

Methods to Find the Cost-Effectiveness of Funding Air Quality Projects

*For Evaluating
Motor Vehicle Registration Fee Projects
and
Congestion Mitigation and
Air Quality (CMAQ) Improvement Projects*

*Emission Factor Tables
March 2018*

California Air Resources Board

Table 3 Average Auto Emission Factors
(Fleet of Light-Duty Passenger Vehicles, Light-Duty Trucks and Motor Cycles)

Analysis Period or Project Life	1-5 Years (2016-2020)	6-10 Years (2016-2025)	11-15 Years (2016-2030)	16-20 Years (2016-2035)
ROG				
VMT (g/mile)	0.119	0.102	0.087	0.084
commute trip ends (g/trip end)	0.400	0.318	0.256	0.225
average trip ends (g/trip end)	0.368	0.296	0.241	0.216
NOx				
VMT (g/mile)	0.114	0.091	0.074	0.067
commute trip ends (g/trip end)	0.125	0.095	0.074	0.063
average trip ends (g/trip end)	0.175	0.132	0.103	0.088
PM2.5				
VMT (g/mile)	0.053	0.053	0.053	0.053
Running exhaust only (g/mile)	0.002	0.002	0.002	0.002
Tire and brake wear (g/mile)	0.024	0.024	0.024	0.024
Road dust (g/mile)	0.028	0.028	0.028	0.028
Commute trip ends (g/trip end)	0.005	0.005	0.004	0.004
Average trip ends (g/trip end)	0.003	0.002	0.002	0.002
CO				
VMT (g/mile)	1.170	0.974	0.812	0.760
Commute trip ends (g/trip end)	2.967	2.384	1.929	1.719
Average trip ends (g/trip end)	2.448	1.943	1.569	1.408

Source: EMFAC2014 V1.0.7, statewide average annual emissions.

Output runs use 50% relative humidity and 75 degrees Fahrenheit temperature.

PM2.5, road dust: statewide average annual PM2.5 emission factor is based on US EPA's Compilation of Air Pollutant Emission Factors, Vol. 5 (AP-42, Chapter 13.2.1, Jan. 2011), and CARB's Miscellaneous Process Methodology 7.9, Entrained Paved Road Travel, Paved Road Dust (Updated Nov. 2016)

[PM10] = 0.15*[PM2.5]

Table 3A Average Auto Emission Factors
(Fleet of Light-Duty Passenger Vehicles, Light-Duty Trucks and Motor Cycles)

Analysis Period or Project Life	1 Year 2016	1 Year 2017	1 Year 2018
ROG			
VMT (g/mile)	0.145	0.129	0.116
Commute trip ends (g/trip end)	0.503	0.444	0.392
Average trip ends (g/trip end)	0.459	0.407	0.361
NOx			
VMT (g/mile)	0.145	0.127	0.111
Commute trip ends (g/trip end)	0.163	0.141	0.122
Average trip ends (g/trip end)	0.230	0.199	0.172
PM_{2.5}			
VMT (g/mile)	0.053	0.053	0.053
Running exhaust only (g/mile)	0.002	0.002	0.002
Tire and brake wear (g/mile)	0.024	0.024	0.024
Road dust (g/mile)	0.028	0.028	0.028
Commute trip ends (g/trip end)	0.005	0.005	0.005
Average trip ends (g/trip end)	0.003	0.002	0.002
CO			
VMT (g/mile)	1.453	1.285	1.142
Commute trip ends (g/trip end)	3.726	3.284	2.903
Average trip ends (g/trip end)	3.085	2.723	2.403

Source: EMFAC2014 V1.0.7, statewide average annual emissions

Output runs use 50% relative humidity and 75 degrees Fahrenheit temperature.

PM_{2.5}, road dust: statewide average annual PM_{2.5} emission factor, based on US EPA's Compilation of Air Pollutant Emission Factors, Vol. 5 (AP-42, Chapter 13.2.1, Jan. 2011), and CARB's Miscellaneous Process Methodology 7.9, Entrained Paved Road Travel, Paved Road Dust (updated Nov. 2016).

[PM₁₀ = 0.15*PM_{2.5}]

Table 4 Emission Factors by Speed

Project Life 1-5 years (2016-2020)

<i>Speed</i>					<i>Grams per Mile</i>					<i>Speed</i>				
<i>(mph)</i>	ROG	CO	NOx	PM2.5 Ex	<i>(mph)</i>	ROG	CO	NOx	PM2.5 Ex	<i>(mph)</i>	ROG	CO	NOx	PM2.5 Ex
5	0.34	2.74	1.14	0.02	35	0.05	1.30	0.39	0.005					
6	0.31	2.66	1.10	0.02	36	0.05	1.28	0.39	0.005					
7	0.29	2.57	1.06	0.02	37	0.05	1.26	0.38	0.004					
8	0.27	2.49	1.02	0.02	38	0.05	1.24	0.38	0.004					
9	0.25	2.41	0.98	0.02	39	0.05	1.22	0.37	0.004					
10	0.23	2.34	0.94	0.01	40	0.04	1.21	0.37	0.004					
11	0.21	2.27	0.89	0.01	41	0.04	1.19	0.37	0.004					
12	0.19	2.20	0.84	0.01	42	0.04	1.18	0.37	0.004					
13	0.18	2.13	0.79	0.01	43	0.04	1.16	0.36	0.004					
14	0.16	2.07	0.75	0.01	44	0.04	1.15	0.36	0.004					
15	0.15	2.00	0.70	0.01	45	0.04	1.13	0.36	0.004					
16	0.14	1.95	0.67	0.01	46	0.04	1.12	0.36	0.004					
17	0.13	1.90	0.64	0.01	47	0.04	1.11	0.35	0.004					
18	0.12	1.85	0.61	0.01	48	0.04	1.10	0.35	0.004					
19	0.11	1.80	0.58	0.01	49	0.04	1.09	0.35	0.004					
20	0.10	1.76	0.55	0.01	50	0.04	1.07	0.35	0.004					
21	0.10	1.72	0.53	0.01	51	0.04	1.07	0.35	0.004					
22	0.09	1.68	0.52	0.01	52	0.04	1.06	0.35	0.004					
23	0.09	1.64	0.50	0.01	53	0.04	1.05	0.35	0.004					
24	0.08	1.60	0.48	0.01	54	0.04	1.05	0.35	0.004					
25	0.08	1.57	0.47	0.01	55	0.04	1.04	0.35	0.004					
26	0.08	1.54	0.46	0.01	56	0.04	1.04	0.35	0.005					
27	0.07	1.51	0.45	0.01	57	0.04	1.03	0.35	0.005					
28	0.07	1.48	0.44	0.01	58	0.04	1.03	0.35	0.005					
29	0.07	1.45	0.43	0.01	59	0.04	1.03	0.35	0.005					
30	0.06	1.42	0.42	0.01	60	0.04	1.02	0.35	0.005					
31	0.06	1.40	0.41	0.01	61	0.04	1.03	0.35	0.005					
32	0.06	1.37	0.41	0.005	62	0.04	1.03	0.35	0.005					
33	0.06	1.35	0.40	0.005	63	0.04	1.03	0.36	0.005					
34	0.05	1.32	0.40	0.005	64	0.04	1.04	0.36	0.005					
					65	0.04	1.04	0.36	0.005					

Source: EMFAC2014 V1.0.7, average annual emissions, statewide vehicle fleet, 50% humidity, temperature 75 degrees F. ROG includes running exhaust and running evaporative emissions. PM2.5 Ex includes running exhaust emissions only.

Table 4 Emission Factors by Speed (Continued)

Project Life 6-10 years (2016-2025)

<i>Speed</i>					<i>Grams per Mile</i>					<i>Speed</i>				
<i>(mph)</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>PM2.5 Ex</i>	<i>(mph)</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>PM2.5 Ex</i>	<i>(mph)</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>PM2.5 Ex</i>
5	0.28	2.26	1.09	0.02	35	0.04	1.08	0.30	0.003	6	0.26	2.20	1.04	0.02
6	0.26	2.20	1.04	0.02	36	0.04	1.06	0.29	0.003	7	0.24	2.13	1.00	0.01
7	0.24	2.13	1.00	0.01	37	0.04	1.05	0.29	0.003	8	0.22	2.06	0.96	0.01
8	0.22	2.06	0.96	0.01	38	0.04	1.03	0.28	0.003	9	0.20	2.00	0.92	0.01
9	0.20	2.00	0.92	0.01	39	0.04	1.02	0.28	0.003	10	0.19	1.94	0.88	0.01
10	0.19	1.94	0.88	0.01	40	0.04	1.00	0.28	0.003	11	0.17	1.88	0.83	0.01
11	0.17	1.88	0.83	0.01	41	0.04	0.99	0.27	0.003	12	0.16	1.82	0.77	0.01
12	0.16	1.82	0.77	0.01	42	0.03	0.97	0.27	0.003	13	0.15	1.77	0.72	0.01
13	0.15	1.77	0.72	0.01	43	0.03	0.96	0.27	0.003	14	0.13	1.72	0.68	0.01
14	0.13	1.72	0.68	0.01	44	0.03	0.95	0.27	0.003	15	0.12	1.66	0.63	0.01
15	0.12	1.66	0.63	0.01	45	0.03	0.93	0.26	0.003	16	0.11	1.62	0.59	0.01
16	0.11	1.62	0.59	0.01	46	0.03	0.92	0.26	0.003	17	0.11	1.58	0.56	0.01
17	0.11	1.58	0.56	0.01	47	0.03	0.91	0.26	0.003	18	0.10	1.54	0.53	0.01
18	0.10	1.54	0.53	0.01	48	0.03	0.90	0.26	0.003	19	0.09	1.50	0.50	0.01
19	0.09	1.50	0.50	0.01	49	0.03	0.89	0.26	0.003	20	0.09	1.46	0.47	0.01
20	0.09	1.46	0.47	0.01	50	0.03	0.89	0.26	0.003	21	0.08	1.43	0.45	0.01
21	0.08	1.43	0.45	0.01	51	0.03	0.88	0.26	0.003	22	0.08	1.40	0.43	0.01
22	0.08	1.40	0.43	0.01	52	0.03	0.87	0.25	0.003	23	0.07	1.36	0.41	0.01
23	0.07	1.36	0.41	0.01	53	0.03	0.86	0.25	0.003	24	0.07	1.33	0.39	0.005
24	0.07	1.33	0.39	0.005	54	0.03	0.86	0.25	0.003	25	0.06	1.30	0.37	0.005
25	0.06	1.30	0.37	0.005	55	0.03	0.85	0.25	0.003	26	0.06	1.28	0.36	0.005
26	0.06	1.28	0.36	0.005	56	0.03	0.85	0.25	0.003	27	0.06	1.25	0.35	0.004
27	0.06	1.25	0.35	0.004	57	0.03	0.84	0.25	0.003	28	0.06	1.23	0.34	0.004
28	0.06	1.23	0.34	0.004	58	0.03	0.84	0.25	0.003	29	0.05	1.20	0.33	0.004
29	0.05	1.20	0.33	0.004	59	0.03	0.84	0.25	0.003	30	0.05	1.18	0.33	0.004
30	0.05	1.18	0.33	0.004	60	0.03	0.83	0.25	0.003	31	0.05	1.16	0.32	0.004
31	0.05	1.16	0.32	0.004	61	0.03	0.84	0.26	0.003	32	0.05	1.14	0.31	0.004
32	0.05	1.14	0.31	0.004	62	0.03	0.84	0.26	0.003	33	0.05	1.12	0.31	0.004
33	0.05	1.12	0.31	0.004	63	0.03	0.84	0.26	0.004	34	0.04	1.10	0.30	0.004
34	0.04	1.10	0.30	0.004	64	0.04	0.84	0.26	0.004					
					65	0.04	0.84	0.26	0.004					

Source: EMFAC2014 V1.0.7, average annual emissions, statewide vehicle fleet, 50% humidity, temperature 75 degrees F. ROG includes running exhaust and running evaporative emissions. PM2.5 Ex includes running exhaust emissions only.