RS	Regional Statistics
IS	International Statistics
PS	Plant Specific data
AS	Associations, business organisations
Q	specific questionnaires, surveys

EF - Emission Factors	
D	Default (EMEP Guidebook)
C	Confidential
CS	Country Specific
PS	Plant Specific data

Methodology

Actitvity Data

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

the main chapter on civil aviation.

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

1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
13,676	15,973	21,785	25,168	26,381	27,295	27,439	26,538	26,256	24,701	27,164	28,075	27,274	27,546	29,875	32,999	34,160	

source: Knörr et al. (2019c) & Gores (2019) [1], [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 (Knörr, W., Schacht, A., & Gores, S. (2010)) [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	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
JET KEROSENE														
NH_3														
NMVOC														
NO_x														
SO_x														
BC^1														
PM^2														
CO														
AVIATION GASOLINE														
NH_3														
NMVOC														
NO_x														
SO_x														
BC^1														
PM^2														
TSP^3														
CO														

[1] estimated via a f-BCs (avgas: 0.15, jet kerosene: 0.48) as provided in [5]
[2] EF(PM,,2.5,,) also applied for PM,,10,, and TSP (assumption: > 99% of TSP from diesel oil combustion consists of PM,,2.5,,)
[3] also including TSP from lead: EF(TSP) = 1.6 x EF(Pb) - see road transport

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

Discussion of emission trends

> NFR 1.A.3.a i (i) - International Civil Aviation - LTO is **no key category**.

Recalculations

As mentioned in the superordinate chapter on 1.A.3.a, the LTO fuel consumptions applied in TREMOD AV have been adapted to the the EMERP/EEA Guidebook 2019. [6)]

Hence, the percentual annual shares of kerosene consumed during L/TO for international flights have been re-estimated...

Table 3: Revised percentual share of kerosene consumed during L/TO for international flights, in %

	= 1990	= 1995	= 2000	= 2005	= 2006	= 2007	= 2008	= 2009	= 2010	= 2011	= 2012	= 2013	= 2014	= 2015	= 2016	= 2017
~ Submission 2020	> 8.31	> 7.84	> 8.21	> 8.02	> 7.98	> 7.96	> 7.92	> 7.87	> 7.91	> 7.82	> 7.95	> 8.05	> 8.15	> 8.24	> 8.26	> 8.28
~ Submission 2019	> 7.52	> 8.50	> 7.72	> 7.49	> 7.41	> 7.48	> 7.58	> 7.50	> 7.94	> 8.77	> 8.01	> 7.73	> 8.16	> 8.47	> 8.14	> 7.60
~ absolute change	> 0.79	> -0.66	> 0.49	> 0.53	> 0.57	> 0.48	> 0.34	> 0.37	> -0.03	> -0.95	> -0.07	> 0.32	> -0.01	> -0.23	> 0.13	> 0.68
~ relative change	> 10.5%	> -7.80%	> 6.37%	> 7.03%	> 7.65%	> 6.37%	> 4.45%	> 4.88%	> -0.39%	> -10.8%	> -0.84%	> 4.15%	> -0.10%	> -2.77%	> 1.54%	> 8.89%

... and the amounts of kerosene allocated to sub-category 1.A.3.a i (i) were revised accordingly:

Table 4: Revised kerosene usage in 1.A.3.a i (i), in terajoules

	= 1990	= 1995	= 2000	= 2005	= 2006	= 2007	= 2008	= 2009	= 2010	= 2011	= 2012	= 2013	= 2014	= 2015	= 2016	= 2017
~ Submission 2020	> 13,676	> 15,973	> 21,785	> 25,168	> 26,381	> 27,295	> 27,439	> 26,538	> 26,256	> 24,701	> 27,164	> 28,075	> 27,274	> 27,546	> 29,875	> 32,999
~ Submission 2019	> 12,419	> 17,315	> 20,352	> 23,432	> 24,422	> 25,597	> 26,193	> 25,189	> 26,243	> 27,570	> 27,317	> 26,897	> 27,305	> 28,246	> 29,301	> 30,226
~ absolute change	> 1,257	> -1,342	> 1,434	> 1,736	> 1,959	> 1,699	> 1,246	> 1,349	> 13	> -2,870	> -154	> 1,178	> -31	> -700	> 575	> 2,773
~ relative change	> 10.1%	> -7.75%	> 7.05%	> 7.41%	> 8.02%	> 6.64%	> 4.76%	> 5.36%	> 0.05%	> -10.4%	> -0.56%	> 4.38%	> -0.11%	> -2.48%	> 1.96%	> 9.17%

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 [7)] and Eurocontrol's AEM model [8)]. Here, among others, the EF for SO,,2,, from jet kerosene has been replaced by new and more reliable data showing no sulphur reduction since 1990.

Table 5: Revised country-specific emission factors

	= 1990	= 1995	= 2000	= 2005	= 2006	= 2007	= 2008	= 2009	= 2010	= 2011	= 2012	= 2013	= 2014	= 2015	= 2016	= 2017

< Non-methane volatile organic compounds - NMVOC																
~ Submission 2020	> 56.6	> 37.1	> 25.0	> 22.6	> 22.8	> 22.5	> 22.1	> 21.3	> 21.9	> 21.8	> 21.8	> 21.7	> 21.2	> 21.9	> 21.7	> 22.3
~ Submission 2019	> 71.8	> 39.0	> 32.3	> 26.7	> 26.5	> 25.7	> 25.2	> 24.2	> 23.2	> 23.3	> 22.5	> 21.9	> 21.5	> 20.8	> 20.5	> 20.8
~ absolute change	> -15.2	> -1.91	> -7.35	> -4.15	> -3.65	> -3.19	> -3.10	> -2.90	> -1.31	> -1.48	> -0.77	> -0.19	> -0.23	> 1.17	> 1.12	> 1.50
~ relative change	> -21.2%	> -4.9%	> -22.7%	> -15.5%	> -13.8%	> -12.4%	> -12.3%	> -12.0%	> -5.63%	> -6.37%	> -3.42%	> -0.87%	> -1.08%	> 5.62%	> 5.45%	> 7.20%
< Nitrogen oxides - NO,,x,,																
~ Submission 2020	> 283	> 299	> 285	> 307	> 310	> 314	> 316	> 324	> 330	> 333	> 334	> 337	> 343	> 340	> 345	> 347
~ Submission 2019	> 302	> 310	> 307	> 322	> 324	> 328	> 330	> 336	> 344	> 345	> 349	> 353	> 355	> 358	> 362	> 363
~ absolute change	> -19.0	> -10.8	> -21.4	> -15.1	> -13.8	> -13.5	> -13.5	> -12.5	> -13.9	> -11.6	> -14.3	> -15.6	> -11.9	> -18.0	> -16.7	> -16.7
~ relative change	> -6.28%	> -3.50%	> -6.99%	> -4.67%	> -4.27%	> -4.11%	> -4.09%	> -3.73%	> -4.04%	> -3.35%	> -4.11%	> -4.42%	> -3.35%	> -5.02%	> -4.62%	> -4.59%
< 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%
< Particulate Matter - PM (PM,,2.5,, = PM,,10,, = TSP)																
~ Submission 2020	> 2.50	> 2.48	> 2.48	> 2.50	> 2.50	> 2.50	> 2.50	> 2.50	> 2.50	> 2.50	> 2.50	> 2.50	> 2.50	> 2.50	> 2.49	> 2.49
~ Submission 2019	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16	> 2.16
~ absolute change	> 0.34	> 0.33	> 0.33	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34
~ relative change	> 15.9%	> 15.1%	> 15.1%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.6%	> 15.6%
< Black Carbon - BC																
~ Submission 2020	> 1.20	> 1.19	> 1.19	> 1.20	> 1.20	> 1.20	> 1.20	> 1.20	> 1.20	> 1.20	> 1.20	> 1.20	> 1.20	> 1.20	> 1.20	> 1.20
~ Submission 2019	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04	> 1.04
~ absolute change	> 0.17	> 0.16	> 0.16	> 0.16	> 0.16	> 0.16	> 0.16	> 0.16	> 0.16	> 0.16	> 0.16	> 0.16	> 0.16	> 0.16	> 0.16	> 0.16
~ relative change	> 15.9%	> 15.1%	> 15.1%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.7%	> 15.6%	> 15.6%
< Carbon monoxide - CO																
~ Submission 2020	> 225	> 214	> 209	> 192	> 192	> 188	> 186	> 181	> 186	> 185	> 188	> 187	> 182	> 186	> 182	> 183
~ Submission 2019	> 245	> 222	> 235	> 224	> 220	> 215	> 212	> 208	> 202	> 201	> 197	> 194	> 191	> 188	> 184	> 184
~ absolute change	> -20.1	> -8.0	> -26.5	> -31.5	> -28.0	> -27.3	> -25.8	> -26.4	> -15.5	> -15.2	> -9.07	> -6.71	> -9.32	> -1.36	> -2.21	> -0.68
~ relative change	> -8.20%	> -3.59%	> -11.2%	> -14.1%	> -12.7%	> -12.7%	> -12.2%	> -12.7%	> -7.70%	> -7.58%	> -4.60%	> -3.46%	> -4.87%	> -0.73%	> -1.20%	> -0.37%

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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