Draft Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression-Ignition Engines Less than 30 Liters per Cylinder

Chapter 3
Emission Inventory

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Emission Inventory

This chapter presents our analysis of the emission impact of the proposed rule for the three source categories affected: commercial marine diesel engines, recreational marine diesel engines, and locomotives. The proposed control requirements include NO_x and PM[a] emission standards for Category 1 and Category 2 commercial marine diesel engines (both above and below 37 kilowatts [kW]). New NO_x and PM emission standards would also apply to all recreational marine diesel engines and locomotives. There are no new standards for HC or CO; however, the PM standards are also expected to decrease HC emissions.

Section 3.1 describes the methodology and presents the resulting baseline and controlled inventories for commercial marine diesel engines, including the projected emission reductions from the proposed rule. Sections 3.2 and 3.3 present similar information for recreational marine diesel engines and locomotives, respectively. The baseline inventories represent current and future emissions with only the existing standards. The controlled inventories incorporate the new standards in the proposed rule. Section 3.4 follows with the total projected emission reductions from all three affected source categories. Section 3.5 and section 3.6 then describe the contribution of these source categories to national and selected local inventories, respectively. Section 3.7 concludes the chapter by describing the changes in the inputs and resulting emission inventories between the baseline and control scenarios used for the air quality modeling and the updated baseline and control scenarios in this proposed rule.

The inventory estimates reported in this chapter are for the 50-state geographic area. Inventories are presented for the following pollutants: particulate matter ($PM_{2.5}$ and PM_{10}), oxides of nitrogen (NO_x), sulfur dioxide (SO_2), volatile organic compounds (VOC), carbon monoxide (CO), and mobile source air toxics. The specific air toxics are benzene, formaldehyde, acetaldehyde, 1,3-butadiene, acrolein, napthalene, and 15 other compounds grouped together as polycyclic organic matter (POM). The PM inventories include directly emitted PM only, although secondary sulfates are taken into account in the air quality modeling.

3.1 Commercial Marine Diesel Engines

This section describes the methodology and presents the resulting baseline and controlled inventories for commercial marine diesel engines, including the projected emission reductions from the proposed rule. Separate inventories were developed for the following commercial marine diesel engine categories: Category 1 commercial propulsion, Category 1 marine auxiliary, Category 2 commercial propulsion, less than (<) 37kW commercial propulsion, and <37kW marine auxiliary. Category 1 and 2 only include engines greater than or equal to (≥) 37kW, so it was necessary to include separate categories for those

[a] PM in this document refers to PM_{10}, which are particles less than 10 microns in diameter.

engines less than 37kW. Note that the auxiliary categories include engines used on either commercial or recreational vessels; however, given the expected small number of recreational auxiliary engines in comparison to commercial auxiliary engines, and our inability to separate the auxiliary categories by end use, the auxiliary categories have been included in the broader commercial marine category. Category 2 marine auxiliary engines are not included here, since they are used on Category 3 ocean-going vessels that are primarily foreign-flagged and not subject to U.S. regulations. Emissions from Category 2 auxiliary engines are therefore part of the Category 3 inventories.

3.1.1 General Methodology

The general methodology for calculating commercial marine diesel engine inventories for HC, CO, NO_x, and PM is first described. This is followed by the methodologies used to calculate fuel consumption, SO_2, VOC, $PM_{2.5}$, and air toxic inventories.

Commercial marine diesel engine inventories for HC, CO, NO_x, and PM are estimated using the equation:

Equation 1 $$I = N*P*L*A*EF$$

where each term is defined as follows:

I = the emission inventory (gram/year)
N = engine population (units)
P = average rated power (kW)
L = load factor (average fraction of rated power used during operation; unitless)
A = engine activity (operating hours/year)
EF = emission factor (gram/kW-hr)

Emissions are then converted and reported as short tons/year.

The average rated power, load factor, and activity inputs remain constant in any given simulation year. However, populations and emission factors vary by year and age. Populations for a given base calendar year are first calculated, along with the corresponding age distribution, and then projected from that base year into the future. For most of the commercial marine diesel categories, the base year is 2002. The pollutant emission factors vary by age to account for the current and proposed regulations, as well as emissions deterioration. PM emission factors also have an additional adjustment to account for the in-use fuel sulfur level, which is described in more detail below.

Three variables are used to project emissions over time: the annual population growth rate, the engine median life/scrappage, and the relative deterioration rate. Collectively, these variables represent population growth, changes in the population age distribution, and emission deterioration.

Annual Population Growth Rate (percent/year). The population growth rate represents the percentage increase in the total calendar year engine population from year (n) to year (n+1). It is a compound growth rate. These growth rates vary by category.

Engine Median Life (years) and Scrappage. The engine median life defines the length of time engines remain in service. Engines persist in the population over two median lives; during the first median life, 50 percent of the engines are scrapped, and over the second, the remaining 50 percent of the engines are scrapped. Engine median lives also vary by category. The age distribution is defined by the median life and the scrappage algorithm. For commercial marine diesel engines, the scrappage algorithm in the NONROAD model was used for all categories.[1]

Relative Deterioration Rate (percent increase in emission factor/percent median life expended). A deterioration factor can be applied to the emission factor to account for in-use deterioration. The deterioration factor varies by age and is calculated as:

Equation 2 $$DF = 1 + A*(age/ML)$$

where each term is defined as follows:
DF = the deterioration factor for a given pollutant at a given age
A = the relative deterioration rate for a given pollutant (percent increase in emission factor/percent useful life expended)
age = the age of a specific model year group of engines in the simulation year (years)
ML = the median life of the given model year cohort (years)

A given model year cohort is represented as a fraction of the entire population. The deterioration factor adjusts the emission factor for engines in a given model year cohort in relation to the proportion of median life expended. Deterioration is linear over one median life. Following the first median life, the deteriorated emission factor is held constant over the remaining life for engines in the cohort. This is consistent with the diesel deterioration applied in the NONROAD model.[2]

Sulfur Adjustment for PM Emissions. For Tier 2 and prior engines, a sulfate adjustment is added to the PM emissions to account for differences in fuel sulfur content between the certification fuel and the episodic (calendar year) fuel, using the following equation:

Equation 3 $$S_{PM\ adj} = FC * 7.1 * 0.02247 * 224/32 * (soxdsl - soxbas) * 1/2000$$

where each term is defined as follows:
$S_{PM\ adj}$ = PM sulfate adjustment (tons)
FC = fuel consumption (gallons)
7.1 = fuel density (lb/gal)
0.02247 = fraction of fuel sulfur converted to sulfate
224/32 = grams PM sulfate/grams PM sulfur
soxdsl = episodic fuel sulfur weight fraction (varies by calendar year)
soxbas = certification fuel sulfur weight fraction
2000 = conversion from lb to ton

For Tier 3 and later engines, no sulfur adjustment is applied. These engines will be certified to a fuel sulfur level at or lower than the episodic fuel sulfur levels expected when these engines are introduced.

Estimation of fuel consumption. Annual fuel consumption is estimated using the following equation:

Equation 4 $$FC = (BSFC * N * P * L * A)/(7.1 * 454)$$

where each term is defined as follows:
FC = fuel consumption (gallons)
BSFC = brake specific fuel consumption (g/kW-hr)
N = engine population (units)
P = average rated power (kW)
L = load factor (average fraction of rated power used during operation; unitless)
A = engine activity (operating hours/year)
7.1 = fuel density (lb/gal)
454 = conversion from lb to g

Estimation of SO_2 emissions. Annual SO_2 inventories are estimated using the following equation:

Equation 5 $$SO_2 = FC * 7.1 * (1-0.02247) * 64/32 * soxdsl * 1/2000$$

where each term is defined as follows:
SO_2 = sulfur dioxide inventory (tons)
FC = fuel consumption (gallons)
7.1 = fuel density (lb/gal)
(1-0.02247) = fraction of fuel sulfur converted to SO_2
64/32 = grams SO_2/grams sulfur
soxdsl = episodic fuel sulfur weight fraction (varies by calendar year)
2000 = conversion from lb to ton

The calendar year fuel sulfur levels (soxdsl) were taken from the Clean Air Nonroad Diesel Rule.[4]

Estimation of VOC and $PM_{2.5}$ emissions. To estimate VOC emissions, an adjustment factor of 1.053 is applied to the HC output. Similarly, to estimate $PM_{2.5}$ emissions, an adjustment factor of 0.97 is applied to the PM_{10} output. These adjustment factors are consistent with those used in the NONROAD model[3,2] and the Clean Air Nonroad Diesel Rule.[4]

Estimation of air toxic emissions. The air toxic baseline emission inventories for this proposal are based on information developed for EPA's Mobile Source Air Toxics (MSAT) final rulemaking.[5] That rule calculated air toxic emission inventories for all nonroad engines. The gaseous air toxics are correlated to VOC emissions, while POM is correlated to PM_{10} emissions. To calculate the air toxics emission inventories and reductions for this proposal, the percent reductions in VOC and PM_{10} emissions will be applied to the baseline gaseous and POM air toxic inventories, respectively.

3.1.2 Baseline (Pre-Control) Inventory Development

This section describes the inputs and provides the resulting baseline inventories for commercial marine engines.

3.1.2.1 Category 1 Propulsion

The inventory inputs of base year population, average power, load factor, and activity for Category 1 commercial propulsion engines are given in Table 0-1 and Table 0-2. These inventory inputs are used to develop both baseline and control inventories. As a result, there are displacement, power density, and kilowatt subcategories, which are required to model both the current and proposed standards in this rule.

The current emission standards vary only by displacement (disp) category, which is expressed as liters per cylinder (L/cyl). There are four displacement categories for Category 1 engines: 1) less than 0.9 L/cyl (and power greater than or equal to 37kW), 2) greater than or equal to 0.9 L/cyl and less than 1.2 L/cyl, 3) greater than or equal to 1.2 L/cyl and less than 2.5 L/cyl, and 4) greater than or equal to 2.5 L/cyl and less than 5 L/cyl. For simplification, these will be referred to as 1) disp <0.9, 2) 0.9≤ disp <1.2, 3) 1.2≤ disp <2.5, and 4) 2.5≤ disp <5.

In order to model the proposed Tier 3 standards, the 2.5≤ disp <5 category is further broken out into 2.5≤ disp <3.5 and 3.5≤ disp <5 categories. The Tier 3 standards also have cut points at 75kW and 3700kW, so it was necessary to break out the disp<0.9 category into 37<kW≤75 and >75kW categories. Since there are no Category 1 engines greater than 3700kW, this cut point was not necessary to include. Finally, there are different Tier 3 standards for standard power density and high power density engines. Standard power density engines are less than 35 kW per liter (kW/L), and the high power density engines are greater than or equal to 35 kW/L. The inputs for the standard power density engines are given in Table 0-1 and the inputs for the high power density engines in Table 0-2.

The proposed Tier 4 standards that apply to Category 1 engines vary by the following kW categories: <600kW, 600≤kW<1000, 1000≤kW<1400, 1400≤kW<3700, and ≥3700kW. As a result, these power categories were also added, with the exception of the ≥3700kW category, since there are no Category 1 engines in this power range.

The base year populations by displacement category are generated using historical sales estimates in conjunction with the scrappage algorithm described above. Other inventory inputs that affect scrappage are load factor, activity, and median life. The historical sales estimates for calendar years 1973-2002 were obtained from Power Systems Research (PSR). These populations by displacement category were further broken out into power density and kilowatt categories using the 2002 population and engine data from PSR.

The average power estimates were population-weighted, using the 2002 engine and population data from PSR. The load factor and activity estimates were 0.45 and 943 hours per year, respectively for engines <560 kW (750 hp). These are the estimates for commercial marine propulsion engines provided by PSR. For engines >560 kW, the load factor and activity estimates used were 0.79 and 4,503 hours per year. These latter estimates were taken from the 1999 Marine Diesel FRM.[6] Higher load factors and activities were assigned to these larger engines based on information provided by the manufacturers for the previous rule, and supported by more recent discussions with the American Waterways Operators about how these larger engines typically operate.[7] This power break point is not related to the kW categories in the proposed standards.

Load factors for each subcategory were developed by first identifying the engines in the PSR population dataset corresponding to each subcategory. Load factors for each engine in a subcategory were assigned based on the criteria above. An average load factor for each subcategory was then obtained by weighting the individual engine load factors by population and power. A similar approach was followed to obtain activity estimates for each subcategory, with the exception that the weightings were population, power, and load factor. The average power, load factors and activities needed to be estimated using these weightings to ensure that the total inventory from this source category is correctly calculated.

The median life for all C1 propulsion engines used is 13 years, which is the estimate provided by PSR. The annual population growth rate is 1.009, which is the estimate from the Energy and Information Administration (EIA) for domestic shipping.[8]

Table 0-1 Inventory Inputs for C1 Propulsion Standard Power Density Engines

DISPLACEMENT CATEGORY	<35 W/L								TOTAL POPULATION
	<=600KW				600<KW≤1000				
	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	
DISP<0.9 AND 37<KW<=75	1,665	43	0.45	943	0				1,665
DISP<0.9 AND >75KW	1,102	154	0.45	943	0				1,102
0.9<=DISP<1.2	19,255	128	0.45	943	0				19,255
1.2<=DISP<2.5	23,561	294	0.51	1,905	795	781	0.79	4,503	24,356
2.5<=DISP<3.5	5,898	397	0.45	943	675	832	0.79	4,503	6,573
3.5<=DISP<5.0	205	404	0.45	943	308	748	0.79	4,503	513
TOTAL	51,687				1,777				53,464

DISPLACEMENT CATEGORY	<35 KW/L								TOTAL POPULATION
	1000<KW≤1400KW				>1400KW*				
	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	
DISP<0.9 AND 37<KW<=75	0				0				0
DISP<0.9 AND >75KW	0				0				0
0.9<=DISP<1.2	0				0				0
1.2<=DISP<2.5	1,013	1,065	0.79	4,503	0				1,013
2.5<=DISP<3.5	186	1,194	0.79	4,503	0				186
3.5<=DISP<5.0	212	1,119	0.79	4,503	1,264	1,492	0.79	4,503	1,476
TOTAL	1,411				1,264				2,675

Grand Total 53,098 3,041 56,139

* No populations ≥3700KW

Table 0-2 Inventory Inputs for C1 Propulsion High Power Density Engines

DISPLACEMENT CATEGORY	≥35 KW/L								TOTAL POPULATION
	<=600KW				600<KW≤1000				
	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	
DISP<0.9 AND 37<KW<=75	0				0				0
DISP<0.9 AND >75KW	3,151	165	0.45	943	0				3,151
0.9<=DISP<1.2	21	313	0.45	943	0				21
1.2<=DISP<2.5	1,338	341	0.45	943	102	678	0.79	4,503	1,440
2.5<=DISP<3.5	0				0				0
3.5<=DISP<5.0	0				0				0
TOTAL	4,510				102				4,612

DISPLACEMENT CATEGORY	≥35 KW/L								TOTAL POPULATION
	1000<KW≤1400KW				>1400KW*				
	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	
DISP<0.9 AND 37<KW<=75	0				0				0
DISP<0.9 AND >75KW	0				0				0
0.9<=DISP<1.2	0				0				0
1.2<=DISP<2.5	0				0				0
2.5<=DISP<3.5	0				0				0
3.5<=DISP<5.0	214	1,176	0.79	4,503	361	1,765	0.79	4,503	575
TOTAL	214				361				575

Grand Total	4,724	463	5,187

* No populations ≥3700KW

The baseline emission factors are given in Table 0-3 and Table 0-4. The emission factors are provided for three technology types: Base, Tier 1, and Tier 2. The base technology type includes all pre-control engines. Tier 1 refers to the first round of existing standards for NO_x only that begin in 2000. Tier 2 refers to the second round of existing standards for $HC+NO_x$ and PM that began in 2004 to 2007, depending on the displacement category.

Table 0-3 Baseline PM_{10} and NO_x Emission Factors for C1 Propulsion Engines*

DISPLACEMENT CATEGORY	PM_{10} G/KW-HR			NO_X G/KW-HR		
	BASE	TIER 1	TIER 2	BASE	TIER 1	TIER 2
DISP<0.9	0.54	0.54	0.23	10	9.8	5.7
0.9<=DISP<1.2	0.47	0.47	0.12	10	9.8	6.1
1.2<=DISP<2.5	0.34	0.34	0.13	10	9.8	6.0
2.5<=DISP<3.5	0.30	0.30	0.13	10	9.1	6.0
3.5<=DISP<5.0	0.30	0.30	0.13	11	9.2	6.0

* Deterioration is applied to the PM emission factors (EFs); see text for details. The NO_x EFs are not subject to deterioration.

Table 0-4 Baseline HC and CO Emission Factors for C1 Propulsion Engines*

DISPLACEMENT CATEGORY	HC G/KW-HR			CO G/KW-HR		
	BASE	TIER 1	TIER 2	BASE	TIER 1	TIER 2
DISP<0.9	0.41	0.41	0.41	1.6	1.6	1.6
0.9<=DISP<1.2	0.32	0.32	0.32	1.6	1.6	0.9
1.2<=DISP<2.5	0.27	0.27	0.19	1.6	1.6	1.1
2.5<=DISP<3.5	0.27	0.27	0.19	1.6	1.6	1.1
3.5<=DISP<5.0	0.27	0.27	0.19	1.8	1.8	1.1

* The HC and CO emission factors (EFs) are not subject to deterioration.

The base emission factors were taken from the 1999 Marine Diesel rulemaking, and are based on emission data for uncontrolled engines.[6] For Tier 1, the NO_x emission factors were estimated using 2006 certification data. The certification data for engines using the E3 cycle[b] were sales-weighted to obtain Tier 1 NO_x emission factors for each displacement category. Since the Tier 1 standards only affect NO_x, the Tier 1 emission factors for the other pollutants are equal to the base

[b] The E3 duty cycle is designated for propulsion marine diesel engines.

emission factors. For Tier 2, the same 2006 certification data were used to estimate PM, NO_x, and HC emission factors.

For C1 engines, PM is the only pollutant for which deterioration factors are applied. The relative deterioration rate (A) is 0.473, which is used for both pre-control and all regulatory tiers. As a result, the maximum PM deterioration factor is 1.473. This is consistent with the diesel deterioration assumed in the NONROAD model.[2]

The certification fuel sulfur levels, which are used to estimate the PM sulfate adjustments, are 3300ppm for the Base (pre-control) technology type, and 350ppm for Tier 1 and Tier 2. The Base level was taken from the NONROAD model.[2] The Tier 1 and Tier 2 levels were estimated from reviewing the marine certification data and fuel requirements.

For calculating fuel consumption, estimates of brake specific fuel consumption (BSFC) are also required. For this analysis, a value of 213 g/kW-hr was used. This value is consistent with published estimates of BSFC and those for heavy-duty diesel engines.[9]

The resulting baseline 50-state emission inventories for Category 1 propulsion engines are given in Table 0-5.

Table 0-5 Baseline (50-State) Emissions for C1 Propulsion Engines (short tons)

YEAR	PM_{10}	$PM_{2.5}$	NO_X	VOC	HC	CO	SO_2
2002	13,328	12,928	335,561	9,488	9,010	55,303	36,201
2003	13,690	13,279	336,369	9,573	9,091	55,801	36,528
2004	13,807	13,393	332,798	9,561	9,080	55,722	36,862
2005	13,873	13,457	328,810	9,550	9,069	55,582	37,192
2006	13,872	13,456	324,900	9,540	9,060	55,450	36,827
2007	12,230	11,863	316,663	9,415	8,941	54,423	19,121
2008	10,961	10,632	308,524	9,291	8,824	53,405	6,299
2009	10,710	10,388	300,509	9,170	8,708	52,401	6,355
2010	10,304	9,995	292,651	9,051	8,595	51,414	4,705
2011	9,916	9,619	284,979	8,934	8,484	50,445	3,513
2012	9,471	9,187	277,551	8,821	8,377	49,497	1,862
2013	9,003	8,733	270,764	8,711	8,273	48,574	664
2014	8,587	8,330	264,634	8,606	8,173	47,680	799
2015	8,155	7,910	258,879	8,507	8,079	46,827	857
2016	7,718	7,487	253,538	8,415	7,992	46,023	865
2017	7,346	7,126	249,327	8,347	7,927	45,368	872
2018	7,058	6,846	246,339	8,304	7,886	44,879	879
2019	6,805	6,601	243,964	8,272	7,855	44,482	886
2020	6,632	6,433	242,764	8,269	7,852	44,301	893
2021	6,538	6,342	242,677	8,293	7,876	44,329	900
2022	6,470	6,276	242,990	8,326	7,907	44,423	907
2023	6,422	6,229	243,640	8,367	7,946	44,571	915
2024	6,388	6,197	244,563	8,414	7,990	44,760	923
2025	6,368	6,177	245,736	8,466	8,040	44,987	931
2026	6,359	6,168	247,141	8,523	8,094	45,248	939
2027	6,363	6,173	248,720	8,584	8,152	45,539	946
2028	6,381	6,190	250,474	8,649	8,214	45,861	954
2029	6,410	6,218	252,384	8,719	8,280	46,209	962
2030	6,451	6,258	254,450	8,792	8,349	46,583	970
2031	6,499	6,304	256,608	8,868	8,421	46,975	978
2032	6,552	6,356	258,851	8,946	8,495	47,385	986
2033	6,611	6,413	261,181	9,026	8,572	47,811	995
2034	6,671	6,471	263,532	9,107	8,649	48,241	1,006
2035	6,731	6,529	265,903	9,189	8,727	48,675	1,015
2036	6,791	6,588	268,297	9,272	8,805	49,114	1,023
2037	6,852	6,647	270,711	9,356	8,885	49,556	1,032
2038	6,914	6,707	273,148	9,440	8,965	50,002	1,040
2039	6,976	6,767	275,606	9,525	9,045	50,452	1,050
2040	7,039	6,828	278,086	9,610	9,127	50,906	1,059

3.1.2.2 Category 1 Auxiliary

The methodology and data sources for Category 1 marine auxiliary engines are essentially the same as those for Category 1 propulsion engines. For this source category, however, the PSR data for marine auxiliary engines and the certification data with the D2 auxiliary cycle[c] were used instead. The inventory inputs of base year population, average power, load factor, and activity for C1 auxiliary engines are given in Table 0-6 and Table 0-7. The baseline emission factors are given in Table 0-8 and Table 0-9.

For auxiliary engines, the load factor and activity estimates are 0.56 and 724 hours per year, respectively, for engines <560kW. These are the estimates for auxiliary marine engines provided by PSR. For engines >560kW, the load factor and activity estimates used are 0.65 and 2,500 hours per year, taken from the 1999 FRM.[6] The cut point of 560kW is that used for propulsion engines.

The median life for all C1 auxiliary engines is 17 years, which is the estimate provided by PSR. Estimates for the annual growth rate, PM deterioration factor, certification fuel sulfur levels, and BSFC are assumed to be the same as those for C1 propulsion engines.

The resulting baseline 50-state emission inventories for Category 1 auxiliary engines are given in Table 0-10.

[c] The D2 steady-state duty cycle is designated for constant-speed engines.

Table 0-6 Inventory Inputs for C1 Auxiliary Standard Power Density Engines

DISPLACEMENT CATEGORY	<35 KW/L								TOTAL POPULATION
	<=600KW				600<KW≤1000				
	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	
DISP<0.9 AND 37<KW<=75	9,786	44	0.56	724	0				9,786
DISP<0.9 AND >75KW	1,251	83	0.56	724	0				1,251
0.9<=DISP<1.2	11,933	109	0.56	724	0				11,933
1.2<=DISP<2.5	14,119	324	0.57	925	512	741	0.65	2,500	14,631
2.5<=DISP<3.5	785	332	0.56	724	74	882	0.65	2,500	859
3.5<=DISP<5.0	347	356	0.56	724	408	746	0.65	2,500	755
TOTAL	38,221				994				39,215

DISPLACEMENT CATEGORY	<35 KW/L								TOTAL POPULATION
	1000<KW≤1400				>1400KW*				
	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	
DISP<0.9 AND 37<KW<=75	0				0				0
DISP<0.9 AND >75KW	0				0				0
0.9<=DISP<1.2	0				0				0
1.2<=DISP<2.5	0				0				0
2.5<=DISP<3.5	14	1,194	0.65	2,500	0				14
3.5<=DISP<5.0	268	1,119	0.65	2,500	96	1,527	0.65	2,500	364
TOTAL	282				96				378

Grand Total	38,503	1,090	39,593

* No populations ≥3700KW

Table 0-7 Inventory Inputs for C1 Auxiliary High Power Density Engines

DISPLACEMENT CATEGORY	≥35 KW/L								TOTAL POPULATION
	<=600KW				600<KW≤1000				
	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	
DISP<0.9 AND 37<KW<=75	215	75	0.56	724	0				215
DISP<0.9 AND >75KW	218	141	0.56	724	0				218
0.9<=DISP<1.2	0				0				0
1.2<=DISP<2.5	0				0				0
2.5<=DISP<3.5	0				0				0
3.5<=DISP<5.0	0				0				0
TOTAL	433				0				433

DISPLACEMENT CATEGORY	≥35 KW/L								TOTAL POPULATION
	1000<KW≤1400				>1400KW*				
	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	2002 POPULATION	AVG KW	LOAD FACTOR	ACTIVITY, HOURS	
DISP<0.9 AND 37<KW<=75	0				0				0
DISP<0.9 AND >75KW	0				0				0
0.9<=DISP<1.2	11	1,231	0.65	2,500	0				11
1.2<=DISP<2.5	0				39	1,531	0.65	2,500	39
2.5<=DISP<3.5	0				0				0
3.5<=DISP<5.0	0				0				0
TOTAL	11				39				50

Grand Total 444 39 483

* No populations ≥3700KW

Table 0-8 Baseline PM_{10} and NO_x Emission Factors for C1 Auxiliary Engines*

DISPLACEMENT CATEGORY	PM_{10} G/KW-HR			NO_X G/KW-HR		
	BASE	TIER 1	TIER 2	BASE	TIER 1	TIER 2
DISP<0.9	0.84	0.84	0.23	11	9.8	5.7
0.9<=DISP<1.2	0.53	0.53	0.21	10	9.8	5.4
1.2<=DISP<2.5	0.34	0.34	0.15	10	9.8	6.1
2.5<=DISP<3.5	0.32	0.32	0.15	10	9.1	6.1
3.5<=DISP<5.0	0.30	0.30	0.15	11	9.2	6.1

* Deterioration is applied to the PM emission factors (EFs); see text for details. The NO_x EFs are not subject to deterioration.

Table 0-9 Baseline HC and CO Emission Factors for C1 Auxiliary Engines*

DISPLACEMENT CATEGORY	HC G/KW-HR			CO G/KW-HR		
	BASE	TIER 1	TIER 2	BASE	TIER 1	TIER 2
DISP<0.9	0.41	0.41	0.41	2.0	2.0	1.6
0.9<=DISP<1.2	0.32	0.32	0.32	1.7	1.7	0.8
1.2<=DISP<2.5	0.27	0.27	0.21	1.5	1.5	0.9
2.5<=DISP<3.5	0.27	0.27	0.21	1.5	1.5	0.9
3.5<=DISP<5.0	0.27	0.27	0.21	1.8	1.8	0.9

* The HC and CO emission factors (EFs) are not subject to deterioration.

Table 0-10 Baseline (50-State) Emissions for C1 Auxiliary Engines (short tons)

YEAR	PM_{10}	$PM_{2.5}$	NO_X	VOC	HC	CO	SO_2
2002	2,714	2,632	60,641	1,767	1,678	9,624	6,553
2003	2,773	2,690	60,959	1,783	1,693	9,710	6,613
2004	2,791	2,708	60,482	1,785	1,696	9,668	6,673
2005	2,786	2,703	59,774	1,788	1,698	9,585	6,733
2006	2,769	2,686	59,073	1,791	1,700	9,503	6,667
2007	2,482	2,407	58,048	1,787	1,697	9,331	3,461
2008	2,263	2,195	57,030	1,783	1,693	9,160	1,140
2009	2,230	2,163	56,020	1,779	1,690	8,989	1,150
2010	2,170	2,105	55,022	1,776	1,686	8,820	852
2011	2,115	2,052	54,038	1,773	1,684	8,654	636
2012	2,052	1,990	53,069	1,770	1,681	8,489	337
2013	1,993	1,933	52,118	1,767	1,678	8,327	120
2014	1,952	1,893	51,185	1,765	1,676	8,167	145
2015	1,907	1,850	50,277	1,763	1,674	8,010	155
2016	1,860	1,805	49,399	1,761	1,673	7,857	157
2017	1,806	1,752	48,589	1,760	1,672	7,708	158
2018	1,746	1,693	47,849	1,759	1,671	7,563	159
2019	1,685	1,634	47,160	1,759	1,671	7,426	160
2020	1,625	1,576	46,531	1,760	1,672	7,298	162
2021	1,576	1,528	46,079	1,764	1,675	7,198	163
2022	1,543	1,497	45,840	1,771	1,681	7,134	164
2023	1,520	1,474	45,706	1,778	1,689	7,088	166
2024	1,504	1,459	45,683	1,788	1,698	7,066	167
2025	1,495	1,451	45,756	1,799	1,709	7,067	169
2026	1,489	1,445	45,875	1,811	1,720	7,077	170
2027	1,486	1,441	46,035	1,824	1,732	7,094	171
2028	1,484	1,440	46,228	1,837	1,745	7,117	173
2029	1,484	1,440	46,452	1,851	1,758	7,145	174
2030	1,486	1,441	46,703	1,865	1,771	7,178	176
2031	1,489	1,444	46,980	1,880	1,785	7,215	177
2032	1,493	1,448	47,283	1,895	1,800	7,257	179
2033	1,499	1,454	47,611	1,911	1,815	7,303	180
2034	1,506	1,461	47,962	1,927	1,830	7,353	182
2035	1,514	1,469	48,332	1,943	1,845	7,407	184
2036	1,524	1,478	48,721	1,960	1,861	7,464	185
2037	1,535	1,489	49,126	1,977	1,878	7,524	187
2038	1,547	1,501	49,553	1,995	1,894	7,588	188
2039	1,561	1,514	49,991	2,013	1,911	7,654	190
2040	1,574	1,527	50,436	2,031	1,928	7,721	192

3.1.2.3 Category 2 Propulsion

The methodology used for C2 propulsion engines is the same as that used for C1 propulsion engines, as described in section 3.1.1. However, the engine population, average rated power, load factor and engine activity terms shown in Equation 1 of that section were consolidated into a single term for total kW-hr/year for all C2 vessels.[10] The total kW-hr value for C2 propulsion engines in 2002 was estimated at 30,246,809,539 kW-hr. The total kW-hr value was then allocated to the necessary displacement and horsepower categories, using the PSR engine data.

The median life for all C2 propulsion engines is 23 years.[11] The emission factors used for all C2 propulsion engines are largely those we used for the original commercial marine rulemaking analysis.[6] The one exception to this is for Tier 1 NOx, which was updated based on an analysis of 2006 certification data. The C2 emission factors are shown in Table 0-11. Estimates for the annual growth rate, PM deterioration factor, and certification fuel sulfur levels are assumed to be the same as those for C1 propulsion engines.

Table 0-11 Baseline Emission Factors for C2 Engines (g/kW-hr)*

Tier	PM_{10}	NO_x	HC	CO
BASE	0.32	13.36	0.134	2.48
TIER 1	0.32	10.55	0.134	2.48
TIER 2	0.32	8.33	0.134	2.00

* Deterioration is applied to the PM emission factors (EFs); see text for details. The NOx, HC and CO EFs are not subject to deterioration.

The resulting baseline 50-state emission inventories for Category 2 propulsion engines are given in Table 0-12.

Table 0-12 Baseline (50-State) Emissions for C2 Propulsion Engines (short tons)

YEAR	PM_{10}	$PM_{2.5}$	NO_X	VOC	HC	CO	SO_2
2002	12,850	12,464	432,306	4,701	4,464	82,621	36,868
2003	13,112	12,719	431,973	4,743	4,504	83,364	37,193
2004	13,376	12,975	431,683	4,786	4,545	84,115	37,528
2005	13,641	13,232	431,417	4,829	4,586	84,872	37,866
2006	13,907	13,490	431,195	4,872	4,627	85,635	38,207
2007	14,174	13,748	427,380	4,916	4,669	85,621	38,550
2008	14,436	14,003	423,601	4,960	4,711	85,611	38,837
2009	14,706	14,264	419,857	5,005	4,753	85,605	39,204
2010	14,975	14,525	416,169	5,050	4,796	85,609	39,559
2011	15,245	14,787	412,537	5,096	4,839	85,621	39,920
2012	15,515	15,050	408,943	5,141	4,883	85,639	40,278
2013	15,727	15,255	405,428	5,188	4,927	85,665	39,905
2014	14,475	14,041	401,970	5,234	4,971	85,701	21,334
2015	13,635	13,226	398,593	5,281	5,016	85,746	7,888
2016	13,883	13,466	395,295	5,329	5,061	85,800	7,958
2017	13,986	13,566	392,101	5,377	5,106	85,864	6,238
2018	14,127	13,703	388,988	5,425	5,152	85,937	4,998
2019	14,228	13,801	386,000	5,474	5,199	86,020	3,277
2020	14,365	13,934	383,155	5,523	5,245	86,116	2,031
2021	14,613	14,175	380,458	5,573	5,293	86,222	2,185
2022	14,850	14,405	377,990	5,623	5,340	86,341	2,258
2023	15,059	14,607	376,313	5,674	5,388	86,475	2,279
2024	15,243	14,786	375,430	5,725	5,437	86,626	2,299
2025	15,423	14,960	374,784	5,777	5,486	86,790	2,319
2026	15,599	15,131	374,343	5,829	5,535	86,974	2,339
2027	15,772	15,299	374,086	5,881	5,585	87,178	2,359
2028	15,943	15,465	374,039	5,934	5,635	87,406	2,379
2029	16,114	15,630	374,219	5,987	5,686	87,672	2,399
2030	16,283	15,794	375,126	6,041	5,737	88,078	2,421
2031	16,451	15,957	376,727	6,096	5,789	88,623	2,442
2032	16,618	16,120	378,567	6,150	5,841	89,207	2,463
2033	16,786	16,282	380,573	6,206	5,893	89,820	2,485
2034	16,952	16,444	382,749	6,262	5,946	90,457	2,507
2035	17,119	16,605	385,076	6,318	6,000	91,119	2,529
2036	17,286	16,767	387,519	6,375	6,054	91,799	2,551
2037	17,453	16,929	390,097	6,432	6,108	92,500	2,573
2038	17,620	17,091	392,794	6,490	6,163	93,219	2,595
2039	17,787	17,253	395,609	6,549	6,219	93,956	2,618
2040	17,954	17,416	398,527	6,607	6,275	94,707	2,641

3.1.2.4 Under 37 kW Propulsion and Auxiliary

Category 1 commercial marine engines are defined as being greater than or equal to (≥) 37kW and less than (<) 5.0 liters/cylinder; however, there are commercial marine engines <37kW. The majority of these small power engines are used as auxiliary engines, although there are some propulsion engines that fall into this category. Commercial marine engines <37kW are covered under this proposal; therefore, inventories have been estimated.

Emissions were estimated using a special version of the NONROAD2005 model, with Source Classification Codes (SCCs) and associated inputs added for both the commercial and auxiliary engines. An SCC of 2280002030 was assigned to the <37kW propulsion engines, with an SCC of 2280002040 assigned to the <37kW auxiliary engines.

The inventory inputs of base year population, average power, load factor, activity, and median life are given in Table 0-13 below. These inputs were generated using the same methodology and data sources as the C1 propulsion and C1 auxiliary categories. Horsepower (hp) is used as the unit for power in the NONROAD model, so the inputs for power and emission factors are hp and g/hp-hr, respectively. The 2002 base year populations are assigned to one or more of the following hp categories in NONROAD: 0-11, 11-16, 16-25, 25-40, and 40-50. The propulsion engines all fall within the 25-40hp category, whereas there are auxiliary engines in each hp category. The average power values in the table below are population-weighted estimates.

Table 0-13 Inventory Inputs for <37kW Commercial Marine Diesel Engines

INPUTS	PROPULSION	AUXILIARY
2002 POPULATION	1,232	67,708
AVG HP	34.8	24.9
LOAD FACTOR	0.45	0.56
ACTIVITY, HOURS	943	724
MEDIAN LIFE, YEARS	13	17

The baseline emission factors are given in Table 0-14 and Table 0-15. These engines are subject to EPA nonroad diesel regulations that have established two tiers of emission standards.[12] Tier 1 phased in from 1999-2000, depending on the horsepower category, with Tier 2 phased in from 2004-2005. The "Base" entries in the tables refer to emissions from pre-controlled engines. These emission factors are used for both propulsion and auxiliary engines.

Table 0-14 Baseline PM_{10} and NO_x Emission Factors and Deterioration Factors for <37kW Commercial Marine Diesel Engines

HP RANGE	PM_{10} G/HP-HR			NO_X G/HP-HR		
	BASE	TIER 1	TIER 2	BASE	TIER 1	TIER 2
0-11	1.00	0.45	0.38	10.00	5.23	4.39
11-16	0.90	0.27	0.19	8.50	4.44	3.63
16-25	0.90	0.27	0.19	8.50	4.44	3.63
25-50	0.80	0.34	0.23	6.90	4.73	3.71
DF ("A")	0.473	0.473	0.473	0.024	0.024	0.009

Table 0-15 Baseline HC and CO Emission Factors and Deterioration Factors for <37kW Commercial Marine Diesel Engines

HP RANGE	HC G/HP-HR			CO G/HP-HR		
	BASE	TIER 1	TIER 2	BASE	TIER 1	TIER 2
0-11	1.50	0.76	0.68	5.00	4.11	4.11
11-16	1.70	0.44	0.21	5.00	2.16	2.16
16-25	1.70	0.44	0.21	5.00	2.16	2.16
25-50	1.80	0.28	0.54	5.00	1.53	1.53
DF ("A")	0.047	0.036	0.034	0.185	0.101	0.101

The emission factors for the base and Tier 1 technology types are consistent with those used in the NONROAD model.[2] Tier 2 emission factors were estimated using nonroad engine certification data. The deterioration factors by pollutant and technology type are also given in the tables above. The deterioration factors are those used for diesel engines in the NONROAD model.[2]

The certification fuel sulfur levels are 3300ppm for the base and Tier 1 technology type and 350ppm for Tier 2. Brake specific fuel consumption (BSFC) values were taken from the NONROAD model and are 0.408 lb/hp-hr for all hp categories.[2] The annual population growth rate is 1.009, which is the growth rate used for all commercial diesel engines.

The resulting baseline 50-state emission inventories for <37kW commercial marine engines (propulsion and auxiliary combined) are given in Table 0-16.

Table 0-16 Baseline (50-State) Emissions for <37kW Commercial Marine Engines (short tons)

YEAR	PM_{10}	$PM_{2.5}$	NO_X	VOC	HC	CO	SO_2
2002	728	706	5,517	1,273	1,209	3,783	731
2003	710	689	5,448	1,222	1,161	3,680	738
2004	692	671	5,350	1,179	1,120	3,576	745
2005	671	651	5,229	1,128	1,071	3,460	752
2006	648	629	5,101	1,075	1,021	3,339	745
2007	596	578	4,973	1,022	970	3,216	387
2008	551	534	4,846	969	920	3,093	128
2009	526	511	4,719	916	870	2,970	129
2010	499	484	4,594	864	821	2,846	95
2011	472	458	4,472	813	772	2,724	71
2012	444	431	4,351	763	725	2,603	38
2013	417	404	4,234	715	679	2,484	14
2014	392	381	4,120	668	634	2,369	16
2015	368	357	4,011	624	592	2,259	18
2016	348	337	3,917	588	559	2,170	18
2017	332	322	3,846	564	535	2,109	18
2018	320	311	3,790	546	518	2,063	18
2019	310	301	3,744	531	504	2,027	18
2020	301	292	3,704	519	493	1,997	18
2021	294	285	3,675	507	482	1,972	18
2022	288	279	3,659	497	472	1,952	18
2023	284	275	3,654	491	466	1,940	19
2024	280	272	3,654	485	461	1,932	19
2025	278	269	3,658	481	457	1,926	19
2026	276	268	3,670	479	455	1,926	19
2027	275	267	3,685	478	454	1,929	19
2028	275	267	3,703	478	454	1,934	19
2029	275	267	3,723	478	454	1,942	20
2030	275	267	3,746	479	455	1,952	20
2031	276	268	3,771	481	457	1,963	20
2032	278	269	3,798	484	460	1,977	20
2033	279	271	3,828	488	463	1,992	20
2034	282	273	3,859	492	467	2,009	21
2035	284	275	3,891	496	471	2,026	21
2036	286	278	3,924	500	475	2,044	21
2037	289	280	3,958	504	479	2,061	21
2038	291	282	3,992	509	483	2,079	21
2039	294	285	4,026	513	487	2,097	21
2040	296	287	4,061	517	491	2,115	22

3.1.2.5 Commercial Marine Diesel Baseline Inventory Summary

3.1.2.5.1 PM_{10}, $PM_{2.5}$, NO_x, VOC, CO, and SO_2 Emissions

Table 0-17 thru Table 0-22 present the resulting 50-state consolidated commercial marine baseline inventories by pollutant and category, for calendar years 2002-2040.

3.1.2.5.2 Air Toxics Emissions

The baseline air toxics inventories for the consolidated commercial marine diesel engines were taken from the Mobile Source Air Toxics Rule (MSAT)[5] and are provided in Table 0-23. Inventories are provided for calendar years 1999, 2010, 2015, 2020, and 2030.

Table 0-17 Baseline (50-State) PM_{10} Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	13,328	2,714	16,041	12,850	728	29,619
2003	13,690	2,773	16,463	13,112	710	30,285
2004	13,807	2,791	16,598	13,376	692	30,666
2005	13,873	2,786	16,659	13,641	671	30,972
2006	13,872	2,769	16,641	13,907	648	31,196
2007	12,230	2,482	14,712	14,174	596	29,481
2008	10,961	2,263	13,224	14,436	551	28,211
2009	10,710	2,230	12,940	14,706	526	28,172
2010	10,304	2,170	12,474	14,975	499	27,948
2011	9,916	2,115	12,031	15,245	472	27,748
2012	9,471	2,052	11,522	15,515	444	27,482
2013	9,003	1,993	10,996	15,727	417	27,140
2014	8,587	1,952	10,539	14,475	392	25,406
2015	8,155	1,907	10,062	13,635	368	24,066
2016	7,718	1,860	9,579	13,883	348	23,809
2017	7,346	1,806	9,152	13,986	332	23,470
2018	7,058	1,746	8,804	14,127	320	23,250
2019	6,805	1,685	8,490	14,228	310	23,028
2020	6,632	1,625	8,257	14,365	301	22,923
2021	6,538	1,576	8,114	14,613	294	23,021
2022	6,470	1,543	8,013	14,850	288	23,151
2023	6,422	1,520	7,942	15,059	284	23,284
2024	6,388	1,504	7,893	15,243	280	23,416
2025	6,368	1,495	7,864	15,423	278	23,564
2026	6,359	1,489	7,849	15,599	276	23,724
2027	6,363	1,486	7,849	15,772	275	23,897
2028	6,381	1,484	7,865	15,943	275	24,083
2029	6,410	1,484	7,895	16,114	275	24,283
2030	6,451	1,486	7,937	16,283	275	24,495
2031	6,499	1,489	7,988	16,451	276	24,715
2032	6,552	1,493	8,045	16,618	278	24,941
2033	6,611	1,499	8,110	16,786	279	25,175
2034	6,671	1,506	8,177	16,952	282	25,411
2035	6,731	1,514	8,245	17,119	284	25,648
2036	6,791	1,524	8,315	17,286	286	25,887
2037	6,852	1,535	8,387	17,453	289	26,129
2038	6,914	1,547	8,461	17,620	291	26,372
2039	6,976	1,561	8,537	17,787	294	26,617
2040	7,039	1,574	8,613	17,954	296	26,864

Table 0-18 Baseline (50-State) $PM_{2.5}$ Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	12,928	2,632	15,560	12,464	706	28,730
2003	13,279	2,690	15,969	12,719	689	29,377
2004	13,393	2,708	16,100	12,975	671	29,746
2005	13,457	2,703	16,159	13,232	651	30,042
2006	13,456	2,686	16,142	13,490	629	30,260
2007	11,863	2,407	14,270	13,748	578	28,596
2008	10,632	2,195	12,827	14,003	534	27,364
2009	10,388	2,163	12,552	14,264	511	27,327
2010	9,995	2,105	12,100	14,525	484	27,109
2011	9,619	2,052	11,670	14,787	458	26,916
2012	9,187	1,990	11,177	15,050	431	26,657
2013	8,733	1,933	10,666	15,255	404	26,326
2014	8,330	1,893	10,223	14,041	381	24,644
2015	7,910	1,850	9,760	13,226	357	23,344
2016	7,487	1,805	9,291	13,466	337	23,095
2017	7,126	1,752	8,878	13,566	322	22,766
2018	6,846	1,693	8,539	13,703	311	22,553
2019	6,601	1,634	8,235	13,801	301	22,337
2020	6,433	1,576	8,009	13,934	292	22,236
2021	6,342	1,528	7,871	14,175	285	22,330
2022	6,276	1,497	7,773	14,405	279	22,457
2023	6,229	1,474	7,703	14,607	275	22,585
2024	6,197	1,459	7,656	14,786	272	22,714
2025	6,177	1,451	7,628	14,960	269	22,857
2026	6,168	1,445	7,613	15,131	268	23,012
2027	6,173	1,441	7,614	15,299	267	23,180
2028	6,190	1,440	7,629	15,465	267	23,361
2029	6,218	1,440	7,658	15,630	267	23,555
2030	6,258	1,441	7,699	15,794	267	23,760
2031	6,304	1,444	7,748	15,957	268	23,973
2032	6,356	1,448	7,804	16,120	269	24,193
2033	6,413	1,454	7,867	16,282	271	24,420
2034	6,471	1,461	7,932	16,444	273	24,648
2035	6,529	1,469	7,998	16,605	275	24,879
2036	6,588	1,478	8,066	16,767	278	25,111
2037	6,647	1,489	8,136	16,929	280	25,345
2038	6,707	1,501	8,207	17,091	282	25,581
2039	6,767	1,514	8,281	17,253	285	25,819
2040	6,828	1,527	8,355	17,416	287	26,058

Table 0-19 Baseline (50-State) NO_x Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	335,561	60,641	396,202	432,306	5,517	834,025
2003	336,369	60,959	397,328	431,973	5,448	834,749
2004	332,798	60,482	393,280	431,683	5,350	830,313
2005	328,810	59,774	388,583	431,417	5,229	825,229
2006	324,900	59,073	383,973	431,195	5,101	820,269
2007	316,663	58,048	374,710	427,380	4,973	807,063
2008	308,524	57,030	365,554	423,601	4,846	794,001
2009	300,509	56,020	356,529	419,857	4,719	781,105
2010	292,651	55,022	347,673	416,169	4,594	768,436
2011	284,979	54,038	339,017	412,537	4,472	756,026
2012	277,551	53,069	330,621	408,943	4,351	743,915
2013	270,764	52,118	322,882	405,428	4,234	732,544
2014	264,634	51,185	315,819	401,970	4,120	721,910
2015	258,879	50,277	309,156	398,593	4,011	711,760
2016	253,538	49,399	302,937	395,295	3,917	702,150
2017	249,327	48,589	297,916	392,101	3,846	693,862
2018	246,339	47,849	294,188	388,988	3,790	686,966
2019	243,964	47,160	291,123	386,000	3,744	680,867
2020	242,764	46,531	289,295	383,155	3,704	676,154
2021	242,677	46,079	288,756	380,458	3,675	672,889
2022	242,990	45,840	288,831	377,990	3,659	670,480
2023	243,640	45,706	289,346	376,313	3,654	669,313
2024	244,563	45,683	290,245	375,430	3,654	669,329
2025	245,736	45,756	291,492	374,784	3,658	669,934
2026	247,141	45,875	293,016	374,343	3,670	671,029
2027	248,720	46,035	294,755	374,086	3,685	672,525
2028	250,474	46,228	296,703	374,039	3,703	674,445
2029	252,384	46,452	298,836	374,219	3,723	676,778
2030	254,450	46,703	301,153	375,126	3,746	680,025
2031	256,608	46,980	303,588	376,727	3,771	684,087
2032	258,851	47,283	306,134	378,567	3,798	688,500
2033	261,181	47,611	308,792	380,573	3,828	693,193
2034	263,532	47,962	311,494	382,749	3,859	698,103
2035	265,903	48,332	314,236	385,076	3,891	703,203
2036	268,297	48,721	317,017	387,519	3,924	708,460
2037	270,711	49,126	319,838	390,097	3,958	713,892
2038	273,148	49,553	322,701	392,794	3,992	719,486
2039	275,606	49,991	325,597	395,609	4,026	725,233
2040	278,086	50,436	328,522	398,527	4,061	731,111

Table 0-20 Baseline (50-State) VOC Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	9,488	1,767	11,255	4,701	1,273	17,229
2003	9,573	1,783	11,356	4,743	1,222	17,321
2004	9,561	1,785	11,346	4,786	1,179	17,311
2005	9,550	1,788	11,338	4,829	1,128	17,295
2006	9,540	1,791	11,331	4,872	1,075	17,278
2007	9,415	1,787	11,202	4,916	1,022	17,140
2008	9,291	1,783	11,074	4,960	969	17,003
2009	9,170	1,779	10,949	5,005	916	16,870
2010	9,051	1,776	10,826	5,050	864	16,741
2011	8,934	1,773	10,707	5,096	813	16,615
2012	8,821	1,770	10,591	5,141	763	16,495
2013	8,711	1,767	10,479	5,188	715	16,381
2014	8,606	1,765	10,371	5,234	668	16,273
2015	8,507	1,763	10,270	5,281	624	16,175
2016	8,415	1,761	10,176	5,329	588	16,094
2017	8,347	1,760	10,107	5,377	564	16,048
2018	8,304	1,759	10,063	5,425	546	16,034
2019	8,272	1,759	10,031	5,474	531	16,036
2020	8,269	1,760	10,029	5,523	519	16,071
2021	8,293	1,764	10,057	5,573	507	16,137
2022	8,326	1,771	10,097	5,623	497	16,218
2023	8,367	1,778	10,145	5,674	491	16,310
2024	8,414	1,788	10,202	5,725	485	16,412
2025	8,466	1,799	10,265	5,777	481	16,523
2026	8,523	1,811	10,334	5,829	479	16,642
2027	8,584	1,824	10,408	5,881	478	16,767
2028	8,649	1,837	10,487	5,934	478	16,898
2029	8,719	1,851	10,570	5,987	478	17,035
2030	8,792	1,865	10,657	6,041	479	17,178
2031	8,868	1,880	10,748	6,096	481	17,325
2032	8,946	1,895	10,841	6,150	484	17,476
2033	9,026	1,911	10,937	6,206	488	17,631
2034	9,107	1,927	11,034	6,262	492	17,788
2035	9,189	1,943	11,133	6,318	496	17,947
2036	9,272	1,960	11,232	6,375	500	18,107
2037	9,356	1,977	11,333	6,432	504	18,269
2038	9,440	1,995	11,435	6,490	509	18,433
2039	9,525	2,013	11,537	6,549	513	18,599
2040	9,610	2,031	11,641	6,607	517	18,766

Table 0-21 Baseline (50-State) CO Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	55,303	9,624	64,927	82,621	3,783	151,331
2003	55,801	9,710	65,511	83,364	3,680	152,556
2004	55,722	9,668	65,390	84,115	3,576	153,080
2005	55,582	9,585	65,167	84,872	3,460	153,499
2006	55,450	9,503	64,954	85,635	3,339	153,928
2007	54,423	9,331	63,754	85,621	3,216	152,591
2008	53,405	9,160	62,565	85,611	3,093	151,269
2009	52,401	8,989	61,391	85,605	2,970	149,966
2010	51,414	8,820	60,235	85,609	2,846	148,690
2011	50,445	8,654	59,099	85,621	2,724	147,444
2012	49,497	8,489	57,986	85,639	2,603	146,227
2013	48,574	8,327	56,901	85,665	2,484	145,050
2014	47,680	8,167	55,847	85,701	2,369	143,917
2015	46,827	8,010	54,837	85,746	2,259	142,842
2016	46,023	7,857	53,880	85,800	2,170	141,851
2017	45,368	7,708	53,076	85,864	2,109	141,049
2018	44,879	7,563	52,443	85,937	2,063	140,443
2019	44,482	7,426	51,908	86,020	2,027	139,954
2020	44,301	7,298	51,599	86,116	1,997	139,712
2021	44,329	7,198	51,527	86,222	1,972	139,720
2022	44,423	7,134	51,557	86,341	1,952	139,851
2023	44,571	7,088	51,659	86,475	1,940	140,073
2024	44,760	7,066	51,827	86,626	1,932	140,384
2025	44,987	7,067	52,054	86,790	1,926	140,771
2026	45,248	7,077	52,325	86,974	1,926	141,226
2027	45,539	7,094	52,633	87,178	1,929	141,740
2028	45,861	7,117	52,978	87,406	1,934	142,318
2029	46,209	7,145	53,354	87,672	1,942	142,968
2030	46,583	7,178	53,761	88,078	1,952	143,791
2031	46,975	7,215	54,191	88,623	1,963	144,776
2032	47,385	7,257	54,642	89,207	1,977	145,825
2033	47,811	7,303	55,114	89,820	1,992	146,926
2034	48,241	7,353	55,595	90,457	2,009	148,060
2035	48,675	7,407	56,082	91,119	2,026	149,227
2036	49,114	7,464	56,577	91,799	2,044	150,419
2037	49,556	7,524	57,079	92,500	2,061	151,640
2038	50,002	7,588	57,589	93,219	2,079	152,887
2039	50,452	7,654	58,105	93,956	2,097	154,158
2040	50,906	7,721	58,627	94,707	2,115	155,449

Table 0-22 Baseline (50-State) SO_2 Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	36,201	6,553	42,754	36,868	731	80,353
2003	36,528	6,613	43,141	37,193	738	81,073
2004	36,862	6,673	43,535	37,528	745	81,808
2005	37,192	6,733	43,925	37,866	752	82,543
2006	36,827	6,667	43,493	38,207	745	82,445
2007	19,121	3,461	22,583	38,550	387	61,520
2008	6,299	1,140	7,440	38,837	128	46,404
2009	6,355	1,150	7,506	39,204	129	46,838
2010	4,705	852	5,557	39,559	95	45,212
2011	3,513	636	4,148	39,920	71	44,139
2012	1,862	337	2,199	40,278	38	42,515
2013	664	120	784	39,905	14	40,702
2014	799	145	943	21,334	16	22,293
2015	857	155	1,012	7,888	18	8,917
2016	865	157	1,021	7,958	18	8,997
2017	872	158	1,030	6,238	18	7,286
2018	879	159	1,038	4,998	18	6,054
2019	886	160	1,046	3,277	18	4,342
2020	893	162	1,055	2,031	18	3,104
2021	900	163	1,063	2,185	18	3,267
2022	907	164	1,072	2,258	18	3,348
2023	915	166	1,081	2,279	19	3,378
2024	923	167	1,090	2,299	19	3,408
2025	931	169	1,099	2,319	19	3,437
2026	939	170	1,109	2,339	19	3,466
2027	946	171	1,118	2,359	19	3,496
2028	954	173	1,127	2,379	19	3,526
2029	962	174	1,136	2,399	20	3,555
2030	970	176	1,146	2,421	20	3,586
2031	978	177	1,155	2,442	20	3,617
2032	986	179	1,165	2,463	20	3,649
2033	995	180	1,175	2,485	20	3,680
2034	1,006	182	1,188	2,507	21	3,716
2035	1,015	184	1,198	2,529	21	3,748
2036	1,023	185	1,208	2,551	21	3,780
2037	1,032	187	1,218	2,573	21	3,812
2038	1,040	188	1,228	2,595	21	3,845
2039	1,050	190	1,240	2,618	21	3,880
2040	1,059	192	1,251	2,641	22	3,913

Table 0-23 Air Toxics Emissions for Commercial Marine Diesel Engines (short tons)

HAP	1999	2010	2015	2020	2030
BENZENE	530	556	559	572	624
FORMALDEHYDE	3,897	4,091	4,112	4,208	4,587
ACETALDEHYDE	1,937	2,033	2,044	2,091	2,280
1,3-BUTADIENE	6	6	6	6	7
ACROLEIN	75	79	79	81	89
NAPHTHALENE	43	39	37	36	40
POM	11	10	9	9	10

3.1.3 Control Inventory Development

This section describes how the controlled emission inventories were developed for the commercial marine diesel categories: Category 1 propulsion, Category 1 auxiliary, Category 2 propulsion, and less than (<) 37kW. This section will only describe the modifications to the emission factors, since the other inventory inputs are unchanged.

3.1.3.1 Control Scenario(s) Modeled

For commercial marine diesel engines, there are two tiers of proposed PM and either combined $HC+NO_x$ or NO_x only standards for the control scenario that was modeled.

The proposed emission standards for Category 1 engines are summarized in Table 0-24 and Table 0-25. These standards apply to both propulsion and auxiliary engines. There are separate emission standards for standard and high power density engines. Standard power density engines are less than 35 kW per liter (kW/L), and the high power density engines are greater than or equal to 35 kW/L. Within these power density categories, there are also separate standards that vary by power and displacement. There are no Tier 4 standards for engines less than 600 kW. Standards are not shown in cases where there is zero engine population.

The proposed emission standards for Category 2 engines are summarized in Table 0-26. The standards vary by displacement and power. All Category 2 engines are considered to be standard power density engines. These engines are subject to both Tier 3 and Tier 4 emission standards.

The proposed emission standards for <37kW propulsion and auxiliary engines are given in Table 0-27. This category is subject to Tier 3 standards which begin in 2009.

Table 0-24 Proposed Standards (g/kW-hr) for C1 Standard Power Density Engines

DISPLACEMENT CATEGORY	<35 KW/L											
	<=600KW						600<KW≤1000					
		TIER 3			TIER 4			TIER 3			TIER 4	
	YEAR	NO_X	PM	YEAR	NO_X	PM	YEAR	NO_X	PM	YEAR	NO_X	PM
DISP<0.9 AND 37<KW<=75	2009	7.5	0.30	NO TIER 4 STANDARDS			NO ENGINES IN THESE CATEGORIES					
	2014	4.7										
DISP<0.9 AND >75KW	2012	5.4	0.13									
0.9<=DISP<1.2	2013	5.4	0.12									
1.2<=DISP<2.5	2014	5.6	0.11				2014	5.6	0.11	2018	1.7	0.04
	2018		0.09									
2.5<=DISP<3.5	2013	5.6	0.11				2013	5.6	0.11	2018	1.7	0.04
	2018		0.09									
3.5<=DISP<5.0	2012	5.8	0.11				2012	5.8	0.11	2018	1.7	0.04
	2018		0.09									

DISPLACEMENT CATEGORY	<35 KW/L											
	1000<KW≤1400						>1400KW					
		TIER 3			TIER 4			TIER 3			TIER 4	
	YEAR	NO_X	PM	YEAR	NO_X	PM	YEAR	NO_X	PM	YEAR	NO_X	PM
DISP<0.9 AND 37<KW<=75	NO ENGINES IN THESE CATEGORIES						NO ENGINES IN THESE CATEGORIES					
DISP<0.9 AND >75KW												
0.9<=DISP<1.2												
1.2<=DISP<2.5	2014	5.6	0.11	2017	1.7	0.04						
2.5<=DISP<3.5	2013	5.6	0.11	2017	1.7	0.04						
3.5<=DISP<5.0	2012	5.8	0.11	2017	1.7	0.04	2012	5.8	0.11	2016	1.7	0.04

Table 0-25 Proposed Standards (g/kW-hr) for C1 High Power Density Engines

DISPLACEMENT CATEGORY	≥35 KW/L											
	<=600KW						600<KW≤1000					
		TIER 3			TIER 4			TIER 3			TIER 4	
	YEAR	NO_X	PM	YEAR	NO_X	PM	YEAR	NO_X	PM	YEAR	NO_X	PM
DISP<0.9 AND 37<KW<=75	2009	7.5	0.30	NO TIER 4 STANDARDS			NO ENGINES IN THESE CATEGORIES					
	2014	4.7										
DISP<0.9 AND >75KW	2012	5.8	0.15									
0.9<=DISP<1.2	2013	5.8	0.13									
1.2<=DISP<2.5	2014	5.8	0.12				2014	5.6	0.11	2018	1.7	0.04
2.5<=DISP<3.5	NO ENGINES						NO ENGINES IN THESE CATEGORIES					
3.5<=DISP<5.0												

DISPLACEMENT CATEGORY	≥35 KW/L											
	1000<KW≤1400						>1400KW					
		TIER 3			TIER 4			TIER 3			TIER 4	
	YEAR	NO_X	PM	YEAR	NO_X	PM	YEAR	NO_X	PM	YEAR	NO_X	PM
DISP<0.9 AND 37<KW<=75	NO ENGINES IN THESE CATEGORIES						NO ENGINES IN THESE CATEGORIES					
DISP<0.9 AND >75KW												
0.9<=DISP<1.2	2013	5.4	0.12	2017	1.7	0.04						
1.2<=DISP<2.5	NO ENGINES IN THESE CATEGORIES						2014	5.6	0.11	2016	1.7	0.04
2.5<=DISP<3.5							NO ENGINES IN THIS CATEGORY					
3.5<=DISP<5.0	2012	5.8	0.11	2017	1.7	0.04	2012	5.8	0.11	2016	1.7	0.04

Table 0-26 Proposed Standards (g/kW-hr) for C2 Engines

DISPLACEMENT CATEGORY	YEAR	TIER 3		YEAR	TIER 4	
		NO_X+HC	PM		NO_X	PM
5.0<=DISP<15 AND <600KW	2013	6.2	0.13			
5.0<=DISP<15 AND 600≤KW<1000	2013	6.2	0.13	2018	1.7	0.04
5.0<=DISP<15 AND 1000≤KW<1400	2013	6.2	0.13	2017	1.7	0.04
5.0<=DISP<15 AND 1400≤KW<3700	2013	6.2	0.13	2016	1.7	0.04
5.0<=DISP<15 AND ≥3700KW				2014	1.7	0.12
				2017		0.05
15.0<=DISP<20.0 AND <1400KW	NO ENGINES IN THIS CATEGORY					
15.0<=DISP<20.0 AND 1400≤KW<3300	2014	7.0	0.34	2016	1.7	0.04
15.0<=DISP<20.0 AND 3300≤KW<3700	NO ENGINES IN THIS CATEGORY					
15.0<=DISP<20.0 AND ≥3700KW				2014	1.7	0.25
				2017		0.05
20.0<=DISP<30.0	NO ENGINES IN THIS CATEGORY					

Table 0-27 Proposed Standards (g/hp-hr) for <37kW Commercial Marine Diesel Engines

HP RANGE	YEAR	TIER 3	
		NO_X+HC	PM
0-25	2009	5.6	0.30
25-50	2009	5.6	0.22
	2014	3.5	0.22

3.1.3.2 Category 1 Propulsion

The modeled Tier 3 and Tier 4 emission factors corresponding to the emission standards are shown in Table 0-28 and Table 0-29. These emission factors are derived by applying the appropriate relative reductions from the Tier 2 standard to the Tier 2 emission factors, using the following equations:

Equation 3 Tier 3 EF = (Tier 3 std/Tier 2 std) x Tier 2 EF

Equation 4 Tier 4 EF = (Tier 4 std/Tier 2 std) x Tier 2 EF

For NO_x, the standards used in the above equations are the combined HC+NO_x standards. For HC and PM, the PM standards are used.

The resulting control case 50-state emission inventories for Category 1 propulsion engines are given in Table 0-30.

3.1.3.3 Category 1 Auxiliary

The modeled Tier 3 and Tier 4 emission factors for Category 1 auxiliary engines are shown in Table 0-31 and Table 0-32. The methodology described above for Category 1 propulsion engines was used to derive these emission factors.

The resulting control case 50-state emission inventories for Category 1 auxiliary engines are given in Table 0-33.

Table 0-28 Control PM_{10}, NOx, and HC Emission Factors (g/kW-hr) for C1 Propulsion Standard Power Density Engines

DISPLACEMENT CATEGORY	<35 KW/L											
	<=600KW				600<KW≤1000							
	YEAR	TIER 3			YEAR	TIER 3			YEAR	TIER 4		
		HC	NO_X	PM		HC	NO_X	PM		HC	NO_X	PM
DISP<0.9 AND 37<KW<=75	2009	0.30	5.70	0.17	NO ENGINES IN THESE CATEGORIES							
	2014		3.56									
DISP<0.9 AND >75KW	2012	0.14	4.08	0.08								
0.9<=DISP<1.2	2013	0.13	4.54	0.05								
1.2<=DISP<2.5	2014	0.10	4.69	0.07	2014	0.10	4.69	0.07	2018	0.04	1.30	0.03
	2018			0.061								
2.5<=DISP<3.5	2013	0.10	4.69	0.07	2013	0.10	4.69	0.07	2018	0.04	1.30	0.03
	2018			0.061								
3.5<=DISP<5.0	2012	0.10	4.81	0.07	2012	0.10	4.81	0.07	2018	0.04	1.30	0.03
	2018			0.061								

DISPLACEMENT CATEGORY	<35 KW/L															
	1000<KW≤1400								>1400KW							
	YEAR	TIER 3			YEAR	TIER 4			YEAR	TIER 3			YEAR	TIER 4		
		HC	NO_X	PM		HC	NO_X	PM		HC	NO_X	PM		HC	NO_X	PM
DISP<0.9 AND 37<KW<=75	NO ENGINES IN THESE CATEGORIES								NO ENGINES IN THESE CATEGORIES							
DISP<0.9 AND >75KW																
0.9<=DISP<1.2																
1.2<=DISP<2.5	2014	0.10	4.69	0.07	2017	0.04	1.3	0.03								
2.5<=DISP<3.5	2013	0.10	4.69	0.07	2017	0.04	1.3	0.03								
3.5<=DISP<5.0	2012	0.10	4.81	0.07	2017	0.04	1.3	0.03	2012	0.10	4.81	0.07	2016	0.04	1.3	0.03

Table 0-29 Control PM_{10}, NOx, and HC Emission Factors (g/kW-hr) for C1 Propulsion High Power Density Engines

DISPLACEMENT CATEGORY	≥35 KW/L											
	<=600KW				600<KW≤1000							
	YEAR	TIER 3			YEAR	TIER 3			YEAR	TIER 4		
		HC	NO_X	PM		HC	NO_X	PM		HC	NO_X	PM
DISP<0.9 AND 37<KW<=75	NO ENGINES				NO ENGINES IN THESE CATEGORIES							
DISP<0.9 AND >75KW	2012	0.15	4.38	0.08								
0.9<=DISP<1.2	2013	0.14	4.89	0.05								
1.2<=DISP<2.5	2014	0.11	4.81	0.08	2014	0.10	4.69	0.07	2018	0.04	1.3	0.03
2.5<=DISP<3.5	NO ENGINES				NO ENGINES IN THESE CATEGORIES							
3.5<=DISP<5.0												

DISPLACEMENT CATEGORY	≥35 KW/L															
	1000<KW≤1400								>1400KW							
	YEAR	TIER 3			YEAR	TIER 4			YEAR	TIER 3			YEAR	TIER 4		
		HC	NO_X	PM		HC	NO_X	PM		HC	NO_X	PM		HC	NO_X	PM
DISP<0.9 AND 37<KW<=75	NO ENGINES IN THESE CATEGORIES								NO ENGINES IN THESE CATEGORIES							
DISP<0.9 AND >75KW																
0.9<=DISP<1.2																
1.2<=DISP<2.5																
2.5<=DISP<3.5																
3.5<=DISP<5.0	2012	0.10	4.81	0.07	2017	0.04	1.3	0.03	2012	0.10	4.81	0.07	2016	0.04	1.3	0.03

Table 0-30 Control Case (50-State) Emissions for C1 Propulsion Engines (short tons)

YEAR	PM_{10}	$PM_{2.5}$	NO_X	VOC	HC	CO	SO_2
2002	13,328	12,928	335,561	9,488	9,010	55,303	36,201
2003	13,690	13,279	336,369	9,573	9,091	55,801	36,528
2004	13,807	13,393	332,798	9,561	9,080	55,722	36,862
2005	13,873	13,457	328,810	9,550	9,069	55,582	37,192
2006	13,872	13,456	324,900	9,540	9,060	55,450	36,827
2007	12,230	11,863	316,663	9,415	8,941	54,423	19,121
2008	10,961	10,632	308,524	9,291	8,824	53,405	6,299
2009	10,709	10,388	300,509	9,169	8,708	52,401	6,355
2010	10,304	9,995	292,651	9,050	8,594	51,414	4,705
2011	9,916	9,618	284,979	8,933	8,483	50,445	3,513
2012	9,409	9,127	276,209	8,708	8,270	49,497	1,862
2013	8,859	8,593	267,453	8,433	8,008	48,574	664
2014	8,291	8,042	257,691	8,042	7,637	47,680	799
2015	7,700	7,469	248,317	7,658	7,273	46,827	857
2016	7,065	6,853	236,292	7,228	6,864	46,023	865
2017	6,463	6,269	223,265	6,784	6,443	45,368	872
2018	5,911	5,734	209,717	6,334	6,015	44,879	879
2019	5,388	5,226	196,847	5,898	5,601	44,482	886
2020	4,938	4,790	185,242	5,496	5,219	44,301	893
2021	4,562	4,425	174,843	5,126	4,868	44,329	900
2022	4,208	4,082	164,971	4,772	4,532	44,423	907
2023	3,873	3,756	155,589	4,433	4,210	44,571	915
2024	3,552	3,446	146,696	4,111	3,904	44,760	923
2025	3,263	3,165	138,521	3,826	3,634	44,987	931
2026	3,013	2,923	131,195	3,589	3,408	45,248	939
2027	2,808	2,724	124,763	3,400	3,229	45,539	946
2028	2,644	2,565	119,185	3,252	3,089	45,861	954
2029	2,512	2,436	114,708	3,134	2,976	46,209	962
2030	2,417	2,344	111,660	3,049	2,896	46,583	970
2031	2,352	2,282	109,766	2,991	2,841	46,975	978
2032	2,310	2,241	108,624	2,953	2,804	47,385	986
2033	2,284	2,215	107,896	2,927	2,780	47,811	995
2034	2,265	2,197	107,443	2,911	2,764	48,241	1,006
2035	2,254	2,186	107,233	2,902	2,756	48,675	1,015
2036	2,248	2,181	107,236	2,901	2,755	49,114	1,023
2037	2,250	2,182	107,444	2,906	2,760	49,556	1,032
2038	2,256	2,189	107,834	2,919	2,772	50,002	1,040
2039	2,268	2,200	108,376	2,936	2,788	50,452	1,050
2040	2,282	2,214	109,054	2,957	2,808	50,906	1,059

Table 0-31 Control PM_{10}, NOx, and HC Emission Factors (g/kW-hr) for C1 Auxiliary Standard Power Density Engines

DISPLACEMENT CATEGORY	<35 KW/L											
	≤600KW				600<KW≤1000							
		TIER 3				TIER 3				TIER 4		
	YEAR	HC	NO_X	PM	YEAR	HC	NO_X	PM	YEAR	HC	NO_X	PM
DISP<0.9 AND 37<KW<=75	2009	0.30	5.70	0.17	NO ENGINES IN THESE CATEGORIES							
	2014		3.56									
DISP<0.9 AND >75KW	2012	0.14	4.08	0.08								
0.9<=DISP<1.2	2013	0.13	4.02	0.08								
1.2<=DISP<2.5	2014	0.11	4.77	0.08	2014	0.11	4.77	0.08	2018	0.04	1.3	0.03
	2018			0.070								
2.5<=DISP<3.5	2013	0.11	4.77	0.08	2013	0.11	4.77	0.08	2018	0.04	1.3	0.03
	2018			0.070								
3.5<=DISP<5.0	2012	0.11	4.89	0.08	2012	0.11	4.89	0.08	2018	0.04	1.3	0.03
	2018			0.070								

DISPLACEMENT CATEGORY	<35 KW/L															
	1000<KW≤1400								>1400KW							
	YEAR	TIER 3			YEAR	TIER 4			YEAR	TIER 3			YEAR	TIER 4		
		HC	NO_X	PM		HC	NO_X	PM		HC	NO_X	PM		HC	NO_X	PM
DISP<0.9 AND 37<KW<=75	NO ENGINES IN THESE CATEGORIES								NO ENGINES IN THESE CATEGORIES							
DISP<0.9 AND >75KW																
0.9<=DISP<1.2																
1.2<=DISP<2.5																
2.5<=DISP<3.5	2013	0.11	4.77	0.08	2017	0.04	1.3	0.03								
3.5<=DISP<5.0	2012	0.11	4.89	0.08	2017	0.04	1.3	0.03	2012	0.11	4.89	0.08	2016	0.04	1.3	0.03

Table 0-32 Control PM_{10}, NOx, and HC Emission Factors (g/kW-hr) for C1 Auxiliary High Power Density Engines

DISPLACEMENT CATEGORY	≥35 KW/L											
	≤600KW				600<KW≤1000							
	YEAR	TIER 3			YEAR	TIER 3			YEAR	TIER 4		
		HC	NO_X	PM		HC	NO_X	PM		HC	NO_X	PM
DISP<0.9 AND 37<KW<=75	2009	0.30	5.70	0.17	NO ENGINES IN THESE CATEGORIES							
	2014		3.56									
DISP<0.9 AND >75KW	2012	0.15	4.38	0.08								
0.9<=DISP<1.2	NO ENGINES IN THESE CATEGORIES											
1.2<=DISP<2.5												
2.5<=DISP<3.5												
3.5<=DISP<5.0												

DISPLACEMENT CATEGORY	≥35 KW/L															
	1000<KW≤1400								>1400KW							
	YEAR	TIER 3			YEAR	TIER 4			YEAR	TIER 3			YEAR	TIER 4		
		HC	NO_X	PM		HC	NO_X	PM		HC	NO_X	PM		HC	NO_X	PM
DISP<0.9 AND 37<KW<=75	NO ENGINES IN THESE CATEGORIES								NO ENGINES IN THESE CATEGORIES							
DISP<0.9 AND >75KW																
0.9<=DISP<1.2	2013	0.13	4.02	0.08	2017	0.04	1.3	0.03								
1.2<=DISP<2.5	NO ENGINES IN THESE CATEGORIES								2014	0.11	4.77	0.08	2016	0.04	1.3	0.03
2.5<=DISP<3.5									NO ENGINES IN THESE CATEGORIES							
3.5<=DISP<5.0																

Table 0-33 Control Case (50-State) Emissions for C1 Auxiliary Engines (short tons)

YEAR	PM_{10}	$PM_{2.5}$	NO_X	VOC	HC	CO	SO_2
2002	2,714	2,632	60,641	1,767	1,678	9,624	6,553
2003	2,773	2,690	60,959	1,783	1,693	9,710	6,613
2004	2,791	2,708	60,482	1,785	1,696	9,668	6,673
2005	2,786	2,703	59,774	1,788	1,698	9,585	6,733
2006	2,769	2,686	59,073	1,791	1,700	9,503	6,667
2007	2,482	2,407	58,048	1,787	1,697	9,331	3,461
2008	2,263	2,195	57,030	1,783	1,693	9,160	1,140
2009	2,229	2,162	56,020	1,778	1,688	8,989	1,150
2010	2,169	2,104	55,022	1,773	1,684	8,820	852
2011	2,113	2,049	54,038	1,768	1,679	8,654	636
2012	2,042	1,981	52,949	1,753	1,664	8,489	337
2013	1,971	1,912	51,796	1,727	1,640	8,327	120
2014	1,902	1,845	50,317	1,677	1,593	8,167	145
2015	1,829	1,774	48,863	1,628	1,546	8,010	155
2016	1,751	1,698	47,349	1,577	1,497	7,857	157
2017	1,663	1,613	45,754	1,523	1,446	7,708	158
2018	1,561	1,514	43,895	1,463	1,389	7,563	159
2019	1,458	1,414	42,089	1,403	1,333	7,426	160
2020	1,354	1,314	40,347	1,345	1,278	7,298	162
2021	1,261	1,224	38,787	1,290	1,225	7,198	163
2022	1,184	1,149	37,444	1,239	1,176	7,134	164
2023	1,116	1,082	36,210	1,188	1,129	7,088	166
2024	1,054	1,022	35,096	1,141	1,083	7,066	167
2025	998	968	34,089	1,095	1,040	7,067	169
2026	945	917	33,138	1,052	999	7,077	170
2027	895	868	32,243	1,010	959	7,094	171
2028	847	822	31,399	970	921	7,117	173
2029	803	779	30,630	935	888	7,145	174
2030	764	741	29,948	905	859	7,178	176
2031	733	711	29,388	882	838	7,215	177
2032	708	687	28,939	866	823	7,257	179
2033	687	667	28,572	853	810	7,303	180
2034	669	649	28,303	843	801	7,353	182
2035	656	637	28,159	836	794	7,407	184
2036	647	628	28,117	832	790	7,464	185
2037	641	622	28,123	830	788	7,524	187
2038	637	618	28,176	829	787	7,588	188
2039	635	616	28,259	829	788	7,654	190
2040	635	616	28,367	831	789	7,721	192

3.1.3.4 Category 2 Propulsion

The modeled Tier 3 and Tier 4 emission factors for Category 2 propulsion engines are shown in Table 0-34. The methodology described above for Category 1 propulsion engines was used to derive these emission factors.

The resulting control case 50-state emission inventories for Category 2 propulsion engines are given in Table 0-35.

Table 0-34 Control PM_{10}, NOx, and HC Emission Factors (g/kW-hr) for C2 Engines

DISPLACEMENT CATEGORY	YEAR	TIER 3			YEAR	TIER 4		
		HC	NO_X	PM		HC	NO_X	PM
5.0<=DISP<15 AND <600KW	2013	0.07	5.97	0.11				
5.0<=DISP<15 AND 600≤KW<1000	2013	0.07	5.97	0.11	2018	0.02	1.3	0.03
5.0<=DISP<15 AND 1000≤KW<1400	2013	0.07	5.97	0.11	2017	0.02	1.3	0.03
5.0<=DISP<15 AND 1400≤KW<3700	2013	0.07	5.97	0.11	2016	0.02	1.3	0.03
5.0<=DISP<15 AND ≥3700KW					2014	0.06	1.3	0.10
					2017	0.03	1.3	0.04
15.0<=DISP<20.0 AND 1400≤KW<3300	2014	0.09	6.77	0.30	2016	0.01	1.3	0.04
15.0<=DISP<20.0 AND >3700KW					2014	0.07	1.3	0.23
					2017	0.01	1.3	0.05

Table 0-35 Control Case (50-State) Emissions for C2 Propulsion Engines

YEAR	PM_{10}	$PM_{2.5}$	NO_X	VOC	HC	CO	SO_2
2002	12,850	12,464	432,306	4,701	4,464	82,621	36,868
2003	13,112	12,719	431,973	4,743	4,504	83,364	37,193
2004	13,376	12,975	431,683	4,786	4,545	84,115	37,528
2005	13,641	13,232	431,417	4,829	4,586	84,872	37,866
2006	13,907	13,490	431,195	4,872	4,627	85,635	38,207
2007	14,174	13,748	427,380	4,916	4,669	85,621	38,550
2008	14,436	14,003	423,601	4,960	4,711	85,611	38,837
2009	14,706	14,264	419,857	5,005	4,753	85,605	39,204
2010	14,975	14,525	416,169	5,050	4,796	85,609	39,559
2011	15,245	14,787	412,537	5,096	4,839	85,621	39,920
2012	15,515	15,050	408,943	5,141	4,883	85,639	40,278
2013	15,569	15,102	404,127	5,150	4,891	85,665	39,905
2014	14,031	13,610	392,503	5,082	4,826	85,701	21,334
2015	12,996	12,606	380,939	5,014	4,761	85,746	7,888
2016	12,865	12,479	365,582	4,896	4,650	85,800	7,817
2017	12,482	12,107	350,179	4,729	4,491	85,864	5,901
2018	12,130	11,766	334,823	4,563	4,333	85,937	4,574
2019	11,748	11,396	319,586	4,396	4,175	86,020	2,963
2020	11,394	11,052	304,523	4,230	4,017	86,116	1,888
2021	11,108	10,775	289,618	4,066	3,861	86,222	1,976
2022	10,804	10,480	274,971	3,901	3,705	86,341	1,995
2023	10,465	10,151	261,143	3,738	3,550	86,475	1,975
2024	10,094	9,791	248,136	3,576	3,396	86,626	1,954
2025	9,710	9,419	235,393	3,415	3,243	86,790	1,934
2026	9,315	9,035	222,855	3,254	3,090	86,974	1,913
2027	8,909	8,641	210,526	3,094	2,938	87,178	1,894
2028	8,493	8,238	198,433	2,935	2,787	87,406	1,874
2029	8,071	7,829	186,645	2,777	2,637	87,672	1,855
2030	7,644	7,414	175,655	2,622	2,490	88,078	1,836
2031	7,211	6,995	165,474	2,468	2,344	88,623	1,818
2032	6,776	6,573	155,629	2,317	2,200	89,207	1,800
2033	6,342	6,152	146,134	2,169	2,060	89,820	1,783
2034	5,909	5,732	136,983	2,025	1,923	90,457	1,766
2035	5,482	5,318	128,247	1,885	1,790	91,119	1,750
2036	5,089	4,936	120,169	1,757	1,669	91,799	1,735
2037	4,756	4,613	113,689	1,651	1,568	92,500	1,721
2038	4,466	4,332	108,659	1,562	1,484	93,219	1,709
2039	4,220	4,093	104,710	1,488	1,413	93,956	1,700
2040	4,039	3,918	101,729	1,434	1,362	94,707	1,699

3.1.3.5 Less than 37 kW Propulsion and Auxiliary

The modeled Tier 3 emission factors for less than (<) 37kW commercial marine diesel engines are given in Table 0-36. These emission factors apply to both propulsion and auxiliary engines. For HC, the methodology described for Category 1 propulsion engines was used. For PM, a 20 percent compliance margin was applied to the Tier 3 standard; however, if the resulting emission factor was greater than the corresponding Tier 2 emission factor, the Tier 2 value was used for Tier 3. Since the proposed rule does not result in NO_x control for this category, the Tier 3 NO_x emission factors were set equal to Tier 2.

Table 0-36 Control PM_{10}, NO_x, and HC Emission Factors (g/hp-hr) for <37kW Commercial Marine Diesel Engines

HP RANGE	YEAR	TIER 3		
		HC	NO_X	PM
0-11	2009	0.43	4.39	0.24
11-16	2009	0.21	3.63	0.19
	2014	0.21	2.32	0.19
16-25	2009	0.21	3.63	0.19
	2014	0.21	2.32	0.19
25-50	2009	0.41	3.71	0.18
	2014	0.41	2.32	0.18

The resulting control case 50-state emission inventories for <37kW propulsion and auxiliary engines are given in Table 0-37.

3.1.3.6 Commercial Marine Diesel Control Inventory Summary

3.1.3.6.1 PM_{10}, $PM_{2.5}$, NO_x, VOC, CO, and SO_2 Emissions

Table 0-38 thru Table 0-43 present the resulting 50-state consolidated commercial marine control case inventories for each pollutant and category, for calendar years 2002-2040.

3.1.3.6.2 Air Toxics Emissions

The control case air toxics inventories for commercial marine diesel engines are provided in Table 0-44. The gaseous air toxics are assumed to be controlled proportionately to VOC, whereas POM is controlled proportionately to PM.

Table 0-37 Control Case (50-State) Emissions for <37kW Commercial Marine Engines (short tons)

YEAR	PM_{10}	$PM_{2.5}$	NO_X	VOC	HC	CO	SO_2
2002	728	706	5,517	1,273	1,209	3,783	731
2003	710	689	5,448	1,222	1,161	3,680	738
2004	692	671	5,350	1,179	1,120	3,576	745
2005	671	651	5,229	1,128	1,071	3,460	752
2006	648	629	5,101	1,075	1,021	3,339	745
2007	596	578	4,973	1,022	970	3,216	387
2008	551	534	4,846	969	920	3,093	128
2009	524	509	4,719	911	865	2,970	129
2010	495	480	4,594	853	810	2,846	95
2011	466	452	4,472	797	757	2,724	71
2012	437	424	4,351	741	704	2,603	38
2013	409	397	4,234	688	653	2,484	14
2014	383	371	4,073	636	604	2,369	16
2015	357	346	3,917	586	556	2,259	18
2016	334	324	3,777	545	518	2,170	18
2017	317	308	3,658	515	489	2,109	18
2018	303	294	3,556	492	467	2,063	18
2019	291	282	3,462	472	448	2,027	18
2020	280	272	3,377	454	432	1,997	18
2021	271	263	3,301	438	416	1,972	18
2022	263	255	3,240	423	402	1,952	18
2023	257	249	3,188	411	390	1,940	19
2024	252	244	3,144	401	381	1,932	19
2025	248	240	3,103	393	373	1,926	19
2026	244	237	3,070	387	368	1,926	19
2027	242	235	3,042	383	364	1,929	19
2028	241	234	3,018	381	361	1,934	19
2029	240	233	2,998	379	360	1,942	20
2030	240	233	2,982	378	359	1,952	20
2031	240	233	2,978	378	359	1,963	20
2032	241	234	2,983	380	360	1,977	20
2033	242	235	2,993	381	362	1,992	20
2034	244	236	3,007	384	365	2,009	21
2035	245	238	3,022	387	367	2,026	21
2036	247	240	3,040	389	370	2,044	21
2037	249	242	3,058	392	372	2,061	21
2038	251	244	3,079	395	375	2,079	21
2039	253	246	3,100	398	378	2,097	21
2040	255	248	3,123	402	381	2,115	22

Table 0-38 Control Case (50-State) PM_{10} Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	13,328	2,714	16,041	12,850	728	29,619
2003	13,690	2,773	16,463	13,112	710	30,285
2004	13,807	2,791	16,598	13,376	692	30,666
2005	13,873	2,786	16,659	13,641	671	30,972
2006	13,872	2,769	16,641	13,907	648	31,196
2007	12,230	2,482	14,712	14,174	596	29,481
2008	10,961	2,263	13,224	14,436	551	28,211
2009	10,709	2,229	12,939	14,706	524	28,169
2010	10,304	2,169	12,472	14,975	495	27,942
2011	9,916	2,113	12,029	15,245	466	27,740
2012	9,409	2,042	11,451	15,515	437	27,404
2013	8,859	1,971	10,830	15,569	409	26,808
2014	8,291	1,902	10,192	14,031	383	24,606
2015	7,700	1,829	9,528	12,996	357	22,881
2016	7,065	1,751	8,816	12,865	334	22,015
2017	6,463	1,663	8,126	12,482	317	20,925
2018	5,911	1,561	7,472	12,130	303	19,905
2019	5,388	1,458	6,845	11,748	291	18,885
2020	4,938	1,354	6,292	11,394	280	17,967
2021	4,562	1,261	5,824	11,108	271	17,203
2022	4,208	1,184	5,393	10,804	263	16,460
2023	3,873	1,116	4,988	10,465	257	15,710
2024	3,552	1,054	4,606	10,094	252	14,952
2025	3,263	998	4,262	9,710	248	14,219
2026	3,013	945	3,959	9,315	244	13,518
2027	2,808	895	3,704	8,909	242	12,855
2028	2,644	847	3,491	8,493	241	12,225
2029	2,512	803	3,315	8,071	240	11,626
2030	2,417	764	3,181	7,644	240	11,065
2031	2,352	733	3,085	7,211	240	10,537
2032	2,310	708	3,019	6,776	241	10,036
2033	2,284	687	2,971	6,342	242	9,555
2034	2,265	669	2,934	5,909	244	9,087
2035	2,254	656	2,910	5,482	245	8,638
2036	2,248	647	2,896	5,089	247	8,232
2037	2,250	641	2,891	4,756	249	7,895
2038	2,256	637	2,894	4,466	251	7,611
2039	2,268	635	2,903	4,220	253	7,376
2040	2,282	635	2,917	4,039	255	7,211

Table 0-39 Control Case (50-State) $PM_{2.5}$ Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	12,928	2,632	15,560	12,464	706	28,730
2003	13,279	2,690	15,969	12,719	689	29,377
2004	13,393	2,708	16,100	12,975	671	29,746
2005	13,457	2,703	16,159	13,232	651	30,042
2006	13,456	2,686	16,142	13,490	629	30,260
2007	11,863	2,407	14,270	13,748	578	28,596
2008	10,632	2,195	12,827	14,003	534	27,364
2009	10,388	2,162	12,551	14,264	509	27,324
2010	9,995	2,104	12,098	14,525	480	27,104
2011	9,618	2,049	11,668	14,787	452	26,908
2012	9,127	1,981	11,107	15,050	424	26,582
2013	8,593	1,912	10,505	15,102	397	26,004
2014	8,042	1,845	9,887	13,610	371	23,868
2015	7,469	1,774	9,242	12,606	346	22,195
2016	6,853	1,698	8,551	12,479	324	21,354
2017	6,269	1,613	7,882	12,107	308	20,297
2018	5,734	1,514	7,248	11,766	294	19,308
2019	5,226	1,414	6,640	11,396	282	18,318
2020	4,790	1,314	6,103	11,052	272	17,428
2021	4,425	1,224	5,649	10,775	263	16,687
2022	4,082	1,149	5,231	10,480	255	15,966
2023	3,756	1,082	4,838	10,151	249	15,239
2024	3,446	1,022	4,468	9,791	244	14,503
2025	3,165	968	4,134	9,419	240	13,793
2026	2,923	917	3,840	9,035	237	13,113
2027	2,724	868	3,592	8,641	235	12,469
2028	2,565	822	3,386	8,238	234	11,858
2029	2,436	779	3,215	7,829	233	11,277
2030	2,344	741	3,086	7,414	233	10,733
2031	2,282	711	2,993	6,995	233	10,221
2032	2,241	687	2,928	6,573	234	9,735
2033	2,215	667	2,882	6,152	235	9,269
2034	2,197	649	2,846	5,732	236	8,815
2035	2,186	637	2,823	5,318	238	8,378
2036	2,181	628	2,809	4,936	240	7,985
2037	2,182	622	2,804	4,613	242	7,658
2038	2,189	618	2,807	4,332	244	7,383
2039	2,200	616	2,816	4,093	246	7,155
2040	2,214	616	2,829	3,918	248	6,995

Table 0-40 Control Case (50-State) NO_x Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	335,561	60,641	396,202	432,306	5,517	834,025
2003	336,369	60,959	397,328	431,973	5,448	834,749
2004	332,798	60,482	393,280	431,683	5,350	830,313
2005	328,810	59,774	388,583	431,417	5,229	825,229
2006	324,900	59,073	383,973	431,195	5,101	820,269
2007	316,663	58,048	374,710	427,380	4,973	807,063
2008	308,524	57,030	365,554	423,601	4,846	794,001
2009	300,509	56,020	356,529	419,857	4,719	781,105
2010	292,651	55,022	347,673	416,169	4,594	768,436
2011	284,979	54,038	339,017	412,537	4,472	756,026
2012	276,209	52,949	329,158	408,943	4,351	742,453
2013	267,453	51,796	319,249	404,127	4,234	727,609
2014	257,691	50,317	308,007	392,503	4,073	704,584
2015	248,317	48,863	297,181	380,939	3,917	682,037
2016	236,292	47,349	283,640	365,582	3,777	652,999
2017	223,265	45,754	269,020	350,179	3,658	622,856
2018	209,717	43,895	253,612	334,823	3,556	591,991
2019	196,847	42,089	238,936	319,586	3,462	561,984
2020	185,242	40,347	225,589	304,523	3,377	533,489
2021	174,843	38,787	213,630	289,618	3,301	506,550
2022	164,971	37,444	202,415	274,971	3,240	480,625
2023	155,589	36,210	191,800	261,143	3,188	456,131
2024	146,696	35,096	181,792	248,136	3,144	433,072
2025	138,521	34,089	172,610	235,393	3,103	411,106
2026	131,195	33,138	164,333	222,855	3,070	390,259
2027	124,763	32,243	157,006	210,526	3,042	370,574
2028	119,185	31,399	150,584	198,433	3,018	352,035
2029	114,708	30,630	145,338	186,645	2,998	334,981
2030	111,660	29,948	141,608	175,655	2,982	320,245
2031	109,766	29,388	139,154	165,474	2,978	307,605
2032	108,624	28,939	137,563	155,629	2,983	296,175
2033	107,896	28,572	136,468	146,134	2,993	285,596
2034	107,443	28,303	135,746	136,983	3,007	275,735
2035	107,233	28,159	135,392	128,247	3,022	266,661
2036	107,236	28,117	135,352	120,169	3,040	258,561
2037	107,444	28,123	135,566	113,689	3,058	252,314
2038	107,834	28,176	136,009	108,659	3,079	247,747
2039	108,376	28,259	136,635	104,710	3,100	244,445
2040	109,054	28,367	137,421	101,729	3,123	242,273

Table 0-41 Control Case (50-State) VOC Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	9,488	1,767	11,255	4,701	1,273	17,229
2003	9,573	1,783	11,356	4,743	1,222	17,321
2004	9,561	1,785	11,346	4,786	1,179	17,311
2005	9,550	1,788	11,338	4,829	1,128	17,295
2006	9,540	1,791	11,331	4,872	1,075	17,278
2007	9,415	1,787	11,202	4,916	1,022	17,140
2008	9,291	1,783	11,074	4,960	969	17,003
2009	9,169	1,778	10,947	5,005	911	16,863
2010	9,050	1,773	10,823	5,050	853	16,726
2011	8,933	1,768	10,701	5,096	797	16,594
2012	8,708	1,753	10,461	5,141	741	16,344
2013	8,433	1,727	10,160	5,150	688	15,998
2014	8,042	1,677	9,719	5,082	636	15,437
2015	7,658	1,628	9,286	5,014	586	14,885
2016	7,228	1,577	8,805	4,896	545	14,246
2017	6,784	1,523	8,307	4,729	515	13,551
2018	6,334	1,463	7,796	4,563	492	12,851
2019	5,898	1,403	7,302	4,396	472	12,169
2020	5,496	1,345	6,841	4,230	454	11,526
2021	5,126	1,290	6,416	4,066	438	10,920
2022	4,772	1,239	6,010	3,901	423	10,335
2023	4,433	1,188	5,621	3,738	411	9,771
2024	4,111	1,141	5,252	3,576	401	9,229
2025	3,826	1,095	4,922	3,415	393	8,729
2026	3,589	1,052	4,640	3,254	387	8,281
2027	3,400	1,010	4,410	3,094	383	7,887
2028	3,252	970	4,223	2,935	381	7,538
2029	3,134	935	4,068	2,777	379	7,225
2030	3,049	905	3,953	2,622	378	6,953
2031	2,991	882	3,874	2,468	378	6,720
2032	2,953	866	3,819	2,317	380	6,516
2033	2,927	853	3,781	2,169	381	6,331
2034	2,911	843	3,754	2,025	384	6,162
2035	2,902	836	3,738	1,885	387	6,010
2036	2,901	832	3,733	1,757	389	5,880
2037	2,906	830	3,736	1,651	392	5,779
2038	2,919	829	3,748	1,562	395	5,705
2039	2,936	829	3,765	1,488	398	5,652
2040	2,957	831	3,787	1,434	402	5,623

Table 0-42 Control Case (50-State) CO Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	55,303	9,624	64,927	82,621	3,783	151,331
2003	55,801	9,710	65,511	83,364	3,680	152,556
2004	55,722	9,668	65,390	84,115	3,576	153,080
2005	55,582	9,585	65,167	84,872	3,460	153,499
2006	55,450	9,503	64,954	85,635	3,339	153,928
2007	54,423	9,331	63,754	85,621	3,216	152,591
2008	53,405	9,160	62,565	85,611	3,093	151,269
2009	52,401	8,989	61,391	85,605	2,970	149,966
2010	51,414	8,820	60,235	85,609	2,846	148,690
2011	50,445	8,654	59,099	85,621	2,724	147,444
2012	49,497	8,489	57,986	85,639	2,603	146,227
2013	48,574	8,327	56,901	85,665	2,484	145,050
2014	47,680	8,167	55,847	85,701	2,369	143,917
2015	46,827	8,010	54,837	85,746	2,259	142,842
2016	46,023	7,857	53,880	85,800	2,170	141,851
2017	45,368	7,708	53,076	85,864	2,109	141,049
2018	44,879	7,563	52,443	85,937	2,063	140,443
2019	44,482	7,426	51,908	86,020	2,027	139,954
2020	44,301	7,298	51,599	86,116	1,997	139,712
2021	44,329	7,198	51,527	86,222	1,972	139,720
2022	44,423	7,134	51,557	86,341	1,952	139,851
2023	44,571	7,088	51,659	86,475	1,940	140,073
2024	44,760	7,066	51,827	86,626	1,932	140,384
2025	44,987	7,067	52,054	86,790	1,926	140,771
2026	45,248	7,077	52,325	86,974	1,926	141,226
2027	45,539	7,094	52,633	87,178	1,929	141,740
2028	45,861	7,117	52,978	87,406	1,934	142,318
2029	46,209	7,145	53,354	87,672	1,942	142,968
2030	46,583	7,178	53,761	88,078	1,952	143,791
2031	46,975	7,215	54,191	88,623	1,963	144,776
2032	47,385	7,257	54,642	89,207	1,977	145,825
2033	47,811	7,303	55,114	89,820	1,992	146,926
2034	48,241	7,353	55,595	90,457	2,009	148,060
2035	48,675	7,407	56,082	91,119	2,026	149,227
2036	49,114	7,464	56,577	91,799	2,044	150,419
2037	49,556	7,524	57,079	92,500	2,061	151,640
2038	50,002	7,588	57,589	93,219	2,079	152,887
2039	50,452	7,654	58,105	93,956	2,097	154,158
2040	50,906	7,721	58,627	94,707	2,115	155,449

Table 0-43 Control Case (50-State) SO_2 Emissions for Commercial Marine Diesel Engines (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2002	36,201	6,553	42,754	36,868	731	80,353
2003	36,528	6,613	43,141	37,193	738	81,073
2004	36,862	6,673	43,535	37,528	745	81,808
2005	37,192	6,733	43,925	37,866	752	82,543
2006	36,827	6,667	43,493	38,207	745	82,445
2007	19,121	3,461	22,583	38,550	387	61,520
2008	6,299	1,140	7,440	38,837	128	46,404
2009	6,355	1,150	7,506	39,204	129	46,839
2010	4,705	852	5,557	39,559	95	45,212
2011	3,513	636	4,148	39,920	71	44,139
2012	1,862	337	2,199	40,278	38	42,515
2013	664	120	784	39,905	14	40,702
2014	799	145	943	21,334	16	22,293
2015	857	155	1,012	7,888	18	8,917
2016	865	157	1,021	7,817	18	8,855
2017	872	158	1,030	5,901	18	6,949
2018	879	159	1,038	4,574	18	5,630
2019	886	160	1,046	2,963	18	4,028
2020	893	162	1,055	1,888	18	2,961
2021	900	163	1,063	1,976	18	3,058
2022	907	164	1,072	1,995	18	3,085
2023	915	166	1,081	1,975	19	3,074
2024	923	167	1,090	1,954	19	3,063
2025	931	169	1,099	1,934	19	3,052
2026	939	170	1,109	1,913	19	3,041
2027	946	171	1,118	1,894	19	3,031
2028	954	173	1,127	1,874	19	3,020
2029	962	174	1,136	1,855	20	3,010
2030	970	176	1,146	1,836	20	3,002
2031	978	177	1,155	1,818	20	2,993
2032	986	179	1,165	1,800	20	2,985
2033	995	180	1,175	1,783	20	2,978
2034	1,006	182	1,188	1,766	21	2,975
2035	1,015	184	1,198	1,750	21	2,969
2036	1,023	185	1,208	1,735	21	2,964
2037	1,032	187	1,218	1,721	21	2,961
2038	1,040	188	1,228	1,709	21	2,958
2039	1,050	190	1,240	1,700	21	2,962
2040	1,059	192	1,251	1,699	22	2,971

Table 0-44 Control Case (50-State) Air Toxic Emissions for Commercial Marine Diesel Engines (short tons)

HAP	2010	2015	2020	2030
BENZENE	556	515	410	252
FORMALDEHYDE	4,088	3,785	3,018	1,857
ACETALDEHYDE	2,032	1,881	1,500	923
1,3-BUTADIENE	6	5	4	3
ACROLEIN	79	73	58	36
NAPHTHALENE	38	34	26	16
POM	10	9	7	4

3.1.4 Projected Commercial Marine Emission Reductions of Proposal

The $PM_{2.5}$, NO_x, and VOC emission reductions for each category and calendar year are presented in Table 0-45 thru Table 0-47. The air toxic emission reductions by pollutant and calendar year are given in Table 0-48.

Table 0-45 Projected Commercial Marine $PM_{2.5}$ Emission Reductions (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2008	0	0	0	0	0	0
2009	0	1	1	0	2	3
2010	0	2	2	0	4	6
2011	0	2	3	0	5	8
2012	60	9	69	0	6	76
2013	140	21	161	153	8	321
2014	288	49	336	431	9	776
2015	441	76	518	620	11	1,149
2016	634	106	740	988	13	1,740
2017	856	139	995	1,459	15	2,469
2018	1,112	179	1,292	1,937	16	3,245
2019	1,375	220	1,595	2,405	18	4,019
2020	1,643	262	1,905	2,882	20	4,808
2021	1,917	305	2,221	3,400	22	5,644
2022	2,194	348	2,542	3,925	24	6,491
2023	2,473	392	2,865	4,456	26	7,347
2024	2,751	437	3,188	4,995	28	8,210
2025	3,012	482	3,494	5,541	29	9,064
2026	3,245	528	3,773	6,096	31	9,899
2027	3,449	573	4,021	6,658	32	10,711
2028	3,625	618	4,243	7,227	33	11,503
2029	3,782	661	4,442	7,801	33	12,277
2030	3,914	700	4,613	8,380	34	13,027
2031	4,022	733	4,755	8,962	35	13,752
2032	4,115	761	4,876	9,546	35	14,458
2033	4,198	787	4,985	10,130	36	15,151
2034	4,274	811	5,085	10,712	37	15,834
2035	4,343	832	5,175	11,288	37	16,500
2036	4,407	850	5,257	11,831	38	17,126
2037	4,465	867	5,332	12,316	38	17,686
2038	4,518	882	5,400	12,759	39	18,198
2039	4,568	897	5,465	13,160	39	18,664
2040	4,614	911	5,525	13,498	40	19,063

Table 0-46 Projected Commercial Marine NO_x Emission Reductions (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	0	0	0	0	0	0
2011	0	0	0	0	0	0
2012	1,342	121	1,463	0	0	1,463
2013	3,311	322	3,633	1,301	0	4,935
2014	6,944	868	7,812	9,467	47	17,326
2015	10,562	1,414	11,976	17,654	94	29,723
2016	17,246	2,051	19,297	29,714	141	49,151
2017	26,061	2,835	28,896	41,922	188	71,006
2018	36,621	3,954	40,576	54,165	235	94,975
2019	47,117	5,071	52,187	66,413	281	118,882
2020	57,522	6,184	63,705	78,633	328	142,666
2021	67,833	7,292	75,126	90,840	374	166,339
2022	78,019	8,397	86,416	103,020	420	189,855
2023	88,051	9,495	97,546	115,170	465	213,181
2024	97,867	10,586	108,453	127,293	510	236,257
2025	107,215	11,667	118,882	139,391	555	258,828
2026	115,946	12,737	128,683	151,488	599	280,771
2027	123,957	13,792	137,749	163,559	643	301,951
2028	131,290	14,829	146,119	175,606	685	322,410
2029	137,676	15,822	153,498	187,573	726	341,797
2030	142,790	16,755	159,545	199,471	764	359,780
2031	146,842	17,592	164,434	211,253	794	376,481
2032	150,228	18,343	168,571	222,938	815	392,324
2033	153,285	19,039	172,324	234,439	835	407,598
2034	156,089	19,659	175,748	245,767	852	422,367
2035	158,671	20,173	178,844	256,829	869	436,542
2036	161,061	20,604	181,665	267,350	884	449,899
2037	163,268	21,004	184,271	276,408	899	461,578
2038	165,314	21,377	186,692	284,135	913	471,739
2039	167,230	21,732	188,962	290,899	926	480,787
2040	169,033	22,069	191,102	296,798	938	488,838

Table 0-47 Projected Commercial Marine VOC Emission Reductions (short tons)

YEAR	C1 PROPULSION	C1 AUXILIARY	C1 TOTAL	C2 PROPULSION	<37KW	TOTAL
2008	0	0	0	0	0	0
2009	0	2	2	0	5	7
2010	1	3	4	0	11	14
2011	1	5	6	0	16	22
2012	113	17	130	0	22	152
2013	279	40	319	37	27	383
2014	564	88	652	152	32	837
2015	849	135	984	268	38	1,290
2016	1,187	185	1,372	433	43	1,848
2017	1,563	237	1,800	648	49	2,497
2018	1,970	297	2,267	863	54	3,183
2019	2,374	356	2,730	1,078	59	3,867
2020	2,773	415	3,188	1,293	64	4,545
2021	3,167	474	3,640	1,508	70	5,218
2022	3,555	532	4,087	1,722	75	5,883
2023	3,934	590	4,524	1,936	79	6,539
2024	4,303	647	4,950	2,149	84	7,183
2025	4,639	704	5,343	2,362	89	7,794
2026	4,934	760	5,694	2,575	92	8,360
2027	5,184	814	5,998	2,787	95	8,880
2028	5,397	867	6,264	2,999	97	9,360
2029	5,585	917	6,501	3,210	99	9,811
2030	5,743	961	6,704	3,420	101	10,225
2031	5,876	998	6,874	3,628	103	10,605
2032	5,993	1,029	7,022	3,834	105	10,960
2033	6,099	1,058	7,157	4,037	106	11,300
2034	6,197	1,084	7,281	4,237	108	11,625
2035	6,287	1,107	7,394	4,433	109	11,936
2036	6,371	1,128	7,499	4,618	111	12,228
2037	6,449	1,147	7,596	4,781	112	12,490
2038	6,521	1,166	7,687	4,928	114	12,728
2039	6,589	1,183	7,772	5,060	115	12,947
2040	6,654	1,200	7,854	5,173	116	13,143

Table 0-48 Projected Commercial Marine Air Toxic Emission Reductions (short tons)

HAP	2010	2015	2020	2030
BENZENE	0	45	162	371
FORMALDEHYDE	4	328	1,190	2,730
ACETALDEHYDE	2	163	591	1,357
1,3-BUTADIENE	0	0	2	4
ACROLEIN	0	6	23	53
NAPHTHALENE	0	3	10	24
POM	0	0	2	5

3.2 Recreational Marine Diesel Engines

This section describes the methodology and presents the resulting baseline and controlled inventories for recreational marine (pleasure craft) diesel propulsion engines, including the projected emission reductions from the proposed rule. These engines are already subject to existing emission control standards, so the baseline inventories presented here account for those existing standards. Emissions from any diesel auxiliary engines used on recreational marine vessels are covered above in the section on engines less than 37 kW or the section on Category 1 engines, if they are over 37 kW.

3.2.1 General Methodology

The general methodology for calculating recreational marine diesel engine inventories for HC, CO, NO_x, PM_{10}, SO_2, VOC, $PM_{2.5}$, and fuel consumption uses the EPA NONROAD2005 model with inputs modified to reflect the proposed standards as well as updated baseline data.[13] Air toxic inventories are not generated by the NONROAD model, so those are calculated separately. NONROAD separates recreational diesel engines into two basic categories: inboard and outboard engines. NONROAD also subdivides these by power range. There are relatively few outboard diesels, and they are all in the 25 - 40 hp range.

The actual calculation methodology used by the NONROAD model is the same as described above in section 3.1.1 for all other marine diesel engines. Following is a summary of that.

Equation 5 I = N*P*L*A*EF

where each term is defined as follows:

I = the emission inventory (gram/year)

N = engine population (units)

P = average rated power (kW)

L = load factor (average fraction of rated power used during operation; unitless)

A = engine activity (operating hours/year)
EF = emission factor (gram/kW-hr)

Emissions are then converted and reported as short tons/year. In NONROAD the inputs are expressed in terms of horsepower (hp) instead of kW, and gram/bhp-hr instead of gram/kW-hr.

Three variables are used to project emissions over time: the engine population growth, the engine median life/scrappage, and the relative emissions deterioration rate.

Engine Population Growth. Unlike the commercial marine methodology which uses a compound population growth rate, the NONROAD model uses a linear growth assumption for recreational diesel engines, which is represented by a set of growth indexes that provide a ratio of estimation year population relative to the base year population. [14] The growth used for recreational diesel engines is 3.3 percent per year relative to a 1996 base year; i.e., each year the population grows by the same number of engines, and that number is 3.3 percent of the 1996 population.

Engine Median Life (years) and Scrappage. The engine median life defines the length of time engines remain in service. Engines persist in the population over two median lives; during the first median life, 50 percent of the engines are scrapped, and over the second, the remaining 50 percent of the engines are scrapped. Engine median lives also vary by category. The median life of both inboard and outboard engines is assumed to be 20 years, but due to the different activities used for these two categories (200 and 150 hours/year, respectively), the corresponding median life inputs for the model are 1400 and 1050 hours at full load. The age distribution is defined by the median life and the scrappage algorithm. The same basic scrappage algorithm is used for recreational and commercial marine diesel engines.[1]

Relative Deterioration Rate (percent increase in emission factor/percent median life expended). A deterioration factor can be applied to the emission factor to account for in-use deterioration. The deterioration factor varies by age and is calculated as:

Equation 6 $$DF = 1 + A*(age/ML)$$

where each term is defined as follows:
DF = the deterioration factor for a given pollutant at a given age
A = the relative deterioration rate for a given pollutant (percent increase in emission factor/percent useful life expended)
age = the age of a specific model year group of engines in the simulation year (years)
ML = the median life of the given model year cohort (years)

A given model year cohort is represented as a fraction of the entire population. In the NONROAD model the deterioration factor adjusts the emission factor for engines in a given model year cohort in relation to the proportion of median life expended.[2] Deterioration is linear over one median life. Following the first median life, the deteriorated emission factor is held constant over the remaining life for engines in the cohort.

Sulfur Adjustment for PM Emissions. For Tier 2 and prior engines, a sulfate adjustment is added to the PM emissions to account for differences in fuel sulfur content between the certification fuel and the episodic (calendar year) fuel, using the following equation:

Equation 3 $$S_{PM\ adj} = FC * 7.1 * 0.02247 * 224/32 * (soxdsl - soxbas) * 1/2000$$

where each term is defined as follows:
$S_{PM\ adj}$ = PM sulfate adjustment (tons)
FC = fuel consumption (gallons)
7.1 = fuel density (lb/gal)
0.02247 = fraction of fuel sulfur converted to sulfate
224/32 = grams PM sulfate/grams PM sulfur
soxdsl = episodic fuel sulfur weight fraction (varies by calendar year)
soxbas = certification fuel sulfur weight fraction
2000 = conversion from lb to ton

For engines prior to Tier 2 the base fuel sulfur (soxbas) is assumed to be 3300 ppm. For Tier 2 engines less than or equal to 50 hp (37 kW) it is set at 2000 ppm, as described in the Clean Air Nonroad Diesel Rule.[4], since these smaller engines are subject to the same standards as land-based diesel engines. For Tier 2 engines greater than 50 hp (37 kW) it is set at 350 ppm, based on the most recent certification data for these engines. For Tier 3 and later engines, no sulfur adjustment is applied. These engines will be certified to a fuel sulfur level at or lower than the episodic fuel sulfur levels expected when these engines are introduced.

The calendar year fuel sulfur levels (soxdsl) were taken from the Clean Air Nonroad Diesel Rule.[4]

Estimation of air toxic emissions. The air toxic baseline emission inventories for this proposal are based on information developed for EPA's Mobile Source Air Toxics (MSAT) final rulemaking.[5] That rule calculated air toxic emission inventories for all nonroad engines. The gaseous air toxics are correlated to VOC emissions, while POM is correlated to PM_{10} emissions. To calculate the air toxics emission inventories and reductions for this proposal, the percent reductions in VOC and PM_{10} emissions will be applied to the baseline gaseous and POM air toxic inventories, respectively.

3.2.2 Baseline (Pre-Control) Inventory Development

3.2.2.1 Baseline Inventory Inputs

This section describes the NONROAD model inputs that were used to generate the baseline emission inventories for recreational marine diesel engines.

Table 0-49 and Table 0-50 list the base engine populations, average hp by power range, annual activity, load factor, and median life. These also apply to the control case, and are unchanged from the default inputs in the NONROAD model.

Table 0-49 Recreational Marine Diesel Modeling Inputs

NONROAD MODEL INPUT	RECREATIONAL MARINE DIESEL	
	INBOARD	OUTBOARD
POPULATION (year 2000)	291,387*	9,819
HP AVERAGE	*	32.25
ACTIVITY HRS/YEAR	200	150
LOAD FACTOR	0.35	0.35
MEDIAN LIFE (hrs at full load)	1400	1050
MEDIAN LIFE (years)	20	20
* See TABLE 0-50 for breakout by individual power ranges.		

Table 0-50 Recreational Marine Inboard Diesel Population

POWER RANGE	DIESEL REC MARINE INBOARD	
MIN < HP <= MAX	HP AVG	POPULATION
0 - 11	9.736	9,126
11 - 16	14.92	4,478
16 - 25	21.41	9,908
25 - 40	31.2	5,421
40 - 50	42.4	1,002
50 - 75	56.19	8,784
75 - 100	94.22	7,397
100 - 175	144.9	60,632
175 - 300	223.1	99,703
300 - 600	387.1	73,546
600 - 750	677	2,902
750 - 1000	876.5	5,502
1000 - 1200	1154	448
1200 - 2000	1369	1,573
2000 - 3000	2294	964
TOTAL		291,387

The baseline emission factors are given in Table 0-51 and Table 0-52. "Zero Hour" emission factors represent the emissions from new engines that have been broken in, but before any significant deterioration occurs. The Deterioration Factor is used to calculate how emissions change as the engine and emission control system deteriorate over time, as explained above in Equation 2. Engines under 50 hp are subject to EPA nonroad diesel regulations that have established two tiers of emission standards.[12] Tier 1 phased in from 1999-2000, depending on the hp category, and Tier 2 phased in from 2004-2005. Engines above 50 hp are subject to separate standards (shown in the Tier 2 column) that take effect in 2008-2012, depending on hp category. The “Base” entries in the tables refer to emissions from pre-controlled engines. All these emission factors are used for both inboard and outboard diesel engines, although the outboards are all under 50 hp.

The emission factors for the base and Tier 1 technology types are unchanged from what has been in the NONROAD model.[2] Tier 2 emission factors were updated from those in the NONROAD model using all the nonroad engine certification data available in mid-2006. The deterioration factors by pollutant and technology type are also given in the tables above, and they are unchanged from what has been in the NONROAD model.[2]

The certification fuel sulfur levels are 3300ppm for the base and Tier 1 technology type and 350ppm for Tier 2. Brake Specific Fuel Consumption (BSFC) values in the NONROAD model are 0.408 lb/hp-hr for all hp categories.[2]

Table 0-51 Baseline PM_{10} and NO_x Zero Hour Emission Factors and Deterioration Factors for Recreational Marine Diesel Engines

HP RANGE	PM_{10} G/HP-HR			NO_X G/HP-HR		
	BASE	TIER1	TIER2	BASE	TIER1	TIER2
0-11	1.00	0.45	0.38	10.00	5.23	4.39
11-16	0.90	0.27	0.19	8.50	4.44	3.63
16-25	0.90	0.27	0.19	8.50	4.44	3.63
25-50	0.80	0.34	0.23	6.90	4.73	3.71
50-75	0.16	0.16	0.13	6.67	6.67	3.82
75-100	0.16	0.16	0.13	6.67	6.67	3.82
100-175	0.16	0.16	0.13	6.67	6.67	3.82
175-300	0.16	0.16	0.090	6.67	6.67	4.46
300-600	0.16	0.16	0.082	6.67	6.67	4.42
600-750	0.16	0.16	0.082	6.67	6.67	4.42
750-1200	0.16	0.16	0.082	6.67	6.67	4.42
>1200	0.16	0.16	0.082	6.67	6.67	4.42
DF ("A")	0.473	0.473	0.473	0.024	0.024	0.009

Table 0-52 Baseline HC and CO Zero Hour Emission Factors and Deterioration Factors for Recreational Marine Diesel Engines

HP RANGE	HC G/HP-HR			CO G/HP-HR		
	BASE	TIER1	TIER2	BASE	TIER1	TIER2
0-11	1.50	0.76	0.68	5.00	4.11	4.11
11-16	1.70	0.44	0.21	5.00	2.16	2.16
16-25	1.70	0.44	0.21	5.00	2.16	2.16
25-50	1.80	0.28	0.54	5.00	1.53	1.53
50-75	0.22	0.22	0.20	0.95	0.95	0.95
75-100	0.22	0.22	0.20	0.95	0.95	0.95
100-175	0.22	0.22	0.20	0.95	0.95	0.95
175-300	0.22	0.22	0.25	0.95	0.95	0.95
300-600	0.22	0.22	0.33	0.95	0.95	0.95
600-750	0.22	0.22	0.33	0.95	0.95	0.95
750-1200	0.22	0.22	0.33	0.95	0.95	0.95
>1200	0.22	0.22	0.33	0.95	0.95	0.95
DF ("A")	0.047	0.047	0.034	0.185	0.101	0.101

3.2.2.2 Recreational Marine Diesel Baseline Inventory

3.2.2.2.1 PM_{10}, $PM_{2.5}$, NO_x, VOC, CO, and SO_2 Emissions

Table 0-53 shows the baseline 50-state emission inventories for recreational marine diesel engines (inboard and outboard combined) resulting from the baseline model inputs presented above.

3.2.2.2.2 Air Toxics Emissions

The baseline air toxics inventories for recreational marine diesel engines were taken from the final MSAT rule[5] and are summarized in Table 0-54. Inventories are provided for calendar year 1999, and are projected for 2010, 2015, 2020, and 2030.

Table 0-53 Baseline (50-State) Emissions for Recreational Marine Diesel Engines (short tons)

YEAR	PM_{10}	PM2.5	NO_X	VOC	HC	CO	SO_2
2002	1,130	1,096	40,437	1,540	1,462	6,467	5,145
2003	1,161	1,126	41,572	1,578	1,499	6,642	5,290
2004	1,192	1,156	42,704	1,618	1,536	6,816	5,436
2005	1,223	1,186	43,835	1,656	1,573	6,989	5,582
2006	1,247	1,210	44,089	1,720	1,633	7,161	5,621
2007	1,054	1,023	44,307	1,783	1,693	7,331	2,967
2008	915	888	44,513	1,846	1,753	7,499	993
2009	937	909	44,648	1,912	1,816	7,665	1,017
2010	935	907	44,772	1,979	1,879	7,829	764
2011	938	910	44,880	2,045	1,942	7,991	578
2012	934	906	44,977	2,112	2,006	8,150	311
2013	935	907	45,064	2,179	2,069	8,308	113
2014	952	924	45,139	2,246	2,133	8,464	136
2015	969	940	45,208	2,313	2,196	8,618	150
2016	984	954	45,270	2,380	2,260	8,771	153
2017	998	968	45,327	2,448	2,325	8,922	156
2018	1,011	981	45,378	2,516	2,389	9,073	156
2019	1,024	994	45,427	2,584	2,454	9,223	159
2020	1,037	1,006	45,477	2,653	2,520	9,374	162
2021	1,050	1,019	45,531	2,723	2,586	9,525	165
2022	1,063	1,031	45,586	2,793	2,652	9,675	168
2023	1,075	1,043	45,649	2,862	2,718	9,825	171
2024	1,087	1,054	45,729	2,932	2,784	9,975	174
2025	1,099	1,066	45,842	3,000	2,849	10,124	177
2026	1,112	1,079	46,114	3,064	2,910	10,279	180
2027	1,127	1,093	46,549	3,124	2,967	10,439	183
2028	1,143	1,108	47,030	3,184	3,023	10,601	186
2029	1,159	1,124	47,551	3,242	3,079	10,765	189
2030	1,175	1,140	48,102	3,299	3,133	10,930	192
2031	1,192	1,156	48,671	3,356	3,187	11,095	195
2032	1,208	1,172	49,257	3,412	3,240	11,262	199
2033	1,226	1,189	49,861	3,468	3,294	11,429	202
2034	1,243	1,205	50,477	3,524	3,346	11,596	205
2035	1,260	1,222	51,106	3,579	3,399	11,765	208
2036	1,278	1,239	51,748	3,634	3,451	11,933	211
2037	1,295	1,256	52,399	3,689	3,503	12,102	214
2038	1,313	1,274	53,062	3,744	3,555	12,272	217
2039	1,331	1,291	53,735	3,798	3,607	12,442	220
2040	1,349	1,308	54,417	3,852	3,659	12,613	223

Table 0-54 Baseline Air Toxics Emissions for Recreational Marine Diesel Engines (short tons)

HAP	1999	2010	2015	2020	2030
BENZENE	30	34	34	34	35
FORMALDEHYDE	176	199	197	195	201
ACETALDEHYDE	79	89	88	87	90
1,3-BUTADIENE	3	3	3	3	3
ACROLEIN	5	5	5	5	5
NAPHTHALENE	0	0	0	0	0
POM	1	0	0	0	0

3.2.3 Control Inventory Development

3.2.3.1 Control Scenario(s) Modeled

Table 0-55 shows the control case exhaust emission standards that were modeled for recreational marine diesel engines.

Table 0-55 Modeled Standards (g/hp-hr) for Recreational Marine Diesel Engines

<table>
<tr><th rowspan="2">HP RANGE</th><th colspan="3">TIER 3</th><th colspan="3">TIER 4</th></tr>
<tr><th>YEAR</th><th>NO_X+HC</th><th>PM</th><th>YEAR</th><th>NO_X</th><th>PM</th></tr>
<tr><td>0-25</td><td>2009</td><td>5.6</td><td>0.30</td><td rowspan="8"></td><td colspan="2" rowspan="8">NO TIER 4 STANDARDS</td></tr>
<tr><td rowspan="2">25-100</td><td>2009</td><td>5.6</td><td>0.22</td></tr>
<tr><td>2014</td><td>3.5</td><td>0.22</td></tr>
<tr><td>100-175</td><td>2012</td><td>4.3</td><td>0.11</td></tr>
<tr><td>175-300</td><td>2013</td><td>4.3</td><td>0.10</td></tr>
<tr><td>300-750</td><td>2014</td><td>4.3</td><td>0.09</td></tr>
<tr><td>750-1200</td><td>2013</td><td>4.3</td><td>0.09</td></tr>
<tr><td>1200-2680</td><td>2012</td><td>4.0</td><td>0.09</td></tr>
<tr><td>>2680</td><td>2012</td><td>4.0</td><td>0.09</td><td>2016</td><td>1.27</td><td>0.03</td></tr>
</table>

3.2.3.2 Control Inventory Inputs

Table 0-56 shows the NONROAD model emission factor inputs that were used to generate the control case emission inventories for recreational marine diesel engines. These emission factors were applied to engines beginning with the model years shown in Table 0-55. No sulfur adjustment is applied to the Tier 3 or Tier 4 PM calculations, since these engines will be certified to a fuel sulfur level at or lower than the episodic fuel sulfur levels expected when these engines are introduced. The Tier 4 modeled emission factors are identical to the Tier 4 emission factors used for Category 1 standard power density propulsion engines. However, the NONROAD model does not have a hp bin corresponding to greater than 2000 kW (2680 hp), so the 2000-3000 hp bin was used to model the effects of the Tier 4 standard.

All other modeling inputs are the same as shown above for the base case inventory development. Table 0-49 and Table 0-50 list the base engine populations, average hp by power range, annual activity, load factor, and median life. These are unchanged from the default inputs in the NONROAD model.

Table 0-56 Control Emission Factors for Recreational Marine Diesel Engines

HP RANGE	TIER 3 EMISSION FACTORS G/HP-HR				TIER 4 EMISSION FACTORS G/HP-HR			
	PM_{10}	NO_X	HC	CO	PM_{10}	NO_X	HC	CO
0-11	0.24	4.39	0.43	4.11	NO TIER 4 STANDARDS			
11-16	0.19	3.63	0.21	2.16				
16-25	0.19	3.63	0.21	2.16				
25-50	0.18	3.71	0.41	1.53				
	0.18	2.32	0.41	1.53				
50-75	0.13	3.82	0.20	0.95				
	0.13	2.39	0.20	0.95				
75-100	0.13	3.82	0.20	0.95				
	0.13	2.39	0.20	0.95				
100-175	0.088	3.34	0.13	0.95				
175-300	0.080	3.90	0.22	0.95				
300-600	0.072	3.98	0.29	0.95				
600-750	0.072	3.98	0.29	0.95				
750-1200	0.072	3.70	0.29	0.95				
1200-2000	0.072	3.70	0.29	0.95				
>2000	0.072	3.70	0.29	0.95	0.022	0.97	0.03	0.95
DF ("A")	0.473	0.009	0.034	0.101	0.473	0.009	0.034	0.101

3.2.3.3 Recreational Marine Diesel Control Inventory

3.2.3.3.1 PM_{10}, $PM_{2.5}$, NO_x, VOC, CO, and SO_2 Emissions

The control case 50-state emission inventories for recreational marine diesel engines (inboard and outboard combined) resulting from the control case model inputs presented above are shown in Table 0-57.

3.2.3.3.2 Air Toxics Emissions

The control case air toxics inventories for recreational marine diesel engines are provided in Table 0-58. Gaseous air toxics and POM are reduced proportionately to VOC and $PM_{2.5}$, respectively.

Table 0-57 Control Case (50-State) Emissions for Recreational Marine Diesel Engines (short tons)

YEAR	PM_{10}	$PM_{2.5}$	NO_X	VOC	HC	CO	SO_2
2002	1,130	1,096	40,437	1,540	1,462	6,467	5,145
2003	1,161	1,126	41,572	1,578	1,499	6,642	5,290
2004	1,192	1,156	42,704	1,618	1,536	6,816	5,436
2005	1,223	1,186	43,835	1,656	1,573	6,989	5,582
2006	1,247	1,210	44,089	1,720	1,633	7,161	5,621
2007	1,054	1,023	44,307	1,783	1,693	7,331	2,967
2008	915	888	44,513	1,846	1,753	7,499	993
2009	937	909	44,648	1,912	1,816	7,665	1,017
2010	935	907	44,772	1,978	1,878	7,829	764
2011	938	910	44,880	2,044	1,941	7,991	578
2012	931	903	44,931	2,104	1,998	8,150	311
2013	930	902	44,864	2,159	2,051	8,308	113
2014	944	916	44,681	2,206	2,095	8,464	136
2015	957	928	44,490	2,252	2,139	8,618	150
2016	967	938	44,248	2,294	2,179	8,771	153
2017	976	947	43,998	2,337	2,219	8,922	156
2018	985	955	43,742	2,379	2,259	9,073	156
2019	993	963	43,479	2,421	2,300	9,223	159
2020	1,001	971	43,218	2,465	2,341	9,374	162
2021	1,008	978	42,957	2,508	2,382	9,525	165
2022	1,015	985	42,697	2,552	2,423	9,675	168
2023	1,022	991	42,443	2,595	2,465	9,825	171
2024	1,028	997	42,206	2,638	2,505	9,975	174
2025	1,033	1,002	42,001	2,680	2,545	10,124	177
2026	1,041	1,009	41,955	2,717	2,581	10,279	180
2027	1,049	1,018	42,072	2,751	2,613	10,439	183
2028	1,058	1,026	42,237	2,784	2,644	10,601	186
2029	1,068	1,036	42,443	2,816	2,674	10,765	189
2030	1,077	1,045	42,683	2,847	2,704	10,930	193
2031	1,088	1,055	42,946	2,879	2,734	11,095	196
2032	1,098	1,066	43,241	2,911	2,765	11,262	199
2033	1,110	1,077	43,584	2,946	2,797	11,429	202
2034	1,123	1,089	43,979	2,983	2,832	11,596	205
2035	1,136	1,102	44,412	3,021	2,869	11,765	208
2036	1,150	1,115	44,875	3,061	2,907	11,933	211
2037	1,164	1,129	45,359	3,102	2,946	12,102	214
2038	1,179	1,143	45,864	3,143	2,985	12,272	217
2039	1,193	1,158	46,382	3,185	3,025	12,442	220
2040	1,208	1,172	46,915	3,227	3,064	12,613	223

Table 0-58 Control Case Air Toxic Emissions for Recreational Marine Diesel Engines (short tons)

HAP	2010	2015	2020	2030
BENZENE	34	33	31	30
FORMALDEHYDE	198	192	181	174
ACETALDEHYDE	89	86	81	78
1,3-BUTADIENE	3	3	3	3
ACROLEIN	5	5	5	4
NAPHTHALENE	0	0	0	0
POM	0	0	0	0

3.2.4 Projected Recreational Marine Emission Reductions of Proposal

The $PM_{2.5}$, NO_x, and VOC emission reductions by calendar year are shown in Table 0-59. The air toxic emission reductions by pollutant and calendar year are given in Table 0-60.

Table 0-59 Projected Recreational Marine Emission Reductions (short tons)

YEAR	$PM_{2.5}$	NO_X	VOC
2008	0	0	0
2009	0	0	1
2010	0	0	1
2011	1	0	2
2012	3	47	8
2013	5	200	20
2014	8	458	40
2015	12	718	61
2016	16	1,022	86
2017	21	1,328	111
2018	25	1,637	137
2019	30	1,947	163
2020	35	2,260	188
2021	41	2,574	215
2022	46	2,889	241
2023	52	3,206	267
2024	58	3,524	294
2025	63	3,842	320
2026	70	4,160	347
2027	76	4,477	373
2028	82	4,793	400
2029	88	5,108	426
2030	95	5,419	452
2031	101	5,725	477
2032	107	6,016	501
2033	112	6,277	523
2034	116	6,498	541
2035	120	6,693	558
2036	124	6,873	573
2037	127	7,039	587
2038	130	7,199	600
2039	133	7,353	613
2040	136	7,502	626

Table 0-60 Projected Air Toxic Reductions from Recreational Marine Diesel Engines (short tons)

HAP	2010	2015	2020	2030
BENZENE	0	1	2	5
FORMALDEHYDE	0	5	14	28
ACETALDEHYDE	0	2	6	12
1,3-BUTADIENE	0	0	0	0
ACROLEIN	0	0	0	1
NAPHTHALENE	0	0	0	0
POM	0	0	0	0

3.3 Locomotives

3.3.1 General Methodology

Given the quality of the data available, it was possible to develop more detailed estimates of fleet composition and emission rates. Locomotive emissions were calculated based on estimated current and projected fuel consumption rates. Emissions were calculated separately for the following locomotive categories:

- Large Railroad Line-Haul Locomotives
- Large Railroad Switching (including Class II/III Switch railroads owned by Class I railroads)
- Other Line-Haul Locomotives (i.e., local and regional railroads)
- Other Switch/Terminal Locomotives
- Passenger/Commuter Locomotives

We used the following approach for all categories, except for the small railroads (see 3.3.2.3). For each calendar year, locomotives are tracked separately by model year and then the activity is summed (in terms of work, fuel, and emissions) for all model years in the fleet. Seven basic steps were used to determine emissions in any calendar year:

1. Start with the fleet from the previous calendar year.
2. Determine which model years would be due to be remanufactured or scrapped.
3. Update the fleet to remove locomotives that would be scrapped.
4. Determine the amount of work that would be done by the remaining locomotives from the previous year's fleet.

5. Determine the number of freshly manufactured locomotives that would be purchased, and add them to the fleet.

6. Determine the total amount of work that would be done by all the locomotives in the fleet.

7. Determine total emissions from the work and brake-specific emission factors.

3.3.1.1 Base Fleet

As is described later, the base fleet was estimated for 2005 from a variety of industry sources. A new base fleet is calculated for each subsequent calendar year based on the scrappage rates and sales. The base fleet is a sum of multiple model years that are described by the number of locomotives in the fleet, the average work that has been accumulated since the last rebuild (in megawatt-hours or MW-hr), the average horsepower, and the Tier of standards to which they are certified.

3.3.1.2 Useful Life

In this analysis, all locomotives are assumed to be either remanufactured or scrapped when they reach or exceed their useful life. The useful life in MW-hrs is set equal to the rated horsepower of the locomotive multiplied by 7.5. Thus a 4000 horsepower locomotive would have a useful life of 30,000 MW-hrs. Annual accumulation of MW-hrs is projected based on the assumed rated hp of the locomotive and the relative use rate (which is a function of locomotive age). At the end of this second step, the projected fleet is adjusted to reflect a year's worth of use beyond the previous base fleet.

3.3.1.3 Scrappage

For each future calendar year, there will generally be some locomotive model years that will be projected to have reached the end of their current useful life. For example, we estimate that there will be 243 line-haul freight locomotives in use in 2010 that:

- Were originally manufactured in model year 1986.
- Will be accumulating about 2000 MW-hrs per year.
- Will reach the end of their useful lives during 2011.

According to our scrappage curve, we estimate that 15 of these locomotives will be scrapped in 2011. The remaining 228 are projected to be remanufactured. We perform this analysis for each model year, then update that fleet to remove locomotives that would be scrapped and change the emission levels for locomotives that are remanufactured to new standards.

3.3.1.4 Work Done by Old Fleet

Once the existing fleet is adjusted for each new calendar year, we determine the amount of work that would be done by the remaining locomotives from the previous year's fleet. First we calculate the amount of work done by each model year's fleet as follows:

Equation 7 $$W_i = H*LF*N_i*P_i*RUF_i$$

W_i = Combined annual work output for all locomotives remaining in the fleet that were originally manufactured in model year i.

H = Number of hours per year that a newly manufactured locomotive is projected to be used (approximately 4000 to 5000 hrs/yr).

L = Typical average load factor.

N_i = Number of locomotives remaining in the fleet that were originally manufactured in model year i.

P_i = Average rated power of locomotives remaining in the fleet that were originally manufactured in model year i.

RUF_i = Relative use factor for locomotives remaining in the fleet that were originally manufactured in model year i.

The total work done by the remaining fleet (W_r) is calculated by summing the work done by each model year (W_i).

3.3.1.5 New Sales

Sales of newly manufactured locomotives are projected for each calendar year after the remaining fleet has been analyzed. These newly manufactured locomotives are added to the remaining locomotives to comprise a new total fleet. The number is calculated based on the amount of fuel that is projected to be used in that calendar year:

Equation 8 $$\text{New Sales} = (\text{Total Fuel}/\text{BSFC} - W_r)/H/LF/P$$

Where BSFC is the estimated brake specific fuel consumption rate (Gal/MW-hr)

3.3.1.6 Total Work

The total amount of work that would be done by all the locomotives in the fleet is calculated for each calendar year by summing the work projected to be done by the newly manufactured locomotives and the work projected to be done by the remaining locomotives. The total work is calculated separately for each tier of locomotives.

3.3.1.7 Emissions

Emissions are determined from the work calculated in section 3.3.1.6 (converted to hp-hrs) and brake-specific emission factors:

Equation 9 Total emissions = Total Work * Emission factor

The emission factors used are the estimated average in-use emissions for each tier of standards, which are shown in Table 0-61 and Table 0-62. They take into account deterioration of emissions throughout the useful life, production variations, and the compliance margins that manufacturers incorporate into their designs. For this analysis, we are generally assuming that average in-use emission levels will be 10 percent below the applicable standards.

Table 0-61 Baseline Line-Haul Emission Factors (g/bhp-hr)

	PM_{10}	HC	NO_x	CO
UNCONTROLLED	0.32	0.48	13.0	1.28
TIER 0	0.32	0.48	8.60	1.28
TIER 1	0.32	0.47	6.70	1.28
TIER2	0.18	0.26	4.95	1.28

Table 0-62 Baseline Switch Emission Factors (g/bhp-hr)

	PM_{10}	HC	NO_x	CO
UNCONTROLLED	0.44	1.01	17.4	1.83
TIER 0	0.44	1.01	12.6	1.83
TIER 1	0.43	1.01	9.9	1.83
TIER 2	0.19	0.51	7.3	1.83

These PM_{10} emission factors reflect the emission rates expected from locomotives operating on current in-use fuel with sulfur levels at 3000 ppm. The emission inventories described in this chapter, however, account for the reductions in sulfate particulate expected to result from using lower sulfur fuels after 2007. We estimate that the PM_{10} emission rate for locomotives operating on nominally 500 ppm sulfur fuel will be 0.029 g/bhp-hr lower than the PM_{10} emission rate for locomotives operating on 3000 ppm sulfur fuel. Similarly we estimate that the PM_{10} emission rate for locomotives operating on nominally 15 ppm sulfur fuel will be 0.033 g/bhp-hr lower than the PM_{10} emission rate for locomotives operating on 3000 ppm sulfur fuel.

To estimate VOC emissions, an adjustment factor of 1.053 is applied to the HC output. Similarly, to estimate $PM_{2.5}$ emissions, an adjustment factor of 0.97 is applied to the PM_{10} output. These adjustment factors are the same as those used for marine engines.

3.3.2 Baseline (Pre-Control) Inventory Development

In developing the baseline inventory, we collected fuel consumption estimates from the regulated industries, including publicly available estimates for Class I and commuter railroads. We used the same estimated average in-use emission factors and load factors as we used in the previous rulemaking.

We are using a projection by the Energy Information Administration (EIA) that locomotive fuel consumption will grow 1.6 percent annually.[8] We are assuming that this fuel growth applies equally across all categories of locomotives and is directly proportional to engine work performed by the fleet.

Table 0-63 Summary of Locomotive Emission Analysis Inputs

	Large Line-Haul	Large Switch	Small Line-Haul	Small Switch	Passenger/ Commuter
2005 FUEL CONSUMPTION (GAL/YR)	3.910 BILLION	310 MILLION	105 MILLION	39 MILLION	142 MILLION
HOURS USED PER YEAR WHEN NEW	4350	4450	NA	NA	3900
YEARS AFTER WHICH USAGE BEGINS TO DECLINE	8	50	NA	NA	20
HOURS PER YEAR AT END OF LIFE	1740 @ 40 YRS	3115 @ 70 YRS	NA	NA	2340@30YRS
AGE AFTER WHICH SCRAPPAGE BEGINS	20	50	NA	NA	20
AGE AFTER WHICH NO LOCOMOTIVES REMAIN IN FLEET	40	70	NA	NA	30
LOAD FACTOR (AVG HP/RATED HP)	0.275	0.100	0.275	0.100	0.275
AVG HP/GAL	20.8	15.2	18.2	15.2	20.8

3.3.2.1 Large Line-Haul

The large line-haul category includes line-haul freight locomotives that are fully subject to the standards being proposed. Locomotives that are owned and operated by railroads that qualify as small businesses are addressed separately, as described in 3.3.2.3. The large line-haul analysis is based primarily on data collected for Class I railroads. However, as described in 3.3.2.3, the total fuel includes one-third of the estimated Class II and Class III fuel use to account for those Class II and III railroads that do not qualify as small businesses. The estimate of current Class I total fuel use came from the AAR Railroad Facts booklet. This was reduced by 7 percent to reflect fuel used in switching rather than line-haul operation. The fleet composition for all large railroads was estimated based on a contractor analysis. The contractor estimated that this fleet included 19,757 locomotives with more than 2500 hp. (Locomotives with 2500 hp or less were assumed to be used primarily in switching operations.) Usage and scrappage patterns were developed to fit the fuel use and fleet composition data. The average in-use load factor was assumed to be the same as the load factor for a typical line-haul duty cycle test.

3.3.2.2 Large Switch

We generally used the same approach to calculate switch emissions as we used to calculate line-haul emissions, but we used different inputs. We also made one change to the analysis of future sales. We assumed that the majority of growth in switching activity will be achieved by using switch locomotives more rather than by adding new switch locomotives to the fleet. More specifically, we assumed that 1.2 percent of the annual 1.6 percent growth in activity will be achieved by using the existing switchers more, while only 0.4 percent of the growth will be achieved by increasing the number of switchers in the fleet.

As shown in Table 0-63, we believe that switch locomotives tend to last longer in the fleet and have a lower in-use load factor than line-haul locomotives. Thus the average age of switch locomotives is much older then for line-haul. We also estimate that switching operation will use approximately seven percent of total large railroad fuel, and will grow at the same rate as line-haul operation. The switch fleet composition for all large railroads was estimated based on the same contractor analysis used for the line-haul fleet. The contractor estimated that this fleet included 5206 locomotives with 2500 hp or less. This included 1645 locomotives with 2250 to 2500 hp. While we recognize that some of these locomotives will be used in branch service[d], for this analysis they are assumed to be used primarily in switching operations.

3.3.2.3 Small Railroads

We used a simplified approach for small railroads (that is railroads that are not required to retrofit their locomotive with new emission controls because they qualify as "small railroads" under the regulatory definition). We assume that these small railroads are unlike the larger railroads in the following ways:

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[d] Branch service includes short-haul operations that would be considered intermediate to intercity line-haul service and switch service.

- They do not purchase newly manufactured locomotive.
- They use their locomotives at a constant rate.
- They replace their existing locomotives at a constant rate of 3 percent per year.

For this analysis, we considered small railroad activity in the same two categories as the larger railroads: line-haul and switch. For small line-haul operations, we are projecting that railroads will scrap and replace their oldest locomotives with 25 year-old locomotives purchased from the larger railroads. Thus the inventory analysis has these railroads obtaining Tier 1 locomotives starting in 2026, and Tier 2 locomotives in 2030. For small switch operations, the railroads are projected to replace their scrapped locomotives with only uncontrolled or Tier 0 locomotives purchased from the larger railroads. This analysis runs only through 2040 and we consider it unlikely that any significant number of Tier 1 or later switch locomotives will be available for small railroads before 2040.

The analysis of small railroads is based on the survey information provided by the American Shortline Railroad Association for Class II and Class III railroads. These results had to be adjusted upward to correct for a response rate of approximately 85 percent. We also had to adjust these estimates because not all Class II and Class III railroads qualify as small railroads under the regulations. We estimate that one-third of these railroads are owned by Class I railroads or other large businesses. Finally, we estimated the fraction small railroad activity should be characterized as line-haul service versus switching service. We estimate that Class II railroads use 7 percent of their fuel in switching service (the same as Class I railroads), but that Class III railroads use 50 percent of their fuel in switching service. When combined, these factors result in our estimate that small railroads used a total of 105 million gallons of diesel fuel in line-haul service in 2005, and 39 million gallons of diesel fuel in switching service, as shown in Table 3-64.

Table 0-64 Distribution of annual fuel consumption by Class II and Class III railroads (million gallons per year)

	Amount of fuel used by railroads that qualify as small railroads		Fuel used by other Class II and Class III railroads	
	LINE-HAUL	SWITCH	LINE-HAUL	SWITCH
CLASS II	71.5	5.4	35.7	2.7
CLASS III	33.7	33.7	16.8	16.8

3.3.2.4 Passenger/Commuter

We used the same approach to calculate passenger and commuter emissions as we used to calculate large line-haul emissions, but we used different inputs. As shown in the table, we believe that passenger/commuter locomotives tend to have an average age that is slightly newer then for line-haul. We used estimates from AMTRAK and APTA for current fuel consumption rates, and project that these will grow at the same rate as line-haul operation.

3.3.2.5 Locomotive Baseline Inventory Summary

The baseline locomotive inventory is shown separately for PM_{10}, $PM_{2.5}$, NO_x, VOC, HC, CO, and SO_2 in Table 0-65 through Table 0-71.

The baseline air toxics inventories for locomotives were taken from the MSAT rule and are provided in Table 0-72. Inventories are provided for calendar years 1999, 2010, 2015, 2020, and 2030.

Table 0-65 Baseline (50-State) PM_{10} Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2006	27,919	2,270	935	1,023	32,147
2007	27,873	2,295	950	1,011	32,129
2008	25,078	2,162	883	901	29,023
2009	24,965	2,185	897	888	28,934
2010	24,831	2,208	911	874	28,824
2011	24,686	2,232	926	859	28,703
2012	24,536	2,256	940	845	28,577
2013	24,015	2,258	944	817	28,033
2014	23,874	2,282	959	802	27,916
2015	23,724	2,306	974	787	27,791
2016	23,561	2,330	990	771	27,653
2017	23,398	2,355	1,006	756	27,515
2018	23,240	2,380	1,022	741	27,383
2019	23,081	2,405	1,038	726	27,251
2020	22,918	2,431	1,055	711	27,114
2021	22,750	2,457	1,071	696	26,974
2022	22,579	2,483	1,088	681	26,831
2023	22,407	2,490	1,106	666	26,668
2024	22,244	2,489	1,124	651	26,508
2025	22,080	2,483	1,141	636	26,340
2026	21,944	2,472	1,160	624	26,200
2027	21,836	2,456	1,178	614	26,084
2028	21,755	2,434	1,197	607	25,993
2029	21,703	2,410	1,216	602	25,931
2030	21,685	2,380	1,223	598	25,886
2031	21,696	2,343	1,230	597	25,866
2032	21,735	2,301	1,237	598	25,871
2033	21,800	2,257	1,243	600	25,901
2034	21,894	2,209	1,250	603	25,957
2035	22,023	2,161	1,256	608	26,049
2036	22,187	2,113	1,263	613	26,176
2037	22,378	2,066	1,269	618	26,331
2038	22,597	2,018	1,275	623	26,513
2039	22,846	1,971	1,281	628	26,726
2040	23,126	1,924	1,287	633	26,969

Table 0-66 Baseline (50-State) $PM_{2.5}$ Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2006	27,082	2,202	907	992	31,183
2007	27,037	2,226	922	981	31,166
2008	24,325	2,097	856	874	28,153
2009	24,216	2,120	870	861	28,066
2010	24,086	2,142	884	847	27,959
2011	23,946	2,165	898	833	27,842
2012	23,800	2,188	912	819	27,720
2013	23,294	2,190	916	792	27,192
2014	23,157	2,213	930	778	27,079
2015	23,012	2,237	945	763	26,957
2016	22,854	2,260	960	748	26,823
2017	22,696	2,284	975	734	26,690
2018	22,542	2,309	991	719	26,561
2019	22,389	2,333	1,007	704	26,433
2020	22,230	2,358	1,023	690	26,301
2021	22,067	2,383	1,039	675	26,165
2022	21,902	2,409	1,056	660	26,026
2023	21,734	2,415	1,073	646	25,868
2024	21,577	2,415	1,090	631	25,713
2025	21,417	2,408	1,107	617	25,550
2026	21,286	2,398	1,125	605	25,414
2027	21,181	2,382	1,143	596	25,301
2028	21,102	2,361	1,161	589	25,213
2029	21,052	2,338	1,180	584	25,153
2030	21,034	2,308	1,186	581	25,109
2031	21,045	2,273	1,193	579	25,090
2032	21,083	2,232	1,200	580	25,094
2033	21,146	2,190	1,206	582	25,124
2034	21,238	2,143	1,212	585	25,178
2035	21,362	2,096	1,219	590	25,267
2036	21,521	2,050	1,225	595	25,391
2037	21,707	2,004	1,231	600	25,541
2038	21,919	1,958	1,237	604	25,718
2039	22,160	1,912	1,243	609	25,925
2040	22,432	1,866	1,248	614	26,160

Table 0-67 Baseline (50-State) NO_x Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2006	779,842	86,861	37,690	38,466	942,858
2007	770,409	87,803	38,293	36,409	932,914
2008	761,768	87,623	38,906	34,361	922,658
2009	755,490	88,573	39,528	32,338	915,929
2010	745,431	88,625	40,161	30,370	904,587
2011	735,641	89,586	40,803	28,459	894,490
2012	730,031	88,909	41,456	27,212	887,608
2013	726,116	89,872	42,119	26,017	884,125
2014	722,365	89,090	42,793	24,872	879,121
2015	718,800	90,055	43,168	24,382	876,405
2016	714,893	89,682	43,544	23,325	871,445
2017	711,364	90,653	43,921	22,922	868,860
2018	708,525	90,875	44,299	22,559	866,258
2019	706,475	91,859	44,609	22,197	865,139
2020	704,353	89,367	44,917	21,836	860,474
2021	702,449	90,332	45,224	21,477	859,481
2022	700,505	89,231	45,529	21,119	856,383
2023	698,881	89,395	45,832	20,797	854,905
2024	697,737	87,896	46,134	20,510	852,277
2025	696,922	85,521	46,433	20,256	849,133
2026	696,845	85,305	46,730	20,066	848,946
2027	697,488	84,961	46,863	19,935	849,248
2028	698,814	84,538	46,989	19,860	850,202
2029	700,893	84,058	47,107	19,836	851,894
2030	703,847	83,458	47,062	19,859	854,226
2031	707,554	82,732	47,002	19,926	857,214
2032	711,989	81,917	46,929	20,033	860,868
2033	717,100	81,067	46,842	20,160	865,168
2034	722,959	80,141	46,739	20,305	870,144
2035	729,705	79,228	46,622	20,468	876,023
2036	737,374	78,332	46,488	20,631	882,826
2037	745,744	77,455	46,339	20,797	890,334
2038	754,836	76,596	46,172	20,963	898,567
2039	764,711	75,766	45,989	21,131	907,596
2040	775,388	74,931	45,788	21,300	917,407

Table 0-68 Baseline (50-State) VOC Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2006	43,874	5,501	2,891	1,609	53,874
2007	43,762	5,566	2,937	1,589	53,853
2008	43,636	5,630	2,984	1,568	53,818
2009	43,486	5,696	3,032	1,546	53,759
2010	43,301	5,763	3,080	1,523	53,667
2011	43,100	5,830	3,129	1,500	53,559
2012	42,891	5,898	3,179	1,476	53,445
2013	42,700	5,967	3,230	1,453	53,349
2014	42,518	6,037	3,282	1,429	53,265
2015	42,323	6,108	3,335	1,404	53,169
2016	42,107	6,179	3,388	1,380	53,054
2017	41,892	6,252	3,442	1,356	52,941
2018	41,684	6,325	3,497	1,332	52,838
2019	41,478	6,399	3,553	1,307	52,738
2020	41,265	6,475	3,610	1,283	52,633
2021	41,044	6,551	3,668	1,259	52,522
2022	40,820	6,628	3,726	1,235	52,410
2023	40,596	6,664	3,786	1,212	52,259
2024	40,391	6,686	3,847	1,188	52,112
2025	40,185	6,696	3,908	1,165	51,954
2026	40,027	6,697	3,971	1,146	51,841
2027	39,916	6,685	4,034	1,132	51,768
2028	39,850	6,665	4,099	1,121	51,735
2029	39,833	6,639	4,164	1,114	51,750
2030	39,873	6,600	4,231	1,110	51,813
2031	39,961	6,547	4,299	1,109	51,917
2032	40,098	6,485	4,367	1,111	52,062
2033	40,278	6,419	4,437	1,116	52,250
2034	40,507	6,345	4,508	1,123	52,483
2035	40,793	6,271	4,580	1,132	52,776
2036	41,139	6,197	4,654	1,141	53,131
2037	41,531	6,125	4,728	1,150	53,534
2038	41,969	6,053	4,804	1,159	53,986
2039	42,459	5,983	4,881	1,169	54,491
2040	43,000	5,912	4,959	1,178	55,049

Table 0-69 Baseline (50-State) HC Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/Commuter	Total
2006	41,665	5,225	2,745	1,528	51,163
2007	41,559	5,285	2,789	1,509	51,143
2008	41,439	5,347	2,834	1,489	51,109
2009	41,297	5,409	2,879	1,468	51,053
2010	41,122	5,473	2,925	1,446	50,965
2011	40,930	5,537	2,972	1,424	50,863
2012	40,733	5,601	3,019	1,402	50,755
2013	40,550	5,667	3,068	1,379	50,664
2014	40,378	5,733	3,117	1,357	50,584
2015	40,192	5,800	3,167	1,334	50,493
2016	39,988	5,868	3,217	1,311	50,384
2017	39,783	5,937	3,269	1,288	50,277
2018	39,586	6,007	3,321	1,265	50,179
2019	39,391	6,077	3,374	1,242	50,084
2020	39,188	6,149	3,428	1,219	49,984
2021	38,978	6,221	3,483	1,196	49,879
2022	38,766	6,294	3,539	1,173	49,772
2023	38,553	6,329	3,595	1,151	49,628
2024	38,358	6,350	3,653	1,129	49,489
2025	38,162	6,359	3,711	1,107	49,339
2026	38,013	6,360	3,771	1,089	49,232
2027	37,907	6,349	3,831	1,075	49,162
2028	37,844	6,330	3,892	1,064	49,131
2029	37,828	6,305	3,955	1,058	49,145
2030	37,866	6,268	4,018	1,054	49,205
2031	37,950	6,218	4,082	1,053	49,304
2032	38,079	6,159	4,148	1,055	49,441
2033	38,250	6,096	4,214	1,060	49,621
2034	38,468	6,025	4,281	1,067	49,841
2035	38,740	5,955	4,350	1,075	50,120
2036	39,068	5,885	4,419	1,084	50,457
2037	39,440	5,817	4,490	1,092	50,839
2038	39,857	5,748	4,562	1,101	51,269
2039	40,322	5,682	4,635	1,110	51,749
2040	40,836	5,614	4,709	1,119	52,278

Table 0-70 Baseline (50-State) CO Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2006	116,584	9,620	5,805	4,201	136,211
2007	118,450	9,774	5,898	4,234	138,356
2008	120,345	9,930	5,993	4,268	140,536
2009	122,271	10,089	6,089	4,302	142,751
2010	124,227	10,251	6,186	4,337	145,000
2011	126,215	10,415	6,285	4,371	147,286
2012	128,234	10,581	6,386	4,406	149,607
2013	130,286	10,751	6,488	4,442	151,966
2014	132,370	10,923	6,592	4,477	154,362
2015	134,488	11,097	6,697	4,513	156,796
2016	136,640	11,275	6,804	4,549	159,268
2017	138,826	11,455	6,913	4,585	161,780
2018	141,047	11,639	7,024	4,622	164,332
2019	143,304	11,825	7,136	4,659	166,924
2020	145,597	12,014	7,250	4,696	169,558
2021	147,927	12,206	7,366	4,734	172,233
2022	150,293	12,402	7,484	4,772	174,951
2023	152,698	12,600	7,604	4,810	177,712
2024	155,141	12,802	7,725	4,849	180,517
2025	157,624	13,006	7,849	4,887	183,366
2026	160,146	13,215	7,975	4,926	186,261
2027	162,708	13,426	8,102	4,966	189,202
2028	165,311	13,641	8,232	5,006	192,189
2029	167,956	13,859	8,364	5,046	195,224
2030	170,643	14,081	8,497	5,086	198,308
2031	173,374	14,306	8,633	5,127	201,440
2032	176,148	14,535	8,771	5,168	204,622
2033	178,966	14,768	8,912	5,209	207,855
2034	181,830	15,004	9,054	5,251	211,139
2035	184,739	15,244	9,199	5,293	214,475
2036	187,695	15,488	9,346	5,335	217,864
2037	190,698	15,736	9,496	5,378	221,307
2038	193,749	15,987	9,648	5,421	224,805
2039	196,849	16,243	9,802	5,464	228,359
2040	199,999	16,503	9,959	5,508	231,969

Table 0-71 Baseline (50-State) SO_2 Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2006	83,769	6,637	3,085	3,018	96,510
2007	85,110	6,743	3,134	3,042	98,030
2008	10,088	799	372	358	11,617
2009	10,250	812	377	361	11,800
2010	10,414	825	384	364	11,986
2011	10,580	838	390	366	12,175
2012	10,750	852	396	369	12,367
2013	312	25	11	11	359
2014	317	25	12	11	365
2015	322	26	12	11	370
2016	327	26	12	11	376
2017	333	26	12	11	382
2018	338	27	12	11	388
2019	343	27	13	11	394
2020	349	28	13	11	400
2021	354	28	13	11	407
2022	360	29	13	11	413
2023	366	29	13	12	420
2024	372	29	14	12	426
2025	378	30	14	12	433
2026	384	30	14	12	440
2027	390	31	14	12	447
2028	396	31	15	12	454
2029	402	32	15	12	461
2030	409	32	15	12	468
2031	415	33	15	12	476
2032	422	33	16	12	483
2033	429	34	16	12	491
2034	435	35	16	13	499
2035	442	35	16	13	506
2036	450	36	17	13	515
2037	457	36	17	13	523
2038	464	37	17	13	531
2039	471	37	17	13	539
2040	479	38	18	13	548

Table 0-72 Baseline (50-State) Air Toxics Emissions for Locomotives (short tons)

HAP	1999	2010	2015	2020	2030
BENZENE	92	84	82	80	76
FORMALDEHYDE	1,467	1,339	1,318	1,280	1,214
ACETALDEHYDE	640	584	575	558	530
1,3-BUTADIENE	107	98	96	93	88
ACROLEIN	104	94	93	90	86
NAPHTHALENE	58	42	40	38	34
POM	35	25	24	23	20

3.3.3 Control Inventory Development

Control inventories were developed in the same manner as the baseline inventories. The only change was in the emission factors.

3.3.3.1 Control Scenario Modeled

The proposed regulations would apply in largely the same manner as the existing program. Thus, the control scenario can be defined simply by the proposed standards and the model years for which they would become effective. Two new sets of emission standards are being proposed: line-haul locomotive standards and switch locomotive standards. The line-haul standards would apply for freight and passenger line-haul locomotives, while the switch standards would apply for freight and passenger switch locomotives. Note; we are not changing the emission standards for CO.

As in the baseline analysis, average in-use emission factors for the analysis of the proposed standards were generally assumed to be 10 percent below the applicable standards, to account for deterioration of emissions throughout the useful life, production variations, and the compliance margins that manufacturers incorporate into their designs. The exceptions to this general rule are the HC emissions for all locomotives and the NO_x emissions for Tier 4 locomotives. While we are not proposing changes to the Tier 3 or earlier HC standards, we expect the emission controls for PM_{10} will generally achieve proportional reductions in HC. For Tier 4 NO_x standards, we expect that manufacturers will need to have lower zero-hour emission rates to account for potential deterioration and include larger compliance margins (expressed as a percentage of the standards).

The emission factors used to generate the control case inventories are given in Table 0-73 and Table 0-74.

Table 0-73 Projected Line-Haul Emission Factors with Proposed Standards

Tier	Initial Model Year	NO_x (g/bhp-hr)	PM_{10} (g/bhp-hr)	HC (g/bhp-hr)
TIER 0	2008/2010[A]	8.60	0.20	0.30
TIER 1	2008/2010	6.70	0.20	0.29
TIER 2	2013	4.95	0.09	0.13
TIER 3	2012	4.95	0.09	0.13
TIER 4	2015/2017[B]	1.00	0.027	0.04

[A] The new Tier 0 standard would apply in 2008 where kits are available, and for all locomotives in 2010. This is modeled as a 40/80/100 phase-in.

[B] The Tier 4 NOx standard would not apply until 2017, while the other standards would apply starting in 2015. The Tier 4 NOx standard would apply, however, at remanufacture for model year 2015 and 2016 locomotives.

Table 0-74 Projected Switch Emission Factors with Proposed Standards

Tier	Initial Model Year	NO_x (g/bhp-hr)	PM_{10} (g/bhp-hr)	HC (g/bhp-hr)
TIER 0	2008	12.60	0.25	0.57
TIER 1	2008	9.90	0.25	0.57
TIER2	2013	7.30	0.09	0.26
TIER3	2012	5.40	0.09	0.26
TIER4	2015	1.00	0.02	0.08

3.3.3.2 Locomotive Control Inventory Summary

The control locomotive inventory is shown separately for PM_{10}, $PM_{2.5}$, NO_x, VOC, and HC in Table 0-75 through Table 0-79. See section 3.3.2.5 for CO and SO_2 inventories which are not projected to change as a result of the proposed standards.

The control air toxic inventories for locomotives are provided in Table 0-80. The gas phase air toxics are assumed to be controlled proportionately to VOC, while POM is controlled proportionately to PM.

Table 0-75 Control Case PM_{10} Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2006	27,919	2,270	935	1,023	32,147
2007	27,873	2,295	950	1,011	32,129
2008	24,919	2,111	883	901	28,814
2009	24,393	2,134	897	888	28,311
2010	23,777	2,109	911	848	27,645
2011	22,544	2,128	926	809	26,407
2012	21,311	2,068	940	761	25,081
2013	20,030	2,069	944	707	23,750
2014	19,279	2,015	959	663	22,916
2015	18,377	2,029	974	623	22,003
2016	17,108	1,968	990	574	20,639
2017	15,849	1,981	1,006	527	19,363
2018	14,965	1,954	1,022	480	18,422
2019	14,113	1,968	1,038	435	17,554
2020	13,567	1,851	1,055	402	16,874
2021	13,014	1,862	1,071	379	16,326
2022	12,427	1,793	1,088	355	15,664
2023	11,831	1,774	1,106	332	15,043
2024	11,246	1,687	1,124	309	14,366
2025	10,656	1,557	1,141	286	13,641
2026	10,098	1,518	1,160	265	13,041
2027	9,561	1,473	1,178	247	12,459
2028	9,045	1,425	1,197	230	11,896
2029	8,553	1,374	1,216	215	11,358
2030	8,092	1,321	1,223	201	10,837
2031	7,656	1,263	1,230	189	10,337
2032	7,243	1,200	1,237	178	9,858
2033	6,851	1,136	1,243	168	9,398
2034	6,501	1,069	1,250	158	8,978
2035	6,181	1,001	1,256	150	8,589
2036	5,905	934	1,263	143	8,244
2037	5,661	866	1,269	136	7,933
2038	5,451	799	1,275	131	7,656
2039	5,277	733	1,281	127	7,417
2040	5,140	665	1,287	124	7,216

Table 0-76 Control Case $PM_{2.5}$ Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2006	27,082	2,202	907	992	31,183
2007	27,037	2,226	922	981	31,166
2008	24,171	2,048	856	874	27,950
2009	23,661	2,070	870	861	27,462
2010	23,063	2,046	884	823	26,816
2011	21,868	2,064	898	785	25,614
2012	20,672	2,006	912	738	24,329
2013	19,429	2,007	916	686	23,037
2014	18,701	1,954	930	643	22,228
2015	17,826	1,968	945	604	21,343
2016	16,594	1,909	960	557	20,020
2017	15,373	1,922	975	511	18,782
2018	14,516	1,896	991	466	17,869
2019	13,690	1,909	1,007	422	17,027
2020	13,160	1,795	1,023	390	16,368
2021	12,623	1,806	1,039	367	15,836
2022	12,054	1,740	1,056	345	15,194
2023	11,476	1,721	1,073	322	14,592
2024	10,909	1,637	1,090	300	13,935
2025	10,336	1,511	1,107	277	13,232
2026	9,795	1,473	1,125	257	12,650
2027	9,274	1,429	1,143	239	12,085
2028	8,773	1,382	1,161	223	11,539
2029	8,297	1,332	1,180	208	11,017
2030	7,849	1,281	1,186	195	10,512
2031	7,426	1,225	1,193	183	10,027
2032	7,026	1,164	1,200	172	9,562
2033	6,645	1,102	1,206	163	9,116
2034	6,306	1,037	1,212	154	8,709
2035	5,996	971	1,219	145	8,331
2036	5,728	906	1,225	138	7,997
2037	5,491	840	1,231	132	7,695
2038	5,287	775	1,237	127	7,426
2039	5,118	711	1,243	123	7,195
2040	4,985	645	1,248	120	6,999

Table 0-77 Control Case NO_x Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2006	779,842	86,861	37,690	38,466	942,858
2007	770,409	87,803	38,293	36,409	932,914
2008	757,789	87,056	38,906	34,361	918,111
2009	751,364	87,999	39,528	32,338	911,229
2010	731,807	87,513	40,161	29,845	889,326
2011	705,203	88,324	40,803	27,408	861,738
2012	692,606	86,614	41,456	25,933	846,609
2013	679,298	87,409	42,119	24,545	833,372
2014	673,879	85,623	42,793	23,239	825,533
2015	670,297	86,221	43,168	22,879	822,565
2016	658,944	84,610	43,544	21,717	808,815
2017	628,992	85,186	43,921	20,575	778,674
2018	608,010	84,612	44,299	19,496	756,417
2019	588,239	85,177	44,609	18,438	736,463
2020	569,144	80,769	44,917	17,662	712,492
2021	549,859	81,278	45,224	16,903	693,264
2022	529,725	78,845	45,529	16,144	670,243
2023	490,882	78,025	45,832	14,732	629,471
2024	451,535	74,751	46,134	13,316	585,735
2025	431,091	70,098	46,433	12,558	560,179
2026	411,268	68,538	46,730	11,833	538,369
2027	391,811	66,724	46,863	11,182	516,581
2028	372,842	64,743	46,989	10,555	495,130
2029	354,485	62,635	47,107	9,948	474,175
2030	336,949	60,285	47,062	9,355	453,651
2031	320,021	57,681	47,002	8,775	433,480
2032	303,667	54,892	46,929	8,204	413,692
2033	287,812	52,013	46,842	7,641	394,307
2034	272,853	48,969	46,739	7,082	375,643
2035	258,735	45,924	46,622	6,527	357,807
2036	246,204	42,882	46,488	6,048	341,622
2037	234,905	39,846	46,339	5,623	326,713
2038	224,870	36,814	46,172	5,270	313,127
2039	216,190	33,806	45,989	4,986	300,970
2040	208,892	30,761	45,788	4,765	290,205

Table 0-78 Control Case VOC Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2006	43,874	5,501	2,891	1,609	53,874
2007	43,762	5,566	2,937	1,589	53,853
2008	42,998	5,488	2,984	1,568	53,037
2009	42,008	5,552	3,032	1,546	52,137
2010	40,825	5,483	3,080	1,470	50,858
2011	38,373	5,534	3,129	1,395	48,431
2012	35,890	5,364	3,179	1,301	45,734
2013	33,597	5,413	3,230	1,210	43,451
2014	31,991	5,253	3,282	1,122	41,648
2015	30,268	5,291	3,335	1,045	39,939
2016	27,758	5,112	3,388	952	37,210
2017	25,275	5,147	3,442	861	34,725
2018	23,607	5,066	3,497	771	32,941
2019	22,010	5,100	3,553	683	31,346
2020	21,142	4,760	3,610	623	30,135
2021	20,266	4,790	3,668	586	29,310
2022	19,340	4,588	3,726	549	28,204
2023	18,402	4,538	3,786	512	27,238
2024	17,483	4,291	3,847	476	26,096
2025	16,556	3,916	3,908	439	24,819
2026	15,681	3,810	3,971	406	23,869
2027	14,839	3,692	4,034	377	22,943
2028	14,031	3,565	4,099	351	22,047
2029	13,263	3,432	4,164	328	21,187
2030	12,543	3,302	4,231	307	20,383
2031	11,863	3,160	4,299	288	19,609
2032	11,220	3,009	4,367	270	18,866
2033	10,611	2,853	4,437	255	18,156
2034	10,068	2,689	4,508	241	17,506
2035	9,573	2,525	4,580	228	16,907
2036	9,147	2,362	4,654	217	16,379
2037	8,771	2,199	4,728	207	15,906
2038	8,448	2,037	4,804	199	15,488
2039	8,182	1,876	4,881	193	15,132
2040	7,974	1,714	4,959	188	14,835

Table 0-79 Control Case HC Emissions for Locomotives (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2006	41,665	5,225	2,745	1,528	51,163
2007	41,559	5,285	2,789	1,509	51,143
2008	40,834	5,211	2,834	1,489	50,368
2009	39,894	5,272	2,879	1,468	49,513
2010	38,770	5,207	2,925	1,396	48,298
2011	36,441	5,255	2,972	1,325	45,993
2012	34,083	5,094	3,019	1,236	43,432
2013	31,906	5,141	3,068	1,149	41,264
2014	30,381	4,989	3,117	1,065	39,552
2015	28,745	5,025	3,167	993	37,929
2016	26,361	4,854	3,217	904	35,337
2017	24,003	4,888	3,269	817	32,977
2018	22,419	4,811	3,321	732	31,283
2019	20,902	4,844	3,374	648	29,769
2020	20,078	4,521	3,428	591	28,618
2021	19,246	4,549	3,483	556	27,835
2022	18,367	4,357	3,539	521	26,784
2023	17,476	4,310	3,595	487	25,867
2024	16,603	4,075	3,653	452	24,783
2025	15,722	3,719	3,711	417	23,570
2026	14,892	3,619	3,771	386	22,667
2027	14,092	3,506	3,831	358	21,788
2028	13,325	3,386	3,892	334	20,937
2029	12,595	3,259	3,955	311	20,121
2030	11,912	3,136	4,018	291	19,357
2031	11,266	3,001	4,082	273	18,622
2032	10,655	2,857	4,148	257	17,917
2033	10,077	2,709	4,214	242	17,242
2034	9,561	2,554	4,281	229	16,625
2035	9,092	2,398	4,350	216	16,056
2036	8,687	2,243	4,419	206	15,555
2037	8,330	2,089	4,490	197	15,105
2038	8,023	1,934	4,562	189	14,709
2039	7,770	1,782	4,635	183	14,370
2040	7,573	1,627	4,709	178	14,088

Table 0-80 Control Case Air Toxic Emissions for Locomotives (short tons)

HAP	2010	2015	2020	2030
BENZENE	79	62	46	30
FORMALDEHYDE	1,269	990	733	478
ACETALDEHYDE	554	432	320	208
1,3-BUTADIENE	92	72	53	35
ACROLEIN	90	70	52	34
NAPHTHALENE	40	30	22	13
POM	24	19	14	9

3.3.4 Projected Locomotive Emission Reductions from the Proposed Rule

The projected emission reductions for $PM_{2.5}$, NO_x and VOC for each category and calendar year are given in Table 0-81, Table 0-82, and Table 0-83. Table 0-84 presents the air toxic emission reductions.

Table 0-81 Projected Locomotive $PM_{2.5}$ Emission Reductions (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2008	154	49	0	0	203
2009	555	50	0	0	604
2010	1,023	96	0	24	1,144
2011	2,078	101	0	49	2,227
2012	3,128	182	0	81	3,391
2013	3,865	183	0	107	4,155
2014	4,457	259	0	135	4,850
2015	5,186	269	0	159	5,614
2016	6,260	352	0	191	6,803
2017	7,323	363	0	222	7,908
2018	8,026	413	0	253	8,692
2019	8,699	425	0	283	9,406
2020	9,070	563	0	300	9,933
2021	9,444	577	0	308	10,329
2022	9,848	669	0	316	10,832
2023	10,258	694	0	324	11,276
2024	10,668	778	0	332	11,777
2025	11,081	898	0	339	12,318
2026	11,490	926	0	348	12,764
2027	11,907	953	0	356	13,216
2028	12,329	979	0	365	13,674
2029	12,755	1,006	0	375	14,136
2030	13,185	1,027	0	385	14,597
2031	13,619	1,048	0	396	15,063
2032	14,057	1,068	0	407	15,532
2033	14,501	1,087	0	419	16,007
2034	14,932	1,106	0	432	16,470
2035	15,366	1,125	0	445	16,936
2036	15,794	1,144	0	457	17,394
2037	16,215	1,163	0	467	17,846
2038	16,632	1,182	0	477	18,291
2039	17,042	1,201	0	486	18,730
2040	17,447	1,220	0	494	19,161

Table 0-82 Projected Locomotive NO_x Emission Reductions (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2008	3,978	568	0	0	4,546
2009	4,126	575	0	0	4,700
2010	13,624	1,111	0	526	15,261
2011	30,439	1,261	0	1,051	32,751
2012	37,425	2,295	0	1,278	40,999
2013	46,819	2,463	0	1,472	50,753
2014	48,487	3,468	0	1,634	53,588
2015	48,503	3,834	0	1,503	53,840
2016	55,949	5,072	0	1,608	62,630
2017	82,372	5,467	0	2,347	90,186
2018	100,515	6,263	0	3,063	109,841
2019	118,236	6,681	0	3,759	128,676
2020	135,209	8,598	0	4,175	147,982
2021	152,589	9,054	0	4,574	166,217
2022	170,780	10,386	0	4,975	186,141
2023	207,999	11,370	0	6,065	225,434
2024	246,202	13,144	0	7,195	266,541
2025	265,831	15,424	0	7,699	288,954
2026	285,577	16,767	0	8,233	310,577
2027	305,677	18,237	0	8,753	332,667
2028	325,972	19,795	0	9,305	355,071
2029	346,408	21,423	0	9,888	377,719
2030	366,898	23,173	0	10,504	400,575
2031	387,533	25,050	0	11,151	423,735
2032	408,322	27,025	0	11,828	447,175
2033	429,288	29,054	0	12,519	470,861
2034	450,106	31,171	0	13,223	494,501
2035	470,970	33,304	0	13,941	518,215
2036	491,170	35,451	0	14,584	541,204
2037	510,838	37,609	0	15,173	563,621
2038	529,966	39,782	0	15,693	585,440
2039	548,521	41,960	0	16,145	606,626
2040	566,497	44,171	0	16,534	627,202

Table 0-83 Projected Locomotive VOC Emission Reductions (short tons)

Calendar Year	Large Line-haul	Large Switch	Small Railroads	Passenger/ Commuter	Total
2008	638	143	0	0	780
2009	1,477	144	0	0	1,622
2010	2,476	279	0	52	2,808
2011	4,727	296	0	105	5,128
2012	7,002	534	0	175	7,711
2013	9,102	554	0	242	9,899
2014	10,527	784	0	307	11,617
2015	12,054	817	0	359	13,230
2016	14,349	1,067	0	428	15,844
2017	16,617	1,104	0	495	18,217
2018	18,078	1,259	0	561	19,897
2019	19,468	1,299	0	625	21,392
2020	20,122	1,714	0	661	22,498
2021	20,778	1,760	0	674	23,212
2022	21,480	2,040	0	687	24,206
2023	22,194	2,126	0	699	25,020
2024	22,908	2,395	0	713	26,016
2025	23,629	2,780	0	726	27,135
2026	24,346	2,887	0	740	27,973
2027	25,077	2,993	0	754	28,825
2028	25,819	3,100	0	770	29,688
2029	26,570	3,207	0	786	30,563
2030	27,329	3,297	0	803	31,430
2031	28,099	3,387	0	822	32,308
2032	28,878	3,477	0	841	33,196
2033	29,667	3,566	0	861	34,095
2034	30,439	3,656	0	882	34,977
2035	31,220	3,745	0	904	35,869
2036	31,992	3,835	0	924	36,752
2037	32,759	3,926	0	943	37,628
2038	33,521	4,016	0	960	38,497
2039	34,276	4,107	0	976	39,360
2040	35,026	4,198	0	990	40,214

Table 0-84 Projected Locomotive Air Toxic Emission Reductions (short tons)

HAP	2010	2015	2020	2030
BENZENE	4	20	34	46
FORMALDEHYDE	70	328	547	736
ACETALDEHYDE	31	143	239	321
1,3-BUTADIENE	5	24	40	54
ACROLEIN	5	23	39	52
NAPHTHALENE	2	10	16	20
POM	1	5	9	12

3.4 Projected Total Emission Reductions from the Proposed Rule

The total base and control inventories, as well as emission reductions by calendar year, for $PM_{2.5}$, NO_x, and VOC are given in Table 0-85. The totals include emissions from the three major categories affected by this proposed rule: commercial marine diesel engines, recreational marine diesel engines, and locomotives. The results for $PM_{2.5}$ and NO_x are also illustrated in Figure 1 and Figure 2. Reductions by pollutant and category are also provided in Table 0-86 thru Table 0-88.

The total air toxics reductions are provided in Table 0-89.

Calendar year 2040 was chosen as the end date for the analysis; however, additional reductions are expected to occur beyond this date.

Figure 1 Estimated PM2.5 Reductions from Locomotive and Marine Diesel Engine Standards (short tons)

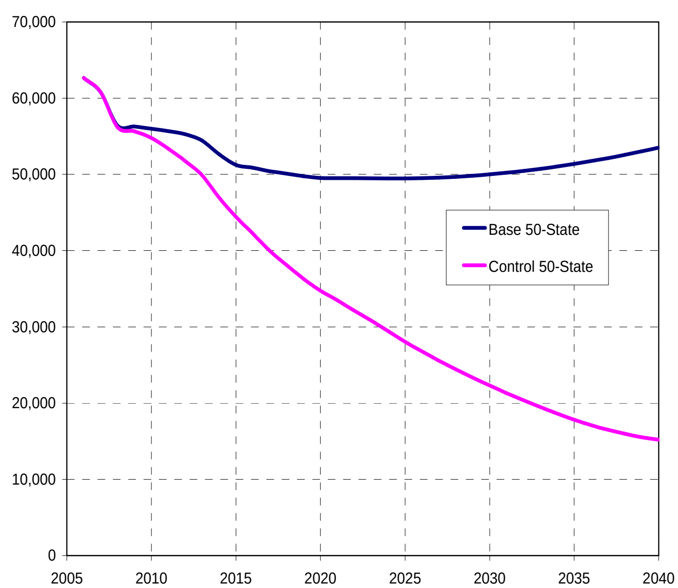

Figure 2 Estimated NOx Reductions from Locomotive and Marine Diesel Engine Standards (short tons)

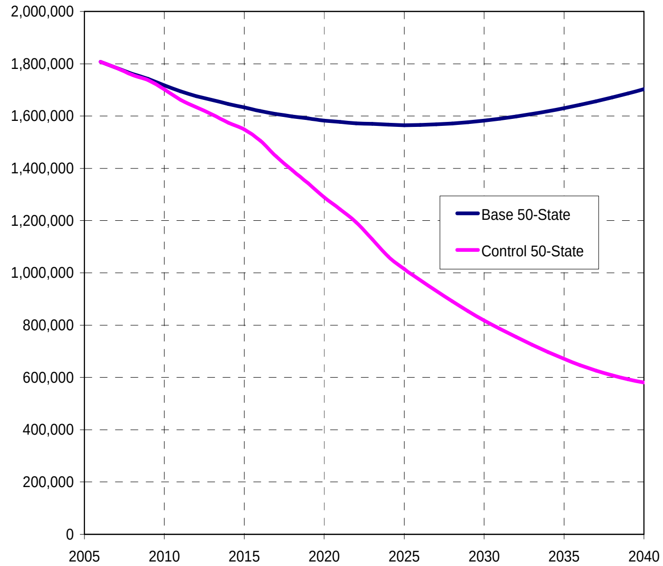

Table 0-85 Total Emissions and Projected Reductions (short tons)

Year	$PM_{2.5}$			NO_X			VOC		
	Base	Control	Reduction	Base	Control	Reduction	Base	Control	Reduction
2006	62,653	62,653	0	1,807,216	1,807,216	0	72,872	72,872	0
2007	60,785	60,785	0	1,784,284	1,784,284	0	72,776	72,776	0
2008	56,405	56,202	203	1,761,171	1,756,625	4,546	72,667	71,887	780
2009	56,302	55,694	608	1,741,683	1,736,983	4,700	72,541	70,912	1,629
2010	55,976	54,826	1,149	1,717,796	1,702,535	15,261	72,386	69,562	2,824
2011	55,667	53,431	2,236	1,695,396	1,662,645	32,751	72,219	67,068	5,151
2012	55,283	51,813	3,469	1,676,501	1,633,993	42,508	72,052	64,182	7,870
2013	54,424	49,943	4,481	1,661,733	1,605,845	55,888	71,909	61,608	10,301
2014	52,646	47,011	5,635	1,646,170	1,574,799	71,371	71,784	59,291	12,494
2015	51,240	44,466	6,775	1,633,374	1,549,093	84,281	71,657	57,077	14,580
2016	50,872	42,313	8,560	1,618,865	1,506,062	112,803	71,528	53,750	17,778
2017	50,424	40,026	10,397	1,608,049	1,445,528	162,520	71,437	50,613	20,824
2018	50,095	38,133	11,962	1,598,602	1,392,149	206,453	71,388	48,170	23,218
2019	49,764	36,308	13,455	1,591,433	1,341,927	249,506	71,359	45,937	25,421
2020	49,543	34,767	14,776	1,582,106	1,289,199	292,907	71,357	44,126	27,231
2021	49,514	33,501	16,013	1,577,901	1,242,771	335,130	71,382	42,738	28,645
2022	49,514	32,145	17,369	1,572,450	1,193,565	378,885	71,420	41,090	30,330
2023	49,496	30,821	18,675	1,569,867	1,128,045	441,821	71,431	39,604	31,827
2024	49,481	29,436	20,045	1,567,335	1,061,013	506,322	71,456	37,963	33,493
2025	49,473	28,027	21,446	1,564,909	1,013,286	551,623	71,477	36,228	35,249
2026	49,505	26,772	22,733	1,566,090	970,582	595,508	71,547	34,867	36,680
2027	49,575	25,572	24,003	1,568,322	929,227	639,095	71,659	33,581	38,077
2028	49,683	24,424	25,258	1,571,677	889,403	682,274	71,817	32,369	39,448
2029	49,831	23,330	26,501	1,576,224	851,600	724,624	72,027	31,228	40,799
2030	50,009	22,290	27,719	1,582,353	816,578	765,775	72,290	30,184	42,106
2031	50,219	21,303	28,916	1,589,972	784,030	805,941	72,597	29,208	43,389
2032	50,460	20,363	30,097	1,598,625	753,109	845,516	72,950	28,293	44,657
2033	50,733	19,462	31,271	1,608,222	723,487	884,735	73,349	27,432	45,917
2034	51,032	18,612	32,420	1,618,723	695,357	923,366	73,794	26,651	47,144
2035	51,368	17,812	33,557	1,630,331	668,881	961,451	74,302	25,939	48,364
2036	51,741	17,097	34,644	1,643,034	645,058	997,976	74,873	25,320	49,553
2037	52,142	16,482	35,660	1,656,625	624,387	1,032,239	75,493	24,787	50,705
2038	52,572	15,953	36,620	1,671,116	606,737	1,064,379	76,163	24,337	51,826
2039	53,034	15,507	37,527	1,686,564	591,798	1,094,766	76,888	23,968	52,920
2040	53,526	15,166	38,360	1,702,935	579,393	1,123,542	77,667	23,684	53,983

Table 0-86 Projected Total $PM_{2.5}$ Emission Reductions (short tons)

YEAR	COMMERCIAL MARINE	RECREATIONAL MARINE	LOCOMOTIVES	TOTAL
2008	0	0	203	203
2009	3	0	604	608
2010	6	0	1,144	1,149
2011	8	1	2,227	2,236
2012	76	3	3,391	3,469
2013	321	5	4,155	4,481
2014	776	8	4,850	5,635
2015	1,149	12	5,614	6,775
2016	1,740	16	6,803	8,560
2017	2,469	21	7,908	10,397
2018	3,245	25	8,692	11,962
2019	4,019	30	9,406	13,455
2020	4,808	35	9,933	14,776
2021	5,644	41	10,329	16,013
2022	6,491	46	10,832	17,369
2023	7,347	52	11,276	18,675
2024	8,210	58	11,777	20,045
2025	9,064	63	12,318	21,446
2026	9,899	70	12,764	22,733
2027	10,711	76	13,216	24,003
2028	11,503	82	13,674	25,258
2029	12,277	88	14,136	26,501
2030	13,027	95	14,597	27,719
2031	13,752	101	15,063	28,916
2032	14,458	107	15,532	30,097
2033	15,151	112	16,007	31,271
2034	15,834	116	16,470	32,420
2035	16,500	120	16,936	33,557
2036	17,126	124	17,394	34,644
2037	17,686	127	17,846	35,660
2038	18,198	130	18,291	36,620
2039	18,664	133	18,730	37,527
2040	19,063	136	19,161	38,360

Table 0-87 Projected Total NO_x Emission Reductions (short tons)

YEAR	COMMERCIAL MARINE	RECREATIONAL MARINE	LOCOMOTIVES	TOTAL
2008	0	0	4,546	4,546
2009	0	0	4,700	4,700
2010	0	0	15,261	15,261
2011	0	0	32,751	32,751
2012	1,463	47	40,999	42,508
2013	4,935	200	50,753	55,888
2014	17,326	458	53,588	71,371
2015	29,723	718	53,840	84,281
2016	49,151	1,022	62,630	112,803
2017	71,006	1,328	90,186	162,520
2018	94,975	1,637	109,841	206,453
2019	118,882	1,947	128,676	249,506
2020	142,666	2,260	147,982	292,907
2021	166,339	2,574	166,217	335,130
2022	189,855	2,889	186,141	378,885
2023	213,181	3,206	225,434	441,821
2024	236,257	3,524	266,541	506,322
2025	258,828	3,842	288,954	551,623
2026	280,771	4,160	310,577	595,508
2027	301,951	4,477	332,667	639,095
2028	322,410	4,793	355,071	682,274
2029	341,797	5,108	377,719	724,624
2030	359,780	5,419	400,575	765,775
2031	376,481	5,725	423,735	805,941
2032	392,324	6,016	447,175	845,516
2033	407,598	6,277	470,861	884,735
2034	422,367	6,498	494,501	923,366
2035	436,542	6,693	518,215	961,451
2036	449,899	6,873	541,204	997,976
2037	461,578	7,039	563,621	1,032,239
2038	471,739	7,199	585,440	1,064,379
2039	480,787	7,353	606,626	1,094,766
2040	488,838	7,502	627,202	1,123,542

Table 0-88 Projected Total VOC Emission Reductions (short tons)

YEAR	COMMERCIAL MARINE	RECREATIONAL MARINE	LOCOMOTIVES	TOTAL
2008	0	0	780	780
2009	7	1	1,622	1,629
2010	14	1	2,808	2,824
2011	22	2	5,128	5,151
2012	152	8	7,711	7,870
2013	383	20	9,899	10,301
2014	837	40	11,617	12,494
2015	1,290	61	13,230	14,580
2016	1,848	86	15,844	17,778
2017	2,497	111	18,217	20,824
2018	3,183	137	19,897	23,218
2019	3,867	163	21,392	25,421
2020	4,545	188	22,498	27,231
2021	5,218	215	23,212	28,645
2022	5,883	241	24,206	30,330
2023	6,539	267	25,020	31,827
2024	7,183	294	26,016	33,493
2025	7,794	320	27,135	35,249
2026	8,360	347	27,973	36,680
2027	8,880	373	28,825	38,077
2028	9,360	400	29,688	39,448
2029	9,811	426	30,563	40,799
2030	10,225	452	31,430	42,106
2031	10,605	477	32,308	43,389
2032	10,960	501	33,196	44,657
2033	11,300	523	34,095	45,917
2034	11,625	541	34,977	47,144
2035	11,936	558	35,869	48,364
2036	12,228	573	36,752	49,553
2037	12,490	587	37,628	50,705
2038	12,728	600	38,497	51,826
2039	12,947	613	39,360	52,920
2040	13,143	626	40,214	53,983

Table 0-89 Projected Total Air Toxic Emission Reductions (short tons)

HAP	2010	2015	2020	2030
BENZENE	5	66	198	422
FORMALDEHYDE	74	661	1,751	3,494
ACETALDEHYDE	32	308	836	1,691
1,3-BUTADIENE	5	24	42	58
ACROLEIN	5	30	62	105
NAPHTHALENE	2	13	27	44
POM	1	6	11	17

3.5 Contribution of Marine Diesel Engines and Locomotives to Baseline National Emission Inventories

This section provides the contribution of marine diesel engines and locomotives to baseline nationwide emission inventories in 2001, 2020, and 2030. The baseline represents current and future emissions with the existing standards. The calendar years correspond to those chosen for the air quality modeling.

The pollutants included in this section are directly emitted $PM_{2.5}$, NO_x, VOC, CO, and SO_2. While we do not provide estimates for other pollutants here, it should be noted that the affected engines also contribute to national ammonia (NH_3) and air toxics inventories.

3.5.1 Categories and Sources of Data

As described more fully earlier in this chapter, our current inventories for marine diesel engines and locomotives were developed using multiple methodologies, but they all are based on combining engine populations, hours of use, average engine loads, and in-use emissions factors. Locomotive emissions were calculated based on estimated current and projected fuel consumption rates. Emissions were calculated separately for the following locomotive categories: Large Railroad Line-Haul Locomotives, Large Railroad Switching (including Class II/III Switch railroads owned by Class I railroads), Other Line-Haul Locomotives (i.e., Class II/III local and regional railroads), Other Switcher/Terminal Locomotives and Passenger Locomotives. The inventories for marine diesel engines were created separately for Category 1 and 2 propulsion and auxiliary engines, including those less than or equal to 37 kW, and diesel fueled recreational marine propulsion engines.

The locomotive, commercial marine (C1 & C2), and diesel recreational marine values given for 2001 are actually 2002 estimates, since that is the base year that was used for air quality modeling. The stationary, aircraft, onroad diesel, and C3 commercial marine values are from the PM NAAQS 2001 air quality modeling platform, which is more recent than, but essentially the same as CAIR (2001 platform) for these sources. The 2030 stationary source values are set equal to 2020, since no specific estimates for 2030 stationary source emissions are available. All the stationary source values exclude "non-manmade" sources, such as fires and fugitive dust. Onroad gasoline vehicle values are from the National Mobile Inventory Model (NMIM) outputs for the final Mobile Source Air Toxics rulemaking, which includes the assumed implementation of Renewable Fuels Standards (RFS) and corrections for cold-start HC effects. Nonroad land-based diesel values are from the latest publicly released version of EPA's nonroad model (NONROAD2005a). Nonroad spark-ignition (SI) values in these tables (small SI, SI recreational marine, large SI, and SI recreational vehicles) are also from NONROAD2005a. The NONROAD2005 model runs were all run at the nationwide/annual level using single default nationwide temperature & RVP, using the full 50-state equipment population including all California equipment.

3.5.2 $PM_{2.5}$ Contributions to Baseline

Table 0-90 provides the contribution of locomotives and diesel-fueled recreational and commercial marine engines to mobile source diesel and to total man-made $PM_{2.5}$ emissions. $PM_{2.5}$ emissions from these sources are 18 percent of the mobile source diesel $PM_{2.5}$ emissions in 2001, and this percentage increases to about 65 percent by 2030. $PM_{2.5}$ emissions from the affected sources decreases from 59,000 tons in 2002 to 50,000 tons in 2020 due to the existing emission standards. From 2020 to 2025 emissions remain relatively constant as growth offsets the effect of continued turnover of older engines to engines meeting the existing emission standards. These emissions begin to increase again around 2025 and exceed 2015 levels by 2035.

3.5.3 NO_x Contributions to Baseline

Table 0-91 provides the contribution of locomotives and diesel-fueled recreational and commercial marine engines to mobile source NO_x and to total man-made NO_x emissions. NO_x emissions from these sources are 16 percent of the mobile source NO_x emissions in 2001, and this percentage increases to 35 percent by 2030. NO_x emissions from affected sources decrease from 1,993,000 tons in 2002 to 1,582,000 tons in 2020 due to the existing emission standards. From 2020 to 2025 emissions remain relatively constant as growth offsets the effect of continued turnover of older engines to engines meeting the existing emission standards. These emissions begin to increase again in 2025 and by 2035 exceed 2015 emission levels.

3.5.4 VOC Contributions to Baseline

Table 0-92 provides the contribution of locomotives and diesel-fueled recreational and commercial marine engines to mobile source VOC and to total man-made VOC emissions. Due to the efficient combustion in diesel engines, mobile source VOC emissions are dominated by spark-ignition engines, and the VOC emissions from the affected sources are only 0.8 percent of the mobile source VOC in 2001, increasing to 1.3 percent by 2030. VOC emissions from affected sources increase from 67,000 tons in 2002 to 71,000 tons in 2020 and 72,000 tons in 2030, since the existing emission standards are not aimed at controlling VOC.

3.5.5 CO Contributions to Baseline

Table 0-93 provides the contribution of locomotives and diesel-fueled recreational and commercial marine engines to mobile source carbon monoxide (CO) and to total man-made CO emissions. As with VOC, mobile source CO emissions are dominated by spark-ignition engines, so the CO emissions from the affected sources are only 0.3 percent of the mobile source CO in 2001, increasing to 0.5 percent by 2030. CO emissions from affected sources increase from 281,000 tons in 2002 to 319,000 tons in 2020 and 353,000 tons in 2030, since the existing emission standards are not aimed at controlling CO.

3.5.6 SO_2 Contributions to Baseline

Table 0-94 provides the contribution of locomotives and diesel-fueled recreational and commercial marine engines to mobile source SO_2 and to total man-made SO_2 emissions. SO_2 emissions from these sources are 21 percent of the mobile source SO_2 emissions in 2001, and this percentage decreases significantly to about one percent in 2020 and 2030 due to existing diesel fuel sulfur standards. SO_2 emissions from affected sources decrease from 162,000 tons in 2002 to 3,700 tons in 2020. From 2020 to 2030 emissions increase to 4,200 tons due to continued projected growth in these sectors.

Table 0-90 50-State Annual PM $_{2.5}$ Baseline Emission Levels for Mobile and Other Source Categories

Category	2001*			2020			2030		
	short tons	% of diesel mobile	% of total	short tons	% of diesel mobile	% of total	short tons	% of diesel mobile	% of total
Locomotive	29,660	8.9%	1.2%	26,301	23.6%	1.3%	25,109	32.2%	1.2%
Recreational Marine Diesel	1,096	0.3%	0.0%	1,006	0.9%	0.0%	1,140	1.5%	0.1%
Commercial Marine (C1 & C2)	28,730	8.6%	1.2%	22,236	20.0%	1.1%	23,760	30.5%	1.1%
Land-Based Nonroad Diesel	164,180	49.2%	6.8%	46,075	41.4%	2.2%	17,934	23.0%	0.9%
Commercial Marine (C3)**	20,023	-	0.8%	36,141	-	1.7%	52,682	-	2.5%
Small Nonroad SI	25,575		1.1%	31,083		1.5%	35,761		1.7%
Recreational Marine SI	17,101		0.7%	6,595		0.3%	6,378		0.3%
SI Recreational Vehicles	12,301		0.5%	11,773		0.6%	9,953		0.5%
Large Nonroad SI (>25hp)	1,610		0.1%	2,421		0.1%	2,844		0.1%
Aircraft	5,664		0.2%	7,044		0.3%	8,569		0.4%
Total Off Highway	305,941		12.6%	190,675		9.2%	184,130		8.9%
Highway Diesel	109,952	33.0%	4.5%	15,800	14.2%	0.8%	10,072	12.9%	0.5%
Highway non-diesel	50,277		2.1%	47,354		2.3%	56,734		2.7%
Total Highway	160,229		6.6%	63,154		3.0%	66,806		3.2%
Total Diesel (distillate) Mobile	333,619	100%	13.7%	111,418	100%	5.4%	78,015	100%	3.8%
Total Mobile Sources	466,170		19.2%	253,829		12.3%	250,936		12.1%
Stationary Point and Area Sources	1,963,264		80.8%	1,817,722		87.7%	1,817,722		87.9%
Total Man-Made Sources	2,429,434		100%	2,071,551		100%	2,068,658		100%

* The locomotive, commercial marine (C1 & C2), and diesel recreational marine estimates are for calendar year 2002.
** This category includes emissions from Category 3 (C3) propulsion engines and C2/3 auxiliary engines used on ocean-going vessels.

Table 0-91 50-State Annual NO_x Baseline Emission Levels for Mobile and Other Source Categories

Category	**2001***			**2020**			**2030**		
	short tons	% of mobile source	% of total	short tons	% of mobile source	% of total	short tons	% of mobile source	% of total
Locomotive	1,118,786	9.0%	5.1%	860,474	17.2%	7.8%	854,226	19.0%	8.1%
Recreational Marine Diesel	40,437	0.3%	0.2%	45,477	0.9%	0.4%	48,102	1.1%	0.5%
Commercial Marine (C1 & C2)	834,025	6.7%	3.8%	676,154	13.6%	6.1%	680,025	15.1%	6.4%
Land-Based Nonroad Diesel	1,548,236	12.5%	7.1%	678,377	13.6%	6.1%	434,466	9.7%	4.1%
Commercial Marine (C3)**	224,100	1.8%	1.0%	369,160	7.4%	3.3%	531,641	11.8%	5.0%
Small Nonroad SI	100,319	0.8%	0.5%	98,620	2.0%	0.9%	114,287	2.5%	1.1%
Recreational Marine SI	42,252	0.3%	0.2%	83,312	1.7%	0.8%	92,188	2.1%	0.9%
SI Recreational Vehicles	5,488	0.0%	0.0%	17,496	0.4%	0.2%	20,136	0.4%	0.2%
Large Nonroad SI (>25hp)	321,098	2.6%	1.5%	46,319	0.9%	0.4%	46,253	1.0%	0.4%
Aircraft	83,764	0.7%	0.4%	105,133	2.1%	0.9%	118,740	2.6%	1.1%
Total Off Highway	4,318,505	34.8%	19.8%	2,980,523	59.7%	26.9%	2,940,064	65.5%	27.7%
Highway Diesel	3,750,886	30.2%	17.2%	646,961	13.0%	5.8%	260,915	5.8%	2.5%
Highway non-diesel	4,354,430	35.0%	20.0%	1,361,276	27.3%	12.3%	1,289,780	28.7%	12.2%
Total Highway	8,105,316	65.2%	37.2%	2,008,237	40.3%	18.1%	1,550,695	34.5%	14.6%
Total Diesel (distillate) Mobile	7,292,308	58.7%	33.5%	2,907,578	58.3%	26.2%	2,277,735	50.7%	21.5%
Total Mobile Sources	12,423,821	100%	57.0%	4,988,760	100%	44.9%	4,490,759	100%	42.4%
Stationary Point and Area Sources	9,355,659	-	43.0%	6,111,866	-	55.1%	6,111,866	-	57.6%
Total Man-Made Sources	21,779,480	-	100%	11,100,626	-	100%	10,602,625	-	100%

* The locomotive, commercial marine (C1 & C2), and diesel recreational marine estimates are for calendar year 2002.

** This category includes emissions from Category 3 (C3) propulsion engines and C2/3 auxiliary engines used on ocean-going vessels.

Table 0-92 50-State Annual VOC Baseline Emission Levels for Mobile and Other Source Categories

Category	2001*			2020			2030		
	short tons	% of mobile source	% of total	short tons	% of mobile source	% of total	short tons	% of mobile source	% of total
Locomotive	50,665	0.6%	0.3%	52,633	1.0%	0.4%	51,813	0.9%	0.4%
Recreational Marine Diesel	1,540	0.0%	0.0%	2,653	0.0%	0.0%	3,299	0.1%	0.0%
Commercial Marine (C1 & C2)	17,229	0.2%	0.1%	16,071	0.3%	0.1%	17,178	0.3%	0.1%
Land-Based Nonroad Diesel	188,884	2.3%	1.1%	76,047	1.4%	0.5%	63,144	1.1%	0.4%
Commercial Marine (C3)**	9,572	0.1%	0.1%	18,458	0.3%	0.1%	27,582	0.5%	0.2%
Small Nonroad SI	1,314,015	15.9%	7.3%	999,810	18.6%	7.2%	1,156,408	19.7%	8.1%
Recreational Marine SI	1,212,446	14.7%	6.8%	688,774	12.8%	5.0%	697,712	11.9%	4.9%
SI Recreational Vehicles	512,059	6.2%	2.9%	454,979	8.5%	3.3%	391,541	6.7%	2.7%
Large Nonroad SI (>25hp)	132,888	1.6%	0.7%	12,429	0.2%	0.1%	10,276	0.2%	0.1%
Portable Fuel Containers	244,545	3.0%	1.4%	254,479	4.7%	1.8%	288,630	4.9%	2.0%
Aircraft	22,084	0.3%	0.1%	27,644	0.5%	0.2%	30,331	0.5%	0.2%
Total Off Highway	3,705,926	44.9%	20.7%	2,603,977	48.5%	18.8%	2,737,914	46.7%	19.1%
Highway Diesel	223,519	2.7%	1.2%	123,449	2.3%	0.9%	138,758	2.4%	1.0%
Highway non-diesel	4,316,615	52.3%	24.1%	2,646,363	49.2%	19.1%	2,987,562	50.9%	20.8%
Total Highway	4,540,134	55.1%	25.3%	2,769,812	51.5%	20.0%	3,126,320	53.3%	21.8%
Total Diesel (distillate) Mobile	479,285	5.8%	2.7%	270,844	5.0%	2.0%	274,189	4.7%	1.9%
Total Mobile Sources	8,246,060	100%	46.0%	5,373,789	100%	38.8%	5,864,234	100%	40.9%
Stationary Point and Area Sources	9,692,344	-	54.0%	8,475,443	-	61.2%	8,475,443	-	59.1%
Total Man-Made Sources	17,938,404	-	100%	13,849,232	-	100%	14,339,677	-	100%

* The locomotive, commercial marine (C1 & C2), and diesel recreational marine estimates are for calendar year 2002.
** This category includes emissions from Category 3 (C3) propulsion engines and C2/3 auxiliary engines used on ocean-going vessels.

Table 0-93 50-State Annual CO Baseline Emission Levels for Mobile and Other Source Categories

Category	2001*			2020			2030		
	short tons	% of mobile source	% of total	short tons	% of mobile source	% of total	short tons	% of mobile source	% of total
Locomotive	123,210	0.1%	0.1%	169,558	0.3%	0.2%	198,308	0.3%	0.2%
Recreational Marine Diesel	6,467	0.0%	0.0%	9,374	0.0%	0.0%	10,930	0.0%	0.0%
Commercial Marine (C1 & C2)	151,331	0.2%	0.2%	139,712	0.2%	0.2%	143,791	0.2%	0.2%
Land-Based Nonroad Diesel	893,320	1.0%	0.9%	310,258	0.5%	0.4%	155,625	0.2%	0.2%
Commercial Marine (C3)**	19,391	0.0%	0.0%	37,459	0.1%	0.1%	56,713	0.1%	0.1%
Small Nonroad SI	18,843,914	21.4%	19.4%	27,269,797	41.7%	36.8%	31,623,016	42.5%	38.1%
Recreational Marine SI	2,816,005	3.2%	2.9%	2,136,234	3.3%	2.9%	2,178,413	2.9%	2.6%
SI Recreational Vehicles	1,229,707	1.4%	1.3%	1,922,020	2.9%	2.6%	1,902,925	2.6%	2.3%
Large Nonroad SI (>25hp)	1,801,679	2.0%	1.9%	304,532	0.5%	0.4%	281,993	0.4%	0.3%
Aircraft	263,232	0.3%	0.3%	327,720	0.5%	0.4%	358,012	0.5%	0.4%
Total Off Highway	26,148,256	29.6%	26.9%	32,626,663	49.9%	44.1%	36,909,725	49.6%	44.4%
Highway Diesel	1,098,213	1.2%	1.1%	248,689	0.4%	0.3%	149,784	0.2%	0.2%
Highway non-diesel	60,985,008	69.1%	62.7%	32,503,404	49.7%	43.9%	37,399,211	50.2%	45.0%
Total Highway	62,083,221	70.4%	63.8%	32,752,093	50.1%	44.2%	37,548,995	50.4%	45.2%
Total Diesel (distillate) Mobile	2,272,530	2.6%	2.3%	877,583	1.3%	1.2%	658,428	0.9%	0.8%
Total Mobile Sources	88,231,477	100%	90.7%	65,378,756	100%	88.3%	74,458,720	100%	89.6%
Stationary Point and Area Sources	9,014,249	-	9.3%	8,641,678	-	11.7%	8,641,678	-	10.4%
Total Man-Made Sources	97,245,726	-	100%	74,020,434	-	100%	83,100,398	-	100%

* The locomotive, commercial marine (C1 & C2), and diesel recreational marine estimates are for calendar year 2002.

** This category includes emissions from Category 3 (C3) propulsion engines and C2/3 auxiliary engines used on ocean-going vessels.

Table 0-94 50-State Annual SO_2 Baseline Emission Levels for Mobile and Other Source Categories

Category	2001*			2020			2030		
	short tons	% of mobile source	% of total	short tons	% of mobile source	% of total	short tons	% of mobile source	% of total
Locomotive	76,727	9.7%	0.5%	400	0.1%	0.0%	468	0.1%	0.0%
Recreational Marine Diesel	5,145	0.7%	0.0%	162	0.0%	0.0%	192	0.0%	0.0%
Commercial Marine (C1 & C2)	80,353	10.2%	0.5%	3,104	0.9%	0.0%	3,586	0.7%	0.0%
Land-Based Nonroad Diesel	167,615	21.2%	1.1%	999	0.3%	0.0%	1,078	0.2%	0.0%
Commercial Marine (C3)**	166,739	21.1%	1.1%	272,535	79.9%	3.2%	400,329	83.2%	4.6%
Small Nonroad SI	6,723	0.9%	0.0%	8,620	2.5%	0.1%	9,990	2.1%	0.1%
Recreational Marine SI	2,755	0.3%	0.0%	2,980	0.9%	0.0%	3,160	0.7%	0.0%
SI Recreational Vehicles	1,241	0.2%	0.0%	2,643	0.8%	0.0%	2,784	0.6%	0.0%
Large Nonroad SI (>25hp)	925	0.1%	0.0%	905	0.3%	0.0%	1,020	0.2%	0.0%
Aircraft	7,890	1.0%	0.0%	9,907	2.9%	0.1%	11,137	2.3%	0.1%
Total Off Highway	516,113	65.4%	3.3%	302,255	88.7%	3.5%	433,745	90.2%	5.0%
Highway Diesel	103,632	13.1%	0.7%	3,443	1.0%	0.0%	4,453	0.9%	0.1%
Highway non-diesel	169,125	21.4%	1.1%	35,195	10.3%	0.4%	42,709	8.9%	0.5%
Total Highway	272,757	34.6%	1.7%	38,638	11.3%	0.5%	47,162	9.8%	0.5%
Total Diesel (distillate) Mobile	433,465	54.9%	2.7%	8,108	2.4%	0.1%	9,777	2.0%	0.1%
Total Mobile Sources	788,870	100%	5.0%	340,893	100%	4.0%	480,907	100%	5.5%
Stationary Point and Area Sources	15,057,420	-	95.0%	8,215,016	-	96.0%	8,215,016	-	94.5%
Total Man-Made Sources	15,846,290	-	100%	8,555,909	-	100%	8,695,923	-	100%

* The locomotive, commercial marine (C1 & C2), and diesel recreational marine estimates are for calendar year 2002.

** This category includes emissions from Category 3 (C3) propulsion engines and C2/3 auxiliary engines used on ocean-going vessels.

3.6 Contribution of Marine Diesel Engines and Locomotives to Non-Attainment Area Emission Inventories

Table 0-95 and Table 0-96 show the percent contribution to mobile source diesel $PM_{2.5}$ and total mobile source NO_x for certain non-attainment areas where there are large rail yards and/or commercial marine ports. The county-level inventories were estimated by allocating the nationwide baseline inventories to the counties using the same county:national ratios as used in the 2002 National Emissions Inventory (NEI).[15] It can be seen that locomotives and diesel marine vessels make up a substantial portion of the $PM_{2.5}$ and NO_x mobile source inventories in these areas. For instance, the combination of rail and commercial marine activity in the Huntington-Ashland WV-KY-OH area yields a contribution over 50% of mobile source diesel PM2.5 in 2002, increasing to 90% in 2030.

These percentages are the same as shown in Chapter 2 of the Preamble of this proposed rule. Additional details, including the annual tons of PM2.5 and NOx from locomotives, diesel marine engines, and all mobile sources within each of the counties of these metropolitan areas are provided in Appendix 3A of this chapter.

Table 0-95 Locomotive and Diesel Marine Engine Contributions to Non-Attainment Area Mobile Source Diesel $PM_{2.5}$ Emissions

$PM_{2.5}$ Metropolitan Area	2002	2020	2030
	LM %	LM %	LM %
Huntington-Ashland WV-KY-OH	52.9%	82.1%	90.4%
Houston, TX	41.9%	72.9%	84.6%
Los Angeles, CA	31.3%	49.3%	72.1%
Cleveland-Akron-Lorain, OH	25.1%	56.0%	72.0%
Chicago, IL	24.6%	54.9%	70.0%
Cincinnati, OH	23.2%	53.6%	69.5%
Chattanooga, TN	21.1%	56.3%	69.5%
Kansas City, MO	20.6%	51.3%	68.0%
Baltimore, MD	22.5%	52.6%	67.8%
St. Louis, MO	21.4%	51.3%	67.5%
Philadelphia, PA	19.6%	47.0%	63.9%
Seattle, WA	17.0%	43.3%	60.4%
Birmingham, AL	16.3%	46.6%	57.5%
Minneapolis-St. Paul, MN	10.7%	31.3%	47.8%
Boston, MA	7.8%	22.9%	40.5%
San Joaquin Valley, CA	8.8%	19.4%	38.2%
Atlanta, GA	5.2%	19.6%	29.9%
Indianapolis, IN	5.0%	17.5%	29.3%
Phoenix-Mesa, AZ	4.9%	17.3%	26.8%
Detroit, MI	4.1%	15.3%	26.0%
New York, NY	3.5%	11.1%	20.3%

Table 0-96 Locomotive and Diesel Marine Engine Contributions to Non-Attainment Area Total Mobile Source NO_x Emissions

NOx Metropolitan Area	2002	2020	2030
	LM %	LM %	LM %
Houston, TX	31.5%	46.3%	44.8%
Kansas City, MO	19.3%	39.3%	43.2%
Birmingham, AL	16.7%	38.3%	42.6%
Chicago, IL	19.9%	37.8%	41.1%
Cleveland-Akron-Lorain, OH	18.8%	37.2%	39.5%
Chattanooga, TN	15.6%	35.7%	39.1%
Cincinnati, OH	17.5%	35.7%	38.3%
Los Angeles, CA	18.1%	30.8%	37.2%
St. Louis, MO	15.7%	33.8%	36.9%
Huntington-Ashland WV-KY-OH	38.1%	41.9%	36.2%
Seattle, WA	13.2%	27.7%	30.3%
San Joaquin Valley, CA	8.4%	16.0%	25.7%
Minneapolis-St. Paul, MN	8.1%	17.5%	19.4%
Philadelphia, PA	13.4%	19.7%	18.8%
Phoenix-Mesa, AZ	5.1%	11.7%	14.6%
Atlanta, GA	4.2%	10.7%	12.8%
Indianapolis, IN	4.3%	10.7%	12.7%
Boston, MA	6.3%	10.6%	10.8%
Baltimore, MD	7.1%	10.4%	9.7%
Detroit, MI	2.8%	7.2%	8.2%
New York, NY	4.7%	7.4%	7.3%

3.7 Emission Inventories Used for Air Quality Modeling

3.7.1 Comparison of Air Quality and Proposed Rule Inventories

The emission inventory estimates used to demonstrate the effect of the proposed rule on air quality relied on the best estimates available at that time of the emission contributions from all sources in the base calendar year and projections into future calendar years. However, because of the long lead time necessary to prepare inputs for the air quality models and to run the models, the emission inventory estimates used in the air quality analysis are not the inventories that are now our best estimate of the impacts of the proposed rule. In all cases, the changes to the emission inventory estimates reflect improvements made to the inventories which reflect new information about the emission contributions from various sources that was not available at the time the air quality analysis inventories were prepared. This section describes the differences in the inventories used for the air quality analysis and the inventories used for the proposed rule. Chapter 2 of this document discusses the air quality analysis results and addresses the likely impact of these differences (if any) on the air quality outcomes from the proposed rule.

In addition to the diesel locomotive, commercial marine vessel, and diesel recreational marine sources, the air quality inventories include emission contributions from all sources, including sources not directly affected by the proposed rule:

- Stationary and area sources
- Aircraft
- Oceangoing commercial marine vessels (Category 3)
- Onroad (highway) mobile sources
- Nonroad mobile sources other than diesel pleasure craft

The emission inventory estimates used in the air quality analysis for aircraft, oceangoing vessels, stationary and area sources were not updated between the air quality analysis and the proposed rule. However, changes were made in the onroad and nonroad inventories and in the locomotive and commercial marine vessel inventories for both the base (uncontrolled) and proposed rule control cases.

Table 0-97, Table 0-98, and Table 0-99 summarize the differences between the air quality inventories and the more updated proposed rule inventories for baseline VOC, NO_x, and $PM_{2.5}$. Similarly, Table 0-100, Table 0-101, and Table 0-102 summarize the differences between the air quality inventories and the more updated proposed rule inventories for control case VOC, NO_x, and $PM_{2.5}$. Lastly, Table 0-103, Table 0-104, and Table 0-105 summarize the differences in ton reductions for these pollutants between the air quality inventories and the more updated proposed rule inventories. Only the years 2020 and 2030 are shown for the latter two sets of tables, since this proposal has no benefits prior to 2008. Although the actual inventories change up to 20% depending on pollutant and year between the air quality inventories and the later proposed rule inventories, the net effect of all the changes on ton reductions of these pollutants ranges only from -4 percent to +3 percent. For the final rule air quality analysis, we will be incorporating the changes described below, as well as any future updates to the baseline estimates and control programs, which we expect will have counterbalancing impacts on both baseline and control cases for the final rule.

3.7.2 Onroad Inventory Changes

The onroad (highway) emission inventory estimates used in the air quality analysis were taken directly from the estimates used for the recent Clean Air Interstate Rule (CAIR)[16] using the National Mobile Inventory Model (NMIM) tool and the March 25, 2004, version of the NMIM County database (County20040325).

The updated emission inventory estimates for onroad in the proposed rule were originally calculated for use in the proposed Mobile Source Air Toxics (MSAT) rule. The MSAT emission inventory estimates use the NMIM tool and the July 25, 2006 version of the NMIM County database (NCD20060725MSATFinal). This new database includes important corrections to the inputs for 13 states regarding the implementation of California emission standards. The error in the old database resulted in significantly over-predicted NO_x emissions for light-duty gasoline vehicles in the onroad emission inventory estimates used in the air quality analysis, especially in the projection years of 2020 (+995,000 tons, +60%) and 2030 (+995,000 tons, +60%). This resulted in an overprediction of the ozone levels in both the base and control cases, and probably also a small overprediction of the air quality benefits of this proposed rule. Using the corrected database, light-duty gasoline NOx emissions decrease by 434,000 tons (-24%) in 2020 and 464,000 tons (-26%) in 2030.

The updated emission inventory estimates in the proposed rule for onroad also made use of an in-house version of the EPA MOBILE6.2 emission factor model which has been adapted to use new temperature correction factors for hydrocarbon (HC) emissions for light duty gasoline vehicles. These new temperature correction factors were developed as part of the MSAT rule. Using the new temperature correction factors significantly increases the HC inventories for light duty gasoline vehicles, especially in the projection years of 2020 (+995,000 tons, +60%) and 2030 (+1,358,000 tons, +83%), during periods where temperatures are less than 75 degrees Fahrenheit.

These changes do not affect the estimated ton reductions from this proposed rule, but they do affect the total emission inventory in both base and control cases. This is shown in Table 0-97 through Table 0-102 in combination with the inventory changes for nonroad equipment.

3.7.3 Nonroad Inventory Changes

The air quality analysis for the nonroad emission inventory estimates for all sources other than diesel pleasure craft (which are included in this proposed rule) were taken directly from the estimates used for the recent Clean Air Interstate Rule (CAIR) and are based on the 2004 version of the EPA NONROAD model.

The updated nonroad inventory for the proposed rule is based on the recently released 2005 version of the EPA NONROAD model. This newer nonroad model includes many changes from the 2004 version, but the ones that most significantly affect the estimated inventories are as follows:

- Addition of new evaporative categories for tank permeation, hose permeation, hot soak, and running loss emissions.
- Revised methodology for calculating diurnal emissions
- Incorporated the effects of evaporative emission standards for recreational vehicles and large spark ignition engines.
- Updated allocations from the national to the state and county level.
- Updated the power range distributions and technology fractions for spark-ignition recreational marine engines.
- Updated emission factors, deterioration factors, and technology mix for phase-2 Class 1 small gasoline engines (≤ 25 hp).

The net effect of these changes is a 55% increase in VOC from these sources (increase of 793,000 tons in 2020 and 820,000 tons in 2030). The corresponding change in NOx is a small decrease of 13,000 tons (1.4%) in 2020 and 40,000 tons (5%) in 2030. These changes do not affect the estimated ton reductions from this proposed rule, but they do affect the total emission inventory in both base and control cases. This is shown in Table 0-97 through Table 0-102 in combination with the onroad inventory changes described above in section 3.7.2.

3.7.4 Locomotive Inventory Changes

The locomotive emission inventory estimates used in the air quality analysis were calculated by EPA using a new national inventory estimation spreadsheet model developed for this purpose. However, since the air quality analysis, changes have been made in the emission rate estimates used in the model and the rate of turnover for the locomotive switcher fleet. These changes affect the emission inventory estimates for all pollutants and in all calendar years.

In addition to the changes in the model, the inventory benefits of the proposed rule were affected by a change in the assumptions for the effects of the rule. The NO_x

emissions of all Tier 0 engines were originally assumed to be affected by the rule in the locomotive emission inventory estimates used in the air quality analysis. The updated inventories assume that only 1994 and later model year Tier 0 engines are affected by the rule.

The last change to note is that the air quality inventory for locomotives treated the calculated HC inventory as if it were VOC. In the updated inventory the HC value is properly treated as Total Hydrocarbons (THC), and VOC is reported as 1.053 * THC.

The net effect of these updates is a change in tons reduced from locomotives ranging from -8 percent to +5 percent, depending on pollutant and year.

3.7.5 Commercial Marine Vessel Inventory Changes

The commercial marine vessel (Category 1 and Category 2) emission inventory estimates used in the air quality analysis were calculated by EPA using new national inventory estimation spreadsheet models developed for this purpose. However, since the air quality analysis, changes have been made in some of the assumptions used in the model, including the load factors, the sulfur content of the diesel certification fuel used for pleasure craft, and the sulfur content of diesel fuel used by commercial marine vessels. These changes did not affect the projected ton reductions for marine diesel engines, since the baseline and control cases were equally affected. These reductions are 5,000 tons VOC and 139,000 tons NO_x in 2020, and 11,000 tons VOC and 346,000 tons NO_x in 2030.

Table 0-97 50-State Annual VOC Baseline Emission Levels for Mobile and Other Source Categories

CATEGORY	2001*			2020			2030		
	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF
LOCOMOTIVE	48,115	50,665	5.3%	49,039	52,633	7.3%	47,606	51,813	8.8%
MARINE DIESEL	14,176	18,768	32.4%	13,677	18,724	36.9%	14,588	20,477	40.4%
ALL OTHER SOURCES (MOBILE & STATIONARY)	16,978,113	17,868,970	5.2%	11,736,377	13,777,876	17.4%	11,804,110	14,267,387	20.9%
TOTAL MAN-MADE SOURCES	17,040,404	17,938,403	5.3%	11,799,094	13,849,233	17.4%	11,866,304	14,339,677	20.8%
* LOCOMOTIVE AND MARINE DIESEL VALUES IN THE "2001" COLUMN ARE ACTUALLY 2002 ESTIMATES.									

Table 0-98 50-State Annual NO_x Baseline Emission Levels for Mobile and Other Source Categories

CATEGORY	2001*			2020			2030		
	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF
LOCOMOTIVE	1,118,786	1,118,786	0.0%	844,932	860,474	1.8%	835,059	854,226	2.3%
MARINE DIESEL	711,656	874,462	22.9%	606,021	721,632	19.1%	608,761	728,127	19.6%
ALL OTHER SOURCES (MOBILE & STATIONARY)	19,854,001	19,786,232	-0.3%	10,006,926	9,518,521	-4.9%	9,570,157	9,020,273	-5.7%
TOTAL MAN-MADE SOURCES	21,684,444	21,779,480	0.4%	11,457,878	11,100,627	-3.1%	11,013,977	10,602,626	-3.7%
* LOCOMOTIVE AND MARINE DIESEL VALUES IN THE "2001" COLUMN ARE ACTUALLY 2002 ESTIMATES.									

Table 0-99 50-State Annual $PM_{2.5}$ Baseline Emission Levels for Mobile and Other Source Categories

CATEGORY	2001*			2020			2030		
	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF
LOCOMOTIVE	29,660	29,660	0.0%	25,843	26,301	1.8%	24,334	25,109	3.2%
MARINE DIESEL	23,627	29,827	26.2%	20,087	23,242	15.7%	21,852	24,900	13.9%
ALL OTHER SOURCES (MOBILE & STATIONARY)	2,393,848	2,369,947	-1.0%	2,044,184	2,022,009	-1.1%	2,041,701	2,018,649	-1.1%
TOTAL MAN-MADE SOURCES	2,447,136	2,429,434	-0.7%	2,090,114	2,071,552	-0.9%	2,087,886	2,068,658	-0.9%
* LOCOMOTIVE AND MARINE DIESEL VALUES IN THE "2001" COLUMN ARE ACTUALLY 2002 ESTIMATES.									

Table 0-100 50-State Annual VOC Control Case Emission Levels for Mobile and Other Source Categories

CATEGORY	2020			2030		
	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF
LOCOMOTIVE	26,790	30,135	12.5%	17,394	20,383	17.2%
MARINE DIESEL	8,890	13,991	57.4%	3,969	9,801	146.9%
ALL OTHER SOURCES (MOBILE & STATIONARY)	11,736,377	13,777,876	17.4%	11,804,110	14,267,387	20.9%
TOTAL MAN-MADE SOURCES	11,772,057	13,822,002	17.4%	11,825,474	14,297,571	20.9%
* AQ MODELING FOR LOCOMOTIVES USED THC AS VOC, INSTEAD OF USING ACTUAL VOC =1.053 * THC.						

Table 0-101 50-State Annual NO_x Control Case Emission Levels for Mobile and Other Source Categories

CATEGORY	2020			2030		
	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF
LOCOMOTIVE	690,885	712,492	3.1%	452,453	453,651	0.3%
MARINE DIESEL	467,327	576,706	23.4%	262,345	362,927	38.3%
ALL OTHER SOURCES (MOBILE & STATIONARY)	10,006,926	9,518,521	-4.9%	9,570,157	9,020,273	-5.7%
TOTAL MAN-MADE SOURCES	11,165,138	10,807,720	-3.2%	10,284,956	9,836,851	-4.4%

Table 0-102 50-State Annual $PM_{2.5}$ Control Case Emission Levels for Mobile and Other Source Categories

CATEGORY	2020			2030		
	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF
LOCOMOTIVE	15,318	16,368	6.9%	9,617	10,512	9.3%
MARINE DIESEL	15,367	18,399	19.7%	8,893	11,778	32.4%
ALL OTHER SOURCES (MOBILE & STATIONARY)	2,044,184	2,022,009	-1.1%	2,041,701	2,018,649	-1.1%
TOTAL MAN-MADE SOURCES	2,074,870	2,056,776	-0.9%	2,060,211	2,040,939	-0.9%

Table 0-103 50-State Annual VOC Ton Reductions for Mobile and Other Source Categories

CATEGORY	2020			2030		
	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF
LOCOMOTIVE	22,249	22,498	1.1%	30,211	31,430	4.0%
MARINE DIESEL	4,787	4,734	-1.1%	10,619	10,676	0.5%
ALL OTHER SOURCES (MOBILE & STATIONARY)	0	0	0.0%	0	0	0.0%
TOTAL MAN-MADE SOURCES	27,036	27,231	0.7%	40,830	42,106	3.1%

Table 0-104 50-State Annual NO_x Ton Reductions for Mobile and Other Source Categories

CATEGORY	2020			2030		
	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF
LOCOMOTIVE	154,047	147,982	-3.9%	382,606	400,575	4.7%
MARINE DIESEL	138,694	144,925	4.5%	346,416	365,199	5.4%
ALL OTHER SOURCES (MOBILE & STATIONARY)	0	0	0.0%	0	0	0.0%
TOTAL MAN-MADE SOURCES	292,741	292,907	0.1%	729,022	765,775	5.0%

Table 0-105 50-State Annual $PM_{2.5}$ Ton Reductions for Mobile and Other Source Categories

CATEGORY	2020			2030		
	AQ MODELING	NPRM	% DIFF	AQ MODELING	NPRM	% DIFF
LOCOMOTIVE	10,525	9,933	-5.6%	14,717	14,597	-0.8%
MARINE DIESEL	4,720	4,843	2.6%	12,959	13,122	1.3%
ALL OTHER SOURCES (MOBILE & STATIONARY)	0	0	0.0%	0	0	0.0%
TOTAL MAN-MADE SOURCES	15,245	14,776	-3.1%	27,675	27,719	0.2%

APPENDIX 3A

Locomotive and Diesel Marine Contributions to County-Specific Mobile Source Emissions in Non-attainment Areas

Table 0-106 2002 Locomotive and Diesel Marine PM2.5 Tons/Year and Percent of Total Diesel Mobile Sources

FIPS	MSA	County	ST	2002 PM2.5			
				Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
13013	Atlanta	Barrow	GA	5.77	0.01	41	14.3%
13015	Atlanta	Bartow	GA	20.64	0.20	109	19.1%
13045	Atlanta	Carroll	GA	5.65	0.08	92	6.2%
13057	Atlanta	Cherokee	GA	0.00	0.19	118	0.2%
13063	Atlanta	Clayton	GA	10.87	0.03	164	6.7%
13067	Atlanta	Cobb	GA	28.66	0.08	504	5.7%
13077	Atlanta	Coweta	GA	14.35	0.06	123	11.8%
13089	Atlanta	DeKalb	GA	13.29	0.05	440	3.0%
13097	Atlanta	Douglas	GA	5.22	0.01	68	7.7%
13113	Atlanta	Fayette	GA	3.71	0.04	86	4.4%
13117	Atlanta	Forsyth	GA	0.00	0.39	114	0.3%
13121	Atlanta	Fulton	GA	39.07	0.11	857	4.6%
13135	Atlanta	Gwinnett	GA	9.95	0.07	476	2.1%
13139	Atlanta	Hall	GA	6.62	0.65	146	5.0%
13149	Atlanta	Heard	GA	0.00	0.09	11	0.8%
13151	Atlanta	Henry	GA	14.63	0.04	154	9.5%
13217	Atlanta	Newton	GA	1.65	0.05	80	2.1%
13223	Atlanta	Paulding	GA	12.13	0.03	86	14.2%
13237	Atlanta	Putnam	GA	0.35	0.30	15	4.3%
13247	Atlanta	Rockdale	GA	2.35	0.03	71	3.4%
13255	Atlanta	Spalding	GA	0.62	0.03	53	1.2%
13297	Atlanta	Walton	GA	1.99	0.01	47	4.2%
24003	Baltimore	Anne Arundel	MD	14.68	1.82	302	5.5%
24005	Baltimore	Baltimore	MD	39.65	1.22	576	7.1%
24013	Baltimore	Carroll	MD	6.14	0.04	158	3.9%
24025	Baltimore	Harford	MD	11.40	1.18	186	6.8%
24027	Baltimore	Howard	MD	17.07	0.41	203	8.6%
24510	Baltimore	Baltimore	MD	46.07	313.45	590	60.9%
1073	Birmingham	Jefferson	AL	80.24	1.08	631	12.9%
1117	Birmingham	Shelby	AL	41.96	0.29	157	26.9%
1127	Birmingham	Walker	AL	17.15	1.08	81	22.4%
9007	Boston	Middlesex	CT	0.00	1.70	114	1.5%
25001	Boston	Barnstable	MA	7.23	20.34	179	15.4%
25005	Boston	Bristol	MA	13.57	14.82	311	9.1%
25007	Boston	Dukes	MA	0.00	133.61	143	93.4%
25009	Boston	Essex	MA	17.74	4.90	424	5.3%
25019	Boston	Nantucket	MA	0.00	19.79	29	67.4%
25021	Boston	Norfolk	MA	21.42	6.80	460	6.1%
25023	Boston	Plymouth	MA	11.20	4.99	256	6.3%
25025	Boston	Suffolk	MA	11.57	57.64	2,518	2.7%
25027	Boston	Worcester	MA	43.94	1.04	556	8.1%
33011	Boston	Hillsborough	NH	1.33	0.42	266	0.7%

FIPS	MSA	County	ST	2002 PM2.5			
				Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
33015	Boston	Rockingham	NH	1.00	36.02	263	14.1%
47065	Chattanooga	Hamilton	TN	40.53	29.56	283	24.7%
47115	Chattanooga	Marion	TN	5.67	5.70	63	18.1%
47153	Chattanooga	Sequatchie	TN	0.00	0.00	7	0.0%
13047	Chattanooga	Catoosa	GA	12.28	0.01	52	23.6%
13083	Chattanooga	Dade	GA	11.66	0.00	46	25.3%
13295	Chattanooga	Walker	GA	0.00	0.01	48	0.0%
17031	Chicago	Cook	IL	708.71	209.67	3,661	25.1%
17043	Chicago	DuPage	IL	200.17	0.14	812	24.7%
17063	Chicago	Grundy	IL	13.55	6.45	114	17.6%
17089	Chicago	Kane	IL	70.19	0.10	371	19.0%
17093	Chicago	Kendall	IL	8.97	0.01	78	11.5%
17097	Chicago	Lake	IL	37.26	22.02	406	14.6%
17111	Chicago	McHenry	IL	20.29	0.16	189	10.8%
17197	Chicago	Will	IL	186.94	4.74	498	38.5%
18089	Chicago	Lake	IN	129.22	14.34	541	26.5%
18127	Chicago	Porter	IN	45.64	12.55	216	26.9%
18029	Cincinnati	Dearborn	IN	6.21	22.72	92	31.3%
21015	Cincinnati	Boone	KY	8.45	34.08	133	31.9%
21037	Cincinnati	Campbell	KY	16.05	23.57	95	41.5%
21117	Cincinnati	Kenton	KY	30.93	11.78	147	29.1%
39017	Cincinnati	Butler	OH	45.48	0.05	279	16.3%
39025	Cincinnati	Clermont	OH	1.96	44.98	181	25.9%
39061	Cincinnati	Hamilton	OH	44.25	133.23	737	24.1%
39165	Cincinnati	Warren	OH	6.75	0.09	192	3.6%
39007	Cleveland	Ashtabula	OH	30.49	178.56	310	67.4%
39035	Cleveland	Cuyahoga	OH	83.10	122.90	1,119	18.4%
39085	Cleveland	Lake	OH	21.22	26.15	190	25.0%
39093	Cleveland	Lorain	OH	50.28	113.72	414	39.6%
39103	Cleveland	Medina	OH	15.82	0.06	166	9.6%
39133	Cleveland	Portage	OH	31.34	0.24	198	15.9%
39153	Cleveland	Summit	OH	25.49	0.17	392	6.5%
26093	Detroit	Livingston	MI	2.47	0.07	174	1.5%
26099	Detroit	Macomb	MI	3.83	5.35	437	2.1%
26115	Detroit	Monroe	MI	18.09	8.90	198	13.6%
26125	Detroit	Oakland	MI	15.09	4.59	781	2.5%
26147	Detroit	St. Clair	MI	7.39	21.37	224	12.8%
26161	Detroit	Washtenaw	MI	4.04	0.05	269	1.5%
26163	Detroit	Wayne	MI	29.94	10.03	1,140	3.5%
48039	Houston	Brazoria	TX	18.79	247.18	463	57.4%
48071	Houston	Chambers	TX	1.07	7.41	57	14.8%
48157	Houston	Fort Bend	TX	26.30	0.09	270	9.8%
48167	Houston	Galveston	TX	13.07	566.43	751	77.1%
48201	Houston	Harris	TX	68.97	1,477.09	3,940	39.2%
48291	Houston	Liberty	TX	28.79	3.02	112	28.3%

FIPS	MSA	County	ST	2002 PM2.5			
				Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
48339	Houston	Montgomery	TX	22.38	0.27	300	7.5%
48473	Houston	Waller	TX	6.50	0.04	45	14.5%
21019	Huntington	Boyd	KY	11.13	18.28	65	45.2%
21127	Huntington	Lawrence	KY	10.86	5.94	33	51.6%
39001	Huntington	Adams	OH	0.39	52.61	88	60.0%
39053	Huntington	Gallia	OH	3.44	23.13	62	42.8%
39087	Huntington	Lawrence	OH	12.48	34.34	86	54.5%
39145	Huntington	Scioto	OH	27.95	33.28	124	49.5%
54011	Huntington	Cabell	WV	24.48	25.26	112	44.5%
54053	Huntington	Mason	WV	6.12	39.72	92	50.0%
54099	Huntington	Wayne	WV	30.53	60.21	133	68.1%
18011	Indianapolis	Boone	IN	6.78	0.06	120	5.7%
18057	Indianapolis	Hamilton	IN	0.16	0.62	224	0.3%
18059	Indianapolis	Hancock	IN	5.17	0.03	107	4.9%
18063	Indianapolis	Hendricks	IN	18.14	0.03	188	9.7%
18081	Indianapolis	Johnson	IN	0.91	0.21	115	1.0%
18095	Indianapolis	Madison	IN	16.17	0.12	156	10.5%
18097	Indianapolis	Marion	IN	31.30	1.34	662	4.9%
18109	Indianapolis	Morgan	IN	0.41	0.22	93	0.7%
18145	Indianapolis	Shelby	IN	7.35	0.02	102	7.2%
20091	Kansas City	Johnson	KS	55.73	0.04	481	11.6%
20103	Kansas City	Leavenworth	KS	14.29	0.50	84	17.6%
20121	Kansas City	Miami	KS	81.56	0.15	139	58.6%
20209	Kansas City	Wyandotte	KS	30.24	4.47	148	23.5%
29037	Kansas City	Cass	MO	16.72	0.12	110	15.3%
29047	Kansas City	Clay	MO	28.19	4.43	188	17.3%
29049	Kansas City	Clinton	MO	0.00	0.16	49	0.3%
29095	Kansas City	Jackson	MO	90.00	33.46	646	19.1%
29107	Kansas City	Lafayette	MO	23.25	4.16	124	22.1%
29165	Kansas City	Platte	MO	22.68	0.84	151	15.6%
29177	Kansas City	Ray	MO	44.83	3.97	108	45.2%
6037	Los Angeles	Los Angeles	CA	241.14	1,666.68	5,016	38.0%
6059	Los Angeles	Orange	CA	63.57	176.82	1,696	14.2%
6065	Los Angeles	Riverside	CA	109.12	1.01	872	12.6%
6071	Los Angeles	San Bernardino	CA	359.75	0.47	1,040	34.6%
6111	Los Angeles	Ventura	CA	12.49	231.21	524	46.5%
27003	Minneapolis	Anoka	MN	21.27	12.73	232	14.7%
27019	Minneapolis	Carver	MN	0.05	0.79	82	1.0%
27037	Minneapolis	Dakota	MN	12.70	11.89	278	8.9%
27053	Minneapolis	Hennepin	MN	31.68	35.83	870	7.8%
27123	Minneapolis	Ramsey	MN	12.03	11.31	349	6.7%
27139	Minneapolis	Scott	MN	2.70	1.38	94	4.3%
27163	Minneapolis	Washington	MN	23.15	50.70	237	31.1%
9001	New York	Fairfield	CT	0.00	44.84	705	6.4%

FIPS	MSA	County	ST	2002 PM2.5 Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
9005	New York	Litchfield	CT	0.00	0.89	109	0.8%
34003	New York	Bergen	NJ	26.97	3.48	512	6.0%
34013	New York	Essex	NJ	6.64	0.99	416	1.8%
34017	New York	Hudson	NJ	22.70	27.96	402	12.6%
34019	New York	Hunterdon	NJ	9.60	0.33	185	5.4%
34023	New York	Middlesex	NJ	12.54	4.94	421	4.1%
34025	New York	Monmouth	NJ	10.14	29.48	418	9.5%
34027	New York	Morris	NJ	6.96	0.53	300	2.5%
34029	New York	Ocean	NJ	0.52	13.26	256	5.4%
34031	New York	Passaic	NJ	6.11	0.51	233	2.8%
34035	New York	Somerset	NJ	13.21	0.02	195	6.8%
34037	New York	Sussex	NJ	0.99	0.63	113	1.4%
34039	New York	Union	NJ	11.04	17.95	355	8.2%
36005	New York	Bronx	NY	0.13	0.75	372	0.2%
36047	New York	Kings	NY	0.00	1.30	696	0.2%
36059	New York	Nassau	NY	0.00	11.73	518	2.3%
36061	New York	New York	NY	0.00	0.54	1,296	0.0%
36071	New York	Orange	NY	9.19	2.55	288	4.1%
36081	New York	Queens	NY	0.06	2.02	982	0.2%
36085	New York	Richmond	NY	0.00	2.29	166	1.4%
36087	New York	Rockland	NY	6.91	2.69	125	7.7%
36103	New York	Suffolk	NY	0.00	39.17	690	5.7%
36119	New York	Westchester	NY	0.00	3.76	479	0.8%
10003	Philadelphia	New Castle	DE	22.95	47.44	458	15.4%
24015	Philadelphia	Cecil	MD	9.27	1.70	125	8.7%
24029	Philadelphia	Kent	MD	0.07	1.41	42	3.6%
24031	Philadelphia	Montgomery	MD	28.82	0.53	485	6.0%
34005	Philadelphia	Burlington	NJ	0.00	54.50	328	16.6%
34007	Philadelphia	Camden	NJ	4.82	21.83	273	9.8%
34011	Philadelphia	Cumberland	NJ	0.57	55.22	155	36.0%
34015	Philadelphia	Gloucester	NJ	0.80	29.18	214	14.0%
34021	Philadelphia	Mercer	NJ	5.56	6.66	277	4.4%
34033	Philadelphia	Salem	NJ	0.27	16.91	86	19.9%
42017	Philadelphia	Bucks	PA	2.29	1.20	330	1.1%
42029	Philadelphia	Chester	PA	11.62	0.16	328	3.6%
42045	Philadelphia	Delaware	PA	4.55	193.17	409	48.4%
42101	Philadelphia	Philadelphia	PA	6.45	339.10	922	37.5%
4013	Phoenix	Maricopa	AZ	98.35	0.78	2,828	3.5%
4021	Phoenix	Pinal	AZ	52.54	0.17	256	20.6%
6019	San Joaquin	Fresno	CA	17.77	0.58	647	2.8%
6029	San Joaquin	Kern	CA	92.07	0.22	635	14.5%
6031	San Joaquin	Kings	CA	2.57	0.02	155	1.7%
6039	San Joaquin	Madera	CA	18.89	0.16	145	13.2%
6047	San Joaquin	Merced	CA	17.75	0.46	218	8.4%
6077	San Joaquin	San Joaquin	CA	29.94	30.32	437	13.8%

FIPS	MSA	County	ST	2002 PM2.5			
				Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
6099	San Joaquin	Stanislaus	CA	12.07	0.24	267	4.6%
6107	San Joaquin	Tulare	CA	26.68	0.16	340	7.9%
53029	Seattle	Island	WA	0.00	19.63	69	28.5%
53033	Seattle	King	WA	28.95	191.88	1,568	14.1%
53035	Seattle	Kitsap	WA	0.00	1.27	134	0.9%
53045	Seattle	Mason	WA	0.00	0.58	37	1.6%
53053	Seattle	Pierce	WA	18.18	173.52	612	31.3%
53061	Seattle	Snohomish	WA	36.65	29.32	471	14.0%
53067	Seattle	Thurston	WA	10.80	12.02	179	12.7%
17027	St. Louis	Clinton	IL	23.14	0.08	99	23.5%
17083	St. Louis	Jersey	IL	1.86	19.07	65	32.1%
17119	St. Louis	Madison	IL	7.81	10.33	247	7.4%
17133	St. Louis	Monroe	IL	37.61	16.72	104	52.1%
17163	St. Louis	St. Clair	IL	8.93	19.78	229	12.5%
29055	St. Louis	Crawford	MO	5.23	0.04	45	11.6%
29071	St. Louis	Franklin	MO	31.20	2.36	153	21.9%
29099	St. Louis	Jefferson	MO	8.38	16.93	186	13.6%
29113	St. Louis	Lincoln	MO	13.80	6.69	87	23.4%
29183	St. Louis	St. Charles	MO	16.62	15.02	244	13.0%
29189	St. Louis	St. Louis	MO	26.77	19.32	831	5.5%
29219	St. Louis	Warren	MO	2.82	2.31	47	10.9%
29510	St. Louis	St. Louis	MO	23.28	261.28	456	62.4%

Table 0-107 2020 Locomotive and Diesel Marine PM2.5 Tons/Year and Percent of Total Diesel Mobile Sources

FIPS	MSA	County	ST	2020 PM2.5			
				Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
13013	Atlanta	Barrow	GA	5.45	0.01	11	49.6%
13015	Atlanta	Bartow	GA	19.49	0.17	35	56.9%
13045	Atlanta	Carroll	GA	5.28	0.07	19	27.6%
13057	Atlanta	Cherokee	GA	0.00	0.17	23	0.7%
13063	Atlanta	Clayton	GA	10.27	0.02	41	25.2%
13067	Atlanta	Cobb	GA	26.96	0.07	137	19.8%
13077	Atlanta	Coweta	GA	13.55	0.05	33	41.2%
13089	Atlanta	DeKalb	GA	12.49	0.04	103	12.1%
13097	Atlanta	Douglas	GA	4.86	0.01	16	30.0%
13113	Atlanta	Fayette	GA	3.50	0.03	20	18.0%
13117	Atlanta	Forsyth	GA	0.00	0.35	24	1.5%
13121	Atlanta	Fulton	GA	36.74	0.09	224	16.4%
13135	Atlanta	Gwinnett	GA	9.33	0.06	118	8.0%
13139	Atlanta	Hall	GA	5.67	0.57	31	19.9%
13149	Atlanta	Heard	GA	0.00	0.08	2	4.4%
13151	Atlanta	Henry	GA	13.81	0.03	41	34.2%
13217	Atlanta	Newton	GA	1.56	0.04	15	10.4%
13223	Atlanta	Paulding	GA	11.45	0.02	24	47.5%
13237	Atlanta	Putnam	GA	0.31	0.26	3	17.2%
13247	Atlanta	Rockdale	GA	2.22	0.02	16	14.2%
13255	Atlanta	Spalding	GA	0.59	0.02	10	6.4%
13297	Atlanta	Walton	GA	1.88	0.01	10	18.8%
24003	Baltimore	Anne Arundel	MD	10.36	1.57	73	16.4%
24005	Baltimore	Baltimore	MD	34.68	1.03	154	23.1%
24013	Baltimore	Carroll	MD	5.34	0.03	37	14.6%
24025	Baltimore	Harford	MD	8.84	1.00	46	21.5%
24027	Baltimore	Howard	MD	12.62	0.32	56	22.9%
24510	Baltimore	Baltimore	MD	46.50	242.61	328	88.1%
1073	Birmingham	Jefferson	AL	75.36	0.86	188	40.6%
1117	Birmingham	Shelby	AL	39.49	0.26	65	61.4%
1127	Birmingham	Walker	AL	14.91	0.86	30	52.9%
9007	Boston	Middlesex	CT	0.00	1.50	22	6.7%
25001	Boston	Barnstable	MA	6.28	16.59	55	41.7%
25005	Boston	Bristol	MA	11.82	11.64	79	29.6%
25007	Boston	Dukes	MA	0.00	103.75	106	97.6%
25009	Boston	Essex	MA	15.42	4.13	101	19.4%
25019	Boston	Nantucket	MA	0.00	15.54	18	85.4%
25021	Boston	Norfolk	MA	18.39	5.32	114	20.9%
25023	Boston	Plymouth	MA	9.78	4.30	65	21.8%
25025	Boston	Suffolk	MA	9.83	44.70	688	7.9%
25027	Boston	Worcester	MA	37.77	0.92	142	27.3%
33011	Boston	Hillsborough	NH	1.15	0.37	56	2.7%

FIPS	MSA	County	ST	2020 PM2.5 Diesel Locomotive	2020 PM2.5 Diesel Marine	2020 PM2.5 Total Diesel Mobile	2020 PM2.5 LM Percent
33015	Boston	Rockingham	NH	0.87	28.09	74	39.1%
47065	Chattanooga	Hamilton	TN	38.28	22.98	103	59.3%
47115	Chattanooga	Marion	TN	5.36	4.45	18	53.8%
47153	Chattanooga	Sequatchie	TN	0.00	0.00	1	0.0%
13047	Chattanooga	Catoosa	GA	11.60	0.01	18	63.7%
13083	Chattanooga	Dade	GA	11.01	0.00	16	67.9%
13295	Chattanooga	Walker	GA	0.00	0.01	9	0.1%
17031	Chicago	Cook	IL	608.24	164.40	1,362	56.7%
17043	Chicago	DuPage	IL	162.78	0.12	317	51.4%
17063	Chicago	Grundy	IL	13.20	5.01	42	43.5%
17089	Chicago	Kane	IL	59.50	0.09	138	43.3%
17093	Chicago	Kendall	IL	8.18	0.01	27	30.5%
17097	Chicago	Lake	IL	30.80	19.13	138	36.2%
17111	Chicago	McHenry	IL	17.00	0.14	61	28.0%
17197	Chicago	Will	IL	163.07	3.70	242	68.9%
18089	Chicago	Lake	IN	132.19	12.15	232	62.3%
18127	Chicago	Porter	IN	40.84	10.56	85	60.4%
18029	Cincinnati	Dearborn	IN	5.59	17.59	35	65.7%
21015	Cincinnati	Boone	KY	7.99	26.40	54	63.8%
21037	Cincinnati	Campbell	KY	15.10	18.27	43	77.4%
21117	Cincinnati	Kenton	KY	29.20	9.12	59	65.4%
39017	Cincinnati	Butler	OH	40.67	0.04	92	44.2%
39025	Cincinnati	Clermont	OH	1.76	34.82	63	58.0%
39061	Cincinnati	Hamilton	OH	39.70	103.13	268	53.3%
39165	Cincinnati	Warren	OH	6.08	0.08	49	12.5%
39007	Cleveland	Ashtabula	OH	27.38	138.54	185	89.5%
39035	Cleveland	Cuyahoga	OH	76.82	96.57	379	45.7%
39085	Cleveland	Lake	OH	18.90	21.00	71	56.4%
39093	Cleveland	Lorain	OH	45.04	88.60	190	70.4%
39103	Cleveland	Medina	OH	14.17	0.05	45	31.8%
39133	Cleveland	Portage	OH	28.09	0.21	61	46.1%
39153	Cleveland	Summit	OH	22.96	0.15	101	22.8%
26093	Detroit	Livingston	MI	2.33	0.06	35	6.8%
26099	Detroit	Macomb	MI	3.62	4.26	96	8.2%
26115	Detroit	Monroe	MI	17.08	6.95	60	39.7%
26125	Detroit	Oakland	MI	14.21	3.58	188	9.5%
26147	Detroit	St. Clair	MI	6.90	16.67	64	37.1%
26161	Detroit	Washtenaw	MI	3.82	0.04	61	6.3%
26163	Detroit	Wayne	MI	28.47	7.97	253	14.4%
48039	Houston	Brazoria	TX	17.74	191.47	248	84.2%
48071	Houston	Chambers	TX	1.01	5.88	16	44.1%
48157	Houston	Fort Bend	TX	24.70	0.08	79	31.5%
48167	Houston	Galveston	TX	12.47	438.65	487	92.6%
48201	Houston	Harris	TX	65.54	1,143.23	1,727	70.0%
48291	Houston	Liberty	TX	27.14	2.35	45	65.6%

FIPS	MSA	County	ST	2020 PM2.5			
				Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
48339	Houston	Montgomery	TX	21.14	0.24	68	31.6%
48473	Houston	Waller	TX	6.14	0.04	15	42.5%
21019	Huntington	Boyd	KY	10.44	14.15	31	79.9%
21127	Huntington	Lawrence	KY	9.43	4.60	17	84.4%
39001	Huntington	Adams	OH	0.35	40.72	49	84.4%
39053	Huntington	Gallia	OH	3.09	17.90	28	73.8%
39087	Huntington	Lawrence	OH	11.20	26.58	44	85.6%
39145	Huntington	Scioto	OH	25.08	25.76	63	80.7%
54011	Huntington	Cabell	WV	22.84	19.57	54	78.0%
54053	Huntington	Mason	WV	5.31	30.79	47	76.4%
54099	Huntington	Wayne	WV	28.80	46.62	85	88.8%
18011	Indianapolis	Boone	IN	5.92	0.05	34	17.6%
18057	Indianapolis	Hamilton	IN	0.15	0.55	54	1.3%
18059	Indianapolis	Hancock	IN	4.58	0.03	28	16.2%
18063	Indianapolis	Hendricks	IN	16.27	0.03	55	29.9%
18081	Indianapolis	Johnson	IN	0.88	0.19	26	4.2%
18095	Indianapolis	Madison	IN	14.62	0.11	45	32.9%
18097	Indianapolis	Marion	IN	27.99	1.19	166	17.5%
18109	Indianapolis	Morgan	IN	0.40	0.20	19	3.1%
18145	Indianapolis	Shelby	IN	6.54	0.02	29	22.3%
20091	Kansas City	Johnson	KS	52.60	0.03	155	33.9%
20103	Kansas City	Leavenworth	KS	13.49	0.39	29	47.4%
20121	Kansas City	Miami	KS	77.03	0.14	92	83.9%
20209	Kansas City	Wyandotte	KS	28.47	3.46	56	57.5%
29037	Kansas City	Cass	MO	15.70	0.11	37	42.4%
29047	Kansas City	Clay	MO	26.78	3.48	64	47.6%
29049	Kansas City	Clinton	MO	0.00	0.14	12	1.2%
29095	Kansas City	Jackson	MO	85.15	25.94	223	49.8%
29107	Kansas City	Lafayette	MO	21.96	3.26	49	51.3%
29165	Kansas City	Platte	MO	21.42	0.67	51	42.9%
29177	Kansas City	Ray	MO	42.28	3.09	61	74.5%
6037	Los Angeles	Los Angeles	CA	217.08	1,290.10	2,697	55.9%
6059	Los Angeles	Orange	CA	56.50	136.94	729	26.6%
6065	Los Angeles	Riverside	CA	93.21	0.90	380	24.8%
6071	Los Angeles	San Bernardino	CA	321.96	0.42	574	56.2%
6111	Los Angeles	Ventura	CA	11.01	179.05	298	63.8%
27003	Minneapolis	Anoka	MN	19.93	10.06	72	41.9%
27019	Minneapolis	Carver	MN	0.05	0.67	20	3.6%
27037	Minneapolis	Dakota	MN	11.92	9.37	80	26.5%
27053	Minneapolis	Hennepin	MN	29.88	28.17	242	24.0%
27123	Minneapolis	Ramsey	MN	11.29	8.91	89	22.8%
27139	Minneapolis	Scott	MN	2.55	1.15	25	14.6%
27163	Minneapolis	Washington	MN	21.74	39.42	96	63.8%
9001	New York	Fairfield	CT	0.00	35.19	184	19.1%

FIPS	MSA	County	ST	2020 PM2.5			
				Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
9005	New York	Litchfield	CT	0.00	0.79	23	3.4%
34003	New York	Bergen	NJ	22.36	2.76	146	17.2%
34013	New York	Essex	NJ	5.18	0.79	95	6.3%
34017	New York	Hudson	NJ	19.90	21.74	120	34.7%
34019	New York	Hunterdon	NJ	7.47	0.29	41	19.0%
34023	New York	Middlesex	NJ	11.14	3.88	106	14.1%
34025	New York	Monmouth	NJ	6.84	23.33	114	26.6%
34027	New York	Morris	NJ	5.01	0.47	73	7.6%
34029	New York	Ocean	NJ	0.41	11.45	58	20.3%
34031	New York	Passaic	NJ	4.28	0.45	54	8.7%
34035	New York	Somerset	NJ	11.03	0.01	51	21.8%
34037	New York	Sussex	NJ	0.96	0.55	23	6.6%
34039	New York	Union	NJ	8.53	13.90	97	23.1%
36005	New York	Bronx	NY	0.12	0.62	75	1.0%
36047	New York	Kings	NY	0.00	1.07	146	0.7%
36059	New York	Nassau	NY	0.00	9.33	139	6.7%
36061	New York	New York	NY	0.00	0.44	364	0.1%
36071	New York	Orange	NY	8.01	2.02	63	15.9%
36081	New York	Queens	NY	0.06	1.66	228	0.8%
36085	New York	Richmond	NY	0.00	1.84	39	4.8%
36087	New York	Rockland	NY	6.33	2.13	37	22.9%
36103	New York	Suffolk	NY	0.00	32.24	193	16.7%
36119	New York	Westchester	NY	0.00	3.02	123	2.5%
10003	Philadelphia	New Castle	DE	23.49	36.76	144	41.7%
24015	Philadelphia	Cecil	MD	7.73	1.40	30	30.2%
24029	Philadelphia	Kent	MD	0.06	1.21	12	10.5%
24031	Philadelphia	Montgomery	MD	21.88	0.43	127	17.6%
34005	Philadelphia	Burlington	NJ	0.00	42.25	100	42.2%
34007	Philadelphia	Camden	NJ	3.47	16.92	72	28.3%
34011	Philadelphia	Cumberland	NJ	0.55	43.19	65	67.8%
34015	Philadelphia	Gloucester	NJ	0.83	22.64	63	37.2%
34021	Philadelphia	Mercer	NJ	4.55	5.17	64	15.3%
34033	Philadelphia	Salem	NJ	0.25	13.18	28	47.6%
42017	Philadelphia	Bucks	PA	1.95	1.00	78	3.8%
42029	Philadelphia	Chester	PA	9.26	0.14	81	11.7%
42045	Philadelphia	Delaware	PA	3.76	149.53	199	77.0%
42101	Philadelphia	Philadelphia	PA	5.74	262.48	383	69.9%
4013	Phoenix	Maricopa	AZ	89.13	0.69	709	12.7%
4021	Phoenix	Pinal	AZ	48.94	0.15	92	53.5%
6019	San Joaquin	Fresno	CA	15.98	0.51	236	7.0%
6029	San Joaquin	Kern	CA	80.81	0.19	265	30.6%
6031	San Joaquin	Kings	CA	2.13	0.02	56	3.8%
6039	San Joaquin	Madera	CA	17.29	0.14	63	27.9%
6047	San Joaquin	Merced	CA	15.33	0.40	84	18.6%
6077	San Joaquin	San Joaquin	CA	26.62	23.51	184	27.3%

FIPS	MSA	County	ST	2020 PM2.5			
				Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
6099	San Joaquin	Stanislaus	CA	10.69	0.21	101	10.8%
6107	San Joaquin	Tulare	CA	24.00	0.14	133	18.1%
53029	Seattle	Island	WA	0.00	15.26	25	60.2%
53033	Seattle	King	WA	27.06	149.20	484	36.4%
53035	Seattle	Kitsap	WA	0.00	1.13	27	4.2%
53045	Seattle	Mason	WA	0.00	0.50	7	7.1%
53053	Seattle	Pierce	WA	16.97	134.63	238	63.7%
53061	Seattle	Snohomish	WA	33.68	23.01	140	40.4%
53067	Seattle	Thurston	WA	9.33	9.42	48	39.1%
17027	St. Louis	Clinton	IL	21.27	0.07	41	51.8%
17083	St. Louis	Jersey	IL	1.73	14.76	28	57.9%
17119	St. Louis	Madison	IL	8.44	8.01	67	24.7%
17133	St. Louis	Monroe	IL	33.99	12.95	60	77.8%
17163	St. Louis	St. Clair	IL	9.49	15.31	69	36.2%
29055	St. Louis	Crawford	MO	4.54	0.04	12	38.8%
29071	St. Louis	Franklin	MO	29.11	1.86	54	57.6%
29099	St. Louis	Jefferson	MO	7.90	13.13	49	43.3%
29113	St. Louis	Lincoln	MO	13.04	5.22	34	53.8%
29183	St. Louis	St. Charles	MO	15.70	11.75	73	37.4%
29189	St. Louis	St. Louis	MO	25.09	15.01	214	18.8%
29219	St. Louis	Warren	MO	2.66	1.81	14	32.7%
29510	St. Louis	St. Louis	MO	22.18	202.23	256	87.7%

Table 0-108 2030 Locomotive and Diesel Marine PM2.5 Tons/Year and Percent of Total Diesel Mobile Sources

FIPS	MSA	County	ST	2030 PM2.5 Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
13013	Atlanta	Barrow	GA	5.25	0.01	9	60.3%
13015	Atlanta	Bartow	GA	18.79	0.20	28	68.0%
13045	Atlanta	Carroll	GA	5.08	0.08	14	37.1%
13057	Atlanta	Cherokee	GA	0.00	0.19	14	1.3%
13063	Atlanta	Clayton	GA	9.90	0.03	27	36.7%
13067	Atlanta	Cobb	GA	25.96	0.08	85	30.8%
13077	Atlanta	Coweta	GA	13.06	0.06	25	53.1%
13089	Atlanta	DeKalb	GA	12.03	0.05	66	18.2%
13097	Atlanta	Douglas	GA	4.66	0.01	12	40.2%
13113	Atlanta	Fayette	GA	3.37	0.04	13	26.9%
13117	Atlanta	Forsyth	GA	0.00	0.40	14	2.9%
13121	Atlanta	Fulton	GA	35.38	0.11	130	27.4%
13135	Atlanta	Gwinnett	GA	8.98	0.07	69	13.2%
13139	Atlanta	Hall	GA	5.34	0.65	21	29.0%
13149	Atlanta	Heard	GA	0.00	0.09	1	8.2%
13151	Atlanta	Henry	GA	13.32	0.04	28	47.3%
13217	Atlanta	Newton	GA	1.50	0.05	9	16.7%
13223	Atlanta	Paulding	GA	11.04	0.03	19	58.6%
13237	Atlanta	Putnam	GA	0.29	0.30	2	26.8%
13247	Atlanta	Rockdale	GA	2.14	0.03	10	22.0%
13255	Atlanta	Spalding	GA	0.57	0.03	6	10.2%
13297	Atlanta	Walton	GA	1.81	0.01	6	28.3%
24003	Baltimore	Anne Arundel	MD	9.01	1.77	43	24.8%
24005	Baltimore	Baltimore	MD	32.54	1.15	94	36.0%
24013	Baltimore	Carroll	MD	5.05	0.04	22	23.1%
24025	Baltimore	Harford	MD	8.01	1.11	28	32.2%
24027	Baltimore	Howard	MD	11.21	0.35	35	33.5%
24510	Baltimore	Baltimore	MD	45.29	259.26	330	92.2%
1073	Birmingham	Jefferson	AL	72.52	0.94	143	51.5%
1117	Birmingham	Shelby	AL	38.03	0.29	52	73.3%
1127	Birmingham	Walker	AL	14.10	0.93	26	58.7%
9007	Boston	Middlesex	CT	0.00	1.70	14	12.3%
25001	Boston	Barnstable	MA	5.94	18.19	42	58.0%
25005	Boston	Bristol	MA	11.25	12.53	55	43.6%
25007	Boston	Dukes	MA	0.00	111.06	112	98.9%
25009	Boston	Essex	MA	14.59	4.59	63	30.3%
25019	Boston	Nantucket	MA	0.00	16.73	18	93.2%
25021	Boston	Norfolk	MA	17.74	5.72	72	32.7%
25023	Boston	Plymouth	MA	9.26	4.83	42	33.7%
25025	Boston	Suffolk	MA	9.40	47.81	295	19.4%
25027	Boston	Worcester	MA	35.83	1.04	91	40.4%
33011	Boston	Hillsborough	NH	1.09	0.42	31	4.9%

FIPS	MSA	County	ST	2030 PM2.5 Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
33015	Boston	Rockingham	NH	0.82	30.13	56	55.2%
47065	Chattanooga	Hamilton	TN	36.91	24.61	85	72.5%
47115	Chattanooga	Marion	TN	5.16	4.78	15	67.1%
47153	Chattanooga	Sequatchie	TN	0.00	0.00	1	0.0%
13047	Chattanooga	Catoosa	GA	11.18	0.01	15	74.0%
13083	Chattanooga	Dade	GA	10.61	0.00	14	76.7%
13295	Chattanooga	Walker	GA	0.00	0.01	5	0.1%
17031	Chicago	Cook	IL	583.11	176.82	1,069	71.1%
17043	Chicago	DuPage	IL	150.13	0.14	227	66.1%
17063	Chicago	Grundy	IL	12.86	5.35	29	62.4%
17089	Chicago	Kane	IL	55.63	0.10	91	61.3%
17093	Chicago	Kendall	IL	7.87	0.01	16	48.2%
17097	Chicago	Lake	IL	28.70	21.57	96	52.5%
17111	Chicago	McHenry	IL	15.86	0.16	37	42.9%
17197	Chicago	Will	IL	154.37	3.97	195	81.2%
18089	Chicago	Lake	IN	129.63	13.55	186	77.1%
18127	Chicago	Porter	IN	39.03	11.74	68	75.0%
18029	Cincinnati	Dearborn	IN	5.39	18.81	30	79.5%
21015	Cincinnati	Boone	KY	7.70	28.23	46	78.5%
21037	Cincinnati	Campbell	KY	14.53	19.53	40	85.6%
21117	Cincinnati	Kenton	KY	28.15	9.75	49	78.1%
39017	Cincinnati	Butler	OH	38.73	0.05	64	60.4%
39025	Cincinnati	Clermont	OH	1.68	37.21	53	72.9%
39061	Cincinnati	Hamilton	OH	38.03	110.20	216	68.7%
39165	Cincinnati	Warren	OH	5.88	0.09	26	23.0%
39007	Cleveland	Ashtabula	OH	26.16	148.22	185	94.4%
39035	Cleveland	Cuyahoga	OH	73.82	103.97	280	63.4%
39085	Cleveland	Lake	OH	17.97	22.85	57	71.2%
39093	Cleveland	Lorain	OH	42.97	94.99	165	83.8%
39103	Cleveland	Medina	OH	13.67	0.06	30	45.8%
39133	Cleveland	Portage	OH	26.81	0.24	45	60.8%
39153	Cleveland	Summit	OH	21.98	0.17	63	35.3%
26093	Detroit	Livingston	MI	2.25	0.06	20	11.7%
26099	Detroit	Macomb	MI	3.49	4.61	56	14.6%
26115	Detroit	Monroe	MI	16.47	7.45	42	56.9%
26125	Detroit	Oakland	MI	13.69	3.84	108	16.2%
26147	Detroit	St. Clair	MI	6.63	17.88	44	55.4%
26161	Detroit	Washtenaw	MI	3.80	0.04	35	11.1%
26163	Detroit	Wayne	MI	29.36	8.63	151	25.1%
48039	Houston	Brazoria	TX	17.11	204.68	242	91.5%
48071	Houston	Chambers	TX	0.97	6.36	12	59.3%
48157	Houston	Fort Bend	TX	23.77	0.09	52	45.9%
48167	Houston	Galveston	TX	13.22	468.88	500	96.4%
48201	Houston	Harris	TX	67.89	1,221.64	1,557	82.8%
48291	Houston	Liberty	TX	26.15	2.52	37	77.9%

FIPS	MSA	County	ST	2030 PM2.5 Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
48339	Houston	Montgomery	TX	20.38	0.27	49	42.2%
48473	Houston	Waller	TX	5.92	0.04	10	58.2%
21019	Huntington	Boyd	KY	10.05	15.13	29	87.4%
21127	Huntington	Lawrence	KY	8.93	4.91	15	90.7%
39001	Huntington	Adams	OH	0.34	43.51	48	92.1%
39053	Huntington	Gallia	OH	2.94	19.13	26	85.9%
39087	Huntington	Lawrence	OH	10.68	28.40	43	91.2%
39145	Huntington	Scioto	OH	23.91	27.52	58	89.0%
54011	Huntington	Cabell	WV	21.94	20.93	49	86.9%
54053	Huntington	Mason	WV	5.03	32.92	42	89.3%
54099	Huntington	Wayne	WV	27.75	49.83	82	95.0%
18011	Indianapolis	Boone	IN	5.59	0.06	19	30.0%
18057	Indianapolis	Hamilton	IN	0.18	0.63	26	3.1%
18059	Indianapolis	Hancock	IN	4.35	0.03	16	28.1%
18063	Indianapolis	Hendricks	IN	15.52	0.03	33	46.7%
18081	Indianapolis	Johnson	IN	1.02	0.21	14	8.9%
18095	Indianapolis	Madison	IN	13.96	0.12	29	47.9%
18097	Indianapolis	Marion	IN	26.79	1.35	98	28.7%
18109	Indianapolis	Morgan	IN	0.46	0.22	10	6.6%
18145	Indianapolis	Shelby	IN	6.23	0.02	17	36.6%
20091	Kansas City	Johnson	KS	50.70	0.04	101	50.4%
20103	Kansas City	Leavenworth	KS	13.00	0.42	21	63.9%
20121	Kansas City	Miami	KS	74.26	0.15	81	91.7%
20209	Kansas City	Wyandotte	KS	27.42	3.70	43	71.6%
29037	Kansas City	Cass	MO	15.11	0.12	26	59.1%
29047	Kansas City	Clay	MO	27.23	3.74	48	64.9%
29049	Kansas City	Clinton	MO	0.00	0.16	6	2.9%
29095	Kansas City	Jackson	MO	85.76	27.74	171	66.5%
29107	Kansas City	Lafayette	MO	21.17	3.50	36	68.5%
29165	Kansas City	Platte	MO	20.65	0.74	35	61.6%
29177	Kansas City	Ray	MO	42.32	3.31	53	86.7%
6037	Los Angeles	Los Angeles	CA	214.05	1,378.65	2,053	77.6%
6059	Los Angeles	Orange	CA	57.93	146.38	433	47.2%
6065	Los Angeles	Riverside	CA	87.56	1.02	189	46.8%
6071	Los Angeles	San Bernardino	CA	306.89	0.48	400	76.8%
6111	Los Angeles	Ventura	CA	10.79	191.39	247	81.7%
27003	Minneapolis	Anoka	MN	19.16	10.87	51	59.0%
27019	Minneapolis	Carver	MN	0.05	0.75	10	7.6%
27037	Minneapolis	Dakota	MN	11.47	10.11	51	42.4%
27053	Minneapolis	Hennepin	MN	28.80	30.34	153	38.7%
27123	Minneapolis	Ramsey	MN	10.87	9.61	56	36.4%
27139	Minneapolis	Scott	MN	2.46	1.27	14	26.4%
27163	Minneapolis	Washington	MN	20.93	42.22	81	78.3%
9001	New York	Fairfield	CT	0.00	37.87	112	33.7%

FIPS	MSA	County	ST	2030 PM2.5 Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
9005	New York	Litchfield	CT	0.00	0.90	13	6.6%
34003	New York	Bergen	NJ	20.91	2.98	89	26.9%
34013	New York	Essex	NJ	4.68	0.85	50	11.0%
34017	New York	Hudson	NJ	18.73	23.28	79	53.1%
34019	New York	Hunterdon	NJ	6.78	0.33	25	28.1%
34023	New York	Middlesex	NJ	10.49	4.17	63	23.1%
34025	New York	Monmouth	NJ	5.78	25.21	75	41.6%
34027	New York	Morris	NJ	4.44	0.53	42	11.9%
34029	New York	Ocean	NJ	0.36	12.87	39	33.6%
34031	New York	Passaic	NJ	3.75	0.51	30	14.0%
34035	New York	Somerset	NJ	10.24	0.02	32	32.2%
34037	New York	Sussex	NJ	1.10	0.63	13	12.9%
34039	New York	Union	NJ	7.68	14.86	59	38.2%
36005	New York	Bronx	NY	0.12	0.69	38	2.1%
36047	New York	Kings	NY	0.00	1.18	77	1.5%
36059	New York	Nassau	NY	0.00	10.10	78	12.9%
36061	New York	New York	NY	0.00	0.48	168	0.3%
36071	New York	Orange	NY	7.53	2.18	39	25.2%
36081	New York	Queens	NY	0.05	1.83	103	1.8%
36085	New York	Richmond	NY	0.00	2.00	19	10.3%
36087	New York	Rockland	NY	6.09	2.31	23	36.8%
36103	New York	Suffolk	NY	0.00	35.49	118	30.1%
36119	New York	Westchester	NY	0.00	3.29	61	5.4%
10003	Philadelphia	New Castle	DE	23.04	39.30	105	59.6%
24015	Philadelphia	Cecil	MD	7.20	1.55	20	43.2%
24029	Philadelphia	Kent	MD	0.06	1.36	6	22.2%
24031	Philadelphia	Montgomery	MD	19.61	0.46	78	25.7%
34005	Philadelphia	Burlington	NJ	0.00	45.18	76	59.6%
34007	Philadelphia	Camden	NJ	3.05	18.09	49	43.0%
34011	Philadelphia	Cumberland	NJ	0.64	46.39	58	81.6%
34015	Philadelphia	Gloucester	NJ	0.83	24.22	45	55.3%
34021	Philadelphia	Mercer	NJ	4.21	5.53	38	25.5%
34033	Philadelphia	Salem	NJ	0.26	14.13	22	65.7%
42017	Philadelphia	Bucks	PA	1.82	1.10	44	6.7%
42029	Philadelphia	Chester	PA	8.44	0.16	46	18.8%
42045	Philadelphia	Delaware	PA	3.48	159.80	188	86.8%
42101	Philadelphia	Philadelphia	PA	5.93	280.49	347	82.6%
4013	Phoenix	Maricopa	AZ	85.15	0.79	425	20.2%
4021	Phoenix	Pinal	AZ	46.98	0.17	71	66.3%
6019	San Joaquin	Fresno	CA	15.23	0.58	101	15.7%
6029	San Joaquin	Kern	CA	76.62	0.22	145	52.9%
6031	San Joaquin	Kings	CA	1.98	0.02	21	9.3%
6039	San Joaquin	Madera	CA	16.55	0.16	32	52.1%
6047	San Joaquin	Merced	CA	14.48	0.46	41	36.8%
6077	San Joaquin	San Joaquin	CA	25.33	25.14	100	50.3%

FIPS	MSA	County	ST	2030 PM2.5			
				Diesel Locomotive	Diesel Marine	Total Diesel Mobile	LM Percent
6099	San Joaquin	Stanislaus	CA	10.15	0.23	45	23.3%
6107	San Joaquin	Tulare	CA	22.89	0.16	65	35.4%
53029	Seattle	Island	WA	0.00	16.34	22	75.7%
53033	Seattle	King	WA	26.00	159.80	344	54.0%
53035	Seattle	Kitsap	WA	0.00	1.28	16	8.1%
53045	Seattle	Mason	WA	0.00	0.57	4	12.8%
53053	Seattle	Pierce	WA	16.30	144.03	206	77.8%
53061	Seattle	Snohomish	WA	32.24	24.77	102	56.0%
53067	Seattle	Thurston	WA	8.81	10.12	36	53.2%
17027	St. Louis	Clinton	IL	20.38	0.08	29	69.4%
17083	St. Louis	Jersey	IL	1.66	15.78	23	76.4%
17119	St. Louis	Madison	IL	8.64	8.56	43	40.3%
17133	St. Louis	Monroe	IL	32.45	13.84	52	88.4%
17163	St. Louis	St. Clair	IL	9.36	16.36	48	53.5%
29055	St. Louis	Crawford	MO	4.30	0.04	9	50.9%
29071	St. Louis	Franklin	MO	27.96	2.00	43	70.5%
29099	St. Louis	Jefferson	MO	7.62	14.04	38	57.1%
29113	St. Louis	Lincoln	MO	12.57	5.60	26	70.5%
29183	St. Louis	St. Charles	MO	15.14	12.62	51	54.2%
29189	St. Louis	St. Louis	MO	24.13	16.08	130	30.9%
29219	St. Louis	Warren	MO	2.56	1.95	9	49.3%
29510	St. Louis	St. Louis	MO	23.99	216.11	260	92.3%

Table 0-109 2002 Locomotive and Diesel Marine NOx Tons/Year and Percent of Total Mobile Sources

FIPS	MSA	County	ST	2002 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
13013	Atlanta	Barrow	GA	224.1	0.5	2,039	11.0%
13015	Atlanta	Bartow	GA	799.6	7.0	5,172	15.6%
13045	Atlanta	Carroll	GA	219.5	3.0	4,762	4.7%
13057	Atlanta	Cherokee	GA	0.0	6.8	5,828	0.1%
13063	Atlanta	Clayton	GA	420.9	1.0	9,512	4.4%
13067	Atlanta	Cobb	GA	1,110.1	2.8	23,542	4.7%
13077	Atlanta	Coweta	GA	555.6	2.0	5,727	9.7%
13089	Atlanta	DeKalb	GA	515.4	1.8	26,283	2.0%
13097	Atlanta	Douglas	GA	202.2	0.5	3,952	5.1%
13113	Atlanta	Fayette	GA	143.8	1.3	3,977	3.6%
13117	Atlanta	Forsyth	GA	0.0	14.1	4,418	0.3%
13121	Atlanta	Fulton	GA	1,512.7	3.8	39,991	3.8%
13135	Atlanta	Gwinnett	GA	385.8	2.5	21,343	1.8%
13139	Atlanta	Hall	GA	258.8	23.1	6,452	4.4%
13149	Atlanta	Heard	GA	0.0	3.3	465	0.7%
13151	Atlanta	Henry	GA	567.2	1.3	6,479	8.8%
13217	Atlanta	Newton	GA	64.4	1.8	3,584	1.8%
13223	Atlanta	Paulding	GA	470.2	1.0	3,801	12.4%
13237	Atlanta	Putnam	GA	14.1	10.6	630	3.9%
13247	Atlanta	Rockdale	GA	91.1	1.0	3,158	2.9%
13255	Atlanta	Spalding	GA	24.5	1.0	2,584	1.0%
13297	Atlanta	Walton	GA	77.1	0.5	2,211	3.5%
24003	Baltimore	Anne Arundel	MD	520.4	63.4	15,497	3.8%
24005	Baltimore	Baltimore	MD	1,243.0	41.5	24,021	5.3%
24013	Baltimore	Carroll	MD	199.2	1.3	5,995	3.3%
24025	Baltimore	Harford	MD	389.4	40.2	7,894	5.4%
24027	Baltimore	Howard	MD	594.5	12.7	8,160	7.4%
24510	Baltimore	Baltimore	MD	1,282.5	1,670.4	23,591	12.5%
1073	Birmingham	Jefferson	AL	4,615.9	268.9	32,416	15.1%
1117	Birmingham	Shelby	AL	1,156.1	10.4	6,159	18.9%
1127	Birmingham	Walker	AL	889.2	116.8	3,687	27.3%
9007	Boston	Middlesex	CT	160.2	121.4	282	99.8%
25001	Boston	Barnstable	MA	318.1	474.3	8,446	9.4%
25005	Boston	Bristol	MA	588.4	238.7	15,719	5.3%
25007	Boston	Dukes	MA	0.0	1,589.6	2,042	77.9%
25009	Boston	Essex	MA	777.6	197.2	21,303	4.6%
25019	Boston	Nantucket	MA	0.0	282.5	596	47.4%
25021	Boston	Norfolk	MA	902.6	163.4	22,498	4.7%
25023	Boston	Plymouth	MA	493.8	169.6	12,655	5.2%
25025	Boston	Suffolk	MA	489.2	855.0	38,095	3.5%
25027	Boston	Worcester	MA	1,860.6	36.5	26,614	7.1%
33011	Boston	Hillsborough	NH	49.0	15.0	12,444	0.5%
33015	Boston	Rockingham	NH	37.0	1,112.9	11,846	9.7%

FIPS	MSA	County	ST	2002 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
47065	Chattanooga	Hamilton	TN	1,569.2	909.5	14,329	17.3%
47115	Chattanooga	Marion	TN	220.0	176.6	2,998	13.2%
47153	Chattanooga	Sequatchie	TN	0.0	0.0	270	0.0%
13047	Chattanooga	Catoosa	GA	475.9	0.3	2,527	18.8%
13083	Chattanooga	Dade	GA	452.1	0.0	2,263	20.0%
13295	Chattanooga	Walker	GA	0.0	0.3	1,996	0.0%
17031	Chicago	Cook	IL	24,769.1	6,520.5	178,269	17.6%
17043	Chicago	DuPage	IL	7,028.5	5.0	31,241	22.5%
17063	Chicago	Grundy	IL	479.6	198.0	3,244	20.9%
17089	Chicago	Kane	IL	2,446.9	3.5	8,879	27.6%
17093	Chicago	Kendall	IL	310.8	0.3	1,789	17.4%
17097	Chicago	Lake	IL	1,301.3	774.4	16,423	12.6%
17111	Chicago	McHenry	IL	700.7	5.8	5,103	13.8%
17197	Chicago	Will	IL	6,401.5	146.5	16,000	40.9%
18089	Chicago	Lake	IN	4,656.8	490.6	23,491	21.9%
18127	Chicago	Porter	IN	1,588.7	425.4	8,840	22.8%
18029	Cincinnati	Dearborn	IN	216.3	696.0	3,628	25.1%
21015	Cincinnati	Boone	KY	327.3	1,044.5	5,966	23.0%
21037	Cincinnati	Campbell	KY	621.1	722.6	4,914	27.3%
21117	Cincinnati	Kenton	KY	1,197.5	360.8	7,316	21.3%
39017	Cincinnati	Butler	OH	1,581.9	1.7	10,604	14.9%
39025	Cincinnati	Clermont	OH	68.2	1,377.2	7,579	19.1%
39061	Cincinnati	Hamilton	OH	1,540.5	4,078.9	34,403	16.3%
39165	Cincinnati	Warren	OH	235.3	3.2	5,948	4.0%
39007	Cleveland	Ashtabula	OH	1,062.3	5,482.2	12,796	51.1%
39035	Cleveland	Cuyahoga	OH	2,914.2	3,832.5	49,767	13.6%
39085	Cleveland	Lake	OH	738.0	837.5	8,866	17.8%
39093	Cleveland	Lorain	OH	1,749.1	3,509.5	15,702	33.5%
39103	Cleveland	Medina	OH	551.8	2.1	6,896	8.0%
39133	Cleveland	Portage	OH	1,090.9	8.6	8,119	13.5%
39153	Cleveland	Summit	OH	888.7	6.0	18,330	4.9%
26093	Detroit	Livingston	MI	95.5	1.9	7,393	1.3%
26099	Detroit	Macomb	MI	148.2	169.4	24,046	1.3%
26115	Detroit	Monroe	MI	700.2	276.4	7,675	12.7%
26125	Detroit	Oakland	MI	584.1	140.9	38,601	1.9%
26147	Detroit	St. Clair	MI	285.7	662.4	9,871	9.6%
26161	Detroit	Washtenaw	MI	154.9	1.3	12,742	1.2%
26163	Detroit	Wayne	MI	1,133.9	318.6	68,502	2.1%
48039	Houston	Brazoria	TX	728.4	7,573.7	18,133	45.8%
48071	Houston	Chambers	TX	41.6	234.3	2,586	10.7%
48157	Houston	Fort Bend	TX	1,019.2	3.3	11,057	9.2%
48167	Houston	Galveston	TX	491.0	17,352.7	30,023	59.4%
48201	Houston	Harris	TX	2,609.1	45,215.7	165,530	28.9%
48291	Houston	Liberty	TX	1,115.9	93.4	4,073	29.7%
48339	Houston	Montgomery	TX	867.4	9.7	13,754	6.4%
48473	Houston	Waller	TX	252.5	1.5	1,574	16.1%

FIPS	MSA	County	ST	2002 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
21019	Huntington	Boyd	KY	430.5	559.8	3,171	31.2%
21127	Huntington	Lawrence	KY	425.1	181.8	1,317	46.1%
39001	Huntington	Adams	OH	13.7	1,610.6	3,248	50.0%
39053	Huntington	Gallia	OH	119.7	708.1	2,184	37.9%
39087	Huntington	Lawrence	OH	433.9	1,051.2	3,946	37.6%
39145	Huntington	Scioto	OH	972.1	1,018.7	4,780	41.7%
54011	Huntington	Cabell	WV	946.3	774.1	9,978	17.2%
54053	Huntington	Mason	WV	239.7	1,218.0	2,909	50.1%
54099	Huntington	Wayne	WV	1,182.1	1,844.2	4,489	67.4%
18011	Indianapolis	Boone	IN	235.9	2.1	3,600	6.6%
18057	Indianapolis	Hamilton	IN	5.7	22.6	7,413	0.4%
18059	Indianapolis	Hancock	IN	179.7	1.2	3,342	5.4%
18063	Indianapolis	Hendricks	IN	630.8	1.2	5,968	10.6%
18081	Indianapolis	Johnson	IN	33.0	7.6	4,964	0.8%
18095	Indianapolis	Madison	IN	563.4	4.3	6,314	9.0%
18097	Indianapolis	Marion	IN	1,089.8	48.3	33,822	3.4%
18109	Indianapolis	Morgan	IN	15.0	8.0	3,634	0.6%
18145	Indianapolis	Shelby	IN	255.6	0.9	3,130	8.2%
20091	Kansas City	Johnson	KS	2,157.3	1.4	18,312	11.8%
20103	Kansas City	Leavenworth	KS	553.1	15.5	2,984	19.1%
20121	Kansas City	Miami	KS	3,157.4	5.5	4,481	70.6%
20209	Kansas City	Wyandotte	KS	1,170.2	137.0	7,329	17.8%
29037	Kansas City	Cass	MO	646.8	4.4	3,752	17.4%
29047	Kansas City	Clay	MO	1,073.0	137.9	8,204	14.8%
29049	Kansas City	Clinton	MO	0.0	5.8	1,517	0.4%
29095	Kansas City	Jackson	MO	3,434.0	1,026.2	30,133	14.8%
29107	Kansas City	Lafayette	MO	899.9	129.2	3,796	27.1%
29165	Kansas City	Platte	MO	878.0	26.9	5,793	15.6%
29177	Kansas City	Ray	MO	1,713.2	122.5	3,190	57.5%
6037	Los Angeles	Los Angeles	CA	9,771.2	42,754.8	257,574	20.4%
6059	Los Angeles	Orange	CA	2,374.1	2,363.7	68,174	6.9%
6065	Los Angeles	Riverside	CA	4,414.1	56.3	45,019	9.9%
6071	Los Angeles	San Bernardino	CA	14,261.8	26.3	56,392	25.3%
6111	Los Angeles	Ventura	CA	479.2	4,087.6	18,815	24.3%
27003	Minneapolis	Anoka	MN	822.8	399.5	10,508	11.6%
27019	Minneapolis	Carver	MN	2.0	27.0	2,563	1.1%
27037	Minneapolis	Dakota	MN	491.2	371.9	11,559	7.5%
27053	Minneapolis	Hennepin	MN	1,226.2	1,117.3	42,042	5.6%
27123	Minneapolis	Ramsey	MN	465.4	353.7	18,199	4.5%
27139	Minneapolis	Scott	MN	104.5	46.1	2,947	5.1%
27163	Minneapolis	Washington	MN	895.5	1,560.4	9,536	25.8%
9001	New York	Fairfield	CT	589.7	257.5	28,368	3.0%
9005	New York	Litchfield	CT	100.0	31.6	4,615	2.9%
34003	New York	Bergen	NJ	1,055.1	193.9	23,136	5.4%
34013	New York	Essex	NJ	228.1	51.3	21,624	1.3%

FIPS	MSA	County	ST	2002 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
34017	New York	Hudson	NJ	777.7	1,486.3	16,558	13.7%
34019	New York	Hunterdon	NJ	331.3	11.7	7,327	4.7%
34023	New York	Middlesex	NJ	481.9	282.2	19,497	3.9%
34025	New York	Monmouth	NJ	379.8	682.3	17,750	6.0%
34027	New York	Morris	NJ	234.4	18.7	13,461	1.9%
34029	New York	Ocean	NJ	19.6	435.6	12,234	3.7%
34031	New York	Passaic	NJ	229.2	18.1	11,334	2.2%
34035	New York	Somerset	NJ	509.9	0.6	8,259	6.2%
34037	New York	Sussex	NJ	36.0	22.2	4,546	1.3%
34039	New York	Union	NJ	420.7	1,084.1	14,897	10.1%
36005	New York	Bronx	NY	5.1	203.9	18,301	1.1%
36047	New York	Kings	NY	0.0	1,713.6	36,548	4.7%
36059	New York	Nassau	NY	0.0	586.4	22,268	2.6%
36061	New York	New York	NY	0.0	1,207.0	44,035	2.7%
36071	New York	Orange	NY	349.9	80.2	13,475	3.2%
36081	New York	Queens	NY	2.3	2,056.4	39,760	5.2%
36085	New York	Richmond	NY	0.0	2,386.5	8,667	27.5%
36087	New York	Rockland	NY	265.0	16.6	4,886	5.8%
36103	New York	Suffolk	NY	0.0	1,361.4	27,455	5.0%
36119	New York	Westchester	NY	0.0	127.5	16,193	0.8%
10003	Philadelphia	New Castle	DE	818.9	2,545.5	21,119	15.9%
24015	Philadelphia	Cecil	MD	306.8	56.0	5,150	7.0%
24029	Philadelphia	Kent	MD	2.4	48.8	984	5.2%
24031	Philadelphia	Montgomery	MD	987.2	16.9	23,771	4.2%
34005	Philadelphia	Burlington	NJ	0.0	1,178.2	13,449	8.8%
34007	Philadelphia	Camden	NJ	182.3	471.7	13,996	4.7%
34011	Philadelphia	Cumberland	NJ	20.8	1,242.9	5,472	23.1%
34015	Philadelphia	Gloucester	NJ	36.7	633.3	10,121	6.6%
34021	Philadelphia	Mercer	NJ	193.5	144.7	12,609	2.7%
34033	Philadelphia	Salem	NJ	10.3	374.9	3,009	12.8%
42017	Philadelphia	Bucks	PA	86.8	40.0	13,732	0.9%
42029	Philadelphia	Chester	PA	435.2	5.7	12,150	3.6%
42045	Philadelphia	Delaware	PA	171.7	5,914.4	18,361	33.1%
42101	Philadelphia	Philadelphia	PA	239.6	10,381.6	44,901	23.7%
4013	Phoenix	Maricopa	AZ	3,884.9	28.0	105,636	3.7%
4021	Phoenix	Pinal	AZ	2,030.8	6.2	10,844	18.8%
6019	San Joaquin	Fresno	CA	765.2	32.2	24,853	3.2%
6029	San Joaquin	Kern	CA	3,687.8	12.0	27,768	13.3%
6031	San Joaquin	Kings	CA	104.0	1.1	4,389	2.4%
6039	San Joaquin	Madera	CA	819.3	8.9	5,469	15.1%
6047	San Joaquin	Merced	CA	790.7	25.4	9,353	8.7%
6077	San Joaquin	San Joaquin	CA	1,287.6	603.0	18,977	10.0%
6099	San Joaquin	Stanislaus	CA	528.7	12.5	12,862	4.2%
6107	San Joaquin	Tulare	CA	1,172.3	8.9	13,310	8.9%
53029	Seattle	Island	WA	0.0	2,098.3	3,999	52.5%
53033	Seattle	King	WA	1,119.6	5,906.0	68,488	10.3%

FIPS	MSA	County	ST	2002 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
53035	Seattle	Kitsap	WA	0.0	45.6	6,933	0.7%
53045	Seattle	Mason	WA	0.1	26.7	1,679	1.6%
53053	Seattle	Pierce	WA	703.0	5,327.1	27,443	22.0%
53061	Seattle	Snohomish	WA	1,279.7	912.6	20,798	10.5%
53067	Seattle	Thurston	WA	369.2	373.3	8,518	8.7%
17027	St. Louis	Clinton	IL	801.1	2.8	2,597	31.0%
17083	St. Louis	Jersey	IL	64.8	583.9	1,759	36.9%
17119	St. Louis	Madison	IL	287.0	316.7	10,200	5.9%
17133	St. Louis	Monroe	IL	1,288.0	512.0	3,122	57.7%
17163	St. Louis	St. Clair	IL	325.2	605.6	10,049	9.3%
29055	St. Louis	Crawford	MO	204.7	1.5	2,080	9.9%
29071	St. Louis	Franklin	MO	1,206.1	73.8	6,434	19.9%
29099	St. Louis	Jefferson	MO	324.2	519.4	9,205	9.2%
29113	St. Louis	Lincoln	MO	534.3	206.8	2,771	26.7%
29183	St. Louis	St. Charles	MO	643.6	465.6	10,406	10.7%
29189	St. Louis	St. Louis	MO	1,035.3	594.2	41,254	4.0%
29219	St. Louis	Warren	MO	109.1	71.9	1,692	10.7%
29510	St. Louis	St. Louis	MO	866.5	7,998.7	23,595	37.6%

Table 0-110 2020 Locomotive and Diesel Marine NOx Tons/Year and Percent of Total Mobile Sources

FIPS	MSA	County	ST	2020 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
13013	Atlanta	Barrow	GA	189.4	0.6	682	27.9%
13015	Atlanta	Bartow	GA	675.7	8.5	1,838	37.2%
13045	Atlanta	Carroll	GA	183.4	3.6	1,404	13.3%
13057	Atlanta	Cherokee	GA	0.0	8.1	1,834	0.4%
13063	Atlanta	Clayton	GA	355.6	1.2	3,382	10.6%
13067	Atlanta	Cobb	GA	933.8	3.3	7,245	12.9%
13077	Atlanta	Coweta	GA	469.5	2.4	1,995	23.7%
13089	Atlanta	DeKalb	GA	433.1	2.1	7,494	5.8%
13097	Atlanta	Douglas	GA	168.0	0.6	1,353	12.5%
13113	Atlanta	Fayette	GA	121.5	1.5	1,333	9.2%
13117	Atlanta	Forsyth	GA	0.0	16.9	1,392	1.2%
13121	Atlanta	Fulton	GA	1,272.1	4.5	15,332	8.3%
13135	Atlanta	Gwinnett	GA	323.3	3.0	6,226	5.2%
13139	Atlanta	Hall	GA	186.3	27.8	1,919	11.2%
13149	Atlanta	Heard	GA	0.0	3.9	128	3.1%
13151	Atlanta	Henry	GA	479.3	1.5	2,241	21.5%
13217	Atlanta	Newton	GA	54.4	2.1	996	5.7%
13223	Atlanta	Paulding	GA	397.3	1.2	1,372	29.0%
13237	Atlanta	Putnam	GA	10.3	12.7	202	11.4%
13247	Atlanta	Rockdale	GA	77.0	1.2	1,026	7.6%
13255	Atlanta	Spalding	GA	20.7	1.2	728	3.0%
13297	Atlanta	Walton	GA	65.1	0.6	664	9.9%
24003	Baltimore	Anne Arundel	MD	306.6	71.4	8,342	4.5%
24005	Baltimore	Baltimore	MD	936.5	45.1	11,487	8.5%
24013	Baltimore	Carroll	MD	145.4	1.5	2,579	5.7%
24025	Baltimore	Harford	MD	251.7	42.9	3,608	8.2%
24027	Baltimore	Howard	MD	366.4	10.6	3,859	9.8%
24510	Baltimore	Baltimore	MD	1,186.5	1,357.0	15,594	16.3%
1073	Birmingham	Jefferson	AL	4,173.3	221.1	12,112	36.3%
1117	Birmingham	Shelby	AL	1,026.2	12.5	2,492	41.7%
1127	Birmingham	Walker	AL	649.1	97.7	1,530	48.8%
9007	Boston	Middlesex	CT	110.6	121.2	233	99.6%
25001	Boston	Barnstable	MA	232.2	490.2	4,681	15.4%
25005	Boston	Bristol	MA	436.1	214.3	7,364	8.8%
25007	Boston	Dukes	MA	0.0	1,332.0	1,732	76.9%
25009	Boston	Essex	MA	567.6	201.2	9,768	7.9%
25019	Boston	Nantucket	MA	0.0	256.8	530	48.4%
25021	Boston	Norfolk	MA	682.9	140.1	10,197	8.1%
25023	Boston	Plymouth	MA	363.1	191.5	6,163	9.0%
25025	Boston	Suffolk	MA	362.6	703.7	17,700	6.0%
25027	Boston	Worcester	MA	1,382.7	43.9	12,067	11.8%
33011	Boston	Hillsborough	NH	35.8	18.0	6,327	0.8%
33015	Boston	Rockingham	NH	27.0	928.5	6,652	14.4%

FIPS	MSA	County	ST	2020 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
47065	Chattanooga	Hamilton	TN	1,326.0	749.8	5,500	37.7%
47115	Chattanooga	Marion	TN	185.9	148.4	1,048	31.9%
47153	Chattanooga	Sequatchie	TN	0.0	0.0	73	0.0%
13047	Chattanooga	Catoosa	GA	402.1	0.3	953	42.2%
13083	Chattanooga	Dade	GA	382.0	0.0	814	46.9%
13295	Chattanooga	Walker	GA	0.0	0.3	555	0.1%
17031	Chicago	Cook	IL	18,683.3	5,549.0	69,728	34.8%
17043	Chicago	DuPage	IL	4,853.4	5.9	11,856	41.0%
17063	Chicago	Grundy	IL	436.8	161.9	1,367	43.8%
17089	Chicago	Kane	IL	1,791.2	4.2	3,786	47.4%
17093	Chicago	Kendall	IL	253.3	0.3	774	32.7%
17097	Chicago	Lake	IL	930.4	886.7	6,916	26.3%
17111	Chicago	McHenry	IL	496.6	7.0	1,870	26.9%
17197	Chicago	Will	IL	4,767.5	122.8	7,685	63.6%
18089	Chicago	Lake	IN	4,582.7	527.6	12,632	40.5%
18127	Chicago	Porter	IN	1,239.8	449.0	4,478	37.7%
18029	Cincinnati	Dearborn	IN	172.0	565.9	1,708	43.2%
21015	Cincinnati	Boone	KY	276.6	850.5	3,457	32.6%
21037	Cincinnati	Campbell	KY	522.3	588.4	2,204	50.4%
21117	Cincinnati	Kenton	KY	1,011.3	293.3	2,771	47.1%
39017	Cincinnati	Butler	OH	1,225.0	2.0	3,504	35.0%
39025	Cincinnati	Clermont	OH	53.0	1,117.4	3,185	36.7%
39061	Cincinnati	Hamilton	OH	1,208.2	3,308.4	13,388	33.7%
39165	Cincinnati	Warren	OH	188.0	3.8	1,673	11.5%
39007	Cleveland	Ashtabula	OH	833.8	4,487.1	9,441	56.4%
39035	Cleveland	Cuyahoga	OH	2,405.6	3,286.2	18,923	30.1%
39085	Cleveland	Lake	OH	568.9	773.0	3,859	34.8%
39093	Cleveland	Lorain	OH	1,360.5	2,917.8	8,463	50.5%
39103	Cleveland	Medina	OH	438.3	2.5	1,945	22.7%
39133	Cleveland	Portage	OH	851.4	10.3	2,483	34.7%
39153	Cleveland	Summit	OH	702.5	7.2	4,985	14.2%
26093	Detroit	Livingston	MI	80.7	2.3	2,010	4.1%
26099	Detroit	Macomb	MI	125.2	151.8	7,234	3.8%
26115	Detroit	Monroe	MI	591.7	231.4	2,799	29.4%
26125	Detroit	Oakland	MI	492.0	117.6	12,011	5.1%
26147	Detroit	St. Clair	MI	238.4	552.6	4,414	17.9%
26161	Detroit	Washtenaw	MI	137.0	1.6	3,811	3.6%
26163	Detroit	Wayne	MI	1,064.0	284.1	23,915	5.6%
48039	Houston	Brazoria	TX	615.5	6,160.6	12,492	54.2%
48071	Houston	Chambers	TX	35.1	208.0	1,047	23.2%
48157	Houston	Fort Bend	TX	855.7	4.0	4,021	21.4%
48167	Houston	Galveston	TX	481.5	14,101.9	24,831	58.7%
48201	Houston	Harris	TX	2,463.1	36,663.4	88,044	44.4%
48291	Houston	Liberty	TX	940.8	77.6	1,866	54.6%
48339	Houston	Montgomery	TX	732.9	11.6	4,332	17.2%
48473	Houston	Waller	TX	213.4	1.8	593	36.3%

FIPS	MSA	County	ST	2020 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
21019	Huntington	Boyd	KY	361.2	454.4	1,599	51.0%
21127	Huntington	Lawrence	KY	310.3	147.8	706	64.9%
39001	Huntington	Adams	OH	10.6	1,305.9	2,379	55.3%
39053	Huntington	Gallia	OH	93.0	574.4	1,310	50.9%
39087	Huntington	Lawrence	OH	337.7	852.5	2,252	52.8%
39145	Huntington	Scioto	OH	755.3	826.2	2,737	57.8%
54011	Huntington	Cabell	WV	789.0	630.5	10,401	13.6%
54053	Huntington	Mason	WV	175.0	993.3	2,088	56.0%
54099	Huntington	Wayne	WV	997.3	1,498.1	3,047	81.9%
18011	Indianapolis	Boone	IN	178.0	2.5	1,171	15.4%
18057	Indianapolis	Hamilton	IN	6.4	27.1	2,259	1.5%
18059	Indianapolis	Hancock	IN	138.0	1.4	1,042	13.4%
18063	Indianapolis	Hendricks	IN	490.3	1.4	1,989	24.7%
18081	Indianapolis	Johnson	IN	37.1	9.1	1,445	3.2%
18095	Indianapolis	Madison	IN	444.2	5.2	2,073	21.7%
18097	Indianapolis	Marion	IN	851.8	58.0	11,238	8.1%
18109	Indianapolis	Morgan	IN	16.9	9.6	1,015	2.6%
18145	Indianapolis	Shelby	IN	197.5	1.0	1,011	19.6%
20091	Kansas City	Johnson	KS	1,821.4	1.7	6,851	26.6%
20103	Kansas City	Leavenworth	KS	467.1	13.3	1,177	40.8%
20121	Kansas City	Miami	KS	2,667.9	6.6	3,085	86.7%
20209	Kansas City	Wyandotte	KS	985.3	111.7	2,919	37.6%
29037	Kansas City	Cass	MO	543.2	5.2	1,476	37.1%
29047	Kansas City	Clay	MO	984.8	118.0	3,214	34.3%
29049	Kansas City	Clinton	MO	0.0	7.0	435	1.6%
29095	Kansas City	Jackson	MO	3,099.6	837.4	12,014	32.8%
29107	Kansas City	Lafayette	MO	760.4	109.5	1,724	50.5%
29165	Kansas City	Platte	MO	741.9	25.2	2,964	25.9%
29177	Kansas City	Ray	MO	1,528.5	101.4	2,106	77.4%
6037	Los Angeles	Los Angeles	CA	8,078.6	34,699.8	126,737	33.8%
6059	Los Angeles	Orange	CA	2,064.2	1,935.3	27,820	14.4%
6065	Los Angeles	Riverside	CA	3,206.9	67.6	18,781	17.4%
6071	Los Angeles	San Bernardino	CA	10,808.1	31.6	26,747	40.5%
6111	Los Angeles	Ventura	CA	380.6	3,334.9	9,593	38.7%
27003	Minneapolis	Anoka	MN	688.9	350.5	4,088	25.4%
27019	Minneapolis	Carver	MN	1.7	29.2	848	3.6%
27037	Minneapolis	Dakota	MN	412.2	322.9	4,372	16.8%
27053	Minneapolis	Hennepin	MN	1,034.8	960.2	16,513	12.1%
27123	Minneapolis	Ramsey	MN	390.6	306.8	6,337	11.0%
27139	Minneapolis	Scott	MN	88.3	47.8	1,053	12.9%
27163	Minneapolis	Washington	MN	752.2	1,287.7	4,813	42.4%
9001	New York	Fairfield	CT	497.8	269.3	13,775	5.6%
9005	New York	Litchfield	CT	112.5	37.9	2,050	7.3%
34003	New York	Bergen	NJ	778.5	164.7	11,244	8.4%
34013	New York	Essex	NJ	153.0	43.8	11,579	1.7%

FIPS	MSA	County	ST	2020 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
34017	New York	Hudson	NJ	620.9	1,217.1	8,314	22.1%
34019	New York	Hunterdon	NJ	218.2	14.0	2,859	8.1%
34023	New York	Middlesex	NJ	393.0	235.8	9,099	6.9%
34025	New York	Monmouth	NJ	216.0	617.7	8,620	9.7%
34027	New York	Morris	NJ	149.1	22.5	6,081	2.8%
34029	New York	Ocean	NJ	13.6	500.0	6,071	8.5%
34031	New York	Passaic	NJ	139.0	21.8	5,226	3.1%
34035	New York	Somerset	NJ	368.6	0.7	3,670	10.1%
34037	New York	Sussex	NJ	40.5	26.7	1,901	3.5%
34039	New York	Union	NJ	278.8	880.2	7,151	16.2%
36005	New York	Bronx	NY	4.3	170.4	8,855	2.0%
36047	New York	Kings	NY	0.0	1,397.7	18,231	7.7%
36059	New York	Nassau	NY	0.0	506.2	11,407	4.4%
36061	New York	New York	NY	0.0	980.8	31,145	3.1%
36071	New York	Orange	NY	270.9	70.5	6,487	5.3%
36081	New York	Queens	NY	2.0	1,679.8	22,109	7.6%
36085	New York	Richmond	NY	0.0	1,942.3	4,992	38.9%
36087	New York	Rockland	NY	219.1	19.6	2,500	9.6%
36103	New York	Suffolk	NY	0.0	1,342.6	14,755	9.1%
36119	New York	Westchester	NY	0.0	117.2	7,870	1.5%
10003	Philadelphia	New Castle	DE	803.4	2,069.6	11,598	24.8%
24015	Philadelphia	Cecil	MD	213.9	56.2	2,142	12.6%
24029	Philadelphia	Kent	MD	1.8	53.8	541	10.3%
24031	Philadelphia	Montgomery	MD	627.6	15.6	12,024	5.3%
34005	Philadelphia	Burlington	NJ	0.0	963.9	6,299	15.3%
34007	Philadelphia	Camden	NJ	111.6	385.6	7,049	7.1%
34011	Philadelphia	Cumberland	NJ	23.4	1,063.5	3,128	34.8%
34015	Philadelphia	Gloucester	NJ	38.0	520.5	6,743	8.3%
34021	Philadelphia	Mercer	NJ	133.5	119.1	5,604	4.5%
34033	Philadelphia	Salem	NJ	9.3	315.8	1,442	22.5%
42017	Philadelphia	Bucks	PA	65.3	40.8	6,119	1.7%
42029	Philadelphia	Chester	PA	304.0	6.8	5,242	5.9%
42045	Philadelphia	Delaware	PA	125.2	4,798.6	12,519	39.3%
42101	Philadelphia	Philadelphia	PA	215.5	8,420.9	28,921	29.9%
4013	Phoenix	Maricopa	AZ	3,043.5	33.6	36,074	8.5%
4021	Phoenix	Pinal	AZ	1,689.8	7.5	4,626	36.7%
6019	San Joaquin	Fresno	CA	596.5	38.7	9,566	6.6%
6029	San Joaquin	Kern	CA	2,751.1	14.4	11,518	24.0%
6031	San Joaquin	Kings	CA	72.7	1.4	1,747	4.2%
6039	San Joaquin	Madera	CA	652.3	10.6	2,530	26.2%
6047	San Joaquin	Merced	CA	574.3	30.5	3,697	16.4%
6077	San Joaquin	San Joaquin	CA	980.7	496.4	7,856	18.8%
6099	San Joaquin	Stanislaus	CA	401.8	14.8	4,881	8.5%
6107	San Joaquin	Tulare	CA	905.5	10.6	5,493	16.7%
53029	Seattle	Island	WA	0.0	1,709.1	2,406	71.1%
53033	Seattle	King	WA	935.0	4,874.1	26,130	22.2%

FIPS	MSA	County	ST	2020 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
53035	Seattle	Kitsap	WA	0.0	54.6	2,268	2.4%
53045	Seattle	Mason	WA	0.1	28.7	541	5.3%
53053	Seattle	Pierce	WA	586.2	4,359.7	12,505	39.6%
53061	Seattle	Snohomish	WA	1,050.1	779.7	7,046	26.0%
53067	Seattle	Thurston	WA	267.7	317.1	3,088	18.9%
17027	St. Louis	Clinton	IL	653.3	3.4	1,223	53.7%
17083	St. Louis	Jersey	IL	54.0	473.6	1,104	47.8%
17119	St. Louis	Madison	IL	321.8	257.9	3,094	18.7%
17133	St. Louis	Monroe	IL	1,017.1	415.5	2,060	69.5%
17163	St. Louis	St. Clair	IL	339.2	491.8	3,360	24.7%
29055	St. Louis	Crawford	MO	149.4	1.7	640	23.6%
29071	St. Louis	Franklin	MO	1,005.6	63.6	2,226	48.0%
29099	St. Louis	Jefferson	MO	273.6	424.7	2,736	25.5%
29113	St. Louis	Lincoln	MO	451.5	172.5	1,301	48.0%
29183	St. Louis	St. Charles	MO	543.8	393.2	3,393	27.6%
29189	St. Louis	St. Louis	MO	867.4	489.5	12,921	10.5%
29219	St. Louis	Warren	MO	92.1	61.3	595	25.8%
29510	St. Louis	St. Louis	MO	874.5	6,486.7	13,766	53.5%

Table 0-111 2030 Locomotive and Diesel Marine NOx Tons/Year and Percent of Total Mobile Sources

FIPS	MSA	County	ST	2030 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
13013	Atlanta	Barrow	GA	186.5	0.7	583	32.1%
13015	Atlanta	Bartow	GA	665.4	9.2	1,596	42.3%
13045	Atlanta	Carroll	GA	180.2	3.9	1,168	15.8%
13057	Atlanta	Cherokee	GA	0.0	8.8	1,502	0.6%
13063	Atlanta	Clayton	GA	350.2	1.3	2,912	12.1%
13067	Atlanta	Cobb	GA	918.9	3.6	5,714	16.1%
13077	Atlanta	Coweta	GA	462.3	2.6	1,676	27.7%
13089	Atlanta	DeKalb	GA	426.2	2.3	5,791	7.4%
13097	Atlanta	Douglas	GA	165.0	0.7	1,146	14.5%
13113	Atlanta	Fayette	GA	119.7	1.6	1,109	10.9%
13117	Atlanta	Forsyth	GA	0.0	18.3	1,115	1.6%
13121	Atlanta	Fulton	GA	1,251.8	4.9	13,644	9.2%
13135	Atlanta	Gwinnett	GA	318.0	3.3	4,804	6.7%
13139	Atlanta	Hall	GA	185.4	30.1	1,581	13.6%
13149	Atlanta	Heard	GA	0.0	4.3	100	4.3%
13151	Atlanta	Henry	GA	472.0	1.6	1,860	25.5%
13217	Atlanta	Newton	GA	53.5	2.3	800	7.0%
13223	Atlanta	Paulding	GA	391.3	1.3	1,152	34.1%
13237	Atlanta	Putnam	GA	10.3	13.8	169	14.2%
13247	Atlanta	Rockdale	GA	75.8	1.3	848	9.1%
13255	Atlanta	Spalding	GA	20.4	1.3	597	3.6%
13297	Atlanta	Walton	GA	64.1	0.7	550	11.8%
24003	Baltimore	Anne Arundel	MD	285.6	76.7	8,572	4.2%
24005	Baltimore	Baltimore	MD	896.2	48.2	11,329	8.3%
24013	Baltimore	Carroll	MD	145.3	1.7	2,442	6.0%
24025	Baltimore	Harford	MD	242.3	45.7	3,508	8.2%
24027	Baltimore	Howard	MD	347.0	10.7	3,770	9.5%
24510	Baltimore	Baltimore	MD	1,142.1	1,365.5	17,705	14.2%
1073	Birmingham	Jefferson	AL	4,081.7	223.2	10,639	40.5%
1117	Birmingham	Shelby	AL	1,005.0	13.6	2,211	46.1%
1127	Birmingham	Walker	AL	648.6	99.0	1,403	53.3%
9007	Boston	Middlesex	CT	105.1	127.5	234	99.4%
25001	Boston	Barnstable	MA	232.0	518.9	4,797	15.7%
25005	Boston	Bristol	MA	435.3	220.7	7,523	8.7%
25007	Boston	Dukes	MA	0.0	1,350.2	1,773	76.2%
25009	Boston	Essex	MA	567.2	212.4	9,820	7.9%
25019	Boston	Nantucket	MA	0.0	265.1	551	48.1%
25021	Boston	Norfolk	MA	679.2	142.8	10,138	8.1%
25023	Boston	Plymouth	MA	362.5	205.8	6,197	9.2%
25025	Boston	Suffolk	MA	360.0	710.3	16,310	6.6%
25027	Boston	Worcester	MA	1,368.9	47.6	11,980	11.8%
33011	Boston	Hillsborough	NH	35.8	19.5	6,461	0.9%
33015	Boston	Rockingham	NH	27.0	940.3	6,892	14.0%

FIPS	MSA	County	ST	2030 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
47065	Chattanooga	Hamilton	TN	1,305.7	757.2	5,151	40.1%
47115	Chattanooga	Marion	TN	183.1	150.6	932	35.8%
47153	Chattanooga	Sequatchie	TN	0.0	0.0	56	0.0%
13047	Chattanooga	Catoosa	GA	395.9	0.3	830	47.8%
13083	Chattanooga	Dade	GA	376.2	0.0	699	53.8%
13295	Chattanooga	Walker	GA	0.0	0.3	438	0.1%
17031	Chicago	Cook	IL	18,514.9	5,645.1	63,116	38.3%
17043	Chicago	DuPage	IL	4,720.6	6.5	10,269	46.0%
17063	Chicago	Grundy	IL	427.7	163.2	1,168	50.6%
17089	Chicago	Kane	IL	1,750.8	4.6	3,281	53.5%
17093	Chicago	Kendall	IL	250.2	0.4	641	39.1%
17097	Chicago	Lake	IL	906.2	955.2	6,310	29.5%
17111	Chicago	McHenry	IL	488.4	7.6	1,548	32.0%
17197	Chicago	Will	IL	4,733.7	124.5	7,002	69.4%
18089	Chicago	Lake	IN	4,451.2	562.4	12,715	39.4%
18127	Chicago	Porter	IN	1,230.3	477.1	4,520	37.8%
18029	Cincinnati	Dearborn	IN	171.1	569.5	1,694	43.7%
21015	Cincinnati	Boone	KY	272.4	856.3	3,615	31.2%
21037	Cincinnati	Campbell	KY	514.0	592.5	2,128	52.0%
21117	Cincinnati	Kenton	KY	995.8	295.2	2,456	52.6%
39017	Cincinnati	Butler	OH	1,215.2	2.2	2,901	42.0%
39025	Cincinnati	Clermont	OH	52.6	1,124.0	3,076	38.2%
39061	Cincinnati	Hamilton	OH	1,200.0	3,327.7	12,598	35.9%
39165	Cincinnati	Warren	OH	187.1	4.2	1,261	15.2%
39007	Cleveland	Ashtabula	OH	826.5	4,523.2	10,335	51.8%
39035	Cleveland	Cuyahoga	OH	2,374.0	3,348.9	17,334	33.0%
39085	Cleveland	Lake	OH	563.9	800.5	3,676	37.1%
39093	Cleveland	Lorain	OH	1,350.4	2,952.3	8,584	50.1%
39103	Cleveland	Medina	OH	435.4	2.7	1,508	29.1%
39133	Cleveland	Portage	OH	844.5	11.2	2,012	42.5%
39153	Cleveland	Summit	OH	696.4	7.8	3,944	17.9%
26093	Detroit	Livingston	MI	79.5	2.5	1,589	5.2%
26099	Detroit	Macomb	MI	123.3	156.2	6,116	4.6%
26115	Detroit	Monroe	MI	582.6	234.6	2,409	33.9%
26125	Detroit	Oakland	MI	484.2	119.1	10,112	6.0%
26147	Detroit	St. Clair	MI	234.3	559.6	4,539	17.5%
26161	Detroit	Washtenaw	MI	135.7	1.7	3,199	4.3%
26163	Detroit	Wayne	MI	1,061.8	292.0	21,886	6.2%
48039	Houston	Brazoria	TX	606.1	6,200.9	13,541	50.3%
48071	Houston	Chambers	TX	34.6	213.6	964	25.8%
48157	Houston	Fort Bend	TX	841.8	4.3	3,437	24.6%
48167	Houston	Galveston	TX	483.0	14,191.0	27,937	52.5%
48201	Houston	Harris	TX	2,459.9	36,874.9	91,005	43.2%
48291	Houston	Liberty	TX	926.1	78.5	1,679	59.8%
48339	Houston	Montgomery	TX	721.7	12.6	3,561	20.6%
48473	Houston	Waller	TX	210.1	1.9	497	42.7%

FIPS	MSA	County	ST	2030 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
21019	Huntington	Boyd	KY	355.3	457.1	1,606	50.6%
21127	Huntington	Lawrence	KY	310.0	148.8	704	65.2%
39001	Huntington	Adams	OH	10.5	1,313.4	2,628	50.4%
39053	Huntington	Gallia	OH	92.3	577.8	1,377	48.7%
39087	Huntington	Lawrence	OH	335.2	857.5	2,351	50.7%
39145	Huntington	Scioto	OH	749.9	831.1	2,788	56.7%
54011	Huntington	Cabell	WV	775.3	634.9	13,900	10.1%
54053	Huntington	Mason	WV	174.8	1,000.4	2,292	51.3%
54099	Huntington	Wayne	WV	981.9	1,507.4	3,047	81.7%
18011	Indianapolis	Boone	IN	175.6	2.7	922	19.3%
18057	Indianapolis	Hamilton	IN	6.6	29.4	1,804	2.0%
18059	Indianapolis	Hancock	IN	136.6	1.6	816	16.9%
18063	Indianapolis	Hendricks	IN	486.8	1.6	1,616	30.2%
18081	Indianapolis	Johnson	IN	37.8	9.9	1,158	4.1%
18095	Indianapolis	Madison	IN	440.3	5.6	1,721	25.9%
18097	Indianapolis	Marion	IN	845.5	62.9	9,848	9.2%
18109	Indianapolis	Morgan	IN	17.2	10.4	785	3.5%
18145	Indianapolis	Shelby	IN	195.8	1.1	797	24.7%
20091	Kansas City	Johnson	KS	1,793.4	1.8	5,960	30.1%
20103	Kansas City	Leavenworth	KS	460.0	13.6	1,012	46.8%
20121	Kansas City	Miami	KS	2,627.2	7.1	2,928	90.0%
20209	Kansas City	Wyandotte	KS	969.7	112.5	2,648	40.9%
29037	Kansas City	Cass	MO	534.4	5.7	1,248	43.3%
29047	Kansas City	Clay	MO	980.2	120.2	2,864	38.4%
29049	Kansas City	Clinton	MO	0.0	7.6	320	2.4%
29095	Kansas City	Jackson	MO	3,078.5	843.5	10,916	35.9%
29107	Kansas City	Lafayette	MO	748.8	111.3	1,515	56.8%
29165	Kansas City	Platte	MO	730.6	26.2	2,855	26.5%
29177	Kansas City	Ray	MO	1,515.9	102.4	1,995	81.1%
6037	Los Angeles	Los Angeles	CA	8,037.8	34,907.8	110,332	38.9%
6059	Los Angeles	Orange	CA	2,064.0	1,951.1	22,503	17.8%
6065	Los Angeles	Riverside	CA	3,176.5	73.4	12,138	26.8%
6071	Los Angeles	San Bernardino	CA	10,729.1	34.3	20,287	53.1%
6111	Los Angeles	Ventura	CA	379.6	3,359.2	8,627	43.3%
27003	Minneapolis	Anoka	MN	677.4	359.0	3,678	28.2%
27019	Minneapolis	Carver	MN	1.7	31.1	683	4.8%
27037	Minneapolis	Dakota	MN	405.5	330.0	3,860	19.1%
27053	Minneapolis	Hennepin	MN	1,018.8	979.0	15,108	13.2%
27123	Minneapolis	Ramsey	MN	384.3	313.5	5,585	12.5%
27139	Minneapolis	Scott	MN	86.9	50.7	871	15.8%
27163	Minneapolis	Washington	MN	740.1	1,300.7	4,730	43.1%
9001	New York	Fairfield	CT	484.0	285.7	13,975	5.5%
9005	New York	Litchfield	CT	114.5	41.2	2,010	7.7%
34003	New York	Bergen	NJ	756.3	167.5	11,281	8.2%
34013	New York	Essex	NJ	146.0	44.6	13,693	1.4%

FIPS	MSA	County	ST	2030 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
34017	New York	Hudson	NJ	596.4	1,227.0	11,022	16.5%
34019	New York	Hunterdon	NJ	210.5	15.2	2,703	8.4%
34023	New York	Middlesex	NJ	377.1	238.9	10,943	5.6%
34025	New York	Monmouth	NJ	196.7	637.0	8,926	9.3%
34027	New York	Morris	NJ	138.6	24.4	5,958	2.7%
34029	New York	Ocean	NJ	12.6	539.0	6,186	8.9%
34031	New York	Passaic	NJ	129.1	23.6	5,198	2.9%
34035	New York	Somerset	NJ	358.4	0.8	3,620	9.9%
34037	New York	Sussex	NJ	41.2	29.0	1,794	3.9%
34039	New York	Union	NJ	265.7	885.6	8,205	14.0%
36005	New York	Bronx	NY	4.3	172.6	9,872	1.8%
36047	New York	Kings	NY	0.0	1,407.8	23,002	6.1%
36059	New York	Nassau	NY	0.0	516.6	11,386	4.5%
36061	New York	New York	NY	0.0	987.0	17,781	5.6%
36071	New York	Orange	NY	263.2	72.3	6,601	5.1%
36081	New York	Queens	NY	1.9	1,692.5	24,125	7.0%
36085	New York	Richmond	NY	0.0	1,955.3	6,930	28.2%
36087	New York	Rockland	NY	215.1	21.3	2,459	9.6%
36103	New York	Suffolk	NY	0.0	1,408.8	14,851	9.5%
36119	New York	Westchester	NY	0.0	121.2	8,399	1.4%
10003	Philadelphia	New Castle	DE	781.2	2,083.0	12,157	23.6%
24015	Philadelphia	Cecil	MD	210.9	59.2	2,059	13.1%
24029	Philadelphia	Kent	MD	1.8	57.6	506	11.7%
24031	Philadelphia	Montgomery	MD	593.4	16.1	12,274	5.0%
34005	Philadelphia	Burlington	NJ	0.0	971.5	6,198	15.7%
34007	Philadelphia	Camden	NJ	104.7	388.6	7,322	6.7%
34011	Philadelphia	Cumberland	NJ	23.8	1,083.2	3,125	35.4%
34015	Philadelphia	Gloucester	NJ	36.9	525.2	7,922	7.1%
34021	Philadelphia	Mercer	NJ	131.1	120.3	5,616	4.5%
34033	Philadelphia	Salem	NJ	9.4	320.5	1,393	23.7%
42017	Philadelphia	Bucks	PA	63.2	43.1	6,003	1.8%
42029	Philadelphia	Chester	PA	290.2	7.4	5,004	5.9%
42045	Philadelphia	Delaware	PA	120.5	4,827.0	13,735	36.0%
42101	Philadelphia	Philadelphia	PA	213.8	8,470.2	31,412	27.6%
4013	Phoenix	Maricopa	AZ	3,019.1	36.5	18,989	16.1%
4021	Phoenix	Pinal	AZ	1,660.1	8.1	4,001	41.7%
6019	San Joaquin	Fresno	CA	590.6	42.0	5,860	10.8%
6029	San Joaquin	Kern	CA	2,741.2	15.7	7,256	38.0%
6031	San Joaquin	Kings	CA	71.7	1.5	902	8.1%
6039	San Joaquin	Madera	CA	644.9	11.5	1,488	44.1%
6047	San Joaquin	Merced	CA	573.0	33.1	2,108	28.7%
6077	San Joaquin	San Joaquin	CA	974.8	501.1	5,322	27.7%
6099	San Joaquin	Stanislaus	CA	398.9	16.0	2,978	13.9%
6107	San Joaquin	Tulare	CA	898.7	11.5	3,414	26.7%
53029	Seattle	Island	WA	0.0	1,720.9	2,318	74.2%
53033	Seattle	King	WA	919.1	4,923.0	23,930	24.4%

FIPS	MSA	County	ST	2030 NOx			
				Diesel Locomotive	Diesel Marine	Total Mobile	LM Percent
53035	Seattle	Kitsap	WA	0.0	59.2	1,921	3.1%
53045	Seattle	Mason	WA	0.1	30.6	449	6.8%
53053	Seattle	Pierce	WA	576.1	4,394.7	12,254	40.6%
53061	Seattle	Snohomish	WA	1,033.3	793.9	6,039	30.3%
53067	Seattle	Thurston	WA	266.9	322.4	2,775	21.2%
17027	St. Louis	Clinton	IL	645.5	3.7	1,056	61.4%
17083	St. Louis	Jersey	IL	53.2	476.4	1,134	46.7%
17119	St. Louis	Madison	IL	312.6	259.6	2,469	23.2%
17133	St. Louis	Monroe	IL	1,008.1	417.9	2,049	69.6%
17163	St. Louis	St. Clair	IL	328.1	494.8	2,832	29.1%
29055	St. Louis	Crawford	MO	149.3	1.9	526	28.7%
29071	St. Louis	Franklin	MO	988.2	64.9	1,850	56.9%
29099	St. Louis	Jefferson	MO	269.4	428.0	2,271	30.7%
29113	St. Louis	Lincoln	MO	444.6	174.7	1,179	52.5%
29183	St. Louis	St. Charles	MO	535.5	399.3	2,847	32.8%
29189	St. Louis	St. Louis	MO	853.1	494.2	11,003	12.2%
29219	St. Louis	Warren	MO	90.7	62.4	503	30.4%
29510	St. Louis	St. Louis	MO	880.1	6,524.3	14,654	50.5%

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