

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

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

***Emission Factor Tables***  
**December 2008**

**California Air Resources Board**

## Table 1 Diesel Bus Emission Factors

(through Model Year 2009)

Pollutant	Model Year	Emission Factor (g/mi)	
		Average	45 MPH
<b>ROG</b>	Entire Fleet	0.75	0.44
	1973-83	0.83	0.49
	1984-90	0.84	0.49
	1991-93	0.82	0.48
	1994-95	0.89	0.48
	1996-2001	0.79	0.47
	2002	0.73	0.47
	2003 - 2006	0.25	0.13
	2007-2009	0.0003	0.02
<b>CO</b>	Entire Fleet	3.85	2.03
	1973-83	6.49	3.43
	1984-90	6.03	3.18
	1991-93	3.45	1.83
	1994-95	2.31	1.23
	1996-2001	1.83	0.96
	2002	1.76	0.96
	2003 - 2006	1.32	0.70
	2007-2009	1.40	0.59
<b>NOx</b>	Entire Fleet	19.99	17.89
	1973-83	28.73	25.77
	1984-90	26.19	23.45
	1991-93	15.86	14.22
	1994-95	18.52	16.65
	1996-2001	18.41	16.49
	2002	12.74	11.38
	2003 - 2006	4.60	4.11
	2007-2009	0.70	0.57
<b>PM10 - Exhaust</b>	Entire Fleet	0.34	0.20
	1973-83	0.44	0.24
	1984-90	0.39	0.23
	1991-93	0.38	0.22
	1994-95	0.53	0.27
	1996-2001	0.35	0.21
	2002	0.15	0.11
	2003 - 2006	0.06	0.02
	2007-2009	0.0004	0.02
PM10 - Tire Wear	All Years	0.007	Not Speed Dependent
PM10 - Brake Wear	All Years	0.014	Not Speed Dependent
PM10 - Road Dust*	All Years	0.184	Not Speed Dependent

Source: EMFAC2007, V2.3 (Nov 1 2006), average annual emissions, statewide urban diesel bus fleet, running exhaust emissions only, humidity 50%, temperature 75 degrees F.

\*PM10 Road Dust (paved) emission factor is based on US EPA's Compilation of Air Pollutant Emission Factors (AP-42, January 1995).

Average factors for ROG (MY 2007) and PM10 (MY 2007) exhaust were estimated using proportional analysis relative to 45 mph factors because exhaust emissions were too small to show up in EMFAC model output files (csv files).

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**Table 2 Cleaner Vehicles Emission Factors (2004+)**  
**For Light-Duty and Medium-Duty Vehicles (Chassis Certified)**  
**Based on LEV II Exhaust Emission Standards**

**Baseline Vehicles**

Low-emission light-duty and medium-duty vehicle (LEV) emission factors in grams per mile with 120,000 mile durability					
Weight (lbs.) <sup>1</sup>	ROG	NOx	PM10 <sup>2</sup>		CO
			Exhaust	Total <sup>3</sup>	
Up to 8500	0.08	0.06	0.01	0.22	3.87
8501-10,000	0.20	0.20	0.12	0.33	6.40
10,001-14,000	0.23	0.40	0.12	0.33	7.30

**Cleaner Vehicles**

Ultra low-emission light-duty and medium-duty vehicle (ULEV) emission factors in grams per mile with 120,000 mile durability					
Weight (lbs.)	ROG	NOx	PM10		CO
			Exhaust	Total	
Up to 8500	0.05	0.06	0.01	0.22	1.93
8501-10,000	0.14	0.20	0.06	0.27	6.40
10,001-14,000	0.17	0.40	0.06	0.27	7.30

Super ultra low-emission vehicle (SULEV) factors in grams per mile with 120,000 mile durability					
Partial zero emission vehicle (PZEV) with 150,000 mile durability					
Advanced technology zero emission vehicle (AT-PZEV) with 150,000 mile durability					
Weight (lbs.)	ROG	NOx	PM10		CO
			Exhaust	Total	
Up to 8500	0.01	0.02	0.01	0.22	1.00
8501-10,000	0.10	0.10	0.06	0.27	3.20
10,001-14,000	0.12	0.20	0.06	0.27	3.70

Zero-emission light-duty and medium-duty vehicle (ZEV) emission factors in grams per mile					
Weight (lbs.)	ROG	NOx	PM10		CO
			Exhaust	Total	
All weights	0	0	0	0.21	0

**Source:** Based on California Vehicle Exhaust Standards ("LEV II") for chassis certified vehicles. Factors represent a weighted average of emission standards over a 120,000-mile life; the first 50,000 miles are assessed at the 50,000-mile standard, and the remaining 70,000 miles are assessed at the 120,000-mile standard. The SULEVs exhaust standards apply over the full 120,000 mile life. PZEVs and AT-PZEVs must comply to SULEV standards over 150,000 miles and have near zero evaporative emissions. AT-PZEV must also make use of additional "ZEV-enabling" clean technology such as alternative fuel, electric drive, or other advanced technology systems. The PM10 exhaust factors are based on standards; tire wear and brake wear factors are based on EMFAC2002, version 2.2 (Apr03). The road dust portion of the PM10 factor is based on U.S. EPA's *Compilation of Air Pollutant Emission Factors* (AP-42, January 1995). Silt loading and vehicle weight data used as inputs to EPA's equation are from *Improvement of Specific Emission Factors* (BACM Project No. 1), Final Report, Midwest Research Institute, March 1996. Vehicle trip reductions may have little, if any effect on road dust emissions from high volume facilities thought to be in equilibrium, i.e., the dust is fully entrained due to the heavy traffic. The road dust PM10 factor, however, may be multiplied times total VMT reductions as it has been scaled down to reflect emissions from lower-volume local and collector roads only.

<sup>1</sup> Gross vehicle weights can be associated with passenger capacity as follows: 5751-8500, roughly 8 passengers; 8501-10,000, roughly 10-15 passengers; 10,001-14,000, roughly 20 passengers or more.

<sup>2</sup> PM10 factors are based on standards for diesel vehicles only. There is no applicable standard for gasoline vehicles; gasoline vehicles are known to emit significantly less PM10.

<sup>3</sup> Total PM10 factors include motor vehicle exhaust, tire wear (0.008 g/m), brake wear (0.013 g/m), and entrained road dust (0.184 g/m).

### Table 3 Average Auto Emission Factors

(Fleet of Light-Duty Passenger Vehicles, Light-Duty Trucks and Motorcycles)

Analysis Period or Project Life	1-5 Years (2007-2011)	6-10 Years (2007-2016)	11-15 Years (2007-2021)	16-20 Years (2007-2026)
<b>ROG</b>				
VMT (g/mile)	0.304	0.251	0.216	0.192
commute trip ends (g/trip end)	1.106	0.929	0.795	0.693
average trip ends (g/trip end)	0.824	0.694	0.597	0.523
<b>NOx</b>				
VMT (g/mile)	0.357	0.289	0.241	0.206
commute trip ends (g/trip end)	0.498	0.413	0.343	0.290
average trip ends (g/trip end)	0.477	0.399	0.333	0.282
<b>PM10</b>				
VMT (g/mile)	0.220	0.221	0.221	0.221
running exhaust only (g/mile)	0.016	0.016	0.017	0.017
tire and brake wear (g/mile)	0.020	0.020	0.020	0.020
road dust (g/mile)	0.184	0.184	0.184	0.184
commute trip ends (g/trip end)	0.016	0.016	0.017	0.017
average trip ends (g/trip end)	0.008	0.009	0.009	0.009
<b>CO</b>				
VMT (g/mile)	3.696	3.018	2.544	2.211
commute trip ends (g/trip end)	9.447	7.956	6.764	5.840
average trip ends (g/trip end)	6.773	5.689	4.827	4.161

Source: EMFAC2007, V2.3 (Nov 1 2006), statewide average annual emissions

RTS runs use humidity 50%, temperature 75 degrees F.

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## Table 3A Average Auto Emission Factors

(Fleet of Light-Duty Passenger Vehicles, Light-Duty Trucks and Motorcycles)

Analysis Period or Project Life	1 Year 2008	1 Year 2009	1 Year 2010
<b>ROG</b>			
VMT (g/mile)	0.332	0.302	0.273
commute trip ends (g/trip end)	1.189	1.100	1.016
average trip ends (g/trip end)	0.885	0.819	0.756
<b>NOx</b>			
VMT (g/mile)	0.391	0.354	0.321
commute trip ends (g/trip end)	0.535	0.498	0.461
average trip ends (g/trip end)	0.511	0.477	0.444
<b>PM10</b>			
VMT (g/mile)	0.220	0.220	0.220
running exhaust only (g/mile)	0.016	0.016	0.016
tire and brake wear (g/mile)	0.020	0.020	0.020
road dust (g/mile)	0.184	0.184	0.184
commute trip ends (g/trip end)	0.015	0.016	0.016
average trip ends (g/trip end)	0.008	0.008	0.008
<b>CO</b>			
VMT (g/mile)	4.032	3.668	3.325
commute trip ends (g/trip end)	10.113	9.422	8.747
average trip ends (g/trip end)	7.259	6.753	6.261

Source: EMFAC2007, V2.3 (Nov 1 2006), statewide average annual emissions

RTS runs use humidity 50%, temperature 75 degrees F.

\*PM10 Road Dust (paved) emission factor is based on US EPA's Compilation of Air Pollutant Emission Factors

(AP-42, January 1995).

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**Table 4 Emission Factors by Speed**

**Project Life 1-5 years (2007-2011)**

		<i>Grams per Mile</i>								
<i>Speed (mph)</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>PM10 Ex</i>	<i>Speed (mph)</i>	<i>ROG</i>	<i>CO</i>	<i>NOx</i>	<i>PM10 Ex</i>	
<b>5</b>	<b>1.12</b>	<b>8.00</b>	<b>2.38</b>	<b>0.19</b>	<b>35</b>	<b>0.16</b>	<b>3.50</b>	<b>1.08</b>	<b>0.04</b>	
6	1.04	7.70	2.25	0.18	36	0.16	3.45	1.08	0.04	
7	0.95	7.40	2.13	0.17	37	0.16	3.41	1.08	0.04	
8	0.87	7.10	2.01	0.16	38	0.15	3.37	1.08	0.04	
9	0.78	6.80	1.89	0.14	39	0.15	3.33	1.08	0.04	
<b>10</b>	<b>0.69</b>	<b>6.50</b>	<b>1.77</b>	<b>0.13</b>	<b>40</b>	<b>0.15</b>	<b>3.29</b>	<b>1.08</b>	<b>0.04</b>	
11	0.64	6.29	1.69	0.12	41	0.15	3.27	1.08	0.04	
12	0.59	6.08	1.61	0.11	42	0.14	3.24	1.08	0.03	
13	0.54	5.87	1.54	0.11	43	0.14	3.22	1.08	0.03	
14	0.48	5.66	1.46	0.10	44	0.14	3.19	1.08	0.03	
<b>15</b>	<b>0.43</b>	<b>5.45</b>	<b>1.39</b>	<b>0.09</b>	<b>45</b>	<b>0.14</b>	<b>3.17</b>	<b>1.09</b>	<b>0.03</b>	
16	0.40	5.30	1.35	0.08	46	0.14	3.16	1.09	0.03	
17	0.38	5.15	1.32	0.08	47	0.14	3.16	1.10	0.03	
18	0.35	5.00	1.29	0.07	48	0.14	3.15	1.10	0.04	
19	0.32	4.86	1.25	0.07	49	0.14	3.15	1.11	0.04	
<b>20</b>	<b>0.29</b>	<b>4.71</b>	<b>1.22</b>	<b>0.06</b>	<b>50</b>	<b>0.14</b>	<b>3.14</b>	<b>1.11</b>	<b>0.04</b>	
21	0.28	4.60	1.21	0.06	51	0.14	3.16	1.12	0.04	
22	0.27	4.50	1.19	0.06	52	0.15	3.17	1.13	0.04	
23	0.26	4.39	1.18	0.06	53	0.15	3.19	1.14	0.04	
24	0.24	4.29	1.17	0.05	54	0.15	3.20	1.15	0.04	
<b>25</b>	<b>0.23</b>	<b>4.18</b>	<b>1.15</b>	<b>0.05</b>	<b>55</b>	<b>0.15</b>	<b>3.22</b>	<b>1.16</b>	<b>0.04</b>	
26	0.22	4.10	1.15	0.05	56	0.16	3.26	1.18	0.04	
27	0.21	4.02	1.14	0.05	57	0.16	3.30	1.19	0.04	
28	0.21	3.94	1.13	0.05	58	0.16	3.35	1.21	0.04	
29	0.20	3.87	1.12	0.05	59	0.17	3.39	1.22	0.04	
<b>30</b>	<b>0.19</b>	<b>3.79</b>	<b>1.11</b>	<b>0.04</b>	<b>60</b>	<b>0.17</b>	<b>3.44</b>	<b>1.24</b>	<b>0.04</b>	
31	0.18	3.73	1.11	0.04	61	0.18	3.52	1.26	0.04	
32	0.18	3.67	1.10	0.04	62	0.18	3.61	1.28	0.05	
33	0.17	3.61	1.10	0.04	63	0.19	3.70	1.31	0.05	
34	0.17	3.55	1.09	0.04	64	0.20	3.78	1.33	0.05	
					<b>65</b>	<b>0.20</b>	<b>3.87</b>	<b>1.35</b>	<b>0.05</b>	

Source: EMFAC2007 Version 2.3 (Nov 1, 2006), average annual emissions, statewide vehicle fleet, 50% humidity, temperature 75 degrees F.  
 ROG includes running exhaust and running evaporative emissions. PM10 Ex includes running exhaust emissions only.

**Table 4 Emission Factors by Speed (Continued)**

**Project Life 6-10 years (2007-2016)**

<i>Speed (mph)</i>	<i>Grams per Mile</i>				<i>Speed (mph)</i>	ROG	CO	NOx	PM10 Ex
	ROG	CO	NOx	PM10 Ex					
<b>5</b>	<b>0.93</b>	<b>6.56</b>	<b>1.96</b>	<b>0.17</b>	<b>35</b>	<b>0.13</b>	<b>2.91</b>	<b>0.89</b>	<b>0.03</b>
6	0.86	6.32	1.86	0.16	36	0.13	2.88	0.89	0.03
7	0.78	6.08	1.76	0.15	37	0.13	2.85	0.88	0.03
8	0.71	5.83	1.66	0.14	38	0.13	2.81	0.88	0.03
9	0.64	5.59	1.56	0.13	39	0.12	2.78	0.88	0.03
<b>10</b>	<b>0.57</b>	<b>5.35</b>	<b>1.47</b>	<b>0.11</b>	<b>40</b>	<b>0.12</b>	<b>2.74</b>	<b>0.88</b>	<b>0.03</b>
11	0.53	5.18	1.40	0.11	41	0.12	2.72	0.88	0.03
12	0.48	5.01	1.34	0.10	42	0.12	2.70	0.88	0.03
13	0.44	4.84	1.28	0.09	43	0.12	2.68	0.88	0.03
14	0.39	4.67	1.21	0.09	44	0.12	2.66	0.88	0.03
<b>15</b>	<b>0.35</b>	<b>4.50</b>	<b>1.15</b>	<b>0.08</b>	<b>45</b>	<b>0.11</b>	<b>2.64</b>	<b>0.88</b>	<b>0.03</b>
16	0.33	4.38	1.12	0.07	46	0.12	2.63	0.89	0.03
17	0.31	4.26	1.09	0.07	47	0.12	2.62	0.89	0.03
18	0.28	4.14	1.07	0.07	48	0.12	2.61	0.90	0.03
19	0.26	4.02	1.04	0.06	49	0.12	2.61	0.90	0.03
<b>20</b>	<b>0.24</b>	<b>3.90</b>	<b>1.01</b>	<b>0.06</b>	<b>50</b>	<b>0.12</b>	<b>2.60</b>	<b>0.91</b>	<b>0.03</b>
21	0.23	3.82	1.00	0.05	51	0.12	2.61	0.91	0.03
22	0.22	3.73	0.99	0.05	52	0.12	2.62	0.92	0.03
23	0.21	3.65	0.97	0.05	53	0.12	2.63	0.93	0.03
24	0.20	3.56	0.96	0.05	54	0.12	2.64	0.94	0.03
<b>25</b>	<b>0.19</b>	<b>3.48</b>	<b>0.95</b>	<b>0.05</b>	<b>55</b>	<b>0.12</b>	<b>2.65</b>	<b>0.95</b>	<b>0.03</b>
26	0.18	3.41	0.94	0.04	56	0.13	2.68	0.96	0.04
27	0.18	3.35	0.94	0.04	57	0.13	2.71	0.97	0.04
28	0.17	3.28	0.93	0.04	58	0.13	2.74	0.99	0.04
29	0.16	3.22	0.92	0.04	59	0.14	2.77	1.00	0.04
<b>30</b>	<b>0.16</b>	<b>3.16</b>	<b>0.91</b>	<b>0.04</b>	<b>60</b>	<b>0.14</b>	<b>2.81</b>	<b>1.01</b>	<b>0.04</b>
31	0.15	3.11	0.91	0.04	61	0.15	2.87	1.03	0.04
32	0.15	3.06	0.90	0.04	62	0.15	2.94	1.05	0.04
33	0.14	3.01	0.90	0.04	63	0.16	3.00	1.07	0.04
34	0.14	2.96	0.89	0.03	64	0.16	3.07	1.08	0.04
					<b>65</b>	<b>0.17</b>	<b>3.13</b>	<b>1.10</b>	<b>0.05</b>

Source: EMFAC2007 Version 2.3 (Nov 1, 2006), average annual emissions, statewide vehicle fleet, 50% humidity, temperature 75 degrees F.  
 ROG includes running exhaust and running evaporative emissions. PM10 Ex includes running exhaust emissions only.

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**Table 5 On-Road Emission Factors  
for Heavy-Duty Cleaner Vehicle Projects (2007-2009)**

**BEFORE PROJECT Baseline Emission Factors  
New Diesel Vehicles**

Vehicle Type	Gross Vehicle Weight Rating (lbs)	Model Year	Emission Factors (g/mi)	
			NO <sub>x</sub>	PM
Urban transit buses	> 33,000	2007 - 2009	<b>6.4</b>	<b>0.03</b>
Transit buses, School buses, and trucks	14,001 – 33,000	2007 - 2009	<b>2.8</b>	<b>0.02</b>
Class 8 trucks	> 33,000	2007 - 2009	<b>6.4</b>	<b>0.03</b>

Source: Draft Emission Calculations Tables for Discussion at November 7, 2007 Carl Moyer Program Workshop, Table B-4 and Table B-5.

**Retrofit Diesel Vehicles**

Vehicle Type	Gross Vehicle Weight Rating (lbs)	Model Year	Emission Factors (g/mi)	
			NO <sub>x</sub>	PM
Urban transit buses	> 33,000	1994-1997	<b>18.0</b>	<b>0.4</b>
Transit buses, School buses, and trucks	14,001 – 33,000	1994-1997	<b>10.7</b>	<b>0.2</b>
Class 8 trucks	> 33,000	1994-1997	<b>18.0</b>	<b>0.4</b>

Source: Draft Emission Calculations Tables for Discussion at November 7, 2007 Carl Moyer Program Workshop, Table B-4 and Table B-5.

**AFTER PROJECT Emission Factors  
New Cleaner Vehicle Purchases or Re-powers (Typically Alternative-Fueled Vehicles)**

Vehicle Type	Gross Vehicle Weight Rating (lbs)	Engine Certification Emission Rates (g/bhp-hr)		Conversion Factors* (bhp-hr/mi)	Emission Factors (g/mi)	
		NO <sub>x</sub>	PM		NO <sub>x</sub>	PM
Urban transit buses	> 33,000	1.2	0.01	4.0	<b>4.8</b>	<b>0.04</b>
		0.2	0.01	4.0	<b>0.8</b>	<b>0.04</b>
Buses and trucks	14,001 – 33,000	1.2	0.01	1.8	<b>2.1</b>	<b>0.02</b>
		0.2	0.01	1.8	<b>0.4</b>	<b>"</b>
Class 8 trucks	> 33,000	1.2	0.01	2.9	<b>3.5</b>	<b>0.03</b>
		0.2	0.01	2.9	<b>0.6</b>	<b>"</b>

Source: Draft Emission Calculations Tables for Discussion at November 7, 2007 Carl Moyer Program Workshop, Table B-4 and Table B-5.

\* Draft Emission Calculations Tables for Discussion at November 7, 2007 Carl Moyer Program Workshop, Table B-8.

**Cleaner vehicles** could be compressed natural gas (CNG), liquefied natural gas (LNG), or cleaner diesel with after-treatment technology to reduce NO<sub>x</sub> and PM. The "After Project" emission factors are based on typical CNG vehicles; however, after-treatment applied to CNG vehicles has been shown to reduce even more PM and also, formaldehyde.

If the project's NO<sub>x</sub> engine certification rate is not shown in the table, multiply the appropriate rate times the conversion factor corresponding to the vehicle class to get grams per mile. For refuse vehicles or retrofit projects, see Carl Moyer Program Guidelines for emission rates.



**Table 6 Off-Road Emission Factors  
for Cleaner Vehicle Projects (2006 – 2008)**

Find the horsepower (hp) and model year for the engine that best describes the engine being replaced to determine the “before project” baseline emission factors. Find the hp and model year for the newer engine. These factors represent the “after project” cleaner engine emission factors.

HP	Model Year	(g/hp-hr)	(g/hp-hr)	(g/hp-hr)	(g/hp-hr)
		ROG	CO	NOx	PM
51-120	1987 or older	1.44	4.80	13.00	0.84
51-120	1988 - 1997	0.99	3.49	8.75	0.69
51-120	1998 - 2003	0.99	3.49	6.90	0.69
51-120	2004	0.46	3.23	5.64	0.39
51-120	2005	0.28	3.14	5.22	0.29
51-120	2006 - 2008	0.19	3.09	5.01	0.24
121-175	1969 or older	1.32	4.40	14.00	0.77
121-175	1970 - 1971	1.10	4.40	13.00	0.66
121-175	1972 - 1979	1.00	4.40	12.00	0.55
121-175	1980 - 1984	0.94	4.30	11.00	0.55
121-175	1985 - 1987	0.88	4.20	11.00	0.55
121-175	1988 - 1996	0.68	2.70	8.17	0.38
121-175	1997 - 2002	0.68	2.70	6.90	0.38
121-175	2003	0.33	2.70	5.26	0.24
121-175	2004	0.22	2.70	4.72	0.19
121-175	2005 – 2006	0.16	2.70	4.44	0.16
121-175	2007 - 2008	0.10	2.70	2.45	0.14
176-250	1969 or older	1.32	4.40	14.00	0.77
176-250	1970 - 1971	1.10	4.40	13.00	0.66
176-250	1972 - 1979	1.00	4.40	12.00	0.55
176-250	1980 - 1984	0.94	4.30	11.00	0.55
176-250	1985 - 1987	0.88	4.20	11.00	0.55
176-250	1988 - 1995	0.68	2.70	8.17	0.38
176-250	1996 - 2002	0.32	0.92	6.25	0.15
176-250	2003	0.19	0.92	5.00	0.12
176-250	2004	0.14	0.92	4.58	0.11
176-250	2005 – 2006	0.12	0.92	4.38	0.11
176-250	2007 - 2008	0.10	0.92	2.45	0.11
251-500	1969 or older	1.26	4.20	14.00	0.74
251-500	1970 - 1971	1.05	4.20	13.00	0.63
251-500	1972 - 1979	0.95	4.20	12.00	0.53
251-500	1980 - 1984	0.90	4.20	11.00	0.53
251-500	1985 - 1987	0.84	4.10	11.00	0.53
251-500	1988 - 1995	0.68	2.70	8.17	0.38
251-500	1996 - 2000	0.32	0.92	6.25	0.15
251-500	2001	0.19	0.92	4.95	0.12
251-500	2002	0.14	0.92	4.51	0.11
251-500	2003 - 2004	0.12	0.92	4.29	0.11
251-500	2005	0.10	0.92	4.00	0.11
251-500	2006 - 2008	0.10	0.92	2.45	0.11

**Table 6 (cont.)**

		(g/hp-hr)	(g/hp-hr)	(g/hp-hr)	(g/hp-hr)
<b>HP</b>	<b>Model Year</b>	<b>ROG</b>	<b>CO</b>	<b>NOx</b>	<b>PM</b>
501-750	1969 or older	1.26	4.20	14.00	0.74
501-750	1970 - 1971	1.05	4.20	13.00	0.63
501-750	1972 - 1979	0.95	4.20	12.00	0.53
501-750	1980 - 1984	0.90	4.20	11.00	0.53
501-750	1985 - 1987	0.84	4.10	11.00	0.53
501-750	1988 - 1995	0.68	2.70	8.17	0.38
501-750	1996 - 2001	0.32	0.92	6.25	0.15
501-750	2002	0.19	0.92	4.95	0.12
501-750	2003	0.14	0.92	4.51	0.11
501-750	2004 - 2005	0.12	0.92	4.29	0.11
>750	1969 or older	1.26	4.20	14.00	0.74
>750	1970 - 1971	1.05	4.20	13.00	0.63
>750	1972 - 1979	0.95	4.20	12.00	0.53
>750	1980 - 1984	0.90	4.20	11.00	0.53
>750	1985 - 1987	0.84	4.10	11.00	0.53
>750	1988 - 1999	0.68	2.70	8.17	0.38
>750	2000 - 2005	0.32	0.92	6.25	0.15

Source: Air Resources Board Emission Inventory for Off-Road Large Compression-Ignited Engines Using the New Off-Road Emissions Model (Mail Out MSC #99-32)

**Other information needed** to estimate emissions are operating hours and load factor. Operating hours for construction equipment can range from 535 to 1641 hours per year and the load factor can vary between 0.43 and 0.78. Operating hours for agricultural equipment can range from 90 to 790 hours per year and the load factor can vary between 0.43 to 0.70.

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**Table 7 Medium-Duty Vehicle Emission Factors  
For Vanpool and Shuttle Evaluations  
(Model Years 1995 - 2003)**

Low-emission medium-duty vehicle (LEV) emission factors in grams per mile					
Weight (lbs.)*	ROG	NOx	PM10		CO
			Exhaust	Total**	
5751-8500	0.24	0.77	0.12	0.33	6.34
8501-10,000	0.29	0.88	0.12	0.33	7.02
10,001-14,000	0.38	1.29	0.12	0.33	8.93

Ultra low-emission medium-duty vehicle (ULEV) emission factors in grams per mile					
Weight (lbs.)*	ROG	NOx	PM10		CO
			Exhaust	Total**	
5751-8500	0.15	0.77	0.06	0.27	6.34
8501-10,000	0.17	0.88	0.06	0.27	7.02
10,001-14,000	0.23	1.29	0.06	0.27	8.93

Super ultra low-emission medium-duty vehicle (SULEV) emission factors in grams per mile					
Weight (lbs.)*	ROG	NOx	PM10		CO
			Exhaust	Total**	
5751-8500	0.07	0.39	0.06	0.27	3.20
8501-10,000	0.09	0.44	0.06	0.27	3.56
10,001-14,000	0.11	0.62	0.06	0.27	4.49

Zero-emission medium-duty vehicle (ZEV) emission factors in grams per mile					
Weight (lbs.)*	ROG	NOx	PM10		CO
			Exhaust	Total**	
All weights	0	0	0	0.21	0

If vanpool/shuttle project is using 2004+ model year vehicles, refer to Table 2.

**Source:** Based on California Vehicle Exhaust Standards ("LEV I"), January 1999. (LEV II went into effect in 2004.) Factors represent a weighted average of emission standards over a 120,000-mile life; the first 50,000 miles are assessed at the 50,000-mile standard, and the remaining 70,000 miles are assessed at the 120,000-mile standard.

\*Gross vehicle weights can be associated with passenger capacity as follows: 5751-8500, roughly 8 passengers; 8501-10,000, roughly 10-15 passengers; 10,001-14,000, roughly 20 passengers or more.

\*\* Total PM10 factors include motor vehicle exhaust, tire wear (0.008 g/m for all), brake wear (0.013 g/m for all), and entrained road dust (0.184 g/m for all). The PM10 exhaust factors are based on engine standards; tire wear and brake wear factors are based on EMFAC2002, version 2.2. The road dust portion of the PM10 factor is based on U.S. EPA's Compilation of Air Pollutant Emission Factors (AP-42, January 1995). Silt loading and vehicle weight data used as inputs to EPA's equation are from Improvement of Specific Emission Factors (BACM Project No. 1), Final Report, Midwest Research Institute, March 1996. Vehicle trip reductions may have little, if any, effect on road dust emissions from high volume facilities thought to be in equilibrium, i.e., the dust is fully entrained due to the heavy traffic. The road dust PM10 factor, however, may be multiplied times total VMT reductions as it has been scaled down to reflect emissions from lower-volume local and collector roads only.