Supplement of

Emissions of organic aerosol mass, black carbon, particle number, and regulated and unregulated gases from scooters and light and heavy duty vehicles with different fuels

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Table S1 . Descriptions of the tests

Vehicle	Date	EXP #	Cycle	Engine temperature	Fuel type	CVS dilution air	Ejector diluter
HDDV(EIII)	02.04.2009	2	NEDC	hot	10 ppm	80 m ³ /min	1
HDDV(EIII)		3	ETC	hot	10 ppm	80 m ³ /min	1
HDDV(EIII)	03.04.2009	1	NEDC	cold	10 ppm	80 m ³ /min	1
HDDV(EIII)		2	ETC	hot	10 ppm	80 m ³ /min	1
HDDV(EIII)		3	steady state	hot	10 ppm	80 m ³ /min	1
HDDV(EIII)	06.04.2009	1	ETC	cold	10 ppm	80 m ³ /min	1
HDDV(EIII)		2	NEDC	hot	10 ppm	80 m ³ /min	1
HDDV(EIII)		3	steady state	hot	10 ppm	80 m ³ /min	1
HDDV(EIII)	07.04.2009	1	steady state	cold	10 ppm	80 m ³ /min	1
Diesel-P(E3)	08.04.2009	3	steady state	hot	10 ppm	7.5 m ³ /min	2
Diesel-P(E3)		4	speed ramp	hot	10 ppm	11 m ³ /min	1
Diesel-P(E3)	09.04.2009	1	NEDC	cold	10 ppm	6 m ³ /min	2
Diesel-P(E3)	14.04.2009	1	NEDC	cold	50 ppm	6 m ³ /min	1
Diesel-P(E3)		2	steady state	hot	50 ppm	7.5 m ³ /min	2
Diesel-P(E3)		3	speed ramp	hot	50 ppm	11 m ³ /min	2
Diesel-P(E3)	15.04.2009	1	NEDC	cold	50 ppm	6 m ³ /min	2
Diesel-P(E4)	16.04.2009	1	NEDC	cold	10 ppm	6 m ³ /min	1
Diesel-P(E4)		3	speed ramp	hot	10 ppm	6 m ³ /min	2
Diesel-P(E4)	17.04.2009	1	NEDC	cold	10 ppm+10%biodiesel	6 m ³ /min	2
Gasoline-P(E4)	20.04.2009	1	NEDC	cold	gasoline	6 m ³ /min	0
Gasoline-P(E4)		2	steady state	hot	gasoline	6 m ³ /min	0
Gasoline-P(E4)		3	NEDC	cold	gasoline	6 m ³ /min	0
Gasoline-P(E4)	21.04.2009	1	NEDC	cold	gasoline	6 m ³ /min	0
Gasoline-P(E4)		2	speed ramp	hot	gasoline	6 m ³ /min	0
Gasoline-P(E4)		3	speed ramp	hot	gasoline	12 m ³ /min	0
Diesel-V(E3)	27.04.2009	1	NEDC	cold	10 ppm	12 m ³ /min	2
Diesel-V(E3)		2	steady state	hot	10 ppm	12 m ³ /min	1
Diesel-V(E3)		3	steady state	hot	10 ppm	12 m ³ /min	1
Diesel-V(E3)		4	NEDC	cold	10 ppm	12 m ³ /min	1
Diesel-V(E3)		5	speed ramp	hot	10 ppm	15 m ³ /min	2
Diesel-V(E3)	28.04.2009	1	NEDC	cold	10 ppm	12 m ³ /min	2
Diesel-V(E3)		2	speed ramp	hot	10 ppm	15 m ³ /min	1
Diesel-V(E3)	29.04.2009	1	NEDC	cold	10 ppm+30%biodiesel	12 m ³ /min	1
Diesel-V(E3)		2	steady state	hot	10 ppm+30%biodiesel	12 m ³ /min	1
Diesel-V(E3)		3	speed ramp	hot	10 ppm+30%biodiesel	15 m ³ /min	1
Diesel-V(E3)	30.04.2009	1	NEDC	cold	10 ppm+30%biodiesel	12 m ³ /min	2
Scooter(E1)	04.05.2009	1	ECE 47	cold	Unleaded fuel + 2% oil	4.5 m ³ /min	1
Scooter(E1)		3	steady state	hot	Unleaded fuel + 2% oil	4.5 m ³ /min	1
Scooter(E1)		4	WMTC	cold	Unleaded fuel + 2% oil	4.5 m ³ /min	1
Scooter(E1)		5	ECE 47	hot	Unleaded fuel + 2% oil	4.5 m ³ /min	1
Scooter(E2)	05.05.2009	1	ECE 47	cold	Unleaded fuel + 2% oil	4.5 m ³ /min	1
Scooter(E2)		2	steady state	hot	Unleaded fuel + 2% oil	4.5 m ³ /min	2
Scooter(E2)		3	steady state	hot	Unleaded fuel + 2% oil	4.5 m ³ /min	1
Scooter(E2)		5	ECE 47	cold	Unleaded fuel + 2% oil	4.5 m ³ /min	1
Scooter(E2)		6	WMTC	hot	Unleaded fuel + 2% oil	4.5 m ³ /min	1

Table S2. Effect of Biodiesel on emission factors for different species.

Species	Cycle	Diesel-V(E3)		
		Regular fuel	30% Biodiesel	% change
OA (mg/km)	NEDC	3.83	3.04	-21
	UDC	7.68	6.52	-15
	EUDC	1.59	1.00	-37
	60 km/h	0.21	0.14	-33
	90 km/h	0.80	0.42	-48
	120 km/h	6.20	1.90	-69
	50 km/h	1.80	1.05	-42
	90 km/h	0.99	0.54	-45
	120 km/h	2.35	1.62	-31
	140 km/h	18.2	9.82	-46
	120 km/h	2.18	1.67	-23
	90 km/h	1.12	0.61	-46
	50 km/h	0.56	0.47	-16
BC (mg/km)	NEDC	23.3	13.8	-41
	UDC	22.5	15.9	-29
	EUDC	23.8	12.6	-47
	60 km/h	4.75	2.78	-41
	90 km/h	20.8	9.95	-52
	120 km/h	21.2	12.5	-41
	50 km/h	17.7	9.41	-47
	90 km/h	23.6	16.4	-31
	120 km/h	19.5	14.2	-27
	140 km/h	113	108	-4
	120 km/h	20.0	16.0	-20
	90 km/h	18.6	10.8	-42
	50 km/h	8.15	7.06	-13

Table S2. Effect of Biodiesel on emission factors for different species (Continuation).

Species	Cycle	Diesel-V(E3)		
		Regular fuel	30% Biodiesel	% change
CO (mg/km)	NEDC	1333	1132	-15
	UDC	3608	3069	-15
	EUDC	8	N.D.	
CO ₂ (g/km)	NEDC	222	224	1
	UDC	283	286	1
	EUDC	187	187	0
NO _x (mg/km)	NEDC	477	499	5
	UDC	407	436	7
	EUDC	519	537	3
HC (mg/km)	NEDC	107	91	-15
	UDC	269	228	-15
	EUDC	13	12	-8
Particles (#/km)	NEDC	2.24E+14	1.48E+14	-34
	UDC	2.85E+14	2.19E+14	-23
	EUDC	1.89E+14	1.06E+14	-44
	60 km/h	4.44E+13	3.06E+13	-31
	90 km/h	2.01E+14	1.06E+14	-47
	120 km/h	3.59E+14	1.92E+14	-47
	50 km/h	1.03E+14	7.97E+13	-23
	90 km/h	1.52E+14	1.18E+14	-22
	120 km/h	3.17E+14	2.22E+14	-30
	140 km/h	9.26E+14	7.26E+14	-22
	120 km/h	1.20E+15	8.38E+14	-30
	90 km/h	2.14E+14	6.70E+14	213
	50 km/h	2.22E+14	2.83E+14	27

Table S2. Effect of Biodiesel on emission factors for different species (Continuation).

Species	Cycle	Regular fuel	Regular fuel	30% Biodiesel	% Change	% Change
		1	2		30%Bio vs 1	30%Bio vs 2
NO (g/km)	NEDC	5.38E-01	1.68E-01	1.66E-01	-69	-1,5
NO2 (g/km)		3.47E-01	1.26E-01	1.37E-01	-61	8,4
N2O (g/km)		5.26E-02	1.28E-02	1.57E-02	-70	23
NH3 (g/km)		N.D.	N.D.	1.62E-07		
HCN (g/km)		1.14E-03	3.96E-04	2.05E-05	-98	-95
HCHO (g/km)		9.41E-02	2.45E-02	2.22E-02	-76	-9,4
CH3CHO (g/km)		6.45E-02	1.83E-02	1.54E-02	-76	-15
SO2 (g/km)		3.02E-02	6.28E-03	1.87E-02	-38	198
CH4 (g/km)		6.55E-02	1.32E-02	1.35E-02	-79	2,2
Benzene (mg/km)	NEDC	3.646	2.814	2.934	-20	4,3
Toluene (mg/km)		1.408	1.197	0.765	-46	-36
C2-Benzene (mg/km)		1.143	1.082	0.551	-52	-49
C3-Benzene (mg/km)		0.520	4.178	0.213	-59	-95
Napthalene (mg/km)		0.496	0.409	0.212	-57	-48
Methyl-Napthalene (mg/km)		0.393	0.220	0.165	-58	-25
C2-Napthalene (mg/km)		0.114	0.063	0.060	-48	-5,4
C3-Napthalene (mg/km)		0.036	0.023	0.022	-41	-6,2
Phenanthrene (mg/km)		0.0014	0.0038	0.0012	-9	-67
Methyl-Phenanthrene (mg/km)		0.0010	0.0053	0.0008	-19	-85
C2-Phenanthrene (mg/km)		0.0005	0.0053	0.0007	31	-87
C3-Phenanthrene (mg/km)		0.0002	0.0026	0.0005	159	-79
Pyrene (mg/km)		0.0015	0.0043	0.0013	-11	-69

Table S3. Typical parameters of the regulated cycles.

	NEDC	UDC	EUDC	ETC	ETC Urban	ETC Rural	ETC Motorway	WMTC-part1 reduced speed (x2)	ECE47
Total distance (m)	110116.6	4060	6955.1	29493.6	3874.3	11556.6	14062.7	7874.0	6720
Total time (s)	1180	780	400	1800	600	600	600	1200	896
Driving time (s)	939	540	365	1800	600	600	600	1050	784
Drive time spent accelerating (s)	278	212	119	522	245	218	59	414	88
% of the time accelerating	23.6	27.2	29.8	29.0	40.8	36.3	9.8	34.5	9.8
Average speed (km/h)	33.6	19.0	62.6	59.0	23.3	69.3	84.4	23.6	27
Maximum speed (km/h)	120	50	120	90.8	50	78.5	90.8	50	50
Accelerations per km	2.8	12.1	0.6	2.2	22.2	9.4	9.3	11.7	1.2
Average positive acceleration (m/s ²)	0.3	0.3	0.5	0.2	0.3	0.2	0.0	0.4	1.2

Table S4. OA, BC and particle emissions and exhaust temperature

Type of vehicle	Test	# of repetitions	Part of the test	Exhaust temperature		OA		BC		OA/BC	Particle number	
				AVG	STDV	AVG	AVG	AVG	AVG		AVG	AVG
				°C		mg/km	mg/m ³	mg/km	mg/m ³		#/km	#/m ³
HDDV(EIII)	Steady state	3	All	134	54	19.7	3.75	159	30.5	0.12	3.15E+14	6.04E+13
			idle	50	5	-	0.943	-	6.05	0.21	-	1.86E+13
			40 km/h	112	7	5.35	1.23	59.1	13.8	0.09	8.33E+13	1.93E+13
			60 km/h	153	3	6.53	1.84	98.3	27.9	0.07	1.34E+14	3.80E+13
			90 km/h	213	3	21.9	4.20	208	49.9	0.11	5.20E+14	9.97E+13
			idle	136	14	-	0.303	-	2.77	0.11	-	3.87E+12
	NEDC	3*	NEDC	141	36	22.6	3.84	200	33.6	0.11	2.37E+14	4.07E+13
			UDC	123	25	39.2	5.03	266	33.7	0.15	2.03E+14	2.66E+13
			EUDC	180	22	12.2	2.59	158	33.7	0.08	2.58E+14	5.46E+13
	ETC	3*	ETC	170	42	21.3	4.29	168	33.9	0.13	2.90E+14	5.73E+13
			Urban	117	25	33.0	4.91	194	28.9	0.17	1.70E+14	2.49E+13
			Rural	183	12	13.3	4.55	151	51.6	0.09	2.04E+14	6.81E+13
			Motorway	207	9	19.5	3.73	164	31.3	0.12	4.00E+14	7.51E+13
Diesel-P(E3) 10ppm	Steady state	1	All	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
			idle	37	9	-	2.01	-	9.58	0.21	-	4.61E+13
			60 km/h	111	19	1.24	1.56	15.1	19.0	0.08	3.95E+13	4.97E+13
			90 km/h	210	23	1.62	1.74	29.2	31.5	0.06	6.33E+13	6.82E+13
			120 km/h	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	NEDC	1	NEDC	111	49	5.31	3.32	31.1	19.5	0.17	7.37E+13	4.62E+13
			UDC	87	27	9.88	4.08	35.3	14.6	0.28	1.06E+14	4.36E+13
			EUDC	162	44	2.62	2.35	28.7	25.8	0.09	5.50E+13	4.94E+13
	Speed ramp	1	All	225	108	6.36	2.57	62.1	25.1	0.10	5.86E+14	2.37E+14
			idle	32	3	-	0.245	-	2.84	0.09	-	6.11E+12
			50 km/h	74	17	3.20	1.00	28.1	8.75	0.11	6.67E+13	2.07E+13
			90 km/h	164	21	2.14	1.17	32.7	17.9	0.07	1.40E+14	7.64E+13
			120 km/h	277	17	3.31	2.55	41.7	32.1	0.08	4.82E+14	3.71E+14
			140 km/h	372	15	9.19	5.57	57.9	35.1	0.16	5.10E+14	3.09E+14
			120 km/h	348	17	3.69	2.32	86.4	54.3	0.04	5.92E+14	3.72E+14
			90 km/h	301	10	2.99	2.02	22.5	15.1	0.13	7.91E+14	5.34E+14
			50 km/h	272	12	2.25	0.81	21.7	7.79	0.10	1.11E+15	3.99E+14
			idle	218	17	-	0.37	-	2.19	0.17	-	1.02E+14

*=only 2 tests for particle number; N.A.=not available; N.D.=below limit of detection

Table S4. OA, BC and particle emissions and exhaust temperature (Continuation).

Type of vehicle	Test	# of repetitions	Part of the test	Exhaust temperature		OA		BC		OA/BC	Particle number	
				AVG	STDV	AVG	AVG	AVG	AVG		AVG	AVG
				°C		mg/km	mg/m ³	mg/km	mg/m ³		#/km	#/m ³
Diesel-P(E3) 50ppm	Steady state	1	All	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
			idle	33	8	-	1.89	-	14.2	0.13	-	3.94E+13
			60 km/h	103	24	1.54	1.98	16.5	21.2	0.09	3.99E+13	5.14E+13
			90 km/h	205	21	1.37	1.51	26.3	28.9	0.05	5.89E+13	6.49E+13
			120 km/h	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	NEDC	1	NEDC	111	49	5.19	3.27	35.5	22.4	0.15	8.20E+13	5.17E+13
			UDC	86	27	9.53	3.94	41.5	17.2	0.23	1.19E+14	4.93E+13
			EUDC	161	44	2.65	2.41	31.9	29.1	0.08	6.01E+13	5.47E+13
	Speed ramp	1	All	212	107	3.95	1.65	26.7	11.18	0.15	1.58E+15	6.63.E+14
			idle	25	3	-	0.632	-	1.97	0.32	-	8.49E+12
			50 km/h	64	16	5.72	1.81	9.34	2.95	0.61	6.55E+13	2.07E+13
			90 km/h	152	22	1.83	1.02	21.4	11.91	0.09	5.42E+13	3.02E+13
			120 km/h	264	14	1.83	1.42	19.6	15.21	0.09	2.37E+14	1.85E+14
			140 km/h	350	18	2.99	1.77	21.7	12.89	0.14	4.54E+15	2.70E+15
			120 km/h	338	12	1.60	1.24	22.2	17.27	0.07	2.11E+15	1.64E+15
			90 km/h	297	11	1.40	0.94	24.5	16.37	0.06	5.29E+14	3.53E+14
			50 km/h	257	12	0.63	0.23	14.8	5.29	0.04	6.13E+14	2.20E+14
			idle	187	18	-	0.31	-	1.59	0.20	-	7.76E+13
Diesel-P(E4) 10ppm	NEDC	1	NEDC	89	43	1.79	1.49	19.1	15.9	0.09	8.30E+13	6.92E+13
			UDC	67	20	2.32	1.29	17.8	9.91	0.13	6.06E+13	3.39E+13
			EUDC	135	40	1.48	1.73	19.8	23.1	0.07	9.59E+13	1.12E+14
	Speed ramp	1	All	190	100	4.50	4.23	38.7	36.4	0.12	1.02E+15	9.64E+14
			idle	26	2	-	0.531	-	9.01	0.06	-	1.58E+13
			50 km/h	54	10	0.123	0.133	6.50	7.03	0.02	2.57E+13	2.78E+13
			90 km/h	126	16	1.16	1.62	35.9	49.8	0.03	5.18E+13	7.18E+13
			120 km/h	234	14	1.77	1.66	42.8	40.2	0.04	8.05E+13	7.55E+13
			140 km/h	338	11	14.1	11.3	36.3	29.0	0.39	2.47E+15	1.98E+15
			120 km/h	319	14	2.74	2.65	38.0	36.8	0.07	1.33E+15	1.29E+15
			90 km/h	269	13	1.09	1.66	27.6	41.9	0.04	4.43E+14	6.73E+14
			50 km/h	225	11	0.453	0.516	10.5	11.9	0.04	1.20E+15	1.36E+15
			idle	165	17	-	0.308	-	8.83	0.03	-	9.54E+14
Diesel-P(E4) 10ppm+10%Bio	NEDC	1	NEDC	87	41	1.40	1.17	15.2	12.6	0.09	4.83E+13	3.65E+13
			UDC	66	20	2.42	1.35	13.0	7.24	0.19	5.66E+13	3.15E+13
			EUDC	131	38	0.81	0.95	16.3	19.1	0.05	3.62E+13	4.24E+13

Table S4. OA, BC and particle emissions and exhaust temperature (Continuation).

Type of vehicle	Test	# of repetitions	Part of the test	Exhaust temperature		OA		BC		OA/BC	Particle number	
				AVG	STDV	AVG	AVG	AVG	AVG		AVG	AVG
				°C		mg/km	mg/m ³	mg/km	mg/m ³		#/km	#/m ³
Diesel-V(E3) 10ppm	Steady state	2	All	187	77	3.49	1.26	20.6	7.54	0.17	2.74E+14	1.00E+14
			idle	49	4	-	0.03	-	0.32	0.07	-	1.29E+12
			60 km/h	131	23	0.21	0.12	4.75	2.59	0.05	4.44E+13	2.39E+13
			90 km/h	209	7	0.80	0.59	20.8	15.4	0.04	2.01E+14	1.48E+14
			120 km/h	266	1	6.20	2.34	21.2	8.00	0.29	3.59E+14	1.36E+14
	NEDC	2	NEDC	127	47	3.83	1.52	23.3	9.21	0.16	2.24E+14	8.89E+13
			UDC	103	29	7.68	1.96	22.5	5.73	0.34	2.85E+14	7.30E+13
			EUDC	176	37	1.59	0.92	23.8	13.8	0.07	1.89E+14	1.10E+14
	Speed ramp	2	All	204	87	5.22	2.13	42.5	17.3	0.12	5.80E+14	2.37E+14
			idle	51	5	-	0.34	-	6.58	0.05	-	1.73E+13
			50 km/h	114	15	1.80	0.70	17.7	6.85	0.11	1.03E+14	3.99E+13
			90 km/h	188	5	0.99	0.61	23.6	14.6	0.04	1.52E+14	9.36E+13
			120 km/h	260	2	2.35	0.84	19.5	6.93	0.12	3.17E+14	1.13E+14
			140 km/h	363	13	18.2	7.16	113	43.7	0.16	9.26E+14	3.62E+14
			120 km/h	308	22	2.18	0.84	20.0	7.67	0.11	1.20E+15	4.64E+14
			90 km/h	240	8	1.12	0.87	18.6	14.4	0.06	2.14E+14	1.65E+14
			50 km/h	209	9	0.56	0.27	8.15	3.87	0.07	2.22E+14	1.05E+14
			idle	159	9	-	0.72	-	4.15	0.18	-	1.79E+13
Diesel-V(E3) 10ppm+30% Bio	Steady state	1	All	186	75	1.27	0.48	11.2	4.22	0.11	1.62E+14	6.11E+13
			idle	51	3	-	0.03	-	0.24	0.14	-	1.23E+12
			60 km/h	137	15	0.14	0.10	2.78	2.00	0.05	3.06E+13	2.20E+13
			90 km/h	206	8	0.42	0.30	9.95	7.27	0.04	1.06E+14	7.74E+13
			120 km/h	264	2	1.90	0.71	12.5	4.71	0.15	1.92E+14	7.24E+13
	NEDC	2	NEDC	135	40	3.04	1.20	13.8	5.45	0.22	1.48E+14	5.82E+13
			UDC	108	31	6.52	1.67	15.9	4.07	0.41	2.19E+14	5.60E+13
			EUDC	175	33	1.00	0.58	12.6	7.26	0.08	1.06E+14	6.10E+13
	Speed ramp	1	All	203	90	2.93	1.20	34.1	14.0	0.09	5.11E+14	2.09E+14
			idle	48	4	-	0.33	-	3.92	0.08	-	1.95E+13
			50 km/h	112	18	1.05	0.43	9.41	3.80	0.11	7.97E+13	3.22E+13
			90 km/h	185	7	0.54	0.34	16.4	10.3	0.03	1.18E+14	7.38E+13
			120 km/h	260	3	1.62	0.58	14.2	5.08	0.11	2.22E+14	7.94E+13
			140 km/h	365	18	9.82	3.64	108	40.0	0.09	7.26E+14	2.70E+14
			120 km/h	308	20	1.67	0.62	16.0	5.98	0.10	8.38E+14	3.14E+14
			90 km/h	240	9	0.61	0.48	10.8	8.45	0.06	6.70E+14	5.25E+14
			50 km/h	205	5	0.47	0.22	7.06	3.33	0.07	2.83E+14	1.34E+14
			idle	159	9	-	0.40	-	2.48	0.16	-	2.81E+13

Table S4. OA, BC and particle emissions and exhaust temperature (Continuation).

Type of vehicle	Test	# of repetitions	Part of the test	Exhaust temperature		OA		BC		OA/BC	Particle number	
				AVG	STDV	AVG	AVG	AVG	AVG		AVG	AVG
				°C		mg/km	mg/m ³	mg/km	mg/m ³		#/km	#/m ³
Gasoline-P(E4)	Steady state	1	All	233	120	0.0025	0.0034	0.0452	0.0540	0.064	8.69E+11	1.04E+12
			idle	37	5	-	0.0018	-	0.0409	0.057		4.79E+10
			60 km/h	124	33	0.0027	0.0050	0.0251	0.0456	0.060	1.60E+10	2.91E+10
			90 km/h	243	7	0.0009	0.0016	0.0101	0.0186	0.063	4.66E+09	8.61E+09
			120 km/h	372	15	0.0029	0.0038	0.0399	0.0525	0.073	1.63E+12	2.15E+12
	NEDC	2	NEDC	122	58	0.0087	0.0115	0.227	0.300	0.039	2.28E+12	3.02E+12
			UDC	89	30	0.0198	0.0194	0.512	0.503	0.038	5.41E+12	5.32E+12
			EUDC	187	43	0.0022	0.0037	0.0596	0.0989	0.037	4.52E+11	7.50E+11
	Speed ramp	2	All	235	133	0.0134	0.0168	0.314	0.395	0.042	3.78E+12	4.79E+12
			idle	39	1	-	0.0328	-	1.28	0.022	-	1.16E+12
			50 km/h	66	7	N.D.	N.D.	0.0484	0.0853	N.A.	9.31E+10	1.66E+11
			90 km/h	178	21	0.0050	0.0080	0.233	0.377	0.022	1.37E+11	2.15E+11
			120 km/h	332	18	0.0063	0.0076	0.299	0.359	0.023	1.82E+11	2.17E+11
			140 km/h	449	18	0.0123	0.0124	0.176	0.177	0.067	1.18E+13	1.19E+13
			120 km/h	415	14	0.0030	0.0038	0.0327	0.0417	0.086	5.48E+12	7.00E+12
			90 km/h	323	20	N.D.	N.D.	0.0084	0.0157	N.A.	1.09E+10	2.03E+10
			50 km/h	234	15	N.D.	N.D.	0.0121	0.0249	N.A.	8.76E+09	1.80E+10
			idle	163	10	-	N.D.	-	N.D.	N.A.	-	8.50E+10

Table S4. OA, BC and particle emissions and exhaust temperature (Continuation).

Type of vehicle	Test	# of repetitions	Part of the test	Exhaust temperature		OA		BC		OA/BC	Particle number	
				AVG	STDV	AVG	AVG	AVG	AVG		AVG	AVG
				°C		mg/km	mg/m ³	mg/km	mg/m ³		#/km	#/m ³
S(E1)-unleaded fuel+2% oil	Steady state	1	All	146	94	122	463	0.760	2.87	161	4.55E+12	1.72E+13
			idle	29	1	-	-	-	0.244	0	-	N.A.
			30 km/h	71	20	104	434	0.143	0.599	725	4.18E+12	1.75E+13
			50 km/h	237	57	133	625	1.15	5.43	115	4.67E+12	2.19E+13
			idle	213	34	-	13	-	0.264	48	-	9.54E+11
	ECE 47	2	ECE 47	171	80	228	950	1.61	6.66	142	7.04E+12	2.91E+13
			cold	101	54	414	1685	2.17	8.81	190	9.70E+12	3.94E+13
			hot	239	25	49.9	213	1.07	4.51	47	4.51E+12	1.90E+13
	WMTC	1	WMTC	180	84	191	716	1.66	6.20	115	5.89E+12	2.21E+13
			cold	115	66	361	1343	2.19	8.16	165	7.35E+12	2.74E+13
			hot	250	23	30.3	114	1.15	4.32	26.5	4.51E+12	1.70E+13
S(E2)-unleaded fuel+2% oil	Steady state	2	All	128	67	293	609	0.96	1.99	281	2.00E+13	4.16E+13
			idle	28	1	-	7.41	-	4.52	-	-	2.39E+12
			30 km/h	84	26	85.4	193	0.43	0.97	128	1.42E+13	3.21E+13
			50 km/h	192	26	405	1000	0.88	2.16	441	2.33E+13	5.74E+13
			idle	173	26	-	292	-	0.69	485	-	3.98E+12
	ECE 47	2	ECE 47	137	47	345	753	2.80	6.18	124	1.80E+13	3.96E+13
			cold	101	43	267	568	3.05	6.61	85.7	1.90E+13	4.09E+13
			hot	172	10	420	936	2.56	5.75	169	1.72E+13	3.84E+13
	WMTC	1	WMTC	135	46	379	833	2.95	6.49	128	1.79E+13	3.93E+13
			cold	105	46	283	622	3.41	7.49	83.0	1.71E+13	3.76E+13
			hot	170	9	472	1036	2.52	5.53	188	1.86E+13	4.08E+13

Table S5. Emissions of regulated compounds and CO₂.

Type of vehicle	Test	# of repetitions	Part of the test	Exhaust temperature		CO	CO ₂	NO _x	HC
				AVG	STDV	AVG	AVG	AVG	AVG
				°C		mg/km	g/km	mg/km	mg/km
HDDV(EIII)	NEDC	3	NEDC	141	36	2979	528	4024	59
			UDC	123	25	4871	652	5636	39
			EUDC	180	22	1796	450	3016	72
	ETC	3	ETC	170	42	1930	450	2925	69
			Urban	117	25	4345	564	5772	54
			Rural	183	12	1958	404	2513	74
			Motorway	207	9	1277	454	2488	70
Diesel-P(E3)-50 ppm	NEDC	1	NEDC	108	51	325	179	657	106
			UDC	81	31	896	233	749	250
			EUDC	159	44	14	149	608	28
Diesel-P(E4)-10ppm	NEDC	1	NEDC	89	43	234	142	392	119
			UDC	67	20	622	173	332	234
			EUDC	135	40	8	125	427	52
Diesel-V(E3)-10ppm	NEDC	2	NEDC	127	47	1333	222	477	107
			UDC	103	29	3608	283	407	269
			EUDC	176	37	8	187	519	13
Diesel-V(E3)-10ppm+30% Bio	NEDC	2*	NEDC	135	40	1132	224	499	91
			UDC	108	31	3069	286	436	228
			EUDC	175	33	N.D.	187	537	12
Gasoline-P(E4)	NEDC	3	NEDC	122	58	1363	164	51	115
			UDC	89	30	3329	209	72	292
			EUDC	187	43	210	137	38	11
S(E1)-unleaded fuel+2% oil	ECE 47	2	ECE 47	171	80	7335	44	28	3580
			cold	101	54	5985	47	37	5037
			hot	239	25	8674	40	19	2134
	WMTC	1	WMTC	180	84	9118	47	23	3594
			cold	115	66	7992	52	32	4981
			hot	250	23	10243	42	14	2207
S(E2)-unleaded fuel+2% oil	ECE 47	2	ECE 47	137	47	1452	45	372	1510
			cold	101	43	2312	48	353	1873
			hot	172	10	601	42	391	1151
	WMTC	1	WMTC	135	46	1157	46	416	1525
			cold	105	46	1620	49	449	1789
			hot	170	9	690	42	382	1258

Table S6. Emission factors for species measured with FTIR.

	HDDV(EIII)						HDDV(EIII)						Gasoline-P(E4)
	NEDC						ETC						NEDC
	1	2	3	AVG (3 tests)	STDV	RSD(%)	1	2	3	AVG (3 tests)	STDV	RSD(%)	AVG (2 tests)
	g/km	g/km	g/km	g/km	g/km		g/km	g/km	g/km	g/km	g/km		g/km
NO	2.38E+00	2.57E+00	2.11E+00	2.35E+00	1.88E-01	8.0	1.52E+00	1.62E+00	1.75E+00	1.63E+00	9.42E-02	5.8	2.68E-02
NO2	4.00E-01	4.57E-01	3.49E-01	4.02E-01	4.39E-02	10.9	2.79E-01	2.88E-01	3.07E-01	2.91E-01	1.17E-02	4.0	1.48E-07
N2O	2.22E-03	1.04E-03	3.11E-03	2.12E-03	8.48E-04	39.9	3.42E-03	1.47E-03	2.55E-03	2.48E-03	7.97E-04	32.1	6.00E-04
NH3	4.84E-04	2.36E-04	4.15E-04	3.78E-04	1.05E-04	27.7	3.68E-04	2.54E-04	3.51E-04	3.24E-04	5.00E-05	15.4	6.48E-03
HCN	1.52E-03	1.46E-03	1.67E-03	1.55E-03	8.76E-05	5.7	4.86E-04	7.34E-04	9.86E-04	7.35E-04	2.04E-04	27.8	1.32E-04
HCHO	1.68E-02	1.68E-02	1.23E-02	1.53E-02	2.13E-03	13.9	1.06E-02	1.01E-02	1.26E-02	1.11E-02	1.09E-03	9.8	6.25E-04
CH3CHO	4.07E-02	4.47E-02	3.60E-02	4.05E-02	3.58E-03	8.9	3.43E-02	3.19E-02	3.50E-02	3.37E-02	1.29E-03	3.8	6.99E-04
SO2	7.86E-02	4.18E-02	6.93E-02	6.33E-02	1.56E-02	24.7	8.02E-02	1.05E-02	5.08E-02	.72E-02	2.85E-02	60.5	8.33E-03
CH4	7.09E-05	4.55E-04	1.70E-05	1.81E-04	1.95E-04	107.8	7.50E-06	8.00E-06	1.31E-04	4.90E-05	5.83E-05	119.0	9.14E-03
	S(E1)-unleaded fuel+2%oil				S(E2)-unleaded fuel+2%oil				Diesel-V(E3)_10ppm			Diesel-V(E3) 10ppm+30% Bio	
	ECE47			WMTC	ECE47			WMTC	NEDC			NEDC	
	1	2	AVG (2 tests)	1	1	2	AVG (2 tests)	1	1	2	AVG (2 tests)	1	
	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	
NO	1.59E-02	1.21E-02	1.40E-02	1.01E-02	1.81E-01	1.82E-01	1.82E-01	1.84E-01	5.38E-01	1.68E-01	3.53E-01	166E-01	
NO2	5.99E-05	1.24E-04	9.22E-05	N.D.	5.71E-03	4.82E-03	5.26E-03	3.96E-03	3.47E-01	1.26E-01	2.36E-01	1.37E-01	
N2O	N.D.	N.D.		N.D.	2.38E-03	2.37E-03	2.37E-03	2.45E-03	5.26E-02	1.28E-02	3.27E-02	1.57E-02	
NH3	4.76E-03	3.64E-03	4.20E-03	5.06E-03	2.89E-04	3.08E-06	1.46E-04	6.84E-07	N.D.	N.D.		1.62E-07	
HCN	1.06E-03	9.72E-04	1.01E-03	1.05E-03	4.62E-04	5.33E-04	4.98E-04	3.88E-04	1.14E-03	3.96E-04	7.67E-04	2.05E-05	
HCHO	2.08E-02	1.80E-02	1.94E-02	1.88E-02	2.74E-02	2.69E-02	2.71E-02	2.44E-02	9.41E-02	2.45E-02	5.93E-02	2.22E-02	
CH3CHO	2.33E-02	1.93E-02	2.13E-02	2.17E-02	4.01E-02	4.12E-02	4.07E-02	3.80E-02	6.45E-02	1.83E-02	4.14E-02	1.54E-02	
SO2	4.57E-03	3.88E-03	4.22E-03	5.54E-03	3.12E-03	2.17E-03	2.64E-03	1.73E-03	3.02E-02	6.28E-03	1.82E-02	17E-02	
CH4	7.80E-02	6.36E-02	7.08E-02	1.29E-01	1.16E-02	9.86E-03	1.07E-02	8.81E-03	6.55E-02	1.32E-02	3.94E-02	1.35E-02	

Table S7. Emission factors of monocyclic and polycyclic aromatic hydrocarbons.

	HDDV(EIII)										
	NEDC					ETC					
	1	2	AVG (2 tests)		1	2	3	AVG (3 tests)	STDV	RSD(%)	
	mg/km	mg/km	mg/km		mg/km	mg/km	mg/km	mg/km	mg/km		
Benzene	2.5	1.9	2.2		1.7	1.6	2.0	1.8	0.16	9.1	
Toluene	0.77	0.50	0.63		0.44	0.47	0.51	0.47	0.03	6.3	
C2-Benzene	1.5	0.88	1.2		0.99	1.1	0.86	0.99	0.11	11.4	
C3-Benzene	0.83	0.72	0.78		0.61	0.69	0.70	0.66	0.04	6.1	
Napthalene	0.55	0.64	0.60		0.35	0.40	0.70	0.48	0.15	31.5	
Methyl-Naphthalene	0.77	1.2	0.96		0.46	0.58	1.16	0.73	0.30	41.3	
C2-Naphthalene	0.77	0.79	0.78		0.44	0.59	0.82	0.62	0.15	25.0	
C3-Naphthalene	0.51	0.44	0.48		0.29	0.40	0.48	0.39	0.08	20.0	
Phenanthrene	0.045	0.023	0.034		0.025	0.032	0.031	0.029	0.003	11.4	
Methyl-Phenanthrene	0.045	0.021	0.033		0.025	0.035	0.028	0.029	0.004	13.5	
C2-Phenanthrene	0.029	0.012	0.021		0.019	0.024	0.020	0.021	0.002	10.6	
C3-Phenanthrene	0.010	0.004	0.007		0.0068	0.0085	0.0072	0.007	0.001	9.9	
Pyrene	0.021	0.009	0.015		0.013	0.017	0.014	0.014	0.002	12.2	
	Scooter(E1)-unleaded fuel+2% oil		Scooter(E2)-unleaded fuel+2% oil				Diesel-V(E3)_10ppm			Diesel-V(E3)_10ppm+30% Bio	Gasoline-P(E4)
	ECE47	WMTC	ECE47	ECE47	ECE47	WMTC	NEDC	NEDC	NEDC	NEDC	NEDC
	AVG (2 tests)	1	1	2	AVG (2 tests)	1	1	2	AVG (2 tests)	1	1
	mg/km	mg/km	mg/km	mg/km	mg/km	mg/km	mg/km	mg/km	mg/km	mg/km	mg/km
Benzene	19.5	21.8	19.7	7.1	13.4	7.3	3.6	2.8	3.2	2.9	6.3
Toluene	50.1	53.8	21.8	29.8	25.8	28.5	1.4	1.2	1.3	0.76	13.8
C2-Benzene	99.4	116.1	52.0	72.6	62.3	69.9	1.1	1.1	1.1	0.55	20.7
C3-Benzene	16.9	18.0	4.4	6.3	5.3	6.1	0.52	4.2	2.3	0.21	5.4
Napthalene	0.27	0.27	0.98	1.3	1.1	1.3	0.50	0.41	0.45	0.21	0.20
Methyl-Naphthalene	0.35	0.33	0.13	0.12	0.13	0.12	0.39	0.22	0.31	0.17	0.14
C2-Naphthalene	0.20	0.19	0.06	0.04	0.050	0.040	0.11	0.063	0.089	0.060	0.052
C3-Naphthalene	0.093	0.085	0.040	0.010	0.025	0.013	0.036	0.023	0.030	0.022	0.0093
Phenanthrene	0.011	0.012	0.012	0.0055	0.009	0.0062	0.0014	0.0038	0.003	0.0012	0.0033
Methyl-Phenanthrene	0.021	0.021	0.010	0.0032	0.007	0.0044	0.0010	0.0053	0.003	0.0008	0.0009
C2-Phenanthrene	0.017	0.018	0.009	0.0022	0.006	0.0035	0.0005	0.0053	0.003	0.0007	N.D.
C3-Phenanthrene	0.0067	0.0078	0.0077	0.0001	0.004	0.0012	0.0002	0.0026	0.001	0.0005	N.D.
Pyrene	0.0021	0.0027	0.0086	0.0012	0.005	0.0019	0.0015	0.0043	0.003	0.0013	N.D.