Appendix 2.4 - POP emissions from mobile combustion sources

Road Transport

For PAH exhaust-emissions, default emission factors from the 2019 version of EMEP Guidebook (EMEP/EEA, 2019) [1)] have been applied. Regarding PCDD/F, a tier1 EF from (Rentz et al., 2008) [2)] is used instead.

Table 1: Tier1 default emisison factors applied to road vehicles

	B[a]P	B[b]F	B[k]F	I[...]P	PAHs 1-4	PCDD/F
	[mg/TJ]					[µg/km]
Diesel oil	368	386	203	368	1,324	
Biodiesel[1]	368	386	203	368	1,324	
Gasoline fuels	96	140	69	158	464	
CNG	NE	NE	NE	NE	NE	
LPG	4.35	0.00	4.35	4.35	13.2	
Biogas	NE	NE	NE	NE	NE	
all fuels						0.0000056

[1] values differ from EFs applied for fossil diesel oil to take into account the specific NCV of biodiesel

Here, the tier1 values for PAH exhaust emissions have been derived from the following tier1 default values provided in the July 2017 version of the 2016 EMEP/EEA Guidebook:

Non-road Mobile Machinery in 1.A.2.g vii, 1.A.4.a.ii,1.A.4.b.i, 1.A.4.c.ii and 1.A.5.b i

Table 3: Tier1 default emisison factors applied to NRMM

	B[a]P	B[b]F	B[k]F	I[...]P	PAH 1-4	PCDD/F
	[mg/TJ]					[µg/TJ]
Diesel oil	698	1.164	801	184	2,847	1.62[3]
Biodiesel[1]	806	1.343	924	212	3,284	1.87
Gasoline fuels - 4-stroke	919	919	90	204	2,131	2.76[3]
Gasoline fuels - 2-stroke[2]	919	919	90	204	2,131	57.5[3]
LPG (1.A.4.a ii only)	4.35	0.00	4.35	4.35	13.04	NE

[1] values differ from EFs applied for fossil diesel oil to take into account the specific NCV of biodiesel
[2] no separate values available for 2-stroke-mix including 1:50 lube oil.
[3] tier1 values derived from [3)]

Railways

Table 3: Tier1 default emisison factors applied to railway vehicles

	B[a]P	B[b]F	B[k]F	I[...]p	PAH 1-4[3]	PCDD/F
	[mg/TJ]					[µg/TJ]
Diesel oil	698[2]	1,164[2]	801[1]	184[1]	2,847[3]	2.09
Biodiesel	806	1,343	924	212	3,284	2.41
Lignite Briquettes	34,500	NE	NE	NE	90,000	29.80
Raw Lignite	NE					NE

	B[a]P	B[b]F	B[k]F	I[...]p	PAH 1-4[3]	PCDD/F
Hard Coal	NE					NE
Hard Coal Coke	NE					NE

[1] tier1 default from [4)], chapter: 1.A.3.b i-iv - Road transport: exhaust emissions: tier1 value for diesel vehicles
[2] tier1 default from [5)], chapter: 1.A.3.c - Railways
[3] sum of tier1 default value applied for B[a]P, B[b]F, B[k]F, and I[…]P

As the EMEP/EEA GB 2019 does not provide a tier1 value for **PCDD/F**, the EF applied here has been derived from a study carried out by Rentz et al. (2008) [6)] for the German Federal Environment Agency. Furthermore, both **HCB** and **PCBs** emissions are stated as *not applicable* in [7)], chapter 1.A.3.c Railways, Table 3-1 Tier 1 emission factors for railways.

Inland Vessels and Ships in 1.A.3.d ii

Table 4: Tier1 default emission factors applied to inland ships and vessels

	B[a]P	B[b]F	B[k]F	I[...]p	PAH 1-4[2]	HCB	PCBs	PCDD/F
	[mg/TJ]							[µg/TJ]
Diesel oil	698[4]	1,164[4]	801[5]	184[5]	2,847	1.86[3]	0.88[3]	93.0[7]
Biodiesel[1]	806	1,343	924	212	3,284	1.02	2.15	107

[1] similar EF for biodiesel applied for all mobile sources; due to lack of better information EF values are derived from conventional diesel oil but taking into account the specific NCV of biodiesel
[2] sum of tier1 default values applied for B[a]P, B[b]F, B[k]F, and I[1,2,3-c,d]P
[3] tier1 defaults from [8)], Chapter: 1.A.3.d.i, 1.A.3.d.ii, 1.A.4.c.iii Navigation: Tables 3-1 and 3-2
[4] tier1 defaults from [9)], Chapter: 1.A.3.c Railways: Diesel, Table 3-1
[5] tier1 defaults from [10)], Chapter: 1.A.3.b.i, 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv - Road transport, Table 3-8: HDV, Diesel

Maritime Vessels and Ships in 1.A.3.d i, 1.A.3.d ii, 1.A.4.c iii and 1.A.5.b iii

The following table provides the tier1 EF applied for POPs from ships and vessels in both civil and military operation in NFR categories 1.A.3.d i -International Maritime Navigation, 1.A.3.d ii - National Navigation (Shipping), 1.A.4.c iii -Fisheryand 1.A.5.b iii - Other: Military Navigation.

Table 4: Tier1 default emission factors applied to maritime ships and vessels

	B[a]P	B[b]F	B[k]F	I[...]p	PAH 1-4[2]	HCB	PCBs	PCDD/F
	[mg/TJ]							[µg/TJ]
Diesel oil	698[4]	1,164[4]	801[5]	184[5]	2,847	1.86[3]	0.88[3]	93.0[7]
Biodiesel[1]	806	1,343	924	212	3,284	2.15	1.02	107
Heavy Fuel oil[6]	741	1,235	849	195	3,020	3.46	14.1	98.7

[1] similar EF for biodiesel applied for all mobile sources; due to lack of better information EF values are derived from conventional diesel oil but taking into account the specific NCV of biodiesel
[2] sum of tier1 default values applied for B[a]P, B[b]F, B[k]F, and I[1,2,3-c,d]P
[3] tier1 defaults from [11)], Chapter: 1.A.3.d.i, 1.A.3.d.ii, 1.A.4.c.iii Navigation: Tables 3-1 and 3-2
[4] tier1 defaults from [12)], Chapter: 1.A.3.c Railways: Diesel, Table 3-1
[5] tier1 defaults from [13)], Chapter: 1.A.3.b.i, 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv - Road transport, Table 3-8: HDV, Diesel
[6] derived from default for fossil diesel oil, but adapted to specific NCV of heavy fuel oil
[7] tier1 value derived from [14)]

Aircraft in 1.A.3.a and 1.A.5.b ii

The EMEP/EEA GB 2016 (July 2017) does not provide specific defaults for POP emissions from the combustion of jet kerosene and aviation gasoline, stating that for for aviation gasoline these emissions are *not estimated* (NE):

Therefore, the inventory compiler decided to apply the tier1 EF for **PAHs** from gasoline fuel used in non-road mobile machinery here, too. Furthermore, both **HCB** and **PCBs** emissions are stated as *not applicable* in [15], chapter 1.A.3.a, 1.A.5.b Aviation, Table 3.3 Tier 1 emission factors for NFR 1.A.3.a.ii.(i): Civil aviation (domestic, LTO).

As the Party assumes that POP emissions from the combustion of jet kerosene are unlikely to occur, these emission are reported as *not applicable* (NA).

Table 5: Tier1 default emisison factors applied to aircraft, in mg/TJ

	B[a]P	**B[b]F**	**B[k]F**	**I[...]p**	**PAH 1-4**	**PCDD/F**
Kerosene	NA	NA	NA	NA	NA	NA
Aviation gasoline	126	182	90	205	602	NE

[1], [4], [5], [7], [8], [9], [10], [11], [12], [13], [15] EMEP/EEA (2019): EMEP/EEA air pollutant emission inventory guidebook 2019, Copenhagen, 2019.
[2], [3], [6], [14] Rentz et al., 2008: Nationaler Durchführungsplan unter dem Stockholmer Abkommen zu persistenten organischen Schadstoffen (POPs), im Auftrag des Umweltbundesamtes, FKZ 205 67 444, UBA Texte | 01/2008, January 2008 - URL: https://www.umweltbundesamt.de/en/publikationen/nationaler-durchfuehrungsplan-unter-stockholmer