Appendix VI
2025 Projection Emissions Inventory

1.0 Projection Emissions Inventory Introduction

In order to determine future inventory trends it is necessary to first grow the base inventory to the year of interest and then account for the reductions achieved from any control measures, Federal or State, which were applicable prior to or in that year. The starting inventory for the projections is the 2007 emission inventories for emissions in tons per year for fine particulate matter ($PM_{2.5}$), oxides of nitrogen (NO_x), and sulfur dioxide (SO_2). The projected emission inventories are “grown” from the 2007 actual emission inventory and then “controlled”.

In order to project future year emissions, it is necessary to determine appropriate growth factors and the applicable control efficiencies. The projected emission inventories for 2007 were calculated by first estimating growth in each source category, in each of the inventory sectors (point, area, nonroad, onroad). As appropriate, the 2007 actual emission inventories were used as the base for applying factors to account for inventory growth. The United States Environmental Protection Agency (USEPA) preferred approach for projecting emissions growth incorporates locality-specific estimates [1] such as population, employment, historical averaging or other category specific activity such as fuel consumption, product output, vehicle miles traveled, equipment populations.

Annual growth rates were evaluated for each of the emission categories, in each of the four emission sectors (point, area, nonroad, onroad). In three of the emission sectors (point, area, MAR(nonroad marine, air and rail)) growth factors were calculated for a specific range of years and used in spreadsheets or databases to calculate future year emissions. Nonroad equipment growth was projected utilizing the USEPA National NONROAD Emissions Model and other Federal and state specific data. Onroad growth was projected using travel demand models.

Once the emission inventories are grown, the next step is to determine which control measures within each of the various emission sectors would be in place during or prior to that year, and includes the emission reduction benefits from those control measures at that time. The combined effect of growth and controls represents the inventory projection. Post-2007 control measure benefits (including benefits from pre-2007 and post-2007 rules) were applied to each emission sector as appropriate.

The 2025 projection emissions inventory was prepared with the support of the Mid-Atlantic Regional Air Management Association (MARAMA) and its contractors, AMEC Environment and Infrastructure and SRA International, Inc. A copy of the Technical Support Document[2] prepared by AMEC and SRA for MARAMA is included as Attachment 1 to this appendix.

[1] Economic Growth Analysis System Version 4.0 Reference Manual, E.H. Pechan & Associates, Inc., January 26, 2001.
[2] AMEC and SRA for MARAMA. Technical Support Document for the Development of the 2025 Emission Inventory for PM Nonattainment Counties in the MANE-VU Region Version 3.3, Rev.1. AMEC Environment and Infrastructure and SRA International, Inc for Mid-Atlantic Regional Air Management Association (MARAMA), January 23, 2012.

2.0 Point Sources

2.1 Growth

Estimated growth factors were applied to the base inventory at the source classification codes (SCC) and equipment unit level. SCCs are the USEPA's primary identifying emission element codes. For point sources they are made up of 8-digits which contain 4 levels of the description. The first level uses the first digit and provides the most general information on the category of the emissions. There are five major categories, which split the major industries into groups. The categories are external combustion boilers, internal combustion sources, manufacturing processes, petroleum and solvent evaporation, and waste disposal. The second level of description is associated with the first 3-digits of the code and subdivides them into the above mentioned industry groups. The third level of description includes the first six digits and identifies a specific industry or emission source category. The fourth level of description is associated with the full eight-digit code. The last 2 digits specify the particular emitting process.

Growth was estimated in the point source sector by using actual estimated data submitted to the NJDEP through the Emission Statement Program, the USDOE's Annual Energy Outlook Projections, and employment projections from the New Jersey Department of Labor. Specifically, the EGU sector growth was based on the AEO2011, and the non-EGU growth was based on New Jersey Department of Labor's employment projections and actual estimated data submitted to the NJDEP through the Emission Statement Program. Estimated negative growth predictions based on this data was assumed to be no growth in order to be conservative and to account for the NJDEP's offset emission credit banking program. Existing facility shutdowns or anticipated facility shutdowns were also left in the inventory to account for NJDEP's offset emission credit banking program.

The growth factors are shown in the point source emission inventory by unit in Appendix V, Attachment 4.

2.2 Controls

New Jersey and the USEPA have implemented control measures that reduce point source emissions of air pollutants. In developing the 2025 projection inventory, control efficiency factors for post-2007 rules were applied to the 2025 grown, uncontrolled emissions inventory in order to estimate the projected 2025 emissions inventory. The equation that was used to project emissions in a future year, y, incorporating growth and the application of new control measures between year x and year y is:

$$E_y = E_x * GF_{x-y} * [1 - (CE * RE * RP)_{x-y}]$$

where:
- E_y = Controlled emissions in year y
- E_x = Controlled emissions in year x
- GF_{x-y} = Growth factor used to grow emissions from year x to year y
- CE = Control efficiency factor for a control measure implemented between years X and Y
- RE = Rule Effectiveness Factor
- RP = Rule Penetration Factor
- CF=Control Factor = $[1 - (CE * RE * RP)_{x-y}]$

The control factors (CF) applied to the 2025 inventory are shown in the point source emission inventory in Appendix V, Attachment 4. The 2007 emission inventory was used as a base for the projection inventory. The existing control measures which reduce point source emissions for $PM_{2.5}$, NO_x, and SO_2 in the projection inventory from 2007 to 2025 are shown in Table 1.

Table 1
Point Source Control Measures

Federal or State	Control Measure	New Jersey Administrative Code	Pollutants
New Jersey	EGUs - PSE&G Consent Decrees (Hudson and Mercer)	NA	PM, SO_2, NO_x
New Jersey	EGUs - Coal-fired Boilers	NJAC 7:27-4.2, 10.2, 19.4	PM, SO_2, NO_x
New Jersey	EGUs - Oil and Gas Fired	NJAC 7:27-4.2, 10.2, 19.4	NO_x
New Jersey	EGUs - High Electric Demand Day (HEDD) Program	NJAC 7:27-19.29	SO_2, NO_x
Federal	ICI Boiler MACT	NA	PM, NO_x
Federal	RICE MACT	NA	PM, NO_x
Federal	Refinery Consent Decrees (Sunoco, Valero, and ConocoPhillips)	NA	PM, SO_2, NO_x
New Jersey	ICI Boiler Rule 2006	NJAC 7:27-16.8, 19.7	NO_x
New Jersey	ICI Boiler Rule 2009	NJAC 7:27-19.7	NO_x
New Jersey	Asphalt Production Plants Rule	NJAC 7:27-19.9	NO_x
New Jersey	Glass Manufacturing	NJAC 7:27-19.10	NO_x
New Jersey	Low Sulfur Distillate and Residual Fuel Strategies	NJAC 7:27-27.9	SO_2
New Jersey	Municipal Waste Combustors (Incinerators)	NJAC 7:27-19.13	PM, NO_x
New Jersey	Sewage and Sludge Incinerators	NJAC 7:27-19.28	NO_x
New Jersey	Case by Case NO_x Emission Limit Determinations (FSELs/AELs)	NJAC 7:27-19.13	NO_x

The control measures are discussed below.

EGUs – PSE&G Administrative Consent Order

Public Service Electric & Gas' (PSEG) Consent Decree applies to Hudson unit 2, Mercer units 1 and 2, and Kearny units 7 and 8. Per the Consent Decree, Kearny units 7 and 8 were shut down in 2007, and therefore, no additional post-2007 emissions reduction was included in the projection inventory.

The Consent Decree required Mercer units 1 and 2 to install selective catalytic reduction (SCR) by 2007 to control NO_x, therefore, no additional post-2007 NO_x reduction was included in the projection inventory. Hudson unit 2 was required to install SCR by 2010. After the installation of the SCRs, the three units can emit NO_x at no greater than 0.100 lb/mmBtu, based on a 30-day rolling average emission rate.

The Consent Decree required Hudson unit 2 and Mercer units 1 and 2 to install flue gas desulfurization system (FGD) to control SO_2 by 2010. After the installation of the FGDs, the three units can emit SO_2 at no greater than 0.150 lb/mmBtu, based on a 30-day rolling average emission rate.

The resulting emissions reduction from the Consent Decree is 2,015 tons NO_x, 15,681 tons of SO_2, and 1,786 tons of direct PM. No rule effectiveness is required for this because these reductions are not based on any rules.

EGUs - Coal-fired Boilers

The State amended its rules governing coal-fired boilers at N.J.A.C. 7:27-4.2 addressing PM emissions, N.J.A.C. 7:27-10.2 addressing SO_2 emissions from solid fuel, and N.J.A.C. 7:27-19.4 addressing NO_x emissions, which were adopted on March 20, 2009. At the time of the rule proposal, there were ten coal-fired boilers serving EGUs, with the Logan unit and the Carney unit 1 and 2 already in compliance. Since then, the Hudson unit 2 and Mercer unit 1 and 2 have installed controls for PM, NO_x, and SO_2, per the ACO (see above Administrative Consent Order); the Vineland unit 10 has stopped burning coal per its ACO; and, the Deepwater unit has switch to natural gas. The State is finalizing the ACO with BL England to have their two units meet the limits by the applicable date of 2015; BL England's options are to install control devices, switch fuel, or shut down.

There is no additional reduction for this rule in the two PM nonattainment areas because the only coal-fired units in these areas are already controlled under the above Administrative Consent Order. Additional reductions would come from coal-fired units located outside of the two PM nonattainment areas.

EGUs - Oil and Gas Fired Boilers

Along with amended limits for coal-fired boilers for EGUs in the March 20, 2009 rule amendments, the amendments at N.J.A.C. 7:27-19.4 address NO_x emissions for oil and gas-fired boilers. These amendments are estimated to achieve emission reductions of 352 tons of NO_x and 176 tons of SO_2. A rule effectiveness of 100% was applied because these units have CEMS.

High Electric Demand Day (HEDD)

As part of the March 20, 2009 rule amendments, the State adopted new rules at N.J.A.C. 7:27-19.29 to address the NO_x emissions from High Electric Demand Day (HEDD) units. This rule focuses on units that are electric generating units capable of generating 15 MW or more and are operated less than or equal to an average of 50 percent of the time during the previous three ozone seasons. The State tightened the emission standards for HEDD units because these units emit significant quantities of NO_x on high electric demand days, which are typically high temperature and high ozone days during the summer. At the time of the proposal, the HEDD units in New Jersey consisted of eight boilers and approximately 160 stationary combustion turbines.

The HEDD rule has two phases, a short term strategy and a long term strategy. The short term strategy at N.J.A.C. 7:27-19.29 achieves NO_x emission reductions from some HEDD units starting in 2009, which achieve 19.8 tpd of NO_x emission reductions on high electric demand days. This allows all companies with affected electric generating units time to develop and implement the long term strategy at N.J.A.C. 7:27-19.30 to achieve the more stringent emission performance standards at the amended N.J.A.C. 7:27-19.4 and 19.5 by 2015.

Because the HEDD rule is for high electric demand days when high ozone is most likely to occur, the emissions reductions during those days is quite significant (tons/hour or tons/day). But it is more difficult to quantify reductions on an annual basis, as the amount of high electric demand days in a year is not known and spread out over 365 days appears less significant, and therefore, is not quantified in this inventory.

USEPA Maximum Available Control Technology (MACT) Standards

As discussed in the “Technical Supporting Document for the Development of the 2025 Emission Inventory for PM Nonattainment Counties in the MANE-VU Region Version 3.3”, prepared by AMEC Environmental & Infrastructure, dated January 23, 2012, it discussed how post-2007 MACT standards were applied on a general scale to all sources with certain SCCs. Every source with a SCC determined to be affected by a post-2007 MACT standard was assigned an incremental percent reduction for the entire applicable MACT standard. Exhibit 3.3 in Section 3.3.3.1 of the TSD lists the SCCs the RICE MACT impacts and the expected emissions reduction for each SCC. Also in 3.3.3.1 of the TSD is the reduction expected from the ICI Boiler MACT. For all the reductions from MACT sources, a rule effectiveness of 80% was applied in the calculation files.

Refinery Enforcement Actions

The USEPA’s national Petroleum Refinery Initiative was an integrated enforcement and compliance strategy to addresses air emissions from the nation’s petroleum refineries. The four refineries located in New Jersey are Valero Refining, Conoco Phillips, Citgo, and Sunoco Coastal Eagle Point. The major refinery sources that were affected by the judicial settlement are FCCUs, flare gas recovery, and equipment leaks. The Fluid Catalytic Cracking Units (FCCUs) or cracking units was to reduce NO_x emissions by 60%. Flare gas recovery was to have a 53% reduction in both VOC and NO_x emissions. Lastly, leak detection and repair was to have a 50% control on VOC emissions. These reductions are based on Table A-1 through A-8 in the “Assessment of Control Technology Options For Petroleum Refineries in the Mid-Atlantic Region” report from January 2007 prepared by MACTEC for MARAMA. A rule effectiveness of 100% was applied to these controls because these reductions are specifically written into enforcement actions for these individual facilities.

Since the release of the Petroleum Refinery Initiative, Citgo no longer is a petroleum refinery and Sunoco Coastal Eagle Point has ceased all refinery operations.

NO_x Reasonably Available Control Technology (RACT) Rule 2006 (Industrial/Commercial/Institutional (ICI) Boilers Rule 2006)

Rule amendments to N.J.A.C. 7:27-19 were adopted in November 2005, affecting large natural gas fired boilers > 100 million British thermal units/hour (mmBtu/hr) by reducing their NO_x emission limit from <0.20 to <0.10 lb/mmBtu. Annual tune-ups are required for all boilers greater than 5 mmBtu/hr phased-in starting in 2007 and ending in 2010. Oil-fired combustion turbines are subject to lower NO_x emission limits. Combined or regenerative cycle will have their emission limit reduced from 0.35 lb/MMBtu to 0.26 lb/mmBtu. Simple cycle turbines will be reduced from 0.4 lb/mmBtu to 0.3 lb/mmBtu. Reciprocating engines burning natural gas and diesel also had their emission limits tightened. The new limits implemented in this rule were effective in 2007 and are therefore reflected in the 2007 base inventory. The annual tune-ups for boilers phased in after 2007 were reflected in the 2025 projection inventory as shown in Table 2 below.

Table 2
Point Source Emissions Reductions from the NO_x RACT Rule (2006)

Boiler Size (mmBtu/hr)	Fuel Type	Reduction	Reduction w/RE
≥ 5 and < 20	All	25%	20%

Industrial/Commercial/Institutional (ICI) Boilers Rule 2009

Rule amendments to N.J.A.C. 7:27-19 were adopted in March 2009. These amendments set new NO_x emissions limits for boilers greater than 25 MMBtu/hr. Table 3 below lists the NO_x emissions reduction from this rule that is applied to the projection inventory based on boiler size.

Table 3
Point Source Emissions Reductions from the ICI Boiler Rule

<table>
<tr><th>Boiler Size (mmBtu/hr)</th><th>Fuel Type</th><th>Reduction</th><th>Reduction w/RE</th></tr>
<tr><td>≥ 25 and < 50</td><td>All</td><td>50%</td><td>40%</td></tr>
<tr><td rowspan="4">≥ 50 and < 100</td><td>Natural Gas</td><td rowspan="2">50%</td><td rowspan="2">40%</td></tr>
<tr><td>Duel Fuel</td></tr>
<tr><td>#2 Fuel Oil</td><td rowspan="2">33%</td><td rowspan="2">27%</td></tr>
<tr><td>Other liquid fuels</td></tr>
<tr><td>≥ 100</td><td>#2 Fuel Oil</td><td>50%</td><td>40%</td></tr>
</table>

Asphalt Production Plants

Rule amendments to N.J.A.C. 7:27-19.9 were adopted in March 2009 for Asphalt Production Plants. The amendments impacted 70 asphalt production dryers at 51 asphalt pavement production plants in New Jersey. The rule required BMP and the new limit was 75 ppmvd (~0.025 lbs/ton) for natural gas, 100 ppmvd (~0.04 lbs/ton) for No. 2 fuel oil, and 125 ppmvd (~0.05 lbs/ton) for No. 4 or heavier fuel oils/on-specification used oil. The reduction would be phased in over a 3-year period, from 2010 to 2012. These amendments were estimated to reduce NO_x by 35% from these sources. A rule effectiveness of 80% was applied to the estimated control efficiency, resulting in an estimated reduction of 28%.

Glass Manufacturing

Rule amendments to N.J.A.C. 7:27-19.10 were adopted in March 2009 to lower NO_x emissions from glass manufacturing furnaces. There were seven plants in New Jersey, with a total of 25 furnaces that produce container glass, pressed glass, blown glass, and fiberglass. Nine of these furnaces are electric. Five furnaces use oxy-firing, which burn nearly pure oxygen, reducing most of the nitrogen that is present in ambient air. These 14 furnaces already comply with the proposed NO_x limits. Two of the remaining 11 furnaces are temporarily inactive. The rule required the remaining nine furnaces to implement additional emission control measures to comply with the proposed emission limit. These amendments were estimated to reduce NO_x by

50% from these sources. A rule effectiveness of 80% was applied to the estimated control efficiency, resulting in an estimated reduction of 40%.

Low Sulfur Distillate and Residual Fuel Oil Rule

In 2010, the State adopted amendments to its Sulfur in Fuels rule, N.J.A.C. 7:27-9, which will reduce the sulfur content in #2 fuel oil to 15 ppm, #4 fuel oil to 2,500 ppm, and #6 fuel oil to 5,000 ppm by 2016. The % reduction (or CE) from the rule was calculated based on the difference between the existing New Jersey limits and the future effective limits in the rule. A rule effectiveness of 80% and a rule penetration of 100% was applied. The resulting % reductions and control factors for SO_2 emission reductions expected by 2016 are summarized in Table 4.

Table 4
Sulfur in Fuels Rule Control Factors for SO_2

County		#2 Fuel Oil/Kerosene			#4 Fuel Oil		
		% Reduction without RE	% Reduction with RE	Control Factor with RE	% Reduction without RE	% Reduction with RE	Control Factor with RE
Bergen Burlington Camden Essex Gloucester Mercer	Middlesex Monmouth Morris Passaic Somerset Union	99%	79%	0.21	17%	13%	0.87
Hudson		99%	79%	0.21	38%	30%	0.7

Municipal Waste Combustors (Incinerators)

Rule amendments to N.J.A.C. 7:27-19.12 were adopted in March 2009 to address the NO_x emissions from municipal solid waste (MSW) incinerators, with maximum allowable NO_x emission concentration of 150 parts million by volume. There are 13 MSW incinerators at five resource recovery facilities in Essex, Union, Camden, Gloucester and Warren counties. The four facilities in Essex, Union, Warren and Gloucester counties, with 10 MSW incinerators, have SNCR installed, which will enable these facilities to meet the 150 ppmvd limit. Camden County Resource Recovery facility's three MSW incinerators do not have SNCR, and therefore, would need to install control device system on each incinerator to reduce the NO_x emissions to meet the limit. These amendments were estimated to reduce NO_x by 37% from these sources. A rule effectiveness of 80% was applied to the estimated control efficiency, resulting in an estimated reduction of 29.6%.

Sewage and Sludge Incinerators

Rule amendments to N.J.A.C. 7:27-19.28 were adopted in March 2009 to establish maximum allowable NO_x emission rates for sewage sludge incinerators. The State's RACT maximum allowable NO_x emission rates for sewage sludge incinerators at N.J.A.C. 7:27-19.28 will not provide additional emissions reduction at these incinerators, as they all are currently complying with the new maximum allowable emission rates.

Case by Case NO_x Emission Limit Determinations (FSELs/AELs)

Rule amendments to N.J.A.C. 7:27-19.13 were adopted in March 2009 which require each facility with an alternative maximum allowable NO_x emission rate approved before May 1, 2005 to submit a new request for an alternative maximum allowable emission rate 60 days after the operative date of these amendments. The State expects the amendments to impact approximately 25 facilities. The amount of emissions reductions that the amendments to the alternative and facility-specific maximum allowable emission rate rules will achieve depends on the alternative maximum allowable emission rate or facility-specific maximum allowable emission rate that a facility applies for, and that the State approves. Because the emissions reduction will depend on each facility that request AELs, the reduction is not quantifiable at this time.

2.3 Point Source Emission Inventory

Table 5 summarizes the 2025 projected point source emission inventory by county for $PM_{2.5}$, NO_x and SO_2. Appendix V, Attachments 2, 3 and 4, contain the detailed point source emission inventories. These attachments are only available electronically.

Table 5
2025 Point Source Emission Inventory by County and Pollutant

County	$PM_{2.5}$* Tons per Year	NO_x Tons per Year	SO_2 Tons per Year
New Jersey Portion of Northern NJ-NY-CT NAA			
Bergen	229	969	47
Essex	272	2,705	213
Hudson	293	1,863	662
Mercer	1,047	2,090	1,895
Middlesex	512	2,218	270
Monmouth	34	187	35
Morris	35	182	34
Passaic	6	88	10
Somerset	80	254	34
Union	735	2,898	700
Total	**3,243**	**13,454**	**3,900**
New Jersey Portion of Southern NJ-Phila. NAA			
Burlington	183	535	148
Camden	174	709	77
Gloucester	501	3,189	1,130
Total	**859**	**4,432**	**1,355**

***** These totals include adjusted emissions from fugitive dust categories.

3.0 Area Sources

3.1 Growth

Growth factors were calculated for area sources utilizing state population projections, USDOE fuel consumption projections, employment projections from the New Jersey Department of Labor, and state specific indicators such as vehicle miles traveled.

A summary table which shows the growth factors and growth rate (in percent per year) for each SCC category and the indicators for those growth factors is included as Table 1 in Attachment 2 of this appendix.

Population

Projected population is the most appropriate growth indicator to use for certain source categories whose emissions are calculated using population such as architectural coatings, consumer products and graphic arts.

For transportation planning purposes, New Jersey is divided into three Metropolitan Planning Organizations (MPOs). The three MPOs are the North Jersey Transportation Planning Authority (NJTPA), the South Jersey Transportation Planning Organization (SJTPO) and the Delaware Valley Regional Planning Commission (DVRPC). The MPOs use demographic data in their projection work. The NJDEP used the population projections developed by each of the three MPOs in the State to grow the appropriate categories of the emission inventory.

Population projection data was obtained from the NJTPA, SJTPO, and the DVRPC. The data was combined and straight line interpolation was used to calculate population for the projection years. Statewide growth factors were then calculated using the following equations:

2007-2025 Growth Factor =
2025 Statewide Population / 2007 Statewide Population

2007-2025 Growth Rate (percent per year) =
{[(2007-2025 Growth Factor)^1/y] – 1} * 100 percent

Where:y = the # of years being analyzed (ex: y = 2025-2007 = 18)

A summary table of the population data is included as Table 2, in Attachment 2.

Fuel Consumption

Projected fuel consumption data was obtained from the USDOE Energy Information Administration (EIA), Annual Energy Outlook Report. The growth factors were calculated in the same manner as the population growth factors, using the same equations, but substituting projected fuel consumption for projected population. A summary table of the fuel consumption data is included as Table 3, in Attachment 2.

Employment

Projected employment is the most appropriate growth indicator to use for certain source categories whose emissions are calculated using employment such as autobody refinishing and dry cleaning. It is also the best growth indicator for other categories in which their emissions are calculated using state specific data but state specific data projections are not available, such as construction activities, mining and quarrying and agricultural tilling.

Projected employment data was obtained from the New Jersey Department of Labor website. The growth factors were calculated in the same manner as the population growth factors, using the same equations, but substituting projected employment for projected population. A summary table of the employment data is included as Table 4, in Attachment 2.

Vehicle Miles Traveled

Projections of vehicle miles traveled (VMT) for 2007 to 2025 were used as the growth factor for projecting emissions from re-entrained road dust from travel on paved roads. The VMT data was derived from the MOVES modeling discussed in Appendix V. A summary table of the VMT data is included as Table 5, in Attachment 2.

Residential Wood Combustion

Growth and control of the residential wood combustion is incorporated into one factor, per the USEPA 2005-based V4 Modeling Platform[3]. The factors account for the USEPA rule that sets new source performance standard (NSPS) for woodstoves. The factors are based on estimated turnover of the old stoves to the new stoves. The estimated combined growth and control rates are as follows:

- Fireplaces increase 1%/yr
- Old woodstoves (non-USEPA certified) decrease 2%/yr
- New woodstoves (USEPA certified) increase 2%/yr

Table 6 shows the estimated growth factors by SCC and year.

Table 6
Residential Wood Combustion Growth/Control Factors

SCC	SCC Description	Assumptions	Growth and Control Factors 2007-2025
2104008000	Total: Woodstoves and Fireplaces	2104008000 total: 1 - 0.01056*(Year-2007)	0.8099
2104008100	Fireplaces: General	2104008100 fireplaces up 1%/yr: 1 + 0.01*(Year-2007)	1.180
2104008210	Fireplaces: Insert; non-USEPA certified	2104008210 old inserts down 2%/yr: 1 - 0.02*(Year-2007)	0.640
2104008220	Fireplaces: Insert; USEPA certified; non-catalytic	2104008220 new inserts up 2%/yr: 1 + 0.02*(Year-2007)	1.360
2104008230	Fireplaces: Insert; USEPA certified; catalytic	2104008230 new inserts up 2%/yr (same as 2104008220)	1.360
2104008310	Woodstove: freestanding; non-EPA certified	2104008310 old woodstoves down 2%/yr (same as 2104008210)	0.640

[3] U.S. Environmental Protection Agency. *2020 Emissions Data from EPA's 2005-based V4 Modeling Platform; Projection and Control Factors*. Provided to MARAMA by Rich Mason on April 15, 2010.

2104008320	Non-catalytic Woodstoves: freestanding; EPA certified	2104008320 new woodstoves up 2%/yr (same as 2104008220)	1.360
2104008330	Catalytic Woodstoves: freestanding; EPA certified	2104008330 new woodstoves up 2%/yr (same as 2104008220)	1.360
2104008400	Woodstoves: pellet-fired, general; EPA certified	2104008400 new woodstoves up 2%/yr (same as 2104008220)	1.360
2104008510	Wood;Furnace:Indoor, cordwood-fired; non-EPA certified	2104008510 old wood furnaces down 2%/yr (same as 2104008210)	0.640
2104008610	Wood;Hydronic heater: outdoor	2104008610 hydronic heaters up 1%/yr(same as 2104008100)	1.180
2104008700	Outdoor woodburning device, NEC	2104008700 outdoor woodburning devices up 1%/yr (same as 2104008100)	1.180
2104009000	Firelog /Total: All Combustor Types	2104008700 firelogs up 1%/yr (same as 2104008100)	1.180

No Growth

No growth was projected for wildfires, managed burning, motor vehicle fires, structural fires, incineration, open burning, agricultural field burning, cigarette smoking and unpaved roads.

3.2 Controls

Overview

New Jersey and the USEPA have developed and will develop rules that require control measures to reduce area source emissions of air pollutants. In developing the 2007 emissions inventory, control efficiency factors for the NJDEP pre-2007 rules were applied to the 2007 uncontrolled emissions inventory in order to calculate the 2007 “actual” or controlled emissions inventory. In a similar fashion, control efficiency factors (CEs) reflecting post-2007 rules, relative to existing rules, were applied to the grown emissions inventories, and emission reduction benefits were calculated. The CEs were applied to the grown inventory, to determine emission reduction benefits from the New Jersey rules, relative to the existing rules. These benefits grow in future years in direct relation to the growth factor for the respective emission categories. The equation that was used to project emissions in a future year, y, incorporating growth and the application of new control measures between year x and year y is:

E y = E x * GFx-y * [1 - (CE * RE * RP)x-y]

where:
Ey = Controlled emissions in year y
Ex = Controlled emissions in year x
GFx-y = Growth factor used to grow emissions from year x to year y
CE = Control efficiency factor for a control measure implemented between years X and Y
RE = Rule Effectiveness Factor
RP = Rule Penetration Factor
CF=Control Factor = [1 - (CE * RE * RP)x-y]

The control factors (CF) applied to the 2025 inventory are shown in the area source emission inventory in Appendix V, Attachment 6. The 2007 emission inventory was used as a base for the projection inventory. The existing control measures which reduce area source emissions for $PM_{2.5}$, NO_x, and SO_2 in the projection inventory from 2007 to 2025 are shown in Table 7.

Table 7
Area Source $PM_{2.5}$, NO_x and SO_2 Control Measures

Control Measures	Sector	Pollutant	Area Source Category
Federal Residential Woodstove New Source Performance Standards (NSPS)	Area	$PM_{2.5}$, NO_x, SO_2	Residential Wood Combustion categories, see Table 6
New Jersey ICI Boiler Rule 2006 (Tune-up Requirements)	Point and Area	NO_x	Industrial Natural Gas Combustion, Commercial/Institutional Natural Gas Combustion, Industrial Distillate Oil Combustion, Commercial/Institutional Distillate Oil Combustion, Industrial Residual Oil Combustion, Commercial Institutional Residual Oil Combustion, Industrial LPG Combustion, Commercial/Institutional LPG Combustion,
Federal Maximum Achievable Control Technology for Reciprocating Internal Combustion Engines (RICE MACT)	Point and Area	$PM_{2.5}$, NO_x	Industrial Natural Gas Combustion, Commercial/Institutional Natural Gas Combustion, Industrial Distillate Oil Combustion, Commercial/Institutional Distillate Oil Combustion
New Jersey Low Sulfur Fuel Oil Rule	Point and Area	SO_2	Industrial Distillate Oil Combustion, Commercial/Institutional Distillate Oil Combustion, Residential Distillate Oil Combustion, Industrial Residual Oil Combustion, Commercial Institutional Residual Oil Combustion, Industrial LPG Combustion, Commercial/Institutional LPG Combustion

A discussion of the control measure control factors is included below.

Control Factors

Residential Woodstove NSPS

Growth and control of the residential wood combustion is incorporated into one factor, per the USEPA 2005-based V4 Modeling Platform[4]. The factors account for the USEPA rule that sets new source performance standard (NSPS) for woodstoves. The factors are based on estimated turnover of the old stoves to the new stoves. See detailed discussion under Residential Wood Combustion discussion above under Growth.

[4] U.S. Environmental Protection Agency. *2020 Emissions Data from EPA's 2005-based V4 Modeling Platform; Projection and Control Factors*. Provided to MARAMA by Rich Mason on April 15, 2010.

Federal RICE MACT

As discussed in the “Technical Supporting Document for the Development of the 2025 Emission Inventory for PM Nonattainment Counties in the MANE-VU Region Version 3.3”, prepared by AMEC Environmental & Infrastructure, dated January 23, 2012, it discussed how post-2007 MACT standards were applied on a general scale to all sources with certain SCCs. Every source with a SCC determined to be affected by a post-2007 MACT standard was assigned an incremental percent reduction for the entire applicable MACT standard. Exhibit 2-15 of the TSD Shows the USEPA Estimated Percent Reductions for the RICE MACT Standard for each SCC.

Based on EPA estimates, there are two different control factors that were used for the RICE MACT control in the area source inventory, one for $PM_{2.5}$ and one for NO_x. The $PM_{2.5}$ control factor is 0.9243. The NO_x control factor is 0.9203. This results in an 8% reduction (CE) in NO_x from RICE MACT for industrial, commercial and institutional natural gas combustion and an 8% reduction (CE) of $PM_{2.5}$ for industrial, commercial and institutional distillate oil combustion. A rule effectiveness (RE) of 100% was assumed since the rule is a Federal measure.

New Jersey ICI Boiler Rule 2006 Tune-Up Requirements

Rule amendments to N.J.A.C. 7:27-19 were adopted in November 2005, requiring annual tune-ups for all boilers greater than 5 mmBtu/hr phased-in starting in 2007 and ending in 2010.

The estimated control factor for New Jersey’s ICI boiler tune-up requirement for area sources is 0.94. This was calculated from an estimated 25% reduction (CE) in NO_x emissions from ICI boiler tune-ups, a rule effectiveness (RE) of 80%, and rule penetration (RP) of 30%. The RP of 30% assumes that approximately 30% of the emissions in the fuel combustion categories that the rule applies are coming from ICI boilers. This results in an overall estimated emission reduction of 6%.

Combined Federal RICE MACT and New Jersey ICI Boiler Rule 2006 Tune-Up Requirements

There are two categories (industrial and commercial natural gas combustion) where both the Federal RICE MACT and New Jersey ICI Boiler Tune-Up requirement were applied. In these instances, New Jersey applied only the 7.97% NO_x reduction (control factor of 0.9203) from the Federal RICE MACT rule (the higher reduction of the two rules), rather than combining the benefits of both rules, to be conservative.

Low Sulfur Fuel Oil Rule

In 2010, the State adopted amendments to its Sulfur in Fuels rule, N.J.A.C. 7:27-9, which will reduce the sulfur content in #2 fuel oil to 15 ppm, #4 fuel oil to 2,500 ppm, and #6 fuel oil to 5,000 ppm by 2016. The % reduction (or CE) from the rule was calculated based on the difference between the existing New Jersey limits and the future effective limits in the rule. A rule effectiveness of 80% and a rule penetration of 100% was applied. The resulting % reductions and control factors for SO_2 emission reductions expected by 2016 are summarized in Table 4 above under the point source discussion.

3.3 Area Source Emission Inventory

Table 8 summarizes the 2025 projected area source emission inventory by county for $PM_{2.5}$, NO_x and SO_2. Appendix V, Attachment 6 contains the detailed area source emission inventories. These attachments are only available electronically.

Table 8
2025 Area Source Emission Inventory by County and Pollutant

County	$PM_{2.5}$* Tons per Year	NO_x Tons per Year	SO_2 Tons per Year
New Jersey Portion of Northern NJ-NY-CT NAA			
Bergen	622	2,519	165
Essex	544	2,070	168
Hudson	436	1,523	92
Mercer	297	1,129	76
Middlesex	911	2,198	130
Monmouth	890	1,656	121
Morris	700	1,516	159
Passaic	349	1,137	92
Somerset	486	944	55
Union	382	1,367	97
Total	**5,616**	**16,059**	**1,157**
New Jersey Portion of Southern NJ-Phila. NAA			
Burlington	1,563	1,368	105
Camden	409	1,353	93
Gloucester	679	706	62
Total	**2,651**	**3,427**	**260**

***** These totals include adjusted emissions from fugitive dust categories.

Overall Emissions Summary

The statewide overall growth rate (with growth and controls) for area sources from 2007 to 2025 is approximately -0.05 percent per year for $PM_{2.5}$, -0.03 percent per year for NO_x and -7.80 percent per year for SO_2. The statewide average growth rates from 2007 to 2025 vary within the individual SCC categories and pollutants from approximately negative 10.47 percent per year for commercial/institutional distillate oil combustion for SO_2 to 1.74 percent per year for residential woodstoves for all three pollutants.

$PM_{2.5}$ Emissions Summary

Overall, negative growth is projected in categories such as industrial residual oil, LPG, and distillate oil combustion; commercial/institutional distillate oil and kerosene combustion; residential wood burning of non-USEPA certified devices, residential distillate oil and LPG combustion.

Overall, no growth is projected in categories such as industrial kerosene combustion; commercial/institutional coal, residual oil, LPG, and kerosene combustion; residential coal and kerosene combustion; incineration, open burning, agricultural field burning, forest wildfires, cigarette smoke, prescribed burning, structure and motor vehicle fires.

Overall, positive growth from zero to one percent is projected in categories such as residential natural gas combustion, agricultural tilling, construction, commercial/institutional cooking, mining & quarrying, residential wood combustion of fireplaces, firelogs, and outdoor hydronic heaters.

Overall, one to two percent growth is projected for categories such as commercial/institutional natural gas combustion, paved roads, residential wood combustion of USEPA –certified woodstoves, fireplace inserts, and pellet-fired woodstoves.

NO_x Emissions Summary

Overall, negative growth is projected in categories such as industrial residual oil and LPG combustion; commercial/institutional distillate, residual oil and LPG combustion; residential wood combustion of non-USEPA certified devices, residential distillate and LPG combustion.

Overall, no growth is projected in categories such as industrial kerosene combustion, commercial/institutional coal and kerosene combustion, residential coal and kerosene combustion, incineration, open burning, forest wildfires, cigarette smoke, structure and motor vehicle fires.

Overall, positive growth from zero to one percent is projected in categories such as residential natural gas combustion, commercial/institutional natural gas combustion, residential wood combustion of fireplaces, firelogs, and outdoor hydronic heaters.

Overall, one to two percent growth is projected for categories such as residential wood combustion of USEPA –certified woodstoves, fireplace inserts, and pellet-fired woodstoves.

SO_2 Emissions Summary

Overall, negative growth is projected in categories such as commercial/institutional distillate oil and kerosene combustion; residential distillate oil and LPG combustion; industrial distillate oil, kerosene, residual oil, and LPG combustion; and residential wood combustion of non-USEPA certified devices.

Overall, no growth is projected in categories such as commercial/institutional residual oil combustion; residential coal and kerosene combustion; incineration, and open burning.

Overall, positive growth from zero to one percent is projected in categories such as residential natural gas combustion and residential wood combustion of fireplaces and outdoor hydronic heaters.

Overall, one to two percent growth is projected for categories such as commercial/institutional natural gas combustion and residential wood combustion of USEPA –certified woodstoves, fireplace inserts, and pellet-fired woodstoves.

4.0 Onroad Sources

New Jersey's 2025 projection emissions inventory for onroad sources is discussed in Appendix VII.

5.0 Nonroad Sources

Non-road Mobile Sources include internal combustion engines used to propel marine vessels, airplanes, and locomotives, or to operate equipment such as forklifts, lawn and garden equipment, portable generators, etc. For activities other than marine vessels, airplanes, and locomotives, the inventory was developed using the most current version of USEPA's NONROAD model NONROAD2008a (July 2009 version). Since the NONROAD model does not include emissions from marine vessels, airplanes, and locomotives, these emissions were estimated using the latest USEPA guidance or by groups such as the Eastern Regional Technical Advisory Committee (ERTAC) and Starcrest.

5.1 NONROAD Model

The USEPA's NONROAD model estimates emissions from equipment such as recreational marine vessels, recreational land-based vehicles, farm and construction machinery, lawn and garden equipment, aircraft ground support equipment (GSE) and rail maintenance equipment. This equipment is powered by diesel, gasoline, compressed natural gas or liquefied petroleum gas engines.

New Jersey ran the non-road model for each county included in the $PM_{2.5}$ NAA by inputting its own specific fuel parameters and climatological data. New Jersey utilized 2010 year specific meteorology data from the National Oceanic and Atmospheric Administration Climatological Data and fuel oil property revisions based on a New Jersey review of a USEPA gasoline formulation survey data (Reid vapor pressure, sulfur content, oxygenate fractions and ethanol volume and content) and diesel fuel sulfur content included in the USEPA "Suggested Nationwide Average Fuel Properties".

5.1.1 NONROAD Model Inputs

The normal maximum and minimum and average ambient temperatures were compiled from those reported at Newark Airport in 2010 for application to Northern New Jersey Counties located in the $PM_{2.5}$ NAA (Bergen, Essex, Hudson, Middlesex, Monmouth, Morris, Passaic, Somerset and Union) and from those reported at Philadelphia Airport in 2010 for application to Southern New Jersey Counties located in the $PM_{2.5}$ NAA (Burlington, Camden, Gloucester and Mercer) as specified in table below. Similarly, New Jersey compiled seasonal USEPA Reformulated Fuel Gasoline (RFG) formulations survey data into annual averages for application to the Northern and Southern New Jersey counties referenced above as specified in Exhibit 5.1.1 below.

Exhibit 5.1.1
Temperatures and Fuel Oil Specification Inputs Used in 2025 USEPA NONROAD Model Runs

Gasoline Specifications Used for 2007 in the MOBILE Model	Northern RFG – ANNUAL*	Southern RFG – Winter*
Fuel Reid Vapor Pressure (psi)	9.859	9.842
Fuel Oxygen Content (% by weight)	0.00394	0.00387
Ethanol Volume	9.895	9.869
Ethanol Market Share	1.0000	1.0000
Diesel Sulfur %	0.0011	0.0011
Marine Diesel Sulfur%	0.0055	0.0055
CNG/LPG Sulfur%	0.0030	0.0030
Minimum Temperature	46.7	47.4
Maximum Temperature	62.3	63.2
Average Ambient Temperature	54.5	55.3
Stage II Control	0	0

5.1.2 Update of NONROAD Allocation Files for Population and Housing

Several NONROAD categories use housing unit or population data to allocate the emissions to the county level from State calculations. MARAMA states identified some discrepancies in the housing and population data contained in the NONROAD model and requested that the Contractor update the allocation files for those categories. As a consequence, the Contractor obtained 1 and 2 unit housing information and updated 2007 population estimates. Data were obtained from the sources listed in Exhibit 5.1.2.

Exhibit 5.1.2
Data Sources for Population and Housing Data

Source Type	Data Source
2007 Population Data Source	http://www.census.gov/popest/counties/CO-EST2008-01.html
Total Housing Data Source	http://www.census.gov/popest/housing/HU-EST2007-CO.html
1 yr – 1 and 2 Unit Housing Data	2007 American Community Survey 1-Year Estimates
3 yr – 1 and 2 Unit Housing Data	B25024. UNITS IN STRUCTURE - Universe: HOUSING UNITS Data Set: 2005-2007 American Community Survey 3-Year Estimates, Survey: American Community Survey

Three sources for the housing unit data were required to evaluate all counties within the MARAMA region. Census data are frequently withheld when the data reporting can lead to disclosure of confidential business information or due to incomplete survey response. For the 1 and 2 unit housing data, the predominant source was the 1 year -1 and 2 unit housing data. If that was unavailable due to either confidentiality issues or lack of survey response, then the 3 year data was used by determining an average value for the three year period. Finally if no data were available for the 3 year 1 and 2 unit housing information, total housing unit data were utilized. The revised housing unit data affected the allocation of residential lawn and garden equipment.

NJ provided revised human population data for 2002, 2005, 2010, 2015 and 2020. This human population data is the same as those used by the Metropolitan Planning Organizations in their travel demand models to calculate on-road sector emissions. Because of the way NONROAD handles missing data, if data for 2025 are not found, the most current data (in this case 2020) are used to assist in determining a 2025 value.

5.1.3 Recreational Marine Vessel Population Revision

Total New Jersey default populations for each of the three major recreational marine vessel categories contained in the NONROAD model (outboard, inboard/sterndrive and personal watercraft) were updated. The National Marine Manufacturers Association (NMMA) provided updated populations for the outboard and personal watercraft vessel engine categories for the year 2007. Because the population files used by the NONROAD model (and thus NMIM) were configured with population values for various horsepower categories, the contractor determined the fraction of the total for each marine vessel type in each horsepower category from the NONROAD default population files. These fractions were then used to allocate the total State population obtained from NMMA to the various horsepower categories. The only exception to this was the addition of data for sailboats. The sailboat populations were split among the outboard and inboard/sterndrive watercraft vessels.

Updated recreational marine population data was also estimated for the years 2017 and 2020s. EPA had recommended that rather than use the default growth algorithm built into the nonroad model for those states that had their 2007 base year data updated for this category, separate population estimates for each projection year should be prepared and included in the population files. The contractor then used the national growth factors supplied in the default NMIM/NONROAD model to estimate populations for each year. Each horsepower/population category in the 2007 population file was grown to either 2017 or 2020 using the ratio between the 2005 and 2015 national growth factors (to represent growth between 2007 and 2017) and between the 2005 and 2025 national growth factors (to represent growth between 2007 and 2020). Those ratios were used to grow the 2007 population to 2017 and 2020 respectively. For the 2025 projection year emission inventory, New Jersey did not follow this practice but allowed the default growth algorithm built into the model to grow the population to the 2025 projection year based on the updated 2007, 2017 and 2020 recreational marine populations now in place.

5.1.4 Airport Ground Support Equipment Removal

New Jersey provided revised equipment population values for Airport Ground Support Equipment. As discussed in Section 5.4.4 of this document, emissions from airport ground support equipment is also included in USEPA's aircraft inventory prepared using the Federal Aviation Administration's Emissions and Dispersion Modeling System (EDMS). Correspondence with USEPA indicated that USEPA considers the emissions calculated by EDMS to be better than those calculated by NONROAD. For this reason, all emissions calculated by NMIM/NONROAD for airport ground support equipment were removed from the inventory to avoid double counting.

5.1.5 NONROAD Model Growth and Control Information

In estimating future year emissions, the NONROAD model includes growth and scrappage rates for equipment in addition to a variety of control programs. It is not possible to separate out the future year emissions due to "growth only" or "control only" in a single run. That is, the model run provides a single future year estimate that is a "growth and control" scenario.

The growth data used in the NONROAD model is documented in a USEPA report.[5] The GROWTH packet of the NONROAD model cross-references each SCC to a growth indicator code. The indicator code is an arbitrary code that identifies an actual predicted value such as human population or employment that is used to estimate the future year equipment population. The GROWTH packet also defines the scrappage curves used to estimate the future year model year distribution.

The NONROAD model also accounts for all USEPA emission standards for Nonroad equipment. There are multiple standards that vary by equipment type, rated power, model year, and pollutant. Exhibit 5.1.5 is a summary of the emission control programs accounted for in the NONROAD model. A complete summary of the nonroad equipment emission standards can be found on USEPA's nonroad emission standards reference guide website.

Exhibit 5.1.5
Control Programs Included in the USEPA's NONROAD Model

Regulation	**Description**
Control of Air Pollution; Determination of Significance for Nonroad Sources and Emission Standards for New Nonroad Compression Ignition Engines At or Above 37 Kilowatts 59 FR 31036 June 17, 1994	This rule establishes Tier 1 exhaust emission standards for HC, NO_x, CO, and PM for nonroad compression-ignition (CI) engines ≥37kW (≥50hp). Marine engines are not included in this rule. The start dates and pollutants affected vary by hp category as follows: 50-100 hp: Tier 1,1998; NO_x only 100-175 hp: Tier 1, 1997; NO_x only 175-750 hp: Tier 1, 1996; HC, CO, NO_x, PM >750 hp: Tier 1, 2000; HC, CO, NO_x, PM
Emissions for New Nonroad Spark-Ignition Engines At or Below 19 Kilowatts; Final Rule 60 FR 34581 July 3, 1995	This rule establishes Phase 1 exhaust emission standards for HC, N NO_x Ox, and CO for nonroad spark-ignition engines ≤19kW (≤25hp). This rule includes both handheld (HH) and non-hand-held (NHH) engines. The Phase 1 standards become effective in 1997 for : Class I NHH engines (<225cc), Class II NHH engines (≥225cc), Class III HH engines (<20cc), and Class IV HH engines (≥20cc and <50cc). The Phase 1 standards become effective in 1998 for: Class V HH engines (≥50cc)
Final Rule for New Gasoline Spark-Ignition Marine Engines; Exemptions for New Nonroad Compression-Ignition Engines at or Above 37 Kilowatts and New Nonroad Spark-Ignition Engines at or Below 19 Kilowatts	This rule establishes exhaust emission standards for HC+ NO_x for personal watercraft and outboard (PWC/OB) marine SI engines. The standards are phased in from 1998-2006.

[5] U.S. Environmental Protection Agency. Nonroad Engine Growth Estimates. EPA-420/P-04-08.

Regulation	**Description**
61 FR 52088 October 4, 1996	
Control of Emissions of Air Pollution From Nonroad Diesel Engines 63 FR 56967 October 23, 1998	This final rule sets Tier 1 standards for engines under 50 hp, phasing in from 1999 to 2000. It also phases in more stringent Tier 2 standards for all engine sizes from 2001 to 2006, and yet more stringent Tier 3 standards for engines rated over 50 hp from 2006 to 2008. The Tier 2 standards apply to NMHC+ NO_x, CO, and PM, whereas the Tier 3 standards apply to NMHC+ NO_x and CO. The start dates by hp category and tier are as follows: hp<25: Tier 1,2000; Tier 2, 2005; no Tier 3 25-50 hp: Tier 1, 1999; Tier 2, 2004; no Tier 3 50-100 hp: Tier 2, 2004; Tier 3, 2008 100-175 hp: Tier 2, 2003; Tier 3, 2007 175-300 hp: Tier 2, 2003; Tier 3, 2006 300-600 hp: Tier 2, 2001, Tier 3, 2006 600-750 hp: Tier 2, 2002; Tier 3, 2006 >750 hp: Tier 2, 2006, no Tier 3 This rule does not apply to marine diesel engines above 50 hp.
Phase 2: Emission Standards for New Nonroad Nonhandheld Spark Ignition Engines At or Below 19 Kilowatts 64 FR 15207 March 30, 1999	This rule establishes Phase 2 exhaust emission standards for HC+ NO_x for nonroad nonhandheld (NHH) spark-ignition engines ≤19kW (≤25hp). The Phase 2 standards for Class I NHH engines (<225cc) become effective on August 1, 2007 (or August 1, 2003 for any engine initially produced on or after that date). The Phase 2 standards for Class II NHH engines (≥225cc) are phased in from 2001-2005.
Phase 2: Emission Standards for New Nonroad Spark-Ignition Handheld Engines At or Below 19 Kilowatts and Minor Amendments to Emission Requirements Applicable to Small Spark-Ignition Engines and Marine Spark-Ignition Engines; Final Rule 65 FR 24268 April 25, 2000	This rule establishes Phase 2 exhaust emission standards for HC+ NO_x for nonroad handheld (HH) spark-ignition engines ≤19kW (≤25hp). The Phase 2 standards are phased in from 2002-2005 for Class III and Class IV engines and are phased in from 2004-2007 for Class V engines.
Control of Emissions From Nonroad Large Spark-Ignition Engines and Recreational Engines (Marine and Land-Based); Final Rule 67 FR 68241 November 8, 2002	This rule establishes exhaust and evaporative standards for several nonroad categories: 1) Two tiers of emission standards are established for large spark-ignition engines over 19 kW. Tier 1 includes exhaust standards for HC+ NO_x and CO and is phased in from 2004-2006. Tier 2 becomes effective in 2007 and includes exhaust standards for HC+ NO_x and CO, as along with evaporative controls affecting fuel line permeation, diurnal emissions and running loss emissions. 2) Exhaust and evaporative emission standards are established for recreational vehicles, which include snowmobiles, off-highway motorcycles, and all-terrain vehicles (ATVs). For snowmobiles, HC and CO exhaust

Regulation	Description
	standards are phased-in from 2006-2012. For off-highway motorcycles, HC+ NO_x and CO exhaust emission standards are phased in from 2006-2007. For ATVs, HC+NO_x and CO exhaust emission standards are phased in from 2006-2007. Evaporative emission standards for fuel tank and hose permeation apply to all recreational vehicles beginning in 2008. 3) Exhaust emission standards for HC+ NO_x, CO, and PM for recreational marine diesel engines over 50 hp begin in 2006-2009, depending on the engine displacement. These are "Tier 2" equivalent standards.
Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel; Final Rule (Clean Air Nonroad Diesel Rule – Tier 4) 69 FR 38958 June 29, 2004	This final rule sets Tier 4 exhaust standards for CI engines covering all hp categories (except marine and locomotives), and also regulates nonroad diesel fuel sulfur content. 1) The Tier 4 start dates and pollutants affected vary by hp and tier as follows: hp<25: 2008, PM only 25-50 hp: Tier 4 transitional, 2008, PM only; Tier 4 final, 2013, NMHC+ NO_x and PM 50-75 hp: Tier 4 transitional, 2008; PM only; Tier 4 final, 2013, NMHC+ NO_x and PM 75-175 hp: Tier 4 transitional, 2012, HC, NO_x, and PM; Tier 4 final, 2014, HC, NO_x,PM 175-750 hp:Tier 4 transitional, 2011, HC, NO_x, and PM; Tier 4 final, 2014, HC, NO_x,PM >750 hp: Tier 4 transitional, 2011, HC, NO_x, and PM; Tier 4 final, 2015, HC, NO_x,PM 2) This rule will reduce nonroad diesel fuel sulfur levels in two steps. First, starting in 2007, fuel sulfur levels in nonroad diesel fuel will be limited to a maximum of 500 ppm, the same as for current highway diesel fuel. Second, starting in 2010, fuel sulfur levels in most nonroad diesel fuel will be reduced to 15 ppm.
Control of Emissions From Nonroad Spark-Ignition Engines and Equipment; Final Rule (Bond Rule) 73 FR 59034 October 8, 2008	This rule establishes exhaust and evaporative standards for small SI engines and marine SI engines: 1) Phase 3 HC+ NO_x exhaust emission standards are established for Class I NHH engines starting in 2012 and for Class II NHH engines starting in 2011. There are no new exhaust emission standards for handheld engines. New evaporative standards are adopted for both handheld and nonhandheld equipment. The new evaporative standards control fuel tank permeation, fuel hose permeation, and diffusion losses. The evaporative standards begin in 2012 for Class I NHH engines and 2011 for Class II NHH engines. For handheld engines, the evaporative standards are phased-in from 2012-2016. 2) More stringent HC+ NO_x and CO standards are established for marine SI PWC/OB engines beginning in 2010. In addition, new exhaust HC+ NO_x and CO standards are established for sterndrive and inboard (SD/I) marine SI engines also beginning in 2010. High

Regulation	Description
	performance SD/I engines are subject to separate HC+ NO_x and CO exhaust standards that are phased-in from 2010-2011. New evaporative standards were also adopted for all marine SI engines that control fuel hose permeation, diurnal emissions, and fuel tank permeation emissions. The hose permeation, diurnal, and tank permeation standards take effect in 2009, 2010, and 2011, respectively.

5.1.6 NONROAD Model Run Operation

The NONROAD model run operation comprises the inputting of the climatic and fuel specification data and New Jersey specific files into the model template panels, the running of the model, and the selection of the model run output format included in reporting utility panels. The settings for each template and reporting utility panel in the NONROAD model are detailed below.

NONROAD MODEL TEMPLATE SETTINGS

- OPTIONS: A short descriptive term for the run is entered for each State specific run and also all the temperature and fuel oil parameters included in Exhibit 5.1.1 above.
- GEOGRAPHY: The “county” option was selected for each State specific run. All counties within the New Jersey were selected for the run.
- PERIOD: Includes the episode, growth and technology panels. On the episode panel, the year 2025 was selected in the drop down box and added to the year selections area. This automatically directs the model to grow emissions and apply all phased-in nonroad control measures to the end of this episode year unless the user specifies that a different year be used as the technology year to end all control measure phase-ins. This is an important feature of the nonroad model because nonroad control measures usually phase-in over a certain number of years. This is unlike point and area sector control measures which are generally effective on a particular date. Thus to determine uncontrolled emissions after the baseline (2007) for the last year of the maintenance period (2025), the year 2025 for growth remains the same but now the year 2007 will be selected in the drop down box for the technology panel. Additionally, selections were made to specify emissions for a total annual period.
- SOURCES: All sources were selected. Thus all fuels and all vehicle types were selected for each State run. Aircraft ground support equipment was included in the run specifications but those records were removed during post-processing steps.
- REGION: The “county” option was selected for the State of New Jersey. Thus all counties within the New Jersey were selected for the 13 runs to be conducted for each county included within the New Jersey portions of the New York North New Jersey-Long Island and Connecticut and the Philadelphia-Wilmington Pennsylvania-New Jersey-Delaware PM2.5 Nonattainment Areas.
- ADVANCED OPTIONS: GEOGRAPHIC ALLOCATION: The NONROAD model default file for housing “NJ_HOUSE.ALO” was replaced with the updated New Jersey housing file created by AMEC “34000hou.ALO” discussed in Section 5.1.2 above. Additionally, the NONROAD model default file for population “NJ_POP.ALO” was replaced with the updated New Jersey population file “34000cen.ALO”. These files can be found in the 2025 Non-Road Model Inputs directory included in Attachment 3.

- ADVANCED OPTIONS: EQUIP. POPULATION: The NONROAD model default nonroad equipment population, "NJ.POP", was replaced with the updated New Jersey nonroad equipment population "34000.pop". This file can be found in the 2025 Non-Road Model Inputs directory included in Attachment 3.
- MODEL: Select RUN with template options to run model.

REPORTING UTILITY SETTINGS

- REPORTS: Select the Emissions Totals by SCC.
- SELECT RUN TO USE: Select the desired run imported from the output file of the NONROAD MODEL
- REPORT ONE STATE/COUNTY: Select desired county in New Jersey.
- POLLUTANTS TO REPORT: Select all pollutants.
- SELECT THE HC: Select VOC.
- SELECT THE PM SIZE: Select $PM_{2.5}$.

Specifics on the controlled and uncontrolled runs conducted with these template and reporting utility settings, other assumptions and references for data can be found in the 2025 Non-Road Model Output files included in Attachment 3.

5.1.7 NON-ROAD Model Equipment Emission Inventory

Table 9 summarizes the 2025 non-road model source emission inventory by county for $PM_{2.5}$, NO_x and SO_2. Appendix V, Attachment 7 contains the detailed nonroad source emission inventories. This attachment is only available electronically.

Table 9
2025 NON-ROAD Model Equipment
Emission Inventory by County, Nonattainment Area (NAA) and Pollutant

County	$PM_{2.5}$* Tons per Year	NO_x Tons per Year	SO_2 Tons per Year
New Jersey Portion of Northern NJ-NY-CT NAA			
Bergen	214	1,761	10
Essex	84	877	4
Hudson	55	771	3
Mercer	78	647	3
Middlesex	163	1,410	7
Monmouth	146	1,328	7
Morris	138	986	6
Passaic	70	660	4
Somerset	108	666	4
Union	89	693	4
Total	**1,144**	**9,798**	**51**
New Jersey Portion of Southern NJ-Phila. NAA			
Burlington	93	772	4
Camden	69	593	3
Gloucester	61	468	2
Total	**223**	**1,833**	**9**

5.1.8 Non-road Model Control Measure Benefit Calculations

Control measure emission benefits by nonattainment area were calculated by difference between the last year of the maintenance period emissions without control technologies applied after the base year (2007) and the last year of the maintenance period emissions (2025) with control technologies applied throughout this entire period (2007 to 2025). Emission benefits accrue from rules establishing lower emission standards for nonroad spark and compression ignition engines and nonroad diesel engines. Emisson benefits are summarized in Table 10 by county for $PM_{2.5}$, NO_x and SO_2. Appendix V, Attachment 7 contains the detailed non-road source emission benefits. This attachment is only available electronically.

Table 10
2025 NON-ROAD Model Equipment
Emission Benefits by County, Nonattainment Area (NAA) and Pollutant

County	$PM_{2.5}$* Tons per Year	NO_x Tons per Year	SO_2 Tons per Year
New Jersey Portion of Northern NJ-NY-CT NAA			
Bergen	171	1,897	249
Essex	110	1,096	157
Hudson	111	1,023	158
Mercer	97	937	138
Middlesex	174	1,773	251
Monmouth	139	1,446	217
Morris	100	1,072	142
Passaic	72	722	101
Somerset	73	794	105
Union	69	750	98
Total	**1,116**	**11,509**	**1,616**
New Jersey Portion of Southern NJ-Phila. NAA			
Burlington	93	889	127
Camden	67	682	93
Gloucester	52	516	73
Total	**212**	**2,087**	**294**

5.2 Commercial Marine Vessels (CMV)

For the purpose of emission calculations, CMV engines are divided into three categories based on displacement (swept volume) per cylinder. Category 1 and Category 2 marine diesel engines typically range in size from about 500 to 8,000 kW (700 to 11,000 hp). These engines are used to provide propulsion power on many kinds of vessels including towboats, assist tugs, pushboats, supply vessels, fishing vessels, and other commercial vessels in and around ports. They are also used as stand-alone generators for auxiliary electrical power on vessels. Category 3 marine diesel engines typically range in size from 2,500 to 70,000 kW (3,000 to 100,000 hp). These are very large marine diesel engines used for propulsion power on ocean-going vessels such as container ships, oil tankers, bulk carriers and cruise ships.

The majority of marine vessels are powered by diesel engines that are either fueled with distillate or residual fuel oil blends. For the purpose of emission inventories, USEPA has assumed that Category 3 vessels primarily use residual blends while Category 1 and 2 vessels typically use distillate fuels.

CMV emission inventories for Category 1, 2 and 3 vessels were available from USEPA 2008 National Emission Inventory (NEI).[6] This NEI database included residual and diesel fueled CMV emissions for both the port and underway operation modes of Cruise (C), Maneuver (M), Reduced Speed Zone (Z) and Hotelling (H) that can be configured into CMV Category 1, 2 and 3 vessels emission inventories. This database was matched to GIS ArcInfo shape files for use in plotting emissions.

New Jersey indicated that they had developed CMV emission inventories that they preferred over those provided by USEPA for certain counties. However, these emissions were only available in NIF area source file format (county/SCC summary level) and not spatially allocated. Thus for consistency, NJDEP mapped the shape files to determine exactly what constituted the port and underway areas in both South and North New Jersey. New Jersey visually determined that the USEPA shape files for the port mainly constituted the docking facilities themselves while those for the underway region constituted almost all the waterborne area outside or adjacent to the docking facilities. On this basis and following guidance included in a September 28, 2011 email from Laurel Driver of the USEPA, New Jersey classified all residual fueled (Category 3) vessels not otherwise docked as conducting either a C or Z mode of underway operation and all residual fueled (Category 3) docked vessels as conducting an H mode of port operation. For all diesel fueled (Category 2) vessels, New Jersey classified them as mainly conducting either a C mode of underway operation, and in a few instances where EPA made this determination, as conducting a M mode of port operation. Exhibit 5.3 below provides a summary of these determinations as well as the Source Category Code (SCC) designation of each CMV operation included in the 2007 emission inventory:

Exhibit 5.2
CMV SCC, Description, Mode and Vessel Category

SCC	Description	Emission Mode	Vessel Category
2280002100	Diesel Port	M	Category 1 & 2
2280002200	Diesel Underway	C	Category 1 & 2
2280003100	Residual Port	H or M	Category 3
2280003200	Residual Port	C or Z	Category 3

A description of how CMV emissions were determined for specific New Jersey counties follows below. This description is presented in two parts analogous with the different methodologies applied for those Northern New Jersey counties associated with the New York North New Jersey (NYNNJ) Harbor system and for those Southern New Jersey counties associated with the New Jersey Delaware River Basin. Only one county, Passaic County, was not associated with either the harbor system or the river basin. Therefore, New Jersey relied upon the USEPA 2008 NEI to determine CMV emissions for this county.

[6] U.S. Environmental Protection Agency. Documentation for the Commercial Marine Vessel Component of the National Emissions Inventory Methodology, Eastern Research Group report # 0245.02.302.001, USEPA Contract number EP-D-07-097. March 30, 2010.

5.2.1 New Jersey Portion of the NYNNJ Harbor System

The most significant New Jersey CMV operations occur in the NJ portion of the NYNNJ Harbor system. This encompasses the North Jersey counties of Bergen, Hudson, Essex, Union, Middlesex and Monmouth. CMV emissions for this harbor system were mainly developed from the information included in the CMV Emissions Inventory Report prepared by Starcrest Consulting Croup, LLC.[7] This inventory was prepared as a part of the New York Harbor Deepening Project. This report relied on actual operational data, to the extent such information was available, and then used local activity parameters to extend emission estimates to those portions not directly inventoried. Actual operational data was obtained from extensive interviews with vessel operators, crew, pilots, and the United States Coast Guard's vessel traffic system that tracks oceangoing commercial marine vessels from points of origin and destination. From these emission estimates were prepared based on estimated horsepower demand. The original inventory was conducted for the year 2000 and did not consider USEPA Tier 1 or MARPOL control measures for CMV. Therefore, NJDEP needed to grow the emissions to 2007 and then apply USEPA Tier 1/MARPOL control factors to the grown emissions.

New York New Jersey Port Authority (NYNJPA) Trade Statistics were used to grow the Northern NJ Starcrest emissions from 2000 to 2007. These trade statistics provide the total bulk and general cargo tonnage and the number of motor vehicles and twenty foot equivalent containers (TEUs) delivered to or from Northern Jersey ports from 2000 to 2007. New Jersey divided the amount of cargo, TEUs and cars delivered in 2007 over those delivered in 2000 to obtain growth factors to be applied to each type of category 3 vessel emissions associated with their delivery to and from the port. This is a direct correspondence because the Starcrest report includes separate emissions for each major type of category 3 vessel that operates in the port. For example, the growth in containers delivered to and from the port in 2000 to 2007 relates directly to the growth in containerships and hence the growth in their emissions during this period. Similarly, the growth in bulk and general cargo and cars respectively relates to the growth in category 3 bulk carriers, RoRo vessels and car carriers emissions. In concern for category 3 tankers, the growth rate was based on the increase in petroleum products delivered to New Jersey from 2000 and 2007 as determined by the Energy Information Administration (EIA), United States Department of Energy.

The Starcrest report also specifically relates emissions from harborcraft such as assist tug boats to the specific type of OGV that they assist in their harbor maneuvering and docking so that the same OGV growth factors may be applied to them. In concern for towboats, which represent the other major contributor of harborcraft emissions that operates in the New York and North New Jersey harbor, New Jersey assumed that their growth would relate to the increase in bulk and general cargo from 2000 to 2007. This is because towboats pull or push barges that transport bulk and general cargo.

5.2.2 New Jersey Portion of the Delaware River Basin

In concern for the Southern New Jersey counties associated with CMV operations in the Delaware River Basin, New Jersey relied on the above referenced USEPA NEI and the state of Pennsylvania. New Jersey used the USEPA NEI to develop all of its category 3 CMV underway and port emissions and the category 1 and 2 CMV port emissions for Mercer, Burlington, Camden and Gloucester counties. New Jersey used the Pennsylvania category 1 and 2

[7] Starcrest Consulting Group, LLC, 2003, "The New York, Northern New Jersey, Long Island Nonattainment Area Commercial Marine Vessel Emissions Inventory"

underway inventory to develop its own inventory for category 1 and 2 harborcraft underway emissions for these same counties.

New Jersey assumed that CMV emissions generated in the New Jersey counties on the eastern bank of the Delaware River Basin except for individual port operations are equivalent to those generated in corresponding Pennsylvania counties located on the western bank. A similar allocation process had been agreed to by New Jersey and Pennsylvania as part of the 1990 emission inventory submittal. New Jersey did not use the Pennsylvania inventory for category 3 CMV emissions because Pennsylvania had also relied on the USEPA 2008 NEI to determine emissions for this category in the Delaware River Basin.

New Jersey obtained 2008 data from Pennsylvania and the USEPA NEI data was for 2008. No changes were made to the 2008 data for 2007 (i.e., the 2007 emissions were assumed to be equal to 2008). Also, New Jersey has no significant lightering operations.

5.2.3 CMV Growth Factors

New Jersey grew its entire 2007 CMV inventory from 2007 to 2025 based on methodologies developed by the USEPA. The methodologies used to develop the 2025 emission projection (for both a baseline and controlled scenario) are documented in three regulatory impact assessments (RIA). The USEPA's May 2008 RIA (EPA2008a) was used to develop the 2025 projection year inventory for category 1 and 2 vessels (diesel). While the USEPA's December 2009 RIA (EPA2009a) and April 2009 proposal (EPA2009b) was used to develop the 2025 projection year inventory for category 3 vessels (residual).[8,9]

5.2.4 CMV Diesel Growth Factors

For Category 1 and 2 diesel vessels, EPA2008a used projection data for domestic shipping from the EIA 2006. The annual growth rate is 0.9 percent. This growth rate applies to approximately 78 percent of all Category 1 and 2 diesel vessels. This percentage considers all the diesel vessels except for assist tugs. In concern for assist tugboats, New Jersey assumed that the assist tug growth rate would be equivalent with the growth rate of the category 3 residual fueled vessels that they assist in maneuvering and docking procedures. Thus the annualized growth factor of 4.5 percent used for category 3 residual fueled vessels (See Section 5.2.5 below) was considered in the final determination of an overall annualized growth factor of 1.684 percent used for CMV diesel port emissions (SCC 22-80-002-100) and CMV diesel underway emissions (SCC 22-80-002-200).

5.2.5 CMV Diesel Control Factors

Once the growth rate was applied, then a control factor for each pollutant was calculated by dividing the emission factor for the future year (2025) controlled emissions by the baseline (2007) controlled emission factor included in the controlled cmv diesel inventory developed for the EIA 2008. In developing their emission projections, USEPA considered the following scenarios that accounted for both the 2004 Nonroad diesel rule and the 2008 diesel marine vessel rule:

1. The impact of existing tier 1 and 2 engine regulations that took effect in 2007,

---

[8] Regulatory Impact Analysis:Control of Emissions of Air Pollution from Category 3 Marine Diesel Engines. EPA420-R-09-019.

[9] Proposal to Designate an Emissions Control Area for Nitrogen Oxides, Sulfur Oxides, and Particulate Matter. EPA420-R-09-007.

2. The 2004 Clean Air Nonroad Diesel Rule that will decrease the allowable levels of sulfur in fuel beginning in 2007, and
3. Fleet turnover,
4. The reductions from USEPA's 2008 rule Final Locomotive-Marine rule for Tier 3 and 4 engines,
5. The 2008 final rule that includes the first-ever national emission standards for existing marine diesel engines, applying to engines larger than 600kW when they are remanufactured. The rule also sets Tier 3 emissions standards for newly-built engines that are phasing in from 2009. Finally, the rule establishes Tier 4 standards;
6. For newly-built commercial marine diesel engines above 600kW, phasing in beginning in 2014.

Exhibit 5.2.5 shows the control factors to be applied from 2007 to 2025 for the two CMV diesel fueled classifications and pollutants. These control factors are applied directly to the grown emissions. Thus the NO_x control factor of 0.415 would control NO_x emissions by 58.5 percent.

Exhibit 5.2.5
CMV Diesel Control Factors by SCC and Pollutant

SCC	NO_x	$PM_{2.5}$	SO_2
22-80-002-100, 200	0.415	0.428	0.080

5.2.6 CMV Residual Oil Growth Factors

For Category 3 residual oil vessels, data from EPA2009a was used to develop an annualized growth factor of 4.5 percent for the region. These growth factors were used for CMV residual oil port emissions (SCC 22-80-003-100) and CMV residual oil underway emissions (SCC 22-80-003-200).

5.2.7 CMV Residual Oil Control Factors

On December 22, 2009, USEPA announced final emission standards under the Clean Air Act for new marine diesel engines with per-cylinder displacement at or above 30 liters (called Category 3 marine diesel engines) installed on U.S.-flagged vessels. The final engine standards are equivalent to those adopted in the amendments to Annex VI to the International Convention for the Prevention of Pollution from Ships (a treaty called "MARPOL"). The emission standards apply in two stages: near-term standards for newly-built engines will apply beginning in 2011, and long-term standards requiring an 80 percent reduction in NO_x will begin in 2016. USEPA also adopted changes to the diesel fuel program to allow for the production and sale of diesel fuel with no more than 1,000 ppm sulfur for use in Category 3 marine vessels. The regulations generally forbid production and sale of fuels with more than 1,000 ppm sulfur for use in most U.S. waters, unless operators achieve equivalent emission reductions in other ways.

On March 26, 2010, the International Maritime Organization (IMO) officially designated waters off North American coasts as an emissions control area (ECA) in which stringent international emission standards will apply to ships. In practice, implementation of the ECA means that ships entering the designated area would need to use compliant fuel for the duration of their voyage that is within that area, including time in port and voyages whose routes pass through the area without calling on a port. The North American ECA includes waters adjacent the Atlantic extending up to 200 nautical miles from east coast of the US. The quality of fuel that complies with the ECA standard will change over time. From the effective date in 2012 until 2015, fuel used by vessels operating in designated areas cannot exceed 1.0 percent sulfur (10,000 ppm). Beginning in 2015, fuel used by vessels operating in these areas cannot exceed 0.1 percent sulfur (1000 ppm). Beginning in 2016, NO_x after treatment requirements become applicable.

To calculate a control factor that accounted for reductions included in the USEPA controlled inventory, it was necessary to first calculate a "growth only" scenario applying USEPA's 4.5 percent annual growth rate to the 2007 base emissions. Once the growth rate was applied, then a control factor for each pollutant was calculated by dividing the future year controlled emissions by the future year "growth only" emissions.

Exhibit 5.2.7 shows the control factors to apply to the residual CMV emissions grown from 2007 to 2025. These control factors are applied directly to the grown emissions. Thus the NO_x control factor of 0.446 would control NO_x emissions by 55.4 percent.

Exhibit 5.2.7
CMV Residual Oil Control Factors by SCC and Pollutant

SCC	NOx	$PM_{2.5}$	SO_2
SCC-80-003-100, 200	0.412	0.135	0.036

5.2.8 Commercial Marine Vessel Emission Inventory

Table 13 summarizes the 2025 CMV source emission inventory by county for $PM_{2.5}$, NO_x and SO_2. Appendix V, Attachment 7 contains the detailed nonroad source emission inventories. This attachment is only available electronically.

Table 13
2025 Commercial Marine Vessel Emission Inventory by County and Pollutant

County	$PM_{2.5}$* Tons per Year	NO_x Tons per Year	SO_2 Tons per Year
New Jersey Portion of Northern NJ-NY-CT NAA			
Bergen	6	147	5
Essex	4	274	27
Hudson	49	1,877	109
Mercer	0	0	0
Middlesex	10	301	16
Monmouth	18	723	56
Morris	0	0	0
Passaic	0	4	0
Somerset	0	0	0
Union	49	1,911	133
Total	**135**	**5,237**	**347**
New Jersey Portion of Southern NJ-Phila. NAA			
Burlington	0	11	3
Camden	20	732	45
Gloucester	14	510	63
Total	**35**	**1,253**	**111**

Specifics on the equations used for the calculation of these emissions, other assumptions and references for data can be found in CMV file included in Attachment 3.

5.2.9 CMV Control Measure Benefit Calculations

Control measure emission benefits by nonattainment area were calculated by difference between the last year of the maintenance period emissions (2025) without control technologies applied after the base year (2007) and the last year of the maintenance period emissions (2025) with control technologies applied throughout this entire period (2007 to 2025). Emission benefits accrue from exisitng tier 1 to 2 engine standards that take effect in 2008 and the long term effects of the May 2008 Final Locomotive-Marine rule for Tier 3 and 4 engines and the December 2009 rule on the new Tier standards for new category 3 diesel engines and the implementation of ECA. Emisson benefits are summarized in tables 14 by county for $PM_{2.5}$, NO_x and SO_2. Appendix V, Attachment 7 contains the detailed CMV emission benefits. This attachment is only available electronically.

Table 14
2025 CMV Emission Benefits by County, Nonattainment Area (NAA) and Pollutant

County	$PM_{2.5}$ Tons per Year	NO_x Tons per Year	SO_2 Tons per Year
New Jersey Portion of Northern NJ-NY-CT NAA			
Bergen	8	207	55
Essex	19	391	712
Hudson	147	2,661	2,447
Mercer	0	0	0
Middlesex	19	426	335
Monmouth	109	1,031	1,493
Morris	0	0	0
Passaic	0	5	1
Somerset	0	0	0
Union	120	2,710	3,122
Total	**421**	**7,431**	**8,165**
New Jersey Portion of Southern NJ-Phila. NAA			
Burlington	1	15	85
Camden	107	1,042	1,186
Gloucester	73	726	1,691
Total	**180**	**1,783**	**2,962**

5.3 Aircraft

Aircraft emissions in the 2025 inventory are available on either a county-by-county or airport-by-airport basis for six types of aircraft operations:

- Air carrier operations represent landings and take-offs (LTOs) of commercial aircraft with seating capacity of more than 60 seats (SCC 22-75-020-000);
- Commuter/air taxi operations are one category. Commuter operations include LTOs by aircraft with 60 or fewer seats that transport regional passengers on scheduled commercial flights. Air taxi operations include LTOs by aircraft with 60 or fewer seats

conducted on non-scheduled or for-hire flights (SCC 22-75-060-011 (Piston) or 012 (Turbine);

- General aviation represents all civil aviation LTOs not classified as commercial (SCC 22-75-050-011 (Piston) or 012 (Turbine):
- Military operations represent LTOs by military aircraft (SCC 22-75-001-000);
- Ground Support Equipment (GSE) typically includes aircraft refueling and baggage handling vehicles and equipment, aircraft towing vehicles, and passenger buses (SCC 22-65-008-005 (4-Stroke Gasoline), 22-67-008-005 (LPG), 22-68-008-005 (CNG), 22-70-008-005 (Diesel); and
- Auxiliary power units (APUs) provide power to start the main engines and run the heating, cooling, and ventilation systems prior to starting the main engines. (SCC 22-75-070-000).

5.3.1 Emission Dispersion Modeling of New Jersey Airports

New Jersey aircraft emissions were calculated based on the number of landing and take-off (LTO) cycles generated at each airport. Nine Airports which are Newark Liberty International, Teterboro, Atlantic City, Morris Municipal, Essex County, Mercer County, Naval Lakehurst Base, Monmouth Executive and Millville Municipal supplied New Jersey with LTO counts for each specific aircraft type (i.e., Boeing 707, Airbus 300) that operated at their airport in 2007. These LTO counts were applied to the Emissions and Dispersion Modeling System (EDMS), the Federal Aviation Agency (FAA) aircraft emissions modeling tool, to determine their emissions.

5.3.2 McGuire Air Force Base (McGuire)

McGuire Air Force Base (McGuire) supplied LTO and Touch and Go information for that facility for general conformity for the year 2005. This information was used for the year 2007 because there has not been any significant change to it. Information on time-in-mode, number of engines and emission factors for military aircraft was obtained from *Air Emission Inventory Guidance for Mobile Sources at Air Force Installations*, January 2002 and used to determine LTOs emissions at this facility.

5.3.3 Federal Aviation Agency (FAA) Airports

For all other remaining airports, total LTO numbers for the aircraft categories of commercial, military, air taxi and general aviation airports were obtained from the FAA. An average aircraft emission factor developed from the most common aircraft types for a given category was applied to the total aircraft category counts.

5.3.4 Aircraft Ground Support Equipment (GSE)

NJ provided GSE/Auxiliary Power Unit (APU) emissions for each of the seven major airports that submitted LTO fleet mix counts. The EDMS model determined these emissions by applying default GSE/APU equipment to those aircraft types that are known to use these units. Those emissions had GSE emissions as a single value without an indication of the fuel type of the equipment. In this case, the fuel type ratios used in the USEPA NEI were used to divide GSE emissions by their SCC designated fuel type. Those ratios are included in Exhibit 5.3.4 below:

Exhibit 5.4.4: GSE Fractional Apportionment

SCC	SCC Level Two	Fraction
2265008005	Off-highway Vehicle Gasoline, 4-Stroke	0.1686
2267008005	LPG	0.0165
2268008005	CNG	0.0131
2270008005	Off-highway Vehicle Diesel	0.8017

In concern for those smaller airports whose emissions were not determined by the EDMS, they were considered to not generate any GSE/APU emissions because generally only small Air Taxi, General Aviation and Military aircraft operate from these airports. Many of these aircraft do not use GSE/APU.

5.3.5 Airport Growth Factors

Aircraft operations were projected to future years by applying activity growth using data on itinerant (ITN) operations at every airport in New Jersey as reported in the Federal Aviation Administration's (FAA) Terminal Area Forecast (TAF) System for 2009-2030.[10] The ITN operations are defined as aircraft take-offs or landings. This information is available for approximately 3300 individual airports. Actual LTOs are reported for 2007 and projected LTOs are provided for all years up to 2030.

The data was aggregated and applied at the county level for the four operation types: commercial, general, air taxi and military. A growth factor was computed for each operation type by dividing future-year ITN by 2007-year ITN. Inventory SCCs were assigned factors based on the operation type, as shown in Exhibit 5.3.5.1.

Exhibit 5.3.5.1: Crosswalk between SCC and FAA Operations Type

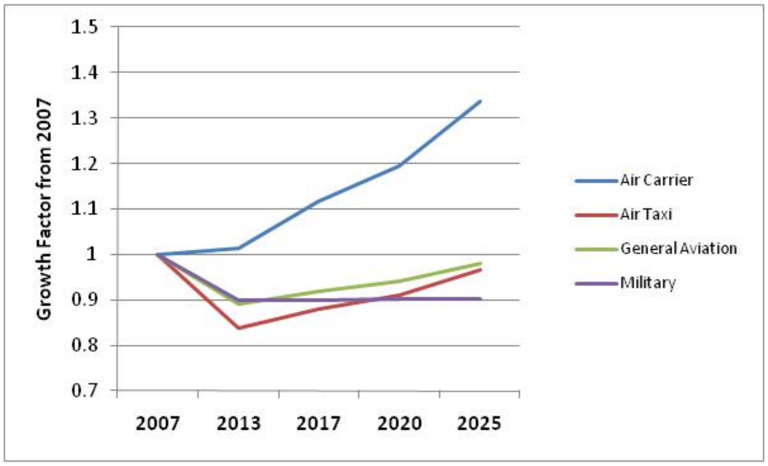
SCC	SCC Description	FAA Operation Type Used for Growth Factor
2265008005	Airport Ground Support Equipment, 4-Stroke Gas	Total Itinerant Operations
2267008005	Airport Ground Support Equipment, LPG	Total Itinerant Operations
2268008005	Airport Ground Support Equipment, CNG	Total Itinerant Operations
2270008000	Airport Ground Support Equipment, Diesel	Total Itinerant Operations
2270008005	Airport Ground Support Equipment, Diesel	Total Itinerant Operations
2275001000	Aircraft /Military Aircraft /Total	Itinerant Military Operations
2275020000	Aircraft /Commercial Aircraft /Total: All Types	Itinerant Air Carrier Operations
2275050000	Aircraft /General Aviation /Total	Itinerant General Aviation Operations
2275050011	Aircraft /General Aviation /Piston	Itinerant General Aviation Operations
2275050012	Aircraft /General Aviation /Turbine	Itinerant General Aviation Operations
2275060000	Aircraft /Air Taxi /Total	Itinerant Air Taxi Operations
2275060011	Aircraft /Air Taxi /Piston	Itinerant Air Taxi Operations

[10] Federal Aviation Administration, Terminal Area Forecast 2009-2030 Database File

SCC	SCC Description	FAA Operation Type Used for Growth Factor
2275060012	Aircraft /Air Taxi /Turbine	Itinerant Air Taxi Operations
2275070000	Aircraft /Aircraft Auxiliary Power Units /Total	Total Itinerant Operations

Exhibit 5.3.5.2 summarizes the region-wide growth factors by FAA operation type. The growth factor for individual airports/counties may deviate substantially from these region- wide growth factors.

Exhibit 5.3.5.2: Region-wide Growth Factors from 2007 by FAA Operations Type



5.3.6 Aircraft Control Factors

The NO_x aircraft engine emissions standards adopted by USEPA in November 2005 were reviewed.[11] The standards are equivalent to the NO_x emission standards (adopted in 1999 for implementation beginning in 2004) of the United Nations International Civil Aviation Organization (ICAO), and will bring the US aircraft standards into alignment with the international standards. The standards apply to new aircraft engines used on commercial aircraft including small regional jets, single-aisle and twin-aisle aircraft, and 747s and larger aircraft. The standards also apply to general aviation and military aircraft, which sometimes use commercial engines. For example, small regional jet engines are used in executive general aviation aircraft, and larger commercial aircraft engines may be used in military transport aircraft.

Nearly all previously certified or in-production engine models currently meet or perform better than the standards USEPA adopted in the November 2005 rule. In addition, manufacturers have already been developing improved technology in response to the ICAO standards. According to USEPA's recent analysis for the proposed transport rule, this rule is expected to reduce NO_x emissions by approximately 2 percent in 2015 and 3 percent in 2020.[12] Because of the relatively small amount of NO_x reductions, our aircraft emission projections do not account for this control program.

[11] U.S. Environmental Protection Agency. Control of Air Pollution from Aircraft and Aircraft Engines, Emission Standards and Test Procedures:Final Rule. November 17, 2005.
[12] U.S. Environmental Protection Agency. Transport Rule Emission Inventories Notice of Data Availability (NODA). Docket ID No. EPA-HQ-QAR-2009-0491. October 27, 2010.

USEPA has also issued an Advance Notice of Proposed Rulemaking (ANPR) on lead emissions from piston-engine aircraft using leaded aviation gasoline.[13] However, this rule has not yet been adopted and co-benefits for criteria air pollutants are likely to be small. Therefore, the effects of this rule were not included in the future-year emissions projections.

5.3.7 Aircraft Emission Inventory

Table 15 summarizes the 2025 aircraft source emission inventory by county for $PM_{2.5}$, NO_x and SO_2. Appendix V, Attachment 7 contains the detailed nonroad source emission inventories. This attachment is only available electronically.

Table 15
2025 Aircraft Emission Inventory by County and Pollutant

County	$PM_{2.5}$* Tons per Year	NO_x Tons per Year	SO_2 Tons per Year
New Jersey Portion of Northern NJ-NY-CT NAA			
Bergen	9	192	32
Essex	76	4,099	435
Hudson	0	0	0
Mercer	1	21	4
Middlesex	0	3	1
Monmouth	1	8	2
Morris	3	70	14
Passaic	0	2	0
Somerset	0	10	2
Union	0	5	1
Total	**90**	**4,410**	**491**
New Jersey Portion of Southern NJ-Phila.NAA			
Burlington	52	540	20
Camden	0	1	0
Gloucester	0	5	1
Total	**52**	**546**	**21**

Specifics on the equations used for the calculation of these emissions, other assumptions and references for data can be found in the Aircraft file included in Attachment 3.

5.3.8 Aircraft Control Measure Benefit Calculations

Aircraft emission benefits were considered to be zero because of the relatively small amount of NO_x emission reductions that occur in 2025 as explained in Section 5.3.6 above.

5.4 Railroad Diesel Locomotives

Railroad diesel locomotive engines are classified into the following categories:

[13] U.S> Environmental Protection Agency. Advance Notice of Proposed Rulemaking on Lead Emissions from Piston-Engine Aircraft Using Leaded Aviation gasoline. April 2010.

- Class I line haul locomotives are operated by large freight railroad companies and are used to power freight train operations over long distances (SCC 22-85-002-006);
- Class II/III line haul locomotives are operated by smaller freight railroad companies and are used to power freight train operations over long distances (SCC 22-85-002-007);
- Inter-city passenger train locomotives are operated primarily by Amtrak to provide inter-city passenger transport (SCC 22-85-002-008);
- Independent commuter rail systems operate locomotives provide passenger transport within a metropolitan area (SCC 22-85-002-009); and
- Yard/switch locomotives are used in freight yards to assemble and disassemble trains, for short hauls of trains that are made up of only a few cars (SCC 22-85-002-010).

5.4.1 Class II/III Line Haul, Yard, Commuter and Passenger Diesel Locomotives

USEPA has developed fuel usage based emission factors for each of the above referenced locomotive engine categories. New Jersey developed its emission inventory for these categories by applying these emission factors to specific 2007 fuel usage data received from Class II/III line haul and independent commuter rail systems and yard/switch freight and commuter rail yards. An estimation of fuel consumption based on gross tons miles (tons of freight and number of cars multiplied by the miles traveled) and a fuel consumption index (gross ton miles per gallon of fuel) was prepared for those railroads that did not submit statewide fuel data.

In concern for passenger locomotive emissions (AMTRAK), there were no emissions. This is because AMTRAK only used electric powered locomotives on the Northeast corridor line in New Jersey. These electric engines do not generate any emissions.

5.4.2 Class I Line Haul Diesel Locomotives

In concern for the Class 1 line haul locomotives, New Jersey elected to use the ERTAC 2008 inventory that was made available to the MARAMA states. The ERTAC rail inventory included both the State and the County level Class 1 line haul emissions in NIF format. This inventory was developed from national locomotive fuel consumption data and additional confidential information provided by the two major Class 1 line-haul railroads that operate in New Jersey (Norfolk Southern and CSX). All 2008 emissions were assumed to equal 2007 emissions.

5.4.3 Railroad Diesel Locomotives Hydrocarbon Emissions

Both Class I and Class II/III emissions were reported as hydrocarbons (HC). These emissions were converted to VOC emissions by multiplying the HC emissions by a factor of 1.053.[14]

5.4.4 Railroad Diesel Locomotives Growth Factors

In March 2008, USEPA finalized a three part diesel locomotive rule that will dramatically reduce emissions from diesel locomotives of all types -- line-haul, switch, and passenger rail. As part of this work, USEPA performed a Regulatory Impact Analysis (RIA) in May 2008 (EPA2008a), to

[14] U.S. Environmental Protection Agency. Emission Factors for Locomotives; EPA-420F09025, 2009.

document the projection methodologies it utilized to develop the baseline (pre-control) and controlled diesel locomotive emissions included in the national emissions inventory for calendar years 2002 through 2040.[15] These projection methodologies used 2006 Annual Energy Outlook energy use projection data from the U.S. Department of Energy, Energy Information Administration (EIA2006).[16] This data showed that freight rail energy use will grow 1.6 percent annually. New Jersey used this growth rate for all diesel locomotive operations.

5.4.5 Railroad Diesel Locomotives Control Factors

To calculate control factors that accounted for reductions included in the USEPA controlled inventory, it was necessary to first calculate a "growth only" scenario applying USEPA's 1.6 percent annual growth rate to the 2007 baseline emissions without application of any diesel locomotive controls. The controlled inventory developed also used the EIA2206 1.6 percent annual growth in fuel use in addition to the consideration of the following control measures:

1. The impact of existing regulations for Tier 0, 1, and 2 locomotive engines that take effect in 2008,
2. The 2004 Clean Air Nonroad Diesel Rule that will decrease allowable levels of sulfur in locomotives fuel beginning in 2007,
3. Fleet turnover.
4. Reductions from USEPA's 2008 Final Locomotive-Marine rule for Tier 3 and 4 engines. This rule lowered diesel sulfur content and tightened emission standards for existing and new locomotives.
5. Voluntary retrofits under the National Clean Diesel Campaign are not included in these projections.

Once the growth rate was applied, then a control factor for each pollutant was calculated by dividing the future year controlled emissions by the future year "growth only" emissions. Exhibit 5.4.5 shows the control factors to be applied from 2007 to 2025 for the four locomotive classifications and pollutants. These growth factors are applied directly to the grown emissions. Thus the NO_x control factor of 0.412 would control emissions by 58.8 percent.

Exhibit 5.4.5
Railroad Diesel Locomotive Control Factors by Pollutant, and SCC

SCC	NO_x	$PM_{2.5}$	SO_2
SCC 22-85-002-006 Line Haul Class 1 Operations	0.412	0.252	0.003
SCC 22-85-002-007 Line Haul Class II / III Operations	0.852	0.688	0.003
SCC 22-85-002-009 Commuter Rail	0.241	0.180	0.003
SCC 22-85-002-010 Yard / Switch	0.634	0.534	0.003

[15] U.S. Environmental Protection Agency. Regulatory Impact Analysis: Control or Emissions of Air Pollution from Locomotive Engines and Marine Compression Engines Less than 30 Liters Per Cylinder. EPA420-R-08-001a. May 2008.
[16] U.S. Department of Energy, Energy Information Administration, Table A-7, Annual Energy Outlook with Projections to 2030 document, DOE/EIA-0383. February 2006.

5.4.6 Railroad Diesel Locomotive Emission Inventory

Table 11 summarizes the 2025 diesel railroad source emission inventory by county for $PM_{2.5}$, NO_x and SO_2. Appendix V, Attachment 7 contains the detailed nonroad source emission inventories. This attachment is only available electronically.

Table 11
Railroad Diesel Locomotive Emissions by County, Nonattainment Area (NAA) and Pollutant

County	$PM_{2.5}$ Tons per Year	NO_x Tons per Year	SO_2 Tons per Year
New Jersey Portion of Northern NJ-NY-CT NAA			
Bergen	8	438	0
Essex	6	316	0
Hudson	6	331	0
Mercer	1	61	0
Middlesex	7	355	0
Monmouth	3	165	0
Morris	2	136	0
Passaic	2	103	0
Somerset	3	176	0
Union	3	186	0
Total	**41**	**2,267**	**0**
New Jersey Portion of Southern NJ-Phila. NAA			
Burlington	0	16	0
Camden	4	214	0
Gloucester	1	55	0
Total	**5**	**284**	**0**

Specifics on the equations used for the calculation of these emissions, other assumptions and references for data can be found in the Railroad file included in Attachment 3.

5.4.7: Railroad Diesel Locomotives Control Measure Benefit Calculations

Control measure benefits by nonattainment area were calculated by difference between the last year of the maintenance period emissions without control technologies applied after the base year (2007) and the last year of the maintenance period emissions (2025) with control technologies applied throughout this entire period (2007 to 2025). Emission benefits accrue from exisitng tier 0 to 2 engine standards that take effect in 2008 and the long term effects of the May 2008 Final Locomotive-Marine rule for Tier 3 and 4 engines. Emisson benefits are summarized by county for $PM_{2.5}$, NO_x and SO_2. Appendix V, Attachment 7 contains the detailed Railroad emission benefits. This attachment is only available electronically.

Table 12
2025 Railroad Emission Benefits
by County, Non Attainment Area (NAA) and Pollutant

County	$PM_{2.5}$ Tons per Year	NO_x Tons per Year	SO_2 Tons per Year
New Jersey Portion of Northern NJ-NY-CT NAA			
Bergen	28	1,019	11
Essex	9	285	7
Hudson	16	542	8
Mercer	4	112	2
Middlesex	12	362	8
Monmouth	13	517	5
Morris	7	291	3
Passaic	7	277	3
Somerset	12	367	5
Union	12	418	5
Total	**118**	**4,190**	**56**
New Jersey Portion of Southern NJ-Phila. NAA			
Burlington	0	4	0
Camden	6	204	4
Gloucester	1	13	1
Total	**6**	**221**	**5**

5.5 Total Non-road Emission Inventory

Table 16 summarizes NONROAD model equipment, CMV, Aircraft and Locomotive sources 2025 annual emission inventory by county for $PM_{2.5}$, NO_x and SO_2. Appendix V, Attachment 7 contains the detailed nonroad source emission inventories. This attachment is only available electronically.

Table 16
Total 2025 Non-road Source Emission Inventory by County and Pollutant

County	$PM_{2.5}$ Tons per Year	NO_x Tons per Year	SO_2 Tons per Year
New Jersey Portion of Northern NJ-NY-CT NAA			
Bergen	236	2,538	46
Essex	170	5,566	466
Hudson	110	2,979	112
Mercer	80	729	7
Middlesex	179	2,068	24
Monmouth	167	2,223	64
Morris	143	1,192	20
Passaic	72	768	4
Somerset	112	853	6
Union	141	2,795	138
Total	**1,410**	**21,711**	**887**
New Jersey Portion of Southern NJ-Phila. NAA			
Burlington	145	1,338	27
Camden	93	1,539	48
Gloucester	77	1,037	66
Total	**315**	**3,915**	**141**

5.6 Total Non-road Control Measure Benefit Calculations

Control Measure emission benefits by nonattainment area were calculated by difference between the last year of the maintenance period emissions (2025) without control technologies applied after the base year (2007) and the last year of the maintenance period emissions (2025) with control technologies applied throughout this entire period (2007 to 2025). Table summarizes NONROAD model equipment, CMV, Aircraft and Locomotive sources 2025 annual emission benefits by county for $PM_{2.5}$, NO_x and SO_2. Appendix V, Attachment 7 contains the detailed nonroad source emission inventories. This attachment is only available electronically.

Table 17
Total 2025 Non-road Source Control Measure Benefits
by County, Nonattainment Area (NAA) and Pollutant

County	$PM_{2.5}$ Tons per Year	NO_x Tons per Year	SO_2 Tons per Year
New Jersey Portion of Northern NJ-NY-CT NAA			
Bergen	206	3,123	315
Essex	138	1,741	876
Hudson	274	4,226	2,614
Mercer	101	1,049	139
Middlesex	204	2,561	594
Monmouth	261	2,994	1,715
Morris	107	1,364	145
Passaic	79	1,004	104
Somerset	84	1,161	110
Union	201	3,877	3,225
Total	**1,655**	**23,129**	**9,836**
New Jersey Portion of Southern NJ-Phila. NAA			
Burlington	94	908	213
Camden	179	1,927	1,284
Gloucester	125	1,255	1,765
Total	**398**	**4,090**	**3,261**