Appendix 17.2.1

Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

Appendix 17.2.1: Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

VOCs Speciation (kg TAP/kg VOC) - Part I

Table A17.2.1.1: VOCs Speciation (kg TAP/kg VOC) Extracted from the EDMS V5.1.4.1

TAP	Aircraft & ERUF	GFS & Helicopter	APU	Catering	Fuel Tank	Training Fire	GSE	Marine Navigation [1]	Air Maintance Center
1,3-Butadiene	0.017	0.017	0.017	-	-	-	-	-	
Acetaldehyde	0.043	0.043	0.043	-	-	-	0.030	0.056	
Acrolein	0.025	0.025	0.025	-	-	-	-	0.003	
Benzene	0.017	0.017	0.017	-	-	-	-	0.015	0.016
Diesel particulate matter	-	-	-	-	-	-	-	-	
Formaldehyde	0.124	0.124	0.124	0.487	-	-	0.088	0.112	
Lead	-	-	-	-	-	-	-	0.000	
Naphthalene	0.005	0.005	0.005	-	-	-	-	0.001	0.000
Propionaldehyde	0.007	0.007	0.007	-	-	-	0.018	0.005	
Toluene	0.007	0.007	0.007	-	0.016	-	-	0.002	0.238
o-Xylene	0.002	0.002	0.002	-	-	-	-	0.004	0.033
m-Xylene + P-xylene	0.003	0.003	0.003	-	-	-	-		0.022
n-Hexane	-	-	-	0.108	0.053	-	-	0.004	0.001
Styrene	0.003	0.003	0.003	-	-	-	-	0.002	
Ethylbenzene	0.002	0.002	0.002	-	-	-	-	0.002	0.013
Polycyclic Organic Matter	-	-	-	-	-	-	-	-	
(POM) as 7 Polycyclic Organic Hydrocarbons (PAH)	-	-	-	-	-	-	-	-	
POM as 16 PAH	-	-	-	-	-	-	-	-	
Methyl alcohol (IRIS,CAA)	0.018	0.018	0.018	-	-	-	-		
Isopropylbenzene (cumene) (IRIS,CAA)	0.000	0.000	0.000	-	-	-	-		0.000
Phenol (carbolic acid) (IRIS,CAA)	0.007	0.007	0.007	-	-	-	-		
Acetone (IRIS)	0.004	0.004	0.004	-	-	-	-		0.127
2-methylnaphthalene (IRIS)	0.002	0.002	0.002	-	-	-	-		
Benzaldehyde (IRIS)	0.005	0.005	0.005	-	-	-	0.006		0.008
N-heptane (IRIS)	0.001	0.001	0.001	0.003	0.023	-	-		0.116
Ethane	0.005	0.005	0.005	-	0.031	0.160	-		
Ethylene	0.155	0.155	0.155	-	-	0.515	-		
Acetylene	0.040	0.040	0.040	-	-	-	-		
Propane	0.001	0.001	0.001	0.012	0.182	-	-		
2-methyl-2-propenal (methacrolein)	0.004	0.004	0.004	-	-	-	-		
Methylglyoxal	0.015	0.015	0.015	-	-	-	-		
1-Methylnaphthalene	0.002	0.002	0.002	-	-	-	-		
1,2,4-trimethylbenzene (1,3,4-trimethylbenzene)	0.004	0.004	0.004	-	-	-	-		
N-propylbenzene	0.001	0.001	0.001	-	-	-	-		0.001
p-Tolualdehyde	0.000	0.000	0.000	-	-	-	-		0.011
1-butene	0.018	0.018	0.018	-	-	-	-		
Glyoxal	0.018	0.018	0.018	-	-	-	-		
2-methylpentane	0.004	0.004	0.004	-	-	-	-		
1,3,5-trimethylbenzene	0.001	0.001	0.001	-	-	-	-		
N-pentane	0.002	0.002	0.002	0.047	0.114	-	-		
1-pentene	0.008	0.008	0.008	-	-	-	-		
Valeraldehyde	0.002	0.002	0.002	-	-	-	-		
N-octane	0.001	0.001	0.001	-	-	-	-		
1-octene	0.003	0.003	0.003	-	-	-	-		
N-nonane	0.001	0.001	0.001	-	-	-	-		0.014
N-dodecane	0.005	0.005	0.005	-	-	-	-		
Propylene	0.046	0.046	0.046	-	-	0.030	-		
Butyraldehyde	0.001	0.001	0.001	-	-	-	-		
1-nonene	0.002	0.002	0.002	-	-	-	-		
N-decane	0.003	0.003	0.003	-	-	-	-		
2-methyl-2-butene	0.002	0.002	0.002	-	-	-	-		
1,2,3-trimethylbenzene	0.001	0.001	0.001	-	-	-	-		
o-Tolualdehyde	0.002	0.002	0.002	-	-	-	-		
N-Hexadecane	0.000	0.000	0.001	-	-	-	-		
3-methyl-1-butene	0.001	0.001	0.001	-	-	-	-		
2-methyl-1-butene	0.001	0.001	0.001	-	-	-	-		
Cis-2-butene	0.002	0.002	0.002	-	-	-	-		
Isovaleraldehyde	0.000	0.000	0.000	-	-	-	-		
1-hexene	0.007	0.007	0.007	-	-	-	-		
1-Methyl-2-ethylbenzene (o-ethyltoluene)	0.001	0.001	0.001	-	-	-	-		
1-Methyl-3-ethylbenzene (m-ethyltoluene)	0.002	0.002	0.002	-	-	-	-		
Tolualdehyde	0.003	0.003	0.003	-	-	-	-		
1-Methyl-4-ethylbenzene (p-ethyltoluene)	0.001	0.001	0.001	-	-	-	-		
Cis-2-pentene	0.003	0.003	0.003	-	-	-	-		
N-tridecane	0.005	0.005	0.005	-	-	-	-		
N-Tetradecane	0.004	0.004	0.004	-	-	-	-		
N-Pentadecane	0.002	0.002	0.002	-	-	-	-		
N-heptadecane	0.000	0.000	0.000	-	-	-	-		
Trans-2-pentene	0.004	0.004	0.004	-	-	-	-		
4-methyl-1-pentene	0.001	0.001	0.001	-	-	-	-		
2-methyl-1-pentene	0.000	0.000	0.000	-	-	-	-		
1-decene	0.002	0.002	0.002	-	-	-	-		
N-undecane	0.004	0.004	0.004	-	-	-	-		0.025
Trans-2-hexene	0.000	0.000	0.000	-	-	-	-		
Crotonaldehyde	0.010	0.010	0.010	-	-	-	0.010		
Heptene	0.004	0.004	0.004	-	-	-	-		
Dimethyl napthalene	0.001	0.001	0.001	-	-	-	-		
C-10 Olefins	0.059	0.059	0.059	-	-	-	-		0.022
C-10 Paraffins	0.147	0.147	0.147	-	-	-	-		
C-14 Alkane	0.002	0.002	0.002	-	-	-	-		
C-15 Alkane	0.002	0.002	0.002	-	-	-	-		
C-16 Alkane	0.001	0.001	0.001	-	-	-	-		
C-18 Alkane	0.000	0.000	0.000	-	-	-	-		
C-4 Benzene + C-3 Aroald	0.007	0.007	0.007	-	-	-	-		
C-5 Benzene + C-4 Aroald	0.003	0.003	0.003	-	-	-	-		
Decanol	0.059	0.059	0.059	-	-	-	-		
Dodecanol	0.029	0.029	0.029	-	-	-	-		

Note:

[1] Sourced from Documentation for the Commercial Marine Vessel Component of the National Emissions Inventory - Methodology, 2009

Appendix 17.2.1: Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

VOCs Speciation (kg TAP/kg VOC) - Part II

Table A17.2.1.2: GVWR Range and Emfac Vehicle Classess

Emfac Vehicle Classes	GVWR Range
PC	All
Taxi	All
LGV3	<5000 lbs, GVWR
LGV4	5000-7000 lbs, GVWR
LGV6	>7000 lbs, GVWR
HGV7	11000-30000 lbs, GVWR
HGV8	>30000 lbs. GVWR
PLB	All
PV4	<=7000 lbs, GVWR
PV5	>7000 lbs, GVWR
NFB6	<=12800 lbs, GVWR
NFB7	12800 - 30000 lbs, GVWR
NFB8	>30000 lbs. GVWR
FBSD	All
FBDD	All
MC	All

Table A17.2.1.3: Avg. VOCs speciation for Each Vehicle Class of Motor Vehicles Extracted from the EDMS V5.1.4.1

Emfac Vehicle Classes	EDMS V5.1.3 Built-in Vehicle Class	Fuel	Formaldehyde	Benzene	Acetaldehyde	1,3-butadiene	Acrolein
PC + Taxi	Light Duty Vchivles	Gasoline	0.011173423	0.048734782	0.010215273	0.00595739	0.00047715
	(Passenger Cars)	Diesel	0.038603914	0.020002528	0.012299492	0.009002025	0.003499176
LGV3	Light Duty Trucks 1	Gasoline	0.011568432	0.051045672	0.010595062	0.006393599	0.000511139
	(0-6000 lbs. GVWR,	Diesel[1]	0.038600304	0.019999996	0.012299626	0.008998965	0.003499988
LGV4	Light Duty Trucks 2	Gasoline	0.01193688	0.05236678	0.01093256	0.006596729	0.00052626
	(0-6000 lbs. GVWR,	Diesel[1]	0.038600304	0.019999996	0.012299626	0.008998965	0.003499988
	Light Duty Trucks 3	Gasoline	0.011956199	0.052688539	0.011039946	0.006739932	0.000535222
	(6001-8500 lbs.	Diesel	0.038600304	0.019999996	0.012299626	0.008998965	0.003499988
		Avg. Gasoline	**0.011946539**	**0.05252766**	**0.010986253**	**0.00666833**	**0.000530741**
		Avg. Diesel	**0.038600304**	**0.019999996**	**0.012299626**	**0.008998965**	**0.003499988**
LGV6	Light Duty Trucks 4	Gasoline	0.012226866	0.053670929	0.011291262	0.006892665	0.000546403
	(6001-8500 lbs.	Diesel	0.038600304	0.019999996	0.012299626	0.008998965	0.003499988
	Class 2b Heavy	Gasoline	0.011248891	0.030230287	0.008137761	0.001426858	0.000280376
	Duty Vechicles	Diesel	0.081999058	0.011006251	0.030201533	0.006398041	0.003666436
		Avg. Gasoline	**0.011737879**	**0.041950608**	**0.009714512**	**0.004159761**	**0.000413389**
		Avg. Diesel	**0.060299681**	**0.015503123**	**0.021250579**	**0.007698503**	**0.003583212**
HGV7	Class 3 Heavy Duty	Gasoline	0.011509999	0.030709872	0.008325971	0.00146125	0.000286342
	Vechicles (10000-	Diesel	0.081984263	0.011005135	0.030192831	0.006397973	0.00366665
	Class 4 Heavy Duty	Gasoline	0.011822048	0.026665813	0.007225258	0.001843355	0.000647338
	Vechicles (14001-	Diesel	0.081988741	0.011008265	0.030198025	0.006396587	0.003669126
	Class 5 Heavy Duty	Gasoline	0.012859595	0.02816449	0.007857728	0.002006036	0.000703403
	Vechicles (16001-	Diesel	0.081998103	0.011008318	0.030197727	0.006394657	0.003667627
	Class 6 Heavy Duty	Gasoline	0.012829184	0.028120535	0.007841511	0.002001985	0.000700937
	Vechicles (19501-	Diesel	0.081988687	0.011007763	0.030195682	0.006397238	0.00367052
	Class 7 Heavy Duty	Gasoline	0.013382833	0.028923156	0.008178398	0.002087923	0.000731379
	Vechicles (26001-	Diesel	0.081972366	0.011006755	0.030187997	0.006395528	0.003667879
		Avg. Gasoline	**0.012480732**	**0.028516773**	**0.007885773**	**0.00188011**	**0.00061388**
		Avg. Diesel	**0.081986432**	**0.011007247**	**0.030194452**	**0.006396397**	**0.003668361**
HGV8	Class 8a Heavy	Gasoline	0.013814314	0.029545946	0.008443417	0.002154614	0.000754897
	Duty Vechicles	Diesel	0.081972812	0.011007677	0.030191165	0.006394798	0.003670282
	Class 8b Heavy	Gasoline[2]	0.015245639	0.031557041	0.009316615	0.002377141	0.000834633
	Duty Vechicles	Diesel	0.081971907	0.011007007	0.03018767	0.00639431	0.003669002
		Avg. Gasoline	**0.014529976**	**0.030551493**	**0.008880016**	**0.002265878**	**0.000794765**
		Avg. Diesel	**0.08197236**	**0.011007342**	**0.030189417**	**0.006394554**	**0.003669642**
PLB+PV4+PV5+NFB6+NFB7+NFB8+FBSD+FBDD	School Buses	Gasoline	0.015245639	0.031557041	0.009316615	0.002377141	0.000834633
		Diesel	0.081971282	0.011006388	0.030187885	0.006393708	0.003668796
	Transit and Urban	Gasoline	0.015245639	0.031557041	0.009316615	0.002377141	0.000834633
	Buses	Diesel	0.081954535	0.011001285	0.030181348	0.00639037	0.00366523
		Avg. Gasoline	**0.015245639**	**0.031557041**	**0.009316615**	**0.002377141**	**0.000834633**
		Avg. Diesel	**0.081962909**	**0.011003837**	**0.030184616**	**0.006392039**	**0.003667013**
MC	Motorcycles	Gasoline	-	-	-	-	-
	(gasoline only)	Diesel	-	-	-	-	-

Notes:

[1]: Adopted emission index from Light Duty Trucks 3 (6001-8500 lbs. GVWR, 0-3750 lbs. LVW) as information is not available.

[2]: Adopted emission index from School Buses as information is not available

Appendix 17.2.1: Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

VOCs Speciation (kg TAP/kg VOC) - Part II

a) Weighted-avg. VOCs speciation for Motor Vehicles within the Airport Island

Table A17.2.1.4: Weighted-avg. VOCs speciation for Motor Vehicles within the Airport Island

Emfac Vechicle Class	Fuel	VOC (kg/yr)	Airport Island Roads - TAPs (kg/yr) at Yr 2031				
		Airport Island	Formaldehyde	Benzene	Acetaldehyde	1,3-butadiene	Acrolein
PC	Gasoline	2025.1	22.6	98.7	20.7	12.1	1.0
	Diesel	76.0	2.9	1.5	0.9	0.7	0.3
TAXI	Gasoline	998.7	11.2	48.7	10.2	5.9	0.5
	Diesel	0.0	0.0	0.0	0.0	0.0	0.0
LGV3	Gasoline	8.4	0.1	0.4	0.1	0.1	0.0
	Diesel	2.6	0.1	0.1	0.0	0.0	0.0
LGV4	Gasoline	13.3	0.2	0.7	0.1	0.1	0.0
	Diesel	147.9	5.7	3.0	1.8	1.3	0.5
LGV6	Gasoline	0.0	0.0	0.0	0.0	0.0	0.0
	Diesel	138.2	8.3	2.1	2.9	1.1	0.5
HGV7	Gasoline	0.0	0.0	0.0	0.0	0.0	0.0
	Diesel	392.3	32.2	4.3	11.8	2.5	1.4
HGV8	Gasoline	0.0	0.0	0.0	0.0	0.0	0.0
	Diesel	1630.2	133.6	17.9	49.2	10.4	6.0
PLB	Gasoline	490.6	7.5	15.5	4.6	1.2	0.4
	Diesel	12.3	1.0	0.1	0.4	0.1	0.0
PV4	Gasoline	77.2	1.2	2.4	0.7	0.2	0.1
	Diesel	14.3	1.2	0.2	0.4	0.1	0.1
PV5	Gasoline	329.3	5.0	10.4	3.1	0.8	0.3
	Diesel	23.4	1.9	0.3	0.7	0.1	0.1
NFB6	Gasoline	0.0	0.0	0.0	0.0	0.0	0.0
	Diesel	176.5	14.5	1.9	5.3	1.1	0.6
NFB7	Gasoline	0.0	0.0	0.0	0.0	0.0	0.0
	Diesel	251.3	20.6	2.8	7.6	1.6	0.9
NFB8	Gasoline	0.0	0.0	0.0	0.0	0.0	0.0
	Diesel	102.1	8.4	1.1	3.1	0.7	0.4
FBSD	Gasoline	0.0	0.0	0.0	0.0	0.0	0.0
	Diesel	27.1	2.2	0.3	0.8	0.2	0.1
FBDD	Gasoline	0.0	0.0	0.0	0.0	0.0	0.0
	Diesel	2929.0	240.1	32.2	88.4	18.7	10.7
MC	Gasoline	1729.7	-	-	-	-	-
	Diesel	0	-	-	-	-	-
	Total (kg/yr)	11595.5	520.4	244.6	213.0	58.9	23.9
		kg TAP / kg VOC	**0.0449**	**0.0211**	**0.0184**	**0.0051**	**0.0021**

Appendix 17.2.1: Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

VOCs Speciation (kg TAP/kg VOC) - Part II

b) VOC Emission from Airside Vehicles (non-GSE types)

Table A17.2.1.5: VOCs speciation for Airside Vehicles (Non-GSE)

Emfac Vehicle Classes	Formaldehyde	Benzene	Acetaldehyde	1,3-butadiene	Acrolein
LGV4 (2.5-3.5t)	347.9	180.3	110.9	81.1	31.5
LGV6 (>3.5t)	543.5	139.7	191.5	69.4	32.3
HGV7 (≤15t)	738.9	99.2	272.1	57.7	33.1
HGV8 (>15t)	738.8	99.2	272.1	57.6	33.1
NBF7 (6.4 - 15t)	738.7	99.2	272.1	57.6	33.1
NBF8 (>15t)	738.7	99.2	272.1	57.6	33.1
PV5 (PrLB > 3.5t)	738.7	99.2	272.1	57.6	33.1
TAP Emission (kg/yr)	**4585.3**	**815.9**	**1662.8**	**438.6**	**229.1**

Notes:

[1] Speciation profile for motor vechiles are extracted from EDMS V5.1.4.1 built-in speciation profile; also see VOC-Part III in this appendix

[2] VOC Emission from Airside Vehicles (non-GSE types) in Year 2031: 5499 kg/yr

Appendix 17.2.1: Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

VOCs Speciation (kg TAP/kg VOC) - Part III

Table A17.2.1.6: Weighted-avg. VOCs speciation for Motor Vehicles at Carparks and Truckparks at Airport Island

Carpark Name	Speed (km/h)	Speed (mph)	EDMS Speed (mph)	Fuel Type	Emfac Vehicle Class	EDMS Vehicle Class	Carparks & Truckparks VOC (kg/yr) at Yr2031	Formaldehyde	Benzene	Acetaldehyde	1,3-butadiene	Acrolein
							Total kg/yr TAP	**319.1**	**79.5**	**120.9**	**30.3**	**14.9**
							kg TAP / kg VOC	**0.1288**	**0.0321**	**0.0488**	**0.0122**	**0.0060**
AAT Truck	8	5.0	5.0	Petrol	LGV3	Light Duty Trucks 2 (0-6000 lbs. GVWR, 3751-5750 lbs. LVW)	0.0	0.055	0.250	0.050	0.030	0.003
				Diesel[1]		Light Duty Trucks 2 (0-6000 lbs. GVWR, 3751-5750 lbs. LVW)	3.1	0.118	0.061	0.038	0.028	0.011
				Petrol	LGV4	Light Duty Trucks 4 (6001-8500 lbs. GVWR, 3751-5750 lbs. LVW)	22.2	0.064	0.291	0.059	0.036	0.003
				Diesel		Light Duty Trucks 4 (6001-8500 lbs. GVWR, 3751-5750 lbs. LVW)	114.2	0.118	0.061	0.038	0.028	0.011
				Diesel	LGV6	Class 2b Heavy Duty Vechicles (8501-10000 lbs. GVWR)	307.2	0.071	0.010	0.026	0.006	0.003
				Diesel	HGV7	Class 7 Heavy Duty Vechicles (26001-33000 lbs. GVWR)	245.2	0.189	0.025	0.070	0.015	0.008
				Diesel	HGV8	Class 8b Heavy Duty Vechicles (>60000 lbs. GVWR)	970.7	0.222	0.030	0.082	0.017	0.010
							Sub-total kg/yr TAP	***298.923***	***51.935***	***110.520***	***26.106***	***13.947***
AFFC Car	15	9.3	9.3	Petrol	PC	Light Duty Vchivles (Passenger Cars)	1.7	0.006	0.025	0.005	0.003	0.000
				Diesel	PC	Light Duty Vchivles (Passenger Cars)	0.0	0.010	0.005	0.003	0.002	0.001
							Sub-total kg/yr TAP	***0.010***	***0.042***	***0.008***	***0.005***	***0.000***
AFFC Truck	15	9.3	9.3	Petrol	LGV3	Light Duty Trucks 2 (0-6000 lbs. GVWR, 3751-5750 lbs. LVW)	15.4	0.008	0.035	0.007	0.004	0.000
				Diesel[1]		Light Duty Trucks 2 (0-6000 lbs. GVWR, 3751-5750 lbs. LVW)	0.5	0.021	0.011	0.007	0.005	0.002
				Petrol	LGV4	Light Duty Trucks 4 (6001-8500 lbs. GVWR, 3751-5750 lbs. LVW)	2.7	0.009	0.041	0.008	0.005	0.000
				Diesel		Light Duty Trucks 4 (6001-8500 lbs. GVWR, 3751-5750 lbs. LVW)	22.9	0.021	0.011	0.007	0.005	0.002
				Diesel	LGV6	Class 2b Heavy Duty Vechicles (8501-10000 lbs. GVWR)	46.4	0.012	0.002	0.004	0.001	0.001
				Diesel	HGV7	Class 7 Heavy Duty Vechicles (26001-33000 lbs. GVWR)	35.5	0.031	0.004	0.012	0.002	0.001
				Diesel	HGV8	Class 8b Heavy Duty Vechicles (>60000 lbs. GVWR)	147.8	0.037	0.005	0.014	0.003	0.002
							Sub-total kg/yr TAP	***7.767***	***1.882***	***2.975***	***0.753***	***0.424***
Carpark 1	10	6.2	6.2	Petrol	PC	Light Duty Vchivles (Passenger Cars)	28.4	0.007	0.034	0.007	0.004	0.000
				Diesel	PC	Light Duty Vchivles (Passenger Cars)	0.8	0.011	0.006	0.004	0.003	0.001
							Sub-total kg/yr TAP	***0.208***	***0.970***	***0.202***	***0.116***	***0.001***
Carpark 4	10	6.2	6.2	Petrol	PC	Light Duty Vchivles (Passenger Cars)	65.1	0.023	0.106	0.021	0.012	0.001
				Diesel	PC	Light Duty Vchivles (Passenger Cars)	1.8	0.036	0.018	0.011	0.008	0.003
							Sub-total kg/yr TAP	***1.564***	***6.938***	***1.388***	***0.796***	***0.071***
HACTL Car	10	6.2	6.2	Petrol	PC	Light Duty Vchivles (Passenger Cars)	2.6	0.005	0.024	0.005	0.003	0.000
				Diesel	PC	Light Duty Vchivles (Passenger Cars)	0.0	0.008	0.004	0.003	0.002	0.001
							Sub-total kg/yr TAP	***0.013***	***0.064***	***0.013***	***0.008***	***0.000***
HACTL Truck	10	6.2	6.2	Petrol	LGV3	Light Duty Trucks 2 (0-6000 lbs. GVWR, 3751-5750 lbs. LVW)	0.0	0.007	0.034	0.007	0.004	0.000
				Diesel[1]		Light Duty Trucks 2 (0-6000 lbs. GVWR, 3751-5750 lbs. LVW)	0.5	0.016	0.008	0.005	0.004	0.001
				Petrol	LGV4	Light Duty Trucks 4 (6001-8500 lbs. GVWR, 3751-5750 lbs. LVW)	2.5	0.009	0.040	0.008	0.005	0.000
				Diesel		Light Duty Trucks 4 (6001-8500 lbs. GVWR, 3751-5750 lbs. LVW)	17.1	0.016	0.008	0.005	0.004	0.001
				Diesel	LGV6	Class 2b Heavy Duty Vechicles (8501-10000 lbs. GVWR)	43.1	0.010	0.001	0.004	0.001	0.000
				Diesel	HGV7	Class 7 Heavy Duty Vechicles (26001-33000 lbs. GVWR)	34.4	0.026	0.003	0.010	0.002	0.001
				Diesel	HGV8	Class 8b Heavy Duty Vechicles (>60000 lbs. GVWR)	136.1	0.030	0.004	0.011	0.002	0.001

Appendix 17.2.1: Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

VOCs Speciation (kg TAP/kg VOC) - Part III

Table A17.2.1.6: Weighted-avg. VOCs speciation for Motor Vehicles at Carparks and Truckparks at Airport Island

Carpark Name	Speed (km/h)	Speed (mph)	EDMS Speed (mph)	Fuel Type	Emfac Vehicle Class	EDMS Vehicle Class	Carparks & Truckparks VOC (kg/yr) at Yr2031	Formaldehyde	Benzene	Acetaldehyde	1,3-butadiene	Acrolein
							Total kg/yr TAP	**319.1**	**79.5**	**120.9**	**30.3**	**14.9**
							kg TAP / kg VOC	**0.1288**	**0.0321**	**0.0488**	**0.0122**	**0.0060**
							Sub-total kg/yr TAP	***5.713***	***0.930***	***2.122***	***0.467***	***0.188***
Phase 1-3 storeys (S)	10	6.2	6.2	Petrol	PC	Light Duty Vchivles (Passenger Cars)	15.5	0.022	0.103	0.020	0.012	0.001
				Diesel	PC	Light Duty Vchivles (Passenger Cars)	0.3	0.035	0.018	0.011	0.008	0.003
							Sub-total kg/yr TAP	***0.352***	***1.606***	***0.314***	***0.189***	***0.016***
Phase 1-underbground (N)	10	6.2	6.2	Petrol	PC	Light Duty Vchivles (Passenger Cars)	143.0	0.022	0.103	0.020	0.012	0.001
				Diesel	PC	Light Duty Vchivles (Passenger Cars)	3.9	0.035	0.018	0.011	0.008	0.003
							Sub-total kg/yr TAP	***3.285***	***14.804***	***2.904***	***1.748***	***0.155***
Phase 2 Skycity Carpark	10	6.2	6.2	Petrol	PC	Light Duty Vchivles (Passenger Cars)	0.0	0.022	0.103	0.020	0.012	0.001
				Diesel	PC	Light Duty Vchivles (Passenger Cars)	3.2	0.035	0.018	0.011	0.008	0.003
							Sub-total kg/yr TAP	***0.112***	***0.058***	***0.035***	***0.026***	***0.010***
Tradeport Truckpark	10	6.2	6.2	Petrol	LGV4	Light Duty Trucks 4 (6001-8500 lbs. GVWR, 3751-5750 lbs. LVW)	0.0	0.028	0.123	0.025	0.016	0.001
				Diesel		Light Duty Trucks 4 (6001-8500 lbs. GVWR, 3751-5750 lbs. LVW)	1.1	0.062	0.032	0.020	0.015	0.006
				Diesel	LGV6	Class 2b Heavy Duty Vechicles (8501-10000 lbs. GVWR)	2.4	0.036	0.005	0.013	0.003	0.002
				Diesel	HGV7	Class 7 Heavy Duty Vechicles (26001-33000 lbs. GVWR)	1.8	0.095	0.013	0.035	0.007	0.004
				Diesel	HGV8	Class 8b Heavy Duty Vechicles (>60000 lbs. GVWR)	7.5	0.112	0.015	0.041	0.009	0.005
							Sub-total kg/yr TAP	***1.160***	***0.184***	***0.422***	***0.104***	***0.056***
TradeportCarpark	10	6.2	6.2	Petrol	PC	Light Duty Vchivles (Passenger Cars)	0.8	0.006	0.025	0.005	0.003	0.000
				Diesel	PC	Light Duty Vchivles (Passenger Cars)	0.0	0.010	0.005	0.003	0.002	0.001
							Sub-total kg/yr TAP	***0.005***	***0.021***	***0.004***	***0.002***	***0.000***
T2 North	10	6.2	6.2	Petrol	PC	Light Duty Vchivles (Passenger Cars)	29.8	0.022	0.103	0.020	0.012	0.001
				Diesel	PC	Light Duty Vchivles (Passenger Cars)	0.9	0.035	0.018	0.011	0.008	0.003
							Sub-total kg/yr TAP	***0.018***	***0.085***	***0.016***	***0.010***	***0.001***

Notes:
[1] Adopted emission index from Diesel of Light Duty Trucks 4 (6001-8500 lbs. GVWR, 3751-5750 lbs. LVW) because information is not available
[2] Speciation profile for motor vechiles are extracted from EDMS V5.1.4.1 built-in speciation profile; also see VOC-Part III in this appendix

Appendix 17.2.1: Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

VOCs Speciation (kg TAP/kg VOC) - Part IV

PAHs from Aircrafts & ERUF, GSE & Helicopters, and APUs

Table A17.2.1.7: Polycyclic Aromatic Hydrocarbons (PAHs) Emissions from Aircrafts & ERUF, GSE & Helicopters, and APUs

PAH	kg PAH /kg VOC
Anthracene	4.03E-07
Benzo(a)anthracene	6.10E-08
Benzo(a)pyrene	3.34E-08
Benzo(ghi)perylene	5.54E-09
Chrysene	5.68E-08
Fluoranthene	8.43E-07
Napthalene	4.30E-04
Phenanthrene	3.75E-06
Pyrene	1.03E-06

Source: Select Resource Materials and Annotated Bibliography on the Topic of Hazardous Air Pollutants (HAPs) Associated with Aircraft, Airports, and Aviation (FAA, 2003)

PAHs from GSE

Table A17.2.1.8: Polycyclic Aromatic Hydrocarbons (PAHs) Emissions from GSE

PAH	Gaseous Phase		PM Phase	
	kg PAH/ kg HC	kg PAH/ kg VOC	kg PAH/ kg OC2.5	kg PAH/ kg RSP
Acenaphthene	5.26E-05	5.54E-05	0	0
Acenaphthalene	8.53E-05	8.98E-05	0	0
Anthracene	3.04E-05	3.20E-05	3.34E-05	3.01E-05
Benzo(a)anthracene	3.00E-07	3.16E-07	1.00E-06	9.00E-07
Benzo(a)pyrene	0	0	4.20E-06	3.78E-06
Benzo(bk)fluoranthene	0	0	3.60E-06	3.24E-06
Benzo(ghi)perylene	2.00E-07	2.11E-07	3.00E-07	2.70E-07
Chrysene	5.00E-07	5.27E-07	3.10E-06	2.79E-06
Dibenz(a,h)anthracene	0	0	1.30E-06	1.17E-06
Fluoranthene	4.57E-05	4.81E-05	6.13E-05	5.52E-05
Fluorene	1.96E-04	2.07E-04	6.77E-05	6.09E-05
Indeno(1,2,3-cd)pyrene	0	0	6.00E-07	5.40E-07
Naphthalene	1.63E-02	1.72E-02	0	0
Phenanthrene	8.51E-04	8.96E-04	5.40E-04	4.86E-04
Pyrene	3.79E-05	3.99E-05	5.88E-05	5.29E-05

Note: VOC/ HC = 1.053; FSP / $OC_{2.5}$ = 87.3%; GSE RSP / FSP = 1.03

Source: MOVES2010b - Additional Toxics Added to MOVES, USEPA, 2012 (for 2007 or later diesel engines)

PAHs from Airside Vehicles

Table A17.2.1.9: Polycyclic Aromatic Hydrocarbons (PAHs) Emissions from Airside Vehicles

PAH	Gaseous Phase		PM Phase	
	kg PAH/ kg HC	kg PAH/ kg VOC	kg PAH/ kg OC2.5	kg PAH/ kg RSP
Acenaphthene	5.26E-05	5.54E-05	0	0
Acenaphthalene	8.53E-05	8.98E-05	0	0
Anthracene	3.04E-05	3.20E-05	3.34E-05	3.17E-05
Benzo(a)anthracene	3.00E-07	3.16E-07	1.00E-06	9.49E-07
Benzo(a)pyrene	0	0	4.20E-06	3.98E-06
Benzo(bk)fluoranthene	0	0	3.60E-06	3.42E-06
Benzo(ghi)perylene	2.00E-07	2.11E-07	3.00E-07	2.85E-07
Chrysene	5.00E-07	5.27E-07	3.10E-06	2.94E-06
Dibenz(a,h)anthracene	0	0	1.30E-06	1.23E-06
Fluoranthene	4.57E-05	4.81E-05	6.13E-05	5.82E-05
Fluorene	1.96E-04	2.07E-04	6.77E-05	6.42E-05
Indeno(1,2,3-cd)pyrene	0	0	6.00E-07	5.69E-07
Naphthalene	1.63E-02	1.72E-02	0	0
Phenanthrene	8.51E-04	8.96E-04	5.40E-04	5.12E-04
Pyrene	3.79E-05	3.99E-05	5.88E-05	5.58E-05

Note: VOC/ HC = 1.053; FSP / $OC_{2.5}$ = 87.3%; GSE RSP / FSP = 1.09

Source: MOVES2010b - Additional Toxics Added to MOVES, USEPA, 2012 (for 2007 or later diesel engines)

PAHs from Roads and Carparks & Truckparks

Table A17.2.1.10: Polycyclic Aromatic Hydrocarbons (PAHs) Emissions from Roads and Carparks & Truckparks (Gaseous Phase)

PAH	kg PAH/ kg HC	kg PAH/ kg VOC		Weighted-avg. kg PAH / kg VOC		
	(Diesel Engines)	(Diesel Engines)	(Gasoline Engines)	Airport Island - Roads	Proximity - Roads	Carpark & TruckPark
Acenaphthene	5.26E-05	5.54E-05	1.85E-05	4.81E-05	5.10E-05	4.74E-05
Acenaphthalene	8.53E-05	8.98E-05	1.04E-04	9.24E-05	9.15E-05	9.29E-05
Anthracene	3.04E-05	3.20E-05	1.14E-05	2.79E-05	2.96E-05	2.76E-05
Benzo(a)anthracene	3.00E-07	3.16E-07	7.00E-07	3.90E-07	3.62E-07	3.99E-07
Benzo(a)pyrene	0	0	0	0	0	0
Benzo(bk)fluoranthene	0	0	0	0	0	0
Benzo(ghi)perylene	2.00E-07	2.11E-07	1.50E-06	4.62E-07	3.64E-07	4.89E-07
Chrysene	5.00E-07	5.27E-07	5.00E-07	5.20E-07	5.23E-07	5.21E-07
Dibenz(a,h)anthracene	0	0	0	0	0	0
Fluoranthene	4.57E-05	4.81E-05	1.11E-05	4.08E-05	4.37E-05	4.01E-05
Fluorene	1.96E-04	2.07E-04	3.00E-05	1.72E-04	1.86E-04	1.69E-04
Indeno(1,2,3-cd)pyrene	0	0	0	0	0	0
Naphthalene	1.63E-02	1.72E-02	2.29E-03	1.43E-02	1.54E-02	1.40E-02
Phenanthrene	8.51E-04	8.96E-04	4.27E-05	7.28E-04	7.94E-04	7.11E-04
Pyrene	3.79E-05	3.99E-05	1.41E-05	3.48E-05	3.68E-05	3.43E-05

Notes:

[1] VOC/ HC = 1.053

[2] Weighted-avg. speciation profiles

Source: MOVES2010b - Additional Toxics Added to MOVES, USEPA, 2012 (for gasoline or 2007 and later diesel engines)

Table A17.2.1.11: Polycyclic Aromatic Hydrocarbons (PAHs) Emissions from Roads and Carparks & Truckparks (Gaseous Phase)

PAH	kg PAH/ kg $OC_{2.5}$	kg PAH/ kg RSP	kg PAH/ kg $OC_{2.5}$	kg PAH/ kg RSP	Weighted-avg. kg PAH / kg RSP		
	(Diesel Engines)	(Diesel Engines)	(Gasoline Engines)	(Gasoline Engines)	Airport Island - Roads	Proximity - Roads	Carpark & TruckPark
Acenaphthene	0	0	0	0	0	0	0
Acenaphthalene	0	0	0	0	0	0	0
Anthracene	3.34E-05	3.16E-05	5.02E-04	4.76E-04	1.18E-04	8.44E-05	1.28E-04
Benzo(a)anthracene	1.00E-06	9.48E-07	9.44E-05	8.94E-05	1.82E-05	1.15E-05	2.01E-05
Benzo(a)pyrene	4.20E-06	3.98E-06	1.31E-04	1.24E-04	2.73E-05	1.82E-05	2.99E-05
Benzo(bk)fluoranthene	3.60E-06	3.41E-06	3.10E-04	2.94E-04	6.01E-05	3.79E-05	6.62E-05
Benzo(ghi)perylene	3.00E-07	2.84E-07	2.52E-04	2.39E-04	4.69E-05	2.87E-05	5.19E-05
Chrysene	3.10E-06	2.94E-06	1.08E-04	1.02E-04	2.22E-05	1.47E-05	2.43E-05
Dibenz(a,h)anthracene	1.30E-06	1.23E-06	0	0	0	0	0
Fluoranthene	6.13E-05	5.81E-05	5.98E-04	5.67E-04	1.57E-04	1.18E-04	1.68E-04
Fluorene	6.77E-05	6.41E-05	4.14E-04	3.92E-04	1.28E-04	1.03E-04	1.35E-04
Indeno(1,2,3-cd)pyrene	6.00E-07	5.69E-07	9.79E-05	9.28E-05	1.86E-05	1.15E-05	2.05E-05
Naphthalene	0	0	0	0	0	0	0
Phenanthrene	5.40E-04	5.11E-04	1.08E-03	1.03E-03	6.11E-04	5.72E-04	6.22E-04
Pyrene	5.88E-05	5.57E-05	8.74E-04	8.28E-04	2.06E-04	1.47E-04	2.23E-04

Notes:

[1] FSP / $OC_{2.5}$ = 87.3%; GSE RSP / FSP = 1.09

[2] Weighted-avg. speciation profiles

Appendix 17.2.1: Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

VOCs Speciation (kg TAP/kg VOC) - Part IV

PAHs from Aircrafts & ERUF, GSE & Helicopters, and APUs

Source: MOVES2010b - Additional Toxics Added to MOVES, USEPA, 2012 (for gasoline or 2007 and later diesel engines)

PAHs from Marine Vessels

Table A17.2.1.12: Polycyclic Aromatic Hydrocarbons (PAHs) Emissions from Marine Vessels

PAH	kg PAH/ kg VOC
Benzo(a)pyrene	1.00E-05
Benzo(bk)fluoranthene	4.00E-05
Indeno(1,2,3-cd)pyrene	5.00E-06

Source: Methodology for calculating emissions from ships: 1. Update of emission factors, Swedish Environmental Protection Agency, 2004

PAHs from Catering

Table 1.3-9 of U.S. EPA AP-42 Section 1.3, emissions of PAHs from the combustion of distillate and residual fuel oils were calculated as follows:

Fuel consumption in Yr2031 for catering (m^3)= 11263

Catering VOC (kg/yr) at Yr 2031= 664

Table A17.2.1.13: Polycyclic Aromatic Hydrocarbons (PAHs) Emissions from Catering

PAH	lb emission / 10^3 U.S. gal	kg/m^3 [1]	kg/yr PAH	kg PAH / kg VOC
Acenaphthene	2.11E-05	2.53E-06	2.85E-02	4.29E-05
Acenaphthalene	2.53E-07	3.04E-08	3.42E-04	5.15E-07
Anthracene	1.22E-06	1.46E-07	1.65E-03	2.48E-06
Benz(a)anthracene	4.01E-06	4.81E-07	5.42E-03	8.16E-06
Benzo(bk)fluoranthene	1.48E-06	1.78E-07	2.00E-03	3.01E-06
Benzo(ghi)perylene	2.26E-06	2.71E-07	3.05E-03	4.60E-06
Chrysene	2.38E-06	2.86E-07	3.22E-03	4.84E-06
Dibenz(a,h)anthracene	1.67E-06	2.00E-07	2.26E-03	3.40E-06
Fluoranthene	4.84E-06	5.81E-07	6.54E-03	9.85E-06
Fluorene	4.47E-06	5.36E-07	6.04E-03	9.10E-06
Indeno(1,2,3-cd)pyrene	2.14E-06	2.57E-07	2.89E-03	4.36E-06
Naphthalene	1.13E-03	1.36E-04	1.53E+00	2.30E-03
Phenanthrene	1.05E-05	1.26E-06	1.42E-02	2.14E-05
Pyrene	4.25E-06	5.10E-07	5.74E-03	8.65E-06
Other VOC Species				
Benzene	2.14E-04	2.57E-05	2.89E-01	4.36E-04
Ethylbenzene	6.36E-05	7.63E-06	8.60E-02	1.29E-04
Toluene	6.20E-03	7.44E-04	8.38E+00	1.26E-02
o-Xylene	1.09E-04	1.31E-05	1.47E-01	2.22E-04

Note:

[1] To convert from lb emission /10^3 U.S. gal to kg/m^3, multiplied by 0.12

Appendix 17.2.1: Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

RSP Speciation (kg TAP/kg RSP) - Part I

Table A17.2.1.14: Diesel Particulate Matters(DPM) from Aircraft Emission and Other Key Emissions

Emission Source	Consumption of Diesel	RSP (kg/yr)	RSP Emission due to Diesel Consumption (kg/yr)	Diesel Particulate Matters (kg/yr)	DPM / RSP
Aircraft & ERUF	x	37888	0	0	0.0%
GFS & Helicopter	x	83.23	0	0	0.0%
APU	x	5638	0	0	0.0%
Catering (diesel)	√	1352	1352	1352	100.0%
Fuel tank	x	0	0	0	0.0%
Training fire	x	5240	0	0	0.0%
GSE	√	12601	12601	12601	100.0%
Carpark	√	589	462	462	78.4%
Aircraft maintenance centre	x	0	0	0	0.0%
Marine navigation	√	2656	2656	2656	100.0%
Airport Island Roads	√	4107	3299	3299	80.3%
Airside vehicles	√	6383	6383	6383	100.0%
Proximity Roads	√	24902	21945	21945	88.1%
Tire and Brake Wear	x	143750	0	0	0.0%

Notes:
[a] Extracted from preliminary results at Year 2031
[b] All PM from diesel engine are assumed as DPM

Appendix 17.2.1: Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

RSP Speciation (kg TAP/kg RSP) - Part II

a) Heavy Metals from Major Activities

Table A17.2.1.17: Speciatio Profile of Heavy Metals

kg TAP/kg RSP	Aircraft & ERUF [1]	GFS & Helicopter [2]	APU [1]	Fuel Tank	Training Tire	GSE [3]	Carparks/ Truckparks [3]	Aircraft Maintenance Centre	Marine Navigation [3]	Airport Island Roads [3]	Airside Vehicles [3]
Arsenic	0.010	0.001	0.010	-	-	-	-	-	-	-	-
Barium	0.102	0.009	0.102	-	-	0.010	0.010	-	0.010	0.010	0.010
Beryllium	-	-	-	-	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-	-	-	-	-	-
Chromium	-	0.003	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-
Copper	0.018	0.012	0.018	-	-	-	-	-	-	-	-
Manganese	0.007	0.014	0.007	-	-	-	-	-	-	-	-
Mercury	-	-	-	-	-	-	-	-	-	-	-
Molybdenum	-	-	-	-	-	-	-	-	-	-	-
Nickel	0.002	0.002	0.002	-	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-	-	-	-	-
Vanadium	0.001	0.002	0.001	-	-	-	-	-	-	-	-
Zinc	0.035	0.041	0.035	-	-	0.040	0.040	-	0.040	0.040	0.040
Antimony	-	-	-	-	-	-	-	-	-	-	-
Chloride	-	-	-	-	-	-	-	-	-	-	-
Chromium VI	-	0.000	-	-	-	-	-	-	-	-	-
Fluoride	-	-	-	-	-	-	-	-	-	-	-
Lead	0.002	0.004	0.002	-	-	-	-	-	-	-	-
Phosphorous	-	-	-	-	-	0.020	0.020	-	0.020	0.020	0.020
Calcium	0.067	-	0.067	-	-	0.060	0.060	-	0.060	0.060	0.060

Notes:
[1] Sourced from USEPA Speciate 4.3 - Aircraft Exhaust (http://cfpub.epa.gov/si/speciate/ehpa_speciate_browse_details.cfm?ptype=P&pnumber=3861)
[2] Sourced from USEPA Speciate 4.3 - Helicopter Exhaust (http://cfpub.epa.gov/si/speciate/ehpa_speciate_browse_details.cfm?ptype=P&pnumber=3860)
[3] Sourced from USEPA Speciate 4.3 - Diesel Exhaust (http://cfpub.epa.gov/si/speciate/ehpa_speciate_browse_details.cfm?ptype=P&pnumber=3267)

b) Heavy Metals from Catering

Table 1.3-10 of U.S. EPA AP-42 Section 1.3, emissions of trace elements from the combustion of distillate fuel oils were calculated as follows:

Fuel consumption in Yr2031 for catering (m^3)= 11263
Catering RSP (kg/yr) at Yr 2031= 1352

Table A17.2.1.18: Speciatio Profile of Heavy Metals from Catering

Heavy Metal	lb/10^{12} Btu	lb emission / 10^3 U.S. gal [1]	kg/m^3 [2]	kg/yr TAP	kg TAP / kg RSP
Arsenic	2	2.80E-04	3.36E-05	3.78E-01	2.80E-04
Beryllium	1.5	2.10E-04	2.52E-05	2.84E-01	2.10E-04
Cadmium	1.5	2.10E-04	2.52E-05	2.84E-01	2.10E-04
Chromium VI	1.5	2.10E-04	2.52E-05	2.84E-01	2.10E-04
Copper	3	4.20E-04	5.04E-05	5.68E-01	4.20E-04
Lead	4.5	6.30E-04	7.56E-05	8.51E-01	6.30E-04
Manganese	3	4.20E-04	5.04E-05	5.68E-01	4.20E-04
Mercury	1.5	2.10E-04	2.52E-05	2.84E-01	2.10E-04
Nickel	1.5	2.10E-04	2.52E-05	2.84E-01	2.10E-04
Selenium	7.5	1.05E-03	1.26E-04	1.42E+00	1.05E-03
Zinc	2	2.80E-04	3.36E-05	3.78E-01	2.80E-04

Notes:
[1] To convert from lb emission /10^3 U.S. gal to lb emission/MMBtu, divided by a heating value of 140 MMBtu/10^3 U.S. gal for distillate fuel oil.
[2] To convert from lb emission /10^3 U.S. gal to kg/m^3, multiplied by 0.12
[3] According to the Table 1.3-1 of U.S. EPA AP-42 Section 1.3, the RSP emission rate for distilate fuel oil is 0.24 kg/m^3. Nevetheless, in accordance to the Air Pollution Control (Fuel Restriction) (Amendment) Regulation 2008, the RSP emission rate is 0.12 kg/m3. Hence, it is assumed that the emission control measures in Hong Kong will approximately reduce half pollutant emissions with reference to the U.S. EPA AP-42 Section 1.3.

c) Heavy Metal from Tire Wear and Brake Wear

Tire wear (kg/yr) in Yr 2031 (3RS): 126604
Brake wear (kg/yr) in Yr 2031 (3RS): 17146

Heavy Metal	kg Heavy Metal / kg RSP			kg Heavy Metal
	Tire Wear	Brake Wear	Weighted-avg.	
Chromium	0	1.20E-03	1.43E-04	20.6
Copper	5.00E-04	1.15E-02	1.81E-03	260.5
Lead	2.00E-04	1.00E-04	1.88E-04	27.0
Manganese	1.00E-04	1.70E-03	2.91E-04	41.8
Nickel	1.00E-04	7.00E-04	1.72E-04	24.7

Notes:
Tire wear speciation profile:http://cfpub.epa.gov/si/speciate/ehpa_speciate_browse_details.cfm?ptype=P&pnumber=3156
Brake wear speciation profile: http://cfpub.epa.gov/si/speciate/ehpa_speciate_browse_details.cfm?ptype=P&pnumber=3157

Appendix 17.2.1: Speciation Profiles of TAP from Aircraft Emission and Other Key Emissions

RSP Speciation (kg TAP/kg RSP) - Part III

a) Dioxin from Motor Vehicles

Table A17.2.1.19: RSP Emission and VMT from Vehicles at Airport Island Roads

Airport Island Roads	Total RSP (kg/day)	RSP (kg/day) - by Diesel	RSP (kg/day) - by Gasoline	Total VMT (per day)	VMT (per day) - by Diesel	VMT (per day) - by Gasoline	RSP (g/veh-mil) - by Diesel	RSP (g/veh-mil) - by Gasoline
Airport Island Roads	11.2	9.0	2.2	533849	112719	421130	0.080	0.005
Proximity Roads	68.2	60.1	8.1	2471602	825416	1646186	0.073	0.005

Table A17.2.1.20: Speciatio Profile of TCDD from Vehicles

Pollutant	Diesel Emission	Gasoline Emission	TEF	TCDD TEQ Emission x TEF (mg/veh-mil)		Airport Island - Roads kg TCDD TEQ / kg RSP		Proximity - Roads kg TCDD TEQ / kg RSP	
	mg/veh-mil	mg/veh-mil		Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline
2,3,7,8-TCDD	5.52E-08	8.27E-10	1	5.52E-08	8.27E-10				
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	4.67E-08	3.70E-10	1	4.67E-08	3.70E-10				
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	6.57E-08	3.87E-10	0.1	6.57E-09	3.87E-11				
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	1.29E-08	7.92E-10	0.1	1.29E-09	7.92E-11				
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	2.37E-07	4.93E-10	0.1	2.37E-08	4.93E-11				
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	1.55E-06	5.95E-09	0.01	1.55E-08	5.95E-11				
Octachlorodibenzo-p-dioxin	7.14E-06	4.70E-08	0.0003	2.14E-09	1.41E-11				
2,3,7,8-Tetrachlorodibenzofuran	1.39E-07	2.76E-09	0.1	1.39E-08	2.76E-10				
1,2,3,7,8-Pentachlorodibenzofuran	5.55E-08	1.32E-09	0.03	1.67E-09	3.96E-11	3.22E-09	4.92E-10	3.54E-09	5.21E-10
2,3,4,7,8-Pentachlorodibenzofuran	1.23E-07	9.68E-10	0.3	3.69E-08	2.90E-10				
1,2,3,4,7,8-Hexachlorodibenzofuran	2.08E-07	1.09E-09	0.1	2.08E-08	1.09E-10				
1,2,3,6,7,8-Hexachlorodibenzofuran	9.47E-08	1.16E-09	0.1	9.47E-09	1.16E-10				
1,2,3,7,8,9-Hexachlorodibenzofuran	5.51E-08	3.17E-10	0.1	5.51E-09	3.17E-11				
2,3,4,6,7,8-Hexachlorodibenzofuran	1.37E-07	1.36E-09	0.1	1.37E-08	1.36E-10				
1,2,3,4,6,7,8-Heptachlorodibenzofuran	4.30E-07	1.21E-08	0.01	4.30E-09	1.21E-10				
1,2,3,4,7,8,9-Heptachlorodibenzofuran	4.89E-08	3.87E-10	0.01	4.89E-10	3.87E-12				
Octachlorodibenzofuran	4.91E-07	1.37E-08	0.0003	1.47E-10	4.11E-12				
			Total TCDD TEQ	**2.58E-07**	**2.57E-09**				

Table A17.2.1.21: Summary - Speciatio Profile of TCDD from Motor Vehicles

Activity	RSP (kg/yr) - by Diesel	RSP (kg/yr) - by Gasoline	TCDD (kg/yr) - by Diesel	TCDD (kg/yr) - by Gasoline	Total TCDD TEQ (kg/yr)	kg TCDD TEQ / kg RSP
Airport Island Roads	3299	801	1.06E-05	3.94E-07	1.10E-05	2.68E-09
Proximity Roads	21945	2957	7.77E-05	1.54E-06	7.93E-05	3.18E-09
Carparks & Truckparks	462	127	1.48E-06	6.27E-08	1.55E-06	2.63E-09
GSE	12601	-	4.05E-05	-	4.05E-05	3.22E-09
Airside Vehicles	6383	-	2.05E-05	-	2.05E-05	3.22E-09

Sources:

[1] MOVES2010b - Additional Toxics Added to MOVES, USEPA, 2012

[2] Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds, USEPA, 2010

[3] Assuming the TCDD speciation profile from carparks & truckparks, GSE, and airside vehicles, is the same with the diesel engine vehicles at the Airport Island roads

b) Dioxin from Motor Vehicles

Table A17.2.1.22: Speciatio Profile of TCDD from Marine Vessels

Activity	kg TCDD / kg RSP
Marine Vessels	3.33E-09

Source: Methodology for calculating emissions from ships: 1. Update of emission factors, Swedish Environmental Protection Agency, 2004 (for GT vessels)

c) Dioxin from Catering

Table 1.3-9 of U.S. EPA AP-42 Section 1.3 identified only one dioxin, namely octachlorodibenzo-p-dioxin (OCDD, CAS# 3268-87-9), as being released from the combustion of fuel oils in boilers. Dioxins/furans are reported in units of grams of toxic equivalent (TEQ). Toxic equivalency factors (TEFs) have been assigned to each dioxin/furan cogener as weighting factors. The TEFs are assigned relative to the toxicity of 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD), the most toxic cogener, which is assigned a TEF of 1. OCDD, the only dioxin cogener detected from the combustion of fuel oils in boilers is assigned a TEF of 0.001. Thus, emissions of OCDD from the combustion of distillate and residual fuel oils were calculated as

Emission factor from fuel oil combustion = 1.55E-09 (lb emission /10^3 U.S. gal)

= 1.86E-10 (kg/m^3; to convert from lb emission /10^3 U.S. gal to kg/m^3, multiplied by 0.12)

According to the Table 1.3-1 of U.S. EPA AP-42 Section 1.3, the RSP emission rate for distilate fuel oil is 0.24 kg/m^3. Nevetheless, in accordance to the Air Pollution Control (Fuel Restriction) (Amendment) Regulation 2008, the RSP emission rate is 0.12 kg/m3. Hence, it is assumed that the emission control measures in Hong Kong will approximately reduce half pollutant emissions with reference to the U.S. EPA

Fuel consumption in Yr2031 for catering (m^3)= 11263

kg/yr TEQ TCDD = *kg/year emission x (0.001 TEF for OCDD)*

= 2.09E-09

kg/yr RSP = 1352

kg of TEQ TCDD / kg of RSP = 1.55E-12