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MEMORANDUM

SUBJECT: Development of Nonroad, Stationary, and Area Source Emissions for Tier 2/Sulfur NPRM

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TO: Docket A-97-10

This report describes methods and assumptions used to generate emissions inventories for nonroad, stationary, and area sources for the Tier 2/Sulfur NPRM. For that NPRM, we developed national emissions inventories for all sources nationwide, excluding California, Alaska, and Hawaii, which we refer to as the 47-state inventory. In addition, we also developed inventories for four urban nonattainment areas: Atlanta, Charlotte, Chicago, and New York.

Almost all of the benefits of the proposed Tier 2/Sulfur program occur in the on-highway gasoline vehicle categories. The nonroad, stationary, and area source inventories were primarily created to provide context to the emissions benefits associated with the Tier 2/Sulfur program.

Nonroad emissions inventories

The nonroad equipment category includes a wide range of mobile diesel, gasoline, CNG, and LPG fueled equipment used for agricultural, construction, and other industrial and commercial purposes, as well as lawn and garden equipment and both terrestrial and marine recreational equipment. It also includes locomotives, aircraft, and commercial marine vessels. Developing emissions inventories for this large and diverse group of sources has always been a difficult process. Since 1992, most emissions inventories for nonroad equipment have been based on information developed as part of EPA's Nonroad Engine and Vehicle Emissions Study (NEVES). NEVES was the first comprehensive, nationwide analysis of the emissions contributions of nonroad sources and, as such, it contributed to a major improvement in the quality of nonroad emissions inventories.

However, by the mid-1990's, it became clear that NEVES was soon becoming outdated. Impending nonroad emissions standards were not reflected in NEVES. In the course of developing these new standards, equipment population and usage information was being updated and new information was being developed from test data on emissions factors. To respond to these changes and to give more flexibility to the emissions inventory development process, EPA

began development of a nonroad emissions model. In early 1998, we began the release for comment of a series of technical reports describing methods and assumptions to be used in the model. In June 1998, we held a public workshop in Chicago to coincide with the release of a draft version of NONROAD, EPA's nonroad emissions model.

Based on comments received on the NONROAD technical reports on the NONROAD model, we made several revisions to the model in the late summer and fall of 1998. We are still evaluating other comments and continuing to improve NONROAD. We currently plan to release a revised draft version of NONROAD in early summer of 1999, and a final version by the end of 1999.

Although NONROAD exists only in draft form, we concluded that new information and improvements in methodology incorporated in the model were so significant that it did not make sense to use NEVES as the basis for nonroad inventories for this Tier 2/Sulfur NPRM. As we continue to modify NONROAD in response to comments, nonroad emissions inventories may change. However, we believe these changes will be less significant than the improvements already made in the inventory as a result of moving beyond the NEVES method.

Data and assumptions used to create NONROAD are documented in a series of Technical Reports. More recent revisions to the model are documented in a Technical Report Addendum.¹ The remainder of this section describes the input settings used to run NONROAD for this analysis.

47-State Analysis

NONROAD contains equipment population files for each state, as well as a national (50-state) population file. For this analysis, we created a new 47-state population file that consisted of the sums of equipment populations in all states except California, Alaska, and Hawaii.

The 47-state analysis used NONROAD estimates of annual emissions (tons per year). Table 1 shows the scenario specific parameters that were used for these NONROAD runs. We assumed that gasoline sulfur limits set under the Tier 2/Sulfur program would apply to gasoline used by nonroad equipment. This results in reductions in the SO_x inventory estimates for nonroad equipment, but has no effect on the NO_x or VOC inventory estimates as long as these engines are not equipped with catalysts.

Table 1. Input parameters used in NONROAD runs.

Parameter	Base Case	Tier 2/Sulfur Case
Fuel RVP (psi)	9.0	9.0
Fuel Oxygen Weight %	0.0	0.0
Gasoline Sulfur %	0.034	0.003
Diesel Sulfur %	0.33	0.33
LPG/CNG Sulfur %	0.003	0.003

Minimum Temperature (F)	60	60
Maximum Temperature (F)	84	84
Average Temperature (F)	75	75
Altitude	Low	Low

Urban Nonattainment Area Analysis

We estimated inventories for nonroad equipment in four urban nonattainment areas (Atlanta, Charlotte, Chicago, and New York) using NONROAD. The counties included in these nonattainment areas are given in Table 2.

Table 2. Urban nonattainment area counties

State	County
Atlanta Nonattainment Area	
Georgia	Barrow
Georgia	Bartow
Georgia	Carroll
Georgia	Cherokee
Georgia	Clayton
Georgia	Cobb
Georgia	Coweta
Georgia	DeKalb
Georgia	Douglas
Georgia	Fayette
Georgia	Forsyth
Georgia	Fulton
Georgia	Gwinnett
Georgia	Henry
Georgia	Newton
Georgia	Paulding
Georgia	Pickens
Georgia	Rockdale

Georgia	Spalding
Georgia	Walton
Charlotte Nonattainment Area	
North Carolina	Cabarrus
North Carolina	Gaston
North Carolina	Lincoln
North Carolina	Mecklenburg
North Carolina	Rowan
North Carolina	Union
South Carolina	York
Chicago Nonattainment Area	
Illinois	Cook
Illinois	DeKalb
Illinois	Grundy
Illinois	Kane
Illinois	Kankakee
Illinois	Kendall
Illinois	Lake
Illinois	McHenry
Illinois	Will
Indiana	Lake
Indiana	Porter
Wisconsin	Kenosha
New York Nonattainment Area	
New Jersey	Bergen
New Jersey	Essex
New Jersey	Hudson
New Jersey	Hunterdon
New Jersey	Mercer
New Jersey	Middlesex

New Jersey	Monmouth
New Jersey	Morris
New Jersey	Ocean
New Jersey	Passaic
New Jersey	Somerset
New Jersey	Sussex
New Jersey	Union
New Jersey	Warren
New York	Bronx
New York	Dutchess
New York	Kings
New York	Nassau
New York	New York
New York	Orange
New York	Putnam
New York	Queens
New York	Richmond
New York	Rockland
New York	Suffolk
New York	Westchester
Pennsylvania	Pike

Urban nonattainment area emissions were estimated for the summer ozone season rather than the entire year. The ozone season is typically assumed to be the five months from May through September. NONROAD is capable of directly estimating total emissions for a 3-month summer season, or estimating the emissions in each month specified. Running NONROAD for each county listed above for each of five months would be a very time consuming process. To simplify this analysis, we ran NONROAD for the three month summer season and then multiplied the result by 5/3 to estimate the total emissions over the five month summer ozone season.

Fuel sulfur levels for baseline and Tier 2/Sulfur control cases were identical to those used in the 47-state case. We assumed the same temperatures for all four urban areas: minimum temperature = 72, maximum temperature = 96, average temperature = 84. For Atlanta and Charlotte, we assumed an RVP of 7.8 psi; for Chicago and New York, we assumed an RVP of 6.7 psi based on the presence of Phase II reformulated gasoline in these areas.

Locomotives, Aircraft, and Commercial Marine Vessels

Emissions from aircraft, locomotives and commercial marine vessels posed special problems when creating these inventories. NONROAD does not yet include these categories. At the same time, the method used in the National Emissions Trends (NET) Report is not completely up to date with respect to projected growth rates and the implementation of future emissions standards. Therefore, we had to develop new methods for estimating these inventories.

Aircraft Emissions

For aircraft emissions, we started with the 2005 and 2010 aircraft emissions inventories in Trends. Because the Trends national inventory is developed by summing emissions in every county, we were able to subtract out the aircraft emissions from California, Alaska, and Hawaii to develop a 47 state aircraft emissions inventory.

For aircraft emissions beyond 2010, we applied commercial and general aviation growth rates from FAA long-range aviation forecasts.² These FAA forecasts only extend to 2020. We assumed that the simple annual growth rate that FAA used for the period from 2015 to 2020 would continue through 2030. Because FAA assumes that military aviation activity will stay constant beyond 2010, we did not apply any growth to the military aviation estimates.

Locomotive Emissions

In April 1997, EPA proposed new emissions standards for locomotives. These standards were not accounted for in the December 1997 NET Report because the standards did not become final until 1998. In order to include the effects of these new standards in the locomotive inventories, we needed to use the 50-state locomotive emissions inventory that was developed to support the new locomotive standards.³ However, we first needed to convert that inventory into a 47-state inventory. Unlike the NET inventory, which is developed by summing emissions in every county, the inventory used to support the development of the locomotive regulations was based on national estimates of activity, so we could not simply exclude locomotive emissions in California, Alaska, and Hawaii to get a 47 state inventory.

To resolve this problem, we made the assumption that the distribution of emissions among the states after the new standards go into effect would be identical to the distribution of emissions without the standards. In other words, if the 47 states account for 95% of national locomotive emissions before the new standards go into effect, they would also account for 95% of the emissions after the new standards go into effect. Based on this assumption, we calculated the ratio of the NET 47-state inventory (without standards) to the NET 50-state inventory (without standards). We then multiplied this ratio by the 50-state emissions inventory with standards. The result was an estimate of the 47-state inventory accounting for new standards.

Commercial Marine Emissions

On December 11, 1998, EPA proposed new emissions standards for all commercial compression-ignition marine engines at or above 37 Kw. The final rule is under a court-ordered deadline to be signed by November 23, 1999. For this analysis, we derived projections of the national commercial marine inventory with new standards in place from the Draft Regulatory Impact Analysis for the proposed rule⁴. We needed to convert this national inventory into a 47-state inventory. As for locomotives and aircraft, we assumed that the geographical distribution of emissions would be the same with or without the new regulations. Based on this assumption, we took the ratio of the NET 47-state inventory to the NET 50-state inventory and multiplied that by the projections of national (50-state) commercial marine emissions with proposed standards in place.

Urban Nonattainment Area Inventories for Aircraft, Locomotives, and Commercial Marine

Estimates of aircraft, locomotive, and commercial marine emissions in the Atlanta, Charlotte, Chicago, and New York nonattainment areas are incorporated in the NET projections. As in the case of the 50-state projections, the NET projections for these urban nonattainment areas do not reflect the latest assumptions about the effects of new standards. Emissions estimates that do include these standards do not include the detail needed to derive county-level inventories.

To resolve this problem, we made the assumption that the distribution of emissions in the four urban nonattainment areas would remain the same without or without new standards. In other words, if a particular urban area had 1% of the national total for locomotive emissions without new standards, it would likely have 1% of the national total with new standards. Based on this assumption, we calculated the ratios of the NET urban inventories for each of the four nonattainment areas (without standards) to the NET 47-state inventory (without standards). We then multiplied these ratios by the 50-state emissions inventory with standards. The result was an estimate of the aircraft, locomotive, and commercial marine inventories in each of the four nonattainment areas accounting for new standards.

Stationary and Area Sources

Stationary and area source inventories were developed by E.H. Pechan and Associates and the following description of methods is derived from materials supplied by them. For the 47-state analysis, different methods were used for each of three major types of sources: electric generating units (EGUs), non-EGU point sources, and area sources. In some cases, within each of these source categories, methods also differed among three geographical areas: the 22 states (and District of Columbia) covered by the Regional Ozone Transport Rule (ROTR), the remaining 15 states that participated in the Ozone Transport Assessment Group, and the rest of the country excluding California, Alaska, and Hawaii.

Electric Generating Units

The method for calculating emissions inventories for EGUs was the same for all three geographical areas. Projections of NO_x and SO_x were taken from the 2007 unit-level Integrated Planning Model (IPM) file that was used as the basis for the final ROTR budget. Emissions

of VOC and PM were calculated from the IPM heat input and AP-42 emission factors, taking into account any PM controls already in place. Emissions for all succeeding projection years were assumed to remain constant at 2007 levels. This assumption is based on IPM analysis of projected changes in fuel used for electricity generation. The same projection methods were also used for the urban nonattainment area analysis.

Non-Electric generating Unit Point Sources

The method for calculating emissions from non-EGU point sources varied for different parts of the country. In the 23 ROTR jurisdictions, NO_x and VOC emissions were taken from the post-ROTR 2007 emission projections developed for the ROTR. SO_x and PM projections were taken from the 2007 NET projections. Emissions from all large sources (as defined by the ROTR) were assumed to remain constant at 2007 levels in all succeeding projection years. Small sources were grown using BEA Gross State Product (GSP) projections, assuming no change in control requirements. This method was also used for the urban nonattainment area analysis.

The method used in the remaining OTAG states was identical except that all sources were grown using BEA GSP projections, assuming no change in control requirements. In the rest of the country, emissions for all pollutants were taken from 2005 and 2010 NET projections. For future years, emissions for all sources were grown using BEA GSP projections, with no change in control requirements.

Area Sources

For area sources, identical methods were used for the 23 ROTR jurisdictions and the remaining OTAG states. NO_x and VOC emissions for 2007 were taken from the 2007 SIP Call budget projections. Emissions for SO_x and PM were taken from NET projections. Emissions for succeeding projection years were grown using BEA GSP projections, with no change in control requirements. Emissions for fugitive dust sources were taken from the Section 812 Prospective Study projections, since these represent improved projection methods compared with the NET. Fugitive dust emissions in succeeding years were grown using the same activity indicators applied in the Section 812 study. This method was also used for the urban nonattainment area analysis.

In the rest of the country, all emission projections (except fugitive dust) were based on NET projections, grown using BEA GSP projections. Emissions for fugitive dust were calculated using the same method as in the OTAG states.

1. Harvey, Craig, "U.S. EPA NONROAD Model: Technical Report Addenda for Tier 2 Rulemaking Version", March 1999.
2. FAA Long-Range Aviation Forecasts Fiscal Years 2010, 2015, and 2020; Office of Aviation Policy and Plans, FAA-APO-98-9, June 1998.
3. "Locomotive Emission Standards - Regulatory Support Document", U.S. EPA, Office of Mobile Sources, April 1997

4. "Draft Regulatory Impact Analysis: Control of Emissions from Compression-Ignition Marine Engines", U.S. EPA, Office of Mobile Sources, November 1998.