Appendix E
2008 Base Year Emissions Inventory for the Missouri Portion of the 1997 St. Louis $PM_{2.5}$ Nonattainment Area

Missouri Department of Natural Resources
Division of Environmental Quality
Air Pollution Control Program
Jefferson City, Missouri

Adoption
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Table of Contents

TABLE OF CONTENTS 2

LIST OF APPENDICES 4

LIST OF TABLES 4

1.0 INTRODUCTION 5

1.1 PURPOSE 5
1.2 INVENTORY COVERAGE 5
1.2.1 GEOGRAPHY 5
1.2.2 EMISSION YEAR 5
1.2.3 POLLUTANTS 5
1.3 CONTENTS OF REPORT 6
1.4 AUTOMATED SYSTEMS USED 6
1.5 INVENTORY EXCLUSIONS 6
1.6 GUIDANCE AND REFERENCE DOCUMENTS 6
1.7 LIST OF CONTACTS 7

2.0 EMISSIONS SUMMARY 8

2.1 SUMMARY BY COUNTY AND CATEGORY 8

3.0 INVENTORY DOCUMENTATION 9

3.1 POINT SOURCE EMISSIONS 9
3.1.1 PROCEDURES AND METHODOLOGIES 9
3.1.2 EMISSION INVENTORY QUESTIONNAIRE (EIQ) 9
3.1.3 LIST OF FACILITIES AND EMISSIONS 13
3.1.4 POINT SOURCE EMISSION SUMMARY 20
3.2 NONPOINT SOURCE EMISSIONS 24
3.2.1 PROCEDURES AND METHODOLOGIES 24
3.2.2 LIST OF SOURCE CATEGORIES AND EMISSIONS 24
* NOTE: THIS TABLE DOES NOT INCLUDE VOC REFUELING EMISSIONS (STAGE II) FOR ON-ROAD MOTOR VEHICLES 40
*NOTE: INCLUDES VOC EMISSIONS FROM REFUELING (STAGE II) 40
3.2.3 SOURCE CATEGORY DOCUMENTATION 54
3.2.3.1 Fugitive Dust from Paved Roads 55
3.2.3.2 Fugitive Dust from Unpaved Roads 61
3.2.3.3 Fossil Fuel Combustion – Residential – Coal Combustion 66
3.2.3.4 Fossil Fuel Combustion – Residential – Distillate Oil 75
3.2.3.5 Fossil Fuel Combustion – Residential - Kerosene 80
3.2.3.6 Fossil Fuel Combustion – Residential – Natural Gas 85
3.2.3.7 Non-Residential Construction 89
3.2.3.8 Residential Construction 91

3.2.3.9 Road Construction 94
3.2.3.10 Agricultural Production – Livestock 97
3.2.3.11 Commercial Cooking 106
3.2.3.12 Asphalt Paving – Cutback 111
3.2.3.13 Asphalt Paving – Emulsified 114
3.2.3.14 Gasoline Distribution – Portable Fuel Containers 117
3.2.3.15 Aviation Gasoline Distribution – Stage I 119
3.2.3.16 Aviation Gasoline Distribution – Stage II 125
3.2.3.17 Open Burning – Land Clearing Debris 129
3.2.3.18 Open Burning – Residential Household Waste 135
3.2.3.19 Open Burning – Yard Waste – Leaf and Brush Species 140
3.2.3.20 Agricultural Production – Crops – Fertilizer 146
3.2.3.21 Publicly Owned Treatment Works 154
3.2.3.22 Solvent Utilization 159
3.2.3.23 Gasoline Distribution Stage I 174
3.2.3.24 Gasoline Distribution – Stage II 196
3.2.3.25 Fuel Combustion – Industrial and Commercial/Institutional (ICI) 198
3.2.3.26 Fossil Fuel Combustion – Residential – Liquified Petroleum Gas (LPG) 200
3.2.3.27 Fuel Combustion – Residential- Wood 203
3.2.4 NONPOINT SOURCE EMISSION SUMMARY 203
3.3 MOBILE SOURCE EMISSIONS 204
3.3.1 NONROAD MOBILE SOURCES 204
3.3.1.1 Procedures and Methodologies 204
3.3.1.2 Source Category Documentation 205
3.3.1.3 Nonroad Source Emission Summary 205
3.3.2 ONROAD MOBILE SOURCES 206
3.3.2.1 Mobile Model Choice 206
3.3.2.2 Mobile Model Inputs 206
3.4 BIOGENIC EMISSIONS 229

4.0. QUALITY ASSURANCE/QUALITY CONTROL 230

4.1 POINT SOURCE QA/QC AND RESULTS 230
4.2 NONPOINT SOURCE QA/QC 233
4.3 MOBILE SOURCE QA/QC 234
4.3.1 NONROAD SOURCE QA/QC 234
4.3.2 ONROAD SOURCE QA/QC 234

LIST OF APPENDICES

Appendix E-1: List of Statewide Point Source Emissions by Facility

Appendix E-2: Nonroad 2008 Category Documentation

Appendix E-3: Nonpoint Industrial and Commercial/Institutional (ICI) Fuel Combustion Documentation

LIST OF TABLES

Table 1 STLNA Total Emissions by County and Category (tons per year) 8
Table 2 List of EIQ Forms 11
Table 3 STLNA Point Sources by NAICS 14
Table 4 STLNA 2008 Point Source Listing by Facility (tons per year) 16
Table 5 STLNA Point Source Emissions by County (tons per year) 20
Table 6 Statewide Point Source Emissions by Category (tons per year) 21
Table 7 Statewide Point Emissions by County (tons per year) 21
Table 8 STLNA 2008 Nonpoint Emission Records (tons per year) 25
Table 9 STLNA Nonpoint Annual VOC Emissions (tons per year) 40
Table 10 Nonpoint Category Overview of Methodology 41
Table 11 STLNA Nonpoint Emissions (tons per year) 203
Table 12 STLNA Nonroad Emissions by County (tons per year, excluding Aircraft, Marine, and Rail Emissions) 205
Table 13 STLNA Marine and Rail Emissions by County (tons per year) 205
Table 14 STLNA Aircraft Takeoff and Launch Emissions by County (tons per year) 205
Table 15 STLNA Total Nonroad Mobile Source Emissions by County (tons per year) 205
Table 16 2008 Vehicle Miles Traveled by County 207
Table 17 Missouri Registration Distribution 208
Table 18 2008 Source Type Population 209
Table 19 2008 Annual VMT by HPMS Vehicle Type, County, and Year 209
Table 20 Age Distribution by Source Type 210
Table 21 Inspection and Maintenance Data for 2008 211
Table 22 Fuel Formulation for 2008 212
Table 23 2008 Fuel Supply 213
Table 24 Franklin County Road Type Distribution for 2008 214
Table 25 Jefferson County Road Type Distribution for 2008 215
Table 26 St. Charles County Road Type Distribution for 2008 216
Table 27 St. Louis County Road Type Distribution for 2008 217
Table 28 St. Louis City Road Type Distribution for 2008 218
Table 29 Average Monthly Temperatures by Hour of the Day for Franklin County in Fahrenheit 219
Table 30 Average Monthly Percent Relative Humidity by Hour of the Day for Franklin County 220
Table 31 Average Monthly Temperatures by Hour of the Day for Jefferson County in Fahrenheit 221
Table 32 Average Monthly Percent Relative Humidity by Hour of the Day for Jefferson County 222
Table 33 Average Monthly Temperatures by Hour of the Day for St. Charles County in Fahrenheit 223
Table 34 Average Monthly Percent Relative Humidity by Hour of the Day for St. Charles County 224
Table 35 Average Monthly Temperatures by Hour of the Day for St. Louis County in Fahrenheit 225
Table 36 Average Monthly Percent Relative Humidity by Hour of the Day for St. Louis County 226
Table 37 Average Monthly Temperatures by Hour of the Day for St. Louis City in Fahrenheit 227
Table 38 Average Monthly Percent Relative Humidity by Hour of the Day for St. Louis City 228
Table 39 STLNA On-road Mobile Emissions Summary by county (tons per year) 229
Table 40 2008 Biogenic Emissions for the Missouri Side of the Nonattainment Area 229

1.0 Introduction

1.1 Purpose

This document meets the nonattainment plan provisions under the Clean Air Act Section 172 (c)(3):

> *"Such plan provisions shall include a comprehensive, accurate, current inventory of actual emissions from all sources of the relevant pollutant or pollutants in such area, including such periodic revisions as the Administrator may determine necessary to assure that the requirements of this part are met."*

Missouri's redesignation request and maintenance plan for the 1997 $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS) require a base year emissions inventory for 2008. The inventory is comprehensive in its inclusion of multiple source categories (point, nonpoint or area, and mobile sources), it is accurate based on the quality assurance steps outlined in Section 4, contains current 2008 actual emissions for the pollutants of concern for $PM_{2.5}$, and can be updated through the triennial National Emissions Inventory (NEI). Emissions are documented for both the statewide inventory and the St. Louis Nonattainment (STLNA) counties. Though the nonattainment area is bi-state, the inventory documentation that follows covers the five-county Missouri portion of the nonattainment area.

1.2 Inventory Coverage

1.2.1 Geography

The inventory covers the St. Louis Nonattainment counties of Jefferson, Franklin, St. Charles, and St. Louis Counties and the City of St. Louis. Several summaries of statewide Missouri totals are also included for reference. There are no inventory components provided by local or tribal agencies.

1.2.2 Emission Year

Emission year 2008 is the base year, including both annual emissions for the entire state and ozone season day emissions for the Missouri St. Louis Ozone Nonattainment Area.

1.2.3 Pollutants

The pollutants covered in the inventory include NH_3, SO_2, NO_x, $PM_{2.5}$ Primary (and its components $PM_{2.5}$ Filterable and PM Condensable), and VOC.

1.3 Contents of Report

This report documents the 2008 inventory in detail, from its creation, quality assurance, and final summaries. It also details the qualifications and limitations of the inventory. The document is arranged by purpose, emission summaries, documentation, quality assurance, and detailed appendices with lengthy emissions data tables and EPA provided category documentation.

1.4 Automated Systems Used

The 2008 emission inventory is maintained across multiple computing systems. Point source inventories are compiled from facility-supplied information in the Missouri Emissions Inventory System (MoEIS) database. Point sources are allowed to submit their inventory data via the MoEIS web interface or on hardcopy paper forms which are data entered to the electronic system. Nonpoint emissions are calculated using Microsoft® Excel spreadsheet and Access database tools. Mobile emissions are estimated using EPA's Motor Vehicle Emissions Simulator (MOVES), the MOBILE6 model, and the National Mobile Inventory Model (NMIM) which incorporates the NONROAD2008 model.

1.5 Inventory Exclusions

This inventory does not include hazardous air pollutant (HAP) inventories as they are not relevant pollutants for the Ozone and $PM_{2.5}$ nonattainment plans. The HAP inventory is documented in Missouri's 2008 National Emissions Inventory Documentation and is available on EPA's NEI page at http://www.epa.gov/ttn/chief/net/2008inventory.html. Point emissions data is summarized at the facility level in this document, though facility operational data and emission process data is collected and submitted to the NEI.

1.6 Guidance and Reference Documents

This document is completed with the following references:

- Emissions Inventory Guidance for Implementation of Ozone and Particulate matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations (August 2005, EPA-454/R-05-001, http://www.epa.gov/ttnchie1/eidocs/eiguid/index.html)
- Emission Inventory Improvement Plan (EIIP) (July 1997, http://www.epa.gov/ttn/chief/eiip/index.html)
- 2008 National Emissions Inventory Data version 1.5 and documentation (May 2011, http://www.epa.gov/ttn/chief/net/2008inventory.html)
- Air Emission Reporting Rule (Dec 2008, http://www.epa.gov/ttn/chief/aerr/)
- AP-42, Compilation of Air Pollutant Emission Factors (http://www.epa.gov/ttn/chief/ap42/index.html)

- MOVES Technical Guidance, Policy Memos, etc at (http://www.epa.gov/otaq/models/moves/index.htm)
- National Mobile Inventory Model (NMIM) (http://www.epa.gov/oms/nmim.htm)

1.7 List of Contacts

The emission inventory is compiled by Stacy Allen, Environmental Specialist IV and Emission Inventory/Data Management Unit Chief with the Missouri Department of Natural Resources. Specific contacts for other portions of the inventory are:

Point and Nonpoint Emissions: Stacy Allen, stacy.allen@dnr.mo.gov
Mobile (Onroad and Nonroad) Emissions: Nathan O'Neil, nathan.o'neil@dnr.mo.gov

2.0 Emissions Summary

2.1 Summary by County and Category

Table 1 STLNA Total Emissions by County and Category (tons per year)

	County Name	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC
Point	Franklin	2.82	9,178.19	1,448.96	57,944.69	685.48
	Jefferson	8.97	7,016.40	945.65	68,569.22	600.04
	St. Charles	8.04	7,649.32	316.21	48,595.24	936.97
	St. Louis	720.41	5,843.53	510.91	20,861.90	1,689.72
	St. Louis City	568.40	1,415.83	271.66	5,729.67	1,155.67
	Point Totals	**1,308.64**	**31,103.26**	**3,493.39**	**201,700.73**	**5,067.89**
Nonpoint	Franklin	1,300.09	283.00	2,315.04	991.12	1,604.16
	Jefferson	165.26	383.49	3,428.01	904.61	3,116.32
	St. Charles	883.43	463.05	2,331.71	895.42	5,744.68
	St. Louis	1,036.69	2,219.83	4,584.76	5,445.70	20,110.91
	St. Louis City	129.50	1,033.57	1,374.12	3,273.63	7,639.28
	Nonpoint Totals	**3,514.98**	**4,382.94**	**14,033.64**	**11,510.48**	**38,215.34**
On-road	Franklin	77.75	4,187.90	142.46	30.12	1,555.66
	Jefferson	90.68	5,313.80	183.94	36.32	2,522.89
	St. Charles	133.29	7,788.01	284.16	54.30	3,613.71
	St. Louis	585.26	32,363.41	1,215.47	237.05	12,865.54
	St. Louis City	169.20	9,166.46	353.26	68.87	3,236.00
	On-road Totals	**1,056.17**	**58,819.58**	**2,179.28**	**426.65**	**23,793.80**
Non-road	Franklin	1.81	3,056.59	138.11	36.52	1,036.21
	Jefferson	1.08	1,199.29	85.82	19.29	914.76
	St. Charles	2.82	3,043.73	205.09	57.55	1,934.74
	St. Louis	7.75	9,344.46	618.20	329.93	6,513.17
	St. Louis City	2.22	4,078.51	152.60	101.01	1,146.65
	Non-road Totals	**15.68**	**20,722.57**	**1,199.82**	**544.30**	**11,545.53**
STLNA Total Anthropogenic Emissions		**5,895.47**	**115,028.35**	**20,906.13**	**214,182.16**	**78,622.56**
Biogenic	Franklin	-	265.2	-	-	15,127.2
	Jefferson	-	124.2	-	-	12,624.7
	St. Charles	-	257.4	-	-	7,715.3
	St. Louis	-	159.6	-	-	7,137.8
	St. Louis City	-	31.2	-	-	1,296.7
	Non-road Totals	**-**	**837.6**	**-**	**-**	**43,901.7**
STLNA Total Anthropogenic and Biogenic Emissions		**5,895.47**	**115,865.95**	**20,906.13**	**214,182.16**	**122,524.26**

3.0 Inventory Documentation

3.1 Point Source Emissions

3.1.1 Procedures and Methodologies

The point source inventory is based on information collected on Emissions Inventory Questionnaires (EIQs). Facilities with a construction or operating permit from the Air Pollution Control Program are required to submit an EIQ on an annual basis per 10 CSR 10-6.110. The EIQ details the amount of air pollution emitted and other operational data for the previous calendar year.

2008 point sources include those with Part 70 and Intermediate operating permits. The EIQ solicitation was mailed to facilities in January 2009. The due date for 2008 reporting was June 1, 2009, and all point source reports were received and included in this document summary.

3.1.2 Emission Inventory Questionnaire (EIQ)

All point source emissions data for the State of Missouri is contained in a database called the Missouri Emissions Inventory System (MoEIS). Emission reports may be submitted either directly via the MoEIS web interface, a user-friendly, online portal linked directly to the MoEIS database, or they may be submitted on the hardcopy EIQ forms. Hardcopy EIQ submittals are then data entered into the MoEIS database by EI unit staff members. As a result, the MoEIS database is updated yearly with the most current emissions data for the State of Missouri.

Hardcopy EIQ forms are described in

Table 2. All hardcopy forms have an electronic counterpart in the MoEIS web interface system. In general, forms beginning with number one (1) provide general information about a facility, forms beginning with a two (2) provide the detailed annual emission calculations, including activity or throughput, emission factors, emissions, and operational characteristics. More information on EIQ forms and instructions and MoEIS is available at http://www.dnr.mo.gov/env/apcp/moeis/emissionsreporting.htm

Table 2 List of EIQ Forms

FORM NAME	FORM DESCRIPTION	FORM NUMBER
FORM 1.0 GENERAL PLANT INFORMATION	GENERAL PLANT INFORMATION, PLANT-WIDE EMISSIONS TOTALS, SIGNATURE SECTION CERTIFYING SUBMITTED INFORMATION IS ACCURATE AND COMPLETE	780-1431
FORM 1.1 PROCESS FLOW DIAGRAM	DIAGRAM IDENTIFYING AND LINKING ALL EMISSION UNITS, PROCESSES, AIR POLLUTION CONTROL DEVICES, AND EMISSION RELEASE POINTS FOR A FACILITY. SUBMIT ONLY IF THERE HAVE BEEN CHANGES.	780-1619
FORM 1.2 SUMMARY OF EMISSION UNITS AND RELATED PROCESSES	LIST OF ALL EMISSION UNITS AND ASSOCIATED PROCESSES AND THE STATUS OF EACH (ACTIVE, INSIGNIFICANT, DISMANTLED)	780-1620
FORM 2.0 EMISSION UNIT INFORMATION	MAIN EMISSIONS REPORTING FORM; SEPARATE FORM 2.0 REQUIRED FOR EACH PROCESS FOR WHICH EMISSIONS ARE BEING REPORTED (I.E., FORM 2.0 NOT REQUIRED FOR EMISSIONS BELOW REPORTING THRESHOLDS)	780-1621
FORM 2.0C CONTROL DEVICE INFORMATION	CONTROL DEVICE INFORMATION WHEN THERE IS A CONTROL DEVICE OPERATIVE AT AN EMISSION UNIT; SEPARATE FORM 2.0C REQUIRED FOR EACH CONTROL DEVICE	780-1434
FORM 2.0K CHARCOAL KILN INFORMATION	DETAILS THE OPERATIONS AND CHARACTERISTICS OF CHARCOAL KILNS	780-1530
FORM 2.0L LANDFILL INFORMATION	FORM FOR REPORTING EMISSIONS FROM LANDFILLS	780-1583
FORM 2.0P PORTABLE EQUIPMENT INFORMATION	DETAILS THE LOCATIONS AND OPERATIONS FOR PORTABLE EQUIPMENT OPERATIONS INCLUDING QUARRIES, ASPHALT PLANTS, AND CONCRETE BATCH PLANTS	780-1433
FORM 2.0S STACK/VENT INFORMATION	STACK INFORMATION FOR EMISSION UNITS WHERE EMISSIONS FROM A PROCESS ENTER THE AMBIENT AIR THROUGH ONE OR MORE STACKS/VENTS	780-1435
FORM 2.0Z OZONE SEASON INFORMATION FORM	CALCULATION OF OZONE SEASON DAY EMISSIONS OF VOC, NO_X, OR CO; REQUIRED FROM FACILITIES LOCATED IN ST. LOUIS, ST. CHARLES, FRANKLIN AND JEFFERSON COUNTIES AND ST. LOUIS CITY WITH 10 TONS OR MORE OF VOC, NO_X OR CO ANNUAL EMISSIONS.	780-1452
FORM 2.1 FUEL COMBUSTION WORKSHEET	INFORMATION RELATED TO COMBUSTION EQUIPMENT, FUEL USAGE, AND THE CALCULATIONS ASSOCIATED WITH COMBUSTION PROCESSES	780-1436

FORM NAME	FORM DESCRIPTION	FORM NUMBER
FORM 2.2 INCINERATOR WORKSHEET	INFORMATION RELATED TO THE INCINERATOR, WASTE MATERIAL(S) INCINERATED, AND THE ANNUAL WASTE MATERIAL THROUGHPUT	780-1438
FORM 2.3 VOC PROCESS MASS-BALANCE WORKSHEET	CALCULATES A VOC MASS BALANCE EMISSION FACTOR	780-1440
FORM 2.4 VOLATILE ORGANIC LIQUID LOADING WORKSHEET	CALCULATES AN EMISSION FACTOR FOR PETROLEUM LIQUID LOADING INTO TANK TRUCKS, RAIL CARS, AND BARGES BASED ON AP-42	780-1625
FORM 2.5L GENERAL LIQUID STORAGE TANK INFORMATION	INFORMATION ABOUT STORAGE TANKS	780-1444
FORM 2.7 HAUL ROAD FUGITIVE EMISSIONS WORKSHEET	CALCULATES AN EMISSION FACTOR FOR UNPAVED HAUL ROADS BASED ON AP-42 FORMULA	780-1445
FORM 2.8 STORAGE PILE WORKSHEET	CALCULATES EMISSION FACTORS FOR ACTIVITY AND WIND EROSION FROM STORAGE PILES BASED ON AP-42 FORMULAS	780-1446
FORM 2.9 STACK TEST/CONTINUOUS EMISSION MONITORING WORKSHEET	DOCUMENTATION FOR EMISSION FACTORS DERIVED FROM STACK TESTS OR CEM DEVICES	780-1447
FORM 2.T HAZARDOUS AIR POLLUTANT WORKSHEET	INFORMATION ON HAP CHEMICALS EMITTED AT THE PROCESS LEVEL; SEPARATES INDIVIDUAL HAPS FROM THOSE INCLUDED IN VOC/PM EMISSIONS	780-1448
FORM 3.0 EMISSION FEE CALCULATION	SUMMARY TABLE SHOWING EMISSIONS FROM ALL PROCESSES	780-1509
FORM 3.0CK EMISSION FEE CALCULATION FOR CHARCOAL KILNS	SUMMARY TABLE SHOWING EMISSIONS FROM CHARCOAL KILN OPERATIONS	780-1508
DRY CLEANER – NON-CHLORINATED AND PETROLEUM BASED SOLVENTS	EMISSIONS CALCULATIONS FOR DRY CLEANERS USING NON-CHLORINATED SOLVENT AND WITH COMBINED DRYER CAPACITY OF 84 POUNDS OR MORE	780-1954

FORM NAME	FORM DESCRIPTION	FORM NUMBER
FORM 4.0 FINANCIAL COST ESTIMATE	ESTIMATE THE COST OF COMPLYING WITH AIR POLLUTION REGULATION	780-1622

Point source EIQ data received via hard copy forms is data entered to the MoEIS emissions database by emission inventory staff. During this step, process-level emissions and operational information are checked for consistency between the hardcopy forms and database calculations, and inconsistencies are flagged for review. Problems include, but are not limited to:

- Incorrect Source Classification Codes (SCCs)
- Emission unit numbering changes
- Calculation errors
- Missing or incomplete records
- Transposition errors

If no errors are found during data entry, and the emissions reported on the hardcopy full EIQ match what is calculated by the MoEIS database, then the emission report is considered complete and data entered.

EIQs with inconsistencies are moved from emission inventory data entry staff to a member of the technical review team. The technical review team will address the problems encountered during data entry by identifying the specific issue(s) and possible causes and contacting the facility to resolve those issues. Other issues may also be addressed during the review, including the appropriate use of emission estimation methods, documentation of source data, and consistency with permit emission calculations. Supplemental EIQ information may be collected by staff via telephone or email contact with the facility in question. Information collected in this manner will be recorded on the EIQ for reference, tracking and QA auditing. If the facility is requested to submit follow up verification or additional information in writing, a statement pertaining to this request will also be recorded on the EIQ. The information recorded will include the date of the call or contact, staff person's name, contact person's name, and written documentation of the call.

After the submission deadline of June 1 has passed, a list of unsubmitted EIQs is generated and sent to the compliance and enforcement section of the Air Pollution Control Program. With all emissions data contained in the MoEIS database, further quality assurance steps are completed as described in Section 4.

3.1.3 List of Facilities and Emissions

There are 139 facilities in the point source inventory for the Missouri counties of the St. Louis nonattainment area. Their primary economic activity described by their North American Industry Classification System (NAICS) code is listed in Table 3 by county. The emissions of each facility in tons per year are listed in Table 4.

Table 3 STLNA Point Sources by NAICS

Primary Economic Activity Description	Franklin	Jefferson	St. Charles	St. Louis	St. Louis City
Adhesive Manufacturing				1	1
Administration of Air and Water Resource and Solid Waste Management Programs					1
Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing			1		
Aircraft Manufacturing				1	
All Other Basic Organic Chemical Manufacturing					1
All Other Miscellaneous Textile Product Mills					1
All Other Rubber Product Manufacturing					1
Asphalt Paving Mixture and Block Manufacturing			1	6	1
Automobile Manufacturing			1	2	
Biological Product (except Diagnostic) Manufacturing					1
Breweries					1
Carburetor, Piston, Piston Ring, and Valve Manufacturing				1	
Cement Manufacturing		1			
Coated and Laminated Packaging Paper Manufacturing				1	
Coffee and Tea Manufacturing					1
Colleges, Universities, and Professional Schools				1	1
Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance				1	
Commercial and Institutional Building Construction					1
Commercial Bakeries					1
Commercial Flexographic Printing				1	
Commercial Lithographic Printing				2	2
Crushed and Broken Limestone Mining and Quarrying		2	1	3	
Dry Pasta Manufacturing					1
Electronic Coil, Transformer, and Other Inductor Manufacturing			1		
Electroplating, Plating, Polishing, Anodizing, and Coloring	1	1			
Fabric Coating Mills	1				
Fabricated Structural Metal Manufacturing	1				
Farm Supplies Merchant Wholesalers					1
Flour Milling					2
Folding Paperboard Box Manufacturing	1				
Fossil Fuel Electric Power Generation	1	1	1	1	1
General Medical and Surgical Hospitals			1	5	3
General Warehousing and Storage					1
Glass Container Manufacturing		1			
Glass Product Manufacturing Made of Purchased Glass				1	
Grain and Field Bean Merchant Wholesalers					1
Heating Equipment (except Warm Air Furnaces) Manufacturing					1
Industrial Sand Mining				1	
Industrial Valve Manufacturing	1				
Inorganic Dye and Pigment Manufacturing				1	1
Institutional Furniture Manufacturing				1	
Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	1				

Primary Economic Activity Description	Franklin	Jefferson	St. Charles	St. Louis	St. Louis City
Laminated Aluminum Foil Manufacturing for Flexible Packaging Uses					1
Leather and Hide Tanning and Finishing					1
Machine Tool (Metal Cutting Types) Manufacturing				1	
Manifold Business Forms Printing					1
Metal Can Manufacturing		1			
Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers					2
Motor Vehicle Body Manufacturing	1				
Motor Vehicle Seating and Interior Trim Manufacturing	1				
National Security					1
Natural Gas Distribution					1
Natural Gas Liquid Extraction					2
Newspaper Publishers				1	1
Offices of Physicians (except Mental Health Specialists)					1
Other Aircraft Parts and Auxiliary Equipment Manufacturing				1	
Other Metal Container Manufacturing				1	
Other Metal Valve and Pipe Fitting Manufacturing	1				1
Paint and Coating Manufacturing					3
Pesticide and Other Agricultural Chemical Manufacturing				1	
Petrochemical Manufacturing				1	2
Petroleum Bulk Stations and Terminals				1	
Pharmaceutical Preparation Manufacturing				3	
Plastics Material and Resin Manufacturing		1		1	
Polystyrene Foam Product Manufacturing			1	1	
Primary Smelting and Refining of Nonferrous Metal (except Copper and Aluminum)		1			
Railroad Rolling Stock Manufacturing		1			
Research and Development in the Physical, Engineering, and Life Sciences				1	
Rubber and Plastics Hoses and Belting Manufacturing				1	
Secondary Smelting and Alloying of Aluminum					1
Semiconductor and Related Device Manufacturing			1		
Sewage Treatment Facilities				3	
Ship Building and Repairing		1			
Sign Manufacturing	1				
Soap and Other Detergent Manufacturing					2
Solid Waste Landfill				4	
Spice and Extract Manufacturing	2				1
Steel Foundries (except Investment)		1			
Steel Investment Foundries			1		
Toy and Hobby Goods and Supplies Merchant Wholesalers					1
Truck Trailer Manufacturing				1	
Unlaminated Plastics Profile Shape Manufacturing	2		1		
Wired Telecommunications Carriers					1
Total Number of Facilities	15	12	11	52	49

Table 4 STLNA 2008 Point Source Listing by Facility (tons per year)

EIS Facility ID	Facility Name	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC
5150011	Jefferson Smurfit Corp-Pacific	-	-	-	-	29.68
5150511	Bull Moose Tube Company-Bull Moose Tube Company	-	0.55	0.06	0.00	18.70
5151111	Sullivan Precision Metal Finishing Inc-Sullivan Precision Metal Finishing Inc	-	-	-	-	18.58
5151211	Sporlan Valve Company-Plant #2 - West Main	-	-	-	-	43.42
5151411	Aerofil Technology Inc-Aerofil Technology Inc	-	1.95	2.77	0.01	50.17
5151511	Magnet Llc-Washington	-	-	-	-	9.73
5151611	Marble Decor Inc-Marble Decor Inc	-	-	-	-	0.45
5151811	Plaze Incorporated-Plaze Incorporated	-	1.67	-	0.01	44.87
5152011	GDX Automotive - Danny Scott Drive-New Haven	-	0.00	-	-	23.67
5152111	Sporlan Valve Company-Plant #3 - Lange Drive	-	-	-	-	16.46
6032111	Amerenue-Labadie Plant	2.82	9,170.39	1,446.08	57,944.63	299.61
6032311	Canam Steel Corp-Canam Steel Corp	-	2.54	-	0.03	57.77
6032611	Steelweld Equipment Co-St Clair	-	0.20	-	0.00	15.94
7369411	Meramec Industries Inc-Ramsey St Plant	-	0.31	-	0.00	37.84
8243211	Integram - St Louis Seating-Pacific	-	0.58	0.04	0.00	18.61
Franklin County Totals		**2.82**	**9,178.19**	**1,448.96**	**57,944.69**	**685.48**
5258211	Doe Run Company-Herculaneum Smelter	0.38	12.32	10.83	35,997.75	2.20
5258511	Union Pacific Railroad Co-Desoto Car Shop	-	1.77	2.52	0.01	17.56
5258611	Trautman Quarry-Pevely	-	-	-	-	-
5258811	Amerenue-Rush Island Plant	1.51	4,195.26	662.52	29,592.97	159.93
5259811	Aero Metal Finishing-Aero Metal Finishing	-	2.16	-	0.30	3.10
7270711	Bussen Quarries Inc-Antire Quarry	-	-	0.09	-	-
7271811	Dow Chemical Company The-Riverside Plant	0.04	1.32	0.10	0.01	1.42
7271911	Carondelet Corporation-Carondelet Corporation	0.07	6.48	0.16	0.25	67.10
7272311	Rc Cement Company Inc-River Cement Co - Selma Plant	5.70	2,608.15	197.39	2,758.03	195.65
7272511	Metal Container Corporation-Arnold	-	11.26	2.79	0.07	111.91
7272611	Engineered Coil Company-D B A Marlo Coil	-	0.12	-	0.00	9.47
8112911	Saint-Gobain Containers Llc-Pevely	1.27	177.56	69.26	219.84	31.69
Jefferson County Totals		**8.97**	**7,016.40**	**945.65**	**68,569.22**	**600.04**
6783411	Amerenue-Sioux Plant	0.86	7,336.12	308.71	48,147.62	168.11
6783511	Fred Weber Inc-O'Fallon Asphalt Plant	0.04	2.06	0.12	0.17	0.36
6783611	Fred Weber Inc-O'Fallon Stone Plant	-	-	0.01	-	-
6783911	McDonnell Douglas Corp-Boeing Company	0.08	2.56	0.05	0.02	14.85
6784211	St Joseph Health Center-St Joseph Health Center	0.03	4.67	0.35	0.14	0.28
6797711	Superior Home Products Inc-Superior Home Products Inc	-	-	-	-	10.79
7273311	Memc Electronic Materials Inc-St Peters Plant	5.11	23.58	4.47	0.14	15.08

EIS Facility ID	Facility Name	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC
7284511	General Motors-Wentzville Center	0.34	274.20	1.54	447.12	550.70
7387111	Woodbridge Corporation-St Peters	-	-	-	-	49.74
7387311	True Manufacturing Co-O'Fallon	-	4.29	0.36	0.03	37.09
8100411	O Fallon Casting Llc-O Fallon	1.59	1.85	0.60	0.01	89.98
St. Charles County Totals		**8.04**	**7,649.32**	**316.21**	**48,595.24**	**936.97**
10735111	KV Pharmaceutical - Bridgeton	-	-	0.00	-	18.49
5113811	Nesco Container Corp-Fenton	0.04	2.36	0.02	0.01	93.66
5113911	McDonnell Douglas Corp /Boeing Company-Lindbergh Plant	0.77	22.32	0.66	0.35	69.39
5114011	St Louis Lithographing Company-Heege Avenue	-	-	-	-	17.91
5114511	Bussen Quarries Inc-Bussen Road	-	-	0.51	-	-
5114611	Ruprecht Quarry-Paule Rd	-	-	-	-	-
5114711	BFI Missouri Pass Landfill-Maryland Heights	-	9.17	0.65	2.92	5.25
5114811	Color Art Inc-Crestwood	0.04	1.20	0.02	0.01	24.04
5115911	Onyx Oak Ridge Landfill Inc-(West County)	-	2.39	1.14	0.84	4.14
5116011	Bridgeton Landfill Authority-Bridgeton	-	13.03	5.54	4.56	8.42
5116311	Pro-Tect Mfg Inc-Ferguson Ave	-	-	-	-	19.25
5116411	St Marys Health Center-Richmond Heights	0.05	8.23	0.15	0.15	0.49
5167511	St Joseph Hospital-Kirkwood	0.02	3.56	0.07	0.06	2.25
5181011	Pan-Glo St Louis-Trenton Avenue	-	-	-	-	4.82
5278111	Camie-Campbell Inc-Watson Industrial Park	-	-	-	-	5.13
5278311	Belt Service Corp-Earth City	0.02	0.56	0.01	0.00	42.47
5278411	Kv Pharmaceutical Company-Brentwood	-	-	0.11	-	58.93
5278611	Depaul Health Center-Bridgeton	0.04	7.20	0.55	0.04	0.40
5278811	Kv Pharmaceutical Company-Schuetz Rd	0.05	1.45	0.77	0.01	6.40
5278911	Veterans Admin Medical Center-Jefferson Barracks Drive	-	-	-	-	0.89
5279511	St Luke's Hospital-Woods Mill Road	0.04	6.34	0.13	0.58	0.34
5366411	Printpack Inc-Hazelwood Plant	0.13	4.11	0.08	0.02	233.46
5366611	Metropolitan St Louis Sewer District-Lemay Waste Water Treatment Plant	505.36	51.79	1.86	2.07	18.63
6816611	Amerenue-Meramec Plant	1.30	5,331.86	461.34	20,826.77	109.35
6822011	Whitmire Microgen Research Laboratory-Kirkwood	-	-	-	-	5.91
6822111	Metropolitan St Louis Sewer District-Mo River Wasterwater Treatment Plant	101.19	91.27	0.27	1.41	11.15
6822411	Metropolitan St Louis Sewer District-Coldwater Creek Sewage Treatment Plant	105.85	69.15	0.38	2.02	3.32
6822811	Simpson Construction Materials Llc-Valley Park	-	6.05	0.66	4.44	1.56
6824011	Fred Weber Inc-South Asphalt	-	3.98	0.01	0.28	0.52
6824111	Fred Weber Inc-North Asphalt H & B	-	9.19	0.62	0.88	1.64
6824211	Fred Weber Inc-North Asphalt B & G	-	2.34	-	0.43	0.77
6828611	Fred Weber Inc-North Stone	-	-	4.96	-	-

EIS Facility ID	Facility Name	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC
6828711	Fred Weber Inc-South Stone	-	-	0.02	-	-
6828811	Monsanto World Headquarters-Lindbergh Blvd	0.39	12.29	0.23	0.07	0.68
6828911	U S Silica Company-Pacific	0.13	4.18	2.96	0.03	0.23
6829311	Pharmacia-Chesterfield Village	0.44	15.36	0.27	0.36	20.66
6829611	Washington University-Millbrook Blvd	0.70	22.45	0.45	0.25	1.24
6829711	St Louis Post-Dispatch-Dunlap Ind Dr	0.00	0.19	0.00	0.00	19.15
6829911	Sunnen Products Company-Maplewood	0.04	1.21	0.02	0.01	5.77
7285311	Multiplex Display Fixture-Fenton	-	0.59	0.04	0.00	1.11
7286211	Reichhold Chemicals Inc-Valley Park	0.17	5.24	0.18	0.03	33.03
7387411	St Louis Airport Authority-Lambert International Blvd	0.32	14.92	0.28	3.09	11.67
7387811	Fred Weber Inc Sanitary Landfill-St Louis County	-	6.94	3.30	2.43	8.12
7388011	Chrysler Assembly Plant 1-Fenton	0.83	25.86	3.38	0.16	203.84
7400611	Flex-O-Lite Inc-Fenton	-	-	-	-	24.34
7578011	Gkn Aerospace Services Inc-Berkeley	0.44	7.23	13.36	0.17	51.28
7579111	F & S Real Eastate Inc-St Louis	-	-	-	-	61.13
7688111	Simpson Construction Materials Llc-West Lake Quarry & Material Co	-	4.71	0.08	3.46	0.32
7703011	Energy Petroleum Company-Kienlen	-	-	-	-	7.19
8029111	Chrysler Corp-North Plant	1.69	61.69	5.53	0.47	468.58
8100511	Dana Corporation-Perfect Circle Division	0.01	1.04	0.02	0.01	1.73
8100611	Rockwood Pigments Na Inc-E Hoffmeister	0.37	12.09	0.24	3.53	0.71
St. Louis County Totals		**720.41**	**5,843.53**	**510.91**	**20,861.90**	**1,689.72**
10738111	Washington University – Hilltop Campus	0.01	1.26	0.10	0.01	0.07
5129911	U S Ringbinder Corp-Loose Leaf Metals	-	-	-	-	2.99
5131011	St Louis Post Dispatch-St Louis Post Dispatch	0.00	0.53	0.01	0.00	1.92
5131711	National Geospatial-Intelligence Agency-National Geospatial-Intelligence Agency	0.05	1.92	0.13	0.03	0.11
5132111	Southern Metal Processing-Southern Metal Processing	-	6.93	0.45	6.49	1.26
5132411	Allied Health Care Products-Allied Health Care Products	-	-	-	-	3.63
5132511	Energy Center (The)-St Louis Univ Health Sciences Center	-	11.64	0.39	0.92	0.70
5146111	Connector Castings-Connector Castings	0.01	0.12	0.58	0.01	0.91
5146411	J S Alberici Construction-J S Alberici Construction	-	-	-	-	24.79
5341711	Chemisphere Corporation-Chemisphere	-	-	-	-	3.20
5341811	PQ Corporation (The)-St Louis	0.53	113.75	66.57	0.18	5.19
5342111	Interstate Brands Corp-Interstate Brands Corp	0.05	2.12	0.11	0.01	43.55
5342911	Goodwin Printing Co -St Louis	-	-	-	-	8.86
5343111	Mid-West Industrial Chemical-Mid-West Industrial Chemical	-	-	-	-	6.24
5343211	Brenntag Mid-South Inc-Brenntag Mid-South Inc	-	0.00	-	-	0.22

EIS Facility ID	Facility Name	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC
6009311	ADM Gromark River Systems-St Louis	-	0.00	0.90	-	-
6009611	Trigen-St Louis Energy Corp-Ashley Street Station	2.13	37.02	5.60	1.18	3.32
6009711	Washington Univ Medical School-Boiler Plant	0.18	38.06	2.86	1.58	2.00
6009811	Fred Weber Inc-Asphalt Plant	0.00	1.75	-	0.11	0.22
6009911	Metropolitan St Louis Sewer District-Bissel Plant	534.96	89.34	3.62	10.93	43.21
6010311	Dial Corp-Dial Corp	-	9.99	24.47	0.06	1.95
6110211	Astaris Llc-Carondelet Plant	0.55	8.36	1.31	0.33	1.31
6123811	Alumax Foils Inc-Alcoa Foil Products/Alumax Foils Inc	0.01	22.94	46.99	0.68	488.67
6124211	ADM/TPC Milling Co-Pillsbury Company	-	-	15.60	-	6.96
6124311	Marquette Tool & Die-Marquette Tool & Die	-	-	-	-	7.40
6124811	Italgrani Elevator-Italgrani Elevator	0.12	3.84	0.93	0.02	0.62
6125211	St Alexius Hospital-St Louis	-	1.33	-	0.01	0.03
6125311	Bjc Health System-Pavillion	-	6.56	-	0.40	0.32
6125511	Sensient Colors Inc-Baldwin Plant	0.09	2.90	0.23	0.09	0.20
6126211	Hermann Oak Leather Co-Hermann Oak Leather Co	-	-	-	-	6.70
6126311	Lange-Stegmann Co-Lange-Stegmann Co	-	0.00	-	-	0.00
7287111	Poly One Corporation-St Louis	-	-	-	-	3.34
7287211	St Louis Metallizing-St Louis	-	0.33	-	0.00	4.38
7301011	Elementis Specialties Inc-Elementis Specialties Inc	0.26	8.07	0.38	0.05	56.32
7304011	Precoat Metals-Precoat Metals	-	6.07	-	0.04	29.21
7765811	Anheuser-Busch Inc-St Louis	24.25	668.29	24.38	5,431.34	250.30
7766311	Sigma - Aldrich Co-Sigma Chemical Company	-	5.86	-	0.04	9.47
7766411	Procter & Gamble-Procter & Gamble	0.38	11.91	47.35	0.73	0.65
7766811	Ashland Distribution Company-St Louis Plant	-	-	-	-	8.44
7767411	P D George Co (The)-P D George Co (The)	0.30	4.66	1.43	0.03	38.27
7767511	U S Paint Div Of Grow Group-U S Paint Div Of Grow Group	-	-	-	-	33.00
7768911	Sigma - Aldrich Co-Sigma - Aldrich Co	-	2.91	-	0.02	4.05
7769011	Permacel St Louis Inc-Permacel St Louis Inc	0.03	1.73	0.08	0.01	0.75
7833711	Superior Solvent & Chemical-St Louis	-	-	-	-	2.94
7833811	Laclede Tower Associates Llc-Laclede Gas Building	0.00	207.44	0.87	0.05	2.71
7834011	New World Pasta- Marceau Facility-New World Pasta	0.17	5.46	0.98	0.03	0.30
7834611	Southwestern Bell Telephone Company-Southwestern Bell Telephone Company	0.11	14.06	0.50	0.72	0.60
7835511	St Louis University-Facilities Svcs	0.06	11.55	0.88	0.07	0.64
8398811	Mallinckrodt Inc -Mallinckrodt Inc	4.13	107.11	23.96	273.50	43.76
St. Louis City Totals		**568.40**	**1,415.83**	**271.66**	**5,729.67**	**1,155.67**
Grand Total		**1,308.64**	**31,103.26**	**3,493.39**	**201,700.73**	**5,067.89**

3.1.4 Point Source Emission Summary

Point source emissions for the five-county Missouri portion of the St. Louis Nonattainment Area are summarized in Table 5. Point source emissions for the entire state of Missouri are summarized by category in Table 6 and by county in Table 7. Appendix E-1 is a listing of statewide point source emissions by facility.

Table 5 STLNA Point Source Emissions by County (tons per year)

County	NH_3	NO_X	PM_{25}-PRI	SO_2	VOC
Franklin	2.82	9,178.19	1,448.96	57,944.69	685.48
Jefferson	8.97	7,016.40	945.65	68,569.22	600.04
St. Charles	8.04	7,649.32	316.21	48,595.24	936.97
St. Louis	720.41	5,843.53	510.91	20,861.90	1,689.72
St. Louis City	568.40	1,415.83	271.66	5,729.67	1,155.67
Total	**1,308.64**	**31,103.26**	**3,493.39**	**201,700.73**	**5,067.89**

Table 6 Statewide Point Source Emissions by Category (tons per year)

Description	Number of Facilities	NH3	NOX	PM25-PRI	SO2	VOC
Fossil Fuel Electric Power Generation	70	202	95,206	6,689	291,981	1,630
Primary Smelting and Refining of Nonferrous Metal (except Copper and Aluminum)	3	0	76	69	38,517	4
Cement Manufacturing	5	31	13,009	673	11,029	878
Petrochemical Manufacturing	6	21	1,078	48	5,861	292
Breweries	1	24	668	24	5,431	250
Primary Aluminum Production	1	1	36	257	4,688	239
Lime Manufacturing	2	0	5,159	62	4,433	43
Pesticide and Other Agricultural Chemical Manufacturing	5	1	601	144	2,438	100
Automobile Manufacturing	4	5	430	51	448	2,523
Glass Container Manufacturing	1	1	178	69	220	32
Sewage Treatment Facilities	3	712	212	3	6	33
Pipeline Transportation of Natural Gas	10	2	8,551	115	2	328
Motor Vehicle Body Manufacturing	11	0	30	6	1	579
Laminated Aluminum Foil Manufacturing for Flexible Packaging Uses	1	0	23	47	1	489
Soybean Processing	4	0	40	71	0	1,009
Nitrogenous Fertilizer Manufacturing	1	25	929	57		
All Other Categories	422	628	3,727	612	2,315	9,003
Missouri Total	**550**	**1,655**	**129,953**	**8,997**	**367,370**	**17,432**

Table 7 Statewide Point Emissions by County (tons per year)

State County FIPS Code	County Name	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC
29001	Adair		0.19		0.00	0.01
29003	Andrew		0.54	0.12	0.10	0.18
29007	Audrain	1.95	96.24	44.82	19.94	398.65
29009	Barry	2.75	59.74	5.85	15.84	527.72
29011	Barton		8.67	4.00	2.34	4.39
29013	Bates		8.06	0.73	0.77	0.59
29017	Bollinger	2.36	2,497.11	27.15	0.33	67.43
29019	Boone	51.78	3,153.74	143.53	9,966.06	157.51
29021	Buchanan	0.81	3,251.50	39.69	3,704.35	746.92
29023	Butler	0.26	154.10	4.08	4.86	145.81
29025	Caldwell			0.15		-
29027	Callaway	0.31	53.40	19.27	42.87	63.95
29029	Camden	0.01	2.80		0.00	13.08
29031	CapeGirardeau	23.61	1,398.71	188.48	450.57	367.56
29033	Carroll	0.02	5.23	1.08	0.18	87.16
29037	Cass	22.80	162.26	20.95	5.25	6.59
29039	Cedar	0.21	6.55	33.42	0.06	0.54
29041	Chariton					5.13
29047	Clay	2.46	649.95	202.44	2,676.97	1,508.81
29049	Clinton		-	0.02	-	1.68

State County FIPS Code	County Name	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC
29051	Cole	0.08	39.22	8.10	9.33	202.83
29053	Cooper	0.11	29.94	2.81	4.05	63.11
29055	Crawford					36.04
29061	Daviess		6.21	0.49	0.41	1.17
29063	DeKalb		9.26	-	-	1.30
29065	Dent	-	32.20	17.58	1.59	5.00
29069	Dunklin	23.58	55.87	2.32	1.82	5.95
29071	Franklin	2.82	9,178.19	1,448.96	57,944.69	685.48
29073	Gasconade	0.06	1.88	0.14	0.01	145.12
29075	Gentry		-		-	-
29077	Greene	3.01	4,904.76	140.69	8,682.05	364.20
29079	Grundy	0.13	5.39	0.40	0.44	51.82
29081	Harrison		47.03	-	-	3.47
29083	Henry	0.98	6,420.34	245.94	12,123.91	242.39
29087	Holt	0.97	16.84	23.65	117.57	154.17
29091	Howell	0.14	87.42	6.06	3.18	485.66
29093	Iron		63.64	59.98	2,518.78	3.87
29095	Jackson	18.62	13,339.46	1,124.98	28,174.46	930.77
29097	Jasper	77.72	5,127.28	529.85	10,827.85	571.27
29099	Jefferson	8.97	7,016.40	945.65	68,569.22	600.04
29101	Johnson	0.48	66.12	3.66	7.96	70.63
29105	Laclede	1.38	37.29	6.69	1.63	173.10
29107	Lafayette	0.24	8.23	1.60	0.08	88.97
29109	Lawrence	0.01	13.40	0.10	0.03	122.77
29111	Lewis					44.80
29113	Lincoln		39.91	5.40	0.29	80.39
29115	Linn	0.02	0.21	0.02	0.00	55.68
29117	Livingston	0.04	3.21	0.13	0.05	2.90
29119	McDonald	10.79	38.65	23.93	0.38	3.45
29121	Macon		55.20	4.26	1.38	61.11
29123	Madison	-	324.94	0.96	0.03	74.93
29125	Maries		112.17		15.75	54.77
29127	Marion	0.12	555.05	142.19	2,437.52	40.73
29131	Miller	0.00	0.08	0.13	0.00	25.23
29133	Mississippi		1.10	0.28	0.01	0.22
29137	Monroe		0.18		0.01	0.01
29139	Montgomery		170.16	25.04	578.44	0.00
29143	NewMadrid	6.85	11,835.86	606.03	19,674.94	556.53
29145	Newton	0.13	83.65	1.29	0.97	62.07
29147	Nodaway	0.07	1,037.33	26.28	1.32	220.23
29151	Osage	0.10	2,409.99	247.69	5,038.05	55.48
29155	Pemiscot	-	7.42	1.19	0.04	126.81
29157	Perry	0.01	10.00	0.73	25.80	430.82
29159	Pettis	9.85	2,067.85	41.82	153.30	298.26
29161	Phelps	2.46	44.26	0.50	460.68	50.86
29163	Pike	44.96	7,244.57	287.55	13,422.43	686.71
29165	Platte	2.12	6,982.63	297.31	15,077.12	233.79
29167	Polk		-	-	-	36.65
29169	Pulaski	9.01	40.45	0.76	29.79	21.70
29171	Putnam		1.50	0.02	0.26	0.20
29173	Ralls	-	2,413.44	32.25	135.46	34.36
29175	Randolph	1.63	12,126.80	439.61	15,102.36	203.60
29179	Reynolds		-	1.61	-	2.00
29183	St.Charles	8.04	7,649.32	316.21	48,595.24	936.97
29186	Ste.Genevieve	0.06	5,246.81	63.58	4,432.97	59.96
29187	St.Francois	17.59	403.95	27.36	25.71	46.73

State County FIPS Code	County Name	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC
29189	St.Louis	720.41	5,843.53	510.91	20,861.90	1,689.72
29195	Saline	0.35	659.55	157.89	3,147.31	37.33
29201	Scott	-	2,921.37	120.58	6,530.38	90.68
29203	Shannon		15.96	0.58	0.81	0.55
29205	Shelby	-	2.69	0.00	0.02	23.59
29207	Stoddard		77.18	22.84	1.78	262.64
29209	Stone					
29213	Taney	2.79	25.69	6.88	7.34	10.21
29215	Texas		10.25		0.05	36.76
29217	Vernon		39.12	2.81	0.23	279.89
29219	Warren	0.77	10.24	0.86	0.06	171.17
29221	Washington	0.09	5.42	0.72	0.03	18.31
29225	Webster	0.06	0.80	0.07	0.00	7.04
29229	Wright	0.10	3.04	2.11	0.67	28.11
29510	St.Louiscity	568.40	1,415.83	271.66	5,729.67	1,155.67
Missouri Total		**1,655.45**	**129,952.55**	**8,997.41**	**367,370.10**	**17,432.49**

3.2 Nonpoint Source Emissions

3.2.1 Procedures and Methodologies

The nonpoint (also known as area) source categories with published methods of estimation are too numerous to calculate county-level inventories given current resources. The EPA, in conjunction with the Eastern Region Technical Advisory Committee (ERTAC), will complete inventory documentation and calculation for most nonpoint source categories using national defaults. Several categories are then improved with state-level information or with point-source subtraction.

Missouri prepared inventories for 18 categories that required point source subtraction or state-specific data. These categories are listed in the Missouri Category Summary section below. Documentation of the calculation methodology and data sources is included in Table 10. Categories that did not require point source subtraction that were calculated by EPA are listed in the EPA Category Summary section. Table 9 lists the total nonpoint VOC emissions by county for the Missouri portion of the St. Louis $PM_{2.5}$ nonattainment area, including refueling VOC emissions, which were calculated using EPA's Motor Vehicle Emissions Simulator (MOVES).

3.2.2 List of Source Categories and Emissions

Table 8 STLNA 2008 Nonpoint Emission Records (tons per year)

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
Franklin	2102001000	-	-	-	-	-
Franklin	2102002000	0.38	137.70	-	903.83	0.63
Franklin	2102004000	0.04	1.10	-	2.34	0.01
Franklin	2102005000	0.01	0.96	-	6.13	0.00
Franklin	2102006000	0.02	0.75	-	0.00	0.04
Franklin	2102007000	-	-	-	-	-
Franklin	2102008000	4.66	11.90	-	1.35	0.92
Franklin	2102011000	-	-	-	-	-
Franklin	2103001000	-	-	-	-	-
Franklin	2103002000	0.01	5.47	-	34.96	0.02
Franklin	2103004000	0.00	0.07	-	0.15	0.00
Franklin	2103005000	0.00	0.05	-	0.35	0.00
Franklin	2103006000	0.07	13.33	-	0.08	0.73
Franklin	2103007000	0.00	0.58	-	0.00	0.03
Franklin	2103008000	0.38	0.98	-	0.11	0.08
Franklin	2103011000	-	0.03	-	0.08	-
Franklin	2104001000	-	-	-	-	-
Franklin	2104002000	-	-	-	-	-
Franklin	2104004000	0.58	10.38	1.23	24.56	0.40
Franklin	2104006000	2.97	13.96	0.06	0.09	0.82
Franklin	2104007000	0.10	29.11	0.09	0.12	1.13
Franklin	2104008100	1.52	2.19	19.88	0.34	15.92
Franklin	2104008210	1.39	2.28	24.95	0.33	43.21
Franklin	2104008220	0.24	0.60	5.13	0.10	3.14
Franklin	2104008230	0.08	0.17	1.78	0.03	1.31
Franklin	2104008310	1.25	2.07	22.58	0.30	39.12
Franklin	2104008320	0.21	0.54	4.63	0.09	2.84
Franklin	2104008330	0.07	0.16	1.60	0.03	1.18
Franklin	2104008400	0.07	0.89	0.72	0.07	0.01
Franklin	2104008510	0.79	0.81	12.15	0.89	5.19
Franklin	2104008610	0.80	0.82	28.52	0.90	30.04
Franklin	2104009000	-	0.86	3.19	-	4.44
Franklin	2104011000	0.24	4.41	0.52	10.43	0.17
Franklin	2294000000	-	-	240.75	-	-
Franklin	2296000000	-	-	1,555.69	-	-
Franklin	2302002100	-	-	2.51	-	0.61
Franklin	2302002200	-	-	17.79	-	2.09
Franklin	2302003000	-	-	-	-	0.64
Franklin	2302003100	-	-	5.20	-	0.30
Franklin	2302003200	-	-	0.35	-	0.01
Franklin	2311010000	-	-	2.37	-	-
Franklin	2311020000	-	-	26.14	-	-
Franklin	2311030000	-	-	13.00	-	-
Franklin	2325000000	-	-	9.57	-	-
Franklin	2401001000	-	-	-	-	152.36
Franklin	2401005000	-	-	-	-	26.30
Franklin	2401008000	-	-	-	-	16.84
Franklin	2401015000	-	-	-	-	1.10
Franklin	2401020000	-	-	-	-	25.87

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
Franklin	2401025000	-	-	-	-	26.48
Franklin	2401030000	-	-	-	-	-
Franklin	2401040000	-	-	-	-	-
Franklin	2401050000	-	-	-	-	64.93
Franklin	2401055000	-	-	-	-	45.08
Franklin	2401060000	-	-	-	-	-
Franklin	2401065000	-	-	-	-	4.92
Franklin	2401070000	-	-	-	-	17.90
Franklin	2401075000	-	-	-	-	1.93
Franklin	2401080000	-	-	-	-	14.29
Franklin	2401085000	-	-	-	-	-
Franklin	2401090000	-	-	-	-	40.46
Franklin	2401100000	-	-	-	-	55.49
Franklin	2401200000	-	-	-	-	0.35
Franklin	2415000000	-	-	-	-	92.82
Franklin	2420000000	-	-	-	-	1.46
Franklin	2425000000	-	-	-	-	75.43
Franklin	2460100000	-	-	-	-	95.85
Franklin	2460200000	-	-	-	-	90.81
Franklin	2460400000	-	-	-	-	68.61
Franklin	2460500000	-	-	-	-	47.93
Franklin	2460600000	-	-	-	-	28.76
Franklin	2460800000	-	-	-	-	89.80
Franklin	2460900000	-	-	-	-	3.53
Franklin	2461021000	-	-	-	-	36.99
Franklin	2461022000	-	-	-	-	19.34
Franklin	2461850000	-	-	-	-	62.93
Franklin	2501011011	-	-	-	-	15.22
Franklin	2501011012	-	-	-	-	29.72
Franklin	2501011013	-	-	-	-	3.46
Franklin	2501011014	-	-	-	-	1.14
Franklin	2501011015	-	-	-	-	0.10
Franklin	2501012011	-	-	-	-	0.49
Franklin	2501012012	-	-	-	-	0.95
Franklin	2501012013	-	-	-	-	4.72
Franklin	2501012014	-	-	-	-	2.19
Franklin	2501012015	-	-	-	-	0.18
Franklin	2501050120	-	-	-	-	7.02
Franklin	2501055120	-	-	-	-	5.46
Franklin	2501060053	-	-	-	-	20.35
Franklin	2501060201	-	-	-	-	28.78
Franklin	2501080050	-	-	-	-	11.52
Franklin	2501080100	-	-	-	-	0.60
Franklin	2505030120	-	-	-	-	1.88
Franklin	2505040120	-	-	-	-	5.97
Franklin	2610000100	-	0.83	2.26	0.10	3.73
Franklin	2610000400	-	0.67	2.02	0.22	2.53
Franklin	2610000500	-	20.55	53.86	-	47.67
Franklin	2610030000	-	17.84	103.47	2.97	25.45
Franklin	2630020000	0.38	-	-	-	1.91
Franklin	2801000003	-	-	151.11	-	-

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
Franklin	2801500000	-	0.60	1.90	0.08	1.20
Franklin	2801700001	81.45	-	-	-	-
Franklin	2801700002	-	-	-	-	-
Franklin	2801700003	0.03	-	-	-	-
Franklin	2801700004	400.32	-	-	-	-
Franklin	2801700005	27.01	-	-	-	-
Franklin	2801700006	2.63	-	-	-	-
Franklin	2801700007	-	-	-	-	-
Franklin	2801700010	5.02	-	-	-	-
Franklin	2801700011	-	-	-	-	-
Franklin	2801700012	-	-	-	-	-
Franklin	2801700013	41.32	-	-	-	-
Franklin	2801700014	-	-	-	-	-
Franklin	2801700015	-	-	-	-	-
Franklin	2801700099	0.08	-	-	-	-
Franklin	2805001100	17.29	-	-	-	-
Franklin	2805001200	0.01	-	-	-	-
Franklin	2805001300	13.17	-	-	-	-
Franklin	2805002000	116.29	-	-	-	-
Franklin	2805003100	113.26	-	-	-	-
Franklin	2805007100	1.49	-	-	-	-
Franklin	2805007300	0.03	-	-	-	-
Franklin	2805008100	-	-	-	-	-
Franklin	2805008200	-	-	-	-	-
Franklin	2805008300	-	-	-	-	-
Franklin	2805009100	0.05	-	-	-	-
Franklin	2805009200	0.01	-	-	-	-
Franklin	2805009300	0.04	-	-	-	-
Franklin	2805010100	0.02	-	-	-	-
Franklin	2805010200	0.00	-	-	-	-
Franklin	2805010300	0.01	-	-	-	-
Franklin	2805018000	22.18	-	-	-	-
Franklin	2805019100	0.53	-	-	-	-
Franklin	2805019200	1.49	-	-	-	-
Franklin	2805019300	0.15	-	-	-	-
Franklin	2805021100	14.12	-	-	-	-
Franklin	2805021200	19.14	-	-	-	-
Franklin	2805021300	23.76	-	-	-	-
Franklin	2805022100	2.07	-	-	-	-
Franklin	2805022200	0.10	-	-	-	-
Franklin	2805022300	1.20	-	-	-	-
Franklin	2805023100	9.42	-	-	-	-
Franklin	2805023200	0.17	-	-	-	-
Franklin	2805023300	12.57	-	-	-	-
Franklin	2805025000	-	-	-	-	-
Franklin	2805030000	0.14	-	-	-	-
Franklin	2805030007	0.21	-	-	-	-
Franklin	2805030008	0.16	-	-	-	-
Franklin	2805035000	38.28	-	-	-	-
Franklin	2805039100	93.85	-	-	-	-
Franklin	2805039200	171.60	-	-	-	-

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
Franklin	2805039300	14.78	-	-	-	-
Franklin	2805040000	4.20	-	-	-	-
Franklin	2805045000	3.75	-	-	-	-
Franklin	2805047100	20.99	-	-	-	-
Franklin	2805047300	8.95	-	-	-	-
Franklin	2805053100	0.45	-	-	-	-
Franklin	2810060100	-	0.35	0.02	0.05	0.00
Franklin County Total		**1,300.09**	**283.00**	**2,315.04**	**991.12**	**1,585.82**
Jefferson	2102001000	-	-	-	-	-
Jefferson	2102002000	0.36	131.59	-	863.70	0.60
Jefferson	2102004000	0.04	1.05	-	2.24	0.01
Jefferson	2102005000	0.01	0.91	-	5.86	0.00
Jefferson	2102006000	0.02	0.72	-	0.00	0.04
Jefferson	2102007000	-	-	-	-	-
Jefferson	2102008000	4.46	11.38	-	1.29	0.88
Jefferson	2102011000	-	-	-	-	-
Jefferson	2103001000	-	-	-	-	-
Jefferson	2103002000	0.00	1.09	-	6.97	0.00
Jefferson	2103004000	0.00	0.01	-	0.03	0.00
Jefferson	2103005000	0.00	0.01	-	0.07	0.00
Jefferson	2103006000	0.01	2.66	-	0.02	0.15
Jefferson	2103007000	0.00	0.12	-	0.00	0.01
Jefferson	2103008000	0.08	0.19	-	0.02	0.02
Jefferson	2103011000	-	0.01	-	0.02	-
Jefferson	2104001000	-	-	-	-	-
Jefferson	2104002000	-	-	-	-	-
Jefferson	2104004000	0.27	4.93	0.58	11.66	0.19
Jefferson	2104006000	16.58	77.94	0.36	0.50	4.56
Jefferson	2104007000	0.14	40.01	0.12	0.17	1.56
Jefferson	2104008100	3.21	4.64	42.15	0.71	33.76
Jefferson	2104008210	2.94	4.85	52.95	0.69	91.72
Jefferson	2104008220	0.50	1.27	10.89	0.22	6.67
Jefferson	2104008230	0.17	0.37	3.78	0.07	2.78
Jefferson	2104008310	2.66	4.38	47.91	0.63	82.99
Jefferson	2104008320	0.45	1.15	9.84	0.20	6.03
Jefferson	2104008330	0.15	0.33	3.40	0.07	2.50
Jefferson	2104008400	0.15	1.86	1.49	0.16	0.02
Jefferson	2104009000	-	1.80	6.67	-	9.29
Jefferson	2104011000	0.12	2.09	0.25	4.95	0.08
Jefferson	2294000000	-	-	229.48	-	-
Jefferson	2296000000	-	-	2,484.70	-	-
Jefferson	2302002100	-	-	5.42	-	1.31
Jefferson	2302002200	-	-	38.39	-	4.51
Jefferson	2302003000	-	-	-	-	1.37
Jefferson	2302003100	-	-	11.22	-	0.65
Jefferson	2302003200	-	-	0.76	-	0.03
Jefferson	2311010000	-	-	6.82	-	-
Jefferson	2311020000	-	-	56.75	-	-
Jefferson	2311030000	-	-	43.02	-	-
Jefferson	2325000000	-	-	19.13	-	-
Jefferson	2401001000	-	-	-	-	328.70

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
Jefferson	2401005000	-	-	-	-	30.22
Jefferson	2401008000	-	-	-	-	16.71
Jefferson	2401015000	-	-	-	-	0.17
Jefferson	2401020000	-	-	-	-	10.31
Jefferson	2401025000	-	-	-	-	1.25
Jefferson	2401030000	-	-	-	-	18.22
Jefferson	2401040000	-	-	-	-	-
Jefferson	2401050000	-	-	-	-	17.57
Jefferson	2401055000	-	-	-	-	11.18
Jefferson	2401060000	-	-	-	-	0.93
Jefferson	2401065000	-	-	-	-	-
Jefferson	2401070000	-	-	-	-	1.45
Jefferson	2401075000	-	-	-	-	1.93
Jefferson	2401080000	-	-	-	-	0.82
Jefferson	2401085000	-	-	-	-	-
Jefferson	2401090000	-	-	-	-	12.24
Jefferson	2401100000	-	-	-	-	119.72
Jefferson	2401200000	-	-	-	-	0.76
Jefferson	2415000000	-	-	-	-	50.67
Jefferson	2420000000	-	-	-	-	10.51
Jefferson	2425000000	-	-	-	-	73.46
Jefferson	2460100000	-	-	-	-	206.80
Jefferson	2460200000	-	-	-	-	195.91
Jefferson	2460400000	-	-	-	-	148.02
Jefferson	2460500000	-	-	-	-	103.40
Jefferson	2460600000	-	-	-	-	62.04
Jefferson	2460800000	-	-	-	-	193.73
Jefferson	2460900000	-	-	-	-	7.62
Jefferson	2461021000	-	-	-	-	67.05
Jefferson	2461022000	-	-	-	-	35.06
Jefferson	2461850000	-	-	-	-	13.40
Jefferson	2501011011	-	-	-	-	33.20
Jefferson	2501011012	-	-	-	-	64.83
Jefferson	2501011013	-	-	-	-	7.55
Jefferson	2501011014	-	-	-	-	2.48
Jefferson	2501011015	-	-	-	-	0.21
Jefferson	2501012011	-	-	-	-	1.06
Jefferson	2501012012	-	-	-	-	2.07
Jefferson	2501012013	-	-	-	-	10.29
Jefferson	2501012014	-	-	-	-	4.78
Jefferson	2501012015	-	-	-	-	0.40
Jefferson	2501050120	-	-	-	-	79.68
Jefferson	2501055120	-	-	-	-	62.00
Jefferson	2501060052	-	-	-	-	520.75
Jefferson	2501060201	-	-	-	-	50.80
Jefferson	2501080050	-	-	-	-	1.57
Jefferson	2501080100	-	-	-	-	0.08
Jefferson	2505030120	-	-	-	-	3.32
Jefferson	2505040120	-	-	-	-	67.69
Jefferson	2610000100	-	1.06	2.91	0.13	4.80
Jefferson	2610000400	-	0.86	2.61	0.28	3.26

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
Jefferson	2610000500	-	62.49	163.79	-	144.98
Jefferson	2610030000	-	22.97	133.22	3.83	32.77
Jefferson	2630020000	0.82	-	-	-	4.13
Jefferson	2801000003	-	-	49.33	-	-
Jefferson	2801700001	-	-	-	-	-
Jefferson	2801700002	-	-	-	-	-
Jefferson	2801700003	-	-	-	-	-
Jefferson	2801700004	15.47	-	-	-	-
Jefferson	2801700005	-	-	-	-	-
Jefferson	2801700006	0.01	-	-	-	-
Jefferson	2801700007	-	-	-	-	-
Jefferson	2801700010	6.04	-	-	-	-
Jefferson	2801700011	-	-	-	-	-
Jefferson	2801700012	-	-	-	-	-
Jefferson	2801700013	2.18	-	-	-	-
Jefferson	2801700014	-	-	-	-	-
Jefferson	2801700015	-	-	-	-	-
Jefferson	2801700099	0.05	-	-	-	-
Jefferson	2805001100	1.91	-	-	-	-
Jefferson	2805001200	0.00	-	-	-	-
Jefferson	2805001300	1.45	-	-	-	-
Jefferson	2805002000	16.10	-	-	-	-
Jefferson	2805003100	20.20	-	-	-	-
Jefferson	2805007100	0.94	-	-	-	-
Jefferson	2805007300	0.02	-	-	-	-
Jefferson	2805008100	-	-	-	-	-
Jefferson	2805008200	-	-	-	-	-
Jefferson	2805008300	-	-	-	-	-
Jefferson	2805009100	0.02	-	-	-	-
Jefferson	2805009200	0.00	-	-	-	-
Jefferson	2805009300	0.02	-	-	-	-
Jefferson	2805010100	0.02	-	-	-	-
Jefferson	2805010200	0.00	-	-	-	-
Jefferson	2805010300	0.01	-	-	-	-
Jefferson	2805018000	6.19	-	-	-	-
Jefferson	2805019100	0.16	-	-	-	-
Jefferson	2805019200	0.45	-	-	-	-
Jefferson	2805019300	0.04	-	-	-	-
Jefferson	2805021100	4.63	-	-	-	-
Jefferson	2805021200	6.27	-	-	-	-
Jefferson	2805021300	7.79	-	-	-	-
Jefferson	2805022100	0.67	-	-	-	-
Jefferson	2805022200	0.03	-	-	-	-
Jefferson	2805022300	0.39	-	-	-	-
Jefferson	2805023100	3.08	-	-	-	-
Jefferson	2805023200	0.06	-	-	-	-
Jefferson	2805023300	4.11	-	-	-	-
Jefferson	2805025000	-	-	-	-	-
Jefferson	2805030000	0.20	-	-	-	-
Jefferson	2805030007	0.20	-	-	-	-
Jefferson	2805030008	0.18	-	-	-	-

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
Jefferson	2805035000	22.70	-	-	-	-
Jefferson	2805039100	1.04	-	-	-	-
Jefferson	2805039200	2.02	-	-	-	-
Jefferson	2805039300	0.17	-	-	-	-
Jefferson	2805040000	1.91	-	-	-	-
Jefferson	2805045000	5.03	-	-	-	-
Jefferson	2805047100	0.23	-	-	-	-
Jefferson	2805047300	0.10	-	-	-	-
Jefferson	2805053100	0.00	-	-	-	-
Jefferson	2810060100	-	0.75	0.05	0.12	0.00
Jefferson County Total		**165.26**	**383.49**	**3,428.01**	**904.61**	**3,094.23**
St. Charles	2102001000	-	-	-	-	-
St. Charles	2102002000	0.33	121.74	-	799.05	0.55
St. Charles	2102004000	0.04	0.97	-	2.07	0.01
St. Charles	2102005000	0.01	0.84	-	5.42	0.00
St. Charles	2102006000	0.02	0.66	-	0.00	0.04
St. Charles	2102007000	-	-	-	-	-
St. Charles	2102008000	4.12	10.52	-	1.20	0.81
St. Charles	2102011000	-	-	-	-	-
St. Charles	2103001000	-	-	-	-	-
St. Charles	2103002000	0.01	4.56	-	29.14	0.02
St. Charles	2103004000	0.00	0.06	-	0.13	0.00
St. Charles	2103005000	0.00	0.05	-	0.29	0.00
St. Charles	2103006000	0.05	11.11	-	0.07	0.61
St. Charles	2103007000	0.00	0.48	-	0.00	0.03
St. Charles	2103008000	0.32	0.81	-	0.09	0.06
St. Charles	2103011000	-	0.03	-	0.06	-
St. Charles	2104001000	-	-	-	-	-
St. Charles	2104002000	0.82	3.71	1.57	42.85	4.08
St. Charles	2104004000	0.14	2.56	0.30	6.05	0.10
St. Charles	2104006000	52.03	244.54	1.12	1.56	14.31
St. Charles	2104007000	0.08	23.74	0.07	0.10	0.92
St. Charles	2104008100	5.06	7.30	66.29	1.12	53.09
St. Charles	2104008210	4.63	7.62	83.30	1.09	144.28
St. Charles	2104008220	0.79	1.99	17.11	0.35	10.48
St. Charles	2104008230	0.26	0.58	5.95	0.12	4.37
St. Charles	2104008310	4.19	6.90	75.38	0.99	130.56
St. Charles	2104008320	0.71	1.80	15.48	0.32	9.47
St. Charles	2104008330	0.24	0.53	5.36	0.11	3.94
St. Charles	2104008400	0.23	2.97	2.39	0.25	0.03
St. Charles	2104009000	-	2.88	10.64	-	14.82
St. Charles	2104011000	0.06	1.09	0.13	2.57	0.04
St. Charles	2294000000	-	-	260.13	-	-
St. Charles	2296000000	-	-	964.31	-	-
St. Charles	2302002100	-	-	8.70	-	2.11
St. Charles	2302002200	-	-	61.62	-	7.25
St. Charles	2302003000	-	-	-	-	2.20
St. Charles	2302003100	-	-	18.00	-	1.04
St. Charles	2302003200	-	-	1.22	-	0.04
St. Charles	2311010000	-	-	14.67	-	-
St. Charles	2311020000	-	-	92.66	-	-

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
St. Charles	2311030000	-	-	77.73	-	-
St. Charles	2325000000	-	-	18.87	-	-
St. Charles	2401001000	-	-	-	-	527.61
St. Charles	2401005000	-	-	-	-	71.07
St. Charles	2401008000	-	-	-	-	18.78
St. Charles	2401015000	-	-	-	-	2.37
St. Charles	2401020000	-	-	-	-	11.24
St. Charles	2401025000	-	-	-	-	-
St. Charles	2401030000	-	-	-	-	-
St. Charles	2401040000	-	-	-	-	-
St. Charles	2401050000	-	-	-	-	88.88
St. Charles	2401055000	-	-	-	-	137.97
St. Charles	2401060000	-	-	-	-	0.93
St. Charles	2401065000	-	-	-	-	-
St. Charles	2401070000	-	-	-	-	97.01
St. Charles	2401075000	-	-	-	-	-
St. Charles	2401080000	-	-	-	-	0.82
St. Charles	2401085000	-	-	-	-	5.91
St. Charles	2401090000	-	-	-	-	60.66
St. Charles	2401100000	-	-	-	-	192.17
St. Charles	2401200000	-	-	-	-	1.22
St. Charles	2415000000	-	-	-	-	184.72
St. Charles	2420000000	-	-	-	-	112.55
St. Charles	2425000000	-	-	-	-	831.61
St. Charles	2460100000	-	-	-	-	331.94
St. Charles	2460200000	-	-	-	-	314.47
St. Charles	2460400000	-	-	-	-	237.60
St. Charles	2460500000	-	-	-	-	165.97
St. Charles	2460600000	-	-	-	-	99.58
St. Charles	2460800000	-	-	-	-	310.97
St. Charles	2460900000	-	-	-	-	12.23
St. Charles	2461021000	-	-	-	-	74.55
St. Charles	2461022000	-	-	-	-	38.98
St. Charles	2461850000	-	-	-	-	96.05
St. Charles	2501011011	-	-	-	-	66.71
St. Charles	2501011012	-	-	-	-	130.25
St. Charles	2501011013	-	-	-	-	15.16
St. Charles	2501011014	-	-	-	-	4.98
St. Charles	2501011015	-	-	-	-	0.42
St. Charles	2501012011	-	-	-	-	2.13
St. Charles	2501012012	-	-	-	-	4.16
St. Charles	2501012013	-	-	-	-	20.68
St. Charles	2501012014	-	-	-	-	9.60
St. Charles	2501012015	-	-	-	-	0.81
St. Charles	2501050120	-	-	-	-	40.94
St. Charles	2501055120	-	-	-	-	31.82
St. Charles	2501060052	-	-	-	-	795.18
St. Charles	2501060201	-	-	-	-	77.57
St. Charles	2501080050	-	-	-	-	26.80
St. Charles	2501080100	-	-	-	-	1.39
St. Charles	2505030120	-	-	-	-	5.07

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
St. Charles	2505040120	-	-	-	-	34.79
St. Charles	2610000100	-	-	-	-	-
St. Charles	2610000400	-	-	-	-	-
St. Charles	2610000500	-	-	-	-	-
St. Charles	2610030000	-	-	-	-	-
St. Charles	2630020000	1.32	-	-	-	6.63
St. Charles	2801000003	-	-	522.93	-	-
St. Charles	2801500000	-	1.80	5.70	0.24	3.60
St. Charles	2801700001	51.93	-	-	-	-
St. Charles	2801700002	-	-	-	-	-
St. Charles	2801700003	375.03	-	-	-	-
St. Charles	2801700004	102.23	-	-	-	-
St. Charles	2801700005	0.01	-	-	-	-
St. Charles	2801700006	0.83	-	-	-	-
St. Charles	2801700007	0.17	-	-	-	-
St. Charles	2801700010	30.78	-	-	-	-
St. Charles	2801700011	-	-	-	-	-
St. Charles	2801700012	-	-	-	-	-
St. Charles	2801700013	14.66	-	-	-	-
St. Charles	2801700014	6.03	-	-	-	-
St. Charles	2801700015	2.90	-	-	-	-
St. Charles	2801700099	0.04	-	-	-	-
St. Charles	2805001100	8.40	-	-	-	-
St. Charles	2805001200	0.00	-	-	-	-
St. Charles	2805001300	6.38	-	-	-	-
St. Charles	2805002000	17.42	-	-	-	-
St. Charles	2805003100	25.21	-	-	-	-
St. Charles	2805007100	0.63	-	-	-	-
St. Charles	2805007300	0.01	-	-	-	-
St. Charles	2805008100	-	-	-	-	-
St. Charles	2805008200	-	-	-	-	-
St. Charles	2805008300	-	-	-	-	-
St. Charles	2805009100	-	-	-	-	-
St. Charles	2805009200	-	-	-	-	-
St. Charles	2805009300	-	-	-	-	-
St. Charles	2805010100	-	-	-	-	-
St. Charles	2805010200	-	-	-	-	-
St. Charles	2805010300	-	-	-	-	-
St. Charles	2805018000	3.79	-	-	-	-
St. Charles	2805019100	0.18	-	-	-	-
St. Charles	2805019200	0.52	-	-	-	-
St. Charles	2805019300	0.05	-	-	-	-
St. Charles	2805021100	4.42	-	-	-	-
St. Charles	2805021200	5.99	-	-	-	-
St. Charles	2805021300	7.44	-	-	-	-
St. Charles	2805022100	0.67	-	-	-	-
St. Charles	2805022200	0.03	-	-	-	-
St. Charles	2805022300	0.39	-	-	-	-
St. Charles	2805023100	2.96	-	-	-	-
St. Charles	2805023200	0.05	-	-	-	-
St. Charles	2805023300	3.95	-	-	-	-

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
St. Charles	2805025000	-	-	-	-	-
St. Charles	2805030000	0.14	-	-	-	-
St. Charles	2805030007	0.02	-	-	-	-
St. Charles	2805030008	0.02	-	-	-	-
St. Charles	2805035000	10.40	-	-	-	-
St. Charles	2805039100	35.38	-	-	-	-
St. Charles	2805039200	70.75	-	-	-	-
St. Charles	2805039300	5.82	-	-	-	-
St. Charles	2805040000	0.68	-	-	-	-
St. Charles	2805045000	0.15	-	-	-	-
St. Charles	2805047100	7.95	-	-	-	-
St. Charles	2805047300	3.39	-	-	-	-
St. Charles	2805053100	0.17	-	-	-	-
St. Charles	2810060100	-	1.20	0.08	0.19	0.00
St. Charles County Total		**883.43**	**463.05**	**2,331.71**	**895.42**	**5,711.78**
St. Louis	2102001000	-	-	-	-	-
St. Louis	2102002000	2.20	805.36	-	5,286.06	3.66
St. Louis	2102004000	0.26	6.43	-	13.69	0.06
St. Louis	2102005000	0.08	5.59	-	35.88	0.03
St. Louis	2102006000	0.14	4.40	-	0.03	0.24
St. Louis	2102007000	-	-	-	-	-
St. Louis	2102008000	27.28	69.63	-	7.91	5.38
St. Louis	2102011000	-	-	-	-	-
St. Louis	2103001000	-	-	-	-	-
St. Louis	2103002000	0.01	5.21	-	33.31	0.02
St. Louis	2103004000	0.00	0.07	-	0.14	0.00
St. Louis	2103005000	0.00	0.05	-	0.33	0.00
St. Louis	2103006000	0.06	12.70	-	0.08	0.70
St. Louis	2103007000	0.00	0.55	-	0.00	0.03
St. Louis	2103008000	0.36	0.93	-	0.11	0.07
St. Louis	2103011000	-	0.03	-	0.07	-
St. Louis	2104001000	-	-	-	-	-
St. Louis	2104002000	0.61	2.78	1.17	32.14	3.06
St. Louis	2104004000	0.24	4.28	0.51	10.12	0.17
St. Louis	2104006000	250.92	1,179.32	5.39	7.53	69.00
St. Louis	2104007000	0.06	16.21	0.05	0.07	0.63
St. Louis	2104008100	15.64	22.60	205.12	3.48	164.27
St. Louis	2104008210	14.32	23.58	257.71	3.37	446.37
St. Louis	2104008220	2.43	6.16	52.94	1.08	32.41
St. Louis	2104008230	0.81	1.80	18.38	0.36	13.52
St. Louis	2104008310	12.95	21.34	233.18	3.05	403.88
St. Louis	2104008320	2.20	5.57	47.89	0.98	29.32
St. Louis	2104008330	0.73	1.63	16.61	0.33	12.21
St. Louis	2104008400	0.74	9.34	7.52	0.79	0.10
St. Louis	2104009000	-	9.06	33.49	-	46.66
St. Louis	2104011000	0.10	1.82	0.21	4.30	0.07
St. Louis	2294000000	-	-	1,041.13	-	-
St. Louis	2296000000	-	-	563.24	-	-
St. Louis	2302002100	-	-	24.69	-	5.98
St. Louis	2302002200	-	-	174.92	-	20.57
St. Louis	2302003000	-	-	-	-	6.25

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
St. Louis	2302003100	-	-	51.10	-	2.95
St. Louis	2302003200	-	-	3.47	-	0.11
St. Louis	2311010000	-	-	7.11	-	-
St. Louis	2311020000	-	-	1,634.59	-	-
St. Louis	2311030000	-	-	37.90	-	-
St. Louis	2325000000	-	-	93.01	-	-
St. Louis	2401001000	-	-	-	-	1,497.67
St. Louis	2401005000	-	-	-	-	370.33
St. Louis	2401008000	-	-	-	-	52.22
St. Louis	2401015000	-	-	-	-	4.28
St. Louis	2401020000	-	-	-	-	98.92
St. Louis	2401025000	-	-	-	-	86.80
St. Louis	2401030000	-	-	-	-	21.69
St. Louis	2401040000	-	-	-	-	1.01
St. Louis	2401050000	-	-	-	-	74.50
St. Louis	2401055000	-	-	-	-	208.30
St. Louis	2401060000	-	-	-	-	-
St. Louis	2401065000	-	-	-	-	0.27
St. Louis	2401070000	-	-	-	-	414.80
St. Louis	2401075000	-	-	-	-	-
St. Louis	2401080000	-	-	-	-	8.49
St. Louis	2401085000	-	-	-	-	-
St. Louis	2401090000	-	-	-	-	189.04
St. Louis	2401100000	-	-	-	-	545.51
St. Louis	2401200000	-	-	-	-	3.47
St. Louis	2415000000	-	-	-	-	563.45
St. Louis	2420000000	-	-	-	-	404.19
St. Louis	2425000000	-	-	-	-	3,440.83
St. Louis	2460100000	-	-	-	-	942.24
St. Louis	2460200000	-	-	-	-	892.65
St. Louis	2460400000	-	-	-	-	674.45
St. Louis	2460500000	-	-	-	-	471.12
St. Louis	2460600000	-	-	-	-	282.67
St. Louis	2460800000	-	-	-	-	882.73
St. Louis	2460900000	-	-	-	-	34.71
St. Louis	2461021000	-	-	-	-	318.28
St. Louis	2461022000	-	-	-	-	166.41
St. Louis	2461850000	-	-	-	-	19.07
St. Louis	2501011011	-	-	-	-	382.31
St. Louis	2501011012	-	-	-	-	746.44
St. Louis	2501011013	-	-	-	-	86.89
St. Louis	2501011014	-	-	-	-	28.53
St. Louis	2501011015	-	-	-	-	2.41
St. Louis	2501012011	-	-	-	-	12.21
St. Louis	2501012012	-	-	-	-	23.84
St. Louis	2501012013	-	-	-	-	118.54
St. Louis	2501012014	-	-	-	-	54.99
St. Louis	2501012015	-	-	-	-	4.65
St. Louis	2501050120	-	-	-	-	204.18
St. Louis	2501055120	-	-	-	-	164.47
St. Louis	2501060052	-	-	-	-	3,571.91

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
St. Louis	2501060201	-	-	-	-	348.44
St. Louis	2501080050	-	-	-	-	55.24
St. Louis	2501080100	-	-	-	-	2.87
St. Louis	2505030120	-	-	-	-	22.79
St. Louis	2505040120	-	-	-	-	179.58
St. Louis	2610000100	-	-	-	-	-
St. Louis	2610000400	-	-	-	-	-
St. Louis	2610000500	-	-	-	-	-
St. Louis	2610030000	-	-	-	-	-
St. Louis	2630020000	3.74	-	-	-	18.82
St. Louis	2801000003	-	-	73.19	-	-
St. Louis	2801700001	0.08	-	-	-	-
St. Louis	2801700002	-	-	-	-	-
St. Louis	2801700003	-	-	-	-	-
St. Louis	2801700004	532.02	-	-	-	-
St. Louis	2801700005	12.04	-	-	-	-
St. Louis	2801700006	1.23	-	-	-	-
St. Louis	2801700007	-	-	-	-	-
St. Louis	2801700010	59.69	-	-	-	-
St. Louis	2801700011	-	-	-	-	-
St. Louis	2801700012	-	-	-	-	-
St. Louis	2801700013	2.84	-	-	-	-
St. Louis	2801700014	0.08	-	-	-	-
St. Louis	2801700015	0.16	-	-	-	-
St. Louis	2801700099	2.22	-	-	-	-
St. Louis	2805001100	3.06	-	-	-	-
St. Louis	2805001200	0.00	-	-	-	-
St. Louis	2805001300	2.32	-	-	-	-
St. Louis	2805002000	2.06	-	-	-	-
St. Louis	2805003100	-	-	-	-	-
St. Louis	2805007100	0.05	-	-	-	-
St. Louis	2805007300	0.00	-	-	-	-
St. Louis	2805008100	-	-	-	-	-
St. Louis	2805008200	-	-	-	-	-
St. Louis	2805008300	-	-	-	-	-
St. Louis	2805009100	-	-	-	-	-
St. Louis	2805009200	-	-	-	-	-
St. Louis	2805009300	-	-	-	-	-
St. Louis	2805010100	0.00	-	-	-	-
St. Louis	2805010200	0.00	-	-	-	-
St. Louis	2805010300	0.00	-	-	-	-
St. Louis	2805018000	-	-	-	-	-
St. Louis	2805019100	-	-	-	-	-
St. Louis	2805019200	-	-	-	-	-
St. Louis	2805019300	-	-	-	-	-
St. Louis	2805021100	-	-	-	-	-
St. Louis	2805021200	-	-	-	-	-
St. Louis	2805021300	-	-	-	-	-
St. Louis	2805022100	-	-	-	-	-
St. Louis	2805022200	-	-	-	-	-
St. Louis	2805022300	-	-	-	-	-

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
St. Louis	2805023100	-	-	-	-	-
St. Louis	2805023200	-	-	-	-	-
St. Louis	2805023300	-	-	-	-	-
St. Louis	2805025000	-	-	-	-	-
St. Louis	2805030000	-	-	-	-	-
St. Louis	2805030007	-	-	-	-	-
St. Louis	2805030008	0.03	-	-	-	-
St. Louis	2805035000	10.35	-	-	-	-
St. Louis	2805039100	21.78	-	-	-	-
St. Louis	2805039200	40.00	-	-	-	-
St. Louis	2805039300	3.54	-	-	-	-
St. Louis	2805040000	-	-	-	-	-
St. Louis	2805045000	0.16	-	-	-	-
St. Louis	2805047100	4.90	-	-	-	-
St. Louis	2805047300	2.09	-	-	-	-
St. Louis	2805053100	0.10	-	-	-	-
St. Louis	2810060100	-	3.42	0.23	0.53	0.01
St. Louis County Total		**1,036.69**	**2,219.83**	**4,584.76**	**5,445.70**	**19,966.90**
St. Louis City	2102001000	-	-	-	-	-
St. Louis City	2102002000	1.31	481.19	-	3,158.32	2.19
St. Louis City	2102004000	0.15	3.84	-	8.18	0.04
St. Louis City	2102005000	0.05	3.34	-	21.43	0.02
St. Louis City	2102006000	0.08	2.63	-	0.02	0.14
St. Louis City	2102007000	-	-	-	-	-
St. Louis City	2102008000	16.30	41.60	-	4.73	3.21
St. Louis City	2102011000	-	-	-	-	-
St. Louis City	2103001000	-	-	-	-	-
St. Louis City	2103002000	0.01	4.55	-	29.05	0.02
St. Louis City	2103004000	0.00	0.06	-	0.12	0.00
St. Louis City	2103005000	0.00	0.05	-	0.29	0.00
St. Louis City	2103006000	0.05	11.08	-	0.07	0.61
St. Louis City	2103007000	0.00	0.48	-	0.00	0.03
St. Louis City	2103008000	0.32	0.81	-	0.09	0.06
St. Louis City	2103011000	-	0.03	-	0.06	-
St. Louis City	2104001000	-	-	-	-	-
St. Louis City	2104002000	0.61	2.78	1.17	32.14	3.06
St. Louis City	2104004000	0.19	3.42	0.41	8.10	0.13
St. Louis City	2104006000	91.88	431.86	1.98	2.76	25.27
St. Louis City	2104007000	0.03	8.20	0.02	0.03	0.32
St. Louis City	2104008100	5.36	7.74	70.27	1.19	56.27
St. Louis City	2104008210	4.91	8.08	88.30	1.15	152.94
St. Louis City	2104008220	0.83	2.11	18.13	0.37	11.10
St. Louis City	2104008230	0.28	0.62	6.28	0.12	4.62
St. Louis City	2104008310	4.44	7.31	79.89	1.04	138.37
St. Louis City	2104008320	0.75	1.91	16.40	0.33	10.04
St. Louis City	2104008330	0.25	0.56	5.67	0.11	4.17
St. Louis City	2104008400	0.27	3.39	2.73	0.29	0.04
St. Louis City	2104009000	-	3.29	12.15	-	16.92
St. Louis City	2104011000	0.08	1.45	0.17	3.44	0.06
St. Louis City	2294000000	-	-	321.54	-	-
St. Louis City	2296000000	-	-	-	-	-

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
St. Louis City	2302002100	-	-	8.82	-	2.14
St. Louis City	2302002200	-	-	62.50	-	7.35
St. Louis City	2302003000	-	-	-	-	2.23
St. Louis City	2302003100	-	-	18.26	-	1.05
St. Louis City	2302003200	-	-	1.24	-	0.04
St. Louis City	2311010000	-	-	2.90	-	-
St. Louis City	2311020000	-	-	477.56	-	-
St. Louis City	2311030000	-	-	13.44	-	-
St. Louis City	2325000000	-	-	164.24	-	-
St. Louis City	2401001000	-	-	-	-	535.09
St. Louis City	2401005000	-	-	-	-	63.23
St. Louis City	2401008000	-	-	-	-	12.57
St. Louis City	2401015000	-	-	-	-	3.05
St. Louis City	2401020000	-	-	-	-	110.85
St. Louis City	2401025000	-	-	-	-	188.80
St. Louis City	2401030000	-	-	-	-	13.91
St. Louis City	2401040000	-	-	-	-	63.81
St. Louis City	2401050000	-	-	-	-	180.88
St. Louis City	2401055000	-	-	-	-	29.51
St. Louis City	2401060000	-	-	-	-	-
St. Louis City	2401065000	-	-	-	-	2.17
St. Louis City	2401070000	-	-	-	-	38.01
St. Louis City	2401075000	-	-	-	-	-
St. Louis City	2401080000	-	-	-	-	1.42
St. Louis City	2401085000	-	-	-	-	-
St. Louis City	2401090000	-	-	-	-	43.79
St. Louis City	2401100000	-	-	-	-	194.90
St. Louis City	2401200000	-	-	-	-	1.24
St. Louis City	2415000000	-	-	-	-	269.09
St. Louis City	2420000000	-	-	-	-	220.89
St. Louis City	2425000000	-	-	-	-	1,695.45
St. Louis City	2460100000	-	-	-	-	336.64
St. Louis City	2460200000	-	-	-	-	318.93
St. Louis City	2460400000	-	-	-	-	240.97
St. Louis City	2460500000	-	-	-	-	168.32
St. Louis City	2460600000	-	-	-	-	100.99
St. Louis City	2460800000	-	-	-	-	315.38
St. Louis City	2460900000	-	-	-	-	12.40
St. Louis City	2461021000	-	-	-	-	115.27
St. Louis City	2461022000	-	-	-	-	60.27
St. Louis City	2461850000	-	-	-	-	-
St. Louis City	2501011011	-	-	-	-	59.21
St. Louis City	2501011012	-	-	-	-	115.61
St. Louis City	2501011013	-	-	-	-	13.46
St. Louis City	2501011014	-	-	-	-	4.42
St. Louis City	2501011015	-	-	-	-	0.37
St. Louis City	2501012011	-	-	-	-	1.89
St. Louis City	2501012012	-	-	-	-	3.69
St. Louis City	2501012013	-	-	-	-	18.36
St. Louis City	2501012014	-	-	-	-	8.52
St. Louis City	2501012015	-	-	-	-	0.72

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
St. Louis City	2501050120	-	-	-	-	219.07
St. Louis City	2501055120	-	-	-	-	170.29
St. Louis City	2501060052	-	-	-	-	913.01
St. Louis City	2501060201	-	-	-	-	89.06
St. Louis City	2501080050	-	-	-	-	0.73
St. Louis City	2501080100	-	-	-	-	0.04
St. Louis City	2505030120	-	-	-	-	5.82
St. Louis City	2505040120	-	-	-	-	186.16
St. Louis City	2610000100	-	-	-	-	-
St. Louis City	2610000400	-	-	-	-	-
St. Louis City	2610000500	-	-	-	-	-
St. Louis City	2610030000	-	-	-	-	-
St. Louis City	2630020000	1.34	-	-	-	6.72
St. Louis City	2801000003	-	-	-	-	-
St. Louis City	2801700001	-	-	-	-	-
St. Louis City	2801700002	-	-	-	-	-
St. Louis City	2801700003	-	-	-	-	-
St. Louis City	2801700004	-	-	-	-	-
St. Louis City	2801700005	-	-	-	-	-
St. Louis City	2801700006	-	-	-	-	-
St. Louis City	2801700007	-	-	-	-	-
St. Louis City	2801700010	-	-	-	-	-
St. Louis City	2801700011	-	-	-	-	-
St. Louis City	2801700012	-	-	-	-	-
St. Louis City	2801700013	-	-	-	-	-
St. Louis City	2801700014	-	-	-	-	-
St. Louis City	2801700015	-	-	-	-	-
St. Louis City	2801700099	-	-	-	-	-
St. Louis City	2805001100	-	-	-	-	-
St. Louis City	2805001200	-	-	-	-	-
St. Louis City	2805001300	-	-	-	-	-
St. Louis City	2805002000	-	-	-	-	-
St. Louis City	2805003100	-	-	-	-	-
St. Louis City	2805007100	-	-	-	-	-
St. Louis City	2805007300	-	-	-	-	-
St. Louis City	2805008100	-	-	-	-	-
St. Louis City	2805008200	-	-	-	-	-
St. Louis City	2805008300	-	-	-	-	-
St. Louis City	2805009100	-	-	-	-	-
St. Louis City	2805009200	-	-	-	-	-
St. Louis City	2805009300	-	-	-	-	-
St. Louis City	2805010100	-	-	-	-	-
St. Louis City	2805010200	-	-	-	-	-
St. Louis City	2805010300	-	-	-	-	-
St. Louis City	2805018000	-	-	-	-	-
St. Louis City	2805019100	-	-	-	-	-
St. Louis City	2805019200	-	-	-	-	-
St. Louis City	2805019300	-	-	-	-	-
St. Louis City	2805021100	-	-	-	-	-
St. Louis City	2805021200	-	-	-	-	-
St. Louis City	2805021300	-	-	-	-	-

CountyName	SCC	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC *
St. Louis City	2805022100	-	-	-	-	-
St. Louis City	2805022200	-	-	-	-	-
St. Louis City	2805022300	-	-	-	-	-
St. Louis City	2805023100	-	-	-	-	-
St. Louis City	2805023200	-	-	-	-	-
St. Louis City	2805023300	-	-	-	-	-
St. Louis City	2805025000	-	-	-	-	-
St. Louis City	2805030000	-	-	-	-	-
St. Louis City	2805030007	-	-	-	-	-
St. Louis City	2805030008	-	-	-	-	-
St. Louis City	2805035000	-	-	-	-	-
St. Louis City	2805039100	-	-	-	-	-
St. Louis City	2805039200	-	-	-	-	-
St. Louis City	2805039300	-	-	-	-	-
St. Louis City	2805040000	-	-	-	-	-
St. Louis City	2805045000	-	-	-	-	-
St. Louis City	2805047100	-	-	-	-	-
St. Louis City	2805047300	-	-	-	-	-
St. Louis City	2805053100	-	-	-	-	-
St. Louis City	2810060100	-	1.22	0.08	0.19	0.00
St. Louis City Total		**129.50**	**1,033.57**	**1,374.12**	**3,273.63**	**7,597.40**
St. Louis Nonattainment Area Total		**3,514.98**	**4,382.94**	**14,033.64**	**11,510.48**	**37,956.13**

* Note: This table does not include VOC refueling emissions (Stage II) for on-road motor vehicles

Because, Stage II refueling VOC emissions were calculated by the Air Program using MOVES, they are not included in the Table 8. The Stage II refueling emissions were added to the totals from the other area source categories in Table 8 to get the complete area source emissions inventory summaries for the Missouri counties of the St. Louis nonattainment area, which are listed below in Table 9.

Table 9 STLNA Nonpoint Annual VOC Emissions (tons per year)

County	VOC*
Franklin	1,604.16
Jefferson	3,116.32
St. Charles	5,744.68
St. Louis	20,110.91
St. Louis City	7,639.28
STLNA Total	**38,215.34**

*Note: Includes VOC emissions from refueling (Stage II)

Table 10 Nonpoint Category Overview of Methodology

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
21030* and 21020*	Industrial and Commercial Institutional Fuel Combustion	16	CAP	Yes	EPA/CENRAP Template including energy intensity per sector NAICS		Huntley 2009 [6]	2006 EIA's SEDS [1]	2006
2401005000	Automobile Refinishing	1	VOC and 5 HAPS	No	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401015000	Wood and Flat Stock (Factory Finished Wood)	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401020000	Wood Furniture	1	VOC only	Yes	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
2401025000	Metal Furniture	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401030000	Paper Film Foil	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401040000	Metal Cans	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401045000	Metal Coil Only	1	VOC and 6 HAPs	No	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
2401050000	Metal Sheet Strip and Coil	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment, HAPs not included in template were created by MODNR		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401055000	Machinery and Equipment	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401060000	Appliances	1	VOC and 6 HAPs	No	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401065000	Electronic and other special coatings	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
2401070000	Motor Vehicles	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment, HAPs not included in template were created by MODNR		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401075000	Aircraft	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment, HAPs not included in template were created by MODNR		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401085000	Railroads	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
2401080000	Marine Coatings	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment, HAPs not included in template were created by MODNR		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401090000	Misc Manufacturing	1	VOC and 6 HAPs	Yes	EPA Template - emissions based on employment, HAPs not included in template were created by MODNR		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2415000000	Degreasing	1	VOC and 1 HAP	Yes	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2420000000	Dry Cleaning	1	VOC only	No	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
2425000000	Graphic Arts	1	VOC and 5 HAPs	Yes	EPA Template - emissions based on employment		Solvent Documentation [4]	Employment from 2006 *County Business Patterns* [2]	2006
2401001000	Architectural Coatings	1	VOC and 5 HAPs	No		Template - population based emissions	Solvent Documentation [4]	Population from US Census [3]	2008
2401008000	Traffic Paints	1	VOC and 4 HAPs	No		Template - emissions based on 2006 highway miles	Solvent Documentation [4]	2006 FHWA HPMS[5]	2006
2401100000	Industrial Maintenance Coatings	1	VOC and 6 HAPs	No		Template - population based emissions	Solvent Documentation [4]	Population from US Census [3]	2008
2401200000	Other Special Purpose Coatings	1	VOC and 6 HAPs	No		Template - population based emissions	Solvent Documentation [4]	Population from US Census [3]	2008

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
2460100000	Personal Care Products	1	VOC and 2 HAPs	No		Template - population based emissions	Solvent Documentation [4]	Population from US Census [3]	2008
2460200000	Cleaning Products: household	1	VOC and 2 HAPs	No		Template - population based emissions	Solvent Documentation [4]	Population from US Census [3]	2008
2460400000	Automotive Aftermarket	1	VOC and 2 HAPs	No		Template - population based emissions	Solvent Documentation [4]	Population from US Census [3]	2008
2460500000	Coatings and Related Products	1	VOC and 2 HAPs	No		Template - population based emissions	Solvent Documentation [4]	Population from US Census [3]	2008
2460600000	Adhesives and Sealants	1	VOC and 2 HAPs	No		Template - population based emissions	Solvent Documentation [4]	Population from US Census [3]	2008

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
2460800000	FIFRA Regulated Products	1	VOC and 2 HAPs	No		Template - population based emissions	Solvent Documentation [4]	Population from US Census [3]	2008
2460900000	Misc Products	1	VOC and 2 HAPs	No		Template - population based emissions	Solvent Documentation [4]	Population from US Census [3]	2008
2501050120	Bulk Terminal	1	VOC and 8 HAPs	Yes	EPA Template - point source emissions subtracted by NAICS and county		No emission factor, scaled up 1998 VOC emission from MACT analysis[8]	Scaled 1998 emissions by 2008 DOE [7]	2008
2501055120	Bulk Plants	1	VOC and 8 HAPs	Yes	EPA Template - point source emissions subtracted by NAICS and county		From Gas distribution MACT standards[8]	9% of total gasoline consumption from 2008 EIA Petroleum Navigator[10]	2008
2505040120	Petroleum Pipeline	1	VOC and 8 HAPs	No	EPA Template		No emission factor, scaled up 1998 VOC emission from MACT analysis[8]	Scaled 1998 emissions by 2008 DOE[7]	2008

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
2501060201	Gasoline Stage 1 Underground Storage Tanks	1	VOC and 8 HAPs	No	EPA Template		EIIP 2001 [9]	2008 NMIM county-level onroad and nonroad estimates	2008
2505030120	Gasoline Stage 1 Trucks in Transit	1	VOC and 8 HAPs	No	EPA Template		EIIP 2001 [9]	2008 NMIM county-level onroad and nonroad estimates	2008
250106005*	Gasoline Service Station Loading (submerg, splash, and balanced fill)	3	VOC and 8 HAPs	No	EPA Template		AP-42 Section 5.2[11]	2008 NMIM county-level onroad and nonroad estimates	2008
2501060100	Gasoline Distribution: Stage II	1	VOC and 8 HAPs	No	EPA Template		AP-42 Section 5.2[11]	2008 NMIM county-level onroad and nonroad estimates	2008
21040*	Residential Fuel Combustion (multiple fuel types)	16	CAPs	No		EPA Templates and Residential Wood Combustion Tool[25]	AP-42	EIA[1]	2006

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
2280002*	Mobile Sources - Marine Vessels - port and underway emissions	2	CAP	No		2002 estimates adjusted for 2008 activity	EPA's Office of Transportation and Air Quality (OTAQ) CAP, SEPA HAP speciation[13]	Regional growth factor for vessel activity	2002 grown to 2008
2294000000 and 2296000000	Paved and Unpaved Roads	2	PM10 FIL/PRI, PM25 FIL/PRI	No		AP-42 Equation with state or regional constants	AP-42 Section 13.2.2	2007 FHWA Highway Statistics[14]	2007
230200*	Commerical Cooking	5	CAP and HAP	No		Template - population based emissions	2002 emissions divided by population to create per captia factors	Population from US Census [3]	2008
23110*	Construction Dust (residential, industrial/commercial, roadway)	3	PM10 PRI, PM25 PRI	No		Residential activity by county used, allocate national roadway by employment	EPA documentation	Construction from Census[15] and highway construction FHWA[14]	2006 for roadway, 2008 for residential and non-residential construction,
246102*	Asphalt (cutback and emulsified)	2	CAP and HAP	No		National usage allocated to county by paved road VMT	EIIP 2001 [17]	Asphalt Institute's *2008 Asphalt Usage Survey*	2008

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
2501011*	Residential Portable Fuel Container	5	VOC And HAP	No		Linear fit between 2002 and 2010 emission estimates	EPA[18]	Nonroad activity from NMIM	2002 grown to 2010 with a linear fit to 2008
2501012*	Commercial Portable Fuel Container	5	VOC and HAP	No		Linear fit between 2002 and 2010 emission estimates	EPA[18]	Nonroad activity from NMIM	2002 grown to 2010 with a linear fit to 2008
2501080*	Aviation Petroleum Product use (Stage 1 and 2)	2	VOC and HAP	No		National use allocated by regions and 2008 landing and take-off activity	Four EPA documents	EIA Petroleum Annual Supply, 2008[19]	2008
26100*	Waste Disposal - Open Burning	4	VOC and HAP	No		Per capita emissions including controls	EPA documentation, EF based on 2007 report	EPA Report[20] and construction activity SCC 23110*	2008
2630020000	Waste Disposal Public Treatment	1	VOC and NH3	No		Calculate national emissions, allocate to counties by population	EPA[23,24] reports	EPA Report[22]	2004 and 2010 figures interpolated to 2008

SCC	Category Name	Number of SCCs	Pollutants Included	Point Source Subtraction	Category Submitted by Missouri - Calculation Method	Category Submitted by EPA - Calculation Method	Emission Factor Source	Activity for Category	Activity Base Year
2801700*	Fertilizer Application	14	NH3	No		Activity used in CMU Ammonia Model	CMU Ammonia Model	2002 and 2007 activity from the Fertilizer Institute[21] grown to 2008	grown 2008 figure
28050*	Animal Husbandry (by animal and manure system)	42	NH3	No		CMU Ammonia Model	CMU Ammonia Model	2007 Census of Agriculture[12]	2007

[1] EIA SEDS - Energy Information Administration - State Energy Data System http://www.eia.doe.gov/emeu/states/_seds.html

[2] Employment US Census Bureau *County Business Patterns* http://www.census.gov/epcd/cbp/download/06_data/index.html

[3] Population from US Census http://factfinder.census.gov

[4] Solvent Documentation, Table 2 and Table 3

[5] FHWA HPMS - Federal Highway Administration Highway Performance Monitoring System http://www.fhwa.dot.gov/policy/ohpi/hpms/index.cfm

[6] Huntley, Roy 2009, Criteria Pollutant Emission Factors for ICI Combustion Area Source Categories

[7] DOE - Department of Energy Energy Information Administration *Petroleum Supply Annual 2008, Volume 1,* Table 2

[8] "Gasoline Distribution Industry (Stage 1) - Background Information for Proposed Standards," EPA-453/R94-002a, OAQPS, Jan 1994 and "Gasoline Distribution Industry (Stage 1) - Background Information for Promulgated Standards," EPA-453/R94-002b, OAQPS, Nov 1994

[9] EIIP, Emission Inventory Improvement Program "Volume III: Chapter 11, Gasoline Marketing (Stage I and Stage II), Revised Final", Jan 2001

[10] EIA Energy Information Administration Petroleum Navigator - Product Supplied from http://tonto.eia.doe.gov/dnav/pet/pet_cons_psup_dc_nus_mbblpd_a.htm

[11] AP-42 Section 5.2 "Transportation and Marketing of Petroleum Liquids"

[12] 2007 Census of Agriculture, US Department of Agriculture, http://www.agcensus.usda.gov/

[13] SEPA - Swedish Environmental Protection Agency report 2004-02-02
http://westcoastcollaborative.org/files/sector-marine/SMED%20Methodology%20for%20Calculating%20Emissions%20from%20Ships.pdf

[14] Federal Highway Administration 2007 Highway Statistics http://www.fhwa.dot.gov/policyinformation/statistics/2007/.

[15] Annual Value of Construction http://www.census.gov/const/www/ototpage.html

[16] Asphalt Institute 2008 Survey http://www.asphaltinstitute.org/.

[17] EIIP, Emission Inventory Improvement Program Volume III – Area Sources, Chapter 17, "Asphalt Paving," 2001

[18] EPA Document *Estimating Emissions from Portable Fuel Containers (PFCs)* http://www.epa.gov/otaq/regs/toxics/420r07001.pdf

[19] EIA 2008 Petroleum Annual Supply,
http://www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_supply_annual/psa_volume1/psa_volume1.html

[20] EPA *Municipal Solid Waste in the United States: 2007 Facts and Figures*, EPA530-R-08-010,
http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw07-rpt.pdf

[21] Assn of American Plant Food Control Officials with The Fertilizer Institute, *Commercial Fertilizers 2002 and Commercial Fertilizers 2007*,
http://www.aapfco.org/aapfcopubs.html

[22] *Biosolids Generation, Use, and Disposal in the United States*, Table A-8 EPA530-R-99-009, September 1999

[23] EPA EIIP Emission Inventory Improvement Program, April 2004, *Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources – Draft Final Report*

[24] VOC Emissions from Wastewater Treatment Plants: Characterization, Control, and Compliance, Lewis Publishers, 2003, p. 261

[25] Residential Wood Combustion Tool, http://www.epa.gov/ttn/chief/net/2008inventory.html

3.2.3 Source Category Documentation

The following documentation covers nonpoint categories that were prepared with guidance from EPA and CENRAP. The documentation files include methodologies to be applied nationally, and include Missouri-specific updates and information.

3.2.3.1 Fugitive Dust from Paved Roads

a. Source Category Description

Fugitive dust emissions from paved road traffic were estimated for PM10-PRI, PM10-FIL, PM25-PRI, and PM25-FIL. Since there are no PM-CON emissions for this category, PM10-PRI emissions are equal to PM10-FIL emissions and PM25-PRI emissions are equal to PM25-FIL.

For this source category, the following SCC was assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2294000000	Mobile Sources	Paved Roads	All Paved Roads	Total: Fugitives

The table below provides a national summary of the estimated 2008 annual vehicle miles traveled (VMT) activity and emissions by pollutant. VMT from 2007 were used to estimate the VMT from 2008 which were unavailable.

2008 National Criteria Air Pollutant Emissions Summary for Fugitive Dust from Paved Roads

Pollutant Description and NIF 3.0 Pollutant Code	Emission Factor	National Activity (Million Miles)	National Emissions (Tons)
PM10-FIL	Reference 1	2,755,891	2,090,319
PM10-PRI	Reference 1	2,755,891	2,090,319
PM25-FIL	Reference 1	2,755,891	128,959
PM25-PRI	Reference 1	2,755,891	128,959

Uncontrolled paved road emissions were calculated at the State level by roadway class and month. This was done by multiplying the State/roadway class VMT by the appropriate monthly temporal allocation factor and by the paved road emission factor. After the paved road dust emissions were calculated at the State/road class/monthly level of detail, the uncontrolled emissions were then allocated to the county level using total VMT as a surrogate. Next, control factors were applied to the paved road emissions in PM_{10} nonattainment area counties. Emissions and VMT by roadway class were then totaled to the county level for reporting in the NEI. The following provides further details on the emission factor equation, temporal and spatial allocation procedures, and controls.

b. Emission Factor Equation

Reentrained road dust emissions for paved roads were estimated using paved road VMT and the emission factor equation from AP-42:[1]

$$E = [\, k * (sL/2)^{0.65} * (W/3)^{1.5} - C \,] * [1 - P/(4*N)]$$

where: E = paved road dust emission factor (gram [g]/VMT)
k = particle size multiplier (7.3 g/VMT for PM10-PRI/-FIL and 1.1 g/VMT for PM25-PRI/-FIL)
sL = road surface silt loading (g/square meter [m^2])
W = average weight (tons) of all vehicles traveling the road
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear (0.2119 g/VMT for PM10-PRI/-FIL and 0.1617 g/VMT for PM 2.5-PRI/-FIL)
N = number of days in the month
P = number of days in the month with at least 0.01 inches of precipitation

The uncontrolled PM10-PRI/-FIL and PM25-PRI/-FIL emission factors are provided in attached file "Paved Roads PM Emission Factors.xls" by State, roadway class, and month.

Paved road silt loadings were assigned to each of the twelve functional roadway classes (six urban and six rural) based on the average annual traffic volume of each functional system by State.[2] The resulting paved road silt loadings calculated from the average annual traffic volume data are shown in the corresponding table below.

The AP-42 equation listed above includes a correction factor to adjust for the number of days with measurable precipitation in each month. The factor of "4" in the precipitation adjustment accounts for the fact that paved roads dry more quickly than unpaved roads and that precipitation may not occur over the entire 24-hour day period. The number of days with at least 0.01 inches of precipitation in each month by State was obtained from the National Climatic Data Center.[3] Data were collected from a meteorological station selected to be representative of urban areas within each State. There are cases where the emission factor calculated using the equation above ends up negative due to the subtraction of the C term that accounts for vehicle exhaust, brake wear, and tire wear. In these cases, the emission factor was reset to 0, under the assumption that the emissions have been accounted for in the onroad emission inventory.

c. Activity

Total annual VMT estimates by State and roadway class were obtained from the Federal Highway Administration's (FHWA) annual Highway Statistics report.[2] Paved road VMT was calculated by subtracting the State/roadway class unpaved road VMT from total State/roadway class VMT.

d. Allocation

The paved road VMT estimates by State/roadway class were first temporally allocated by season using the National Acid Precipitation Assessment Program (NAPAP) Inventory seasonal temporal allocations factors for VMT.[4] These factors are included in the attachment "Unpaved Road county allocation fractions.xls." The seasonal VMT values were then multiplied by the ratio of the number of days in a month to the number of days in a season to adjust to monthly VMT. The emission factors were then applied to estimate emissions by month.

The paved road activity and emissions were spatially allocated to counties according to the fraction of total VMT in each county for the specific roadway class as shown by the following equation:

$$EMIS_{x,y} = EMIS_{ST,y} * VMT_{x,y} / VMT_{ST,y}$$

where: $EMIS_{x,y}$ = paved road emissions (tons) for county x and roadway class y
$EMIS_{ST,y}$ = paved road emissions (tons) for the entire State for roadway class y $VMT_{x,y}$ = total VMT (million miles) in county x and

roadway class y $VMT_{ST,y}$ = total VMT (million miles) in entire State for roadway class y

The county-level VMT by roadway class developed to calculate onroad mobile source emissions was used in this equation.[5] Note that because of differences in the methodologies for calculating total and unpaved road VMT, there are rural counties where unpaved road VMT was higher than total VMT. For these counties, unpaved VMT was reduced to total VMT and paved road VMT was assigned a value of zero.

e. Controls

Paved road dust controls were applied by county to urban and rural roads in serious PM_{10} nonattainment areas and to urban roads in moderate PM_{10} nonattainment areas. The assumed control measure is vacuum sweeping of paved roads twice per month. A control efficiency of 79 percent was assumed for this control measure.[6] The assumed rule penetration varies by roadway class and PM_{10} nonattainment area classification (serious or moderate).[6] The rule penetration rates are shown in the corresponding table below. Rule effectiveness was assumed to be 100% for all counties where this control was applied.

Note that the controls were applied at the county/roadway class level, and the controls differ by roadway class. In the NIF 3.0 emissions table, the emissions for all roadway classes were summed to the county level. Therefore, the emissions at the county level can represent several different control, rule effectiveness, and rule penetration levels. As a result, the control efficiency, rule effectiveness, and rule penetration values were reported in the control equipment table as a composite, overall control level for each county; the rule effectiveness and rule penetration values were not reported separately in the emission table.

2008 Silt Loadings by State and Roadway Class Modeled in Paved Road Emission Factor Calculations (g/m^2)

	Rural Roadway Classes						Urban Roadway Classes					
State	Inter-State	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local	Inter-state	Freeways & Express-ways	Other Principal Arterial	Minor Arterial	Collector	Local
Alabama	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Alaska	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.03	0.2	0.2
Arizona	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.06	0.2
Arkansas	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.6
California	0.015	0.03	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.2	0.2
Colorado	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Connecticut	0.015	0.03	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Delaware	0.015	0.03	0.03	0.2	0.2	0.2	0.015	0.015	0.03	0.03	0.06	0.2
Dist. of Columbia	0.015	0.6	0.6	0.6	0.6	0.6	0.015	0.015	0.03	0.03	0.06	0.2
Florida	0.015	0.03	0.06	0.2	0.2	0.2	0.015	0.015	0.03	0.03	0.06	0.2
Georgia	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.06	0.2
Hawaii	0.015	0.03	0.06	0.2	0.2	0.2	0.015	0.015	0.03	0.03	0.06	0.2
Idaho	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Illinois	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.03	0.06	0.2
Indiana	0.015	0.06	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Iowa	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Kansas	0.015	0.2	0.2	0.6	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Kentucky	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.2	0.2
Louisiana	0.015	0.06	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.6
Maine	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Maryland	0.015	0.03	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.06	0.2
Massachusetts	0.015	0.03	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Michigan	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.2	0.2
Minnesota	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Mississippi	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Missouri	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Montana	0.015	0.2	0.2	0.6	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Nebraska	0.015	0.2	0.2	0.6	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Nevada	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.03	0.06	0.2
New Hampshire	0.015	0.03	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
New Jersey	0.015	0.03	0.06	0.2	0.2	0.2	0.015	0.015	0.03	0.06	0.2	0.2
New Mexico	0.015	0.2	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
New York	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.06	0.2
North Carolina	0.015	0.03	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
North Dakota	0.015	0.2	0.2	0.6	0.6	0.6	0.015	0.015	0.03	0.2	0.2	0.2
Ohio	0.015	0.03	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Oklahoma	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Oregon	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Pennsylvania	0.015	0.03	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Rhode Island	0.015	0.03	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.6
South Carolina	0.015	0.06	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.2	0.6

	Rural Roadway Classes						Urban Roadway Classes					
State	Inter-State	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local	Inter-state	Freeways & Express-ways	Other Principal Arterial	Minor Arterial	Collector	Local
South Dakota	0.015	0.2	0.2	0.6	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.6
Tennessee	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Texas	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.6
Utah	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.03	0.06	0.2
Vermont	0.015	0.06	0.2	0.2	0.2	0.2	0.015	0.015	0.03	0.06	0.2	0.2
Virginia	0.015	0.03	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.2	0.2
Washington	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
West Virginia	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Wisconsin	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Wyoming	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.06	0.2	0.2	0.2

Penetration Rate of Paved Road Vacuum Sweeping

PM_{10} Nonattainment Status	Roadway Class	Vacuum Sweeping Penetration Rate
Moderate	Urban Interstate	0.42
Moderate	Urban Freeway & Expressway	0.67
Moderate	Urban Other Principal Arterial	0.90
Moderate	Urban Minor Arterial	0.67
Moderate	Urban Collector	0.64
Moderate	Urban Local	0.88
Serious	Rural Interstate	0.55
Serious	Rural Other Principal Arterial	0.37
Serious	Rural Minor Arterial	0.71
Serious	Rural Major Collector	0.83
Serious	Rural Minor Collector	0.59
Serious	Rural Local	0.35
Serious	Urban Interstate	0.42
Serious	Urban Freeway & Expressway	0.67
Serious	Urban Other Principal Arterial	0.90
Serious	Urban Minor Arterial	0.67
Serious	Urban Collector	0.64
Serious	Urban Local	0.88

f. References

1. United States Environmental Protection Agency, Office of Air Quality Planning and Standards. "Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 13.2.1, Paved Roads." Research Triangle Park, NC. 2006.

2. U.S. Department of Transportation, Federal Highway Administration. *Highway Statistics 2007*. Office of Highway Policy Information. Washington, DC. 2008. Available at http://www.fhwa.dot.gov/policyinformation/statistics/2007/.

3. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Summary of the Day Element TD-3200, 2008 data provided via FTP. National Climatic Data Center. 2009.

4. U.S. Environmental Protection Agency. “The 1985 NAPAP Emissions Inventory: Development of Temporal Allocation Factors,” EPA-600/7-89-010d. Air & Energy Engineering Research Laboratory. Research Triangle Park, NC. April 1990.

5. E.H. Pechan & Associates, Inc. “Documentation for the Onroad National Emission Inventory (NEI) for Base Years 1970 - 2002,” report prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. January 2004.

6. E.H. Pechan & Associates, Inc. “Phase II Regional Particulate Strategies; Task 4: Particulate Control Technology Characterization,” draft report prepared for U.S. Environmental Protection Agency, Office of Policy, Planning and Evaluation. Washington, DC. June 1995.

7. EPA, 2006. Western Governors' Association. 2006. Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors. Western Regional Air Partnership (WRAP), 1515 Cleveland Place, Suite 200, Denver, Colorado 80202 .

3.2.3.2 Fugitive Dust from Unpaved Roads

a. Source Category Description

Fugitive dust emissions from unpaved road traffic were estimated for PM10-PRI, PM10-FIL, PM25-PRI, and PM25-FIL. Since there are no PM-CON emissions for this category, PM10-PRI emissions are equal to PM10-FIL emissions and PM25-PRI emissions are equal to PM25-FIL.

For this source category, the following SCC was assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2296000000	Mobile Sources	Unpaved Roads	All Unpaved Roads	Total: Fugitives

The table below provides a national summary of the 2008 annual VMT activity and emissions by pollutant.

2008 National Criteria Air Pollutant Emissions Summary for Fugitive Dust from Unpaved Roads

Pollutant Description and NIF 3.0 Pollutant Code	Emission Factor Reference	National Activity (Million Miles)	National Emissions (Tons)
PM10-FIL	Reference 1	41,700	8,448,784
PM10-PRI	Reference 1	41,700	8,448,784
PM25-FIL	Reference 1	41,700	841,571
PM25-PRI	Reference 1	41,700	841,571

Uncontrolled unpaved road emissions were calculated at the State level by roadway class and month. This was done by multiplying the State/roadway class unpaved roadway VMT by the appropriate monthly temporal allocation factor and by the monthly unpaved road emission factor. After the unpaved road dust emissions were calculated at the State/roadway class/monthly level of detail, the uncontrolled emissions were then allocated to the county level using 1990 rural population data as a surrogate. Next, control factors were applied to the unpaved road emissions in PM_{10} nonattainment area counties. Emissions and VMT by roadway class were then totaled to the county level for reporting in the NEI. The following provides further details on the emission factor equation, temporal and spatial allocation procedures, and controls.

b. Emission Factor Equation

Reentrained road dust emissions for unpaved roads were estimated using unpaved road VMT and the emission factor equation from AP-42:[1]

$$E =[k * (s/12)1 * (SPD/30)0.5] / (M/0.5)0.2 - C$$

where k, and C are empirical constants given in the corresponding table below, with

k = particle size multiplier (lb/VMT)
E = size specific emission factor (lb/VMT)
s = surface material silt content (%)
SPD = mean vehicle speed (mph)

M = surface material moisture content (%)
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear (lb/VMT)

The uncontrolled emission factors are provided in the attachment "Unpaved Roads PM Emission Factors.xls" by State, roadway class, and month.

Average State-level unpaved road silt content values, developed as part of the 1985 NAPAP Inventory, were obtained from the Illinois State Water Survey.[2] Silt contents of over 200 unpaved roads from over 30 States were obtained. Average silt contents of unpaved roads were calculated for each sate that had three or more samples for that State. For States that did not have three or more samples, the average for all samples from all States was used as a default value. The silt content values by State, and identifies if the values were based on a sample average or default value.

Constants for Unpaved Roads Re-entrained Dust Emission Factor Equation[1]

Constant	PM25-PRI/ PM25-FIL	PM10-PRI/ PM10-FIL
k (lb/VMT)	0.18	1.8
C	0.00036	0.00047

The table below lists the speeds modeled on the unpaved roads by roadway class. These speeds were determined based on the average speeds modeled for onroad emission calculations and weighted to determine a single average speed for each of the roadway classes. The value of 0.5 percent for M was chosen as the national default as sufficient resources were not available at the time the emissions were calculated to determine more locally-specific values for this variable.

Speeds Modeled by Roadway Type on Unpaved Roads

Unpaved Roadway Type	Speed (mph)
Rural Minor Arterial	39
Rural Major Collector	34
Rural Minor Collector	30
Rural Local	30
Urban Other Principal Arterial	20
Urban Minor Arterial	20
Urban Collector	20
Urban Local	20

Correction factors were applied to the emission factors to account for the number of days with a sufficient amount of precipitation to prevent road dust resuspension. Monthly corrected emission factors by State and roadway classification were calculated using the following equation:

$$E_{corr} = E * [(D-p)/D]$$

where: E_{corr} = unpaved road dust emission factor corrected for precipitation effects
E = uncorrected emission factor
D = number of days in the month

p = number of days in the month with at least 0.01 inches of precipitation

The number of days with at least 0.01 inches of precipitation in each month was obtained from the National Climatic Data Center.[3] Data were collected from a meteorological station selected to be representative of rural areas within the State.

c. Activity

Unpaved roadway mileage estimates were obtained from the FHWA's annual Highway Statistics report.[4] Unpaved mileage data for 2007 were used, as data for 2008 were not yet available. Separate calculations of VMT were performed for county- and noncounty- (State or federally) maintained roadways. State-level, county-maintained roadway mileage was organized by surface type (rural and urban) and the average daily traffic volume (ADTV) groups shown in the corresponding table below. From these data, State-level unpaved roadway mileage estimates were made. The following equation was then used to calculate State-level unpaved road VMT estimates:

$$VMT_{UP} = ADTV * FSRM * 366 \text{ days/year}$$

where: VMT_{UP} = VMT on unpaved roads (miles/year)
ADTV = average daily traffic volume (vehicles/day/mile) FSRM = functional system roadway mileage (miles)

State and federally maintained roadway mileage was categorized by arterial classification, not roadway traffic volume; therefore, the VMT was calculated differently than for county-maintained roadways. The ADTV was assumed to not vary by roadway maintenance responsibility, so the ADTV calculated from county-maintained VMT and mileage (ADTV = VMT / Mileage) was used with noncounty-maintained roadway mileage to calculate VMT in the above equation.

Assumed Values for Average Daily Traffic Volume (ADTV) by Volume Group

Rural Roads				
Volume Category (vehicles per day per mile)	< 50	50-199	200-499	> 500
Assumed ADTV	5*	125**	350**	550***
Urban Roads				
Volume Category (vehicles per day per mile)	< 200	200-499	500-1999	> 2000
Assumed ADTV	20*	350**	1250**	2200***

Notes: *10% of volume group's maximum range endpoint.
** Average of volume group's range endpoints.
*** 110% of volume group's minimum range endpoint.

d. Allocation

The unpaved road VMT estimates by State/roadway class were first temporally allocated by season using the NAPAP Inventory seasonal temporal allocations factors for VMT.[5] These factors are provided in the attachment "Paved and Unpaved Road VMT temp factors.xls". The seasonal VMT values were then multiplied by the ratio of the number of days in a month to the

number of days in a season to adjust to monthly VMT. The emission factors were then applied to estimate emissions by month.

The State/roadway class unpaved road emissions were then spatially allocated to each county using estimates of the ratio of 1990 county rural population to the State rural population from the U.S. Census Bureau[6] as shown by the following equation:

$$EMIS_{x,y} = (CL_x / SL) * EMIS_{,y}$$

where: $EMIS_{x,y}$ = unpaved road emissions (tons) for county x and roadway class y
CL_x = rural population in county x SL = rural population
in the State $EMIS_{,y}$ = unpaved road emissions in entire
State for roadway class y

The county-level allocation factors are provided in the attachment "Unpaved Road county allocation fractions.xls."

e. Controls

The controls assumed for unpaved roads varied by PM_{10} nonattainment area classification and by urban and rural areas. On urban unpaved roads in moderate PM_{10} nonattainment areas, paving of the unpaved road was assumed, and a control efficiency of 96 percent and a rule penetration of 50 percent were applied. Chemical stabilization, with a control efficiency or 75 percent and a rule penetration of 50 percent, was assumed for rural areas in serious PM_{10} nonattainment areas. A combination of paving and chemical stabilization, with a control efficiency of 90 percent and a rule penetration of 75 percent, was assumed for urban unpaved roads in serious PM_{10} nonattainment areas.[7]

Note that the controls were applied at the county/roadway class level, and the controls differ by roadway class. In the NIF 3.0 emissions table, the emissions for all roadway classes were summed to the county level. Therefore, the emissions at the county level can represent several different control, rule effectiveness, and rule penetration levels. As a result, the control efficiency, rule effectiveness, and rule penetration values were reported in the control equipment table as a composite, overall control level for each county; the rule effectiveness and rule penetration values were not reported separately in the emissions table.

f. References

1. United States Environmental Protection Agency, Office of Air Quality Planning and Standards. "Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 13.2.2, Unpaved Roads." Research Triangle Park, NC. 2003.

2. W. Barnard, G. Stensland, and D. Gatz, Illinois State Water Survey, "Evaluation of Potential Improvements in the Estimation of Unpaved Road Fugitive Emission Inventories," paper 87-58.1, presented at the 80th Annual Meeting of the APCA . New York, New York. June 21-26, 1987.

3. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Summary of the Day Element TD-3200, 2008 data provided via FTP. National Climatic Data Center, 2009.

4. U.S. Department of Transportation, Federal Highway Administration. *Highway Statistics 2007.* Office of Highway Policy Information. Washington, DC. 2009. Available at http://www.fhwa.dot.gov/policyinformation/statistics/2007/.

5. U.S. Environmental Protection Agency. "The 1985 NAPAP Emissions Inventory: Development of Temporal Allocation Factors," EPA-600/7-89-010d. Air & Energy Engineering Research Laboratory. Research Triangle Park, NC. April 1990.

6. U.S. Department of Commerce. "1990 Census of Population , Volume I Characteristics of Population," Bureau of the Census. Washington, DC. July 1992.

7. E.H. Pechan & Associates, Inc. "Phase II Regional Particulate Strategies; Task 4: Particulate Control Technology Characterization," draft report prepared for U.S. Environmental Protection Agency, Office of Policy, Planning and Evaluation. Washington, DC. June 1995.

8. EPA, 2006. Western Governors' Association. 2006. Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors. Western Regional Air Partnership (WRAP), 1515 Cleveland Place, Suite 200, Denver, Colorado 80202 .

3.2.3.3 Fossil Fuel Combustion – Residential – Coal Combustion

a. Source Category Description

Residential Coal Combustion is coal that is burned to heat residential housing.

The general approach to calculating emissions for these two SCCs is to take State Coal Consumption from the EIA and allocate it to the county level using methods described below. County-level coal consumption is multiplied by the emission factors to calculate emissions.

For this source category, the following SCCs were assigned:

SCC	Descriptor 1	Descriptor 3	Descriptor 6	Descriptor 8
2104001000	Stationary Source Fuel Combustion	Residential	Anthracite Coal	All Boiler Types
2104002000	Stationary Source Fuel Combustion	Residential	Bituminous/ Subbituminous Coal	All Boiler Types

b. Activity Data

The mass of coal consumed by residential combustion in the U.S. was used to estimate emissions. Coal consumption by energy use sector is presented in State Energy Data 2006 Consumption tables published by the Energy Information Administration (EIA).[1] Year 2006 consumption data were used as a surrogate for 2008 emissions because year 2006 data were the latest data available when this inventory was prepared.

EIA data do not distinguish between anthracite and bituminous coal consumption estimates. The EIA table "Domestic Distribution of U.S. Coal by Destination State, Consumer, Origin and Method of Transportation," provides state-level residential coal distribution data for 2006 that was used to estimate anthracite and bituminous coal consumption. The amount of anthracite distributed to each state and the total coal delivered to each state were used to estimate the proportion of anthracite and bituminous coal consumption.[2] The 2006 ratio of anthracite (and bituminous) coal consumption to total coal consumption was used to distribute the EIA's total residential sector coal consumption data by coal type. The corresponding table below presents the 2006 anthracite and bituminous coal ratios for each state.

State-level coal consumption was allocated to each county using the US Census Bureau's 2000 Census Detailed Housing Information.[3] These data include the number of housing units using a specific type of fuel for residential heating. State coal consumption was allocated to each county using the ratio of the number of houses burning coal in each county to the total number of houses burning coal in the State.

c. Control Factors

No controls were assumed for this category

d. Emission Factors

In some cases (see the corresponding table below), SO_2 and PM emission factors required information on the sulfur and/or ash content of the coal burned. State-specific sulfur and ash contents of anthracite and bituminous coal were obtained from data compiled in preparing the 1999 residential coal combustion emissions estimates.[4] This study mostly relied on data obtained from USGS COALQUAL database. States not included in the database but that reported coal usage were assigned values based on their proximity to coal seams or using an average value for Pennsylvania (see report for details of the analysis). The corresponding table below presents the bituminous coal sulfur content values used for each state. For anthracite coal, an ash content value of 13.38% and a sulfur content of 0.89% were applied to all states except New Mexico (ash content 16.61%, sulfur content 0.77%), Washington (ash content 12%, sulfur content 0.9%), and Virginia (ash content 13.38%, sulfur content 0.43%).

The remaining criteria pollutant and HAP emissions were calculated by multiplying the total coal consumed in each county per year by an emission factor. All emission factors except ammonia are from AP-42.[5] The ammonia emission factor is from EPA's *Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report*.[6]. The corresponding table below presents a summary of the emission factors for residential anthracite coal combustion (SCC 2104001000). The corresponding table below presents a summary of the emission factors for residential bituminous coal combustion (SCC 2104002000).

e. Sample Calculations

Annual emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = FC_x \times (1 - CE_{x,p}) \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for fuel type x and pollutant p (ton/year),
FC_x = annual fuel consumption for fuel type x,
$CE_{x,p}$ = control efficiency for fuel type x and pollutant p, and
$EF_{x,p}$ = emission factor for fuel type x and pollutant p.

County level fuel consumption is calculated using:

$$FC_x = A_{State} \text{ x } Ratio_{Anth,\ Bit} \text{ x } Ratio_{County\ houses}$$

where:

A_{State} = total tons of coal reported by the EIA,
$Ratio_{Anth,\ Bit}$ = ratio reported in the corresponding table below, and
$Ratio_{County\ houses}$ = county allocation ratio based on number of houses burning coal.

<u>Example:</u>
Using Allegheny County, PA as an example:

The State of Pennsylvania had a reported use of 49,935 tons of coal in the residential sector in 2006.

Statewide Anthracite coal use is calculated using the ratio of Anthracite to Bituminous in the corresponding table below for PA: 80.64%. Allegheny County, PA had 183 houses out of the state total of 67,986 that use coal as the primary heating fuel. This equates to a share of 0.27% of the coal used for residential heating in the state.

The emission factor for $PM_{2.5}$-PRI (See the corresponding table below) is 0.6 × state-specific % ash content + 0.08 lbs/ton× state-specific % ash content. The ash content is 13.38%, (See the corresponding table below) so the emission factor is 9.09 lbs/ton.

$FC_{Allegheny,\ anth}$ = 49,935 × 0.8064 × 0.0027 = 109 tons anthracite coal

$Emis_{Allegheny,\ anth,\ PM2.5\text{-}PRI}$ = 109 tons Coal × 9.09 lbs $PM_{2.5}$-PRI per ton coal
= 990 lbs $PM_{2.5}$-PRI

f. References

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3. U.S. Census Bureau. "Table H40. House Heating Fuel Type", Census 2000: Summary File 3. Internet address: http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_submenuId=&_lang=en&_ts=, accessed July 2009.

4. U.S. Environmental Protection Agency. Emission Factor and Inventory Group. Final Summary of the Development and Results of a Methodology for Calculating Area Source Emissions from Residential Fuel Combustion. Prepared by Pacific Environmental Services, Inc. Research Triangle Park, NC. September 2002. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/draft1999_residfuel_inven_apr2003.zip accessed November 2004.

5. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. 1996.

6. U.S. Environmental Protection Agency. Emission Inventory Improvement Program. Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report. Prepared by E.H. Pechan and Associates, Inc. Research Triangle Park, NC. April 2004.

2006 Anthracite and Bituminous Coal Distribution for the Residential and Commercial Sectors

State	Ratio of Bituminous	Ratio of Anthracite	State	Ratio of Bituminous	Ratio of Anthracite
Alabama	1.0000	0.0000	Montana	1.0000	0.0000
Alaska	1.0000	0.0000	Nebraska	1.0000	0.0000
Arizona	0.8140	0.1860	Nevada	1.0000	0.0000
Arkansas	0.8140	0.1860	New Hampshire	0.0000	1.0000
California	1.0000	0.0000	New Jersey	0.0000	1.0000
Colorado	0.9962	0.0038	New Mexico	1.0000	0.0000
Connecticut	0.0000	1.0000	New York	0.6000	0.4000
Delaware	0.8140	0.1860	North Carolina	1.0000	0.0000
Dist. Columbia	1.0000	0.0000	North Dakota	1.0000	0.0000
Florida	0.8140	0.1860	Ohio	0.8727	0.1273
Georgia	1.0000	0.0000	Oklahoma	0.9167	0.0833
Hawaii	1.0000	0.0000	Oregon	1.0000	0.0000
Idaho	0.9792	0.0208	Pennsylvania	0.1936	0.8064
Illinois	0.9981	0.0019	Rhode Island	0.0000	1.0000
Indiana	0.9474	0.0526	South Carolina	0.9972	0.0028
Iowa	0.9992	0.0008	South Dakota	1.0000	0.0000
Kansas	1.0000	0.0000	Tennessee	0.9939	0.0061
Kentucky	0.9981	0.0019	Texas	0.8140	0.1860
Louisiana	1.0000	0.0000	Utah	1.0000	0.0000
Maine	0.0000	1.0000	Vermont	0.0000	1.0000
Maryland	0.9286	0.0714	Virginia	0.9630	0.0370
Massachusetts	0.5000	0.5000	Washington	1.0000	0.0000
Michigan	0.6667	0.3333	West Virginia	0.9048	0.0952
Minnesota	0.9973	0.0027	Wisconsin	0.9914	0.0086
Mississippi	1.0000	0.0000	Wyoming	1.0000	0.0000
Missouri	1.0000	0.0000			

SO_2 and PM Emission Factors for Industrial Anthracite and Bituminous Coal Combustion

Pollutant	Emission Factor (lb/ton)	AP-42 Table
Anthracite Emission Factors (SCC 2104001000)		
PM-CON	0.08* % Ash	1.2-3
PM10-FIL	10	1.2-4
PM25-FIL	0.6 * % Ash	1.2-4
PM10-PRI	10 + 0.08* % Ash	1.2-3 and 1.2-4
PM25-PRI	0.6 * % Ash + 0.08* % Ash	1.2-3 and 1.2-4
Sulfur Dioxide	39 * % Sulfur	1.2-1
Bituminous Emission Factors (SCC 2104002000)		

PM-CON	.04	1.1-5
PM10-FIL	6.2	1.1-9
PM25-FIL	3.8	1.1-9
PM10-PRI	6.24	1.1-5 and 1.1-9
PM25-PRI	3.84	1.1-5 and 1.1-9
Sulfur Dioxide	31 * % Sulfur	1.1-3
NOTE: PM_{10}, $PM_{2.5}$, and condensable PM emission factors for bituminous coal do not require ash content, nor does the condensable PM emission factor for anthracite coal.		

State-Specific Sulfur Content for Bituminous Coal (SCC 2104002000)

State	Percent Sulfur Content	State	Percent Sulfur Content
Alabama	2.08	Montana	0.60
Alaska	0.31	Nebraska	2.43
Arizona	0.47	Nevada	2.30
Arkansas	1.20	New Hampshire	2.42
California	0.47	New Jersey	2.42
Colorado	0.61	New Mexico	0.75
Connecticut	2.42	New York	2.42
Delaware	1.67	North Carolina	1.62
District of Columbia	1.67	North Dakota	0.97
Florida	1.28	Ohio	3.45
Georgia	1.28	Oklahoma	3.08
Hawaii	1.00	Oregon	0.50
Idaho	0.31	Pennsylvania	2.42
Illinois	3.48	Rhode Island	2.42
Indiana	2.49	South Carolina	1.28
Iowa	4.64	South Dakota	0.97
Kansas	5.83	Tennessee	1.62
Kentucky	1.93	Texas	1.14
Louisiana	0.86	Utah	0.80
Maine	2.42	Vermont	2.42
Maryland	1.67	Virginia	1.19
Massachusetts	2.42	Washington	0.50
Michigan	1.20	West Virginia	1.25
Minnesota	0.97	Wisconsin	1.00
Mississippi	1.24	Wyoming	0.87
Missouri	3.39		

National Criteria and HAP Emission Factors for Residential Anthracite Coal Combustion (SCC 2104001000): Not Adjusted for Point Source Fuel Consumption

SCC	Pollutant Code	Pollutant Code Description	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
2104001000	100414	ETHYL BENZENE	0.000094	LB	TON
2104001000	100425	STYRENE	0.000025	LB	TON
2104001000	107028	ACROLEIN	0.00029	LB	TON
2104001000	107062	ETHYLENE DICHLORIDE	0.00004	LB	TON
2104001000	108883	TOLUENE	0.00024	LB	TON
2104001000	108907	CHLOROBENZENE	0.000022	LB	TON
2104001000	108952	PHENOL	0.000016	LB	TON
2104001000	110543	HEXANE	0.000067	LB	TON
2104001000	117817	BIS(2-ETHYLHEXYL)PHTHALATE	0.000073	LB	TON
2104001000	120127	ANTHRACENE	0.00000021	LB	TON
2104001000	123386	PROPIONALDEHYDE	0.00038	LB	TON
2104001000	127184	TETRACHLOROETHYLENE	0.000043	LB	TON
2104001000	129000	PYRENE	0.00000033	LB	TON
2104001000	191242	BENZO[G,H,I,]PERYLENE	0.000000027	LB	TON
2104001000	193395	INDENO[1,2,3-C,D]PYRENE	0.000000061	LB	TON
2104001000	206440	FLUORANTHENE	0.00000071	LB	TON
2104001000	208968	ACENAPHTHYLENE	0.00000025	LB	TON
2104001000	218019	CHRYSENE	0.0000001	LB	TON
2104001000	50000	FORMALDEHYDE	0.00024	LB	TON
2104001000	50328	BENZO[A]PYRENE	0.000000038	LB	TON
2104001000	56553	BENZ[A]ANTHRACENE	0.00000008	LB	TON
2104001000	56832736	Benzofluoranthenes	0.00000011	LB	TON
2104001000	71432	BENZENE	0.0013	LB	TON
2104001000	7439921	LEAD	0.00042	LB	TON
2104001000	7439965	MANGANESE	0.00049	LB	TON
2104001000	7439976	MERCURY	0.000083	LB	TON
2104001000	7440020	NICKEL	0.00028	LB	TON
2104001000	7440360	ANTIMONY	0.000018	LB	TON
2104001000	7440382	ARSENIC	0.00041	LB	TON
2104001000	7440417	BERYLLIUM	0.000021	LB	TON
2104001000	7440439	CADMIUM	0.000051	LB	TON
2104001000	7440473	CHROMIUM	0.000264	LB	TON
2104001000	7440484	COBALT	0.0001	LB	TON
2104001000	74839	METHYL BROMIDE	0.00016	LB	TON
2104001000	74873	METHYL CHLORIDE	0.00053	LB	TON
2104001000	75070	ACETALDEHYDE	0.00057	LB	TON

SCC	Pollutant Code	Pollutant Code Description	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
2104001000	75092	METHYLENE CHLORIDE	0.00029	LB	TON
2104001000	75150	CARBON DISULFIDE	0.00013	LB	TON
2104001000	7647010	HYDROCHLORIC ACID	1.2	LB	TON
2104001000	7664393	HYDROGEN FLUORIDE	0.15	LB	TON
2104001000	7782492	SELENIUM	0.0013	LB	TON
2104001000	78591	ISOPHORONE	0.00058	LB	TON
2104001000	78933	METHYL ETHYL KETONE	0.00039	LB	TON
2104001000	83329	ACENAPHTHENE	0.00000051	LB	TON
2104001000	85018	PHENANTHRENE	0.0000027	LB	TON
2104001000	86737	FLUORENE	0.00000091	LB	TON
2104001000	91203	NAPHTHALENE	0.000013	LB	TON
2104001000	98862	ACETOPHENONE	0.000015	LB	TON
2104001000	CO	CARBON MONOXIDE	275	LB	TON
2104001000	NH3	AMMONIA	2	LB	TON
2104001000	NOX	NITROGEN OXIDES	3	LB	TON
2104001000	VOC	VOLATILE ORGANIC COMPOUNDS	10	LB	TON

National Criteria and HAP Emission Factors for Residential Bituminous Coal Combustion (SCC 2104002000): Not Adjusted for Point Source Fuel Consumption

SCC	Pollutant Code	Pollutant Code Description	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
2104002000	100414	ETHYL BENZENE	0.000094	LB	TON
2104002000	100425	STYRENE	0.000025	LB	TON
2104002000	107028	ACROLEIN	0.00029	LB	TON
2104002000	107062	ETHYLENE DICHLORIDE	0.00004	LB	TON
2104002000	108883	TOLUENE	0.00024	LB	TON
2104002000	108907	CHLOROBENZENE	0.000022	LB	TON
2104002000	108952	PHENOL	0.000016	LB	TON
2104002000	110543	HEXANE	0.000067	LB	TON
2104002000	117817	BIS(2-ETHYLHEXYL)PHTHALATE	0.000073	LB	TON
2104002000	123386	PROPIONALDEHYDE	0.00038	LB	TON
2104002000	127184	TETRACHLOROETHYLENE	0.000043	LB	TON
2104002000	129000	PYRENE	0.00000033	LB	TON
2104002000	191242	BENZO[G,H,I,]PERYLENE	0.000000027	LB	TON
2104002000	193395	INDENO[1,2,3-C,D]PYRENE	0.000000061	LB	TON
2104002000	205992	BENZO[B]FLUORANTHENE	0.00000011	LB	TON

SCC	Pollutant Code	Pollutant Code Description	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
2104002000	218019	CHRYSENE	0.0000001	LB	TON
2104002000	50000	FORMALDEHYDE	0.00024	LB	TON
2104002000	56553	BENZ[A]ANTHRACENE	0.00000008	LB	TON
2104002000	71432	BENZENE	0.0013	LB	TON
2104002000	7439921	LEAD	0.00042	LB	TON
2104002000	7439965	MANGANESE	0.00049	LB	TON
2104002000	7439976	MERCURY	0.000083	LB	TON
2104002000	7440020	NICKEL	0.00028	LB	TON
2104002000	7440360	ANTIMONY	0.000018	LB	TON
2104002000	7440382	ARSENIC	0.00041	LB	TON
2104002000	7440417	BERYLLIUM	0.000021	LB	TON
2104002000	7440439	CADMIUM	0.000051	LB	TON
2104002000	7440473	CHROMIUM	0.00026	LB	TON
2104002000	7440484	COBALT	0.0001	LB	TON
2104002000	74839	METHYL BROMIDE	0.00016	LB	TON
2104002000	74873	METHYL CHLORIDE	0.00053	LB	TON
2104002000	75070	ACETALDEHYDE	0.00057	LB	TON
2104002000	75092	METHYLENE CHLORIDE	0.00029	LB	TON
2104002000	75150	CARBON DISULFIDE	0.00013	LB	TON
2104002000	7782492	SELENIUM	0.0013	LB	TON
2104002000	78591	ISOPHORONE	0.00058	LB	TON
2104002000	78933	METHYL ETHYL KETONE	0.00039	LB	TON
2104002000	98862	ACETOPHENONE	0.000015	LB	TON
2104002000	CO	CARBON MONOXIDE	275	LB	TON
2104002000	NH3	AMMONIA	2.0	LB	TON
2104002000	NOX	NITROGEN OXIDES	9.1	LB	TON
2104002000	VOC	VOLATILE ORGANIC COMPOUNDS	10	LB	TON

3.2.3.4 Fossil Fuel Combustion – Residential – Distillate Oil

a. Source Category Description

Residential Distillate Oil Combustion is oil that is burned in residential housing

The general approach to calculating emissions for this SCC is to take State Distillate Oil Consumption from the EIA and allocate it out to the county level using methods described below. County-level oil consumption is multiplied by the emission factors to calculate emissions.

For this source category, the following SCCs were assigned:

SCC	Descriptor 1	Descriptor 3	Descriptor 6	Descriptor 8
2104004000	Stationary Source Fuel Combustion	Residential	Distillate Oil	Total Boilers and IC Engines

b. Activity Data

The state-level volume of distillate oil consumed by residential combustion in the U.S. was used to estimate emissions. Distillate oil consumption by energy use sector is presented in State Energy Data 2006 Consumption tables published by the Energy Information Administration (EIA).[1] Year 2006 consumption data were used as a surrogate for 2008 emissions because year 2006 data were the latest data available when this inventory was prepared.

State-level distillate oil consumption was allocated to each county using the US Census Bureau's 2000 Census Detailed Housing Information.[2] These data include the number of housing units using a specific type of fuel for residential heating. State distillate oil consumption was allocated to each county using the ratio of the number of houses burning distillate oil in each county to the total number of houses burning distillate oil in the State.

c. Control Factors

No control measures are assumed for this category.

d. Emission Factors

Criteria pollutant emission factors for distillate oil are from AP-42.[3] For all counties in the United States, the distillate oil consumed by commercial/institutional combustion is assumed to be No. 2 fuel oil with a heating value of 140,000 Btu per gallon and a sulfur content of 0.30%.[4] Dioxin/furan and HAP emission factors are from "Documentation of Emissions Estimation methods for Year 2000 and 2001 Mobile Source and Nonpoint Source Dioxin Inventories"[5] and "Documentation for the 1999 Base Year Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants,"[6] respectively. Sulfur content was 0.30% and was obtained from data compiled in preparing the 1999 residential coal combustion emissions estimates.[7] The ammonia emission factor is from EPA's *Estimating Ammonia Emissions from Anthropogenic Sources, Draft Report*.[8]

e. Sample Calculations

Emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = FC_x \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for fuel type x and pollutant p
FC_x = annual fuel consumption for fuel type x
$EF_{x,p}$ = emission factor for fuel type x and pollutant p

And $FC_x = A_{State}$ x (H_{county} / H_{State})

where :

A_{State} = State activity data from EIA
H_{County} = number of houses in the county using distillate oil as the primary heating fuel
H_{State} = number of houses in the state using distillate oil as the primary heating fuel

Example:
Using Allegheny County, PA as an example:

The State of Pennsylvania had a reported use of 16,902 thousand barrels of distillate oil in the residential sector in 2006. Allegheny County, PA had 8,123 houses out of the state total of 1,217,155 that use distillate oil as the primary heating fuel. This equates to a share of 0.67% of the distillate oil used for residential heating in the state. From the corresponding table below, the emission factor for CO is 5 lb/thousand gallons. Because the emission factor is in lbs/thousand gallons, a conversion factor of 42 gallons per barrel is applied.

$$A_{Alegheny} = 16{,}902 \text{ thousand barrels} \times 8{,}123 \text{ houses} / 1{,}217{,}155 \text{ houses}) \times 42 \text{ gal / barrel} = 4{,}737.6 \text{ thousand gallons}$$

$$Emis_{Alegheny,\ CO} = \quad = 4{,}737.6 \text{ thousand gallons} \times 5 \text{ lb CO/ thousand gallons}$$

= 23,688 lbs CO or 11.8 tons CO

f. References

1. U.S. Department of Energy, Energy Information Administration (EIA). State Energy Data 2006 Consumption. Washington, DC 2008. Internet Address: http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_all_phy.csv, accessed November 2008.

2. U.S. Census Bureau. "Table H40. House Heating Fuel Type", Census 2000: Summary File 3. Internet address: http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_submenuId=&_lang=en&_ts=, accessed July 2009.

3. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. 1996.

4. U.S. Environmental Protection Agency. Emission Factor and Inventory Group. Final Summary of the Development and Results of a Methodology for Calculating Area Source Emissions from Residential Fuel Combustion. Prepared by Pacific Environmental Services, Inc. Research Triangle Park, NC. September 2002. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/draft1999_residfuel_inven_apr2003.zip accessed November 2004.

5. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. "Documentation of Emissions Estimation methods for Year 2000 and 2001 Mobile Source and Nonpoint Source Dioxin Inventories." Prepared by E.H. Pechan & Associates, Inc., Durham, NC. May 2003.

6. U.S. Environmental Protection Agency, Emission Factors and Inventory Group. "Documentation for the 1999 Base Year Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants." Prepared by Eastern Research Group, Inc. Morrisville, NC. September 2002.

7. U.S. Environmental Protection Agency. Emission Factor and Inventory Group. Final Summary of the Development and Results of a Methodology for Calculating Area Source Emissions from Residential Fuel Combustion. Prepared by Pacific Environmental Services, Inc. Research Triangle Park, NC. September 2002. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/draft1999_residfuel_inven_apr2003.zip accessed November 2004.

8. U.S. Environmental Protection Agency. Emission Factor and Inventory Group. Estimating Ammonia Emissions from Anthropogenic Sources, Draft Report. Prepared by E.H. Pechan and Associates, Inc. Research Triangle Park, NC. September 2003.

National Emission Factors for Residential Distillate Oil Combustion

Code	Pollutant	Emission Factor	Emission Factor Numerator	Emission Factor Denominator
102	Benzo[B+K]Fluoranthene	1.54517E-06	LB	E3GAL
120127	Anthracene	1.22209E-06	LB	E3GAL
129000	Pyrene	4.2141E-06	LB	E3GAL
1746016	2,3,7,8-Tetrachlorodibenzo-P-Dioxin	4.6592E-10	LB	E3GAL
191242	Benzo[G,H,I,]Perylene	2.24752E-06	LB	E3GAL
193395	Indeno[1,2,3-C,D]Pyrene	2.10705E-06	LB	E3GAL
206440	Fluoranthene	4.91645E-06	LB	E3GAL
208968	Acenaphthylene	2.52846E-07	LB	E3GAL
218019	Chrysene	2.38799E-06	LB	E3GAL
30402154	Total Pentachlorodibenzofuran	3.4944E-09	LB	E3GAL
3268879	Octachlorodibenzo-P-Dioxin	5.4912E-10	LB	E3GAL
36088229	Total Pentachlorodibenzo-P-Dioxin	6.8224E-10	LB	E3GAL
37871004	Total Heptachlorodibenzo-P-Dioxin	5.2416E-10	LB	E3GAL
38998753	Total Heptachlorodibenzofuran	6.0736E-10	LB	E3GAL
39001020	Octachlorodibenzofuran	2.496E-10	LB	E3GAL
50000	Formaldehyde	0.0337128	LB	E3GAL
51207319	2,3,7,8-Tetrachlorodibenzofuran	4.4096E-10	LB	E3GAL
53703	Dibenzo[A,H]Anthracene	1.68564E-06	LB	E3GAL
55684941	Total Hexachlorodibenzofuran	1.4144E-09	LB	E3GAL
56553	Benz[A]Anthracene	4.07363E-06	LB	E3GAL
622	Hexachlorodibenzo-P-Dioxins, Total	5.4912E-10	LB	E3GAL
71432	Benzene	0.000210705	LB	E3GAL
7439921	Lead	0.00126423	LB	E3GAL
7439965	Manganese	0.00084282	LB	E3GAL
7439976	Mercury	0.00042141	LB	E3GAL
7440020	Nickel	0.00042141	LB	E3GAL
7440382	Arsenic	0.00056188	LB	E3GAL
7440417	Beryllium	0.00042141	LB	E3GAL
7440439	Cadmium	0.00042141	LB	E3GAL

Code	Pollutant	Emission Factor	Emission Factor Numerator	Emission Factor Denominator
7440473	Chromium	0.00042141	LB	E3GAL
75070	Acetaldehyde	0.00491645	LB	E3GAL
7782492	Selenium	0.00210705	LB	E3GAL
83329	Acenaphthene	2.10705E-05	LB	E3GAL
85018	Phenanthrene	1.05353E-05	LB	E3GAL
86737	Fluorene	4.49504E-06	LB	E3GAL
91203	Naphthalene	0.001137807	LB	E3GAL
NH3	Ammonia	1.0	LB	E3GAL
CO	Carbon Monoxide	5	LB	E3GAL
NOX	Nitrogen Oxides	18	LB	E3GAL
PM10-FIL	Primary PM10, Filterable Portion Only	1.08	LB	E3GAL
PM25-FIL	Primary PM2.5, Filterable Portion Only	0.83	LB	E3GAL
PM-CON	Primary PM Condensible Portion Only (All Less Than 1 Micron)	1.3	LB	E3GAL
SO2	Sulfur Dioxide	42.6	LB	E3GAL
VOC	Volatile Organic Compounds	0.7	LB	E3GAL
102	Benzo[B+K]Fluoranthene	1.54517E-06	LB	E3GAL
120127	Anthracene	1.22209E-06	LB	E3GAL
129000	Pyrene	4.2141E-06	LB	E3GAL
1746016	2,3,7,8-Tetrachlorodibenzo-P-Dioxin	4.6592E-10	LB	E3GAL
191242	Benzo[G,H,I,]Perylene	2.24752E-06	LB	E3GAL
193395	Indeno[1,2,3-C,D]Pyrene	2.10705E-06	LB	E3GAL
206440	Fluoranthene	4.91645E-06	LB	E3GAL
208968	Acenaphthylene	2.52846E-07	LB	E3GAL
218019	Chrysene	2.38799E-06	LB	E3GAL
30402154	Total Pentachlorodibenzofuran	3.4944E-09	LB	E3GAL

3.2.3.5 Fossil Fuel Combustion – Residential - Kerosene

a. Source Category Description

Residential Kerosene Combustion is kerosene that is burned in residential housing. Common uses of energy associated with this sector include space heating, water heating, cooking, and running a wide variety of other equipment.

The general approach to calculating emissions for this SCC is to take State Kerosene Consumption from the EIA and allocate it to the county level using methods described below. County-level kerosene consumption is multiplied by the emission factors to calculate emissions.

For this source category, the following SCC was assigned:

SCC	Descriptor 1	Descriptor 3	Descriptor 6	Descriptor 8
2104011000	Stationary Source Fuel Combustion	Residential	Kerosene	Total: All Combustor Types

b. Activity Data

The volume of kerosene consumed by residential combustion in the U.S. was used to estimate emissions. Kerosene consumption by energy use sector is presented in State Energy Data 2006 Consumption tables published by the Energy Information Administration (EIA).[1] Year 2006 consumption data were used as a surrogate for 2008 emissions because year 2006 data were the latest data available when this inventory was prepared.

State-level kerosene consumption was allocated to each county using the US Census Bureau's 2000 Census Detailed Housing Information.[2] These data include the number of housing units using a specific type of fuel for residential heating. State kerosene consumption was allocated to each county using the ratio of the number of houses burning kerosene in each county to the total number of houses burning kerosene in the State.

c. Control Factors

No control measures are assumed for this category.

d. Emission Factors

Emission factors for distillate oil were used for kerosene, but the distillate oil emission factors were multiplied by a factor of 135/140 to convert them for this use. This factor is based on the ratio of the heat content of kerosene (135,000 Btu/gallon) to the heat content of distillate oil (140,000 Btu/gallon).[3] Criteria pollutant emission factors are from AP-42.[4] Dioxin/furan and HAP emission factors are from "Documentation of Emissions Estimation methods for Year 2000 and 2001 Mobile Source and Nonpoint Source Dioxin Inventories"[5] and "Documentation for the 1999 Base Year Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants,"[6] respectively. Distillate sulfur content (0.30%) was used for kerosene as well.[7]

e. Sample Calculations

Emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = FC_x \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for fuel type x and pollutant p,
FC_x = annual fuel consumption for fuel type x,
$EF_{x,p}$ = emission factor for fuel type x and pollutant p,

And $FC_x = A_{State}$ x (H_{county} / H_{State})

where :

A_{State} = State activity data from EIA
H_{County} = number of houses in the county using kerosene as the primary heating fuel
H_{State} = number of houses in the state using kerosene as the primary heating fuel

Example:
Using Allegheny County, PA as an example:

The State of Pennsylvania had a reported use of 1,419.7 thousand barrels of kerosene in the residential sector in 2006. Allegheny County, PA had 8,123 houses out of the state total of 1,217,155 that used kerosene as the primary heating fuel. This equates to a share of 0.67% of the kerosene used for residential heating in the state. From the corresponding table below, CO Emission factor is 202.5 lb/thousand barrels.

E_{CO} = 1,419.7 thousand barrels × (8,123 houses / 1,217,155 houses) × 202.5 lb/thousand barrels
= 1,918.6 lbs CO or 0.96 tons CO

f. References

1. U.S. Department of Energy, Energy Information Administration (EIA). State Energy Data 2006 Consumption. Washington, DC 2008. Internet address: http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_all_phy.csv, accessed November 2008.

2. U.S. Census Bureau. "Table H40. House Heating Fuel Type", Census 2000: Summary File 3. Internet address: http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_submenuId=&_lang=en&_ts=, accessed July 2009.

3. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. 1996.

4. U.S. Environmental Protection Agency. Emission Factor and Inventory Group. Final Summary of the Development and Results of a Methodology for Calculating Area Source Emissions from Residential Fuel Combustion. Prepared by Pacific Environmental Services, Inc. Research Triangle Park, NC. September 2002. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/draft1999_ residfuel_inven_apr2003.zip accessed November 2004.

5. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. "Documentation of Emissions Estimation methods for Year 2000 and 2001 Mobile Source and Nonpoint Source Dioxin Inventories." Prepared by E.H. Pechan & Associates, Inc., Durham, NC. May 2003.

6. U.S. Environmental Protection Agency, Emission Factors and Inventory Group. "Documentation for the 1999 Base Year Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants." Prepared by Eastern Research Group, Inc. Morrisville, NC. September 2002.

7. U.S. Environmental Protection Agency. Emission Factor and Inventory Group. Final Summary of the Development and Results of a Methodology for Calculating Area Source Emissions from Residential Fuel Combustion. Prepared by Pacific Environmental Services, Inc. Research Triangle Park, NC. September 2002. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/draft1999_ residfuel_inven_apr2003.zip, accessed November 2004.

National Emission Factors for Residential Kerosene Combustion

Pollutant Code	Pollutant Code Description	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
102	BENZO[B+K]FLUORANTHENE	6.2579E-05	LB	E3BBL
120127	ANTHRACENE	4.9495E-05	LB	E3BBL
129000	PYRENE	0.00017067	LB	E3BBL
1746016	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	1.887E-08	LB	E3BBL
191242	BENZO[G,H,I,]PERYLENE	9.1025E-05	LB	E3BBL
193395	INDENO[1,2,3-C,D]PYRENE	8.5336E-05	LB	E3BBL
206440	FLUORANTHENE	0.00019912	LB	E3BBL
208968	ACENAPHTHYLENE	1.024E-05	LB	E3BBL
218019	CHRYSENE	9.6714E-05	LB	E3BBL
30402154	TOTAL PENTACHLORODIBENZOFURAN	1.4152E-07	LB	E3BBL
3268879	OCTACHLORODIBENZO-P-DIOXIN	2.2239E-08	LB	E3BBL
36088229	TOTAL PENTACHLORODIBENZO-P-DIOXIN	2.7631E-08	LB	E3BBL
37871004	TOTAL HEPTACHLORODIBENZO-P-DIOXIN	2.1228E-08	LB	E3BBL
38998753	TOTAL HEPTACHLORODIBENZOFURAN	2.4598E-08	LB	E3BBL
39001020	OCTACHLORODIBENZOFURAN	1.0109E-08	LB	E3BBL
50000	FORMALDEHYDE	1.3653684	LB	E3BBL
51207319	2,3,7,8-TETRACHLORODIBENZOFURAN	1.7859E-08	LB	E3BBL
53703	DIBENZO[A,H]ANTHRACENE	6.8268E-05	LB	E3BBL
55684941	TOTAL HEXACHLORODIBENZOFURAN	5.7283E-08	LB	E3BBL
56553	BENZ[A]ANTHRACENE	0.00016498	LB	E3BBL
622	HEXACHLORODIBENZO-P-DIOXINS, TOTAL	2.2239E-08	LB	E3BBL
71432	BENZENE	0.00853355	LB	E3BBL
7439921	LEAD	0.05120132	LB	E3BBL
7439965	MANGANESE	0.03413421	LB	E3BBL
7439976	MERCURY	0.01706711	LB	E3BBL
7440020	NICKEL	0.01706711	LB	E3BBL
7440382	ARSENIC	0.02275614	LB	E3BBL
7440417	BERYLLIUM	0.01706711	LB	E3BBL
7440439	CADMIUM	0.01706711	LB	E3BBL
7440473	CHROMIUM	0.01706711	LB	E3BBL
75070	ACETALDEHYDE	0.19911623	LB	E3BBL
7782492	SELENIUM	0.08533553	LB	E3BBL
83329	ACENAPHTHENE	0.00085336	LB	E3BBL
85018	PHENANTHRENE	0.00042668	LB	E3BBL
86737	FLUORENE	0.00018205	LB	E3BBL
91203	NAPHTHALENE	0.04608118	LB	E3BBL

Pollutant Code	Pollutant Code Description	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
NH3	AMMONIA	40.5	LB	E3BBL
CO	CARBON MONOXIDE	202.5	LB	E3BBL
NOX	NITROGEN OXIDES	729	LB	E3BBL
PM10-FIL	PRIMARY PM10, FILTERABLE PORTION ONLY	43.74	LB	E3BBL
PM25-FIL	PRIMARY PM2.5, FILTERABLE PORTION ONLY	33.615	LB	E3BBL
PM-CON	PRIMARY PM CONDENSIBLE PORTION ONLY (ALL LESS THAN 1 MICRON)	52.65	LB	E3BBL
SO2	SULFUR DIOXIDE	1,725.3	LB	E3BBL
VOC	VOLATILE ORGANIC COMPOUNDS	28.35	LB	E3BBL

3.2.3.6 Fossil Fuel Combustion – Residential – Natural Gas

a. Source Category Description

Residential Natural Gas Combustion is natural gas that is burned to heat residential housing as well as in grills, hot water heaters, and dryers.

The general approach to calculating emissions for this SCC is to take State Natural Gas Consumption from the EIA and allocate it to the county level using the methods described below. County level natural gas consumption is multiplied by the emission factors to calculate emissions.

For this source category, the following SCC was assigned:

SCC	Descriptor 1	Descriptor 3	Descriptor 6	Descriptor 8
2104006000	Stationary Source Fuel Combustion	Residential	Natural Gas	Total: Boilers and IC Engines

b. Activity Data

The state-level volume of natural gas consumed by residential combustion in the United States was used to estimate emissions. Natural gas consumption by energy use sector was obtained from the State Energy Data 2006 Consumption tables published by the EIA.[1] Year 2006 consumption data were used as a surrogate for 2008 emissions because these data were the latest data available when this inventory was prepared.

State-level natural gas consumption was allocated to each county using the US Census Bureau's 2000 Census Detailed Housing Information.[2] These data include the number of housing units using a specific type of fuel for residential heating. State natural gas consumption was allocated to each county using the ratio of the number of houses burning natural gas in each county to the total number of houses burning natural gas in the State.

c. Control Factors

No control measures are assumed for this category.

d. Emission Factors

Criteria pollutant emission factors for natural gas are from AP-42.[3] The ammonia emission factor is from EPA's *Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report*.[4] HAP emission factors are from AP-42 and "Documentation for the 1999 Base Year Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants."[5] According to AP-42 (maximum value provided)[2], natural gas has a heat content of 1,050 million BTU per million cubic feet. This value was required to convert those emission factors originally given in

units "pounds per million Btu" to units "pounds per million cubic feet." The grains of sulfur per million cubic feet are assumed to be 2000.[6] Some emission factors were revised based on recommendations by an ERTAC advisory panel composed of state and EPA personnel.

County-level criteria pollutant and HAP emissions were calculated by multiplying the total natural gas consumed in each county per year by an emission factor. The corresponding table below provides a summary of the pollutants, pollutant codes, and emissions factors for residential combustion of natural gas.

e. Sample Calculations

Emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = FC_x \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for fuel type x and pollutant p,
FC_x = annual fuel consumption for fuel type x,
$EF_{x,p}$ = emission factor for fuel type x and pollutant p,

And $FC_x = A_{State}$ x (H_{county} / H_{State})

where :

A_{State} = State activity data from EIA
H_{County} = number of houses in the county using natural gas as the primary heating fuel
H_{State} = number of houses in the state using natural gas as the primary heating fuel

Example:
Using Allegheny County, PA as an example:

The State of Pennsylvania had a reported use of 205,812 million cubic feet of natural gas in the residential sector in 2006. Allegheny County, PA had 474,292 houses out of the state total of 2,452,941 that use natural gas as the primary heating fuel. This equates to a share of 19.34% of the natural gas used for residential heating in the state. From the corresponding table below, CO emission factor is 40 lb/million ft^3.

E_{CO}= 205,812 million ft^3 × (474,292 houses / 2,452,941 houses) × 40 lb CO/ million ft^3

= 1,591,803 lb CO or 795.9 ton CO

f. References

1. U.S. Department of Energy, Energy Information Administration (EIA). State Energy Data 2006 Consumption. Washington, DC 2008. Internet address:

http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_all_phy.csv, accessed November 2008.

2. U.S. Census Bureau. "Table H40. House Heating Fuel Type", Census 2000: Summary File 3. Internet address: http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_submenuId=&_lang=en&_ts=, accessed July 2009.

3. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. 1996.

4. U.S. Environmental Protection Agency. Emission Inventory Improvement Program. Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report. Prepared by E.H. Pechan and Associates, Inc. Research Triangle Park, NC. April 2004.

5. U.S. Environmental Protection Agency, Emission Factors and Inventory Group. "Documentation for the 1999 Base Year Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants." Prepared by Eastern Research Group, Inc. Morrisville, NC. September 2002.

6. U.S. Environmental Protection Agency. Emission Factor and Inventory Group. Final Summary of the Development and Results of a Methodology for Calculating Area Source Emissions from Residential Fuel Combustion. Prepared by Pacific Environmental Services, Inc. Research Triangle Park, NC. September 2002. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/draft1999_ residfuel_inven_apr2003.zip, accessed November 2004.

National Criteria Pollutant and HAP Emission Factors for Residential Natural Gas Combustion

Pollutant Code	Pollutant Code Description	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
129000	PYRENE	0.00000525	LB	E6FT3
206440	FLUORANTHENE	0.00000315	LB	E6FT3
50000	FORMALDEHYDE	0.07875	LB	E6FT3
71432	BENZENE	0.002205	LB	E6FT3
75070	ACETALDEHYDE	0.00001365	LB	E6FT3
85018	PHENANTHRENE	0.00001785	LB	E6FT3
86737	FLUORENE	0.00000294	LB	E6FT3
91203	NAPHTHALENE	0.0006405	LB	E6FT3
CO	CARBON MONOXIDE	40	LB	E6FT3
NH3	AMMONIA	20	LB	E6FT3
NOX	NITROGEN OXIDES	94	LB	E6FT3
PM10-FIL	PRIMARY PM10, FILTERABLE PORTION ONLY	0. 2	LB	E6FT3
PM25-FIL	PRIMARY PM2.5, FILTERABLE PORTION ONLY	0.11	LB	E6FT3
PM-CON	PRIMARY PM CONDENSIBLE PORTION ONLY	0.32	LB	E6FT3
SO2	SULFUR DIOXIDE	0.6	LB	E6FT3
VOC	VOLATILE ORGANIC COMPOUNDS	5.5	LB	E6FT3

3.2.3.7 Non-Residential Construction

a. Source Category Description

Emissions from non-residential construction activity are a function of the acreage disturbed for non-residential construction.
For this source category, the following SCC was assigned:

Source Classification Code	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
2311020000	Industrial Processes	Construction: SIC 15 - 17	Heavy Construction	Total

b. Activity Data

Annual Value of Construction Put in Place in the U.S[1] has the 2008 National Value of Non-residential construction. The national value of non-residential construction put in place (in millions of dollars) was allocated to counties using county-level non-residential construction (NAICS Code 2362) employment data obtained from County Business Patterns[2] (CBP). Because some counties employment data was withheld due to privacy concerns, the following procedure was adopted:
State totals for the known county level employees was subtracted from the number of employees reported in the state level version of CBP. This results in the total number of withheld employees in the state.
A starting guess of the midpoint of the range code was used (so for instance in the 1-19 employees range, a guess of 10 employees would be used) and a state total of the withheld counties was computed.
A ratio of guessed employees (Step 2) to withheld employees (Step 1) was then used to adjust the county level guesses up or down so the state total of adjusted guesses should match state total of withheld employees (Step 1)
In 1999 a figure of 2 acres/$\$10^6$ was developed. The Bureau of Labor Statistics Producer Price Index[3] lists costs of the construction industry from 1999-2007.
2007 acres per $\$10^6$ = 1999 acres per $\$10^6$ x (1999 PPI / 2007 PPI)
=2 acres/$\$10^6$ (132.9 / 204.3)
= 1.301 acres per $\$10^6$

c. Emission Factors

Initial PM_{10} emissions from construction of non-residential buildings are calculated using an emission factor of 0.19 tons/acre/month. The duration of construction activity for non-residential construction is assumed to be 11 months.
Regional variances in construction emissions are corrected using soil moisture level and silt content. These correction parameters are applied to initial PM_{10} emissions from non-residential construction to develop the final emissions inventory.

To account for the soil moisture level, the PM_{10} emissions are weighted using the 30-year average precipitation-evaporation (PE) values from Thornthwaite's PE Index. Average precipitation evaporation values for each State were estimated based on PE values for specific climatic divisions within a State. These values range from 7 to 41.
To account for the silt content, thePM_{10} emissions are weighted using average silt content for each county. A data base containing county-level dry silt values was complied. These values were derived by applying a correction factor developed by the California Air Resources Board to convert wet silt values to dry silt values.[7]
The equation for PM_{10} emissions corrected for soil moisture and silt content is:

$$Corrected\ E_{PM10} = Initial\ \mathrm{E}_{PM10} \times \frac{24}{PE} \times \frac{S}{9\%}$$

where: Corrected E_{PM10} = PM_{10} emissions corrected for soil moisture and silt content,
PE = precipitation-evaporation value for each State,
S = % dry silt content in soil for area being inventoried.
Once PM_{10} adjustments have been made, PM_{25} emissions are set to 10% of PM_{10}

d. Control Factors

No control measures are assumed for this category.

e. Example Calculation

$Emissions_{PM10} = N_{Spending}$ x $(Emp_{county} / Emp_{National})$ x Apd x EF_{Adj}
Where $N_{Spending}$ = National spending
Emp_{county} = county level employment data
$Emp_{National}$ = National level employment data
Apd = Acres per million dollars
EF_{Adj} = Adjusted PM10 emission factor

f. References

Annual Value of Construction Put in Place: http://www.census.gov/const/www/ototpage.html
County Business Patterns: http://www.census.gov/econ/cbp/index.html
Bureau of Labor Statistics: http://www.bls.gov/data/ Table BMNR

3.2.3.8 Residential Construction

a. Source Category Description

Emissions from residential construction activity are a function of the acreage disturbed and volume of soil excavated for residential construction. Residential construction activity is developed from data obtained from the U.S. Department of Commerce (DOC)'s Bureau of the Census

Source Classification Code	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
2311010000	Industrial Processes	Construction: SIC 15 - 17	Residential	Total

b. Activity Data

There are really two types of activity calculations going on for this SCC, acres of surface soil disturbed, and volume of soil removed for basements

Surface Soil disturbed

The US Census Bureau has 2008 data for *Housing Starts - New Privately Owned Housing Units Started*[1] which provides regional level housing starts based on the groupings of 1 unit, 2-4 units, 5 or more units. A consultation with the Census Bureau in 2002 gave a breakdown of approximately 1/3 of the housing starts being for 2 unit structures, and 2/3 being for 3 and 4 unit structures. The 2-4 unit category was then divided into 2-units, and 3-4 units based on this ratio. To get the number of structures for each grouping, the 1unit category was divided by 1, 2 unit category was divided by 2, and the 3-4 unit category was divided by 3.5. The 5 or more unit category listed may be made up of more than one structure. *New Privately Owned Housing Units Authorized Unadjusted Units*[2] gives a conversion factor to determine the ratio of structures to units in the 5 or more unit category. For example if a county has one 40unit apartment building, the ratio would be 40/1. If there are 5 different 8 unit buildings in the same project, the ratio would be 40/5. Structures started by category are then calculated at a regional level. The table *Annual Housing Units Authorized by Building Permit*[3] has 2007 data at the county level to allocate regional housing starts to the county level. This results in county level housing starts by number of units. The following surface areas were assumed disturbed for each unit type:

Surface Soil removed per unit type

1-Unit	1/4 acre/structure
2-Unit	1/3 acre/structure
Apartment	1/2 acre/structure

The 3-4 unit category was considered to be an apartment. Multiplication of housing starts to soil removed results in number of acres disturbed for each unit category.

Basement soil removal
To calculate basement soil removal, 2007 *Characteristics of New Houses*[4] is used to estimate the percentage of 1 unit structures that have a basement (on the regional level). The county level estimate of number of 1 unit starts is multiplied by the percent of 1 unit houses in the region that have a basement to get the number of basements in a county. Basement volume is calculated by assuming a 2000 square foot house has a basement dug to a depth of 8 feet (making 1600 ft^3 per basement). An additional 10% is added for peripheral dirt bringing the total to 1760 ft^3 per basement.

c. Emission Factors

Initial PM_{10} emissions from construction of single family, two family, and apartments structures are calculated using the emission factors given in the table below. The duration of construction activity for houses is assumed to be 6 months and the duration of construction for apartments is assumed to be 12 months.

Emission Factors for Residential Construction

Type of Structure	Emission Factor	Duration of Construction
Apartments	0.11 tons PM10/acre-month	12 months
2-Unit Structures	0.032 tons PM10/acre-month	6 months
1-Unit Structures w/o Basements	0.032 tons PM10/acre-month	6 months
1-unit Structures with Basements	0.011 tons PM10/acre-month	6 months
	0.059 tons PM10/1000 cubic yards	

Regional variances in construction emissions are corrected using soil moisture level, silt content, and control efficiency. These correction parameters are applied to initial PM_{10} emissions from residential construction to develop the final emissions inventory.

To account for the soil moisture level, the PM_{10} emissions are weighted using the precipitation-evaporation (PE) values from Thornthwaite's PE Index. Average precipitation evaporation values for each State were estimated based on PE values for specific climatic divisions within a State. These values range from 7 to 41.

To account for the silt content, thePM_{10} emissions are weighted using average silt content for each county. A data base containing county-level dry silt values was complied. These values

were derived by applying a correction factor developed by the California Air Resources Board to convert wet silt values to dry silt values.[5]

The equation for PM_{10} emissions corrected for soil moisture and silt content is:

$$Corrected\ E_{PM10} = Initial\ E_{PM10} \times \frac{24}{PE} \times \frac{S}{9\%}$$

where: Corrected E_{PM10} = PM_{10} emissions corrected for soil moisture and silt content,
PE = precipitation-evaporation value for each State,
S = % dry silt content in soil for area being inventoried.

Once PM_{10} adjustments have been made, PM_{25} emissions are set to 20% of PM_{10}

d. Control Factors

No control measures are assumed for this category.

e. Example Calculation

PM_{10} Emissions = $\sum(A_{unit} \text{ x } T_{construction} \text{ x } EF_{unit}) \text{ x } Adj_{PM}$
Where $A_{unit} = HS_{Unit} \text{ x } SM_{Unit}$
HS_{Unit} = Regional Housing Starts x (county building permits/Regional building permits)
SM_{Unit} = Area or volume of soil moved for the given unit type
$T_{Construction}$ = Construction time (in months) for given unit type
EF_{Unit} = Unadjusted emission factor for PM_{10} for the given unit type
Adj_{PM} = PM Adjustment factor

f. References

New Privately Owned Housing Units Started for 2008 (Not seasonally adjusted)
http://www.census.gov/const/startsua.pdf
Table 2au. New Privately Owned Housing Units Authorized Unadjusted Units for Regions, Divisions, and States http://www.census.gov/const/C40/Table2/tb2u2007.txt
Annual Housing Units Authorized by Building Permits CO2007A, purchased from US Department of Census
Type of Foundation in New One-Family Houses Completed,
http://www.census.gov/const/C25Ann/sftotalfoundation.pdf

3.2.3.9 Road Construction

a. Source Category Description

Emissions from road construction activity are a function of the acreage disturbed for road construction. Road construction activity is developed from data obtained from the Federal Highway Administration (FHWA).

Source Classification Code	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
2311030000	Industrial Processes	Construction: SIC 15 - 17	Road Construction	Total

b. Activity

The Federal Highway Administration has *Highway Statistics, Section IV - Highway Finance, Table SF-12A, State Highway Agency Capital Outlay*[1] for 2006 which outlines spending by state in several different categories. For this SCC, the following columns are used: New Construction, Relocation, Added Capacity, Major Widening, and Minor Widening. These columns are also differentiated according to the following six classifications:

1. Interstate, urban
2. Interstate, rural
3. Other arterial, urban
4. Other arterial, rural
5. Collectors, urban
6. Collectors, rural

The State expenditure data are then converted to new miles of road constructed using $/mile conversions obtained from the North Carolina Department of Transportation (NCDOT) in 2000. A conversion of $4 million/mile is applied to the interstate expenditures. For expenditures on other arterial and collectors, a conversion factor of $1.9 million/mile is applied, which corresponds to all other projects.

The new miles of road constructed is used to estimate the acreage disturbed due to road construction. The total area disturbed in each state is calculated by converting the new miles of road constructed to acres using an acres disturbed/mile conversion factor for each road type as given in the table below:

Spending per mile and Acres disturbed per mile by highway type

Road Type	Thousand Dollars per mile	Acres Disturbed per mile
URBAN AREAS, INTERSTATE	4000	15.2
RURAL AREAS, INTERSTATE	4000	15.2
URBAN AREAS, OTHER ARTERIALS	1900	15.2
RURAL AREAS, OTHER ARTERIALS	1900	12.7
URBAN AREAS, COLLECTORS	1900	9.8
RURAL AREAS, COLLECTORS	1900	7.9

Residential building starts[2] are used to allocate the state-level acres disturbed by road construction to the county. A ratio of the number of building starts in each county to the total number of building starts in each state is applied to the state-level acres disturbed to estimate the total number of acres disturbed by road construction in each county.

c. Emission Factors

Initial PM_{10} emissions from construction of roads are calculated using an emission factor of 0.42 tons/acre/month. Since most road construction consists of grading and leveling of land, the higher emission factor more accurately reflects the high level of cut and fill activity that occurs at road construction sites. The duration of construction activity for road construction is assumed to be 12 months.

Regional variances in construction emissions are corrected using soil moisture level, silt content, and control efficiency. These correction parameters are applied to initial PM_{10} emissions from non-residential construction to develop the final emissions inventory.

To account for the soil moisture level, the PM_{10} emissions are weighted using the precipitation-evaporation (PE) values from Thornthwaite's PE Index. Average precipitation evaporation values for each State were estimated based on PE values for specific climatic divisions within a State. These values range from 7 to 41.

To account for the silt content, thePM_{10} emissions are weighted using average silt content for each county. A data base containing county-level dry silt values was complied. These values were derived by applying a correction factor developed by the California Air Resources Board to convert wet silt values to dry silt values.

The equation for PM_{10} emissions corrected for soil moisture and silt content is:

$$Corrected\ E_{PM10} = Initial\ \mathrm{E}_{PM10} \times \frac{24}{PE} \times \frac{S}{9\%}$$

where: Corrected E_{PM10} = PM_{10} emissions corrected for soil moisture and silt content,
PE = precipitation-evaporation value for each State,
S = % dry silt content in soil for area being inventoried.

Once PM_{10} adjustments have been made, PM_{25} emissions are set to 20% of PM_{10}

d. Control Factors

No control measures are assumed for this category.

e. Example Calculation

$Emissions_{PM10} = \sum(HD_{rt} \times MC_{rt} \times AC_{rt}) \times (HS_{County} / HS_{State}) \times EFAdj$

Where HD_{rt} = Highway Spending for a specific road type

MC_{rt} = Mileage conversion for a specific road type

AC_{rt} = Acreage conversion for a specific road type

HS_{County} = Housing Starts in a given county

HS_{State} = Housing Starts in a given State

EF_{Adj} = Adjusted PM10 Emission Factor

f. References

2006 Highway Spending : http://www.fhwa.dot.gov/policy/ohim/hs06/xls/sf12a.xls

Annual Housing Units Authorized by Building Permits CO2007A, purchased from US Department of Census

3.2.3.10 Agricultural Production – Livestock

a. Source Category Description

Livestock refers to domesticated animals intentionally reared for the production of food, fiber, or other goods or for the use of their labor. The definition of livestock in this category includes beef cattle, dairy cattle, ducks, geese, goats, horses, poultry, sheep, and swine.

The approach to calculating emissions for the assigned SCCs consisted of four general steps, as follows:

- Determining county-level population of animals for 2007.
- For beef, dairy, poultry, and swine, apportioning animal populations to a manure management train (MMT) for each county. Animal populations for ducks, geese, goats, horses, and sheep were not apportioned to MMTs.
- Modifying the emission factor files provided with the CMU Ammonia Model v. 3.6 to ensure that every county had an assigned emission factor.[1]
- Using the CMU Ammonia Model v. 3.6 to calculate ammonia emissions based on the updated county-level animal populations and emission factors.

For this source category, the following SCCs were assigned:

SCC	Descriptor 2	Descriptor 4	Descriptor 7	Descriptor 8
2805001100	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle - finishing operations on feedlots (drylots)	Confinement
2805001200	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle - finishing operations on feedlots (drylots)	Manure handling and storage
2805001300	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle - finishing operations on feedlots (drylots)	Land application of manure
2805002000	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle production composite	Not Elsewhere Classified
2805003100	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle - finishing operations on pasture/range	Confinement
2805007100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with dry manure management systems	Confinement

SCC	Descriptor 2	Descriptor 4	Descriptor 7	Descriptor 8
2805007300	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with dry manure management systems	Land application of manure
2805008100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with wet manure management systems	Confinement
2805008200	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with wet manure management systems	Manure handling and storage
2805008300	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with wet manure management systems	Land application of manure
2805009100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - broilers	Confinement
2805009200	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - broilers	Manure handling and storage
2805009300	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - broilers	Land application of manure
2805010100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - turkeys	Confinement
2805010200	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - turkeys	Manure handling and storage
2805010300	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - turkeys	Land application of manure
2805018000	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle composite	Not Elsewhere Classified
2805019100	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - flush dairy	Confinement
2805019200	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - flush dairy	Manure handling and storage
2805019300	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - flush dairy	Land application of manure
2805021100	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - scrape dairy	Confinement

SCC	Descriptor 2	Descriptor 4	Descriptor 7	Descriptor 8
2805021200	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - scrape dairy	Manure handling and storage
2805021300	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - scrape dairy	Land application of manure
2805022100	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - deep pit dairy	Confinement
2805022200	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - deep pit dairy	Manure handling and storage
2805022300	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - deep pit dairy	Land application of manure
2805023100	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - drylot/pasture dairy	Confinement
2805023200	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - drylot/pasture dairy	Manure handling and storage
2805023300	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle - drylot/pasture dairy	Land application of manure
2805025000	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production composite	Not Elsewhere Classified (see also 28-05-039, -047, -053)
2805030000	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry Waste Emissions	Not Elsewhere Classified (see also 28-05-007, -008, -009)
2805030007	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry Waste Emissions	Ducks
2805030008	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry Waste Emissions	Geese
2805035000	Miscellaneous Area Sources	Agriculture Production - Livestock	Horses and Ponies Waste Emissions	Not Elsewhere Classified
2805039100	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production - operations with lagoons (unspecified animal age)	Confinement
2805039200	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production - operations with lagoons (unspecified animal age)	Manure handling and storage

SCC	Descriptor 2	Descriptor 4	Descriptor 7	Descriptor 8
2805039300	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production - operations with lagoons (unspecified animal age)	Land application of manure
2805040000	Miscellaneous Area Sources	Agriculture Production - Livestock	Sheep and Lambs Waste Emissions	Total
2805045000	Miscellaneous Area Sources	Agriculture Production - Livestock	Goats Waste Emissions	Not Elsewhere Classified
2805047100	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production - deep-pit house operations (unspecified animal age)	Confinement
2805047300	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production - deep-pit house operations (unspecified animal age)	Land application of manure
2805053100	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production - outdoor operations (unspecified animal age)	Confinement

b. Activity Data

County-level animal numbers for 2007 were obtained from the U.S. Department of Agriculture's 2007 Census of Agriculture report.[2] For Virginia, the county-level census data includes animal populations from Virginia's 39 independent cities. For some counties and states, census data was withheld to avoid disclosing data for individual farms. However, the total national-level animal numbers and most state-level animal numbers for each livestock type reported in the Census include those animal numbers not disclosed at the county-level. When available, state-level animal numbers from the USDA NASS online database were used for states with undisclosed animal numbers in the 2007 Census of Agriculture.[3] To determine the total number of undisclosed animals, disclosed county-level animal numbers for each livestock type were summed and subtracted from the total state animal numbers. The total undisclosed animal population for a specific livestock type was then allocated to those counties reporting undisclosed data based on the number of farms raising that livestock in each county.[2] If the state-level data was undisclosed and not available in the NASS database, then national animal numbers were used to determine undisclosed state numbers. The disclosed county-level data was then summed and subtracted from the state-level data to determine animal numbers not disclosed at the county-level. These numbers were then allocated to those counties reporting undisclosed data based on the number of farms raising that livestock in each county.

County-level animal numbers were apportioned to manure management trains. A MMT consists of an animal confinement area (e.g., drylot, pasture, flush, scrape); components used to store,

process, or stabilize the manure (e.g., anaerobic lagoons, deep pits); and a land application site where manure is used as a fertilizer source.[4] The apportionment was based on county-level MMT percentages derived from the CMU Ammonia Model. For each livestock type, the county-level number of animals in each MMT was divided by the total county-level animal population for that livestock type to calculate the percentage of total animals managed by each MMT. In cases where the county-level numbers were zero in the 2002 CMU Ammonia Model input files, the county was assigned state-level MMT percentages. The county-level animal population for each livestock type from the 2007 Census of Agriculture was multiplied by the MMT percentages to determine the total number of animals in each MMT in 2007. Animal populations for ducks, geese, goats, horses, and sheep were not apportioned to MMTs.

Cattle reported as "Other Cattle" in the 2007 Census of Agriculture were divided between dairy cattle and beef cattle at the county-level using percent allocations derived from county-level dairy and beef cattle reported in the 2007 Census of Agriculture and corrected for undisclosed data. The animal numbers from "Other Cattle" apportioned to dairy and beef cattle were used to create the Dairy Cattle – Composite and Beef Cattle – Composite activity input files for the CMU Ammonia Model.

County-level pullet numbers reported in the 2007 Census of Agriculture were used to create the Poultry – Composite activity input file for the CMU Ammonia Model.

c. Emission Factors

The emission factor for the poultry composite categories was obtained from an EPA report and is reported in the corresponding table below.[4] The county-level emission factors for the beef composite and dairy composite categories were developed using beef and dairy cattle emission factors provided with the 2002 CMU Model. Specifically, weighted average emission factors were calculated based on the number of beef or dairy cattle in each MMT from the 2002 CMU Model activity files and the emission factor assigned to each MMT. All other emission factors were provided with the CMU Ammonia Model v.3.6. The emission factors for some counties in the CMU Ammonia Model files were zero. To ensure that all counties with animal populations were assigned emissions factors, the emission factor input files provided with the CMU Ammonia Model were modified. For all counties with an emission factor of zero, the emission factor was replaced with the state average emission factor. If all counties in the state had emission factors of zero, then the county emission factor was replaced with the national average emission factor. The state average emission factor was calculated by summing the counties with non-zero emission factors in the state and dividing the total by the number of counties in that state with non-zero emission factors. The national average emission factor was calculated by summing the counties with non-zero emission factors in the nation and dividing the total by the number of counties in the nation with non-zero emission factors.

d. Emissions

The livestock activity files provided with the CMU Ammonia Model v.3.6 were replaced with the updated county-level animal population files and modified emissions files. County-level ammonia emissions were then calculated by running the model.

e. Sample Calculations

Allocation of Undisclosed Data

From the 2007 Census of Agriculture, the total national number of beef cattle in Alabama is 678,949. The total number of beef cattle disclosed at the county-level is 388,827.

Total number of beef cattle undisclosed at the county-level = 678,949 - 338,827 = 340,122

From the 2007 Census of Agriculture, the total number of farms in Alabama not disclosing beef cattle numbers is 10,518.

Average beef cattle per farm not disclosing data = 340,122 / 10,518 = 32.3

For 2007, Baldwin County, Alabama beef cattle data was not disclosed. The total number of farms with beef cattle in Baldwin County is 343.

Estimated number of beef cattle in Baldwin County = 32.3 x 343 = 11,092

Manure Management Train

From the 2002 CMU Ammonia Model input files, Chilton County, Alabama had 79 beef cattle under drylot management and 18,900 beef cattle under pasture management in 2002.

Total beef cattle = 79 + 18,900 = 18,979
% of beef cattle under drylot management = 79 / 18,979 = 0.42
% of beef cattle under pasture management = 18,900 / 18,979 = 99.58

The total number of beef cattle for Chilton County reported in the 2007 Census of Agriculture is 7,939.

Number of beef cattle under drylot management in 2007 = 7,939 x 0.0042 = 33
Number of beef cattle under pasture management in 2007 = 7,939 x 0.9958 = 7,906

"Other Cattle"

For Clay County, Alabama, the 2007 Census of Agriculture reports the number of "Other Cattle" as 5,471, the number of dairy cattle as 216, and the number of beef cattle as 9,096.

Total beef and dairy cattle reported = 216 + 9,096 = 9,312
% of other cattle assigned to beef cattle = (9,096/9,312)*100 = 97.68
% of other cattle assigned to dairy cattle = (216/9,312)*100 = 2.32
Other cattle allocated to beef cattle = 5,471 x .9768 = 5,344
Other cattle allocated to dairy cattle = 5,471 x 0.0232 = 127

f. References

1. Cliff Davidson, Peter Adams, Ross Strader, Rob Pinder, Natalie Anderson, Marian Goebes, and Josh Ayers. The Environmental Institute, Carnegie Mellon University, *CMU Ammonia Model v.3.6.*, 2004, at http://www.cmu.edu/ammonia/, accessed 25 April 2009.

2. U.S. Department of Agriculture, *2007 Census of Agriculture*, at http://www.agcensus.usda.gov/, accessed 30 April 2009.

3. U.S. Department of Agriculture, National Agricultural Statistics Service, at http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/, accessed 28 January 2010.

4. U.S. Environmental Protection Agency, *National Emission Inventory – Ammonia Emissions from Animal Agricultural Operations*, Revised Draft Report, 22 April 2005, p. 4-6, at http://www.epa.gov/ttn/chief/net/2002inventory.html, accessed 5 May 2009.

5. Jonathan Dorn, E.H. Pechan & Associates. 2009. A weighted average emission factor calculated using data from the 2002 CMU Ammonia Model v.3.6.

Livestock Emission Factors

Description	Pollutant Code	Emission Factor	Emission Factor Unit	Emission Factor Reference
Beef Cattle - Composite	NH3	county-specific	kg NH_3/cow/month	5
Beef Cattle - Drylot Operation - Confinement	NH3	9.45E-01	kg NH_3/cow/month	1
Beef Cattle - Drylot Operation - Land Application	NH3	state-specific	kg NH_3/cow/month	1
Beef Cattle - Drylot Operation - Manure Storage	NH3	3.78E-04	kg NH_3/cow/month	1
Beef Cattle - Pasture Operation - Confinement	NH3	county-specific	kg NH_3/cow/month	1
Dairy Cattle - Composite	NH3	county-specific	kg NH_3/cow/month	5
Dairy Cattle - Deep Pit Dairy Confinement	NH3	2.42E+00	kg NH_3/cow/month	1

Description	Pollutant Code	Emission Factor	Emission Factor Unit	Emission Factor Reference
Dairy Cattle - Deep Pit Dairy Land Application	NH3	state-specific	kg NH_3/cow/month	1
Dairy Cattle - Deep Pit Dairy Manure Storage	NH3	1.13E-01	kg NH_3/cow/month	1
Dairy Cattle - Drylot Dairy Confinement	NH3	state-specific	kg NH_3/cow/month	1
Dairy Cattle - Drylot Dairy Land Application	NH3	state-specific	kg NH_3/cow/month	1
Dairy Cattle - Drylot Dairy Manure Storage	NH3	state-specific	kg NH_3/cow/month	1
Dairy Cattle - Flush Dairy Confinement	NH3	2.00E+00	kg NH_3/cow/month	1
Dairy Cattle - Flush Dairy Land Application	NH3	state-specific	kg NH_3/cow/month	1
Dairy Cattle - Flush Dairy Manure Storage	NH3	state-specific	kg NH_3/cow/month	1
Dairy Cattle - Scrape Dairy Confinement	NH3	state-specific	kg NH_3/cow/month	1
Dairy Cattle - Scrape Dairy Land Application	NH3	state-specific	kg NH_3/cow/month	1
Dairy Cattle - Scrape Dairy Manure Storage	NH3	state-specific	kg NH_3/cow/month	1
Ducks	NH3	7.67E-02	kg NH_3/duck/month	1
Geese	NH3	7.67E-02	kg NH_3/goose/month	1
Goats	NH3	5.29E-01	kg NH_3/goat/month	1
Horses	NH3	1.02E+00	kg NH_3/horse/month	1
Poultry - Broiler Operation - Confinement	NH3	8.32E-03	kg NH_3/bird/month	1
Poultry - Broiler Operation - Land Application	NH3	6.80E-03	kg NH_3/bird/month	1
Poultry - Broiler Operation - Manure Storage	NH3	1.51E-03	kg NH_3/bird/month	1
Poultry - Composite	NH3	2.00E-02	kg NH_3/bird/month	4
Poultry - Layers - Dry Manure Operation - Confinement	NH3	3.36E-02	kg NH_3/bird/month	1
Poultry - Layers - Dry Manure Operation - Land Application	NH3	county-specific	kg NH_3/bird/month	1
Poultry - Layers - Wet Manure Operation - Confinement	NH3	9.45E-03	kg NH_3/bird/month	1
Poultry - Layers - Wet Manure Operation - Land Application	NH3	county-specific	kg NH_3/bird/month	1
Poultry - Layers - Wet Manure Operation - Manure Storage	NH3	county-specific	kg NH_3/bird/month	1

Description	Pollutant Code	Emission Factor	Emission Factor Unit	Emission Factor Reference
Poultry - Turkey Operation - Confinement	NH3	3.78E-02	kg NH_3/bird/month	1
Poultry - Turkey Operation - Land Application	NH3	3.40E-02	kg NH_3/bird/month	1
Poultry - Turkey Operation - Storage	NH3	6.80E-03	kg NH_3/bird/month	1
Sheep	NH3	2.65E-01	kg NH_3/sheep/month	1
Swine - Composite	NH3	county-specific	kg NH_3/pig/month	1
Swine - Deep Pit Operation - Confinement	NH3	2.65E-01	kg NH_3/pig/month	1
Swine - Deep Pit Operation - Land Application	NH3	county-specific	kg NH_3/pig/month	1
Swine - Lagoon Operation - Confinement	NH3	2.27E-01	kg NH_3/pig/month	1
Swine - Lagoon Operation - Land Application	NH3	county-specific	kg NH_3/pig/month	1
Swine - Lagoon Operation - Manure Storage	NH3	county-specific	kg NH_3/pig/month	1
Swine - Outdoor Operation - Confinement	NH3	county-specific	kg NH_3/pig/month	1

3.2.3.11 Commercial Cooking

a. Source Category Description

Commercial Cooking emissions are for 5 source categories based on equipment type. Emissions estimates are for all types of meat cooked in a particular piece of equipment. Deep fat frying of french fries was also included.

For this source category, the following SCCs were assigned:

Source Classification Code	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
2302002100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Conveyorized Charbroiling
2302002200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Under-fired Charbroiling
2302003000	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Deep Fat Frying
2302003100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Flat Griddle Frying
2302003200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Clamshell Griddle Frying

b. Activity Data

Activity data was collected from the US Census Bureau's county level population estimates for July 1, 2008.[1]

c. Control Factors

No controls were assumed for this category.

d. Emission Factors

Emission factors were developed and reviewed by an ERTAC advisory panel composed of state and EPA personnel (Contact: Roy Huntley, huntley.roy@epa.gov). They were created by taking 2002 emissions in the NEI and dividing by the 2002 population to develop per capita emission factors. These emission factors are listed in the corresponding table below.

e. Sample Calculations

Emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = A_x \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for category x and pollutant p;
A_x = population data associated with category x;
$EF_{x,p}$ = emission factor for category x and pollutant p.

Example:
Using conveyorized charbroiling in Allegheny County, PA as an example:

According to the US Census Bureau, population on July 1, 2008 is 1,215,103
The emission factor for VOC is 0.01205 lb/person

$$E_{VOC} = 1{,}215{,}103 \text{ people} \times 0.01205 \text{ lb VOC/ person}$$

$$= 14{,}650 \text{ lb VOC or } 7.3 \text{ ton VOC}$$

f. References

1. DOC, 2008: U.S. Department of Commerce, Bureau of the Census, 2008 *Population Estimates Program GCT-T1: Population Estimates*, Washington, DC.

Commercial Cooking Emission Factors Developed by ERTAC

SCC	SCC description	Pollutant Code	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
2302002100	Conveyorized Charbroiling	100027	1.326E-05	LB	EACH
2302002200	Under-fired Charbroiling	100027	6.385E-05	LB	EACH
2302002100	Conveyorized Charbroiling	100414	7.668E-05	LB	EACH
2302002200	Under-fired Charbroiling	100414	5.312E-04	LB	EACH
2302002100	Conveyorized Charbroiling	100425	3.730E-04	LB	EACH
2302002200	Under-fired Charbroiling	100425	2.747E-03	LB	EACH
2302002100	Conveyorized Charbroiling	106445	7.003E-06	LB	EACH
2302002200	Under-fired Charbroiling	106445	4.214E-05	LB	EACH
2302002100	Conveyorized Charbroiling	107062	2.682E-05	LB	EACH
2302002200	Under-fired Charbroiling	107062	2.183E-04	LB	EACH
2302002100	Conveyorized Charbroiling	108883	3.597E-04	LB	EACH
2302002200	Under-fired Charbroiling	108883	2.496E-03	LB	EACH
2302002100	Conveyorized Charbroiling	108952	4.421E-05	LB	EACH
2302002200	Under-fired Charbroiling	108952	3.063E-04	LB	EACH
2302002100	Conveyorized Charbroiling	120127	5.943E-06	LB	EACH
2302002200	Under-fired Charbroiling	120127	1.914E-05	LB	EACH
2302003100	Flat Griddle Frying	120127	8.487E-06	LB	EACH
2302002100	Conveyorized Charbroiling	123386	1.466E-04	LB	EACH
2302002200	Under-fired Charbroiling	123386	1.113E-03	LB	EACH

SCC	SCC description	Pollutant Code	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
2302002100	Conveyorized Charbroiling	129000	8.852E-06	LB	EACH
2302002200	Under-fired Charbroiling	129000	3.587E-05	LB	EACH
2302003100	Flat Griddle Frying	129000	3.139E-05	LB	EACH
2302002100	Conveyorized Charbroiling	130498292	2.709E-04	LB	EACH
2302002200	Under-fired Charbroiling	130498292	7.911E-04	LB	EACH
2302003100	Flat Griddle Frying	130498292	2.589E-04	LB	EACH
2302002100	Conveyorized Charbroiling	1330207	7.799E-07	LB	EACH
2302002200	Under-fired Charbroiling	1330207	1.560E-06	LB	EACH
2302002100	Conveyorized Charbroiling	191242	1.309E-06	LB	EACH
2302002200	Under-fired Charbroiling	191242	2.542E-06	LB	EACH
2302002100	Conveyorized Charbroiling	193395	1.278E-06	LB	EACH
2302002200	Under-fired Charbroiling	193395	1.723E-06	LB	EACH
2302002100	Conveyorized Charbroiling	206440	6.484E-06	LB	EACH
2302002200	Under-fired Charbroiling	206440	2.638E-05	LB	EACH
2302003100	Flat Griddle Frying	206440	2.371E-05	LB	EACH
2302002100	Conveyorized Charbroiling	208968	2.476E-05	LB	EACH
2302002200	Under-fired Charbroiling	208968	6.372E-05	LB	EACH
2302003100	Flat Griddle Frying	208968	4.886E-06	LB	EACH
2302002100	Conveyorized Charbroiling	50000	7.796E-04	LB	EACH
2302002200	Under-fired Charbroiling	50000	5.876E-03	LB	EACH
2302002100	Conveyorized Charbroiling	50328	1.450E-06	LB	EACH
2302002200	Under-fired Charbroiling	50328	2.332E-06	LB	EACH
2302003100	Flat Griddle Frying	50328	1.154E-06	LB	EACH
2302002100	Conveyorized Charbroiling	56553	1.772E-06	LB	EACH
2302002200	Under-fired Charbroiling	56553	5.432E-06	LB	EACH
2302003100	Flat Griddle Frying	56553	2.918E-06	LB	EACH
2302002100	Conveyorized Charbroiling	71432	1.006E-03	LB	EACH
2302002200	Under-fired Charbroiling	71432	7.351E-03	LB	EACH
2302002100	Conveyorized Charbroiling	75070	5.562E-04	LB	EACH
2302002200	Under-fired Charbroiling	75070	4.242E-03	LB	EACH
2302002100	Conveyorized Charbroiling	83329	1.613E-06	LB	EACH
2302002200	Under-fired Charbroiling	83329	2.776E-06	LB	EACH
2302003100	Flat Griddle Frying	83329	1.357E-06	LB	EACH
2302002100	Conveyorized Charbroiling	84742	4.140E-06	LB	EACH
2302002200	Under-fired Charbroiling	84742	2.413E-05	LB	EACH

SCC	SCC description	Pollutant Code	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
2302002100	Conveyorized Charbroiling	85018	2.771E-05	LB	EACH
2302002200	Under-fired Charbroiling	85018	8.647E-05	LB	EACH
2302003100	Flat Griddle Frying	85018	6.021E-05	LB	EACH
2302002100	Conveyorized Charbroiling	86737	6.408E-06	LB	EACH
2302002200	Under-fired Charbroiling	86737	2.003E-05	LB	EACH
2302003100	Flat Griddle Frying	86737	6.484E-06	LB	EACH
2302002100	Conveyorized Charbroiling	91203	1.135E-04	LB	EACH
2302002200	Under-fired Charbroiling	91203	2.649E-04	LB	EACH
2302003100	Flat Griddle Frying	91203	1.308E-04	LB	EACH
2302002100	Conveyorized Charbroiling	92524	1.271E-05	LB	EACH
2302002200	Under-fired Charbroiling	92524	2.613E-05	LB	EACH
2302003100	Flat Griddle Frying	92524	2.788E-06	LB	EACH
2302002100	Conveyorized Charbroiling	95476	6.167E-05	LB	EACH
2302002200	Under-fired Charbroiling	95476	4.387E-04	LB	EACH
2302002100	Conveyorized Charbroiling	95487	3.482E-06	LB	EACH
2302002200	Under-fired Charbroiling	95487	2.111E-05	LB	EACH
2302002100	Conveyorized Charbroiling	98862	4.991E-06	LB	EACH
2302002200	Under-fired Charbroiling	98862	3.250E-05	LB	EACH
2302002100	Conveyorized Charbroiling	CO	4.245E-02	LB	EACH
2302002200	Under-fired Charbroiling	CO	1.350E-01	LB	EACH
2302003000	Deep Fat Flying	CO	0.000E+00	LB	EACH
2302003100	Flat Griddle Frying	CO	1.269E-02	LB	EACH
2302003200	Clamshell Griddle Frying	CO	0.000E+00	LB	EACH
2302002200	Under-fired Charbroiling	NOX	0.000E+00	LB	EACH
2302002100	Conveyorized Charbroiling	PM10-FIL	1.648E-04	LB	EACH
2302002200	Under-fired Charbroiling	PM10-FIL	1.048E-03	LB	EACH
2302003100	Flat Griddle Frying	PM10-FIL	2.727E-04	LB	EACH
2302003200	Clamshell Griddle Frying	PM10-FIL	1.981E-05	LB	EACH
2302002100	Conveyorized Charbroiling	PM10-PRI	4.980E-02	LB	EACH
2302002200	Under-fired Charbroiling	PM10-PRI	3.528E-01	LB	EACH
2302003000	Deep Fat Flying	PM10-PRI	0.000E+00	LB	EACH
2302003100	Flat Griddle Frying	PM10-PRI	1.031E-01	LB	EACH
2302003200	Clamshell Griddle Frying	PM10-PRI	6.994E-03	LB	EACH
2302002100	Conveyorized Charbroiling	PM25-FIL	1.597E-04	LB	EACH
2302002200	Under-fired Charbroiling	PM25-FIL	1.013E-03	LB	EACH
2302003100	Flat Griddle Frying	PM25-FIL	2.074E-04	LB	EACH
2302003200	Clamshell Griddle Frying	PM25-FIL	1.685E-05	LB	EACH

SCC	SCC description	Pollutant Code	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
2302002100	Conveyorized Charbroiling	PM25-PRI	4.827E-02	LB	EACH
2302002200	Under-fired Charbroiling	PM25-PRI	3.415E-01	LB	EACH
2302003000	Deep Fat Flying	PM25-PRI	0.000E+00	LB	EACH
2302003100	Flat Griddle Frying	PM25-PRI	7.834E-02	LB	EACH
2302003200	Clamshell Griddle Frying	PM25-PRI	5.910E-03	LB	EACH
2302002200	Under-fired Charbroiling	SO2	0.000E+00	LB	EACH
2302002100	Conveyorized Charbroiling	VOC	1.206E-02	LB	EACH
2302002200	Under-fired Charbroiling	VOC	4.148E-02	LB	EACH
2302003000	Deep Fat Flying	VOC	1.261E-02	LB	EACH
2302003100	Flat Griddle Frying	VOC	5.943E-03	LB	EACH
2302003200	Clamshell Griddle Frying	VOC	2.316E-04	LB	EACH

3.2.3.12 Asphalt Paving – Cutback

a. Source Category Description

Asphalt paving is the process of applying asphalt concrete to seal or repair the surface of roads, parking lots, driveways, walkways, or airport runways. Asphalt concrete is a composite material comprised of a binder and a mineral aggregate. The binder, referred to as asphalt cement, is a byproduct of petroleum refining and contains the semi-solid residual material left after the more volatile chemical fractions have been distilled off.[1]

Asphalt cements thinned with petroleum distillates are known as cutback asphalts. The primary uses of cutback asphalt include tack and seal operations, priming roadbeds, and paving operations for pavements up to several inches thick. Cut-back asphalt is produced by thinning the binder in a diluent containing 25 to 45 percent petroleum distillates by volume prior to mixing with the aggregate. This reduces the viscosity of the asphalt making it easier to work with the mixture.

Emissions from cutback asphalt result from the evaporation of VOCs and HAPS after the mixture is laid down. Of all asphalt types, cutback asphalt has the highest diluent content and, as a result, emits the highest levels of VOCs per ton used. The timeframe and quantity of VOC and HAP emissions depend on the type and the quantity of organic solvent used as a diluent.

For this source category, the following SCC was assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2461021000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Cutback Asphalt	Total: All Solvent Types

The general approach to calculating emissions from cutback asphalt paving is to multiply the estimated county-level cutback asphalt usage by emission factors for VOCs and HAPs.

b. Activity Data

State-level cutback asphalt usage in 2008 was obtained from the Asphalt Institute's *2008 Asphalt Usage Survey*.[2] State-level data were allocated to county-level according to the fraction of paved road vehicle miles traveled (VMT) in each county.

Total annual VMT estimates by State and roadway class were obtained from the Federal Highway Administration's (FHWA) annual Highway Statistics report.[3] Paved road VMT was calculated by subtracting the State/roadway class unpaved road VMT from total State/roadway class VMT. State-level paved road VMT was spatially allocated to counties according to the fraction of total VMT in each county for the specific roadway class as shown by the following equation:

$$VMT_{x,total} = \sum VMT_{ST,y} * VMT_{x,y} / VMT_{ST,y}$$

where: $VMT_{x,total}$ = VMT (million miles) in county x on all paved roadways
$VMT_{ST,y}$ = paved road VMT for the entire State for roadway class y
$VMT_{x,y}$ = total VMT (million miles) in county x and roadway class y

$VMT_{ST,y}$ = total VMT (million miles) in entire State for roadway class y

The county-level total VMT by roadway class used in this calculation was previously developed by E.H. Pechan and Associates, Inc. to support the onroad national emissions inventory.[4]

c. Emission Factors

Emission factors for cutback asphalt usage were obtained from the *Technical Report Series* produced by the U.S. EPA's Emission Inventory Improvement Program and are reported in Table 1 below.[1]

d. Emissions

Emissions were calculated by multiplying the county-level asphalt usage (barrels) by the emission factors listed in the corresponding table below and then dividing by 2000 to convert pounds to tons.

$$\text{Emissions}_{x,y} = (\text{Asphalt Usage}_x * EF_y) / 2000$$

where: $\text{Emissions}_{x,y}$ = emissions (tons) of pollutant y in county x
Asphalt Usage_x = cutback asphalt (barrels) used in county x
EF_y = emission factor for pollutant y

To convert tons of asphalt reported in the *2008 Asphalt Usage Survey* to barrels, it was assumed that the density of asphalt is similar to that of water, 8.34 lbs/gal, and that one barrel equals 42 gallons.

Barrels of Asphalt = (tons of asphalt * 2000 lbs / 8.34 lbs/gal) / 42 gal/barrel

Note that one barrel of asphalt weights approximately 350 pounds.

e. Sample Calculation

VOC emissions from cutback asphalt usage in Autauga County, Alabama:

From the *2008 Asphalt Usage Survey*, the state of Alabama used 1,728 tons of cutback asphalt in 2008. The fraction of paved road VMT traveled in Autauga County is 497 million miles divided by 53,633 million miles which equals 0.0093.

$\text{Asphalt Usage}_{Autauga}$ = ((1,728 tons * 2000 lbs / 8.34 lbs/gal) / 42 gal/barrel) * 0.0093

$\text{Asphalt Usage}_{Autauga}$ = 91.41 barrels

$\text{VOC Emissions}_{Autauga}$ = (91.41 barrels * 88 lbs/barrel) / 2000 lbs/ton

VOC $\text{Emissions}_{\text{Autauga}}$ = 4.022 tons

Criteria and HAP Emission Factors for Cutback Asphalt Paving

Pollutant Description	Pollutant Code	Emission Factor (LBS/BARREL)	Emission Factor Reference
VOLATILE ORGANIC COMPOUNDS	VOC	88.00	1
ETHYL BENZENE	100414	2.02	1
TOLUENE	108883	5.63	1
XYLENES (MIXTURE OF O, M, AND P ISOMERS)	1330207	10.74	1

f. References

1. U.S. Environmental Protection Agency, Emissions Inventory Improvement Program, *Technical Report Series*, Volume III – Area Sources, Chapter 17, "Asphalt Paving," prepared by Eastern Research Group, Inc. for EPA, Research Triangle Park, NC, 2001. Available at http://www.epa.gov/ttn/chief/eiip/techreport/volume03/index.html.

2. Asphalt Institute, *2008 Asphalt Usage Survey for the United States and Canada*, http://www.asphaltinstitute.org/.

3. U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2007,* Office of Highway Policy Information, Washington, DC, 2008. Available at http://www.fhwa.dot.gov/policyinformation/statistics/2007/.

4. E.H. Pechan & Associates, Inc. "Documentation for the Onroad National Emission Inventory (NEI) for Base Years 1970 - 2002," report prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. January 2004.

3.2.3.13 Asphalt Paving – Emulsified

a. Source Category Description

Asphalt paving is the process of applying asphalt concrete to seal or repair the surface of roads, parking lots, driveways, walkways, or airport runways. Asphalt concrete is a composite material comprised of a binder and a mineral aggregate. The binder, referred to as asphalt cement, is a byproduct of petroleum refining and contains the semi-solid residual material left after the more volatile chemical fractions have been distilled off.[1]

Asphalt cements thinned with water and an emulsifying agent are known as emulsified asphalts. This thinning reduces the viscosity of the asphalt making it easier to work with the mixture. The primary uses of emulsified asphalt include tack and seal operations, priming roadbeds, and paving operations for pavements up to several inches thick.

Emulsified asphalt may contain up to 12 percent organic solvents by volume.[1] Emissions from emulsified asphalt result from the evaporation of VOCs after the mixture is laid down. Compared to cutback asphalt, emulsified asphalt has lower VOCs emissions per ton used.

For this source category, the following SCC was assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2461022000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Emulsified Asphalt	Total: All Solvent Types

The general approach to calculating emissions from emulsified asphalt paving is to multiply the estimated county-level emulsified asphalt usage by emission factors for VOCs.

b. Activity Data

State-level emulsified asphalt usage in 2008 was obtained from the Asphalt Institute's *2008 Asphalt Usage Survey*.[2] State-level data were allocated to county-level according to the fraction of paved road vehicle miles traveled (VMT) in each county.

Total annual VMT estimates by State and roadway class were obtained from the Federal Highway Administration's (FHWA) annual Highway Statistics report.[3] Paved road VMT was calculated by subtracting the State/roadway class unpaved road VMT from total State/roadway class VMT. State-level paved road VMT was spatially allocated to counties according to the fraction of total VMT in each county for the specific roadway class as shown by the following equation:

$$VMT_{x,total} = \sum VMT_{ST,y} * VMT_{x,y} / VMT_{ST,y}$$

where: $VMT_{x,total}$ = VMT (million miles) in county x on all paved roadways
$VMT_{ST,y}$ = paved road VMT for the entire State for roadway class y
$VMT_{x,y}$ = total VMT (million miles) in county x and roadway class y
$VMT_{ST,y}$ = total VMT (million miles) in entire State for roadway class y

The county-level total VMT by roadway class used in this calculation was previously developed by E.H. Pechan and Associates, Inc. to support the onroad national emissions inventory.[4]

c. Emission Factors

Emission factors for emulsified asphalt usage were obtained from the *Technical Report Series* produced by the U.S. EPA's Emission Inventory Improvement Program and are reported in Table 1 below.[1]

d. Emissions

Emissions were calculated by multiplying the county-level asphalt usage (barrels) by the emission factors listed in the corresponding table below and then dividing by 2000 to convert pounds to tons.

$$\text{Emissions}_{x,y} = (\text{Asphalt Usage}_x * \text{EF}_y) / 2000$$

where: $\text{Emissions}_{x,y}$ = emissions (tons) of pollutant y in county x
Asphalt Usage_x = emulsified asphalt (barrels) used in county x
EF_y = emission factor for pollutant y

To convert tons of asphalt reported in the *2008 Asphalt Usage Survey* to barrels, it was assumed that the density of asphalt is similar to that of water, 8.34 lbs/gal, and that one barrel equals 42 gallons.

$$\text{Barrels of Asphalt} = (\text{tons of asphalt} * 2000 \text{ lbs} / 8.34 \text{ lbs/gal}) / 42 \text{ gal/barrel}$$

Note that one barrel of asphalt weights approximately 350 pounds.

e. Sample Calculation

VOC emissions from emulsified asphalt usage in Autauga County, Alabama:

From the *2008 Asphalt Usage Survey*, the state of Alabama used 18,988 tons of emulsified asphalt in 2008. The fraction of paved road VMT traveled in Autauga County is 497 million miles divided by 53,633 million miles which equals 0.0093.

$$\text{Asphalt Usage}_{\text{Autauga}} = ((18{,}988 \text{ tons} * 2000 \text{ lbs} / 8.34 \text{ lbs/gal}) / 42 \text{ gal/barrel}) * 0.0093$$

$$\text{Asphalt Usage}_{\text{Autauga}} = 1{,}004 \text{ barrels}$$

$$\text{VOC Emissions}_{\text{Autauga}} = (1{,}004 \text{ barrels} * 9.2 \text{ lbs/barrel}) / 2000 \text{ lbs/ton}$$

$$\text{VOC Emissions}_{\text{Autauga}} = 4.62 \text{ tons}$$

Criteria Emission Factors for Emulsified Asphalt Paving

Pollutant Description	Pollutant Code	Emission Factor (LBS/BARREL)	Emission Factor Reference
VOLATILE ORGANIC COMPOUNDS	VOC	9.2	1

f. References

1. U.S. Environmental Protection Agency, Emissions Inventory Improvement Program, *Technical Report Series*, Volume III – Area Sources, Chapter 17, "Asphalt Paving," prepared by Eastern Research Group, Inc. for EPA, Research Triangle Park, NC, 2001. Available at http://www.epa.gov/ttn/chief/eiip/techreport/volume03/index.html.

2. Asphalt Institute, *2008 Asphalt Usage Survey for the United States and Canada*, http://www.asphaltinstitute.org/.

3. U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2007*, Office of Highway Policy Information, Washington, DC, 2008. Available at http://www.fhwa.dot.gov/policyinformation/statistics/2007/.

4. E.H. Pechan & Associates, Inc. "Documentation for the Onroad National Emission Inventory (NEI) for Base Years 1970 - 2002," report prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. January 2004.

3.2.3.14 Gasoline Distribution – Portable Fuel Containers

a. Source Category Description

Portable fuel containers (PFCs, or gas cans) are consumer products used to refuel a wide variety of gasoline-powered equipment.

The general approach to calculating emissions for this SCC is to take the inventories already prepared by the EPA for 2002 and 2010 and apply a linear fit between to get 2008 emissions.

For this source category, the following SCCs were assigned:

SCC	Descriptor 1	Descriptor 3	Descriptor 6	Descriptor 8
2501011011	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Permeation
2501011012	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Evaporation (includes Diurnal losses)
2501011013	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Spillage During Transport
2501011014	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Vapor Displacement
2501011015	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Spillage
2501012011	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Permeation
2501012012	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Evaporation (includes Diurnal losses)
2501012013	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Spillage During Transport
2501012014	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Vapor Displacement
2501012015	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Spillage

b. Activity Data

Activity data for the 2002 and 2010 inventories were developed using EPA's Nonroad Model which uses a variety of variables like equipment size, equipment population, equipment age, RVP, and air temperature to estimate activity.

c. Control Factors

There are at least 15 states which have enacted or are considering rules for PFCs. Due to the complexities in calculating emissions, these rules have already been accounted for in the emissions, but will not be listed in the control table.

d. Emission Factors

Section 2.2 of the EPA PFC report details emission factors used for each of the activities associated with PFCs.

e. Sample Calculations

Emissions are calculated in the formula

$$Emis_{County,\ Pollutant} = m \times year_{diff} + Emis_{2002}$$

where:

$$m = (Emis_{2010} - Emis_{2002}) / (2010 - 2002)$$

Example:
Using SCC 2501011011 in Allegheny County PA as an example:

$Emis_{2010}$ = 60.7 tons VOC
$Emis_{2002}$ = 181.7 tons VOC

$$m = (60.7 - 181.7) / (2010 - 2002) = -15.125$$

$$Emis_{Alegheny,\ VOC} = -15.125 \times (2008-2002) + 181.7$$

$$= 90.95 \text{ tons VOC}$$

f. References

U.S. Environmental Protection Agency. Estimating Emissions Associated with Portable Fuel Containers (PFCs). Ann Arbor Michigan. February 2007

3.2.3.15 Aviation Gasoline Distribution – Stage I

a. Source Category Description

Aviation gasoline (also called "AvGas") is the only aviation fuel that contains tetraethyl lead (TEL) as a knock-out component for small reciprocating, piston-engine crafts in civil aviation.[1] Commercial and military aviation rarely use this fuel. AvGas is shipped to airports and is filled into bulk terminals, and then into tanker trucks. These processes fall under the definition of stage I, displacement vapors during the transfer of gasoline from tank trucks to storage tanks, and vice versa. These processes are subject to EPA's maximum available control technology (MACT) standards for gasoline distribution.[2]

For this source category, the following SCC was assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501080050	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 1: Total

b. Activity Data

The amount of AvGas consumed was obtained from the Petroleum Supply Annual for designated Petroleum Administration Districts, or PADs.[3] A nationwide total of 5,603,000 barrels of AvGas were consumed in 2008.[3] This information was used to calculate national-level emissions estimates for one criteria pollutant and ten hazardous air pollutants (HAPs). Assumptions for bulk plant processes are summarized in the corresponding table below.

c. Emission Factors

Emission factors were provided by ESD and EIG publications (corresponding tables below).[1,4,5,6]

d. Emissions

In general, national-level emissions were calculated by multiplying AvGas consumption by the appropriate emission factors and then summing emissions. The national-level emission estimates were first allocated based on consumption reported for each PAD, and then allocated to the counties within the PADs based on 2008 Landing-Take Off (LTO) data for general aviation flights.[7] General aviation flights were used in this allocation because they are the primary consumers of AvGas.

There are five PADs across the United States[3]
PAD 1 comprises seventeen states plus the District of Columbia along the Atlantic Coast;
PAD 2 comprises fifteen states in the Midwest;
PAD 3 comprises six states in South Central U.S.;
PAD 4 comprises five states in the Rocky Mountains; and

PAD 5 comprises seven states along the West Coast.

Summary of AvGas Consumed and LTOs by PAD in 2008

PAD	AvGas Consumed (barrels)	LTOs
1	1,039,000	17,588,837
2	1,652,000	16,520,073
3	2,021,000	9,883,668
4	158,000	3,311,438
5	733,000	12,641,441
Total	**5,603,000**	**59,945,457**

e. Sample Calculations

National-Level Calculations

Amount of AvGas consumed in 2008 (barrels) = 5,603,000

Conversion: 1 barrel = 42 gallons
1 gallon = 3.78 liters
1 kg = 2.205 lb
1 kg = 1,000,000 mg
1 ton = 2000 lb

Step 1 - Convert AvGas consumption into gallons using conversion factors.

Amount of AvGas consumed in 2008 (gallons) = 5,603,000 barrels * 42 gallons/barrel
Amount of AvGas consumed in 2008 (gallons) = 235,326,000

Step 2 - Use the gallons of AvGas consumed and apply the non-fugitive VOC emission factors to calculate non-fugitive VOC estimates.

Unloading/Tank Filling: tank fill VOC emissions = 0.009021383 LB/GAL * 235,326,000 GAL / 2,000 LB/TON
Unloading/Tank Filling: tank fill VOC emissions = **1,061.48** tpy

Unloading/Tank Filling: Storage tank VOC emissions = 0.003605215 LB/GAL * 235,326,000 GAL / 2,000 LB/TON
Unloading/Tank Filling: Storage tank VOC emissions = **424.20** tpy

Tank Truck Filling - Composite VOC Emissions = 0.010306575 LB/GAL * 235,326,000 GAL * / 2,000 LB/TON
Tank Truck Filling - Composite VOC Emissions = **1,212.70** tpy

Storage Tank - Breathing losses VOC Emissions = 0.001694117 LB/GAL * 235,326,000 GAL * / 2,000 LB/TON
Storage Tank - Breathing losses VOC Emissions = **199.33** tpy

Total non-fugitive VOC emissions = 1,061.48 tpy + 424.20 tpy + 1,212.70 tpy + 199.33 tpy = **2,897.72** tpy

Step 3 - Use the assumptions in the corresponding table below and the fugitive VOC emission factors in the corresponding table below to generate fugitive VOC emissions.

AvGas - Fugitive from valves VOC Emissions = (# Bulk Plant Equivalents)*(#valves/plant)*EF*days
AvGas - Fugitive from valves VOC Emissions = (2442 plants) * (50 valves/plant) * (0.573201882 LB/valve/day)* 300 days / 2,000 LB/TON
AvGas - Fugitive from valves VOC Emissions = **10,498.19** tpy

AvGas - Fugitive from pumps VOC Emissions = (# Bulk Plant Equivalents)*(#pumps/plant)* (#seals/pump) * EF * days
AvGas - Fugitive from pumps VOC Emissions = (2442 plants) * (2 pumps/plant) * (4 seals/pump) * (5.952481079 LB/seal/day)* 300 days / 2,000 LB/TON
AvGas - Fugitive from pumps VOC Emissions = **17,443.15** tpy

Total fugitive VOC emissions = 10,498.19 tpy + 17,443.15 tpy
Total fugitive VOC emissions = **27,941.34** tpy

Step 4 - Sum the fugitive and non-fugitive VOC emissions together for total VOC emissions.

Total VOC emissions = 2,897.72 tpy + 27,941.34 tpy = **30,839.06** tpy

Step 5 - Apply the speciation emission factors in the corresponding table below for tetraethyl lead, 2,2,4-trimethylpentane, benzene, cumene, ethylbenzene, hexane, naphthalene, toluene, and xylene to calculate HAP emissions.

Tetraethyl Lead emissions = 30,839.06 tpy VOC * 9.78 E-6 = **0.30** tpy
2,2,4-Trimethylpentane emissions = 30,839.06 tpy VOC * 0.008 = **246.71** tpy
Benzene emissions = 30,839.06 tpy VOC * 0.009 = **277.55** tpy
Cumene emissions = 30,839.06 tpy VOC * 0.0001 = **3.08** tpy
Ethylbenzene emissions = 30,839.06 tpy VOC * 0.0010 = **30.84** tpy
Hexane emissions = 30,839.06 tpy VOC * 0.0160 = **493.43** tpy
Naphthalene emissions = 30,839.06 tpy VOC * 0.0005 = **15.42** tpy
Toluene emissions = 30,839.06 tpy VOC * 0.0130 = **400.91** tpy
Xylene emissions = 30,839.06 tpy VOC * 0.005 = **154.20** tpy

Step 6 - Use the ethylene dichloride emission factor in the corresponding table below to calculate ethylene dichloride emissions.

Ethylene dichloride emissions = 235,326,000 GAL * 2.167E-6 LB/GAL * TON/2000 LB = **0.25** tpy

Assumptions Used For Bulk Terminals Using AvGas

Parameter	Data	Reference
Number of Bulk Plant Equivalents (U.S.)	2,442 plants	1
Number of valves per bulk plant	50 valves/plant	
Number of pumps per bulk plant	2 pumps/plant	
Number of seals per bulk plant	4 seals/pump	
Number of days per year used	300 days	

VOC Emission Factors

Pollutant	Emission Source	Emission Factor	Emission Factor Units	Factor Reference
VOC	Aviation Gas Unloading/ Tank Filling - tank fill	0.009021383	LB/GAL AvGas	1
	Aviation Gas Unloading/ Tank Filling - Storage tank working	0.003605215		
	Aviation Gas Tank Truck Filling - Composite	0.010306575		
	Aviation Gas Storage Tank - Breathing losses	0.001694117		
	Aviation Gas - Fugitive from valves	0.573201882	LB/valve/day	
	Aviation Gas - Fugitive from pumps	5.952481079	LB/seal/day	

HAP Emission Factors

Pollutant	Emission Source	Emission Factor	Emission Factor Units	Factor Reference
Ethylene Dichloride	All processes	2.167 E-6	LB/GAL AvGas	4
Tetraethyl Lead (TEL)	All processes	9.78 E-6	LB/LB VOC	1
2,2,4-Trimethylpentane	All processes	0.0080	LB/ LB VOC	
Benzene	All processes	0.0090		5
Cumene	All processes	0.0001		6
Ethylbenzene	All processes	0.0010		
Hexane	All processes	0.0160		
Naphthalene	All processes	0.0005		
Toluene	All processes	0.0130		
Xylene	All processes	0.0050		5

Example Calculations for Wake County, NC

Wake County VOC emissions = (National VOC emissions) * (PAD 1 consumption/Total consumption) * (Wake County LTOs/PAD 1 LTOs)

Wake County VOC emissions = (30,839.06 tpy) * (1,039,000 bbl/5,603,000 bbl) * (95,234 LTOs/17,588,837 LTOs)

Wake County VOC emissions = **30.96** tpy

Wake County Benzene Emissions = (Wake County VOC emissions)*(Benzene Emission Factor)

Wake County Benzene Emissions = (30.96 tpy VOC) * (0.0090 LB benzene/ LB VOC)* (2000 LB VOC/2000 LB benzene)

Wake County Benzene Emissions = **0.28** tpy

f. References

1. TRC Environmental Corporation. *Estimation of Alkylated Lead Emissions, Final Report*. Prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. RTP, NC 1993.

2. U.S. Environmental Protection Agency. National Emission Standards for Source Categories: Gasoline Distribution (Stage I). 40 CFR Part 63. Office of Air Quality Planning and Standards. RTP, NC. February 28, 1997. Pages 9087-9093.

3. Energy Information Administration. *Petroleum Annual Supply, 2008*. Tables 3, 5, 7, 9, and 11. U.S. Department of Energy. Washington, D.C. June 2009. (Internet address: http://www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_supply_annual/psa_volume1/psa_volume1.html)

4. U.S. Environmental Protection Agency. *Locating and Estimating Air Emissions from Sources of Ethylene Dichloride*. EPA-450/4-84-007d. RTP, NC. March 1984.

5. Memorandum from Greg LaFlam and Tracy Johnson (PES) to Stephen Shedd (EPA/OAQPS). *Speciated Hazardous Air Pollutants - Baseline Emissions and Emissions Reductions Under the Gasoline Distribution NESHAP*. August 9, 1996.

6. Personal Communication via e-mail from Stephen Shedd (EPA/OAQPS) to Laurel Driver (EPA/OAQPS). E-mail dated May 29, 2002.

7. [LTObyCtyandSCC.mdb], electronic file from Laurel Driver, U.S. Environmental Protection Agency, OAQPS, to U.S. Environmental Protection Agency, OAQPS, November 12, 2009. Aircraft operations data compiled from FAA's Terminal Area Forecasts (TAF) and 5010 Forms.

3.2.3.16 Aviation Gasoline Distribution – Stage II

a. Source Category Description

Aviation gasoline (also called "AvGas") is the only aviation fuel that contains tetraethyl lead (TEL) as a knock-out component for small reciprocating, piston-engine crafts in civil aviation.[1] Commercial and military aviation rarely use this fuel. AvGas is shipped to airports and is filled into bulk terminals, and then into tanker trucks. These processes fall under the definition of stage I are subject to EPA's maximum available control technology (MACT) standards for gasoline distribution.[2] Stage II, discussed here, involves the transfer of fuel from the tanker trucks into general aviation aircraft.

For this source category, the following SCC was assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501080100	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 2: Total

b. Activity Data

The amount of AvGas consumed was obtained from the Petroleum Supply Annual for designated Petroleum Administration Districts, or PADs.[3] A nationwide total of 5,603,000 barrels of AvGas were consumed in 2008.[3] This information was used to calculate national-level emissions estimates for one criteria pollutant and ten hazardous air pollutants (HAPs).

c. Emission Factors

Emission factors were provided by ESD and EIG publications (corresponding tables below).[1,4,5,6]

d. Emissions

In general, national-level emissions were calculated by multiplying AvGas consumption by the appropriate emission factors and then summing emissions. The national-level emission estimates were first allocated based on consumption reported for each PAD, and then allocated to the counties within the PADs based on 2008 Landing-Take Off (LTO) data for general aviation flights.[7] General aviation flights were used in this allocation because they are the primary consumers of AvGas.

There are five PADs across the United States[3]
PAD 1 comprises seventeen states plus the District of Columbia along the Atlantic Coast;
PAD 2 comprises fifteen states in the Midwest;
PAD 3 comprises six states in South Central U.S.;
PAD 4 comprises five states in the Rocky Mountains; and
PAD 5 comprises seven states along the West Coast.

Summary of AvGas Consumed and LTOs by PAD in 2008

PAD	AvGas Consumed (barrels)	LTOs
1	1,039,000	17,588,837
2	1,652,000	16,520,073
3	2,021,000	9,883,668
4	158,000	3,311,438
5	733,000	12,641,441
	5,603,000	**59,945,457**

e. Sample Calculations

National-Level Calculations

Amount of AvGas consumed in 2008 (barrels) = 5,603,000

Conversion: 1 barrel = 42 gallons
1 gallon = 3.78 liters
1 kg = 2.205 lb
1 kg = 1,000,000 mg
1 ton = 2000 lb

Step 1 - Convert AvGas consumption into gallons using conversion factors.

Amount of AvGas consumed in 2008 (gallons) = 5,603,000 barrels * 42 gallons/barrel
Amount of AvGas consumed in 2008 (gallons) = 235,326,000

Step 2 - Use the gallons of AvGas consumed and apply the refueling VOC emission factors from the corresponding table below to first calculate refueling VOC estimates.

AvGas Refueling VOC emissions = (1.36 E-2 LB/gal AvGas) * 235,326,000 gallons * 1 ton/2000 LB
AvGas Refueling VOC emissions = **1,600.22** tpy

Step 3 - Apply the speciation emission factors in the corresponding table below 3 for 2,2,4-trimethylpentane, benzene, cumene, ethylbenzene, hexane, naphthalene, toluene, and xylene to calculate HAP emissions.

2,2,4-Trimethylpentane emissions = 1,600.22 tpy VOC * 0.008 = **12.80** tpy

Benzene emissions = 1,600.22 tpy VOC * 0.009 = **14.40** tpy
Cumene emissions = 1,600.22 tpy VOC * 0.0001 = **0.16** tpy
Ethylbenzene emissions = 1,600.22 tpy VOC * 0.0010 = **1.60** tpy
Hexane emissions = 1,600.22 tpy VOC * 0.0160 = **25.60** tpy
Naphthalene emissions = 1,600.22 tpy VOC * 0.0005 = **0.80** tpy
Toluene emissions = 1,600.22 tpy VOC * 0.0130 = **20.80** tpy
Xylene emissions = 1,600.22 tpy VOC * 0.005 = **8.00** tpy

Step 6 - Use the ethylene dichloride and tetraethyl lead emission factors in the corresponding table below to calculate ethylene dichloride emissions.

Ethylene dichloride emissions = 235,326,000 GAL * 1.883 E-6 LB/GAL * TON/2000 LB = **0.22** tpy
Tetraethyl lead emissions = 235,326,000 GAL * 1.327E-7 LB/GAL * TON/2000 LB = **0.015** tpy

VOC Emission Factor

Pollutant	Emission Source	Emission Factor	Emission Factor Units	Factor Reference
VOC	Fuel Transfer from Tanker Trucks to General Aviation Aircraft	0.0136	LB/GAL AvGas	1

HAP Emission Factors

Pollutant	Emission Source	Emission Factor	Emission Factor Units	Factor Reference
Ethylene Dichloride	All processes	1.883 E-6	LB/GAL AvGas	4
Tetraethyl Lead (TEL)	All processes	1.327 E-7	LB/GAL AvGas	1
2,2,4-Trimethylpentane	All processes	0.0080	LB/ LB VOC	
Benzene	All processes	0.0090		5
Cumene	All processes	0.0001		6
Ethylbenzene	All processes	0.0010		
Hexane	All processes	0.0160		
Naphthalene	All processes	0.0005		
Toluene	All processes	0.0130		
Xylene	All processes	0.0050		5

Example Calculations for Wake County, NC

Wake County VOC emissions = (National VOC emissions) * (PAD 1 consumption/Total consumption) * (Wake County LTOs/PAD 1 LTOs)

Wake County VOC emissions = (1,600.22 tpy) * (1,039,000 bbl/5,603,000 bbl) * (95,234 LTOs/17,588,837 LTOs)

Wake County VOC emissions = **1.61** tpy

Wake County Benzene Emissions = (Wake County VOC emissions)*(Benzene Emission Factor)

Wake County Benzene Emissions = (1.61 tpy VOC) * (0.0090 LB benzene/ LB VOC)* (2000 lb VOC/2000 lb benzene)

Wake County Benzene Emissions = **0.014** tpy

f. References

1. TRC Environmental Corporation. *Estimation of Alkylated Lead Emissions, Final Report*. Prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. RTP, NC 1993.

2. U.S. Environmental Protection Agency. National Emission Standards for Source Categories: Gasoline Distribution (Stage I). 40 CFR Part 63. Office of Air Quality Planning and Standards. RTP, NC. February 28, 1997. Pages 9087-9093.

3. Energy Information Administration. *Petroleum Annual Supply, 2008*. Tables 3, 5, 7, 9, and 11. U.S. Department of Energy. Washington, D.C. June 2009. (Internet address: http://www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_supply_annual/psa_volume1/psa_volume1.html)

4. U.S. Environmental Protection Agency. *Locating and Estimating Air Emissions from Sources of Ethylene Dichloride*. EPA-450/4-84-007d. RTP, NC. March 1984.

5. Memorandum from Greg LaFlam and Tracy Johnson (PES) to Stephen Shedd (EPA/OAQPS). *Speciated Hazardous Air Pollutants - Baseline Emissions and Emissions Reductions Under the Gasoline Distribution NESHAP*. August 9, 1996.

6. Personal Communication via e-mail from Stephen Shedd (EPA/OAQPS) to Laurel Driver (EPA/OAQPS). E-mail dated May 29, 2002.

7. [LTObyCtyandSCC.mdb], electronic file from Laurel Driver, U.S. Environmental Protection Agency, OAQPS, to U.S. Environmental Protection Agency, OAQPS, November 12, 2009. Aircraft operations data compiled from FAA's Terminal Area Forecasts (TAF) and 5010 Forms.

3.2.3.17 Open Burning – Land Clearing Debris

a. Source Category Description

Open burning of land clearing debris is the purposeful burning of debris, such as trees, shrubs, and brush, from the clearing of land for the construction of new buildings and highways. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates from open burning of land clearing debris are a function of the amount of material or fuel subject to burning per year.

For this source category, the following SCC was assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2610000500	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)

b. Activity Data

The amount of material burned was estimated using the county-level total number of acres disturbed by residential, non-residential, and road construction. County-level weighted loading factors were applied to the total number of construction acres to convert acres to tons of available fuel.

<u>Acres Disturbed from Residential Construction</u>

The US Census Bureau has 2008 data for *Housing Starts - New Privately Owned Housing Units Started*[1] which provides regional level housing starts based on the groupings of 1 unit, 2-4 units, 5 or more units. A consultation with the Census Bureau in 2002 gave a breakdown of approximately 1/3 of the housing starts being for 2 unit structures, and 2/3 being for 3 and 4 unit structures. The 2-4 unit category was divided into 2-units, and 3-4 units based on this ratio. To determine the number of structures for each grouping, the 1 unit category was divided by 1, the 2 unit category was divided by 2, and the 3-4 unit category was divided by 3.5. The 5 or more unit category may be made up of more than one structure. *New Privately Owned Housing Units Authorized Unadjusted Units*[2] gives a conversion factor to determine the ratio of structures to units in the 5 or more unit category. For example if a county has one 40 unit apartment building, the ratio would be 40/1. If there are 5 different 8 unit buildings in the same project, the ratio would be 40/5. Structures started by category are then calculated at a regional level. The table *Annual Housing Units Authorized by Building Permit*[3] has 2007 data at the county level to allocate regional housing starts to the county level. This results in county level housing starts by number of units. The following surface areas were assumed disturbed for each unit type:

Surface Acres Disturbed per Unit Type

1-Unit	1/4 acre/structure
2-Unit	1/3 acre/structure
Apartment	1/2 acre/structure

The 3-4 unit and 5 or more unit categories were considered to be apartments. Multiplication of housing starts to surface acres disturbed results in total number of acres disturbed for each unit category.

Acres Disturbed from Non-Residential Construction

Annual Value of Construction Put in Place in the U.S[4] has the 2008 National Value of Non-residential construction. The national value of non-residential construction put in place (in millions of dollars) was allocated to counties using county-level non-residential construction (NAICS Code 2362) employment data obtained from *County Business Patterns*[5] *(CBP)*. Because some counties employment data was withheld due to privacy concerns, the following procedure was adopted:

1. State totals for the known county level employees were subtracted from the number of employees reported in the state level version of CBP. This results in the total number of withheld employees in the state.

2. A starting guess of the midpoint of the range code was used (so for instance in the 1-19 employees range, a guess of 10 employees would be used) and a state total of the withheld counties was computed.

3. A ratio of guessed employees (Step 2) to withheld employees (Step 1) was then used to adjust the county level guesses up or down so the state total of adjusted guesses should match state total of withheld employees (Step 1)

In 1999 a figure of 2 acres/$\$10^6$ was developed. The Bureau of Labor Statistics *Producer Price Index*[6] lists costs of the construction industry from 1999-2007.

$$\begin{aligned} \text{2007 acres per } \$10^6 &= \text{1999 acres per } \$10^6 \text{ x (1999 PPI / 2007 PPI)} \\ &= 2 \text{ acres}/\$10^6 \ (132.9 / 204.3) \\ &= 1.301 \text{ acres per } \$10^6 \end{aligned}$$

Acres Disturbed by Road Construction

The Federal Highway Administration has *Highway Statistics, Section IV - Highway Finance, Table SF-12A, State Highway Agency Capital Outlay*[7] for 2006 which outlines spending by state in several different categories. For this SCC, the following columns are used: New Construction, Relocation, Added Capacity, Major Widening, and Minor Widening. These columns are also differentiated according to the following six classifications:

1. Interstate, urban
2. Interstate, rural
3. Other arterial, urban
4. Other arterial, rural
5. Collectors, urban
6. Collectors, rural

The State expenditure data are then converted to new miles of road constructed using $/mile conversions obtained from the North Carolina Department of Transportation (NCDOT) in 2000. A conversion of $4 million/mile was applied to the interstate expenditures. For expenditures on other arterial and collectors, a conversion factor of $1.9 million/mile was applied, which corresponds to all other projects.

The new miles of road constructed are used to estimate the acreage disturbed due to road construction. The total area disturbed in each state was calculated by converting the new miles of road constructed to acres using an acres disturbed/mile conversion factor for each road type as given in the table below:

Spending per Mile and Acres Disturbed per Mile by Highway Type

Road Type	Thousand Dollars per mile	Acres Disturbed per mile
Urban Areas, Interstate	4000	15.2
Rural Areas, Interstate	4000	15.2
Urban Areas, Other Arterials	1900	15.2
Rural Areas, Other Arterials	1900	12.7
Urban Areas, Collectors	1900	9.8
Rural Areas, Collectors	1900	7.9

Residential building starts are used to allocate the state-level acres disturbed by road construction to the county.[3] A ratio of the number of building starts in each county to the total number of building starts in each state was applied to the state-level acres disturbed to estimate the total number of acres disturbed by road construction in each county.

Converting Acres Disturbed to Tons of Land Clearing Debris Burned

Version 2 of the Biogenic Emissions Land cover Database (BELD2) within EPA's Biogenic Emission Inventory System (BEIS) was used to identify the acres of hardwoods, softwoods, and grasses in each county. The table below presents the average fuel loading factors by vegetation type. The average loading factors for slash hardwood and slash softwood were adjusted by a factor of 1.5 to account for the mass of tree that is below the soil surface that would be subject to burning once the land is cleared.[8] Weighted average county-level loading factors were calculated by multiplying the average loading factors by the percent contribution of each type of vegetation class to the total land area for each county.

Fuel Loading Factors by Vegetation Type

Vegetation Type	Unadjusted Average Fuel Loading Factor (Ton/acre)	Adjusted Average Fuel Loading Factor (Ton/acre)
Hardwood	66	99
Softwood	38	57
Grass	4.5	Not Applicable

The total acres disturbed by all construction types was calculated by summing the acres disturbed from residential, non-residential, and road construction. The county-level total acres disturbed were then multiplied by the weighted average loading factor to derive tons of land clearing debris in 2008.

c. Controls

Controls for land clearing debris burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that were more than 80% urban were assumed not to practice any open burning. Therefore, criteria pollutant and HAP emissions from open burning of land clearing debris are zero in these counties. In addition, the State of Colorado implemented a state-wide ban on open burning. Emissions from open burning of land clearing debris in all Colorado counties were assumed to be zero.

d. Emission Factors

Emission factors are reported in the corresponding table below. Emission factors for CAPs were developed by the U.S. Environmental Protection Agency (EPA) in consultation with the Eastern Regional Technical Advisory Committee and based primarily on the AP-42 report.[9,10] Emission factors for HAPs are from an EPA Control Technology Center report and emission factors for 17 dioxin congeners were obtained from an EPA dioxin report.[11,12] The Dioxin emission factors were multiplied by 0.002 to convert from mg/kg to lb/ton.

e. Emissions

County-level criteria pollutant and HAP emissions (in lb/year) were calculated by multiplying the total mass of land clearing debris burned per year by an emission factor.

f. Example Calculations

VOC emissions in Autauga County, Alabama from open burning of land clearing debris:

Rural fraction of Autauga County population = 0.448, so no emission controls

Acres disturbed by residential, non-residential, and road construction in Autauga County = 434.26
Weighted average fuel loading factor for Autauga County = 65.48 tons/acre

Mass of land clearing debris burned = 434.26 acres * 65.48 tons/acre = 28,437 tons

VOC emission factor = 11.6 lbs/ton
Factor to convert from lbs to tons = 1/2000

VOC emissions = tons of land clearing debris burned * VOC emission factor

VOC emissions from land clearing debris burning = 28,437 tons * 11.6 lbs/ton * 1 ton/2000 lbs

VOC emissions from land clearing debris burning in Autauga County in 2008 = 165 tons

g. References

1. U.S. Census Bureau, "New Privately Owned Housing Units Started for 2008 (Not seasonally adjusted)," available at http://www.census.gov/const/startsua.pdf

2. U.S. Census Bureau, "Table 2au. New Privately Owned Housing Units Authorized Unadjusted Units for Regions, Divisions, and States, Annual 2007" available at http://www.census.gov/const/C40/Table2/tb2u2007.txt

3. Annual Housing Units Authorized by Building Permits CO2007A, purchased from US Department of Census

4. U.S. Census Bureau, "Annual Value of Construction Put in Place," available at http://www.census.gov/const/www/ototpage.html

5. U.S. Census Bureau, "County Business Patterns," available at http://www.census.gov/econ/cbp/index.html

6. Bureau of Labor Statistics, Producer Price Index, Table BMNR, available at http://www.bls.gov/data/

7. Federal Highway Administration, 2006 Highway Spending, available at http://www.fhwa.dot.gov/policy/ohim/hs06/xls/sf12a.xls

8. Ward, D.E., C.C. Hardy, D.V. Sandberg, and T.E. Reinhardt. "Mitigation of Prescribed Fire Atmospheric Pollution through Increased Utilization of Hardwoods, Piled Residues, and Long-Needled Conifers." Final Report. USDA Forest Service, Pacific Northwest Research Station, Fire and Air Resource Management. 1989.

9. Huntley, Roy, U.S. Environmental Protection Agency, "state_comparison ERTAC SS_version7_3 Oct 20 2009 [electronic file]," November 5, 2009.

10. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 2.5 Open Burning*. Research Triangle Park, NC. October 1992.

11. U.S. Environmental Protection Agency, "Evaluation of Emissions from the Open Burning of Household Waste in Barrels, EPA-600/R-97-134a," Control Technology Center. November 1997.

12. Gullet, B.K. and T. Abderrahmne, "PCDD/F Emissions from Forest Fire Simulations," *Atmospheric Environment*, Vol. 37, No. 6, pp. 803-813. February 2003.

3.2.3.18 Open Burning – Residential Household Waste

a. Source Category Description

Open burning of residential municipal solid waste (MSW) is the purposeful burning of MSW in outdoor areas. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates for MSW burning are a function of the amount of waste burned per year.

For this source category, the following SCC was assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2610030000	Waste Disposal, Treatment, and Recovery	Open Burning	Residential	Household Waste (use 26-10-000-xxx for Yard Wastes)

b. Activity Data

The amount of household MSW burned was estimated using data from EPA's report *Municipal Solid Waste in the United States: 2007 Facts and Figures*.[1] The report presents the total mass of waste generated in the United States by type of waste for the calendar year 2007. This information was used to calculate a daily estimate of the per capita household waste subject to burning, 3.40 lbs/person/day. Non-combustible waste, such as glass and metals, was not considered to be waste subject to burning. Burning of yard waste is included in SCC 2610000100 and SCC 2610000400; therefore, it is not part of residential MSW. Approximately 25 to 32 percent of all waste that is subject to open burning is actually burned.[2] A median value of 28 percent is assumed to be burned in all counties in the United States.

Since open burning is generally not practiced in urban areas, only the rural population of each county was assumed to practice open burning. The ratio of urban to rural population was obtained from 2000 U.S. Census data.[3] This ratio was then multiplied by the 2008 U.S. Census Bureau estimate of the population in each county to obtain the county-level rural population for 2008.[4] The county-level rural population was then multiplied by the per capita household waste subject to burning to determine the amount of rural household MSW generated in each county in 2008.

c. Controls

Controls for residential MSW burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that were more than 80% urban were assumed not to practice any open burning. Therefore, criteria pollutant and HAP emissions from residential municipal solid waste burning are zero in these counties. In addition, the State of Colorado implemented a state-wide ban on open burning. Emissions from open burning of residential waste in all Colorado counties were assumed to be zero.

d. Emission Factors

Emission factors are reported in the corresponding table below. Emission factors for CAPs were developed by the U.S. Environmental Protection Agency (EPA) in consultation with the Eastern Regional Technical Advisory Committee and based primarily on the AP-42 report.[5,6] Emission

factors for HAPs are from an EPA Control Technology Center report and emission factors for 17 dioxin congeners were obtained from an EPA dioxin report.[7,8]

e. Emissions

County-level criteria pollutant and HAP emissions were calculated by multiplying the total amount of residential municipal solid waste burned per year by an emission factor.

f. Example Calculations

VOC emissions in Autauga County, Alabama from open burning of residential MSW:

Population of Autauga County in 2008 = 50,364
Rural fraction of Autauga County population = 0.448
Per capita MSW waste generated (lb/person/day) = 3.40
Fraction of rural population that burns MSW = 0.28
Number of days in a year = 365
Factor to convert from lbs to tons = 1/2000

2008 MSW burning activity in Autauga County = 50,364 * 0.448 * 3.40 * 0.28 * 365 * 1/2000

2008 leaf burning activity in Autauga County = 3,921 tons

VOC emissions = tons of leaves burned * VOC emission factor

VOC emission factor = 8.56 lb/ton

VOC emissions from leaf burning in Autauga County in 2008 = 3,921 tons * 8.56 lbs/ton * 1 ton/2000 lbs

VOC emissions from leaf burning in Autauga County in 2008 = 16.78 tons

g. References

1. U.S. Environmental Protection Agency, *Municipal Solid Waste in the United States: 2007 Facts and Figures*, EPA530-R-08-010, Office of Solid Waste and Emergency Response. November 2008. Available at http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw07-rpt.pdf

2. U.S. Environmental Protection Agency, Region V. "Emission Characteristics of Burn Barrels." Prepared by Two Rivers Regional Council of Public Officials and Patrick Engineering, Inc. June 1994.

3. U.S. Census Bureau, Decennial Censuses, 2000 Census: SF1, Table P2

4. U.S. Census Bureau. *Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2000 to July 1, 2008 (NST-EST2008-01).* Available at http://www.census.gov/popest/states/NST-ann-est.html

5. Huntley, Roy, U.S. Environmental Protection Agency, "state_comparison ERTAC SS_version7_3 Oct 20 2009 [electronic file]," November 5, 2009.

6. United States Environmental Protection Agency, Office of Air Quality Planning and Standards. *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 2.5 Open Burning*. Research Triangle Park, NC. October 1992.

7. U.S. Environmental Protection Agency, Control Technology Center. "Evaluation of Emissions from the Open Burning of Household Waste in Barrels." EPA-600/R-97-134a. November 1997.

8. United States Environmental Protection Agency, Office of Research and Development. *Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzeno-p-Dioxin (TCCD) and Related Compounds. Part I: Estimating Exposure to Dioxin-Like Compounds. Volume 2: Sources of Dioxin-Like Compounds in the United States*. EPA/600/P-00/001Ab. Washington D.C. March 2001.

Emission Factors for Open Burning of Residential MSW (2610030000)

Pollutant	Pollutant Code	Emission Factor (lb/ton)	Emission Factor Reference
CO	CO	8.50E+01	Reference 5
NOX	NOX	6.00E+00	Reference 5
PM10-FIL	PM10-FIL	3.80E+01	Reference 5
PM10-PRI	PM10-FIL	3.80E+01	Reference 5
PM25-FIL	PM25-FIL	3.48E+01	Reference 5
PM25-PRI	PM25-FIL	3.48E+01	Reference 5
SO2	SO2	1.00E+00	Reference 5
VOC	VOC	8.56E+00	Reference 5
1,2,3,4,6,7,8-heptachlorodibenzofuran	67562394	2.48E-07	Reference 8
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	35822469	7.96E-08	Reference 8
1,2,3,4,7,8,9-heptachlorodibenzofuran	55673897	3.00E-08	Reference 8
1,2,3,4,7,8-hexachlorodibenzofuran	70648269	2.28E-07	Reference 8
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	39227286	1.28E-08	Reference 8
1,2,3,6,7,8-hexachlorodibenzofuran	57117449	7.70E-08	Reference 8
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	57653857	1.94E-08	Reference 8
1,2,3,7,8,9-hexachlorodibenzofuran	72918219	5.00E-09	Reference 8
1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	19408743	3.80E-08	Reference 8
1,2,3,7,8-pentachlorodibenzofuran	57117416	7.44E-08	Reference 8
1,2,3,7,8-pentachlorodibenzo-p-dioxin	40321764	1.62E-08	Reference 8
1,2,4-trichlorobenzene	120821	2.20E-04	Reference 7
1,4-dichlorobenzene	106467	3.20E-04	Reference 7
2,3,4,6,7,8-hexachlorodibenzofuran	60851345	1.24E-07	Reference 8
2,3,4,7,8-pentachlorodibenzofuran	57117314	1.30E-07	Reference 8
2,3,7,8-tetrachlorodibenzofuran	51207319	9.12E-08	Reference 8
2,3,7,8-tetrachlorodibenzo-p-dioxin	1746016	5.40E-09	Reference 8
Acenaphthene	83329	1.54E-03	Reference 7
Acenaphthylene	208968	2.26E-02	Reference 7
Anthracene	120127	3.66E-03	Reference 7
Benz[a]anthracene	56553	4.48E-03	Reference 7
Benzene	71432	2.48E+00	Reference 7
Benzo[a]pyrene	50328	4.24E-03	Reference 7
Benzo[b]fluoranthene	205992	5.26E-03	Reference 7
Benzo[g,h,i,]Perylene	191242	3.95E-03	Reference 7
Benzo[k]fluoranthene	207089	2.05E-03	Reference 7
Chlorobenzene	108907	8.48E-04	Reference 7
Chrysene	218019	5.07E-03	Reference 7
Dibenzo[a,h]anthracene	53703	6.46E-04	Reference 7
Fluoranthene	206440	8.14E-03	Reference 7
Fluorene	86737	7.31E-03	Reference 7
Hexachlorobenzene	118741	4.40E-05	Reference 7
Hydrochloric Acid	7647010	5.68E-01	Reference 7
Hydrogen Cyanide	74908	9.36E-01	Reference 7
Indeno[1,2,3-c,d]pyrene	193395	3.75E-03	Reference 7
Naphthalene	91203	3.51E-02	Reference 7
Octachlorodibenzofuran	39001020	7.28E-08	Reference 8
Octachlorodibenzo-p-dioxin	3268879	9.94E-08	Reference 8
Pentachlorophenol	87865	1.06E-04	Reference 7

Pollutant	Pollutant Code	Emission Factor (lb/ton)	Emission Factor Reference
Phenanthrene	85018	1.46E-02	Reference 7
Phenol	108952	2.80E-01	Reference 7
Polychlorinated Biphenyls	1336363	5.72E-03	Reference 7
Pyrene	129000	9.66E-03	Reference 7
Styrene	100425	1.48E+00	Reference 7

Emission Factors for Open Burning of Land Clearing Debris (SCC 2610000500)

Pollutant	Pollutant Code	Emission Factor (lb/ton)	Emission Factor Reference
VOC	VOC	1.16E+01	Reference 9
NOX	NOX	5.00E+00	Reference 9
CO	CO	1.69E+02	Reference 9
PM10-FIL	PM10-FIL	1.70E+01	Reference 9
PM25-FIL	PM25-FIL	1.70E+01	Reference 9
PM10-PRI	PM10-PRI	1.70E+01	Reference 9
PM25-PRI	PM25-PRI	1.70E+01	Reference 9
1,2,3,4,6,7,8-HpCDD	35822469	3.33E-07	Reference 12
1,2,3,4,6,7,8-HpCDF	67562394	5.08E-08	Reference 12
1,2,3,4,7,8,9-HpCDF	55673897	6.12E-09	Reference 12
1,2,3,4,7,8-HxCDD	39227286	1.14E-08	Reference 12
1,2,3,4,7,8-HxCDF	70648269	3.34E-08	Reference 12
1,2,3,6,7,8-HxCDD	57653857	2.14E-08	Reference 12
1,2,3,6,7,8-HxCDF	57117449	1.43E-08	Reference 12
1,2,3,7,8,9-HxCDD	19408743	3.47E-08	Reference 12
1,2,3,7,8,9-HxCDF	72918219	2.23E-09	Reference 12
1,2,3,7,8-PeCDD	40321764	7.66E-09	Reference 12
1,2,3,7,8-PeCDF	57117416	1.27E-08	Reference 12
2,3,4,6,7,8-HxCDF	60851345	1.96E-08	Reference 12
2,3,4,7,8-PeCDF	57117314	2.02E-08	Reference 12
2,3,7,8-TCDD	1746016	2.30E-09	Reference 12
2,3,7,8-TCDF	51207319	1.40E-08	Reference 12
Cumene	98828	1.33E-02	Reference 11
Dibenzofuran	132649	6.75E-03	Reference 11
Ethyl Benzene	100414	4.80E-02	Reference 11
Methyl Ethyl Ketone	78933	6.70E-02	Reference 11
OCDD	3268879	1.33E-06	Reference 12
OCDF	39001020	2.05E-08	Reference 12
Phenol	108952	1.15E-01	Reference 11
Styrene	100425	1.02E-01	Reference 11

3.2.3.19 Open Burning – Yard Waste – Leaf and Brush Species

a. Source Category Description

Open burning of yard waste is the purposeful burning of leaf and brush species in outdoor areas. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates for leaf and brush waste burning are a function of the amount of waste burned per year.

For this source category, the following SCCs were assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2610000100	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste – Leaf Species Unspecified
2610000400	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste – Brush Species Unspecified

b. Activity Data

The amount of leaf and brush waste burned was estimated using data from EPA's report *Municipal Solid Waste in the United States: 2007 Facts and Figures.*[1] The report presents the total mass of waste generated in the United States by type of waste, including yard waste, for the calendar year 2007. This information was used to calculate a daily estimate of the per capita yard waste, 0.59 lbs/person/day. Of the total amount of yard waste generated, the yard waste composition was assumed to be 25 percent leaves, 25 percent brush, and 50 percent grass by weight.[2]

Open burning of grass clippings is not typically practiced by homeowners, and as such only estimates for leaf burning and brush burning were developed. Approximately 25 to 32 percent of all waste that is subject to open burning is actually burned.[2] A median value of 28 percent is assumed to be burned in all counties in the United States.

The per capita estimate was then multiplied by the 2008 population in each county that is expected to burn waste. Since open burning is generally not practiced in urban areas, only the rural population of each county was assumed to practice open burning. The ratio of urban to rural population was obtained from 2000 U.S. Census data.[3] This ratio was then multiplied by the 2008 U.S. Census Bureau estimate of the population in each county to obtain the county-level rural population for 2008.[4]

The percentage of forested acres from Version 2 of BELD2 within BEIS was used to adjust for variations in vegetation. The percentage of forested acres per county (including rural forest and urban forest) was then determined. To better account for the native vegetation that would likely be occurring in the residential yards of farming States, agricultural land acreage was subtracted before calculating the percentage of forested acres. The corresponding table below presents the ranges that were used to make adjustments to the amount of yard waste that is assumed to be generated per county. All municipios in Puerto Rico and counties in the U.S. Virgin Islands, Hawaii, and Alaska were assumed to have greater than 50 percent forested acres.

Adjustment for Percentage of Forested Acres

Percent Forested Acres per County	Adjustment for Yard Waste Generated
< 10%	0% generated
>= 10%, and < 50%	50% generated
>= 50%	100% generated

c. Controls

Controls for yard waste burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that were more than 80% urban were assumed not to practice any open burning. Therefore, criteria pollutant and HAP emissions from residential municipal solid waste burning are zero in these counties. In addition, the State of Colorado implemented a state-wide ban on open burning. Emissions from open burning of residential waste in all Colorado counties were assumed to be zero.

d. Emission Factors

Emission factors are specific to yard waste type and are reported in the corresponding tables below. Emission factors for CAPs were developed by the U.S. Environmental Protection Agency (EPA) in consultation with the Eastern Regional Technical Advisory Committee.[5] Emission factors for HAPs are from AP-42 and an EPA Control Technology Center report.[6,7] Forest fire simulation emission factors were used to estimate emissions for 17 dioxin congeners.[8]

e. Emissions

County-level criteria pollutant and HAP emissions were calculated by multiplying the total amount of yard waste (either leaf or brush) burned per year by an emission factor. Emissions for leaves and residential brush were calculated separately, since emission factors vary by yard waste type. Tons of debris burned were converted to kilograms (kg) by multiplying by 907.18474.

f. Example Calculations

VOC emissions in Autauga County, Alabama from open burning of leaf waste:

Population of Autauga County in 2008 = 50,364
Rural fraction of Autauga County population = 0.448
Per capita waste yard waste generated (lb/person/day) = 0.59
Leaf fraction of waste = 0.25
Fraction of rural population that burns yard waste = 0.28
Adjustment factor based on % forested acres = 1
Number of days in a year = 365
Factor to convert from lbs to tons = 1/2000

2008 leaf burning activity in Autauga County = 50,364 * 0.448 * 0.59 * 0.25 * 0.28 * 1 * 365 * 1/2000

2008 leaf burning activity in Autauga County = 170.11 tons

VOC emissions = tons of leaves burned * VOC emission factor

VOC emission factor = 28 lb/ton

VOC emissions from leaf burning in Autauga County in 2008 = 170.11 tons * 28 lbs/ton * 1 ton/2000 lbs

VOC emissions from leaf burning in Autauga County in 2008 = 2.38 tons

g. References

1. U.S. Environmental Protection Agency, *Municipal Solid Waste in the United States: 2007 Facts and Figures*, EPA530-R-08-010, Office of Solid Waste and Emergency Response. November 2008. Available at http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw07-rpt.pdf

2. Two Rivers Regional Council of Public Officials and Patrick Engineering, Inc. "Emission Characteristics of Burn Barrels," prepared for the U.S. Environmental Protection Agency, Region V. June 1994.

3. U.S. Census Bureau, Decennial Censuses, 2000 Census: SF1, Table P2

4. U.S. Census Bureau. *Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2000 to July 1, 2008 (NST-EST2008-01).* Available at http://www.census.gov/popest/states/NST-ann-est.html

5. Huntley, Roy, U.S. Environmental Protection Agency, "state_comparison ERTAC SS_version7_3 Oct 20 2009 [electronic file]," November 5, 2009.

6. U.S. Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 2.5 Open Burning,, Tables 2.5-5 and 2.5-6. October 1992.

7. U.S. Environmental Protection Agency, *Evaluation of Emissions from the Open Burning of Household Waste in Barrels*, EPA-600/R-97-134a, Control Technology Center. November 1997.

8. Gullet, B.K. and T. Abderrahmne, "PCDD/F Emissions from Forest Fire Simulations," *Atmospheric Environment*, Vol. 37, No. 6, pp. 803-813. February 2003.

Emission Factors for Open Burning of Leaf Species (SCC 2610000100)

Pollutant	Pollutant Code	Emission Factor (lb/ton)	Emission Factor Reference
1,2,3,4,6,7,8-heptachlorodibenzofuran	67562394	5.08E-08	Reference 8
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	35822469	3.32E-07	Reference 8
1,2,3,4,7,8,9-heptachlorodibenzofuran	55673897	6.12E-09	Reference 8
1,2,3,4,7,8-hexachlorodibenzofuran	70648269	3.34E-08	Reference 8
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	39227286	1.136E-08	Reference 8
1,2,3,6,7,8-hexachlorodibenzofuran	57117449	1.428E-08	Reference 8
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	57653857	2.14E-08	Reference 8
1,2,3,7,8,9-hexachlorodibenzofuran	72918219	2.22E-09	Reference 8
1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	19408743	3.46E-08	Reference 6
1,2,3,7,8-pentachlorodibenzofuran	57117416	1.268E-06	Reference 8
1,2,3,7,8-pentachlorodibenzo-p-dioxin	40321764	7.66E-09	Reference 8
2,3,4,6,7,8-hexachlorodibenzofuran	60851345	1.962E-08	Reference 8
2,3,4,7,8-pentachlorodibenzofuran	57117314	2.02E-08	Reference 8
2,3,7,8-tetrachlorodibenzofuran	51207319	1.396E-08	Reference 8
2,3,7,8-tetrachlorodibenzo-p-dioxin	1746016	2.3E-09	Reference 6
CO	CO	112	Reference 5
Cumene	98828	0.01325	Reference 7
Ethyl Benzene	100414	0.048	Reference 6
Methyl Ethyl Ketone	78933	0.067	Reference 8
Nitrogen Oxides	NOX	6.2	Reference 5
Octachlorodibenzofuran	39001020	2.06E-08	Reference 8
Octachlorodibenzo-p-dioxin	3268879	1.328E-06	Reference 6
Phenol	108952	0.115	Reference 6
PM10-FIL	PM10-FIL	22	Reference 5
PM10-PRI	PM10-PRI	22	Reference 5
PM25-FIL	PM25-FIL	22	Reference 5
PM25-PRI	PM25-PRI	22	Reference 5
Styrene	100425	0.1015	Reference 6
Sulfur Dioxide	SO2	0.76	Reference 5
VOC	VOC	28	Reference 5

Emission Factors for Open Burning of Brush Species (SCC 2610000400)

Pollutant	Pollutant Code	Emission Factor (lb/ton)	Emission Factor Reference
CO	CO	140	Reference 5
Nitrogen Oxides	NOX	5	Reference 5
PM10-PRI	PM10-PRI	19.73	Reference 5
PM10-FIL	PM10-FIL	19.73	Reference 5
PM25-PRI	PM25-PRI	15.21	Reference 5
PM25-FIL	PM25-FIL	15.21	Reference 5
Sulfur Dioxide	SO2	1.66	Reference 5
VOC	VOC	19	Reference 5
1,2,3,4,6,7,8-heptachlorodibenzofuran	35822469	3.32E-07	Reference 6
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	67562394	5.08E-08	Reference 6
1,2,3,4,7,8,9-heptachlorodibenzofuran	55673897	6.12E-09	Reference 6
1,2,3,4,7,8-hexachlorodibenzofuran	70648269	3.34E-08	Reference 6
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	39227286	1.136E-08	Reference 6
1,2,3,6,7,8-hexachlorodibenzofuran	57117449	1.428E-08	Reference 6
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	57653857	2.14E-08	Reference 8
1,2,3,7,8,9-hexachlorodibenzofuran	72918219	2.22E-09	Reference 8
1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	19408743	3.46E-08	Reference 8
1,2,3,7,8-pentachlorodibenzofuran	57117416	1.268E-06	Reference 8
1,2,3,7,8-pentachlorodibenzo-p-dioxin	40321764	7.66E-09	Reference 8
2,3,4,6,7,8-hexachlorodibenzofuran	60851345	1.962E-08	Reference 8
2,3,4,7,8-pentachlorodibenzofuran	57117314	2.02E-08	Reference 8
2,3,7,8-tetrachlorodibenzofuran	51207319	1.396E-08	Reference 8
2,3,7,8-tetrachlorodibenzo-p-dioxin	1746016	2.3E-09	Reference 8
Cumene	98828	0.01325	Reference 8
Ethyl Benzene	100414	0.048	Reference 8
Methyl Ethyl Ketone	78933	0.067	Reference 8
Octachlorodibenzofuran	39001020	2.06E-08	Reference 8
Octachlorodibenzo-p-dioxin	3268879	1.328E-06	Reference 8
Phenol	108952	0.115	Reference 7
Styrene	100425	0.1015	Reference 7

3.2.3.20 Agricultural Production – Crops – Fertilizer

a. Source Category Description

Fertilizer in this category refers to any nitrogen-based compound, or mixture containing such a compound, that is applied to land to improve plant fitness.

The approach to calculating emissions for the assigned SCCs consisted of three general steps, as follows:

- Calculating the percent change in county-level fertilizer quantities applied between 2002 and 2007.
- Using the percent change in applied fertilizer quantity to grow the fertilizer activity files provided with the CMU Ammonia Model v.3.6.[1]
- Running the CMU Ammonia Model to calculate ammonia emissions based on the updated county-level fertilizer quantities.

For this source category, the following SCCs were assigned:

SCC	Descriptor 2	Descriptor 4	Descriptor 5	Descriptor 10
2801700001	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Anhydrous Ammonia
2801700002	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Aqueous Ammonia
2801700003	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Nitrogen Solutions
2801700004	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Urea
2801700005	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Ammonium Nitrate
2801700006	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Ammonium Sulfate
2801700007	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Ammonium Thiosulfate
2801700010	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	N-P-K (multi-grade nutrient fertilizers)

2801700011	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Calcium Ammonium Nitrate
2801700012	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Potassium Nitrate
2801700013	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Diammonium Phosphate
2801700014	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Monoammonium Phosphate
2801700015	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Liquid Ammonium Polyphosphate
2801700099	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Miscellaneous Fertilizers

b. Activity Data

County-level fertilizer consumption data for 2002 and 2007 was obtained from the Fertilizer Institute's Commercial Fertilizers 2002 and 2007 reports.[2] The consumption data includes total fertilizer sales or shipments for farm and non-farm use and is reported semi-annually for the fiscal year. To make the fertilizer types listed in the Commercial Fertilizers reports match the activity input files from the CMU Ammonia Model, the fertilizer types were grouped according to the corresponding table below. For any state in 2002 reporting fertilizer quantities from unknown counties, the quantities were apportioned to every county in the state based on cropland area obtained from the U.S. Department of Agriculture's 2002 Census of Agriculture.[3] Similarly for 2007, fertilizer quantities from unknown counties were apportioned based on cropland area reported in the 2007 Census of Agriculture.[4] For each fertilizer group, the percent difference in fertilizer consumption between 2002 and 2007 was calculated for each county. These percentages were used to grow the 2002 county-level nitrogen quantities from the fertilizer activity files provided with the CMU Ammonia Model v.3.6.

The average nitrogen content for each fertilizer group, reported in the corresponding table below, was calculated by summing the county-level fertilizer quantities for all counties from the CMU Ammonia Model activity files to generate total nitrogen applied. For each fertilizer group, the total nitrogen applied was then divided by the 2002 fertilizer consumption data from the 2002 Commercial Fertilizers report to obtain the percent nitrogen content for each fertilizer group. For any county with fertilizer consumption in 2007, but not in 2002, the fertilizer quantity obtained from the 2007 Commercial Fertilizer's report was multiplied by the percent nitrogen content of each fertilizer group to determine tons of nitrogen. The tons of nitrogen were then converted to kilograms and allocated temporally by month according to the state-level percentage of total fertilizer in

that group applied each month. The state-level percentage was calculated using data in the CMU Ammonia Model input files.

c. Emission Factors

Emission factors for each fertilizer group were provided with the CMU Ammonia Model and are reported in the corresponding table below.[3]

d. Emissions

The fertilizer activity files provided with the CMU Ammonia Model v.3.6 were replaced with the updated county-level fertilizer files. County-level ammonia emissions were then calculated by running the model. The model corrects for the difference in mass between nitrogen and ammonia.

N applied x % N volatilized as NH_3 x 17 g /14 g = NH_3 emissions

e. Sample Calculations

Allocation of Fertilizer Quantities from Unknown Counties

From the 2007 Commercial Fertilizers report, Colorado reported 4,774,000 kg of ammonium nitrate from unknown counties for January through June of 2007. This quantity was distributed to counties based on the percent of cropland in the state located in each county. For example, Colorado has 11,484,000 acres of cropland. Adams County, Colorado has 547,000 acres of cropland.

Percent of cropland in CO located in Adams County = (547,000 / 11,484,000) x 100 = 4.76

Ammonium nitrate allocated to Adams County = 4,774,000 kg x .0476 = 227,240 kg

Growing the CMU Ammonia Model Input Files

After allocating fertilizer data from unknown counties for 2002 and 2007, the county-level percent difference between fertilizer quantity applied in 2002 and 2007 was used to grow the data in the activity files provided with the CMU Ammonia Model. For example, Autauga County, Alabama applied 473,180 kg of ammonium nitrate from July 2001 through December 2001 and 516,240 kg from July 2006 through December 2006.

Percent change in ammonium nitrate applied = (516,240 kg / 473,180 kg) x 100 = 109

The quantity of nitrogen, in the form of ammonium nitrate, applied per month from July through December 2002 in Autauga County was extracted from the CMU Ammonia Model activity files and multiplied by the percent change.

July: 3,250 kg x 1.09 = 3,543 kg N

August: 3,210 kg x 1.09 = 3,499 kg N

September: 9,640 kg x 1.09 = 10,508 kg N

October: 6,320 kg x 1.09 = 6,889 kg N

November: 2,600 kg x 1.09 = 2,834 kg N

December: 1,380 kg x 1.09 = 1,504 kg N

Calculation of Nitrogen Content in a Fertilizer Group

The sum of all nitrogen applied in the form of ammonium nitrate from the CMU Ammonia Model ammonium nitrate activity file was 508,000,000 kg. From the 2002 Commercial Fertilizers report, the total quantity of ammonium nitrate applied in 2002 was 1,420,000,000 kg.

N content of ammonium nitrate = (508,000,000 kg / 1,420,000,000 kg) x 100 = 36 %

County Where Fertilizer was Applied in 2007, but not in 2002

In Meade County, Kentucky, there was no ammonium nitrate applied from January to June of 2002, but there were 356,705 kg applied from January to June of 2007. To convert to kg of nitrogen, the quantity of ammonium nitrate applied in 2007 was multiplied by the nitrogen content of ammonium nitrate.

N applied = 356,705 kg x 0.36 = 128,414 kg

The quantity of nitrogen was then allocated temporally by month from January to June based on the state-level distribution of nitrogen applied in the form of ammonium nitrate from the CMU Ammonia Model ammonium nitrate activity file. Total nitrogen in the form of ammonium nitrate applied in Kentucky from January through June of 2002 was 17,000,000 kg. The total for January was 289,000 kg. The total for February was 745,000 kg.

January: (289,000 kg / 17,000,000 kg) x 128,414 kg = 2,183 kg N applied in Meade County

February: (745,000 kg / 17,000,000 kg) x 128,414 kg = 5,600 kg N applied in Meade County

March – June: calculated same as above.

f. References

1. Cliff Davidson, Peter Adams, Ross Strader, Rob Pinder, Natalie Anderson, Marian Goebes, and Josh Ayers. The Environmental Institute, Carnegie Mellon University, *CMU Ammonia Model v.3.6.*, 2004, at http://www.cmu.edu/ammonia/, accessed 25 April 2009.

2. Association of American Plant Food Control Officials in partnership with The Fertilizer Institute, *Commercial Fertilizers 2002* and *Commercial Fertilizers 2007*, at http://www.aapfco.org/aapfcopubs.html, accessed 2 May 2009.

3. U.S. Department of Agriculture, *2002 Census of Agriculture*, at http://www.agcensus.usda.gov/, accessed 30 April 2009.

4. 4. U.S. Department of Agriculture, *2007 Census of Agriculture*, at http://www.agcensus.usda.gov/, accessed 30 April 2009.

Fertilizers Assigned to Fertilizer Groups

CMU Ammonia Model Fertilizer Group	Commercial Fertilizers Report - Fertilizer Code	Description 1	Description 2
Ammonium Nitrate	10	Ammonium Nitrate	Ammoniumnitrate
Ammonium Sulfate	24	Ammonium Sulfate	Ammoniumsulfate
Ammonium Thiosulfate	31	Ammonium Thiosulfate	Ammoniumthiosul
Anhydrous Ammonia	2	Anhydrous Ammonia	Anhy Ammonia
Aqueous Ammonia	6	Aqua Ammonia	Aqua Ammonia
Calcium Ammonium Nitrate	35	Calcium Ammonium Nit	Calcium Amm Nit
Diammonium Phosphate	203	Diammonium Phosphate	DAP
Liquid Ammonium Polyphosphate	249	Liquid Ammonium Poly	Liq Amm Poly
Miscellaneous	12	Ammonium Nitrate Sol	Amm Nit Solution
	13	Ammonium Nitrate-Lim	Amm Nit Lime Mix
	16	Ammonium Nitrate-Sul	Ammoniumnit-Sul
	20	Ammonium Polysulfide	Ammoniumpolysulf
	25	Ammonium Sulfate Sol	Amm Sul Solution
	27	Ammonium Sulfate-Nit	Ammoniumsul-Nit
	29	Ammonium Sulfate-Ure	Ammoniumsul-Urea

CMU Ammonia Model Fertilizer Group	Commercial Fertilizers Report - Fertilizer Code	Description 1	Description 2
	46	Calcium Nitrate-Urea	Calcium Nit-Urea
	52	Magnesium Nitrate	Magnesium Nit
	54	Nitric Acid	Nitric Acid
	62	Sodium Nitrate	Sodium Nitrate
	64	Sulfur Coated Urea	Sul Ctd Urea
	67	Urea Solution	Urea Solution
	68	Urea-Formaldehyde	Urea-Form
	97	Nitrogen Product - C	Nitrogen No Code
	98	Nitrogen Product - C	Nitrogen No Id
	201	Ammonium Metaphospha	Ammoniummetaphos
	202	Ammonium Phosphate	Ammoniumphos
	204	Ammonium Polyphospha	Ammoniumpoly
	206	Ammonium Phosphate N	Amm Phosnitrate
	207	Ammonium Phosphate S	Amm Phossulfate
	241	Nitric Phosphate	Nitric Phos
	413	Manure Salts	Manure Salts
	458	Potassium-Sodium Nit	Pot-Sod Nitrate
	617	Fish Scrap	Fish Scrap
	629	Guano	Guano
	649	Manure	Manure
	652	Peat	Peat
	661	Sewage Sludge, Activ	Act Sew Sludge
	663	Sewage Sludge, Diges	Dig Sew Sludge
	665	Sewage Sludge, Heat	Ht Driedsew Slge
	667	Sewage Sludge, Other	Oth Sew Sludge
	671	Soybean Meal	Soybean Meal
	673	Tankage, Animal	Animal Tankage
	675	Tankage, Process	Process Tankage
	697	Natural Organic Prod	Nat Org No Code
	698	Nat Organic Product	Nat Org No Id
	764	Soil Amendment	Soil Amendmnt
	766	Soil Conditioner	Soil Cond
	767	Potting Soil	Potting Soil
	797	Sec./Micronut. - Cod	Sec/Mic No Code
	798	Sec./Micronut. - Cod	Sec/Mic No Id
	978	Fertilizer Product -	Fert No Id
	988	Single Nutrient - Co	Sgle-Nu No Id
Mix	0	Identified By Grade	Ident. By Grade
	998	Multiple Nutrient -	Mult-Nut No Grade
Monoammonium Phosphate	209	Monoammonium Phosphate	Monoamm Phos
Nitrogen Solutions	56	Nitrogen Solution <28%	Nitrogensol <28%
	58	Nitrogen Solution 28%	Nitrogensol 28%
	59	Nitrogen Solution 30%	Nitrogensol 30%
	60	Nitrogen Solution 32%	Nitrogensol 32%

CMU Ammonia Model Fertilizer Group	Commercial Fertilizers Report - Fertilizer Code	Description 1	Description 2
	61	Nitrogen Solution >32%	Nitrogensol >32%
Potassium Nitrate	453	Potassium Nitrate	Pot Nitrate
Urea	66	Urea	Urea

Fertilizer Nitrogen Content

Fertilizer	Nitrogen Content (percent)
Ammonium Nitrate	36
Ammonium Sulfate	22
Ammonium Thiosulfate	12
Anhydrous Ammonia	82
Aqueous Ammonia	21
Calcium Ammonium Nitrate	17
Diammonium Phosphate	18
Liquid Ammonium Polyphosphate	10
Miscellaneous	8
Mix	12
Monoammonium Phosphate	11
Nitrogen Solutions	29
Potassium Nitrate	14
Urea	46

Fertilizer Emission Factors

Fertilizer Description	Pollutant Code	Emission Factor (varies by county for some fertilizers)			Emission Factor Unit	Emission Factor Reference
		Min	Max	Average		
Ammonium Nitrate	NH3	1.0	3.0	1.91	% N volatilized as NH3	1
Ammonium Sulfate	NH3	5.0	15.0	9.53	% N volatilized as NH3	1
Ammonium Thiosulfate	NH3	2.5	2.5	2.5	% N volatilized as NH3	1
Anhydrous Ammonia	NH3	4.0	4.0	4.0	% N volatilized as NH3	1
Aqueous Ammonia	NH3	4.0	4.0	4.0	% N volatilized as NH3	1
Calcium Ammonium Nitrate	NH3	1.0	3.0	1.91	% N volatilized as NH3	1
Diammonium Phosphate	NH3	5.0	5.0	5.0	% N volatilized as NH3	1
Liquid Ammonium Polyphosphate	NH3	5.0	5.0	5.0	% N volatilized as NH3	1
Miscellaneous Fertilizers	NH3	6.0	8.0	6.59	% N volatilized as NH3	1
Monoammonium Phosphate	NH3	5.0	5.0	5.0	% N volatilized as NH3	1
Nitrogen Solutions	NH3	8.0	8.0	8.0	% N volatilized as NH3	1
N-P-K (multi-grade nutrient fertilizers)	NH3	1.0	3.0	1.91	% N volatilized as NH3	1
Potassium Nitrate	NH3	2.0	2.0	2.0	% N volatilized as NH3	1
Urea	NH3	15.0	20.0	15.8	% N volatilized as NH3	1

3.2.3.21 Publicly Owned Treatment Works

a. Source Category Description

Publicly Owned Treatment Works (POTW) means a treatment works that is owned by a state, municipality, city, town, special sewer district, or other publicly owned and financed entity as opposed to a privately (industrial) owned treatment facility. The definition includes intercepting sewers, outfall sewers, sewage collection systems, pumping, power, and other equipment. The wastewater treated by these POTWs is generated by industrial, commercial, and domestic sources.[1]

The general approach to calculating emissions for POTWs is to estimate the 2008 national POTW flow rate using methods described below and then multiply the estimated flow rate by the emission factors for VOCs, ammonia, and 53 HAPs. The emissions are allocated to the county level using methods described below.

b. Activity Data

A nationwide projected flow rate in 2010 of 39,780 million gallons per day (MMGD) was available from an EPA report.[2] Of this, POTWs account for 98.5 percent of the flow rate or 39,180 MMGD, with privately owned treatment works accounting for the rest. The EPA Clean Watersheds Needs Survey reports the existing flow rate in 2004 for POTWs as 34,370 MMGD.[3] The interpolated 2008 nationwide flow rate (using a linear regression) was calculated at 37,580 MMGD, or 13,754,280 million gallons annually. The nationwide flow rate includes Puerto Rico and the U.S. Virgin Islands.

c. Emission Factors

The ammonia emission factor was obtained from a report to EPA[4], while the VOC emission factor was based on a TriTAC study.[5] Emission factors for the 53 HAPs were derived using 1996 area source emissions estimates that were provided by ESD[6] and the 1996 nationwide flow rate.[7] These HAP emission factors were then multiplied by the 2008 to 2002 VOC emission factor ratio (0.85/9.9) to obtain the final HAP emission factors applied in the 2008 inventory. The emission factors, pollutant codes, and pollutant descriptions are reported in the corresponding table below.

d. Emissions

Emissions were allocated to the county-level by the county proportion of the U.S. population.[8]

It is important to note that the emission estimates for this category represent total emissions. It may be necessary to determine whether there are point source emissions in SCCs 50100701 through 50100781 and 50100791 through 50182599 that need to be subtracted to yield the nonpoint source emission estimates for this category.

Though there are two point source facilities in Missouri that are POTW's, their emissions were not subtracted from the area source category due to time constraints and small level of emissions compared to the area source category.

e. Sample Calculations:

The 1996 flow rate per day was 32,175 MMGD. (1996 was a leap year.) Annually, this computes to:

32,175 MMGD treated * 366 days = 11,776,050 million gallons treated

Benzene emissions in 1996 for area source POTWs were estimated to be 461.44 tons per year. The derived benzene emission factor is calculated as follows:

Benzene emission factor = ((461.44 tons * 2000 lb/ton) / (11,776,050 million gallons treated)) * (0.85/9.9)

Benzene emission factor = 0.0067287 lb/million gallons treated

Benzene emissions for 2008 for area source POTWs are calculated as follows:

2008 Benzene emissions = (37,580 MMGD * 366 days) * (0.0067287 lb/million gallons treated)

2008 Benzene emissions = 92,548 pounds / 2,000 pounds = 46.27 tons/year

Total national 2008 benzene emissions from area source POTWs are allocated to county-level by the county proportion of the U.S. population. The total U.S. population in 2008 is 308,123,578. Benzene emissions for Autauga County, Alabama (2008 population of 50,364) are calculated as follows:

2008 emissions = 46.27 tons/year * 50,364/308,123,578 = 0.0076 tons/year

f. References

1. U.S. Environmental Protection Agency, 64FR57572, National Emission Standards for Publicly Owned Treatment Works, Final Rule, 40 CFR Part 63, 26 October 1999.

2. U.S. Environmental Protection Agency, "Wastewater Flow Projections for POTWs and Privately and Federally Owned Treatment Works in 2000, 2005, and 2010," Table A-8 in *Biosolids Generation, Use, and Disposal in the United States*, EPA530-R-99-009, September 1999.

3. U.S. Environmental Protection Agency, Clean Watersheds Needs Survey, Ask WATERS Online Database Query Tool, at http://iaspub.epa.gov/waters10/query_tool.criteria?srept_no=165&branding=15, accessed 19 May 2009.

4. Stephen M. Roe, Melissa D. Spivey, Holly C. Lindquist, Kirstin B. Thesing, and Randy P. Strait, E.H. Pechan & Associates, Inc., *Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources – Draft Final Report*, prepared for U.S. Environmental Protection Agency, Emission Inventory Improvement Program, April 2004.

5. Prakasam Tata, Jay Witherspoon, Cecil Lue-Hing (eds.), VOC Emissions from Wastewater Treatment Plants: Characterization, Control, and Compliance, Lewis Publishers, 2003, p. 261.

6. Memorandum from Bob Lucas, U.S Environmental Protection Agency to Greg Nizich, U.S. Environmental Protection Agency, "Review of Baseline Emissions Inventory," 16 October 1998.

7. U.S. Environmental Protection Agency, "Facilities Database (Needs Survey) - Frequently Asked Questions," at http://www.epa.gov/owm/mtb/cwns/1996rtc/faqwfd.htm, accessed 22 May 2009.

8. U.S. Census Bureau, "Population Estimates," at http://www.census.gov/popest/estimates.html, released 14 May 2009 with population estimates as of 1 July 2008. Note: The U.S. Census Bureau estimate does not include the U.S. Virgin Islands, so the Census Bureau estimate was supplemented with Virgin Island population data from U.S. Department of Commerce, National Oceanic and Atmospheric Administration, *Demographic Baseline Report of U.S. Territories and Counties Adjacent to Coral Reef Habitats*, June 2008, at http://coris.noaa.gov/activities/coral_demographics, accessed 9 June 2009.

Criteria and HAP Emission Factors for Publicly Owned Treatment Works (SCC 2630020000): Not Adjusted for Point Source Emissions

Pollutant Description	NIF 3.0 Pollutant Codes	Emission Factor (lb/MMGAL)	Emission Factor Reference(s)
1,1,2,2-TETRACHLOROETHANE	79345	1.75E-06	6, 7
1,1,2-TRICHLOROETHANE	79005	1.17E-06	6, 7
1,2,4-TRICHLOROBENZENE	120821	8.67E-05	6, 7
1,3-BUTADIENE	106990	2.51E-05	6, 7
1,4-DICHLOROBENZENE	106467	2.16E-04	6, 7
1-CHLORO-2,3-EPOXYPROPANE	106898	4.52E-06	6, 7
2,4-DINITROTOLUENE	121142	4.81E-05	6, 7
2-NITROPROPANE	79469	2.92E-07	6, 7
ACETALDEHYDE	75070	3.10E-04	6, 7
ACETONITRILE	75058	3.45E-04	6, 7
ACROLEIN	107028	3.84E-04	6, 7
ACRYLONITRILE	107131	3.86E-04	6, 7
ALLYL CHLORIDE	107051	1.94E-05	6, 7

Pollutant Description	NIF 3.0 Pollutant Codes	Emission Factor (lb/MMGAL)	Emission Factor Reference(s)
AMMONIA	NH3	1.69E-01	4
BENZENE	71432	6.73E-03	6, 7
BENZYL CHLORIDE	100447	8.17E-06	6, 7
BIPHENYL	92524	7.52E-05	6, 7
CARBON DISULFIDE	75150	4.32E-03	6, 7
CARBON TETRACHLORIDE	56235	1.12E-03	6, 7
CHLOROBENZENE	108907	4.83E-04	6, 7
CHLOROFORM	67663	6.44E-03	6, 7
CHLOROPRENE	126998	2.38E-05	6, 7
CRESOLS (INCLUDES O, M, & P)/CRESYLIC ACIDS	331	1.61E-06	6, 7
DIMETHYL SULFATE	77781	1.31E-06	6, 7
ETHYL ACRYLATE	140885	1.75E-06	6, 7
ETHYL BENZENE	100414	7.66E-03	6, 7
ETHYLENE OXIDE	75218	2.22E-04	6, 7
FORMALDEHYDE	50000	1.97E-05	6, 7
GLYCOL ETHERS	171	1.15E-02	6, 7
HEXACHLOROBUTADIENE	87683	7.29E-07	6, 7
HEXACHLOROCYCLOPENTADIENE	77474	5.83E-07	6, 7
METHANOL	67561	1.14E-02	6, 7
METHYL CHLOROFORM	71556	5.63E-04	6, 7
METHYL ETHYL KETONE	78933	2.84E-03	6, 7
METHYL ISOBUTYL KETONE	108101	2.69E-03	6, 7
METHYL METHACRYLATE	80626	3.11E-04	6, 7
METHYL TERT-BUTYL ETHER	1634044	6.37E-05	6, 7
METHYLENE CHLORIDE	75092	9.10E-03	6, 7
N,N-DIMETHYLANILINE	121697	3.22E-04	6, 7
NAPHTHALENE	91203	1.31E-03	6, 7
NITROBENZENE	98953	6.56E-06	6, 7
O-TOLUIDINE	95534	1.75E-06	6, 7
P-DIOXANE	123911	1.79E-05	6, 7
PROPIONALDEHYDE	123386	3.50E-06	6, 7
PROPYLENE DICHLORIDE	78875	1.15E-05	6, 7
PROPYLENE OXIDE	75569	7.32E-04	6, 7
STYRENE	100425	2.73E-03	6, 7
TETRACHLOROETHYLENE	127184	4.27E-03	6, 7
TOLUENE	108883	1.23E-02	6, 7
TRICHLOROETHYLENE	79016	3.06E-04	6, 7
VINYL ACETATE	108054	7.66E-05	6, 7
VINYL CHLORIDE	75014	6.71E-06	6, 7
VINYLIDENE CHLORIDE	75354	4.23E-04	6, 7

Pollutant Description	NIF 3.0 Pollutant Codes	Emission Factor (lb/MMGAL)	Emission Factor Reference(s)
VOLATILE ORGANIC COMPOUNDS	VOC	8.50E-01	5
XYLENES (MIXTURE OF O, M, AND P ISOMERS)	1330207	5.98E-02	6, 7

3.2.3.22 Solvent Utilization

a. Source Category Description

Solvent Utilization describes a wide range of activities where the primary pollutants released are volatile organic compounds (VOCs). Some examples would be surface coating operations (where a paint or finish is applied to a manufactured product), or consumer and commercial cleaning product application. The list of SCCs is included in the corresponding table below.

b. Activity Data

The three types of activity data collected are population, road miles (used for traffic markings), and employment data. The corresponding table below shows the type of activity data used for each category and provides the SCC. Employment data is listed by the North American Industrial Classification Standard (NAICS) code(s) that were used to determine county-level employment for the category.

Population data was collected from the U.S. Census Bureau's population estimates for July 1, 2008.

For traffic paints, the Federal Highway Administration provides county-level road miles as a part of their HPMS data. The most recent data set available at the time of compilation was 2006.

Employment data was allocated to each county using *County Business Patterns* (CBP) employment data for 2006 (the most recent data available at the time of compilation). One of the limitations of *County Business Patterns* is the fact that data can be withheld if certain conditions are present so that confidential business data is not revealed. Divita 2009 describes how this limitation is overcome by applying a procedure to estimate the number of employees in a withheld county. For SCCs with multiple NAICS associated with them, this allocation procedure is performed for each individual NAICS.

Point source subtraction is completed by determining the number of employees per county in each of the associated NAICS codes and subtracting them from the CBP county total prior to calculating emissions. The corresponding table below lists the solvent categories and their point source subtraction results. In some cases, the entire county area source emission estimate becomes zero because all of the CBP employees are accounted for in the point source category.

c. Control Factors

For several categories, air pollution regulations exist that regulate the solvent content of products which can be sold. These solvent content limits have been taken into account where appropriate by modifying emission factors rather than developing control efficiency information.

d. Emission Factors

Emission factors were developed and reviewed by an ERTAC advisory panel composed of state and EPA personnel. The corresponding table below lists the SCC, pollutant, and emission factors that were developed for categories with the same factor throughout the country. As mentioned in the control factors section above, there were several categories where the emission factor was adjusted to account for rules that limit solvent content. The corresponding table below lists the categories with their uncontrolled and controlled emission factors while the other corresponding table below lists the states for which controlled emission factors were applied.

e. Sample Calculations

Emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = A_x \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for category x and pollutant p
A_x = Population or employment data associated with category x
$EF_{x,p}$ = emission factor for category x and pollutant p

Example:

Using architectural coatings in Allegheny County, PA as an example:

According to the U.S. Census Bureau, population on July 1, 2008 is 1,215,103
The emission factor for VOC is 2.41 lb/person

$$E_{VOC} = 1{,}215{,}103 \text{ people} \times 2.41 \text{ lb VOC/ person}$$

$$= 2{,}928{,}398 \text{ lb VOC or } 1{,}464.2 \text{ ton VOC}$$

f. References

Divita, 2009: Divita, Frank, E.H. Pechan & Associates, Inc., memorandum to Roy Huntley, U.S. Environmental Protection Agency, "County Business Patterns Allocations," June 30, 2009.

DOC, 2008: U.S. Department of Commerce, Bureau of the Census, 2006 *County Business Patterns*, Washington, DC. Address: http://www.census.gov/epcd/cbp/download/06_data/index.html accessed November 2008.

Activity Data Sources Used for Each SCC

Category Name	SCC	NAICS	Comments
Architectural Coatings	2401001000	N/A	Population based Category
Automobile Refinishing	2401005000	81112	
		4411	
		4412	
Traffic Paints	2401008000	N/A	Road Miles coming from 2006 HPMS Data
Wood and Composition Flat Stock	2401015000	321	
Wood Furniture and Fixtures	2401020000	337110	
		337121	
		337122	
		337127	50% to this and 50% to metal furniture
		337129	
		337211	
		337212	
		337215	50% to this and 50% to metal furniture
		339111	50% to this and 50% to metal furniture
Metal Furniture	2401025000	337124	
		337127	50% to this and 50% to wood furniture
		337214	
		337215	50% to this and 50% to wood furniture
		339111	50% to this and 50% to wood furniture
Paper, Film and Foil	2401030000	322221	
		322222	
		322223	
		322225	
		322226	
Metal Cans	2401040000	33243	
Metal Sheet, Strip and Coils	2401045000	332812	
		339911	
		339912	
		339914	
Misc. Finished Metals	2401050000		Consolidated with Miscellaneous Manufacturing
Machinery and Equipment	2401055000	3331	
		3332	
		3333	
		33341	
Appliances	2401060000	3352	
Electronic and Other Electrical Coatings	2401065000	331319	
		331422	
		331491	
		335921	
		335929	
		335311	
Motor Vehicles	2401070000	3361	
		3362	
		3363	
Aircraft	2401075000	3364	
Railroads	2401085000	3365	
Marine coatings	2401080000	3366	
		488390	

Category Name	SCC	NAICS	Comments
Misc. Manufacturing	2401090000	339	
		3369	
Industrial Maintenance Coatings	2401100000	N/A	Population based Category
Other Special Purpose Coatings	2401200000	N/A	Population based Category
Cleaning Products: Industrial and Institutional	2415000000	331	
		332	
		333	
		334	
		335	
		336	
		337	
		339	
		441	
		483	
		484	
		485	
		488	
		8111	
		8112	
Dry Cleaning	2420000000	81231	
		81232	
		81233	
Graphic Arts	2425000000	32311	Category Calculated using either population or employment
		322211	
		322212	
		322213	
		322214	
		322215	
		322221	
		322222	
		322223	
		322224	
		322225	
		322226	
		322231	
		322232	
		322233	
		322291	
		322299	
Personal Care Products (Cosmetics and Toiletries)	2460100000	N/A	Population based Category
Cleaning Products: Household	2460200000	N/A	Population based Category
Automotive Aftermarket (Transportation: Motor Vehicles)	2460400000	N/A	Population based Category
Coatings and Related Products	2460500000	N/A	Population based Category
Adhesives and Sealants	2460600000	N/A	Population based Category
FIFRA Regulated Products	2460800000	N/A	Population based Category
Misc. Products	2460900000	N/A	Population based Category

Nonpoint Solvent Categories and Point Source Subtraction

Category Name	SCC	Missouri Point Subtraction	
Architectural Coatings	2401001000	Population based, no point contribution	
Automobile Refinishing	2401005000	No point facilities in Missouri	
Appliances	2401060000	No point facilities in Missouri	
Traffic Paints	2401008000	Road mile based, no point contribution	
Industrial Maintenance Coatings	2401100000	Population based, no point subtraction	
Other Special Purpose Coatings	2401200000	Population based, no point subtraction	
Dry Cleaning	2420000000	No point facilities in Missouri	
Personal Care Products (Cosmetics and Toiletries)	2460100000	Population based, no point subtraction	
Cleaning Products: Household	2460200000	Population based, no point subtraction	
Automotive Aftermarket (Transportation: Motor Vehicles)	2460400000	Population based, no point subtraction	
Coatings and Related Products	2460500000	Population based, no point subtraction	
Adhesives and Sealants	2460600000	Population based, no point subtraction	
FIFRA Regulated Products	2460800000	Population based, no point subtraction	
Misc. Products	2460900000	Population based, no point subtraction	
Wood and Composition Flat Stock	2401015000	*County*	*Employees removed*
		53	32
		91	515
		105	200
		107	85
		186	210
		201	290
		203	20
		207	839
Wood Furniture and Fixtures	2401020000	*County*	*Employees removed*
		145	800
		187	40
		189	55
		215	105
Metal Furniture	2401025000	*County*	*Employees removed*
		189	55
Paper, Film and Foil	2401030000	*County*	*Employees removed*
		189	160
		510	250
Metal Cans	2401040000	*County:*	*Employees removed:*
		21	205

Category Name	SCC	Missouri Point Subtraction	
		77	120
		95	147
		99	174
		159	650
		189	54
Metal Sheet, Strip and Coils	2401045000	*County:*	*Number of Employees removed:*
		189	*10*
		510	*125*
Machinery and Equipment	2401055000	*County:*	*Number of Employees removed:*
		21	850
		23	825
		29	165
		53	375
		97	50
		99	175
		183	950
		201	60
Electronic and Other Electrical Coatings	2401065000	*County:*	*Number of Employees removed:*
		27	550
		159	229
Motor Vehicles	2401070000	*County:*	*Number of Employees removed:*
		19	152
		47	5950
		51	534
		71	728
		77	325
		79	125
		91	325
		95	875
		97	251
		117	125
		157	1200
		159	650
		175	100
		183	2600
		189	1635
		201	95
		225	115
		229	170

Category Name	SCC	Missouri Point Subtraction	
Aircraft	2401075000	*County:*	*Number of Employees removed:*
		145	160
		183	945
		189	14555
Railroads	2401085000	*County:*	*Number of Employees removed:*
		99	316
Marine coatings	2401080000	*County:*	*Number of Employees removed:*
		83	195
		105	971
		155	520
		167	188
Misc. Manufacturing	2401090000	*County*	*Number of Employees Subtracted*
		165	900
		510	630
Cleaning Products: Industrial and Institutional	2415000000	*County*	*Number of Employees Subtracted*
		7	27
		9	2331
		19	402
		21	1233
		23	2225
		27	550
		29	165
		47	5950
		51	534
		53	375
		61	142
		71	1684
		77	1199
		79	125
		83	195
		87	85
		91	325
		93	299
		95	3687
		97	1716
		99	1253
		101	1300
		105	1461
		109	35

Category Name	SCC	Missouri Point Subtraction	
		113	590
		117	125
		131	556
		143	1150
		145	1285
		147	1150
		151	400
		155	695
		157	1212
		159	1848
		165	1500
		167	188
		175	100
		183	5480
		187	798
		189	18679
		201	155
		205	178
		215	105
		219	309
		225	115
		229	170
		510	900
Graphic Arts	2425000000	*County:*	*Employees Removed:*
		21	130
		31	1599
		47	270
		51	725
		71	545
		73	450
		77	309
		83	163
		95	4590
		115	375
		165	101
		189	375
		219	48
		510	107

National Emission Factors

SCC	Description	Pollutant Code	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Calculation Material Code	Material Description
2401005000	SC: Automobile Refinishing	107211	0.1424	LB	EACH	992	Employee
2401005000	SC: Automobile Refinishing	171	0.84817	LB	EACH	992	Employee
2401005000	SC: Automobile Refinishing	78933	10.591	LB	EACH	992	Employee
2401005000	SC: Automobile Refinishing	108101	2.848	LB	EACH	992	Employee
2401005000	SC: Automobile Refinishing	108883	1.602	LB	EACH	992	Employee
2401005000	SC: Automobile Refinishing	1330207	1.78	LB	EACH	992	Employee
2401005000	SC: Automobile Refinishing	VOC	89	LB	EACH	992	Employee
2401008000	SC: Traffic Paint	71556	2.2155	LB	ROAD MILE	225	Paint
2401008000	SC: Traffic Paint	78933	1.3504	LB	ROAD MILE	225	Paint
2401008000	SC: Traffic Paint	108101	1.5403	LB	ROAD MILE	225	Paint
2401008000	SC: Traffic Paint	108883	0.18568	LB	ROAD MILE	225	Paint
2401008000	SC: Traffic Paint	VOC	22.1	LB	ROAD MILE	225	Paint
2401015000	SC: Wood and Composition Flat Stock	107211	0.1935	LB	EACH	992	Employee
2401015000	SC: Wood and Composition Flat Stock	171	0.59426	LB	EACH	992	Employee
2401015000	SC: Wood and Composition Flat Stock	78933	1.548	LB	EACH	992	Employee
2401015000	SC: Wood and Composition Flat Stock	108101	3.569	LB	EACH	992	Employee
2401015000	SC: Wood and Composition Flat Stock	71556	0.344	LB	EACH	992	Employee
2401015000	SC: Wood and Composition Flat Stock	108883	1.118	LB	EACH	992	Employee
2401015000	SC: Wood and Composition Flat Stock	1330207	0.946	LB	EACH	992	Employee
2401015000	SC: Wood and Composition Flat Stock	VOC	43	LB	EACH	992	Employee
2401020000	SC: Wood Furniture and Fixtures	VOC	244	LB	EACH	992	Employee
2401025000	SC: Metal Furniture	107211	3.474	LB	EACH	992	Employee
2401025000	SC: Metal Furniture	171	10.66904	LB	EACH	992	Employee
2401025000	SC: Metal Furniture	78933	27.792	LB	EACH	992	Employee
2401025000	SC: Metal Furniture	108101	64.076	LB	EACH	992	Employee
2401025000	SC: Metal Furniture	71556	6.176	LB	EACH	992	Employee
2401025000	SC: Metal Furniture	108883	20.072	LB	EACH	992	Employee
2401025000	SC: Metal Furniture	1330207	16.984	LB	EACH	992	Employee
2401025000	SC: Metal Furniture	VOC	772	LB	EACH	992	Employee
2401030000	SC: Paper, Film and Foil	107211	3.3075	LB	EACH	992	Employee
2401030000	SC: Paper, Film and Foil	171	10.1577	LB	EACH	992	Employee
2401030000	SC: Paper, Film and Foil	78933	26.46	LB	EACH	992	Employee
2401030000	SC: Paper, Film and Foil	108101	61.005	LB	EACH	992	Employee
2401030000	SC: Paper, Film and Foil	71556	5.88	LB	EACH	992	Employee
2401030000	SC: Paper, Film and Foil	108883	19.11	LB	EACH	992	Employee
2401030000	SC: Paper, Film and Foil	1330207	16.17	LB	EACH	992	Employee
2401030000	SC: Paper, Film and Foil	VOC	735	LB	EACH	992	Employee
2401040000	SC: Metal Cans	107211	10.467	LB	EACH	992	Employee
2401040000	SC: Metal Cans	171	32.14532	LB	EACH	992	Employee

SCC	Description	Pollutant Code	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Calculation Material Code	Material Description
2401040000	SC: Metal Cans	78933	83.736	LB	EACH	992	Employee
2401040000	SC: Metal Cans	108101	193.058	LB	EACH	992	Employee
2401040000	SC: Metal Cans	71556	18.608	LB	EACH	992	Employee
2401040000	SC: Metal Cans	108883	60.476	LB	EACH	992	Employee
2401040000	SC: Metal Cans	1330207	51.172	LB	EACH	992	Employee
2401040000	SC: Metal Cans	VOC	2,326	LB	EACH	992	Employee
2401045000	SC: Metal Sheet, Strip and Coils	VOC	2,877	LB	EACH	992	Employee
2401055000	SC: Machinery and Equipment	107211	0.4905	LB	EACH	992	Employee
2401055000	SC: Machinery and Equipment	171	1.50638	LB	EACH	992	Employee
2401055000	SC: Machinery and Equipment	78933	3.924	LB	EACH	992	Employee
2401055000	SC: Machinery and Equipment	108101	9.047	LB	EACH	992	Employee
2401055000	SC: Machinery and Equipment	71556	0.872	LB	EACH	992	Employee
2401055000	SC: Machinery and Equipment	108883	2.834	LB	EACH	992	Employee
2401055000	SC: Machinery and Equipment	1330207	2.398	LB	EACH	992	Employee
2401055000	SC: Machinery and Equipment	VOC	109	LB	EACH	992	Employee
2401060000	SC: Appliances	107211	1.1205	LB	EACH	992	Employee
2401060000	SC: Appliances	171	3.44118	LB	EACH	992	Employee
2401060000	SC: Appliances	78933	8.964	LB	EACH	992	Employee
2401060000	SC: Appliances	108101	20.667	LB	EACH	992	Employee
2401060000	SC: Appliances	71556	1.992	LB	EACH	992	Employee
2401060000	SC: Appliances	108883	6.474	LB	EACH	992	Employee
2401060000	SC: Appliances	1330207	5.478	LB	EACH	992	Employee
2401060000	SC: Appliances	VOC	249	LB	EACH	992	Employee
2401065000	SC: Electronic and Other Electrical Coatings	107211	0.11115	LB	EACH	992	Employee
2401065000	SC: Electronic and Other Electrical Coatings	171	0.341354	LB	EACH	992	Employee
2401065000	SC: Electronic and Other Electrical Coatings	78933	0.8892	LB	EACH	992	Employee
2401065000	SC: Electronic and Other Electrical Coatings	108101	2.0501	LB	EACH	992	Employee
2401065000	SC: Electronic and Other Electrical Coatings	71556	0.1976	LB	EACH	992	Employee
2401065000	SC: Electronic and Other Electrical Coatings	108883	0.6422	LB	EACH	992	Employee
2401065000	SC: Electronic and Other Electrical Coatings	1330207	0.5434	LB	EACH	992	Employee
2401065000	SC: Electronic and Other Electrical Coatings	VOC	24.7	LB	EACH	992	Employee
2401070000	SC: Motor Vehicles (including motor vehicle parts)	107211	0.738	LB	EACH	992	Employee
2401070000	SC: Motor Vehicles (including motor vehicle parts)	171	2.26648	LB	EACH	992	Employee
2401070000	SC: Motor Vehicles (including motor vehicle parts)	78933	5.904	LB	EACH	992	Employee

SCC	Description	Pollutant Code	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Calculation Material Code	Material Description
2401070000	SC: Motor Vehicles (including motor vehicle parts)	108101	13.612	LB	EACH	992	Employee
2401070000	SC: Motor Vehicles (including motor vehicle parts)	71556	1.312	LB	EACH	992	Employee
2401070000	SC: Motor Vehicles (including motor vehicle parts)	108883	4.264	LB	EACH	992	Employee
2401070000	SC: Motor Vehicles (including motor vehicle parts)	1330207	3.608	LB	EACH	992	Employee
2401070000	SC: Motor Vehicles (including motor vehicle parts)	VOC	164	LB	EACH	992	Employee
2401075000	SC: Aircraft	107211	0.0675	LB	EACH	992	Employee
2401075000	SC: Aircraft	171	0.2073	LB	EACH	992	Employee
2401075000	SC: Aircraft	78933	0.54	LB	EACH	992	Employee
2401075000	SC: Aircraft	108101	1.245	LB	EACH	992	Employee
2401075000	SC: Aircraft	71556	0.12	LB	EACH	992	Employee
2401075000	SC: Aircraft	108883	0.39	LB	EACH	992	Employee
2401075000	SC: Aircraft	1330207	0.33	LB	EACH	992	Employee
2401075000	SC: Aircraft	VOC	15	LB	EACH	992	Employee
2401080000	SC: Marine	107211	0.891	LB	EACH	992	Employee
2401080000	SC: Marine	171	2.73636	LB	EACH	992	Employee
2401080000	SC: Marine	78933	7.128	LB	EACH	992	Employee
2401080000	SC: Marine	108101	16.434	LB	EACH	992	Employee
2401080000	SC: Marine	71556	1.584	LB	EACH	992	Employee
2401080000	SC: Marine	108883	5.148	LB	EACH	992	Employee
2401080000	SC: Marine	1330207	4.356	LB	EACH	992	Employee
2401080000	SC: Marine	VOC	198	LB	EACH	992	Employee
2401085000	SC: Railroads	107211	0.999	LB	EACH	992	Employee
2401085000	SC: Railroads	171	3.06804	LB	EACH	992	Employee
2401085000	SC: Railroads	78933	7.992	LB	EACH	992	Employee
2401085000	SC: Railroads	108101	18.426	LB	EACH	992	Employee
2401085000	SC: Railroads	71556	1.776	LB	EACH	992	Employee
2401085000	SC: Railroads	108883	5.772	LB	EACH	992	Employee
2401085000	SC: Railroads	1330207	4.884	LB	EACH	992	Employee
2401085000	SC: Railroads	VOC	222	LB	EACH	992	Employee
2401090000	SC: Misc. Manufacturing	107211	0.612	LB	EACH	992	Employee
2401090000	SC: Misc. Manufacturing	171	1.87952	LB	EACH	992	Employee
2401090000	SC: Misc. Manufacturing	78933	4.896	LB	EACH	992	Employee
2401090000	SC: Misc. Manufacturing	108101	11.288	LB	EACH	992	Employee
2401090000	SC: Misc. Manufacturing	71556	1.088	LB	EACH	992	Employee
2401090000	SC: Misc. Manufacturing	108883	3.536	LB	EACH	992	Employee
2401090000	SC: Misc. Manufacturing	1330207	2.992	LB	EACH	992	Employee
2401090000	SC: Misc. Manufacturing	VOC	136	LB	EACH	992	Employee
2401200000	SC: Other Special Purpose Coatings	107211	0.0000315	LB	EACH	762	Person
2401200000	SC: Other Special Purpose Coatings	171	0.0000967	LB	EACH	762	Person
2401200000	SC: Other Special Purpose Coatings	78933	0.000252	LB	EACH	762	Person
2401200000	SC: Other Special Purpose Coatings	108101	0.000581	LB	EACH	762	Person
2401200000	SC: Other Special Purpose Coatings	71556	0.000056	LB	EACH	762	Person

SCC	Description	Pollutant Code	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Calculation Material Code	Material Description
2401200000	SC: Other Special Purpose Coatings	108883	0.000182	LB	EACH	762	Person
2401200000	SC: Other Special Purpose Coatings	1330207	0.000154	LB	EACH	762	Person
2401200000	SC: Other Special Purpose Coatings	VOC	0.007	LB	EACH	762	Person
2415000000	Cleaning Products: Industrial and Institutional	79016	0.2092418	LB	EACH	992	Employee
2415000000	Cleaning Products: Industrial and Institutional	VOC	30.5	LB	EACH	992	Employee
2420000000	Dry Cleaning	VOC	467	LB	EACH	992	Employee
2425000000	Graphic Arts	107211	0.0163326	LB	EACH	762	Person
2425000000	Graphic Arts	67561	0.1633260	LB	EACH	762	Person
2425000000	Graphic Arts	78933	0.0391982	LB	EACH	762	Person
2425000000	Graphic Arts	108101	0.0097996	LB	EACH	762	Person
2425000000	Graphic Arts	108883	0.1665924	LB	EACH	762	Person
2425000000	Graphic Arts	1330207	0.0424647	LB	EACH	762	Person
2425000000	Graphic Arts	VOC	4.4	LB	EACH	762	Person
2425000000	Graphic Arts	107211	5.5011136	LB	EACH	992	Employee
2425000000	Graphic Arts	67561	55.011136	LB	EACH	992	Employee
2425000000	Graphic Arts	78933	13.202673	LB	EACH	992	Employee
2425000000	Graphic Arts	108101	3.3006682	LB	EACH	992	Employee
2425000000	Graphic Arts	108883	56.111359	LB	EACH	992	Employee
2425000000	Graphic Arts	1330207	14.302895	LB	EACH	992	Employee
2425000000	Graphic Arts	VOC	1,482	LB	EACH	992	Employee
2460100000	Personal Care Products (Cosmetics and Toiletries)	67561	0.255436	LB	EACH	762	Person
2460100000	Personal Care Products (Cosmetics and Toiletries)	108883	0.005092	LB	EACH	762	Person
2460100000	Personal Care Products (Cosmetics and Toiletries)	VOC	1.9	LB	EACH	762	Person
2460200000	Cleaning Products: Household	67561	0.241992	LB	EACH	762	Person
2460200000	Cleaning Products: Household	108883	0.004824	LB	EACH	762	Person
2460200000	Cleaning Products: Household	VOC	1.8	LB	EACH	762	Person
2460400000	Automotive Aftermarket (Transportation: Motor Vehicles)	67561	0.1828384	LB	EACH	762	Person
2460400000	Automotive Aftermarket (Transportation: Motor Vehicles)	108883	0.0036448	LB	EACH	762	Person
2460400000	Automotive Aftermarket (Transportation: Motor Vehicles)	VOC	1.36	LB	EACH	762	Person
2460500000	Coatings and Related Products	67561	0.127718	LB	EACH	762	Person
2460500000	Coatings and Related Products	108883	0.002546	LB	EACH	762	Person
2460500000	Coatings and Related Products	VOC	0.95	LB	EACH	762	Person
2460600000	Adhesives and Sealants	67561	0.0766308	LB	EACH	762	Person
2460600000	Adhesives and Sealants	108883	0.0015276	LB	EACH	762	Person
2460600000	Adhesives and Sealants	VOC	0.57	LB	EACH	762	Person
2460800000	FIFRA Regulated Products	67561	0.2393032	LB	EACH	762	Person
2460800000	FIFRA Regulated Products	108883	0.0047704	LB	EACH	762	Person
2460800000	FIFRA Regulated Products	VOC	1.78	LB	EACH	762	Person

SCC	Description	Pollutant Code	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Calculation Material Code	Material Description
2460900000	Miscellaneous Products	67561	0.0094108	LB	EACH	762	Person
2460900000	Miscellaneous Products	108883	0.0001876	LB	EACH	762	Person
2460900000	Miscellaneous Products	VOC	0.07	LB	EACH	762	Person

Emission Factors Which Vary Based on Presence of Controls

SCC	Pollutant Code	Factor Numeric Value Uncontrolled	Factor Numeric Value Controlled	Factor Unit Numerator	Factor Unit Denominator	Calculation Material Code	Material Description
2401001000	123911	6.18E-05	4.82E-05	LB	EACH	762	Person
2401001000	584849	6.18E-05	4.82E-05	LB	EACH	762	Person
2401001000	101688	0.000433	0.000337	LB	EACH	762	Person
2401001000	75070	0.000309	0.000241	LB	EACH	762	Person
2401001000	117817	9.27E-05	7.23E-05	LB	EACH	762	Person
2401001000	98828	0.001174	0.000916	LB	EACH	762	Person
2401001000	84742	6.18E-05	4.82E-05	LB	EACH	762	Person
2401001000	131113	3.09E-05	2.41E-05	LB	EACH	762	Person
2401001000	100414	0.007663	0.005977	LB	EACH	762	Person
2401001000	107211	0.156014	0.121681	LB	EACH	762	Person
2401001000	50000	6.18E-05	4.82E-05	LB	EACH	762	Person
2401001000	171	0.063809	0.049767	LB	EACH	762	Person
2401001000	110543	0.000464	0.000362	LB	EACH	762	Person
2401001000	67561	0.031147	0.024293	LB	EACH	762	Person
2401001000	80626	0.000371	0.000289	LB	EACH	762	Person
2401001000	71556	0.02883	0.022485	LB	EACH	762	Person
2401001000	108101	0.009301	0.007254	LB	EACH	762	Person
2401001000	78933	0.041684	0.032511	LB	EACH	762	Person
2401001000	75092	0.018447	0.014388	LB	EACH	762	Person
2401001000	91203	0.001421	0.001109	LB	EACH	762	Person
2401001000	100425	0.003152	0.002458	LB	EACH	762	Person
2401001000	127184	0.000185	0.000145	LB	EACH	762	Person
2401001000	108883	0.072059	0.056201	LB	EACH	762	Person
2401001000	121448	0.000185	0.000145	LB	EACH	762	Person
2401001000	108054	0.000371	0.000289	LB	EACH	762	Person
2401001000	1330207	0.088096	0.068709	LB	EACH	762	Person
2401001000	VOC	3.09	2.41	LB	EACH	762	Person
2401100000	107211	0.00495	0.000675	LB	EACH	762	Person
2401100000	171	0.015202	0.002073	LB	EACH	762	Person
2401100000	71556	0.0088	0.0012	LB	EACH	762	Person
2401100000	108101	0.0913	0.01245	LB	EACH	762	Person
2401100000	78933	0.0396	0.0054	LB	EACH	762	Person
2401100000	108883	0.0286	0.0039	LB	EACH	762	Person
2401100000	1330207	0.0242	0.0033	LB	EACH	762	Person
2401100000	VOC	1.1	0.15	LB	EACH	762	Person

States to Which Controlled Emission Factors are Applied

State FIPS	Abbreviation
04	AZ
06	CA
09	CT

10	DE
11	DC
23	ME
24	MD
25	MA
33	NH
34	NJ
36	NY
42	PA
44	RI
48	TX
50	VT
51	VA

3.2.3.23 Gasoline Distribution Stage I

a. Source Category Description

Stage I gasoline distribution includes the following gasoline emission points: 1) bulk terminals; 2) pipeline facilities; 3) bulk plants; 4) tank trucks; and 5) service stations. Emissions from Stage I gasoline distribution occur as gasoline vapors are released into the atmosphere. These Stage I processes are subject to EPA's maximum available control technology (MACT) standards for gasoline distribution.[1]

Emissions from gasoline distribution at bulk terminals and bulk plants take place when gasoline is loaded into a storage tank or tank truck, from working losses (for fixed roof tanks), and from working losses and roof seals (for floating roof tanks). Working losses consist of both breathing and emptying losses. Breathing losses are the expulsion of vapor from a tank vapor space that has expanded or contracted because of daily changes in temperature and barometric pressure; these emissions occur in the absence of any liquid level change in the tank. Emptying losses occur when the air that is drawn into the tank during liquid removal saturates with hydrocarbon vapor and expands, thus exceeding the fixed capacity of the vapor space and overflowing through the pressure vacuum valve.[2]

Emissions from tank trucks in transit occur when gasoline vapor evaporates from (1) loaded tank trucks during transportation of gasoline from bulk terminals/plants to service stations, and (2) empty tank trucks returning from service stations to bulk terminals/plants.[3] Pipeline emissions result from the valves and pumps found at pipeline pumping stations and from the valves, pumps, and storage tanks at pipeline breakout stations. Stage I gasoline distribution emissions also occur when gasoline vapors are displaced from storage tanks during unloading of gasoline from tank trucks at service stations (Gasoline Service Station Unloading) and from gasoline vapors evaporating from service station storage tanks and from the lines going to the pumps (Underground Storage Tank Breathing and Emptying).

The following SCCs are included in Stage I Gasoline Distribution:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501050120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Terminals: All Evaporative Losses	Gasoline
2501055120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Plants: All Evaporative Losses	Gasoline
2501060051	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Submerged Filling
2501060052	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Splash Filling

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501060053	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Balanced Submerged Filling
2501060201	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Underground Tank: Breathing and Emptying
2505030120	Storage and Transport	Petroleum and Petroleum Product Transport	Truck	Gasoline
2505040120	Storage and Transport	Petroleum and Petroleum Product Transport	Pipeline	Gasoline

b. Bulk Terminals and Pipelines

There are no generally accepted activity-based VOC emission factors for the pipelines and bulk terminals sectors because they are generally treated as point sources whose emissions are estimated using site-specific information. For example, emission estimates for bulk terminal storage tanks are typically derived from tank specific parameters that are input into the TANKS program.[4] Therefore, for bulk terminals and pipelines, EPA estimated 2008 national VOC emissions by multiplying 1998 national estimates developed in support of the Gasoline Distribution MACT standard[5] by the 2008 to 1998 ratio of the national volume of wholesale gasoline supplied (see table below). The gasoline supply information was obtained from the corresponding table below in Volume I of Petroleum Supply Annual 2008.[6]

Estimation of National 2008 VOC Emissions for Pipelines and Bulk Terminals

Category	1998 Post-MACT Control Emissions (Mg)	Mg to Ton Conversion Factor	1998 Emissions (tons)	Ratio of 2008 to 1998 Gasoline Supplied	2008 Emissions (tons)
Pipelines	79,830	1.1023	87,997	(8,989 thousand barrels per day / 8,253 thousand barrels per day) = 1.089	95,844
Bulk Terminals	137,555	1.1023	151,627		165,149

To estimate HAP emissions, EPA applied national average speciation profiles to the VOC emission estimates.[7] The corresponding table below presents these speciation profiles and the national bulk terminal and pipeline HAP emission estimates (note that unless otherwise noted, all emission values reported in this section exclude estimates for Puerto Rico and the U.S. Virgin Islands). EPA used total VOC emission estimates, so emissions represent total emissions. Where necessary, States should perform point source subtractions to obtain nonpoint emissions. The following describes how total national VOC estimates were allocated to counties.

HAP Speciation Profiles and 2008 Bulk Terminal and Pipeline Emissions

HAP	Pollutant Code	Percentage of VOC Emissions	Reference	2008 National Emissions (tons)	
				Bulk Terminals	Pipelines
Benzene	71432	0.27	7	4.46E+02	2.59E+02
2,2,4-Trimethylpentane	540841	0.75	7	1.24E+03	7.19E+02
Cumene	98828	0.012	7	1.98E+01	1.15E+01
Ethyl Benzene	100414	0.053	7	8.75E+01	5.08E+01
n-Hexane	110543	1.8	7	2.97E+03	1.73E+03
Naphthalene	91203	0.00027	7	4.46E-01	2.59E-01
Toluene	108883	1.4	7	2.31E+03	1.34E+03
Xylenes	1330207	0.56	7	9.25E+02	5.37E+02

For both categories, EPA allocated national VOC and HAP emissions for these categories in a two-step manner. First, EPA allocated emissions based on 2008 gasoline supply data reported by the U.S. Department of Energy (DOE). Next, EPA allocated emissions based on employment data reported in the 2007 County Business Patterns.[8]

For pipelines, EPA allocated emissions to Petroleum Administration for Defense (PAD) Districts based on the total amount of finished motor gasoline moved by pipeline in each PAD in year 2008. There are five PAD Districts across the United States. PAD District 1 comprises seventeen states plus the District of Columbia along the Atlantic Coast; PAD District 2 comprises fifteen states in the Midwest; PAD District 3 comprises six states in South Central U.S.; PAD District 4 comprises five states in the Rocky Mountains; and PAD District 5 comprises seven states along the West Coast. These data, which are displayed in the corresponding table below, are reported in Table 35 of Volume 1 of Petroleum Supply Annual 2008.[9] Next, EPA allocated pipeline emissions in each PAD District to counties based on County Business Patterns employment data. Because employment data for NAICS code 48691 (Pipeline Transportation of Refined Petroleum Products) are often withheld due to confidentiality reasons, EPA used the number of employees in NAICS code 42471 (Petroleum Bulk Stations and Terminals) for this allocation. To better account for the location of refined petroleum pipelines, however, EPA did not allocate any activity to States which had employees in this NAICS code, but did not have employees in NAICS code 48691 (i.e., District of Columbia, Idaho, Maine, New Hampshire, Vermont, and West Virginia).

Movement of Finished Motor Gasoline by Pipeline Between PAD Districts, 2008

	From I	From II	From III	From IV	From V
To I	n/a	393	333,462	0	0
To II	70,895	n/a	99,167	7,442	0
To III	0	9,193	n/a	0	0
To IV	0	8,680	5,778	n/a	0
To V	0	0	25,453	9,287	n/a

For bulk terminals, EPA first allocated national emissions to States based on the 2008 refinery, bulk terminal, and natural gas plant stocks of motor gasoline reported for each State in Table 33 of Volume 1 of DOE's Petroleum Supply Annual 2008 (see the corresponding table below).[9] Next, EPA allocated emissions in each State to counties based on the number of NAICS code 42471 (Petroleum Bulk Stations and Terminals) employees reported in the 2007 County Business Patterns.[8]

Refinery, Bulk Terminal, and Natural Gas Plant Stocks of Motor Gasoline, 2008

State	Motor Gasoline (Thousand Barrels)	State	Motor Gasoline (Thousand Barrels)
Alabama	1,090	Montana	872
Alaska	616	Nebraska	658
Arizona	470	Nevada	102
Arkansas	819	New Hampshire	0
California	460	New Jersey	2,956
Colorado	748	New Mexico	350
Connecticut	0	New York	1,469
Delaware	105	North Carolina	1,724
District of Columbia	0	North Dakota	291
Florida	1,877	Ohio	2,724
Georgia	1,724	Oklahoma	1,245
Hawaii	12	Oregon	525
Idaho	181	Pennsylvania	3,595
Illinois	1,940	Rhode Island	0
Indiana	2,464	South Carolina	720
Iowa	1,090	South Dakota	283
Kansas	2,347	Tennessee	923
Kentucky	1,045	Texas	9,530
Louisiana	5,209	Utah	793
Maine	374	Vermont	31
Maryland	31	Virginia	1,285
Massachusetts	0	Washington	1,902
Michigan	1,772	West Virginia	183
Minnesota	1,305	Wisconsin	704
Mississippi	1,580	Wyoming	910
Missouri	491		

It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to bulk terminal and pipeline processes. To obtain nonpoint emissions, States should subtract the

2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in the tables.

Pipeline Point Source SCCs

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40600501	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pipeline Leaks
40600502	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pipeline Venting
40600503	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pump Station
40600504	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pump Station Leaks

Bulk Terminal Point Source SCCs

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40400101	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank
40400102	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank
40400103	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank
40400104	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank
40400105	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40400106	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Breathing Loss (250000 Bbl Capacity) - Fixed Roof Tank
40400107	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Working Loss (Diam. Independent) - Fixed Roof Tank
40400108	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Working Loss (Diameter Independent) - Fixed Roof Tank
40400109	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Working Loss (Diameter Independent) - Fixed Roof Tank
40400110	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss (67000 Bbl Capacity)-Floating Roof Tank
40400111	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss (67000 Bbl Capacity)-Floating Roof Tank
40400112	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss (67000 Bbl Capacity)- Floating Roof Tank
40400113	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank
40400114	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank
40400115	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40400116	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk
40400117	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss (250000 Bbl Cap.) - Float Rf Tnk
40400118	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
40400119	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
40400120	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
40400131	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal
40400132	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal
40400133	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal
40400141	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400142	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400143	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - Ext. Floating Roof w/ Secondary Seal

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40400148	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal)
40400150	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Miscellaneous Losses/Leaks: Loading Racks
40400151	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Valves, Flanges, and Pumps
40400152	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Vapor Collection Losses
40400153	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Vapor Control Unit Losses
40400161	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal
40400162	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal
40400163	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal
40400171	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400172	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400173	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400178	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal)

c. Bulk Plants

EPA calculated VOC emissions from bulk plants by developing an average emission factor from the bulk plant motor gasoline VOC emissions and throughput data developed

in support of the Gasoline Distribution MACT standards.[2,5] To estimate 2008 national VOC emissions, the VOC emission factor (8.62 pounds of VOC per 1,000 gallons) was applied to the estimated national volume of gasoline passing through bulk plants in 2008. The volume of bulk plant gasoline throughput was assumed to be 9 percent of total gasoline consumption.[10] Total gasoline consumption for 2008 was assumed to be the same as the volume of finished motor gasoline supplied as reported on the U.S. Energy Information Administration's Petroleum Navigator website.[11] The resulting national VOC emission estimate was then allocated to counties based on employment data for NAICS code 42471 (Petroleum Bulk Stations and Terminals). To estimate benzene emissions from bulk plants, EPA multiplied VOC emission estimates by county-level speciation profiles calculated from the annual onroad refueling (Stage 2) emissions from the 2008 NEI NMIM results.[12] All other HAPs were estimated by multiplying VOC emissions by the national average speciation profiles displayed in the corresponding table below.

Bulk Plant HAP Speciation Profiles and Total Emission Estimates

Pollutant	Pollutant Code	Emission Factor	Reference	National Emissions (tpy)
VOC	VOC	8.62 lb./1,000 gallons	2 and 5	5.35E+04
2,2,4-Trimethylpentane	540841	0.75% of VOC	7	4.01E+02
Cumene	98828	0.012% of VOC	7	6.41E+00
Ethyl Benzene	100414	0.053% of VOC	7	2.83E+01
n-Hexane	110543	1.8% of VOC	7	9.62E+02
Naphthalene	91203	0.00027% of VOC	7	1.44E-01
Toluene	108883	1.4% of VOC	7	7.48E+02
Xylenes	1330207	0.56% of VOC	7	2.99E+02
Benzene	71432	county-specific % of VOC	12	3.94E+02

It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to bulk plants. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in the table below.

Bulk Plant Point Source SCCs

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40400201	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank
40400202	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40400203	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank
40400204	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank
40400205	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank
40400206	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank
40400207	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank
40400208	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank
40400209	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank
40400210	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk
40400211	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
40400212	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
40400213	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40400231	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal
40400232	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal
40400233	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal
40400241	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400242	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400243	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400248	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10/13/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal)
40400250	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Loading Racks
40400251	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Valves, Flanges, and Pumps
40400252	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Miscellaneous Losses/Leaks: Vapor Collection Losses
40400253	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Miscellaneous Losses/Leaks: Vapor Control Unit Losses
40400261	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal
40400262	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40400263	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal
40400271	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400272	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400273	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400278	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10/13/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal)
40400401	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 13: Breathing Loss
40400402	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 13: Working Loss
40400403	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 10: Breathing Loss
40400404	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 10: Working Loss
40400405	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 7: Breathing Loss
40400406	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 7: Working Loss
40600101	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Splash Loading **
40600126	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading **

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40600131	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading (Normal Service)
40600136	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Splash Loading (Normal Service)
40600141	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading (Balanced Service)
40600144	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Splash Loading (Balanced Service)
40600147	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading (Clean Tanks)

d. Tank Trucks in Transit

The EPA calculated VOC emissions from Tank Trucks in Transit by multiplying county-level tank truck gasoline throughput by a 0.06 lb of VOC per 1,000 gallon emission factor. As noted in the corresponding table below, this emission factor is the sum of the individual emission factors reported in the Gasoline Distribution EIIP guidance document for gasoline-filled trucks (traveling to service station/bulk plant for delivery) and vapor-filled trucks (traveling to bulk terminal/plant for reloading).[3] County-level gasoline consumption was estimated by summing county-level onroad and nonroad estimates. County-level onroad consumption was estimated by subtracting the NMIM-derived national nonroad consumption from the EIA's estimate of finished motor gasoline supplied and then allocating to counties using NMIM-derived onroad county-level CO_2 emissions.[11,13] County-level nonroad consumption was estimated by allocating NMIM-derived state/SCC-level nonroad gasoline consumption to the county-level based on nonroad county/SCC-level CO_2 emissions.[13] Gasoline throughput for tank trucks was computed by multiplying the county-level gasoline consumption estimates by a factor of 1.09 to account for gasoline that is transported more than once in a given area (i.e., transported from bulk terminal to bulk plant and then from bulk plant to service station).[10] Benzene emission estimates were calculated by multiplying county-level NMIM speciation profiles by the VOC emission estimates.[12] Emissions for the remaining HAPs were calculated by multiplying VOC emissions by the national speciation profiles presented in the corresponding table below.

Tank Trucks in Transit VOC Emission Factors

VOC Emission Factor	
Vapor-Filled Trucks	0.055 lb/1,000 gallons
Gasoline Filled Trucks	0.005 lb/1,000 gallons
Total	**0.06 lb/1,000 gallons**

Tank Trucks in Transit HAP Speciation Profiles and Total Emission Estimates

Pollutant	Pollutant Code	Emission Factor	Reference	National Emissions (tpy)
VOC	VOC	0.06 lb./1,000 gallons	3	4.51E+03
2,2,4-Trimethylpentane	540841	0.75% of VOC	7	3.38E+01
Cumene	98828	0.012% of VOC	7	5.41E-01
Ethyl Benzene	100414	0.053% of VOC	7	2.39E+00
n-Hexane	110543	1.8% of VOC	7	8.11E+01
Naphthalene	91203	0.00027% of VOC	7	1.22E-02
Toluene	108883	1.4% of VOC	7	6.31E+01
Xylenes	1330207	0.56% of VOC	7	2.52E+01
Benzene	71432	county-specific % of VOC	12	3.13E+01

It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to tank trucks in transit. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in the table below.

Tank Trucks in Transit Point Source SCCs

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40400154	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Tank Truck Vapor Leaks
40400254	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Tank Truck Vapor Losses
40600162	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Loaded with Fuel (Transit Losses)
40600163	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Return with Vapor (Transit Losses)

e. Underground Storage Tank (UST) Breathing and Emptying

The EPA calculated VOC emissions from UST breathing and emptying by multiplying county-level total gasoline consumption, calculated as described above in the Tank Trucks in Transit section, by the 1 lb/1,000 gallons emission factor recommended by the Gasoline Distribution EIIP guidance document.[3] With the exception of benzene, HAP emissions were estimated by multiplying VOC emissions by the national HAP speciation profiles listed in the corresponding table below. To estimate benzene emissions, EPA multiplied VOC emissions by county-level speciation profiles from NMIM.[12]

Underground Storage Tank (UST) Breathing and Emptying Emissions

Pollutant	Pollutant Code	Emission Factor	Reference	National Emissions (tpy)
VOC	VOC	1 lb./1,000 gallons	3	6.89E+04
2,2,4-Trimethylpentane	540841	0.75% of VOC	7	5.17E+02
Cumene	98828	0.012% of VOC	7	8.27E+00
Ethyl Benzene	100414	0.053% of VOC	7	3.65E+01
n-Hexane	110543	1.8% of VOC	7	1.24E+03
Naphthalene	91203	0.00027% of VOC	7	1.86E-01
Toluene	108883	1.4% of VOC	7	9.65E+02
Xylenes	1330207	0.56% of VOC	7	3.86E+02
Benzene	71432	county-specific % of VOC	12	4.78E+02

It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to UST breathing and emptying. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in the table below.

UST Breathing and Emptying Point Source SCCs

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40600307	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Underground Tank Breathing and Emptying
40600707	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I	Underground Tank Breathing and Emptying

f. Gasoline Service Station Unloading

The EPA estimated uncontrolled VOC emissions from unloading of gasoline into service station tanks from county-level total gasoline consumption estimates, calculated as described above in the Tank Trucks in Transit section, and the following AP-42 equation:

$$L = (12.46 \times S \times P \times M)/T$$

where:

L	=	uncontrolled loading loss of liquid loaded (in lb/1,000 gallons)
S	=	saturation factor;
P	=	true vapor pressure of liquid loaded (pounds per square inch absolute);
M	=	molecular weight of vapors (lbs per lb/mole); and
T	=	temperature of liquid loaded (Rankine).[14]

This equation requires geographic-specific information. This information includes the saturation factor, which differs by method of loading (e.g., submerged filling), Reid vapor pressure (RVP), temperature, and true vapor pressure of gasoline.

Gasoline RVP values were obtained from the NMIM 2008 database. Because NMIM is a county-level database that reports RVP values by month, EPA developed county-level monthly gasoline consumption estimates by multiplying annual county gasoline consumption by monthly allocation factors. State-level monthly allocation factors were developed from monthly gasoline sales data reported in the Federal Highway Administration's Highway Statistics 2008.[15] Geographic-specific information on the temperature of gasoline and the method of loading were obtained from a Stage I and II gasoline emission inventory study prepared for the EIIP.[16]

The true vapor pressure of gasoline was estimated for each county/month using the following equation:

where:

P	=	Stock true vapor pressure, in pounds per square inch absolute.
T	=	Stock temperature, in degrees Fahrenheit.
RVP	=	Reid vapor pressure, in pounds per square inch.
S	=	Slope of the ASTM distillation curve at 10 percent evaporated, in degrees Fahrenheit per percent (assumed that S = 3.0 for gasoline per Figure 7.1-14a of AP-42).[17]

This equation was used to calculate monthly county-level true vapor pressure estimates. In cases where more than one filling method was assumed to apply in a county (e.g., due to vapor balancing requirement applying to a portion of a county's total gasoline throughput due to a throughput exemption), EPA developed two sets of calculations for each month, one for each filling method.

The EIIP study regional stock temperature information was used to estimate the temperature of gasoline in each county in each month (see the corresponding table below).[16]

Temperature Data Used in Estimating True Vapor Pressure (ºF)

Region	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1 (Northeast)	46	44	44	48	57	64	70	73	70	64	60	51
2 (Southeast)	66	67	69	74	78	81	80	81	80	77	69	60
3 (Southwest)	60	61	62	66	73	78	81	84	82	78	71	62
4 (Midwest)	33	35	40	47	55	62	71	73	68	65	64	63
5 (West)	50	52	62	66	73	76	80	83	86	84	73	60
6 (Northwest)	49	50	50	52	57	62	67	72	68	60	49	42

Region 1: Alaska, Connecticut, Delaware, DC, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia, Wisconsin
Region 2: Alabama, Arkansas, Florida, Georgia, Hawaii, Louisiana, Mississippi, N. Carolina, S. Carolina, Tennessee
Region 3: Arizona, New Mexico, Oklahoma, Texas
Region 4: Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, N. Dakota, S. Dakota, Wyoming
Region 5: California, Nevada, Utah
Region 6: Idaho, Oregon, Washington

The EPA incorporated the effect of Stage I Gasoline Service Station vapor balancing controls based on the county-level control efficiency values (either 90 or 95 percent) that were compiled for the EIIP study.[16] The corresponding table below presents the HAP speciation profiles and total VOC and HAP emission estimates calculated using these procedures.

Emissions are reported by SCC based on the filling methods used in each county as determined from the EIIP study: SCC 2501060051 (Submerged Filling); SCC 2501060052 (Splash Filling); and SCC 2501060053 (Balanced Submerged Filling).

Stage I Service Station Unloading HAP Speciation Profiles and Total Emission Estimates

Pollutant	Pollutant Code	Emission Factor	Reference	National Emissions (tpy)
VOC	VOC	Equation 1	14	3.82E+05
2,2,4-Trimethylpentane	540841	0.75% of VOC	7	2.86E+03
Cumene	98828	0.012% of VOC	7	4.58E+01
Ethyl Benzene	100414	0.053% of VOC	7	2.02E+02
n-Hexane	110543	1.8% of VOC	7	6.87E+03
Naphthalene	91203	0.00027% of VOC	7	1.03E+00
Toluene	108883	1.4% of VOC	7	5.35E+03
Xylenes	1330207	0.56% of VOC	7	2.14E+03
Benzene	71432	county-specific % of VOC	12	2.97E+03

It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to service station unloading. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in the corresponding tables below.

Service Station Unloading: Submerged Fill Point Source SCCs

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40600302	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Submerged Filling w/o Controls
40600702	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I	Submerged Filling w/o Controls

Service Station Unloading: Splash Fill Point Source SCCs

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40600301	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Splash Filling
40600701	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I	Splash Filling

Service Station Unloading: Balanced Submerged Fill Point Source SCCs

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40600305	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Unloading **
40600306	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Balanced Submerged Filling
40600706	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I	Balanced Submerged Filling

Unloading emissions might also be reported in the point source inventory under SCC 40600399 (Gasoline Retail Operations – Stage I, Not Classified).

g. Example Emission Calculations

Bulk Terminals
2008 national benzene emissions = VOC emissions x HAP speciation factor
1.65E+05 tons x 0.0027
4.46E+02 tons

Pipelines
2008 national cumene emissions = VOC emissions x HAP speciation factor
9.58E+04 tons x 0.00012
1.15E+01 tons

Bulk Plants
2008 national VOC emissions
= national gasoline consumption x proportion passing through bulk plants x VOC emission factor
= 137,801,370 thousand gallons x 0.09 x 8.62 lbs. VOC/thousand gallons
= 1.07E+08 lbs. / 2000 lbs.
= 5.35E+04 tons

Tank Trucks in Transit
2008 Alamance County, North Carolina VOC emissions
= total county gasoline consumption x (1+proportion of gasoline transported twice) x VOC emission factor
= 61,446 thousand gallons x (1+0.09) x 0.06 lbs. VOC/thousand gallons
= 4.02E+03 lbs. / 2000 lbs.
= 2.01E+00 tons

UST Breathing and Emptying
2008 Alamance County, North Carolina VOC emissions

= total county gasoline consumption x VOC emission factor
= 61,466 thousand gallons x 1 lb. VOC/thousand gallons
= 6.15E+04 lbs. / 2000 lbs.
= 30.73E+00 tons

Stage I Gasoline Service Station Unloading - uncontrolled VOC emissions in July for balanced submerged fill unloading in Alamance County, NC

= annual county consumption x proportion of annual gasoline sold in July x VOC emission factor
= 61,466 thousand gallons x 0.1087 x VOC emission factor
= 6,681 thousand gallons x ((12.46 x saturation factor x true vapor pressure x vapor molecular weight) / temperature))
= 6,681 thousand gallons x ((12.46 x 1.0 x 6.309 x 67.811) / 540)
= 65,950 lbs

Incorporate effect of control (vapor balancing requirement)

= Uncontrolled emissions x ((100-CE)/100)
= 65,950 lbs x ((100-90)/100)
= 6,595 lbs / 2,000 lbs
= 3.30E+00 tons

h. References

1. U.S. Environmental Protection Agency, "National Emission Standards for Source Categories: Gasoline Distribution (Stage I), 40 CFR Part 63." Office of Air Quality Planning and Standards, February 28, 1997. Pages 9087-9093.

2. U.S. Environmental Protection Agency, "Gasoline Distribution Industry (Stage I)-Background Information for Proposed Standards," EPA-453/R94-002a, Office of Air Quality Planning and Standards, January 1994.

3. Eastern Research Group, Inc., "Volume III: Chapter 11, Gasoline Marketing (Stage I and Stage II), Revised Final," prepared for the Emission Inventory Improvement Program, January 2001.

4. U.S. Environmental Protection Agency, "TANKS Emission Estimation Software," Office of Air Quality Planning and Standards, Emission Inventory

Group, available from http://www.epa.gov/ttn/chief/software/tanks/index.html, last updated October 29, 2004.

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6. U.S. Department of Energy, Energy Information Administration, "U.S. Daily Average Supply and Distribution of Crude Oil and Petroleum Products," Table 2 in *Petroleum Supply Annual 2008, Volume 1*, retrieved from http://www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_supply_annual/psa_volume1/psa_volume1.html, released June 2009.

7. Hester, Charles, MACTEC, Inc. Memorandum from Charles Hester, MACTEC, Inc., to Stephen Shedd, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Standards Division, "Review of Data on HAP Content in Gasoline," May 18, 2006.

8. U.S. Department of Commerce, Bureau of the Census, County Business Patterns 2007, retrieved from http://www.census.gov/econ/cbp/index.html, released July 2009.

9. U.S. Department of Energy, Energy Information Administration, "Refinery, Bulk Terminal, and Natural Gas Plant Stocks of Selected Petroleum Products by PAD District and State, 2008" and "Movements of Crude Oil and Petroleum Products by Pipeline Between PAD Districts, 2008," Tables 33 and 35 in *Petroleum Supply Annual 2008, Volume 1*, retrieved from http://www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_supply_annual/psa_volume1/psa_volume1.html, released June 2009.

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11. U.S. Department of Energy, Energy Information Administration, Petroleum Navigator – Product Supplied, available from http://tonto.eia.doe.gov/dnav/pet/pet_cons_psup_dc_nus_mbblpd_a.htm, accessed January 2010.

12. Benzene speciation profiles calculated by Jonathan Dorn, E.H. Pechan and Associates, Inc. from county-level VOC and benzene emissions developed from a 2008 NMIM run. The NMIM run was performed by John Van Bruggen, E.H. Pechan and Associates, Inc., January 2010.

13. 2008 NMIM runs performed by John Van Bruggen and Melissa Spivey, E.H. Pechan and Associates, Inc., January 2010.

14. U.S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 5.2 Transportation and Marketing of Petroleum Liquids," Office of Air Quality Planning and Standards, January 1995.

15. Federal Highway Administration, "Monthly Gasoline/Gasohol Reported by States," Table MF-33GA in *Highway Statistics 2008*, Office of Highway Policy Information, available from http://www.fhwa.dot.gov/policyinformation/statistics/2008/, accessed January 2010.

16. Pacific Environmental Services, Inc., "Draft Summary of the Analysis of the Emissions Reported in the 1999 NEI for Stage I and Stage II Operations at Gasoline Service Stations," prepared for the U.S. Environmental Protection Agency and the Emission Inventory Improvement Program, September 2002.

17. U.S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Chapter 7: Liquid Storage Tanks," Office of Air Quality Planning and Standards, Emission Inventory Group, September 1997.

3.2.3.24 Gasoline Distribution – Stage II

a. Source Category Description

Stage II gasoline distribution emissions are the refueling emissions that occur during the transfer of gasoline from storage tanks at service stations to vehicle fuel tanks.

Stage II emissions are reported under the following nonpoint SCC:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501060100	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 2: Total

This SCC is only used in the NEI to report emissions for onroad gasoline vehicle refueling. (Estimates for Stage II nonroad equipment gasoline refueling are included in the nonroad source inventory.)

b. Emissions Calculations

The VOC emission estimates for Stage II gasoline distribution in 2008 were generated via MOVES 2010a. The refueling vapor-loss and refueling spillage emission categories are defined in MOVES 2010a as emission processes 18 and 19. The MOVES runs performed as discussed in the on-road mobile source emission calculation section of this document included these two emission processes, but the emissions from these two emission processes were separated from the on-road mobile source emissions during the post-model emissions analysis. The 2008 annual Stage II gasoline distribution emissions for both vapor loss and spillage for each county in the Missouri portion of the St. Louis Ozone nonattainment area, as calculated with MOVES 2010a, are reported in the corresponding table below.

MOVES 2010a includes a default table for each county in the country called "countyyear". The "countyyear" table establishes values for the stage II control efficiencies in each county. The MOVES default control efficiencies for Stage II vapor loss and Stage II spillage emissions in the St. Louis Ozone nonattainment area are 95% and 50%, respectively. These default values were used when running the MOVES model for 2008.

Annual Refueling VOC Emissions

County	Annual Refueling VOC Emissions (tons/year)
Franklin County	18.34
Jefferson County	22.09
St. Charles County	32.9
St. Louis County	144.01
St. Louis City	41.88
Total	**259.21**

It is important to note that the above discussion addresses the calculation of total onroad VOC emissions from refueling. The 2008 point source NEI reports VOC emissions related to service station refueling. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in the table below.

Gasoline Vehicle Refueling Point Source SCCs

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
40600401	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Filling Vehicle Gas Tanks - Stage II	Vapor Loss w/o Controls
40600402	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Filling Vehicle Gas Tanks - Stage II	Liquid Spill Loss w/o Controls
40600499	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Filling Vehicle Gas Tanks - Stage II	Not Classified **
40600601	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage II	Vapor Loss w/o Controls
40600602	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage II	Liquid Spill Loss w/o Controls
40600603	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage II	Vapor Loss w/controls

c. References

1. 2008 NMIM runs performed by John Van Bruggen and Melissa Spivey, E.H. Pechan and Associates, Inc., January 2010.

2. Hester, Charles, MACTEC, Inc. Memorandum from Charles Hester, MACTEC, Inc., to Stephen Shedd, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Standards Division, "Review of Data on HAP Content in Gasoline," May 18, 2006.

3. Benzene speciation profiles calculated by Jonathan Dorn, E.H. Pechan and Associates, Inc. from county-level VOC and benzene emissions developed from a 2008 NMIM run. The NMIM run was performed by John Van Bruggen, E.H. Pechan and Associates, Inc., January 2010.

3.2.3.25 Fuel Combustion – Industrial and Commercial/Institutional (ICI)

The Central States Regional Planning Association (CENRAP) contracted with Pechan to provide an updated methodology to calculate ICI fuel combustion emissions for 2002, and make the methodology updatable for future inventory projects. Appendix E-3 is documentation of the ICI methodology and describes how it is applied to a revised 2002 inventory.

Statewide emissions are calculated using the fuel activity and emission factors, then statewide point source emission contributions are subtracted, and finally the emissions are allocated to counties. The Energy Information Administration's (EIA's) State Energy Data System (SEDS) provides total energy consumption by sector, but the values have to be adjusted by energy not used for combustion and nonroad equipment use. EIA's *2002 Manufacturing Energy Consumption Survey* (MECS) was used to get regional sectoral energy consumption that is not used for combustion. A run of the NONROAD model for 2006 provided the diesel and LPG quantity to subtract for commercial sector nonroad equipment. Emission factors from Roy Huntley of the EPA, the Emission Inventory improvement Plan (EIIP), and AP-42 cover the various fuel types for criteria pollutants. Emissions from coal combustion require the use of Missouri-specific coal sulfur content from the Energy Information Administration Quarterly Coal Report. Statewide point source emission contributions are subtracted by compiling the sector's CO emissions by Source Classification Code (SCC), which is fuel specific, back-calculating using AP-42 emission factors to a fuel throughput, and subtracting that fuel throughput from the statewide total. Before allocating the remaining nonpoint emissions to Missouri counties, an energy-intensity adjustment is done to account for the variation of energy used per employee for each industrial manufacturing NAICS code. *County Business Patterns* (CBP) published annually by the US Census Bureau outlines employment by NAICS codes and the energy-intensity per employee by NAICS code derived from EIA's 2002 Annual Energy Outlook. Emissions are then allocated to individual counties based on commercial/institutional employment by county and based on energy intensity and employment for the industrial sector.

Appendix E-3 outlines the activity data used, emission factors, and the calculation template spreadsheets for the categories below.

SCC	SCC Description
2102001000	Stationary Source Fuel Combustion; Industrial; Anthracite Coal; Total: All Boiler Types
2102002000	Stationary Source Fuel Combustion; Industrial; Bituminous/Subbituminous Coal; Total: All Boiler Types
2102004000	Stationary Source Fuel Combustion; Industrial; Distillate Oil; Total: Boilers and IC Engines
2102005000	Stationary Source Fuel Combustion; Industrial; Residual Oil; Total: All Boiler Types
2102006000	Stationary Source Fuel Combustion; Industrial; Natural Gas; Total: Boilers and IC Engines
2102007000	Stationary Source Fuel Combustion; Industrial; Liquid Petroleum Gas; Total: All Boiler Types
2102008000	Stationary Source Fuel Combustion; Industrial; Wood; Total: All Boiler Types
2102011000	Stationary Source Fuel Combustion; Industrial; Kerosene; Total: All Boiler Types
2103001000	Stationary Source Fuel Combustion; Commercial/Institutional; Anthracite Coal; Total: All Boiler Types
2103002000	Stationary Source Fuel Combustion; Commercial/Institutional; Bituminous/Subbituminous Coal; Total: All Boiler Types
2103004000	Stationary Source Fuel Combustion; Commercial/Institutional; Distillate Oil; Total: Boilers and IC Engines
2103005000	Stationary Source Fuel Combustion; Commercial/Institutional; Residual Oil; Total: All Boiler Types
2103006000	Stationary Source Fuel Combustion; Commercial/Institutional; Natural Gas; Total: Boilers and IC Engines
2103007000	Stationary Source Fuel Combustion; Commercial/Institutional; Liquid Petroleum Gas; Total: All Combustor Types
2103008000	Stationary Source Fuel Combustion; Commercial/Institutional; Wood; Total: All Boiler Types
2103011000	Stationary Source Fuel Combustion; Commercial/Institutional; Kerosene; Total: All Combustor Types

3.2.3.26 Fossil Fuel Combustion – Residential – Liquified Petroleum Gas (LPG)

a. Source Category Description

Residential LPG Combustion is liquefied propane gas that is burned in residential housing. Common uses of energy associated with this sector include space heating, water heating, and cooking.

The general approach to calculating emissions for this SCC is to take State LPG Consumption from the EIA and allocate it to the county level using methods described below. County level LPG consumption is multiplied by the emission factors to calculate emissions.

For this source category, the following SCC was assigned:

SCC	**Descriptor 1**	**Descriptor 3**	**Descriptor 6**	**Descriptor 8**
2104007000	Stationary Source Fuel Combustion	Residential	Liquefied Petroleum Gas (LPG)	Total: All Combustion Types

b. Activity Data

Residential liquefied petroleum gas (LPG) combustion emissions were calculated using the volume of LPG consumed in the United States. State-level LPG consumption by sector is available from the Energy Information Administration (EIA).[1] Year 2006 consumption data were used as a surrogate for 2008 emissions because these were the latest data available when this inventory was prepared.

State-level LPG consumption was allocated to each county using the US Census Bureau's 2000 Census Detailed Housing Information.[2] These data include the number of housing units using a specific type of fuel for residential heating. State LPG consumption was allocated to each county using the ratio of the number of houses burning LPG in each county to the total number of houses burning LPG in the State.

c. Control Factors

No control measures are assumed for this category.

d. Emission Factors

Pollutant emission factors for residential LPG are based on the residential natural gas emission factors.[3,4,5] For all counties in the United States, the natural gas consumed by residential combustion is assumed to have a heating value of 1,020 Btu per cubic foot and a sulfur content of 2,000 grains per million cubic feet.[3] Those natural gas emission factors originally presented in the units "pounds per million cubic feet" were converted to energy-based units using the 1,020 Btu/cubic foot conversion factor. Once all the natural gas emission factors were converted to energy-based units, the natural gas emission

factors were converted to LPG emission factors by multiplying by 96,750 Btu/gallon. Some emission factors were revised based on recommendations by an ERTAC advisory panel composed of state and EPA personnel.

e. Sample Calculations

Emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = FC_x \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for fuel type x and pollutant p,
FC_x = annual fuel consumption for fuel type x,
$EF_{x,p}$ = emission factor for fuel type x and pollutant p,

And $FC_x = A_{State}$ x (H_{county} / H_{State})

where :

A_{State} = State activity data from EIA
H_{County} = number of houses in the county using LPG as the primary heating fuel
H_{State} = number of houses in the state using LPG as the primary heating fuel.

Example:
Using Allegheny County, PA as an example:

The State of Pennsylvania had a reported use of 4,743 thousand barrels of LPG in the residential sector in 2006. Allegheny County, PA had 4,317 houses out of the state total of 145,254 that use LPG as the primary heating fuel. This equates to a share of 2.97% of the LPG used for residential heating in the state. From Table 1, CO emission factor is 159.6 lb/thousand barrels.

E_{CO} = 4,743 thousand barrels × (4,317 houses / 145,254 houses)
× 159.6 lb/thousand barrels

= 22,498 lb CO or 11.25 tons CO

f. References

1. U.S. Department of Energy, Energy Information Administration (EIA). State Energy Data 2006 Consumption. Washington, DC 2008. Internet address: http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_all_phy.csv, accessed November 2008.

2. U.S. Census Bureau. "Table H40. House Heating Fuel Type", Census 2000: Summary File 3. Internet address:

http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_submenuId=&_lang=en&_ts=, accessed July 2009.

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4. U.S. Environmental Protection Agency, Emission Factors and Inventory Group. "Documentation for the 1999 Base Year Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants." Prepared by Eastern Research Group, Inc. Morrisville, NC. September 2002.

5. U.S. Environmental Protection Agency. Emission Factor and Inventory Group. Final Summary of the Development and Results of a Methodology for Calculating Area Source Emissions from Residential Fuel Combustion. Prepared by Pacific Environmental Services, Inc. Research Triangle Park, NC. September 2002. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/draft1999_residfuel_inven_apr2003.zip accessed, November 2004.

National Criteria Pollutant and HAP Emission Factors for Residential LPG Combustion

Pollutant Code	Pollutant Code Description	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
129000	Pyrene	2.09151E-05	LB	E3BBL
206440	Fluoranthene	1.2549E-05	LB	E3BBL
50000	Formaldehyde	0.313726103	LB	E3BBL
71432	Benzene	0.008784331	LB	E3BBL
75070	Acetaldehyde	5.43792E-05	LB	E3BBL
85018	Phenanthrene	7.11113E-05	LB	E3BBL
86737	Fluorene	1.17124E-05	LB	E3BBL
91203	Naphthalene	0.002551639	LB	E3BBL
CO	CO	159.6	LB	E3BBL
NH3	Ammonia	1.95	LB	E3BBL
NOX	NOX	562.8	LB	E3BBL
PM10-FIL	PM10-FIL	0.796764706	LB	E3BBL
PM25-FIL	PM25-FIL	0.438220588	LB	E3BBL
PM-CON	PM-CON	1.274823529	LB	E3BBL
SO2	SO2	2.390294118	LB	E3BBL
VOC	VOC	21.91102941	LB	E3BBL

3.2.3.27 Fuel Combustion – Residential- Wood

EPA created the Residential Wood Combustion tool to assist states with compiling the 2005 NEI, and has updated the tool with new SCCs to reflect new equipment (certified/ non-certified inserts, outdoor hydronic heaters, wood pellet stoves), revised equipment population based on regional surveys and American Housing Survey (US Census) data, and wood use ratios.

The tool is a Microsoft Access database with data input tables for appliance types and population, fuel inputs, burn temporal profiles, and emission factors. Missouri had no state-specific updates to input files, so the EPA defaults for Missouri were used to calculate emissions. A specific query is ran that performs the calculation and outputs the emission table for the state or counties of interest.

3.2.4 Nonpoint Source Emission Summary

Table 11 STLNA Nonpoint Emissions (tons per year)

County Name	CO	NH_3	NO_X	PM_{10}-Pri	$PM_{2.5}$-Pri	SO_2	VOC
Franklin County	1,965.60	1,300.09	283.00	18,160.54	2,315.04	991.12	1,604.16
Jefferson County	3,892.87	165.26	383.49	27,912.02	3,428.01	904.61	3,116.32
St. Charles County	2,362.84	883.43	463.05	15,712.83	2,331.71	895.42	5,744.68
St. Louis County	7,352.19	1,036.69	2,219.83	28,858.70	4,584.76	5,445.70	20,110.91
St. Louis City	2,744.11	129.50	1,033.57	7,935.13	1,374.12	3,273.63	7,639.28
Totals	**18,317.61**	**3,514.98**	**4,382.94**	**98,579.22**	**14,033.64**	**11,510.48**	**38,215.34**

3.3 Mobile Source Emissions

3.3.1 Nonroad Mobile Sources

Nonroad categories include recreational marine and land-based vehicles, farm and construction machinery, industrial, commercial, logging, and lawn and garden equipment, and railway maintenance equipment. These equipment are powered by compression-ignition engines which are typically diesel-fueled, as well as spark-ignition (gasoline-fueled) engines. Compressed natural gas (CNG) and liquefied petroleum gas (LPG) engines may also power certain types of nonroad equipment.

3.3.1.1 Procedures and Methodologies

For nonroad gasoline, diesel, LPG and CNG sources, EPA's National Mobile Inventory Model (NMIM), incorporating the NONROAD2008 model, was used to calculate nonroad emissions. Using the fuel and meteorological data from the NCD, the NONROAD model was ran and created annual emissions for 2008. The Air Program followed the nonroad modeling protocol, which was submitted by EPA Region 7, except the oxygen weight percent was changed to 3.5% and the market share for ethanol was changed to 100%. This nonroad modeling protocol can be found in Appendix E-2 of this document. The data generated by the NONROAD model for Missouri counties in the St. Louis $PM_{2.5}$ nonattainment area are summarized in Table 12.

For aircraft, EPA ran the Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System (EDMS) using Bureau of Transportation Statistics (BTS) T-100 Landing and Takeoff (LTO) and Terminal Area Forecast (TAF) data. The state of Missouri did not provide alternate emissions or input data, so EPA calculations were accepted.

For commercial marine vehicles, EPA's Office of Transportation and Air Quality (OTAQ) provided emission estimates based on grown 2002 emissions and 2008 Locomotive and Marine federal rule making. Again, EPA emission estimates were accepted.

For locomotives, the Eastern Regional Technical Advisory Committee (ERTAC Rail) provided emission estimates based on fuel use data from the American Association of Railroads (AAR), Surface Transportation Board (STB) Annual Reports, and railroad provided fleet and activity information. These estimates were accepted by Missouri.

EPA generates emissions data for aircraft, commercial marine, and locomotive sources using a emission factor calculation method. In the NEI, aircraft emissions are listed as point sources while commercial marine and locomotive emissions are listed as nonpoint emissions. Therefore, 2008 NEI data for aircraft, commercial marine, and locomotive

emissions, which are listed as point and nonpoint emissions in the NEI data, need to be added to the nonroad mobile source category. See Section 3.3.1.3 for emission totals.

3.3.1.2 Source Category Documentation

The full documentation for nonroad categories follows in Appendix E-2.

3.3.1.3 Nonroad Source Emission Summary

Table 12 STLNA Nonroad Emissions by County (tons per year, excluding Aircraft, Marine, and Rail Emissions)

County Name	NH_3	NO_X	$PM_{2.5}$-Pri	SO_2	VOC
Franklin County	1.20	1,873.72	100.89	24.15	974.70
Jefferson County	0.96	979.85	79.01	16.95	903.31
St. Charles County	2.33	2,512.83	186.81	47.30	1,902.51
St. Louis County	6.87	7,448.64	564.57	213.81	6,305.86
St. Louis City	1.53	2,460.82	102.45	55.38	1,074.08
Totals	**12.89**	**15,275.86**	**1,033.73**	**357.59**	**11,160.46**

Table 13 STLNA Marine and Rail Emissions by County (tons per year)

County Name	NH_3	NO_X	$PM_{2.5}$-Pri	SO_2	VOC
Franklin County	0.54	1,182.00	37.04	12.20	59.87
Jefferson County	0.10	219.16	6.75	2.28	10.92
St. Charles County	0.25	527.37	17.55	9.53	25.78
St. Louis County	0.46	989.33	31.16	10.30	50.39
St. Louis City	0.68	1,617.28	50.12	45.56	72.17
Totals	**2.04**	**4,535.13**	**142.61**	**79.88**	**219.12**

Table 14 STLNA Aircraft Takeoff and Launch Emissions by County (tons per year)

County Name	NH_3	NO_X	$PM_{2.5}$-Pri	SO_2	VOC
Franklin County	0.06	0.86	0.19	0.18	1.64
Jefferson County	0.02	0.28	0.06	0.06	0.53
St. Charles County	0.24	3.53	0.73	0.72	6.45
St. Louis County	0.42	906.49	22.47	105.81	156.92
St. Louis City	0.00	0.41	0.03	0.07	0.41
Totals	**0.75**	**911.58**	**23.48**	**106.83**	**165.95**

Table 15 STLNA Total Nonroad Mobile Source Emissions by County (tons per year)

County Name	NH_3	NO_X	$PM_{2.5}$-Pri	SO_2	VOC
Franklin County	1.81	3,056.59	138.11	36.52	1,036.21
Jefferson County	1.08	1,199.29	85.82	19.29	914.76
St. Charles County	2.82	3,043.73	205.09	57.55	1,934.74
St. Louis County	7.75	9,344.46	618.20	329.93	6,513.17
St. Louis City	2.22	4,078.51	152.60	101.01	1,146.65
Totals	**15.68**	**20,722.57**	**1,199.82**	**544.30**	**11,545.53**

3.3.2 Onroad Mobile Sources

Onroad emission sources are also known as highway sources. They include vehicles used on roads for transportation of passengers or freight. The emissions from internal combustion engines in these vehicles are included in this category. Emissions of particulates entrained by the motion of the vehicle or road contact are included in the nonpoint category.

3.3.2.1 Mobile Model Choice

EPA released the Mobile Vehicle Emission System (MOVES) in December of 2010, and MOVES is now the official model to use for mobile emissions modeling. MOVES was chosen because it is the official model for future inventories and to ensure that grown 2022 emissions and budgets will be calculated consistently. 2008 mobile emissions were initially created using Mobile6.2 via NMIM for the St. Louis nonattainment area for the purpose of submitting state wide emissions data for EPA's 2008 National Emissions Inventory (NEI). The NMIM NCD input data was updated with Missouri specific information. Local VMT data, vehicle registration distributions, and meteorology data from the updated NCD were converted to MOVES formatting using EPA provided conversion workbooks.

MOVES is a completely redesigned model, not just an updated version of the previous Mobile model. The way MOVES calculates emissions has changed to reflect EPA's more current understanding of the emissions produced by vehicles and the various factors that affect the emissions. NO_X emissions were found to be higher because of the larger portion extended idling of heavy duty vehicles contributes to the emissions total. $PM_{2.5}$ emissions were also higher because of a better understanding of the effect of stop and go traffic, which has a significant impact on emissions in highly urban areas, such as the St. Louis nonattainment area. As a result of these changes to the model, MOVES produced higher emissions estimates for both 2008 and 2022 than were originally created with NMIM.

3.3.2.2 Mobile Model Inputs

Local VMT data was gathered from East-West Gateway at the county level. This data is listed in Table 16.

The road type distribution in the baseyearvmt table from the NCD was used to distribute the county level VMT to road type. EPA's VMT converter workbook was then used to produce MOVES input tables.

An age distribution for light duty vehicles was created from a list of Vehicle Identification Numbers (VINs) contained in vehicle registration records from the Missouri Department of Revenue. The VINs were decoded into model year and MOBILE6 vehicle classes by ESP Data Solutions, Inc, a private contractor. A specific

registration distribution was created for the five county Missouri portion of the St. Louis Nonattainment area. This data updated the BaseYearVMT Table and the CountyYear Table. The vehicle distribution was converted to MOVES age distribution table using EPA's VMT converter workbook. The registration data was also used to create the MOVES vehicle population input tables. Vehicle counts were converted from Mobile 6.2 vehicle classes to MOVES source types using the source type fractions from the Source Type Pop Fractions table in EPA's VMT converter workbook. The vehicle distribution is listed in Table 17.

MOVES base data was used for all other inputs, after reviewing the data to ensure accuracy. The base fuel supply tables in MOVES were used for the runs, as they already took into account the reformulated gasoline used in the St. Louis nonattainment area. A separate input database was created for each county, using county specific data where possible. The MOVES input tables, other than default EPA templates, are included in Table 18 through 38.

Table 16 2008 Vehicle Miles Traveled by County

County	2008 Annual VMT
Franklin	1,636,760,381
Jefferson	1,884,745,023
St. Charles	2,728,058,895
St. Louis	11,924,864,323
St. Louis City	3,450,450,085
Total	**21,624,878,706**

Table 17 Missouri Registration Distribution

Vehicle Class	Vehicle Model Year Population Percentage Per Vehicle Classification												
	2008	**2007**	**2006**	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**
LDV	0.0248	0.0564	0.0666	0.0649	0.0653	0.0632	0.0633	0.0679	0.0675	0.0652	0.0604	0.0501	0.0488
LDT1	0.0130	0.0345	0.0103	0.0666	0.0759	0.0255	0.0713	0.0780	0.0859	0.0487	0.0474	0.0398	0.0379
LDT2	0.0179	0.0593	0.0700	0.0750	0.0840	0.0759	0.0728	0.0808	0.0671	0.0640	0.0563	0.0522	0.0427
LDT3	0.0161	0.0734	0.0630	0.0760	0.0785	0.0842	0.0838	0.0728	0.0624	0.0539	0.0561	0.0365	0.0328
LDT4	0.0153	0.0843	0.1358	0.0771	0.0953	0.1119	0.0736	0.0461	0.0564	0.0549	0.0715	0.0395	0.0342
HDV2b	0.0078	0.0468	0.0483	0.0729	0.0660	0.0808	0.0871	0.0713	0.0773	0.0671	0.0642	0.0310	0.0519
HDV3	0.0066	0.0628	0.0602	0.0961	0.0876	0.0681	0.0715	0.0613	0.0774	0.0669	0.0734	0.0272	0.0331
HDV4	0.0040	0.0200	0.0638	0.0404	0.0338	0.0366	0.0385	0.0413	0.0653	0.0781	0.0821	0.0383	0.0630
HDV5	0.0187	0.1207	0.0664	0.0804	0.0535	0.0639	0.0560	0.0450	0.0578	0.0951	0.0899	0.0465	0.0572
HDV6	0.0311	0.0355	0.1005	0.0865	0.0529	0.0268	0.0212	0.0199	0.0840	0.0765	0.0685	0.0572	0.0591
HDV7	0.0182	0.0324	0.1250	0.1080	0.1033	0.0772	0.0847	0.0669	0.0285	0.0427	0.0285	0.0253	0.0281
HDV8a	0.0136	0.0110	0.0524	0.0497	0.0565	0.0513	0.0420	0.0301	0.0426	0.0791	0.0570	0.0386	0.0354
HDV8b	0.0189	0.0726	0.2263	0.0348	0.0639	0.0957	0.0899	0.0552	0.0522	0.1363	0.0697	0.0305	0.0203
HDBS	0.0343	0.0556	0.0925	0.0556	0.1004	0.0587	0.0623	0.0351	0.0489	0.0657	0.0669	0.0678	0.0426
HDBT	0.0060	0.0045	0.0132	0.0144	0.0138	0.0291	0.0378	0.0258	0.0249	0.0390	0.0351	0.0309	0.0351
MC	0.0190	0.0646	0.1035	0.1096	0.1172	0.0874	0.0922	0.0713	0.0610	0.0435	0.0360	0.0255	0.0208
	1995	**1994**	**1993**	**1992**	**1991**	**1990**	**1989**	**1988**	**1987**	**1986**	**1985**	**1984**	
LDV	0.0390	0.0420	0.0313	0.0274	0.0213	0.0184	0.0138	0.0121	0.0083	0.0065	0.0049	0.0106	
LDT1	0.0443	0.0211	0.0168	0.0210	0.0189	0.0193	0.0184	0.0363	0.0582	0.0433	0.0250	0.0426	
LDT2	0.0292	0.0287	0.0266	0.0215	0.0157	0.0149	0.0096	0.0096	0.0076	0.0054	0.0042	0.0090	
LDT3	0.0322	0.0423	0.0338	0.0207	0.0181	0.0106	0.0112	0.0104	0.0070	0.0067	0.0058	0.0117	
LDT4	0.0201	0.0158	0.0145	0.0101	0.0074	0.0055	0.0052	0.0063	0.0074	0.0045	0.0014	0.0059	
HDV2b	0.0350	0.0393	0.0244	0.0196	0.0151	0.0122	0.0124	0.0154	0.0097	0.0062	0.0102	0.0280	
HDV3	0.0266	0.0340	0.0223	0.0165	0.0122	0.0126	0.0134	0.0118	0.0126	0.0096	0.0098	0.0264	
HDV4	0.0504	0.0723	0.0647	0.0308	0.0247	0.0243	0.0238	0.0270	0.0198	0.0121	0.0128	0.0321	
HDV5	0.0517	0.0217	0.0147	0.0083	0.0067	0.0110	0.0113	0.0125	0.0080	0.0012	0.0000	0.0018	
HDV6	0.0557	0.0389	0.0134	0.0152	0.0093	0.0162	0.0292	0.0196	0.0184	0.0240	0.0062	0.0342	
HDV7	0.0253	0.0321	0.0174	0.0202	0.0158	0.0166	0.0139	0.0226	0.0162	0.0178	0.0103	0.0230	
HDV8a	0.0333	0.0786	0.0447	0.0381	0.0239	0.0228	0.0291	0.0360	0.0277	0.0261	0.0163	0.0641	
HDV8b	0.0087	0.0015	0.0015	0.0029	0.0044	0.0044	0.0029	0.0044	0.0000	0.0000	0.0015	0.0015	
HDBS	0.0489	0.0327	0.0185	0.0146	0.0106	0.0095	0.0114	0.0173	0.0024	0.0035	0.0032	0.0410	
HDBT	0.0830	0.0836	0.0492	0.0441	0.0267	0.0399	0.0609	0.0333	0.0558	0.0540	0.0351	0.1248	
MC	0.0189	0.0171	0.0122	0.0119	0.0073	0.0063	0.0063	0.0064	0.0054	0.0068	0.0097	0.0401	

Table 18 2008 Source Type Population

			Source Type Population by County				
YearID	**SourceTypeName**	**SourceTypeID**	**Franklin**	**Jefferson**	**St Charles**	**St Louis County**	**St Louis City**
2008	Motorcycle	11	6,067	13,018	11,151	19,243	3104
2008	Passenger Car	21	46,568	98,009	144,441	527,148	125,776
2008	Passenger Truck	31	45,890	82,509	110,386	303,296	59,406
2008	Light Commercial Truck	32	16,769	28,421	35,913	97,845	20,194
2008	Refuse Truck	41	8	41	36	94	70
2008	Single Unit Short-haul Truck	42	25	123	106	280	208
2008	Single Unit Long-haul Truck	43	302	541	549	2,709	661
2008	Motor Home	51	22	19	19	50	16
2008	School Bus	52	814	901	1,020	3,624	1,249
2008	Transit Bus	53	61	67	76	270	93
2008	Intercity Bus	54	44	71	82	379	143
2008	Combination Short-haul Truck	61	370	324	328	791	248
2008	Combination Long-haul Truck	62	307	257	258	545	160

Table 19 2008 Annual VMT by HPMS Vehicle Type, County, and Year

			HPMSBaseYearVMT by County				
HPMSVtypeID	**HPMSVtypeName**	**YearID**	**Franklin**	**Jefferson**	**St. Charles**	**St. Louis**	**St. Louis City**
10	Motorcycles	2008	11,619,323	13,841,651	20,770,584	91,989,970	26,665,063
20	Passenger Cars	2008	707,169,172	811,173,607	1,171,243,667	5,115,865,231	1,477,495,621
30	Other 2 axle-4 tire vehicles	2008	799,130,600	924,394,839	1,342,595,411	5,875,722,138	1,702,465,533
40	Buses	2008	4,781,820	5,578,789	8,183,119	35,928,481	10,469,862
50	Single Unit Trucks	2008	29,351,955	33,386,793	47,634,481	207,228,073	59,856,119
60	Combination Trucks	2008	84,673,330	96,333,716	137,528,782	598,448,609	173,536,046

Table 20 Age Distribution by Source Type

	Source Type ID												
AgeID	**11**	**21**	**31**	**32**	**41**	**42**	**43**	**51**	**52**	**53**	**54**	**61**	**62**
0	0.019	0.0248	0.016038	0.015215	0.006	0.006	0.03372	0.019407	0.022549	0.022677	0.024421	0.018826	0.017834
1	0.0646	0.0564	0.059034	0.058508	0.0045	0.0045	0.054157	0.048521	0.039325	0.03937	0.032671	0.049995	0.052613
2	0.1035	0.0666	0.063189	0.062229	0.0132	0.0132	0.092687	0.158149	0.129508	0.130555	0.106219	0.16227	0.169835
3	0.1096	0.0649	0.073971	0.073529	0.0144	0.0144	0.057163	0.057986	0.082002	0.084645	0.091592	0.052692	0.04403
4	0.1172	0.0653	0.081725	0.079405	0.0138	0.0138	0.098055	0.068814	0.07432	0.076743	0.07138	0.066656	0.063479
5	0.0874	0.0632	0.072225	0.07206	0.0291	0.0291	0.05743	0.075516	0.060754	0.062113	0.04642	0.077218	0.080584
6	0.0922	0.0633	0.075227	0.075017	0.0378	0.0378	0.060728	0.071294	0.059753	0.061551	0.046468	0.072242	0.074392
7	0.0713	0.0679	0.075731	0.074101	0.0258	0.0258	0.034794	0.048222	0.045101	0.04668	0.038418	0.04791	0.047775
8	0.061	0.0675	0.069095	0.069315	0.0249	0.0249	0.049567	0.050551	0.053801	0.053336	0.05744	0.050259	0.049622
9	0.0435	0.0652	0.059343	0.060606	0.039	0.039	0.065329	0.101607	0.075238	0.074281	0.059218	0.106403	0.114631
10	0.036	0.0604	0.056546	0.058019	0.0351	0.0351	0.065952	0.060365	0.052757	0.052173	0.04901	0.061907	0.064481
11	0.0255	0.0501	0.045379	0.044021	0.0309	0.0309	0.066337	0.035034	0.038694	0.038608	0.041544	0.03448	0.033479
12	0.0208	0.0488	0.040069	0.041299	0.0351	0.0351	0.042714	0.030037	0.038252	0.038379	0.043733	0.028628	0.026173
13	0.0189	0.039	0.031719	0.032547	0.083	0.083	0.048635	0.022609	0.033622	0.033505	0.041779	0.020871	0.017769
14	0.0171	0.042	0.029341	0.030746	0.0836	0.0836	0.033323	0.026945	0.032499	0.031744	0.038573	0.026434	0.025331
15	0.0122	0.0313	0.025132	0.025766	0.0492	0.0492	0.018302	0.014853	0.01522	0.015277	0.015313	0.014766	0.014626
16	0.0119	0.0274	0.020261	0.020238	0.0441	0.0441	0.01489	0.014543	0.016624	0.016485	0.018482	0.014281	0.013778
17	0.0073	0.0213	0.01591	0.015912	0.0267	0.0267	0.010657	0.011093	0.012019	0.01218	0.012215	0.010861	0.010491
18	0.0063	0.0184	0.014002	0.013972	0.0399	0.0399	0.009968	0.011696	0.014667	0.014636	0.016859	0.011229	0.010394
19	0.0063	0.0138	0.011117	0.011398	0.0609	0.0609	0.012691	0.012448	0.018417	0.017168	0.026192	0.012123	0.011221
20	0.0064	0.0121	0.014109	0.014268	0.0333	0.0333	0.018084	0.014903	0.019136	0.018141	0.024946	0.014734	0.014172
21	0.0054	0.0083	0.015761	0.015219	0.0558	0.0558	0.00363	0.01022	0.014831	0.014247	0.019752	0.009773	0.008829
22	0.0068	0.0065	0.011686	0.011205	0.054	0.054	0.00501	0.010636	0.017272	0.016478	0.024234	0.009966	0.008574
23	0.0097	0.0049	0.00791	0.008124	0.0351	0.0351	0.003627	0.006385	0.007661	0.00744	0.00919	0.006293	0.006072
24	0.013837	0.003694	0.00582	0.006825	0.022815	0.022815	0.003017	0.003218	0.003631	0.003569	0.004095	0.003185	0.003108
25	0.019738	0.002785	0.004029	0.004856	0.01483	0.01483	0.002668	0.001864	0.001955	0.001889	0.002204	0.001885	0.001903
26	0.006525	0.002099	0.002201	0.002308	0.009639	0.009639	0.002379	0.001137	0.001109	0.001082	0.001162	0.001156	0.001183
27	0	0.001582	0.001069	0.001073	0.006266	0.006266	0.00214	0.00071	0.000645	0.000647	0.000595	0.000721	0.000739
28	0	0.00044	0.000253	0.000245	0.004073	0.004073	0.001953	0.000417	0.000378	0.000362	0.000398	0.000432	0.000454
29	0	0	0.000147	0.000139	0.002647	0.002647	0.001784	0.00024	0.000223	0.000197	0.000282	0.000256	0.000278
30	0	0	0.001957	0.001836	0.064531	0.064531	0.028609	0.010581	0.018036	0.013841	0.035194	0.011546	0.012147

Table 21 Inspection and Maintenance Data for 2008

Pol Process ID	State ID	Year ID	Source Type ID	Fuel Type ID	IM Program ID	Inspect Freq.	Test Standards ID	Beg Model Year ID	End Model Year ID	Use IM Y/N	Compliance Factor
101	29	2008	21	1	1	1	11	1971	1995	N	93.12
101	29	2008	21	1	10	2	51	1996	2006	Y	97.94
101	29	2008	31	1	1	1	11	1971	1995	N	93.12
101	29	2008	31	1	10	2	51	1996	2006	Y	92.06
101	29	2008	32	1	1	1	11	1971	1995	N	93.12
101	29	2008	32	1	10	2	51	1996	2006	Y	86.18
102	29	2008	21	1	1	1	11	1971	1995	N	93.12
102	29	2008	21	1	10	2	51	1996	2006	Y	97.94
102	29	2008	31	1	1	1	11	1971	1995	N	93.12
102	29	2008	31	1	10	2	51	1996	2006	Y	92.06
102	29	2008	32	1	1	1	11	1971	1995	N	93.12
102	29	2008	32	1	10	2	51	1996	2006	Y	86.18
112	29	2008	21	1	7	1	41	1971	1995	N	93.12
112	29	2008	21	1	8	2	43	1996	2006	Y	97.94
112	29	2008	31	1	7	1	41	1971	1995	N	93.12
112	29	2008	31	1	8	2	43	1996	2006	Y	92.06
112	29	2008	32	1	7	1	41	1971	1995	N	93.12
112	29	2008	32	1	8	2	43	1996	2006	Y	86.18
113	29	2008	21	1	7	1	41	1971	1995	N	93.12
113	29	2008	21	1	8	2	43	1996	2006	Y	97.94
113	29	2008	31	1	7	1	41	1971	1995	N	93.12
113	29	2008	31	1	8	2	43	1996	2006	Y	92.06
113	29	2008	32	1	7	1	41	1971	1995	N	93.12
113	29	2008	32	1	8	2	43	1996	2006	Y	86.18
201	29	2008	21	1	1	1	11	1971	1995	N	93.12
201	29	2008	21	1	10	2	51	1996	2006	Y	97.94
201	29	2008	31	1	1	1	11	1971	1995	N	93.12
201	29	2008	31	1	10	2	51	1996	2006	Y	92.06

Pol Process ID	State ID	Year ID	Source Type ID	Fuel Type ID	IM Program ID	Inspect Freq.	Test Standards ID	Beg Model Year ID	End Model Year ID	Use IM Y/N	Compliance Factor
201	29	2008	32	1	1	1	11	1971	1995	N	93.12
201	29	2008	32	1	10	2	51	1996	2006	Y	86.18
202	29	2008	21	1	1	1	11	1971	1995	N	93.12
202	29	2008	21	1	10	2	51	1996	2006	Y	97.94
202	29	2008	31	1	1	1	11	1971	1995	N	93.12
202	29	2008	31	1	10	2	51	1996	2006	Y	92.06
202	29	2008	32	1	1	1	11	1971	1995	N	93.12
202	29	2008	32	1	10	2	51	1996	2006	Y	86.18
301	29	2008	21	1	10	2	51	1996	2006	Y	97.94
301	29	2008	31	1	10	2	51	1996	2006	Y	92.06
301	29	2008	32	1	10	2	51	1996	2006	Y	86.18
302	29	2008	21	1	10	2	51	1996	2006	Y	97.94
302	29	2008	31	1	10	2	51	1996	2006	Y	92.06
302	29	2008	32	1	10	2	51	1996	2006	Y	86.18

Table 22 Fuel Formulation for 2008

Fuel FormulationID	Fuel SubtypeID	FuelSubtypeDesc	RVP	Sulfur Level	ETOH Volume	MTBE Volume	ETBE Volume	TAME Volume	Aromatic Content	Olefin Content
2302	12	Gasohol (E10)	11.2917	43.0622	10	0	0	0	20.2606	8.39154
2303	12	Gasohol (E10)	8.75115	46.6452	10	0	0	0	18.9623	8.14345
2304	12	Gasohol (E10)	6.84571	49.3325	10	0	0	0	17.9886	7.95739
2305	12	Gasohol (E10)	13.1972	40.375	10	0	0	0	21.2343	8.57759
20043	20	Conventional Diesel	0	43	0	0	0	0	0	0

Fuel FormulationID	Fuel SubtypeID	fuelSubtypeDesc	Benzene Content	e200	e300	biodiesel EsterVolume	cetaneIndex	PAHContent
2302	12	Gasohol (E10)	0.848747	56.4983	84.16	0	0	0
2303	12	Gasohol (E10)	0.763743	53.3414	85.1429	0	0	0
2304	12	Gasohol (E10)	0.69999	50.9738	85.88	0	0	0
2305	12	Gasohol (E10)	0.9125	58.8659	83.4229	0	0	0
20043	20	Conventional Diesel	0	0	0	0	0	0

Table 23 2008 Fuel Supply

FuelYearID	Month GroupID	Fuel FormulationID	Market Share	Market ShareCV
2008	1	2305	1	0.5
2008	1	20043	1	0.5
2008	2	20043	1	0.5
2008	2	2302	1	0.5
2008	3	2302	1	0.5
2008	3	20043	1	0.5
2008	4	20043	1	0.5
2008	4	2303	1	0.5
2008	5	2303	1	0.5
2008	5	20043	1	0.5
2008	6	20043	1	0.5
2008	6	2304	1	0.5
2008	7	2304	1	0.5
2008	7	20043	1	0.5
2008	8	20043	1	0.5
2008	8	2304	1	0.5
2008	9	2304	1	0.5
2008	9	20043	1	0.5
2008	10	20043	1	0.5
2008	10	2303	1	0.5
2008	11	2302	1	0.5
2008	11	20043	1	0.5
2008	12	20043	1	0.5
2008	12	2302	1	0.5

Table 24 Franklin County Road Type Distribution for 2008

Source Type ID	Road Type ID	Road Type VMT Fraction
11	1	0
11	2	0.090246
11	3	0.553444
11	4	0.087268
11	5	0.269042
21	1	0
21	2	0.084309
21	3	0.591423
21	4	0.079558
21	5	0.24471
31	1	0
31	2	0.08262
31	3	0.588941
31	4	0.083327
31	5	0.245112
32	1	0
32	2	0.082331
32	3	0.589795
32	4	0.082902
32	5	0.244973
41	1	0
41	2	0.091642
41	3	0.578893
41	4	0.092985
41	5	0.23648
42	1	0
42	2	0.091642
42	3	0.578893
42	4	0.092985
42	5	0.23648
43	1	0
43	2	0.090795
43	3	0.580059
43	4	0.092167
43	5	0.236979

Source Type ID	Road Type ID	Road Type VMT Fraction
51	1	0
51	2	0.083482
51	3	0.602647
51	4	0.081432
51	5	0.232438
52	1	0
52	2	0.079374
52	3	0.604049
52	4	0.077497
52	5	0.23908
53	1	0
53	2	0.079998
53	3	0.603836
53	4	0.078094
53	5	0.238072
54	1	0
54	2	0.077187
54	3	0.604795
54	4	0.075403
54	5	0.242615
61	1	0
61	2	0.084046
61	3	0.602455
61	4	0.081972
61	5	0.231527
62	1	0
62	2	0.084887
62	3	0.602168
62	4	0.082778
62	5	0.230167

Table 25 Jefferson County Road Type Distribution for 2008

Source Type ID	Road Type ID	Road Type VMT Fraction
11	1	0
11	2	0.027299
11	3	0.327775
11	4	0.296743
11	5	0.348182
21	1	0
21	2	0.026499
21	3	0.363795
21	4	0.280746
21	5	0.32896
31	1	0
31	2	0.025738
31	3	0.359148
31	4	0.288448
31	5	0.326666
32	1	0
32	2	0.02567
32	3	0.359993
32	4	0.287549
32	5	0.326787
41	1	0
41	2	0.028299
41	3	0.349837
41	4	0.3093
41	5	0.312563
42	1	0
42	2	0.028299
42	3	0.349837
42	4	0.3093
42	5	0.312563
43	1	0
43	2	0.028073
43	3	0.351082
43	4	0.307413
43	5	0.313432

Source Type ID	Road Type ID	Road Type VMT Fraction
51	1	0
51	2	0.026449
51	3	0.373764
51	4	0.284734
51	5	0.315052
52	1	0
52	2	0.025151
52	3	0.3747
52	4	0.27602
52	5	0.32413
53	1	0
53	2	0.025348
53	3	0.374558
53	4	0.277343
53	5	0.322751
54	1	0
54	2	0.02446
54	3	0.375196
54	4	0.271382
54	5	0.328963
61	1	0
61	2	0.026628
61	3	0.373636
61	4	0.28593
61	5	0.313806
62	1	0
62	2	0.026894
62	3	0.373444
62	4	0.287715
62	5	0.311948

Table 26 St. Charles County Road Type Distribution for 2008

Source Type ID	Road Type ID	Road Type VMT Fraction
11	1	0
11	2	0.008501
11	3	0.083985
11	4	0.423865
11	5	0.483649
21	1	0
21	2	0.011445
21	3	0.096868
21	4	0.416825
21	5	0.474863
31	1	0
31	2	0.010109
31	3	0.095047
31	4	0.426164
31	5	0.46868
32	1	0
32	2	0.010244
32	3	0.09535
32	4	0.425148
32	5	0.469258
41	1	0
41	2	0.011811
41	3	0.091364
41	4	0.453393
41	5	0.443432
42	1	0
42	2	0.011811
42	3	0.091364
42	4	0.453393
42	5	0.443432
43	1	0
43	2	0.009959
43	3	0.092097
43	4	0.451928
43	5	0.446017

Source Type ID	Road Type ID	Road Type VMT Fraction
51	1	0
51	2	0.010872
51	3	0.100661
51	4	0.428451
51	5	0.460016
52	1	0
52	2	0.010809
52	3	0.100965
52	4	0.41471
52	5	0.473516
53	1	0
53	2	0.010819
53	3	0.100919
53	4	0.416797
53	5	0.471465
54	1	0
54	2	0.010769
54	3	0.101128
54	4	0.407389
54	5	0.480715
61	1	0
61	2	0.010881
61	3	0.10062
61	4	0.430335
61	5	0.458165
62	1	0
62	2	0.010893
62	3	0.100557
62	4	0.433146
62	5	0.455404

Table 27 St. Louis County Road Type Distribution for 2008

Source Type ID	Road Type ID	Road Type VMT Fraction
11	1	0
11	2	0.00113
11	3	0.011837
11	4	0.460448
11	5	0.526585
21	1	0
21	2	0.001544
21	3	0.015158
21	4	0.459076
21	5	0.524222
31	1	0
31	2	0.001361
31	3	0.01387
31	4	0.46841
31	5	0.516359
32	1	0
32	2	0.001379
32	3	0.014014
32	4	0.467447
32	5	0.51716
41	1	0
41	2	0.001583
41	3	0.015108
41	4	0.496442
41	5	0.486867
42	1	0
42	2	0.001583
42	3	0.015108
42	4	0.496442
42	5	0.486867
43	1	0
43	2	0.001336
43	3	0.013582
43	4	0.495108
43	5	0.489975

Source Type ID	Road Type ID	Road Type VMT Fraction
51	1	0
51	2	0.001472
51	3	0.015096
51	4	0.473646
51	5	0.509786
52	1	0
52	2	0.001464
52	3	0.015054
52	4	0.458621
52	5	0.524861
53	1	0
53	2	0.001465
53	3	0.015061
53	4	0.460904
53	5	0.52257
54	1	0
54	2	0.001459
54	3	0.015026
54	4	0.450614
54	5	0.532901
61	1	0
61	2	0.001473
61	3	0.015102
61	4	0.475707
61	5	0.507719
62	1	0
62	2	0.001475
62	3	0.01511
62	4	0.47878
62	5	0.504636

Table 28 St. Louis City Road Type Distribution for 2008

Source Type ID	Road Type ID	Road Type VMT Fraction
11	1	0
11	2	0
11	3	0
11	4	0.408066
11	5	0.591934
21	1	0
21	2	0
21	3	0
21	4	0.408529
21	5	0.591471
31	1	0
31	2	0
31	3	0
31	4	0.419349
31	5	0.580651
32	1	0
32	2	0
32	3	0
32	4	0.41824
32	5	0.58176
41	1	0
41	2	0
41	3	0
41	4	0.455165
41	5	0.544835
42	1	0
42	2	0
42	3	0
42	4	0.455165
42	5	0.544835
43	1	0
43	2	0
43	3	0
43	4	0.452405
43	5	0.547595

Source Type ID	Road Type ID	Road Type VMT Fraction
51	1	0
51	2	0
51	3	0
51	4	0.426701
51	5	0.573299
52	1	0
52	2	0
52	3	0
52	4	0.40783
52	5	0.59217
53	1	0
53	2	0
53	3	0
53	4	0.410705
53	5	0.589295
54	1	0
54	2	0
54	3	0
54	4	0.397721
54	5	0.602279
61	1	0
61	2	0
61	3	0
61	4	0.429279
61	5	0.570721
62	1	0
62	2	0
62	3	0
62	4	0.433119
62	5	0.566881

Table 29 Average Monthly Temperatures by Hour of the Day for Franklin County in Fahrenheit

	MonthID											
HourID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	25.8	29	39.1	48.4	55.9	68.2	70.9	67.1	60.6	49	38.4	24.7
2	24.8	27.4	37	46.4	54.7	67.1	69.6	66.2	60.8	47.9	38.4	24.7
3	23.8	26.3	35.8	45	53.6	66	68.8	65.4	60	47.1	37.5	24
4	22.8	25.3	34.5	44.1	52.6	65	68.1	64.8	59.1	46.5	36.8	23.5
5	22	24.9	33.5	43.2	51.7	64.1	67.5	63.9	58.6	45.7	36	23
6	21.4	24.2	32.6	42.7	51.1	63.5	66.8	63.4	58.2	45.1	35.3	22.5
7	21.2	23.8	32.1	42.7	52.6	65.7	68.2	63.9	57.9	44.6	34.7	22.8
8	21	23.4	32.4	45.3	56.2	69.3	71.4	67.6	60	45.9	34.2	22.3
9	22.2	24.9	36.4	48.9	59.6	72.9	75.2	71.7	63.8	50.9	37.1	23.8
10	26.6	27.8	40.5	52.5	63.2	76.2	78.5	75.7	67.8	56	41.5	27.4
11	31.2	31.1	44.7	55.7	66.4	79	81.3	78.9	71.4	60.5	45.6	31.7
12	36	34.3	48.5	58.5	68.8	81.3	83.6	81.2	74.4	63.9	49.3	36.1
13	39.6	37.2	51.7	61.5	70.6	83	85.6	82.9	76.5	66.1	51.9	39.7
14	42.4	39.5	53.9	63.3	72.1	84.3	87	84.1	77.9	67.5	54	42.2
15	44	41	55.6	64.9	73.6	85.1	88	84.9	78.7	68.4	55.1	43.9
16	44.4	41.6	56.3	65.8	74.3	85.5	88.1	85.1	78.7	68.5	55.1	44.1
17	43.2	41.4	56.1	65.6	74.3	85.2	87.7	84.7	77.9	67.4	53.7	42.2
18	39.4	39.9	54.8	64.6	73.3	84.1	86.7	83.3	75.8	64.2	50.1	37.8
19	35.2	37	51.7	62.1	71.3	82.3	84.6	80.4	71.3	58.9	46.8	34.4
20	32.8	34.9	47.9	58.2	67.3	79	81	75.9	67	55.9	44.8	32
21	31	33.6	45.7	55.6	63.2	74.6	76.9	72.5	65.1	54.1	43.1	30.1
22	29.6	32.2	43.9	53.4	60.7	72.2	75	70.6	63.8	52.7	41.9	28.4
23	28.2	30.9	42.3	51.5	58.9	70.7	73.4	69.2	62.5	51.3	40.7	27.1
24	27.2	29.9	40.5	50	57.2	69.3	72.1	68.1	61.4	50.2	39.5	25.7

Table 30 Average Monthly Percent Relative Humidity by Hour of the Day for Franklin County

	MonthID											
HourID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	68.3	76	71.8	70.6	77	78.3	83.9	86.1	88.2	77	68.9	69.9
2	69	77.2	72.8	72.9	77.2	80.2	84.4	86.9	88.5	78.7	70.3	71.8
3	70.1	78	73.9	74.5	78.2	81.6	85.3	87.5	89.2	79.8	71.7	72.9
4	70.9	78.3	75.3	75.3	79.3	82.4	86.1	88.1	90.1	80.4	72.8	73.8
5	71.8	78.3	76.8	76.1	80.5	83.8	86.4	89.3	90.4	81.6	73.9	75.1
6	72.3	78.9	77.6	77	81.1	84.4	87.3	89.6	90.4	82.5	75	75.7
7	72	78.8	78.2	77.6	80.3	83	85.8	89	90.4	83.4	75.9	76.1
8	72	78.8	78.3	74.5	76.2	77.9	81.4	84.9	89.5	83.2	76.5	76
9	71.2	77.6	74.8	69.8	71.5	72.4	74.9	77.5	84.7	76.8	74.3	75.2
10	66.9	74.3	69.7	64.8	65.8	66.9	69.3	70.2	77.2	67.7	68.4	72.4
11	62	70.4	63.5	61.1	61.1	62.1	64.5	64.2	70.5	59.4	62.1	68.4
12	56.8	67	58.7	58.2	58.1	58.2	60.9	60	64.6	53.3	56.5	64.8
13	53	63.8	54.8	55	56.3	55.4	57.9	57.2	60.9	49.9	52.7	62.1
14	50.2	61.5	52.6	53	55.1	53.7	55.8	55.4	58.3	47.7	49.4	60.2
15	48.4	60	51	51.1	53.1	52.2	54.6	54.2	56.8	46.3	47.6	58.7
16	47.3	59.4	50.7	49.7	52.5	51.5	54.4	54	56.6	46	47.1	58
17	47.9	59.8	50.7	49.1	51.7	51.5	55.1	54.9	58.1	47.2	48.4	59.2
18	51.2	61.6	52.5	49.9	52.1	52.8	56.7	57.6	62.8	52.3	52.9	62.9
19	55.5	65.4	56.2	52.8	54.6	55.5	61.1	63.5	72.5	61.5	57.2	65.6
20	58.3	68.2	61	57.5	60.3	61.6	68.4	72.7	80.5	66.9	60	67
21	60.6	70.1	63.9	60.8	66.3	68.8	75.3	78.4	83.9	69.6	62.5	67.6
22	62.8	72	66.3	63.9	70.3	72.8	78.3	81.9	85.3	71.9	64.4	68.3
23	64.5	73.7	68.2	66.4	73.1	75	80.7	83.8	86.4	73.7	65.9	68.7
24	66.1	75.1	70.3	68.3	75.4	77	82.3	85.2	87.6	75.6	67.6	69.1

Table 31 Average Monthly Temperatures by Hour of the Day for Jefferson County in Fahrenheit

	MonthID											
HourID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	25.6	28.3	38.5	47.4	55	68.3	70.1	67	60.2	48.6	37.5	24.2
2	24.7	26.8	36.3	45.5	53.8	67.3	68.8	66.1	60.4	47.7	37.3	24.2
3	23.7	25.7	35.2	44.3	52.8	66.3	68.1	65.3	59.5	46.9	36.4	23.2
4	22.5	24.8	34.2	43.3	51.8	65.2	67.5	64.6	58.9	46.3	35.8	22.8
5	22	24.2	33.3	42.6	50.9	64.5	66.8	63.9	58.2	45.4	35	22.3
6	21.2	23.5	32.3	42.3	50.5	63.8	66.2	63.4	57.9	44.8	34.3	21.8
7	20.8	23.1	31.8	42.3	52.1	66	67.6	63.9	57.6	44.3	33.7	22.1
8	20.8	22.9	32	44.9	55.7	69.6	70.8	67.6	59.9	45.6	33.5	21.6
9	22	24.2	35.7	48.4	58.9	73	74.5	71.6	63.7	50.7	36.6	23.2
10	26.2	27	39.5	51.7	62.4	76.3	77.6	75.6	67.6	55.8	41	27
11	30.7	30	43.6	54.7	65.5	78.9	80.3	78.7	71.3	60.2	45	31
12	35	33.2	47.1	57.1	67.7	81.1	82.5	80.8	74.2	63.7	48.6	35.2
13	38.3	35.7	50.1	59.7	69.3	82.8	84.3	82.5	76.4	65.8	51.1	38.8
14	41.2	37.9	52.3	61.6	70.4	83.9	85.6	83.7	77.7	67.2	53.2	41.1
15	42.9	39.2	53.7	62.9	71.7	84.6	86.6	84.4	78.5	68.1	54.3	42.8
16	43.3	40	54.5	63.8	72.6	84.9	86.9	84.4	78.6	68.1	54.3	43
17	42.1	39.8	54.3	63.5	72.6	84.6	86.5	84.2	77.8	67.1	52.9	41.1
18	38.5	38.3	53	62.6	71.6	83.6	85.4	82.7	75.6	63.9	49.1	36.9
19	34.4	35.7	50	60.1	69.7	81.8	83.4	79.9	71	58.7	45.7	33.8
20	32	33.6	46.8	56.8	65.8	78.6	79.9	75.6	66.7	55.6	43.7	31.5
21	30.3	32.1	44.6	54.1	62	74.4	76.1	72.3	64.7	53.7	41.9	29.8
22	29.1	31.2	42.7	52.2	59.7	72.2	74.1	70.4	63.3	52.3	40.7	27.9
23	28	29.9	41.4	50.3	57.6	70.7	72.6	69	62.1	50.9	39.5	26.8
24	27	29.1	39.7	48.9	56.2	69.4	71.3	68.1	61.1	49.7	38.4	25.1

Table 32 Average Monthly Percent Relative Humidity by Hour of the Day for Jefferson County

	MonthID											
HourID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	67.9	75.6	72.4	70.8	76.6	76.7	83	85.5	87.6	77.2	68.8	69.6
2	69	77.1	73	73.1	76.8	78.3	83.8	86.6	87.6	78.3	70.2	71.1
3	70.1	78	74.1	74.4	77.6	79.9	84.6	86.9	88.5	80.1	71.3	72.5
4	71.2	78.2	75.2	75.5	78.7	81.2	85.2	87.8	88.8	80.7	72.1	73.1
5	71.8	78.2	76.1	76.1	79.5	82.3	85.8	88.4	89.4	81.9	73.2	74.4
6	72.3	78.8	77.6	76.9	80.1	83.2	86.3	88.7	89.4	82.8	74.3	75
7	72.6	78.8	78.2	77.3	79.3	81.3	85.2	88.4	89.4	83.4	75.2	75.3
8	72.3	78.4	78.5	73.9	75	76	80.5	84	88.2	83.2	75.5	75.6
9	71.1	77.2	75.4	69	70.7	70.4	73.8	76.7	83.2	77.1	73.4	74.8
10	67.1	74.2	70.2	64.4	65	64.8	68.5	69.4	76.1	67.5	67.5	71.7
11	62.2	70.5	64.4	60.9	60.3	60.1	63.7	63.8	69.5	58.9	61.3	68
12	57.2	67.1	59.9	58.5	57.6	56.1	60	59.5	63.9	52.9	56.2	64.6
13	53.7	64.7	56.4	55.6	56.1	53	57.4	56.9	60	49.3	52.6	62
14	50.9	62.1	54.1	53.4	54.8	51.8	55	55.1	57.9	46.8	49.5	59.8
15	48.8	60.8	53	51.6	53.4	50.2	53.7	54.1	56.4	45.5	47.7	58.3
16	47.7	59.9	52.5	50.1	52.4	49.5	53.5	54.1	56	45.4	47	57.9
17	48.1	60.1	52.7	49.7	52	49.5	53.9	54.8	57.5	46.4	48.3	59
18	51.3	61.6	54.4	50.7	52.1	50.5	55.6	57.6	62.3	51.7	52.9	62.7
19	55.6	65.2	58.2	54	54.5	53.5	59.7	63.5	71.7	61	57.3	65.3
20	58.2	68.3	62.5	58.4	60.3	59.2	67.1	71.6	79.3	66.7	59.9	66.6
21	60.5	70.2	65.3	61.8	66.2	66.5	73.7	77.6	82.9	69.6	62.9	67.3
22	62.5	71.9	67.5	64.5	70	70.6	77.2	81	84.6	71.8	64.5	68.2
23	64.2	73.6	69.5	67.3	73.2	72.7	79.5	83.2	85.8	73.7	66.3	68.4
24	65.8	74.7	71.3	68.7	75.3	74.9	81.1	84.3	86.7	75.8	67.8	69.1

Table 33 Average Monthly Temperatures by Hour of the Day for St. Charles County in Fahrenheit

	MonthID											
HourID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	24.3	26.9	37.9	47.5	54.9	68.8	70.2	67.6	60.6	49.2	37.6	23.3
2	23.3	25.3	36.1	45.7	53.7	67.8	69	66.8	60.7	48.1	37.5	23.5
3	22.2	24.1	34.9	44.4	52.6	66.7	68.3	65.9	59.9	47.6	36.6	22.8
4	21.2	23.2	33.8	43.5	51.5	65.7	67.9	65.1	59.2	46.8	35.9	22
5	20.7	22.9	32.8	42.7	50.8	64.8	67.2	64.5	58.6	46	35	21.5
6	20.3	22.4	31.7	42.4	50.2	64.3	66.7	63.9	58.1	45.4	34.2	21.3
7	20.1	21.8	31.2	42.4	51.9	66.4	68	64.5	58	44.8	33.8	21
8	20.1	21.5	31.5	45	55.3	69.8	71	68	60.1	46.1	33.5	20.5
9	21.4	23.1	35.2	48.4	58.2	73	74.4	71.9	63.7	50.8	36.5	22.3
10	25.8	25.6	38.9	51.4	61.8	75.9	77.5	75.7	67.6	55.4	40.5	26
11	30.3	28.6	42.7	54.3	64.7	78.4	79.9	78.7	71.3	59.7	44.2	30.3
12	34.4	31.7	46.2	56.7	66.7	80.8	82.2	80.7	74.1	63.1	47.9	34.8
13	38	34.1	48.9	59.3	68	82.3	84.1	82.2	76.2	65	50.5	38.3
14	40.7	36.2	51	61.1	69.4	83.3	85.4	83.5	77.6	66.4	52.6	40.3
15	42	37.6	52.4	62.5	70.8	84	86.4	84.1	78.3	67.3	53.8	41.8
16	42	38.1	52.9	63.4	71.7	84.4	86.5	84.3	78.4	67.4	53.8	42.1
17	41.1	37.8	52.7	63.3	71.8	84.3	86	84	77.8	66.3	52.5	40.6
18	37.5	36.4	51.6	62.4	71	83.3	85	82.7	75.7	63.3	48.9	36.3
19	33.3	33.6	48.8	60.1	69.1	81.8	83	79.8	71	58.4	45.8	33.3
20	30.9	31.9	45.4	56.5	65.3	78.6	79.7	75.8	66.8	55.4	43.9	31
21	29	30.5	43.5	54	61.5	74.6	76	72.5	65	53.9	42.5	29.3
22	27.8	29.5	41.9	52.3	59.1	72.5	74	70.7	63.4	52.6	41.4	27.3
23	26.5	28.2	40.8	50.5	57.4	71.1	72.7	69.4	62.4	51.4	40	25.8
24	25.4	27.7	39	49.1	56	69.8	71.3	68.5	61.2	50.3	38.8	24.3

Table 34 Average Monthly Percent Relative Humidity by Hour of the Day for St. Charles County

	MonthID											
HourID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	67.5	75.8	71.7	70.5	76.6	77.3	83.3	85.5	87.9	76.1	68.8	69.8
2	68.2	77	72.1	72.8	76.5	78.9	84.1	86.4	88.2	77.8	70.2	71.3
3	69.6	77.5	73.5	74.4	77.9	80.5	84.9	86.9	88.8	78.9	71.6	72.5
4	70.7	78.1	74.9	75.3	79.3	82.1	85.2	88.1	89.4	79.5	72.4	73.4
5	71.6	78.1	76.4	75.8	79.8	82.9	86.4	88.4	90.1	81	73.8	74.9
6	71.9	78	77.5	76.3	81	84.1	86.7	89	90.4	81.9	75.3	75.6
7	71.6	78.7	78.2	77	79.9	81.9	85.2	88.1	90	83.1	76.2	76.5
8	71.6	78.3	78.2	73	75.5	76.3	80.2	84	88.8	82.6	76.4	76.2
9	70.5	76.7	74.7	67.9	71.4	70.6	73.8	76.5	83.8	76.8	73.9	75
10	66.2	73.8	69.8	63.9	64.7	65.5	68.2	69	76.3	67.9	68.3	72.2
11	61.3	70.1	63.8	60.2	59.8	60.5	63.5	62.9	69.2	59.8	62.4	68.5
12	56.4	66.7	58.8	57.5	57	55.9	59.5	58.5	63.9	53.4	56.9	65.4
13	52.5	64	55.1	54.7	55.9	53.1	56.6	55.9	59.8	49.9	53.2	62.7
14	49.9	61.3	53	52.7	54.3	51.7	54.4	54	57.3	47.6	49.8	61.2
15	48.1	59.5	51.6	50.9	52.7	50.1	53.1	52.9	56	46.3	47.8	59.6
16	47.1	58.9	51.4	49.5	51.7	49.2	52.9	53	55.6	46	47.1	59.2
17	47.3	59.5	51.8	49.1	50.8	49.2	53.8	53.9	57.1	47	48.6	60.2
18	50.9	61.1	53.5	50.3	50.7	50.3	55.5	56.4	61.6	52.2	53.3	64
19	55.7	65.2	57.5	53.3	53.1	53.2	60	62.4	71.9	61	57.6	66.6
20	58.6	68.1	62.3	58.2	59	59.3	66.8	71.2	80.5	66.9	60.4	67.7
21	61.1	70.6	64.9	61.5	65.4	66.9	74	77.6	83.5	69.3	62.2	67.8
22	62.6	72.3	67.1	63.7	70.2	71.1	77.4	81.3	85.6	71.1	63.9	68.1
23	64	73.7	68.6	66.6	72.9	73.5	79.2	83.3	86.1	72.9	65.5	68.5
24	65.6	74.9	70.7	68.2	75	76	81.1	84.7	87.6	74.7	67.3	69.3

Table 35 Average Monthly Temperatures by Hour of the Day for St. Louis County in Fahrenheit

	MonthID											
HourID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	25.5	28.1	39	48.2	56.2	70.2	71.8	68.8	62.4	50.7	38.8	24.4
2	24.5	26.6	37.3	46.2	55	69.1	70.6	68.1	62.5	49.8	38.6	24.6
3	23.6	25.2	36.1	45.1	53.8	68	69.9	67.2	61.6	49.1	37.8	23.9
4	22.7	24.5	35.1	44.3	52.8	67	69.6	66.5	60.9	48.4	37	23.2
5	21.9	23.9	34.2	43.6	52.1	66.1	68.9	65.9	60.4	47.6	36.3	22.5
6	21.4	23.4	33.1	43.3	51.6	65.6	68.4	65.3	59.9	47.1	35.6	22.5
7	21.2	23.1	32.6	43.3	53.2	67.7	69.7	65.8	59.8	46.6	35	22.5
8	21.2	22.7	32.9	45.7	56.5	70.9	72.5	69.4	61.9	47.9	34.9	22
9	22.5	24.1	36.4	48.9	59.4	73.9	75.7	72.8	65.2	52.2	37.8	23.9
10	26.6	26.7	39.8	51.8	62.5	76.8	78.5	76.6	68.7	56.7	41.5	27.2
11	30.8	29.5	43.3	54.6	65.2	79.3	81	79.5	72.2	60.7	45.1	31.1
12	34.9	32.5	46.7	56.8	67.1	81.6	83.1	81.4	74.8	63.9	48.4	35.1
13	38.2	35	49.4	59.3	68.4	83.1	84.8	83	76.8	65.8	50.9	38.7
14	41	37.1	51.3	61	69.4	84	86.2	84.1	78.3	67.2	52.8	40.8
15	42.5	38.5	52.7	62.4	70.8	84.8	87.2	84.8	79	67.9	54	42
16	42.5	39	53	63.2	71.6	85	87.3	84.9	79	68.1	54.1	42.5
17	41.6	38.6	53	63.1	71.9	84.9	86.8	84.6	78.4	67	52.8	40.8
18	38.1	37.2	51.7	62.4	70.9	84	85.9	83.2	76.3	64.2	49.5	37
19	34.2	34.6	49.1	60.1	69.3	82.5	83.9	80.5	72.3	59.9	46.6	34.4
20	31.8	32.9	46.3	56.8	65.6	79.5	80.7	76.8	68.5	57.1	44.8	32.3
21	30.1	31.6	44.4	54.4	62.5	76	77.4	73.9	66.6	55.5	43.4	30.6
22	29.2	30.8	42.6	52.8	60.2	73.9	75.8	72.1	65.2	54.1	42.2	28.4
23	27.9	29.5	41.7	51	58.4	72.4	74.4	70.8	64.1	52.9	41.1	27
24	26.8	28.8	40	49.6	57.2	71.2	73	69.8	63.1	51.7	39.9	25.3

Table 36 Average Monthly Percent Relative Humidity by Hour of the Day for St. Louis County

	MonthID											
HourID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	67.3	75.9	71.8	70	75.9	75.8	82.3	85	87.4	75.9	68.9	70.2
2	68.1	77.1	72.2	72.6	76	78.1	83.3	85.8	87.7	77.6	70.3	71.8
3	69.5	78.3	73.3	74.2	77.4	80	84.2	86.7	88.6	79.1	71.7	72.9
4	70.3	78.5	74.4	74.7	78.5	81.3	84.7	87	89.5	79.6	72.5	73.8
5	71.5	78.5	75.9	75.6	79.3	82.4	85.9	87.9	89.8	81.1	73.6	75.7
6	72	78.8	77.7	76.1	80.5	83.3	86.2	88.4	90.1	82	75.4	76.4
7	71.7	79.1	78	76.4	79.4	81.1	84.7	88.2	90.1	82.9	76.3	76.7
8	71.4	78.4	78.6	72.5	75	75.6	79.8	83.2	88.6	82.4	76.6	76.6
9	70.3	77.2	74.8	67.9	71	70	73.4	76.3	83.3	76.7	74.1	75.2
10	66	74.2	69.9	63.7	65	64.7	67.9	68.6	76.2	67.6	68.2	72.7
11	61.4	70.5	64.6	60.2	60	60	63.2	62.8	69.1	59.4	62.3	68.9
12	56.7	67.1	59.6	57.8	57.5	55.2	59.2	58.4	63.5	53.1	57.5	66
13	52.8	64.6	56	54.9	56.4	52.3	56.3	55.8	59.6	49.5	53.4	63.2
14	49.8	62	53.9	53.1	55.1	51.3	54.2	53.9	57	47.2	50.4	61.2
15	47.8	59.9	52.4	51.3	53.5	49.5	52.5	52.9	55.5	45.9	48.4	59.9
16	46.8	59	52.7	49.9	52.7	48.6	52.5	52.9	55.3	45.5	47.5	59.2
17	47.2	59.7	52.9	49.6	51.4	48.6	53.2	53.9	56.8	46.6	48.8	60.5
18	50.6	61.2	54.8	50.5	51.4	49.7	54.7	56.4	61.5	51.4	53.2	64.1
19	55.1	65.1	58.5	54	53.5	52.4	58.9	62	70.6	59.1	57.2	66.5
20	58.2	68.2	62.5	58.2	59	57.9	65.8	69.8	78.6	65.1	60	67.9
21	60.2	70.4	65.3	61.4	64.5	64.3	72.3	76.1	82.2	68.2	62.1	68.3
22	61.9	72.1	67.7	63.6	69.2	69	75.5	80	84.2	70.4	64	68.6
23	63.7	73.8	69.3	66.6	72.5	71.6	77.7	82.2	85.3	72.5	65.7	69
24	65.2	75	71.1	68.3	74.6	74.3	80.1	83.9	86.5	74.6	67.4	69.7

Table 37 Average Monthly Temperatures by Hour of the Day for St. Louis City in Fahrenheit

	MonthID											
HourID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	25.9	28.9	40.2	48.1	56	70.1	72.4	69.2	62.7	51.5	39.4	25.9
2	25	27.5	38.4	46.2	54.9	69.1	71.2	68.5	62.9	50.7	39.2	25.9
3	24	26.3	37.4	45.3	53.8	68	70.6	67.7	62.2	49.9	38.3	25
4	22.9	25.4	36.3	44.3	52.9	67	70.1	67	61.5	49.4	37.8	24.6
5	22.4	24.9	35.6	43.7	52.2	66.2	69.6	66.3	61	48.6	37.1	23.9
6	21.7	24.4	34.5	43.4	51.8	65.6	69.1	65.9	60.6	47.9	36.4	23.9
7	21.5	23.8	33.9	43.7	53.6	67.9	70.6	66.5	60.5	47.5	35.8	23.9
8	21.3	23.5	34.2	46	57	71.2	73.5	70.2	62.6	48.8	35.8	23.2
9	22.8	24.9	37.7	49.2	59.8	74.4	76.5	73.7	66	53.3	38.7	25.2
10	27	27.5	41	52.1	62.9	77.4	79.2	77.5	69.5	57.8	42.5	28.4
11	31	30.3	44.3	54.8	65.6	79.9	81.6	80.3	72.9	61.8	45.9	32
12	35	33	47.4	57	67.7	82.1	83.6	82.3	75.4	64.8	49.3	35.9
13	38.1	35.5	50.1	59.3	68.7	83.8	85.2	83.7	77.3	66.8	51.7	39.3
14	41.1	37.4	51.8	61	69.7	84.5	86.7	84.9	78.7	68.1	53.5	41.5
15	42.7	38.8	53.3	62.4	71.1	85.3	87.6	85.5	79.4	68.8	54.6	42.9
16	42.5	39.3	53.6	63.2	71.7	85.4	87.8	85.5	79.5	68.8	54.6	42.9
17	41.6	39.1	53.4	62.9	72	85.4	87.5	85.3	78.7	67.9	53.3	41.5
18	38.1	37.7	52.2	62.1	71.2	84.4	86.4	83.8	76.8	65.1	50	37.7
19	34.3	35.1	49.5	60.1	69.4	82.9	84.5	81.2	72.5	60.7	47.2	35
20	32.1	33.4	47	56.7	65.8	79.8	81.4	77.2	68.5	57.8	45.2	33.4
21	30.4	32.2	45	54.5	62.5	76	77.9	74.3	66.8	56.2	43.8	31.6
22	29.5	31.3	43.5	52.8	60.2	73.6	76.2	72.3	65.5	54.9	42.7	29.8
23	28.3	30.1	42.6	51	58.3	72.2	74.8	71.2	64.3	53.6	41.6	28.4
24	27.2	29.6	41.1	49.5	57.1	71	73.6	70.3	63.4	52.4	40.6	26.8

Table 38 Average Monthly Percent Relative Humidity by Hour of the Day for St. Louis City

	MonthID											
HourID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	68	76.6	72.6	71.4	77	76.6	83.4	85.9	87.7	76.9	69.3	69.8
2	69	78.1	73.2	73.8	76.9	78.7	84.2	86.5	87.7	78	71	71.3
3	69.8	79	74	74.8	78	80.8	85.4	87	88	79.7	72.1	72.7
4	70.9	79	75.2	75.9	79.1	81.9	85.6	87.6	88.9	80.3	72.3	73.6
5	72.1	78.9	76.3	76.5	79.9	82.7	86.5	88.5	89.5	81.5	73.4	75.2
6	72.4	79.2	78.4	77.4	80.5	83.9	86.8	88.5	89.8	82.7	75.2	75.8
7	72.7	79.5	79	77.1	79.4	81.7	85.1	88.2	89.5	83.3	76.3	76.2
8	72.3	79.1	79.4	73.4	75.1	75.9	80.1	83.3	88.3	83.1	76.3	76.4
9	70.9	77.9	75.6	68.3	71	70	74	76.4	83	77	73.6	75
10	66.7	74.9	70.6	64.2	64.8	64.5	68.4	68.9	75.7	67.4	68	72.5
11	61.9	71.5	65.5	60.7	60.1	59.6	63.7	63.1	68.9	59.1	62.4	69
12	57.4	68.3	60.7	58.5	57.1	55.3	59.7	58.7	63.6	52.8	57.2	66.1
13	53.7	65.5	57	55.7	56.4	52	57.1	56.3	59.7	48.9	53.8	63.1
14	50.6	63.3	55.1	53.7	55.1	51.2	54.6	54.2	57	46.4	50.7	61.1
15	48.4	61.4	53.4	51.7	53.7	49.5	53.1	53.5	55.5	45.5	48.5	59.5
16	47.8	60.3	53.4	50.4	52.9	48.9	52.7	53.5	55.1	45.3	47.8	59.1
17	48	60.7	53.8	50.2	51.8	48.9	53.4	54.2	56.8	46.4	48.9	60.1
18	51.2	62.1	55.8	51.4	51.4	49.9	55.2	57.1	61.6	51.3	53.3	63.6
19	55.9	66	59.7	54.8	53.9	52.4	59.2	62.6	71.1	59.4	57.3	66.2
20	58.7	69.2	63.6	59.6	59.7	58.2	66.3	71.1	79.7	65.7	60.6	67.5
21	60.8	71.1	66.4	62.1	65.5	65	73.6	77.5	83.4	68.8	62.6	68.4
22	62.5	73.1	68.7	64.8	70	70.2	76.8	81.4	84.8	71	64.5	68.7
23	64.3	74.8	70.2	67.7	73.6	72.8	79.1	83.1	86.2	73.1	66.3	68.9
24	66.1	75.7	71.8	69.4	75.7	75.3	81	84.8	87.1	75.5	67.8	69.6

3.3.2.4 On-road Source Emissions Summary

The MOVES model runs were set up selecting all available gasoline and diesel fuel vehicle type combinations, all months, days, hours, and all road types. A separate run was set-up for each pollutant. The emissions were post-aggregated to the year level using MOVES.

Table 39 summarizes the 2008 annual on-road emissions by county as calculated using MOVES for the Missouri counties located in the St. Louis Nonattainment area.

Table 39 STLNA On-road Mobile Emissions Summary by county (tons per year)

County Name	NH_3	NO_X	$PM_{2.5}$-Pri	SO_2	VOC
Franklin County	77.75	4,187.90	142.46	30.12	1,555.66
Jefferson County	90.68	5,313.80	183.94	36.32	2,522.89
St. Charles County	133.29	7,788.01	284.16	54.30	3,613.71
St. Louis County	585.26	32,363.41	1,215.47	237.05	12,865.54
St. Louis City	169.20	9,166.46	353.26	68.87	3,236.00
Totals	**1,056.17**	**58,819.58**	**2,179.28**	**426.65**	**23,793.80**

3.4 Biogenic Emissions

The biogenic emissions for the Missouri portion of the St. Louis PM2.5 nonattainment area are listed below in Table 39. These emissions were developed by EPA for the purposes of developing the 2008 National Emissions Inventory. The State of Missouri did not make any changes to the figures developed by EPA for this category.

Table 40 2008 Biogenic Emissions for the Missouri Side of the Nonattainment Area

County	NO_X Emissions (tons/year)	VOC Emissions (tons/year)
Franklin	265.2	15,127.2
Jefferson	124.2	12,624.7
St. Charles	257.4	7,715.3
St. Louis County	159.6	7,137.8
St. Louis City	31.2	1,296.7
Totals	**837.6**	**43,901.7**

4.0. Quality Assurance/Quality Control

4.1 Point Source QA/QC and Results

Prioritization

The EI Unit prioritizes review of those facilities that have the largest bulk emissions, specifically facilities with a Part 70 or Intermediate operating permit. While every data element collected helps to characterize the emission estimate, in evaluating the data, those fields most directly tied to the emissions calculation are given the highest priority. The MoEIS database system itself was quality assured to provide smooth data transfer from the state inventory to the NEI.

Methods

The EI Unit's general QA procedures utilize any and all of the techniques outlined in the EPA's Emission Inventory Improvement Program (EIIP) Technical Report Series Volume 6: Quality Assurance Procedures. The unit groups these techniques into two basic categories: Phase I, or Bottom-Up QA procedures, and Phase II, or Top-Down QA procedures. Top-Down Procedures analyze groups of emissions data that share a common trait and look for outliers, in keeping with the 'Reality Check' technique. Bottom-Up Procedures evaluate individual EIQs that are believed to be erroneous, whether due to a top-down analysis, errors found when entering the EIQ into the database, or inconsistencies brought to the attention of the EI Unit by a third party. These bottom-up procedures utilize the 'Peer Review', the 'Sample Calculations', or the 'Independent Audit' techniques. Note that any of these techniques could be found in either category; they have simply been mentioned in reference to the category in which they are most often found.

Quality checks are completed using computerized checks in the MoEIS automated system, exploiting its utility in ensuring that the necessary data is reported, and in providing an acceptable numeric range for certain fields. It streamlines the process of ensuring that all data fields required for the EPA's EIS system are present, are compatible with, and meet the needs of the EPA system. For example, emission release point records that were missing fields were corrected with the input of emission modelers and facility staff. Outdated Source Classification Codes (SCC), units of measure, and control device codes were removed, and required data fields for stack emission release points were added.

Phase I reviews address individual EIQs to reconcile discrepancies with emission data. Phase I reviews are generally done only on hardcopy submitted EIQs, but may also be done based on priority. Examples of EIQ issues that were encountered include throughputs and emission factors with inconsistent units of measure, emission unit identifiers that are different from previous EIQs, and MoEIS-calculated emissions that differ from the emissions on the hardcopy forms. Technical staff conducting these reviews worked with the companies to make corrections to their EIQs and place written

documentation of all changes in the hardcopy EIQ files stored in the fileroom. In addition, all changes made to EIQs are tracked in an electronic log file.

Phase II reviews take a top-down look at the emissions data. This phase involves running Access queries to identify potential issues to investigate further. The Phase II QA queries included ensuring condensable particulate emissions were reported, ensuring correct application of sulfur/ash content in emission factors, and reviewing emission trends by facility and industry type to identify any anomalies. In addition, point source data from other databases incorporated by the EPA into the EIS, such as the Toxics Release Inventory (TRI) and the Clean Air Markets Division (CAMD), will be reviewed and compared to MoEIS data. Prioritization of the largest sources, largest changes, and largest anomalies is a top consideration, as is realizing a meaningful emission difference within a reasonable amount of time. Any changes made to EIQs during the Phase II QA process will be done with input from the companies, and written documentation of all changes will be placed in the EIQ files stored in the fileroom and in electronic files.

Results

CAMD Data Comparison: Several emission units in Missouri are subject the Acid Rain Program or the NO_x Budget Trading Program, and these units report SO_x and NO_x emissions directly to EPA's Clean Air Markets Division (CAMD). These units were reviewed to ensure the same emission quantities were reported to EPA and to the APCP in their annual emissions report. Over 70% of all EIQ-reported SO_x and NO_x emissions were quality assured with the help of the CAMD database. Since the naming of the units between the two databases is not always identical, and not all units reported to the APCP are required to report to CAMD in either individual or grouped format, some manual analysis was done to compare emissions reported to the two databases.

The largest difference noted between the two databases was an underreporting of almost 270 tons to MoEIS compared to CAMD. Contact with the facility showed that the cause was a transcription error, and the MoEIS data was corrected. Due to prioritization, the six other facilities that showed reporting differences were not addressed, and their total difference was not more than the single NO_x correction that was completed.

Condensable PM Reporting: Missouri facilities were not required to report condensable emissions prior to emission year 2008, but they were reminded to report condensable starting with emission year 2008 in email or postcard form and in the EIQ packet. The inclusion of condensable PM data in the 2008 emission reporting year is important because it is an EPA triennial inventory year where data will be extensively quality assured for use in detailed air quality analyses and planning. Missouri is required to report condensable PM emissions in 2009 by EPA's Air Emissions Reporting Rule (AERR), 40 CFR Part 51.15, and data collection systems for separate condensable and filterable PM reporting in 2009 are in place. Quality assurance of the 2008 emissions data began with Part 70 and Intermediate operating permit holders who use Source Classification Codes (SCCs) that have condensable emission factors in the webFIRE emission factor database.

Identifying facilities: There are many fuel combustion processes that produce condensable emissions. For the vast majority of fuel combustion processes, the condensable emissions are accounted for in the total PM_{10} and $PM_{2.5}$ emission factors already in use. This is especially true for natural gas, diesel, and fuel oil combustion sources. Coal combustion sources, on the other hand, required additional analysis to determine if condensable emissions were included in the report. Six facilities correctly included condensable in their initial emission report and were contacted to verify those emissions. Seven facilities were identified that may not have included condensable emissions, but the omission did not amount to over 10 ton underreporting. Seventeen facilities that did not report condensable emissions were the highest priority and were contacted from August to October 2009 to correct their emission reports.

Emission Results: Condensable PM emissions added to those seventeen facilities account for over 3,700 tons of PM_{10} emissions statewide.

Point Source QA - Condensable Additions

	Initial Inventory	Condensable Addition	17 Facility Total PM_{10} Inventory
17 facilities	3,049 tons PM_{10}	3,746 Tons PM_{10}	6,795 Tons PM_{10}

Ash/Sulfur Changes: The method of calculating emissions in MoEIS was changed from 2007 to the 2008 emission year. The previous equation used the throughput, emission factor, ash or sulfur content, and control efficiency to calculate emissions. The ash or sulfur term was added to the equation to assist facilities whose emission factor is an equation from AP-42 in the form [EF * A/S]. While the calculation method worked well for a limited number of facilities, it became a source of confusion for the larger group, and misinterpretation of the emission factor term by Air Program users necessitated a change to the calculation to remove the ash or sulfur term from the calculation. Communication of the change to facilities was done via the EIQ mailout and notations in the MoEIS online system. A review of submitted EIQs to ensure all affected facilities had accounted for the new calculation method showed only one facility that did not adjust the emission factor to account for the change. They were contacted to make the correction and it resulted in an over 4,000 ton increase in SO_x emissions compared to their initial report.

Interannual Variability- Facilities that reported over 20 tons of chargeable emissions were examined to find sources with large interannual variability. A list of 20 facilities was generated where plantwide chargeable emissions changed by more than 20%, and each of these facilities were contacted to verify the source of the increase or decrease. Four facilities reported an emission change due to emission factor or control device changes, and the other 16 facilities reported throughput changes were the cause of the emission differences. Since the cause of the emission variability has been documented, there is no cause for changes to the emissions report for these twenty facilities.

Local Agency QA – Four facilities in St. Louis City were selected for a detailed audit based on their level of emissions and variation from past year reporting. At the four facilities, over 20 emission units were audited to confirm throughput, appropriate emission factor use, appropriate control efficiency application, permitted equipment limits, and number of pollutants. Six emission units were found to be incorrectly reported in the 2008 emission report, with one facility having overreported almost 10 tons of PM_{10}, and another underreported 40 tons facility-wide. Phase 1 quality assurance steps were used on 14 facilities in Springfield, 7 facilities in St. Louis County, and twenty facilities in Kansas City. Throughputs, emission factors, incorrect calculations, and HAP reporting were reviewed for these sites.

Stack Parameters – In preparation for point source data submission to the NEI, the required data elements for stack emission release points were queried to ensure the data submittal could occur without errors. Of the over 2,600 stack release points associated with point source emission reports that are submitted to the 2008 NEI, almost 50% required quality assurance before they could be submitted. Three main quality assurance steps were taken to correct the stack data: missing data elements were filled in as possible, data elements that were out of range were quality assured, and previously submitted NEI data elements were compared to current Missouri emission report data to identify discrepancies. Filling in missing data elements took the most time because it required review of modeling files, contact with local agency staff, or contact with the facility. Out of range data elements were a much smaller portion of the quality assurance, but these were also corrected via modeling files and contact with the facility. Discrepancies between the EIS and 2008 Missouri EIQ data were reconciled by accepting the Missouri data instead of EIS data.

4.2 Nonpoint Source QA/QC

EI Unit staff has documented the following information for each nonpoint source category: source of data for activity, emission factors, allocation methodologies, nonpoint source SCCs covered, pollutants covered, and point source subtraction in Table . Much of the documentation for EPA categories appears at the NEI website: http://www.epa.gov/ttn/chief/net/2008inventory.html

Emission inventory staff participated in the ERTAC workgroup that developed many of the updated emission factors and methodologies used for 2008 emission estimates, and the resulting emission factors were checked against those used in EPA templates for accuracy. All nonpoint source categories in the 2008 NEI will be reviewed, including those for which EPA is developing emissions estimates. The emission estimates were compared to the 2005 NEI to identify outlying or missing categories.

Quality checks of the EPA excel worksheets showed that three worksheets had incorrect emission factors when compared to the ERTAC summary emission factor page, and these were corrected before emissions were submitted. Several categories had spreadsheet templates that omitted HAP calculations, and these were amended prior to completing the

categories. Spot checks were also done on the calculation pages to ensure formulas were followed, and no problems were found.

Quality assurance of the data included checks against 2002 NEI data submissions, and completeness checks for the number of counties, number of pollutants, order of magnitude, and correct units of measure. The priority data checks showed no errors, but there are a few source categories included in the 2002 NEI that were not included in the 2008 NEI due to time constraints (see section 3.2).

There are also a few categories that show large differences (>50%) between the 2002 NEI and the 2008 NEI, and virtually all are due to changes in emission factors, activity data, controls, covered categories, or calculation methods. The largest differences between the 2002 and 2008 NEI come in the graphic arts, degreasing, industrial surface coating, miscellaneous non-industrial solvents, and gas stations. The methods and source data for the graphic arts category have changed significantly between 2002 and 2008, and the source of activity data for 2002 did not cover all categories because of restricted release census bureau data. The emission factor for degreasing decreased by 50% from 2002 to 2008 after EPA and ERTAC reviewed the data. The industrial surface coating category was assumed zero in 2002 but is non-zero in 2008. The miscellaneous non-industrial category did not have emissions for portable residential and commercial gas cans in 2002, but that category is included in 2008. Gas stations show a decrease in emissions from 2002 to 2008 that can be attributed to additional controls in the interim years. None of the large differences between 2002 and 2008 can be attributed to errors in the 2008 inventory that need correction.

4.3 Mobile Source QA/QC

4.3.1 Nonroad Source QA/QC

Per Appendix E-2, quality control and quality assurance were conducted throughout the nonroad modeling process. Data collected from various data sources were verified and correctly entered or transcribed into the model. In some instances, input values, i.e., temperatures and fuel values were double and/or triple checked for accuracy to insure they corresponded to Missouri DNR data. In addition, a spot-checking of the modeling results, including rerunning the model for those results in question, was performed to ensure reliability.

4.3.2 Onroad Source QA/QC

The data used for the modeling was originally collected for creating the 2008 NEI. Missouri DNR has conducted extensive quality assurance on the model inputs and the inputs have been reviewed by EPA. The inputs were converted to MOVES formatting using EPA conversion tools. The MOVES converted data was double and/or triple checked to ensure accuracy. In addition, a spot-checking of the modeling results, including rerunning the model for those results in question, was performed to ensure reliability.

Appendix E-1

List of Missouri Statewide Point Source Emissions by Facility

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Facility Site Name	State And County FIPS Code	Facility Site Identifier	NAICS Code	NAICS Description	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC
3M Company-Nevada - Commercial Graphics	29217	0004	326121	Unlaminated Plastics Profile Shape Manufacturing		24.50		0.15	226.23
3M Company-Springfield ITSD/TMD	29077	0051	32552	Adhesive Manufacturing	0.23	7.14	0.54	0.04	29.50
A B Chance Co-Allen Street Complex	29019	0039	335313	Switchgear and Switchboard Apparatus Manufacturing		6.79	0.46	0.05	19.30
A C Riley Cotton Company-New Madrid Gin	29143	0046	115111	Cotton Ginning					
A P Green Industries Inc-Fulton Plant	29027	0010	327124	Clay Refractory Manufacturing		9.27	17.83	20.47	0.63
Aarons Automotive Products Inc-Westgate Ave Facility	29077	0010	336211	Motor Vehicle Body Manufacturing		7.05		0.59	32.93
ABB Inc-Jefferson City Plant	29027	0019	335311	Power, Distribution, and Specialty Transformer Manufacturing		6.20		0.04	61.96
Able Manufacturing & Assembly L L C - Schifferdecker	29097	0089	336211	Motor Vehicle Body Manufacturing					58.85
Able Manufacturing Corporation-7th Street	29097	0095	326121	Unlaminated Plastics Profile Shape Manufacturing					123.82
ADM Gromark River Systems-St Louis	29510	0031	311211	Flour Milling		0.00	0.90	-	-
ADM Milling Company-Carthage Flour Mill	29097	0011	311211	Flour Milling	0.00	0.08	0.01	0.00	0.00
ADM/TPC Milling Co-Pillsbury Company	29510	0159	311211	Flour Milling	-	-	15.60	-	6.96
Aero Metal Finishing-Aero Metal Finishing	29099	0114	332813	Electroplating, Plating, Polishing, Anodizing, and Coloring		2.16		0.30	3.10
Aero Transportation Products Inc-Independence Plant	29095	0191	336211	Motor Vehicle Body Manufacturing					98.58
Aerofil Technology Inc-Aerofil Technology Inc	29071	0151	311942	Spice and Extract Manufacturing		1.95	2.77	0.01	50.17

Ag Processing Inc-St Joseph - Lower Lake Road	29021	0060	311222	Soybean Processing		1.83	19.18	0.01	494.30
AG PROCESSING-ST. JOSEPH BIODIESEL	29021	0118	325199	All Other Basic Organic Chemical Manufacturing					4.50
Agriservices Of Brunswick Llc-Brunswick West	29033	0013	42451	Grain and Field Bean Merchant Wholesalers	-	-	0.99	-	-
Albaugh Inc-Albaugh Inc	29021	0037	32532	Pesticide and Other Agricultural Chemical Manufacturing					34.11
Alcan Cable-Div Of Alcan Products Corporation	29159	0022	331319	Other Aluminum Rolling and Drawing	0.09	2.69	0.20	0.02	5.76
Alliant Llc-Lake City Army Ammunition Plant	29095	0046	332992	Small Arms Ammunition Manufacturing	1.24	49.94	2.89	1.50	115.50
Allied Health Care Products-Allied Health Care Products	29510	1460	332919	Other Metal Valve and Pipe Fitting Manufacturing		-	-	-	3.63
Allied Waste Industries Sanitary Landfil-Kansas City Landfill	29095	2101	562212	Solid Waste Landfill		3.56	1.51	1.25	2.30
Altec Industries Inc-Altec Industries Inc	29021	0078	33312	Construction Machinery Manufacturing	0.07	2.33	0.31	0.03	5.42
Alumax Foils Inc-Alcoa Foil Products/Alumax Foils Inc	29510	0118	322225	Laminated Aluminum Foil Manufacturing for Flexible Packaging Uses	0.01	22.94	46.99	0.68	488.67
Ameren Energy Generating Company-Columbia Energy Center	29019	0105	221112	Fossil Fuel Electric Power Generation		0.13		0.01	0.11
Amerenue-Callaway Nuclear Power Plant	29027	0026	221113	Nuclear Electric Power Generation		18.99		5.51	0.69
Amerenue-Fairgrounds Combustion Turbine	29051	0049	221112	Fossil Fuel Electric Power Generation		3.64		5.27	0.09
Amerenue-Kirksville Combustion Turbine	29001	0006	221112	Fossil Fuel Electric Power Generation		0.19		0.00	0.01
Amerenue-Labadie Plant	29071	0003	221112	Fossil Fuel Electric Power Generation	2.82	9,170.39	1,446.08	57,944.63	299.61
Amerenue-Meramec Plant	29189	0010	221112	Fossil Fuel Electric Power Generation	1.30	5,331.86	461.34	20,826.77	109.35
Amerenue-Mexico	29007	0012	221112	Fossil Fuel Electric Power		1.63		2.36	0.04

Combustion Turbine				Generation					
Amerenue-Moberly Combustion Turbine	29175	0010	221112	Fossil Fuel Electric Power Generation		1.87		2.70	0.05
Amerenue-Moreau Combustion Turbine	29051	0008	221112	Fossil Fuel Electric Power Generation		1.85		2.67	0.05
Amerenue-Peno Creek Energy Center	29163	0047	221112	Fossil Fuel Electric Power Generation		35.74		0.31	3.64
Amerenue-Rush Island Plant	29099	0016	221112	Fossil Fuel Electric Power Generation	1.51	4,195.26	662.52	29,592.97	159.93
Amerenue-Sioux Plant	29183	0001	221112	Fossil Fuel Electric Power Generation	0.86	7,336.12	308.71	48,147.62	168.11
American Airlines-Mci Maintenance And Engineering Base	29165	0005	336411	Aircraft Manufacturing		-	-	-	12.77
Ames True Temper Inc-Bernie North Plant	29207	0007	321999	All Other Miscellaneous Wood Product Manufacturing		0.76	2.07	0.04	0.71
Anheuser-Busch Inc-St Louis	29510	0003	312120	Breweries	24.25	668.29	24.38	5,431.34	250.30
Anr Pipeline Company-Maitland Compressor Station	29147	0024	486210	Pipeline Transportation of Natural Gas		989.77	19.16	0.24	39.99
Aqualon Div Of Hercules Inc-Missouri Chemical Works	29163	0002	32511	Petrochemical Manufacturing	15.58	912.16	19.69	5,586.16	115.70
Aquila Inc-Greenwood Energy Center	29095	0139	221112	Fossil Fuel Electric Power Generation		47.23	0.87	2.14	0.36
Aquila Inc-Lake Road Plant	29021	0004	221112	Fossil Fuel Electric Power Generation		3,193.59	12.09	3,671.51	28.35
Aquila Inc-Nevada Gas Turbine	29217	0034	221112	Fossil Fuel Electric Power Generation		1.68	0.01	0.01	0.00
Aquila Inc-Ralph Green Generating Plant	29037	0003	221112	Fossil Fuel Electric Power Generation		4.89	0.08	0.01	0.04
Aquila Inc-Sibley Generating Station	29095	0031	221112	Fossil Fuel Electric Power Generation		7,726.32	8.78	9,181.02	81.54
Archer Daniels Midland Co-ADM Milling Co	29047	0009	311211	Flour Milling	0.02	0.70	1.27	0.00	0.04
Archer Daniels Midland Co-	29007	0002	311222	Soybean Processing		23.56	22.12	0.14	164.64

Mexico Plant									
ARCHITECTURAL SYSTEMS INC-MONETT	29009	0062	332321	Metal Window and Door Manufacturing		13.67			22.91
Aries Power Plant-Pleasant Hill	29037	0056	221112	Fossil Fuel Electric Power Generation	22.80	59.27	17.27	2.91	3.30
Ashland Distribution Company-St Louis Plant	29510	1423	311942	Spice and Extract Manufacturing					8.44
Associated Electric Cooperative Inc-New Madrid Power Plant	29143	0004	221112	Fossil Fuel Electric Power Generation	5.63	11,794.89	346.33	14,986.52	242.47
Associated Electric Cooperative Inc-St Francis Power Plant	29069	0066	221112	Fossil Fuel Electric Power Generation	23.56	47.67	0.26	1.63	5.37
Associated Electric Cooperative Inc-Thomas Hill Energy Center-Power Division	29175	0001	221112	Fossil Fuel Electric Power Generation	1.59	12,117.61	438.74	15,099.61	169.42
Associated Electric Cooperative Inc-Unionville Power Station	29171	0015	221112	Fossil Fuel Electric Power Generation		1.50	0.02	0.26	0.20
Astaris Llc-Carondelet Plant	29510	0070	211112	Natural Gas Liquid Extraction	0.55	8.36	1.31	0.33	1.31
Audrain Generating Station	29007	0053	221112	Fossil Fuel Electric Power Generation		18.15		0.12	0.37
AYERS OIL CO-CANTON	29111	0019	424710	Petroleum Bulk Stations and Terminals					44.80
Ball Metal Beverage Container Co -Kansas City	29095	0175	332431	Metal Can Manufacturing		8.00		0.05	52.91
Banta Publications-Kansas City	29047	0122	336211	Motor Vehicle Body Manufacturing		1.79		0.01	25.44
Baptist Medical Center-Baptist Medical Center	29095	2087	62211	General Medical and Surgical Hospitals	0.01	3.52	0.19	0.02	0.08
Barber & Sons Aggregates-Barber & Sons Aggregates	29095	0076	212312	Crushed and Broken Limestone Mining and Quarrying		18.94	2.92	0.44	0.46
Bartlett Grain Company Lp-St Joseph	29021	0056	42451	Grain and Field Bean Merchant Wholesalers			0.97		
Bartlett Grain Company Lp-	29107	0050	42451	Grain and Field Bean		0.02	1.10	0.00	0.00

Waverly				Merchant Wholesalers					
Bartlett Grain Company-Birmingham	29047	0025	42451	Grain and Field Bean Merchant Wholesalers			0.25		
Base Rock Minerals Inc-Bonne Terre Plant	29187	0072	212312	Crushed and Broken Limestone Mining and Quarrying		6.11	3.48	2.57	1.21
BASF Agri Chemicals-Hannibal Plant	29127	0001	32532	Pesticide and Other Agricultural Chemical Manufacturing	0.12	553.83	142.19	2,437.52	30.85
Bayer Cropscience-Kansas City	29095	0011	32532	Pesticide and Other Agricultural Chemical Manufacturing	0.85	47.64	2.01	0.35	28.92
Bcp Ingredients-Verona Plant	29109	0004	325411	Medicinal and Botanical Manufacturing		6.39		0.03	47.45
Belt Service Corp-Earth City	29189	1012	326220	Rubber and Plastics Hoses and Belting Manufacturing	0.02	0.56	0.01	0.00	42.47
BFI Missouri Pass Landfill-Maryland Heights	29189	0281	562212	Solid Waste Landfill		9.17	0.65	2.92	5.25
BFI Waste Systems Of North America Inc-Lamar Landfill & Prairie View Reg Waste	29011	0039	562212	Solid Waste Landfill		6.69	3.99	2.34	4.36
Biltbest Windows Corp-Ste Genevieve	29186	0003	321911	Wood Window and Door Manufacturing	0.05	0.58	0.47	0.00	9.63
Biokyowa Inc-Nash Road Site	29031	0064	325411	Medicinal and Botanical Manufacturing	4.96	11.11	1.79	1.96	11.13
Bjc Health System-Pavillion	29510	0204	62211	General Medical and Surgical Hospitals		6.56		0.40	0.32
Black Oak Recycling & Disposal Facility-Div Waste Corporation Of America	29229	0022	562212	Solid Waste Landfill		1.89	2.06	0.66	15.05
Blue River Treatment Plant-Blue River Treatment Plant	29095	0039	562211	Hazardous Waste Treatment and Disposal	0.01	16.45	1.36	0.55	3.28
Blue Valley Station	29095	0050	221112	Fossil Fuel Electric Power Generation	0.19	1,213.61	577.49	10,658.32	7.00
Bootheel Cotton Company Inc-Matthews	29143	0047	115111	Cotton Ginning		-	0.17	-	-
Bp Products North America	29095	0002	32411	Petroleum Refineries		0.43			28.84

Inc-Sugar Creek Terminal									
Brenntag Mid-South Inc-Brenntag Mid-South Inc	29510	1093	42392	Toy and Hobby Goods and Supplies Merchant Wholesalers		0.00		-	0.22
Bridgeton Landfill Authority-Bridgeton	29189	0312	562212	Solid Waste Landfill		13.03	5.54	4.56	8.42
Briggs & Stratton Corp-Poplar Bluff	29023	0038	333618	Other Engine Equipment Manufacturing	0.04	7.59	0.38	0.35	68.40
Bristol Manufacturing Corp-Bristol Manufacturing Corp	29077	0008	311513	Cheese Manufacturing	0.03	2.03	0.08	0.01	30.83
Bruce Hardwood Floors-Bruce Hardwood Floors	29091	0046	321113	Sawmills		3.92		1.90	58.44
Buckhorn Rubber Products Inc-Buckhorn Rubber Company Inc	29173	0037	32622	Rubber and Plastics Hoses and Belting Manufacturing	-	-	9.46	-	8.69
Buckman Laboratories Inc-Cadet	29221	0018	311942	Spice and Extract Manufacturing	0.09	2.92	0.22	0.02	0.37
Bull Moose Tube Company-Bull Moose Tube Company	29071	0087	33121	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel		0.55	0.06	0.00	18.70
Bunge North America Inc-Caruthersville Plant	29155	0063	42451	Grain and Field Bean Merchant Wholesalers	-	-	0.49	-	-
Bunge North America Inc-Linda Elevator	29143	0062	42451	Grain and Field Bean Merchant Wholesalers	0.00	0.12	1.39	0.26	0.00
Bunge North America Inc-Louisiana Plant	29163	0025	49313	Farm Product Warehousing and Storage	0.00	0.13	0.54	0.00	0.01
Bussen Quarries Inc-Antire Quarry	29099	0103	212312	Crushed and Broken Limestone Mining and Quarrying			0.09		-
Bussen Quarries Inc-Bussen Road	29189	0275	212312	Crushed and Broken Limestone Mining and Quarrying			0.51		
Butler County Sanitary Landfill-Allied Waste Industries	29023	0058	562212	Solid Waste Landfill		2.69	1.58	0.94	1.73
Butler Municipal Power Plant-Butler	29013	0029	221112	Fossil Fuel Electric Power Generation		1.07	0.01	0.31	0.01
Camie-Campbell Inc-	29189	0327	325520	Adhesive Manufacturing					5.13

Watson Industrial Park									
Campbell Earl Mfg Co-Campbell Earl Mfg Co	29047	0079	32551	Paint and Coating Manufacturing					0.48
Campbell Municipal Power Plant	29069	0064	221112	Fossil Fuel Electric Power Generation	0.01	0.74	0.01	0.01	0.02
Canam Steel Corp-Canam Steel Corp	29071	0014	332312	Fabricated Structural Metal Manufacturing		2.54		0.03	57.77
Cardwell Cooperative Inc-Cardwell Cooperative Inc	29069	0029	115111	Cotton Ginning					0.00
Cargill Inc-Chouteau Elevator	29047	0027	42451	Grain and Field Bean Merchant Wholesalers		0.06		0.00	0.00
Cargill Inc-Kansas City	29095	2001	311222	Soybean Processing	0.07	2.16	26.82	0.01	296.66
Cargill Inc-New Madrid	29143	0027	325314	Fertilizer (Mixing Only) Manufacturing			0.51		
Carlisle Power Transmission Products Inc-Springfield	29077	0004	326220	Rubber and Plastics Hoses and Belting Manufacturing	0.52	30.31	4.46	79.89	110.72
Carondelet Corporation-Carondelet Corporation	29099	0111	331513	Steel Foundries (except Investment)	0.07	6.48	0.16	0.25	67.10
Carrollton Municipal Utilities	29033	0022	221112	Fossil Fuel Electric Power Generation	0.02	3.61	0.07	0.18	5.06
Carthage Water & Electric	29097	0110	221112	Fossil Fuel Electric Power Generation	0.41	39.55	0.42	0.87	1.96
Cascades Plastics Inc-Warrenton	29219	0038	32614	Polystyrene Foam Product Manufacturing					143.42
Caterpillar Inc-Caterpillar Inc	29053	0019	326291	Rubber Product Manufacturing for Mechanical Use		2.14	2.56	0.01	5.71
Centerpoint Energy-Poplar Bluff Compressor Station	29023	0042	48621	Pipeline Transportation of Natural Gas		128.51	1.82	0.04	6.12
Centerpoint Energy-Ste Genevieve Compressor Station	29186	0024	48621	Pipeline Transportation of Natural Gas	0.00	86.95	0.80	0.01	7.38
Centerpoint Energy-Twelve Mile Compressor Station	29123	0018	48621	Pipeline Transportation of Natural Gas		324.94	0.96	0.03	19.66
Central Electric Power Cooperative-Chamois Plant	29151	0002	221112	Fossil Fuel Electric Power Generation	0.10	2,409.01	247.69	5,038.04	15.53
Central Missouri State University-Physical Plant	29101	0002	61131	Colleges, Universities, and Professional Schools		6.66		0.04	2.47

Ceramo Co Inc-Jackson	29031	0012	327112	Vitreous China, Fine Earthenware, and Other Pottery Product Manufacturing		3.89		1.64	31.46
Cerro Copper Casting Company-Cerro Copper Casting Company	29007	0047	331525	Copper Foundries (except Die-Casting)	0.02	3.37	17.42	1.52	5.02
Cerro Copper Tube Company-Cerro Copper Tube Company	29205	0010	331421	Copper Rolling, Drawing, and Extruding		2.65		0.02	23.58
Chemical Lime Company-Ste Genevieve	29186	0035	32741	Lime Manufacturing		1,427.69	60.42	128.61	8.61
Chemisphere Corporation-Chemisphere	29510	0808	32511	Petrochemical Manufacturing					3.20
Chillicothe Municipal Utilities	29117	0002	221112	Fossil Fuel Electric Power Generation		1.83	0.02	0.04	0.02
Christian Health Systems-Boone Hospital Center	29019	0045	62211	General Medical and Surgical Hospitals	0.01	2.02	0.15	0.01	0.11
Christy Minerals Co-High Hill	29139	0008	212324	Kaolin and Ball Clay Mining		170.16	25.04	578.44	0.00
Chrysler Assembly Plant 1-Fenton	29189	0002	336111	Automobile Manufacturing	0.83	25.86	3.38	0.16	203.84
Chrysler Corp-North Plant	29189	0231	336111	Automobile Manufacturing	1.69	61.69	5.53	0.47	468.58
CITY UTILITIES OF SPRINGFIELD MISSOURI-NOBLE HILL LANDFILL RENEW ENGY CTR	29077	0170	221119	Other Electric Power Generation		21.19	5.51	2.16	-
City Utilities Of Springfield-Fulbright Treatment Plant	29077	0163	92613	Regulation and Administration of Communications, Electric, Gas, and Other Utilities		0.28	0.01	0.03	0.02
City Utilities Of Springfield-Main Avenue Gas Turbine	29077	0145	221112	Fossil Fuel Electric Power Generation		0.19	0.01	0.19	0.00
Clariant Life Science Molecules-Clariant Life Science Molecules	29077	0017	325411	Medicinal and Botanical Manufacturing	0.16	7.19	2.42	0.09	3.61
Clay & Bailey Mfg Co-Clay & Bailey Mfg Co	29095	0012	331511	Iron Foundries		0.25		0.01	1.55

College Of The Ozarks-Branson	29213	0048	61131	Colleges, Universities, and Professional Schools	2.79	7.60	0.76	2.05	1.01
Color Art Inc-Crestwood	29189	0282	323110	Commercial Lithographic Printing	0.04	1.20	0.02	0.01	24.04
Columbia Municipal Power Plant-Columbia	29019	0002	221112	Fossil Fuel Electric Power Generation	0.01	375.72	27.30	1,078.52	1.56
Columbia Sanitary Landfill-Columbia Sanitary Landfill	29019	0091	562212	Solid Waste Landfill		8.62	0.91	1.83	8.51
Command Web Offset Missouri Inc-Jefferson City	29051	0043	323110	Commercial Lithographic Printing		5.37	0.41	0.03	24.22
Conagra Foods-Marshall Plant	29195	0004	311412	Frozen Specialty Food Manufacturing	0.16	5.96	0.37	0.03	1.20
Connector Castings-Connector Castings	29510	1556	331314	Secondary Smelting and Alloying of Aluminum	0.01	0.12	0.58	0.01	0.91
ConocoPhillips Co-Mount Vernon Products Terminal	29109	0036	42471	Petroleum Bulk Stations and Terminals		6.78			55.41
Consolidated Grain And Barge Co-Cape Girardeau	29031	0081	42451	Grain and Field Bean Merchant Wholesalers					
CONSOLIDATED GRAIN AND BARGE CO-CONSOLIDATED GRAIN AND BARGE CO	29201	8001	424510	Grain and Field Bean Merchant Wholesalers		1.10	0.20	0.01	0.06
Consolidated Grain And Barge Co-Dorena Facility	29133	0016	49313	Farm Product Warehousing and Storage		-	0.28		-
CONSTRUCTION TRAILER SPECIALISTS INC-SIKESTON	29201	0110	336212	Truck Trailer Manufacturing					14.10
Consumers Oil And Supply Company-Braymer Plant	29025	0008	42451	Grain and Field Bean Merchant Wholesalers			0.15		-
Consumers Oil Co Inc-Maryville Plant	29147	0027	42451	Grain and Field Bean Merchant Wholesalers					2.15
Continental Cement Company Inc-Ilasco Plant	29173	0001	32731	Cement Manufacturing		2,413.44	22.79	135.46	19.76
CONTINENTAL COAL INC-COTTONWOOD CREEK MINE	29013	0036	212111	Bituminous Coal and Lignite Surface Mining		6.99	0.72	0.46	0.57
Cook Brothers Insulation Inc-Cook Brothers Insulation Inc	29095	2058	32614	Polystyrene Foam Product Manufacturing					0.01

Cook Composites And Polymers Co-North Kansas City	29047	0012	325510	Paint and Coating Manufacturing	0.15	6.82	0.38	0.04	4.41
Courtney Ridge Landfill Llc-Courtney Ridge Landfill Llc	29095	0267	562212	Solid Waste Landfill		6.90	3.75	2.42	4.53
Crowder Gin Company Inc-Sikeston	29201	0073	115111	Cotton Ginning		0.24	0.19	0.00	0.01
Crown Center Redevelopment Corporation-Kansas City	29095	2007	72111	Hotels (except Casino Hotels) and Motels	0.34	11.71	0.87	0.12	0.65
Dairiconcepts-El Dorado Springs	29039	0003	311514	Dry, Condensed, and Evaporated Dairy Product Manufacturing	0.21	6.55	33.42	0.06	0.54
Dairy Farmers Of America Inc-Cabool	29215	0026	311514	Dry, Condensed, and Evaporated Dairy Product Manufacturing		9.16		0.05	0.50
Dairy Farmers Of America Inc-Springfield	29077	0036	311514	Dry, Condensed, and Evaporated Dairy Product Manufacturing	0.30	9.31	0.71	0.06	0.96
Dana Corporation-Perfect Circle Division	29189	0025	336311	Carburetor, Piston, Piston Ring, and Valve Manufacturing	0.01	1.04	0.02	0.01	1.73
Davis Paint Co-Davis Paint Co	29047	0040	32551	Paint and Coating Manufacturing		-		-	13.35
Delta Asphalt Inc-Cape Girardeau	29031	0002	324121	Asphalt Paving Mixture and Block Manufacturing	-	11.13	0.20	4.08	1.97
Depaul Health Center-Bridgeton	29189	1029	62211	General Medical and Surgical Hospitals	0.04	7.20	0.55	0.04	0.40
Detroit Tool & Engineering-Lebanon	29105	0013	332212	Hand and Edge Tool Manufacturing		-			1.38
Dial Corp-Dial Corp	29510	0063	325611	Soap and Other Detergent Manufacturing		9.99	24.47	0.06	1.95
Doe Run Company-Buick Mill	29093	0005	212231	Lead Ore and Zinc Ore Mining		-	1.91	-	2.00
Doe Run Company-Buick Smelter	29093	0009	331419	Primary Smelting and Refining of Nonferrous Metal (except Copper and Aluminum)		63.61	19.22	2,518.78	1.74

Doe Run Company-Bunker (Fletcher Mine)	29179	0006	212231	Lead Ore and Zinc Ore Mining		-	1.61	-	2.00
Doe Run Company-Glover Smelter	29093	0008	331419	Primary Smelting and Refining of Nonferrous Metal (except Copper and Aluminum)		0.03	38.85	0.00	0.13
Doe Run Company-Herculaneum Smelter	29099	0003	331419	Primary Smelting and Refining of Nonferrous Metal (except Copper and Aluminum)	0.38	12.32	10.83	35,997.75	2.20
Donaldson Co Inc-Donaldson Co Inc	29117	0012	336211	Motor Vehicle Body Manufacturing	0.04	1.38	0.10	0.01	2.88
Dow Chemical Company The-Riverside Plant	29099	0014	325211	Plastics Material and Resin Manufacturing	0.04	1.32	0.10	0.01	1.42
DYNAMIC FINISHES - JOPLIN	29097	0154	333131	Mining Machinery and Equipment Manufacturing					6.74
Dyno Nobel Inc-Carthage Plant	29097	0007	32592	Explosives Manufacturing	2.00	12.33	0.35	4.39	0.60
Dyno Nobel Inc-Lomo Plant	29163	0031	325311	Nitrogenous Fertilizer Manufacturing	25.20	928.73	57.23		
E F Marsh Engineering Company-Mt Vernon	29109	0051	333922	Conveyor and Conveying Equipment Manufacturing					11.81
Eagle Ridge Landfill-Bowling Green	29163	0040	562212	Solid Waste Landfill			0.24		2.68
Eagle-Picher Technologies Llc-Federal Systems	29097	0117	335911	Storage Battery Manufacturing		0.88		0.01	3.67
Edwards Fiberglass Inc-Sedalia	29159	0056	326191	Plastics Plumbing Fixture Manufacturing					45.10
EDWARDS FRP REPAIR-WINGATE	29159	0059	325211	Plastics Material and Resin Manufacturing					4.73
Efco Corporation-Efco Corporation	29009	0003	332321	Metal Window and Door Manufacturing	0.93	5.17	0.39	0.03	407.39
Elementis Specialties Inc-Elementis Specialties Inc	29510	0066	325131	Inorganic Dye and Pigment Manufacturing	0.26	8.07	0.38	0.05	56.32
Empire District Electric Co-Asbury Plant	29097	0001	221112	Fossil Fuel Electric Power Generation	4.74	4,829.82	465.26	10,755.97	27.20
Empire District Electric Co-Empire Energy Center	29097	0062	221112	Fossil Fuel Electric Power Generation		40.82	3.38	0.40	1.07

Empire District Electric Co-State Line Facility	29097	0104	221112	Fossil Fuel Electric Power Generation	70.52	114.00	52.37	4.80	63.50
Energy Center (The)-St Louis Univ Health Sciences Center	29510	1505	621111	Offices of Physicians (except Mental Health Specialists)		11.64	0.39	0.92	0.70
Energy Petroleum Company-Kienlen	29189	0141	42471	Petroleum Bulk Stations and Terminals					7.19
Engineered Coil Company-D B A Marlo Coil	29099	0052	336611	Ship Building and Repairing		0.12		0.00	9.47
ENNIS PAINT INC-SAVERTON	29173	0021	325510	Paint and Coating Manufacturing					5.91
Essex Power Plant	29207	0064	221112	Fossil Fuel Electric Power Generation		0.55	0.07	0.01	0.02
Eveready Battery Co Inc-Maryville Plant	29147	0008	335912	Primary Battery Manufacturing	0.07	2.26	0.17	0.01	25.97
Exide Technologies-Canon Hollow	29087	0001	331314	Secondary Smelting and Alloying of Aluminum	0.13	7.35	19.74	117.24	103.95
F & S Real Eastate Inc-St Louis	29189	1520	323112	Commercial Flexographic Printing					61.13
FACILITY OPERATION SERVICES LLC-NW 112TH	29165	2424	221330	Steam and Air-Conditioning Supply		44.05	1.27	0.18	0.86
Fag Bearings Corporation-Joplin	29145	0007	332991	Ball and Roller Bearing Manufacturing	0.11	3.34	0.25	0.02	21.15
Falcon Foam-Falcon Foam	29157	0020	326121	Unlaminated Plastics Profile Shape Manufacturing		2.51		25.07	87.53
Farmers Elevator & Supply Co-Hawk Point	29113	0042	42491	Farm Supplies Merchant Wholesalers		0.02	0.16	0.00	0.00
Farmers Union Gin-Farmers Union Gin	29069	0018	115111	Cotton Ginning			0.96		
FARMINGTON LIGHT & POWER-FARMINGTON	29187	0075	221112	Fossil Fuel Electric Power Generation	0.01	0.68	0.00	0.31	0.02
Fasco Industries Inc-Cassville Plant	29009	0037	335312	Motor and Generator Manufacturing	1.10	6.13	0.53	0.04	1.48
Fasco Industries Inc-Eldon Plant	29131	0032	335312	Motor and Generator Manufacturing	0.00	0.08	0.13	0.00	25.23
Flat River Glass Co-Park Hills	29187	0017	327211	Flat Glass Manufacturing	3.40	323.34	15.13	18.15	6.32
Flex-O-Lite Inc-Fenton	29189	0315	327215	Glass Product		-		-	24.34

				Manufacturing Made of Purchased Glass					
Folgers Coffee Co-Folgers Coffee Co	29095	0017	31192	Coffee and Tea Manufacturing		42.39		13.99	70.37
Ford Motor Co-Kansas City Assembly Plant	29047	0019	336111	Automobile Manufacturing	2.17	67.96	40.81	0.41	1,300.08
Four Way Gin Company-Four Way Gin Company	29069	0027	115111	Cotton Ginning			0.37		
Fred Weber Inc Sanitary Landfill-St Louis County	29189	0308	562212	Solid Waste Landfill		6.94	3.30	2.43	8.12
Fred Weber Inc-Asphalt Plant	29510	0047	324121	Asphalt Paving Mixture and Block Manufacturing	0.00	1.75		0.11	0.22
Fred Weber Inc-North Asphalt B & G	29189	1250	324121	Asphalt Paving Mixture and Block Manufacturing		2.34		0.43	0.77
Fred Weber Inc-North Asphalt H & B	29189	1249	324121	Asphalt Paving Mixture and Block Manufacturing		9.19	0.62	0.88	1.64
Fred Weber Inc-North Stone	29189	0017	324121	Asphalt Paving Mixture and Block Manufacturing			4.96		
Fred Weber Inc-O'Fallon Asphalt Plant	29183	0004	324121	Asphalt Paving Mixture and Block Manufacturing	0.04	2.06	0.12	0.17	0.36
Fred Weber Inc-O'Fallon Stone Plant	29183	0007	212312	Crushed and Broken Limestone Mining and Quarrying			0.01		
Fred Weber Inc-South Asphalt	29189	1248	324121	Asphalt Paving Mixture and Block Manufacturing		3.98	0.01	0.28	0.52
Fred Weber Inc-South Stone	29189	0019	324121	Asphalt Paving Mixture and Block Manufacturing			0.02		
Fulton Power Plant-Fulton	29027	0007	221112	Fossil Fuel Electric Power Generation	0.28	5.30	0.19	0.09	0.15
Fulton State Hospital-Fulton	29027	0021	62221	Psychiatric and Substance Abuse Hospitals	0.03	6.56	0.50	0.04	0.36
G3 Boats-Lebanon	29105	0038	336612	Boat Building				0.01	48.62
Gardner Denver Inc-Sedalia Plant	29159	0039	333912	Air and Gas Compressor Manufacturing		-	0.06	-	4.11
Garnett Wood Products-Charcoal Plant	29091	0038	325191	Gum and Wood Chemical Manufacturing		58.11	-		380.14
Gates Rubber Company-Gates Rubber Company	29133	0014	32622	Rubber and Plastics Hoses and Belting Manufacturing		1.10		0.01	0.22

Gates Rubber Company-Poplar Bluff Division	29023	0032	32622	Rubber and Plastics Hoses and Belting Manufacturing		4.18		0.03	13.36
GDX Automotive - Danny Scott Drive-New Haven	29071	0173	31332	Fabric Coating Mills		0.00		-	23.67
General Electric-Springfield	29077	0056	335312	Motor and Generator Manufacturing	0.02	1.02	0.04	0.04	24.13
General Motors-Wentzville Center	29183	0076	336111	Automobile Manufacturing	0.34	274.20	1.54	447.12	550.70
GEORGE'S INC-POULTRY FEED MILL	29009	0066	311119	Other Animal Food Manufacturing	0.01	0.25	0.85	0.00	0.13
Gkn Aerospace Services Inc-Berkeley	29189	1489	336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	0.44	7.23	13.36	0.17	51.28
Golden Triangle Energy-Craig	29087	0016	32511	Petrochemical Manufacturing	0.84	9.49	3.91	0.33	50.22
Goodwin Printing Co -St Louis	29510	1055	323110	Commercial Lithographic Printing					8.86
Graves Kennett Gin-Kennett	29069	0014	115111	Cotton Ginning		0.16	0.20	0.00	0.01
Greif Inc-Wright City	29219	0036	322214	Fiber Can, Tube, Drum, and Similar Products Manufacturing	0.00	0.11		0.00	12.35
H & G Marine Service Inc-Perryville	29157	0022	332439	Other Metal Container Manufacturing					13.84
Hallmark Cards Inc-Distribution Center	29047	0059	323110	Commercial Lithographic Printing		1.92		0.01	0.57
Hallmark Cards-Hallmark Cards	29095	0114	323110	Commercial Lithographic Printing	0.11	7.98	0.29	0.04	18.42
Harbison-Walker Refractories-Harbison-Walker Refractories	29027	0001	327124	Clay Refractory Manufacturing		7.09	0.75	16.72	0.16
Harbison-Walker Refractories-Vandalia Plant	29007	0003	327124	Clay Refractory Manufacturing		8.53	4.76	14.46	0.82
Harley Davidson Motor Company-Kansas City Plant	29165	2415	336991	Motorcycle, Bicycle, and Parts Manufacturing	1.29	9.57	0.82	0.06	22.48
Havco Wood Products Inc-Havco Wood Products Inc	29201	0021	321113	Sawmills	-	21.26	8.22	2.42	1.61
Hawker Energy Products	29101	0023	335912	Primary Battery		3.23	0.30	0.21	53.03

Inc-Warrensburg				Manufacturing					
Hawthorn Station	29095	0022	221112	Fossil Fuel Electric Power Generation	5.46	1,465.46	90.88	1,725.44	14.68
Hayes Lemmerz International Inc-Sedalia	29159	0027	336211	Motor Vehicle Body Manufacturing		5.90		0.04	76.33
Heartland Regional Medical Center East-St Joseph	29021	0063	62211	General Medical and Surgical Hospitals	0.02	5.05	0.38	0.03	0.28
Henry Wurst Inc-North Kansas City	29047	0032	323110	Commercial Lithographic Printing		1.99		0.00	26.28
Hermann Oak Leather Co-Hermann Oak Leather Co	29510	0391	31611	Leather and Hide Tanning and Finishing		-		-	6.70
Higginsville Municipal Power Facility	29107	0038	221112	Fossil Fuel Electric Power Generation	0.04	1.56	0.04	0.03	0.04
Holcim (Us) Inc-Clarksville	29163	0001	32731	Cement Manufacturing	4.18	5,367.52	209.56	7,835.95	564.31
Holden Power Plant	29101	0051	221112	Fossil Fuel Electric Power Generation		13.39	1.71	1.64	1.16
Holland Usa-Warrenton Facility	29219	0013	332117	Powder Metallurgy Part Manufacturing					11.76
Horner Charcoal Co Inc-Horner Charcoal Co Inc	29213	0002	325191	Gum and Wood Chemical Manufacturing		6.82	0.17		0.77
Hutchens Industries-Mansfield Steel Div	29229	0001	336212	Truck Trailer Manufacturing	0.10	1.15	0.04	0.01	13.06
Hydro Aluminum Wells-Monett	29009	0005	331421	Copper Rolling, Drawing, and Extruding	0.54	17.41	3.66	0.73	77.82
ICI Explosives Environmental Co-Joplin	29097	0138	562211	Hazardous Waste Treatment and Disposal		19.75		0.29	0.34
IESI CORPORATION-TIMBER RIDGE LANDFILL	29221	0031	562212	Solid Waste Landfill					1.02
Independence Power And Light-Missouri City Station	29047	0096	221112	Fossil Fuel Electric Power Generation	0.06	531.30	159.52	2,591.78	0.70
Independence Power And Light-Sub Station H	29095	0223	221112	Fossil Fuel Electric Power Generation		2.13		0.00	0.01
Independence Power And Light-Sub Station I	29095	0222	221112	Fossil Fuel Electric Power Generation		1.28		0.07	0.02
Independence Power And Light-Sub Station J	29095	0224	221112	Fossil Fuel Electric Power Generation		0.61		0.04	0.01
Independence Regional Health Center-	29095	0066	62211	General Medical and Surgical Hospitals	0.04	1.17	0.09	0.01	0.06

Independence									
Independent Stave Co Inc-Lebanon Plant	29105	0001	321920	Wood Container and Pallet Manufacturing	1.38	32.70	6.35	1.62	1.13
Integram - St Louis Seating-Pacific	29071	0144	33636	Motor Vehicle Seating and Interior Trim Manufacturing		0.58	0.04	0.00	18.61
International Paper Company-International Paper Company	29095	2177	322211	Corrugated and Solid Fiber Box Manufacturing	0.02	3.12	0.24	0.02	0.20
Interstate Brands Corp-Interstate Brands Corp	29510	0938	311812	Commercial Bakeries	0.05	2.12	0.11	0.01	43.55
Interstate Brands Corporation-Butternut Bread	29077	0011	311812	Commercial Bakeries	0.03	0.90	0.37	0.01	10.73
Italgrani Elevator-Italgrani Elevator	29510	0179	42451	Grain and Field Bean Merchant Wholesalers	0.12	3.84	0.93	0.02	0.62
J P Ross Cotton Co Inc-J P Ross Cotton Co Inc	29207	0008	115111	Cotton Ginning		0.36	0.30	-	0.01
J S Alberici Construction-J S Alberici Construction	29510	1642	236220	Commercial and Institutional Building Construction		-		-	24.79
Jackson Municipal Utilities-Jackson Municipal Utilities	29031	0061	221112	Fossil Fuel Electric Power Generation		0.44	0.01	0.00	0.01
James River Power Plant	29077	0005	221112	Fossil Fuel Electric Power Generation		2,706.52	83.21	5,288.40	34.88
Jefferson City Landfill-Laidlaw Waste Systems	29051	0058	562212	Solid Waste Landfill		3.76	1.75	1.32	2.44
Jefferson Smurfit Corp-Pacific	29071	0031	322212	Folding Paperboard Box Manufacturing	-	-	-		29.68
Jesco Resources Inc-Jesco Resources Inc	29047	0052	324191	Petroleum Lubricating Oil and Grease Manufacturing		0.60		0.00	0.04
John J Pershing Va Medical Center-Poplar Bluff	29023	0027	62211	General Medical and Surgical Hospitals	0.11	4.21	0.12	1.16	0.09
Johnson Controls Hoover Auto-Johnson Controls Hoover Auto	29051	0037	32614	Polystyrene Foam Product Manufacturing		-	0.14	-	85.81
Justin Boot Company-Carthage (Plant 417)	29097	0058	316219	Other Footwear Manufacturing					12.12
Justin Boot Company-	29009	0052	316213	Men's Footwear (except		0.17	0.01	0.00	17.35

Cassville (Plant 414)				Athletic) Manufacturing					
Kansas City Power & Light Co-Iatan Generating Station	29165	0007	221112	Fossil Fuel Electric Power Generation	0.80	6,922.12	294.70	15,076.71	75.42
Kansas City Power & Light Co-Northeast Station	29095	0023	221112	Fossil Fuel Electric Power Generation		24.76	0.28	3.98	1.01
Kawasaki Motors Mfg Corp-Kawasaki Motors Mfg Corp	29147	0023	333618	Other Engine Equipment Manufacturing		19.50	4.67	0.18	150.47
KCI Airport - KCMO Aviation Dept	29165	2404	488111	Air Traffic Control	0.03	5.45	0.40	0.16	4.85
KCP&L GMO-SOUTH HARPER PEAKING FACILITY	29037	0063	221112	Fossil Fuel Electric Power Generation		48.11	2.73	2.32	1.44
Keller Construction Company-Keller Construction Company	29003	P011	324121	Asphalt Paving Mixture and Block Manufacturing		0.54	0.12	0.10	0.18
Kennett Generating Plant	29069	0063	221112	Fossil Fuel Electric Power Generation		6.09	0.09	0.18	0.49
Kingsford Manufacturing Co-Briquetting Plant	29125	0001	325191	Gum and Wood Chemical Manufacturing		112.17		15.75	54.77
Koch Materials Company-Koch Materials Company	29095	0064	324121	Asphalt Paving Mixture and Block Manufacturing	0.14	4.44	0.34	0.03	0.24
Kraft Foods North America Inc-Kraft Foods North America Inc	29077	0026	311513	Cheese Manufacturing	0.36	11.11	0.84	0.07	5.81
Kv Pharmaceutical Company-Brentwood	29189	1015	325412	Pharmaceutical Preparation Manufacturing	-	-	0.11	-	58.93
Kv Pharmaceutical Company-Schuetz Rd	29189	1047	325412	Pharmaceutical Preparation Manufacturing	0.05	1.45	0.77	0.01	6.40
KV PHARMACEUTICAL-BRIDGETON	29189	1538	325412	Pharmaceutical Preparation Manufacturing	-	-	0.00	-	18.49
L Berry Gin Company-L Berry Gin Company	29155	0021	115111	Cotton Ginning		0.11	0.42	0.00	0.01
Laclede Tower Associates Llc-Laclede Gas Building	29510	2378	22121	Natural Gas Distribution	0.00	207.44	0.87	0.05	2.71
Lafarge North America Inc - Sedalia Quarry & Asphalt	29159	0002	212312	Crushed and Broken Limestone Mining and Quarrying		2.73	0.23	2.05	0.55
LAFARGE NORTH AMERICA INC-COURTNEY RIDGE	29095	0321	212312	Crushed and Broken Limestone Mining and			0.02		

QUARRY				Quarrying					
Lafarge North America Inc-Independence Plant	29095	0030	32731	Cement Manufacturing	4.05	1,455.87	63.05	286.07	77.05
Lamar City Electrical Generation-Lamar	29011	0031	221112	Fossil Fuel Electric Power Generation		1.98	0.01	0.00	0.03
Landmark Mfg Corp-Landmark Mfg Corp	29061	0010	332313	Plate Work Manufacturing		6.21	0.49	0.41	1.17
Lange-Stegmann Co-Lange-Stegmann Co	29510	0468	42491	Farm Supplies Merchant Wholesalers		0.00		-	0.00
La-Z-Boy Chair Company-La-Z-Boy Midwest	29145	0005	337121	Upholstered Household Furniture Manufacturing	0.02	0.96	0.05	0.01	10.82
Lead Belt Materials Co Inc-Park Hills	29187	0001	212312	Crushed and Broken Limestone Mining and Quarrying	-	0.86	0.89	0.02	1.06
Lee'S Summit Sanitary Landfill-Lee'S Summit Sanitary Landfill	29095	0272	562212	Solid Waste Landfill		2.02	1.00	0.71	1.39
Leggett & Platt-Wire Mill - Carthage Central Ave	29097	0143	331222	Steel Wire Drawing		15.08		0.09	2.13
Lemons Sanitary Landfill-Lemons Sanitary Landfill	29207	0062	562212	Solid Waste Landfill		3.62	2.05	1.41	2.33
Life Line Foods-St Joseph	29021	0016	311211	Flour Milling		36.40	2.97	32.42	6.25
Lone Star Industries Inc-Cape Girardeau	29031	0021	32731	Cement Manufacturing	16.89	1,163.76	180.15	13.43	21.62
Lowe Boats-Omc Aluminum Boat Group	29105	0006	336612	Boat Building		1.18			64.69
Loxcreen Company Inc-Hayti	29155	0045	331316	Aluminum Extruded Product Manufacturing		4.21		0.03	4.99
MACON MUNICIPAL UTILITIES-KELLOGG AVE	29121	0035	221112	Fossil Fuel Electric Power Generation		1.16	0.03	0.08	0.10
MACON MUNICIPAL UTILITIES-NEMO GENERATING STATION	29121	0033	221112	Fossil Fuel Electric Power Generation		17.63	3.25	0.29	1.03
MACON MUNICIPAL UTILITIES-NOLL DRIVE	29121	0036	221112	Fossil Fuel Electric Power Generation		0.55	0.01	0.04	0.04
Magellan Pipeline Company Llc-Columbia Station	29019	0005	48691	Pipeline Transportation of Refined Petroleum Products		3.70			38.60
Magellan Pipeline Company	29063	0009	48691	Pipeline Transportation of		9.26			0.71

Llc-Osborn Station				Refined Petroleum Products					
Magellan Pipeline Company Llc-Palmyra Station	29127	0002	48691	Pipeline Transportation of Refined Petroleum Products		1.22			9.88
Magellan Pipeline Company Llc-Ridgeway Station	29081	0010	48691	Pipeline Transportation of Refined Petroleum Products		47.03			3.47
Magellan Pipeline Company Llc-Springfield Terminal	29077	0116	48691	Pipeline Transportation of Refined Petroleum Products		7.18			46.64
Magellan Pipeline Company-Carthage Terminal	29097	0079	48691	Pipeline Transportation of Refined Petroleum Products		0.97		-	13.62
Magnet Llc-Washington	29071	0153	33995	Sign Manufacturing					9.73
Mahan Gin Co-Mahan Gin Co	29143	0012	115111	Cotton Ginning		0.16		0.00	0.01
Mallinckrodt Inc - Mallinckrodt Inc	29510	0017	32511	Petrochemical Manufacturing	4.13	107.11	23.96	273.50	43.76
Manac Trailers Usa Inc-Oran	29201	0102	333294	Food Product Machinery Manufacturing		0.09			1.77
Manchester Packaging Company-Manchester Packaging Company	29161	0039	326121	Unlaminated Plastics Profile Shape Manufacturing		0.03		0.00	50.55
Manscen And Fort Leonard Wood-Manscen And Fort Leonard Wood	29169	0004	928110	National Security	9.01	40.45	0.76	29.79	21.70
Marathon Electric Mfg Corp-Lebanon Plant	29105	0033	335312	Motor and Generator Manufacturing		2.05	0.31	0.00	28.56
Marble Decor Inc-Marble Decor Inc	29071	0154	326121	Unlaminated Plastics Profile Shape Manufacturing		-		-	0.45
Marquette Tool & Die-Marquette Tool & Die	29510	0162	314999	All Other Miscellaneous Textile Product Mills					7.40
Marshall Municipal Utilities	29195	0010	221112	Fossil Fuel Electric Power Generation	0.20	617.32	149.09	3,146.86	4.17
Martin Marietta Materials Inc-Perryville Quarry #366	29157	P023	212312	Crushed and Broken Limestone Mining and Quarrying			0.50		
Martin Marietta Materials-Appleton Quarry #368	29031	0008	212312	Crushed and Broken Limestone Mining and Quarrying		-	0.02	-	-
Martin Marietta Materials-	29157	0032	324121	Asphalt Paving Mixture and		0.92	0.01	0.69	0.52

Carolina Asphalt Company				Block Manufacturing					
Martin Marietta-Greenwood Quarry #527	29037	0001	212312	Crushed and Broken Limestone Mining and Quarrying			0.08		
Martin Marietta-Peculiar Quarry #528	29037	0002	212312	Crushed and Broken Limestone Mining and Quarrying			0.05		
Martinsburg Farmers Elevator-Martinsburg	29007	0033	42451	Grain and Field Bean Merchant Wholesalers			0.19		
Master Marble Inc-Holden	29101	0054	326121	Unlaminated Plastics Profile Shape Manufacturing		-	-		3.15
Mccord Gin Company-Gideon	29143	0023	115111	Cotton Ginning		-	0.35	-	-
McDonnell Douglas Corp /Boeing Company-Lindbergh Plant	29189	0230	336411	Aircraft Manufacturing	0.77	22.32	0.66	0.35	69.39
McDonnell Douglas Corp-Boeing Company	29183	0010	334413	Semiconductor and Related Device Manufacturing	0.08	2.56	0.05	0.02	14.85
Memc Electronic Materials Inc-St Peters Plant	29183	0027	334416	Electronic Coil, Transformer, and Other Inductor Manufacturing	5.11	23.58	4.47	0.14	15.08
Meramec Industries Inc-Ramsey St Plant	29071	0068	326121	Unlaminated Plastics Profile Shape Manufacturing		0.31		0.00	37.84
Metal Container Corporation-Arnold	29099	0044	332431	Metal Can Manufacturing		11.26	2.79	0.07	111.91
Metropolitan St Louis Sewer District-Bissel Plant	29510	0053	92411	Administration of Air and Water Resource and Solid Waste Management Programs	534.96	89.34	3.62	10.93	43.21
Metropolitan St Louis Sewer District-Coldwater Creek Sewage Treatment Plant	29189	1210	22132	Sewage Treatment Facilities	105.85	69.15	0.38	2.02	3.32
Metropolitan St Louis Sewer District-Lemay Waste Water Treatment Plant	29189	0217	22132	Sewage Treatment Facilities	505.36	51.79	1.86	2.07	18.63
Metropolitan St Louis	29189	1205	22132	Sewage Treatment Facilities	101.19	91.27	0.27	1.41	11.15

Sewer District-Mo River Wasterwater Treatment Plant									
Mexico Plastic Company-Mexico	29007	0051	326111	Plastics Bag and Pouch Manufacturing		0.37		0.00	138.47
Midland Lithography Co-North Kansas City	29047	0033	323110	Commercial Lithographic Printing		-	-	-	13.86
MID-MISSOURI ENERGY INC-MALTA BEND	29195	0046	325193	Ethyl Alcohol Manufacturing		36.27	8.42	0.41	31.96
Mid-West Industrial Chemical-Mid-West Industrial Chemical	29510	1077	32552	Adhesive Manufacturing		-	-	-	6.24
Mississippi Lime Company-Mississippi Lime Co	29186	0001	32741	Lime Manufacturing	0.01	3,731.60	1.84	4,304.35	34.34
Missouri Dept Of Corrections-Boonville Correctional Center	29053	0027	92214	Correctional Institutions	0.11	1.08	0.25	1.10	0.18
Missouri Hardwood Flooring Co-Missouri Hardwood Flooring Co	29203	0005	321113	Sawmills		15.96	0.58	0.81	0.55
Missouri Pressed Metals Inc-Sedalia	29159	0041	332117	Powder Metallurgy Part Manufacturing	0.00	0.03	0.00	0.00	8.96
Mo Rehabilitation Center-Mo Rehabilitation Center	29109	0008	62211	General Medical and Surgical Hospitals	0.01	0.11	0.10	0.01	0.07
Modine Manufacturing Co-Modine Manufacturing Co	29029	0009	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	0.01	2.80		0.00	13.08
Modine Manufacturing Company-Jefferson City	29051	0032	336211	Motor Vehicle Body Manufacturing	0.08	2.50	5.51	0.02	11.58
Modine Manufacturing Company-Joplin	29097	0065	332313	Plate Work Manufacturing		0.71		0.00	0.76
Modine Manufacturing Company-Trenton	29079	0004	336211	Motor Vehicle Body Manufacturing	0.13	4.02	0.38	0.00	51.76
Monroe City Power Plant-Monroe City	29137	0028	221112	Fossil Fuel Electric Power Generation		0.18		0.01	0.01
Monsanto World	29189	0020	54171	Research and Development	0.39	12.29	0.23	0.07	0.68

Headquarters-Lindbergh Blvd				in the Physical, Engineering, and Life Sciences					
Montrose Generating Station	29083	0001	221112	Fossil Fuel Electric Power Generation	0.98	6,419.69	245.89	12,123.91	61.91
Most Inc-Troy	29113	0046	331314	Secondary Smelting and Alloying of Aluminum		2.62	5.12	0.22	1.34
Multiplex Display Fixture-Fenton	29189	0242	337127	Institutional Furniture Manufacturing		0.59	0.04	0.00	1.11
N L McCartney Dist Generation	29077	0164	221112	Fossil Fuel Electric Power Generation		29.65	0.95	0.12	0.61
National Geospatial-Intelligence Agency-National Geospatial-Intelligence Agency	29510	1370	92811	National Security	0.05	1.92	0.13	0.03	0.11
National Starch & Chemical Co-National Starch & Chemical Co	29047	0002	311221	Wet Corn Milling		34.20	0.06	84.71	74.57
Natural Gas Pipeline Company-Marble Hill Plant	29017	0019	48621	Pipeline Transportation of Natural Gas	2.36	2,497.11	27.15	0.33	67.43
Nesco Container Corp-Fenton	29189	0226	332439	Other Metal Container Manufacturing	0.04	2.36	0.02	0.01	93.66
Nestle Purina Petcare Company-Bloomfield	29207	0014	212324	Kaolin and Ball Clay Mining		67.86	17.72	0.31	2.84
New Surface Llc-East 12th	29095	2224	327991	Cut Stone and Stone Product Manufacturing		0.00			1.02
NEW SURFACE-ODESSA	29107	0063	326121	Unlaminated Plastics Profile Shape Manufacturing		0.01			0.54
New World Pasta- Marceau Facility-New World Pasta	29510	2433	311823	Dry Pasta Manufacturing	0.17	5.46	0.98	0.03	0.30
Nodaway Plant	29147	0032	221112	Fossil Fuel Electric Power Generation		0.56	0.05	0.01	0.02
Noranda Aluminum Inc-Noranda Aluminum Inc	29143	0008	331312	Primary Aluminum Production	1.15	36.24	257.04	4,688.14	239.37
Nordenia U S A Inc-Neely'S Landing	29031	0072	31213	Wineries		-	0.57	-	93.84
Nordyne Inc-Boonville Plant	29053	0021	333414	Heating Equipment (except Warm Air Furnaces) Manufacturing		0.89		0.01	55.21

Nordyne-Poplar Bluff	29023	0062	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing		0.02		0.00	55.09
Northeast Missouri Grain Llc-Macon	29121	0028	32511	Petrochemical Manufacturing		33.64	0.02	0.20	58.50
Northwest Missouri State University-Maryville	29147	0005	61131	Colleges, Universities, and Professional Schools	-	25.24	2.22	0.87	1.62
O Fallon Casting Llc-O Fallon	29183	0077	331512	Steel Investment Foundries	1.59	1.85	0.60	0.01	89.98
OFFICE OF ADMINISTRATION FMDC-MOBERLY CORRECTIONAL CENTER	29175	0034	922140	Correctional Institutions	0.03	7.08	0.52	0.05	19.95
Old Monroe Elevator & Supplies-Old Monroe	29113	0003	311119	Other Animal Food Manufacturing		0.04	0.11	0.00	0.00
Omnium Llc-St Joseph	29021	0045	32532	Pesticide and Other Agricultural Chemical Manufacturing		-		-	-
Onyx Oak Ridge Landfill Inc-(West County)	29189	0310	562212	Solid Waste Landfill		2.39	1.14	0.84	4.14
P D George Co (The)-P D George Co (The)	29510	0096	32551	Paint and Coating Manufacturing	0.30	4.66	1.43	0.03	38.27
Pace Construction Co-Poplar Bluff Plant	29023	0021	324121	Asphalt Paving Mixture and Block Manufacturing		0.01		2.25	0.27
Package Service Co Llc-Package Service Co Llc	29165	0021	323112	Commercial Flexographic Printing	-	-	-	-	33.76
Pan-Glo St Louis-Trenton Avenue	29189	1192	811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance					4.82
Panhandle Eastern Pipe Line Co-Houstonia	29159	0047	48621	Pipeline Transportation of Natural Gas		1,811.33	36.21	0.44	95.38
Panhandle Eastern Pipeline-Centralia Compressor Station	29019	0077	48621	Pipeline Transportation of Natural Gas		1,932.37	23.94	0.89	76.65

Paramount Metalizing Co-Sullivan	29055	0043	32622	Rubber and Plastics Hoses and Belting Manufacturing					36.04
Pechiney Plastic Packaging Inc-Joplin Plant	29097	0132	323112	Commercial Flexographic Printing	0.04	2.48	0.19	0.01	157.45
Permacel St Louis Inc-Permacel St Louis Inc	29510	1519	326299	All Other Rubber Product Manufacturing	0.03	1.73	0.08	0.01	0.75
Peterson Mfg Co-Grandview	29095	0075	336321	Vehicular Lighting Equipment Manufacturing		0.61	0.04	0.02	1.15
Pharmacia-Chesterfield Village	29189	0032	32511	Petrochemical Manufacturing	0.44	15.36	0.27	0.36	20.66
Phillips Pipeline Company-Jefferson City Terminal	29051	0042	42471	Petroleum Bulk Stations and Terminals		18.28			39.13
Pittsburgh-Corning Corp-Pittsburgh-Corning Corp	29159	0009	327993	Mineral Wool Manufacturing		199.61	3.15	150.50	3.24
Plastene Supply Company-Div Siegel-Robert Inc	29143	0015	326121	Unlaminated Plastics Profile Shape Manufacturing	0.07	4.44	0.06	0.02	74.68
Playpower Lt Farmington Inc-Iron Mountain Forge Corp	29187	0041	337121	Upholstered Household Furniture Manufacturing	0.10	3.18	2.36	0.02	8.46
Plaze Incorporated-Plaze Incorporated	29071	0157	311942	Spice and Extract Manufacturing		1.67		0.01	44.87
POET BIOREFINING-LADDONIA PLANT	29007	0054	325193	Ethyl Alcohol Manufacturing		36.18		1.29	65.53
Poly One Corporation-St Louis	29510	0161	32551	Paint and Coating Manufacturing					3.34
Poplar Bluff Municipal Utilities-Generating Plant	29023	0050	221112	Fossil Fuel Electric Power Generation	0.11	6.89	0.15	0.09	0.75
Portageville Farmers Gin Inc-Portageville Farmers Gin Inc	29143	0013	115111	Cotton Ginning			0.19		
PQ Corporation (The)-St Louis	29510	0809	211112	Natural Gas Liquid Extraction	0.53	113.75	66.57	0.18	5.19
PRAIRIE PRIDE INC-EVE	29217	0043	311222	Soybean Processing		12.94	2.79	0.08	53.66
Precoat Metals-Precoat Metals	29510	0027	332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers		6.07		0.04	29.21
Premier Turbines-Neosho	29145	0044	336412	Aircraft Engine and Engine		15.53		0.94	27.69

Plant				Parts Manufacturing					
Printpack Inc-Hazelwood Plant	29189	0208	322221	Coated and Laminated Packaging Paper Manufacturing	0.13	4.11	0.08	0.02	233.46
Procter & Gamble Paper Products Co-Neely'S Landing	29031	0053	322291	Sanitary Paper Product Manufacturing	1.73	160.77	4.11	0.97	206.93
Procter & Gamble-Procter & Gamble	29510	0057	325611	Soap and Other Detergent Manufacturing	0.38	11.91	47.35	0.73	0.65
Pro-Tect Mfg Inc-Ferguson Ave	29189	0317	32614	Polystyrene Foam Product Manufacturing					19.25
Purcell Tire-Purcell Tire	29221	0022	443112	Radio, Television, and Other Electronics Stores		2.50	0.49	0.02	11.60
Quaker Window Products Company-Quaker Window Products Company	29151	0050	332321	Metal Window and Door Manufacturing		0.98	0.00	0.00	39.95
Ray-Carroll County Grain Growers Inc-Carrollton Facility	29033	0023	42451	Grain and Field Bean Merchant Wholesalers		0.35	0.02	0.00	0.08
Razorback Pipeline Company-Transmontaigne Product Services Inc	29109	0002	49311	General Warehousing and Storage		0.12			8.03
Rc Cement Company Inc-River Cement Co - Selma Plant	29099	0002	32731	Cement Manufacturing	5.70	2,608.15	197.39	2,758.03	195.65
Red Wing Shoe Company Inc-Potosi	29221	0008	316214	Women's Footwear (except Athletic) Manufacturing					5.33
Reichhold Chemicals Inc-Valley Park	29189	1097	325211	Plastics Material and Resin Manufacturing	0.17	5.24	0.18	0.03	33.03
Research Medical Center-Research Medical Center	29095	2054	62211	General Medical and Surgical Hospitals	0.33	9.63	0.13	0.07	0.20
Rockwood Pigments Na Inc-E Hoffmeister	29189	0035	325131	Inorganic Dye and Pigment Manufacturing	0.37	12.09	0.24	3.53	0.71
Rolla Municipal Utilities-Multiple Peaking Plants	29161	0054	221112	Fossil Fuel Electric Power Generation		0.44	0.01	0.01	0.02
Royal Oak Enterprises Inc-Salem Briquet Plant	29065	0038	325191	Gum and Wood Chemical Manufacturing	-	32.20	17.58	1.59	5.00
Royal Oak Enterprises-	29213	0007	325191	Gum and Wood Chemical		9.56	5.95	1.09	7.83

Royal Oak Enterprises				Manufacturing					
RR Donnelley-Owensville	29073	0008	323110	Commercial Lithographic Printing	0.06	1.88	0.14	0.01	145.12
Rumble Recycling And Disposal-Sanitary Landfill Rumble 1 & 2	29095	0273	562212	Solid Waste Landfill		1.24	0.53	0.43	0.35
Ruprecht Quarry-Paule Rd	29189	0276	212312	Crushed and Broken Limestone Mining and Quarrying					
S & K Industries Inc-S & K Industries Inc B #1	29107	0004	337122	Nonupholstered Wood Household Furniture Manufacturing		0.22	0.46	0.01	9.06
S & K Industries Inc-S & K Industries Inc B #2	29107	0029	321912	Cut Stock, Resawing Lumber, and Planing					12.50
Saint-Gobain Containers Llc-Pevely	29099	0068	327213	Glass Container Manufacturing	1.27	177.56	69.26	219.84	31.69
Salisbury Station Platte Pipe Line Co-Salisbury	29041	0013	42472	Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)					5.13
Schreiber Foods Inc-Packaging Converting Plant	29083	0033	322221	Coated and Laminated Packaging Paper Manufacturing		0.65	0.05	0.00	66.13
SCHREIBER FOODS INC-SCHREIBER FOODS INC - MONETT	29009	0021	311513	Cheese Manufacturing	0.17	16.93	0.40	15.04	0.64
Sensient Colors Inc-Baldwin Plant	29510	0269	31192	Coffee and Tea Manufacturing	0.09	2.90	0.23	0.09	0.20
Sericol Inc-Sericol Inc	29047	0141	32591	Printing Ink Manufacturing		0.32		0.00	33.15
Shelbina Power Plant	29205	0011	221112	Fossil Fuel Electric Power Generation	-	0.05	0.00	0.00	0.01
SHOW ME ETHANOL LLC-CARROLLTON	29033	0036	325193	Ethyl Alcohol Manufacturing		-	0.00	-	-
Show-Me Regional Landfill-Show-Me Regional Landfill	29101	0046	562212	Solid Waste Landfill		2.48	1.49	0.87	1.61
Sigma - Aldrich Co-Sigma - Aldrich Co	29510	0697	325199	All Other Basic Organic Chemical Manufacturing		2.91		0.02	4.05
Sigma - Aldrich Co-Sigma	29510	1396	325414	Biological Product (except		5.86		0.04	9.47

Chemical Company				Diagnostic) Manufacturing					
Sikeston Power Station-Sikeston Power Station	29201	0017	221112	Fossil Fuel Electric Power Generation		2,232.69	108.63	6,527.85	5.30
Silgan Containers Corp-Silgan Containers	29021	0064	332431	Metal Can Manufacturing		6.45	0.49	0.04	15.65
Simmons Foods Inc-Southwest City	29119	0017	311615	Poultry Processing	10.79	38.65	23.93	0.38	3.45
Simpson Construction Materials Llc-Valley Park	29189	1226	324121	Asphalt Paving Mixture and Block Manufacturing		6.05	0.66	4.44	1.56
Simpson Construction Materials Llc-West Lake Quarry & Material Co	29189	0111	212312	Crushed and Broken Limestone Mining and Quarrying		4.71	0.08	3.46	0.32
Sinclair Oil Corp-Carrollton Station	29033	0001	48691	Pipeline Transportation of Refined Petroleum Products		1.28			82.01
Smith Flooring Company-Mountain View	29091	0005	321918	Other Millwork (including Flooring)		24.64	6.03	1.26	0.85
Southeast Missouri State University-Facilities Management	29031	0010	61131	Colleges, Universities, and Professional Schools		42.63	1.25	428.43	0.32
Southern Metal Processing-Southern Metal Processing	29510	1407	333414	Heating Equipment (except Warm Air Furnaces) Manufacturing		6.93	0.45	6.49	1.26
Southern Star Central Gas Pipeline-Peculiar Compressor Station	29037	0048	48621	Pipeline Transportation of Natural Gas	0.00	50.00	0.74	-	1.82
Southern Star Central Gas Pipeline-Saginaw Compressor Station	29145	0049	48621	Pipeline Transportation of Natural Gas		63.82	0.98	0.00	2.42
Southwest Mo State Univ-Physical Plant	29077	0047	61131	Colleges, Universities, and Professional Schools	0.07	8.22	0.64	7.23	0.41
Southwest Power Plant	29077	0039	221112	Fossil Fuel Electric Power Generation		2,035.83	37.24	3,301.30	18.52
Southwestern Bell Telephone Company-Southwestern Bell Telephone Company	29510	2545	517110	Wired Telecommunications Carriers	0.11	14.06	0.50	0.72	0.60
Sporlan Valve Company-Plant #2 - West Main	29071	0132	332911	Industrial Valve Manufacturing					43.42

Sporlan Valve Company-Plant #3 - Lange Drive	29071	0178	332919	Other Metal Valve and Pipe Fitting Manufacturing					16.46
Springfield Sanitary Landfill-Willard	29077	0161	562212	Solid Waste Landfill		4.84	1.99	1.69	2.39
S-R Products-Farmington	29187	0048	336991	Motorcycle, Bicycle, and Parts Manufacturing	14.08	3.52		0.02	29.67
St Alexius Hospital-St Louis	29510	0200	62211	General Medical and Surgical Hospitals		1.33	-	0.01	0.03
St Francis Medical Center-Cape Girardeau	29031	0058	62211	General Medical and Surgical Hospitals	0.03	4.98	0.39	0.06	0.27
St John'S Regional Health Center-Springfield	29077	0028	62211	General Medical and Surgical Hospitals	0.62	11.69	1.48	0.12	1.07
St John'S Regional Medical Center-St John'S Regional Medical Center	29097	0021	62211	General Medical and Surgical Hospitals	-	5.49	-	0.23	0.29
St Joseph Health Center-St Joseph Health Center	29183	0019	62211	General Medical and Surgical Hospitals	0.03	4.67	0.35	0.14	0.28
St Joseph Hospital-Kirkwood	29189	1156	62211	General Medical and Surgical Hospitals	0.02	3.56	0.07	0.06	2.25
St Joseph Landfill-St Joseph Landfill	29021	0105	562212	Solid Waste Landfill		0.80	0.96	0.28	14.26
St Louis Airport Authority-Lambert International Blvd	29189	0065	336212	Truck Trailer Manufacturing	0.32	14.92	0.28	3.09	11.67
St Louis Lithographing Company-Heege Avenue	29189	0238	323110	Commercial Lithographic Printing					17.91
St Louis Metallizing-St Louis	29510	0175	332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers		0.33		0.00	4.38
St Louis Post Dispatch-St Louis Post Dispatch	29510	1280	51111	Newspaper Publishers	0.00	0.53	0.01	0.00	1.92
St Louis Post-Dispatch-Dunlap Ind Dr	29189	0057	51111	Newspaper Publishers	0.00	0.19	0.00	0.00	19.15
St Louis University-Facilities Svcs	29510	2711	323110	Commercial Lithographic Printing	0.06	11.55	0.88	0.07	0.64
St Luke'S Hospital-Woods Mill Road	29189	1101	62211	General Medical and Surgical Hospitals	0.04	6.34	0.13	0.58	0.34
St Marys Health Center-	29189	0318	62211	General Medical and	0.05	8.23	0.15	0.15	0.49

Richmond Heights				Surgical Hospitals					
Stahl Specialty Co-Kingsville Plant	29101	0003	331524	Aluminum Foundries (except Die-Casting)	0.39	12.10	-	1.74	0.67
Steel Processors-Steel Processors	29225	0026	336212	Truck Trailer Manufacturing	0.06	0.80	0.07	0.00	7.04
Steelweld Equipment Co-St Clair	29071	0020	336211	Motor Vehicle Body Manufacturing		0.20		0.00	15.94
Still Gin & Grain Inc-Steele	29155	0024	115111	Cotton Ginning		-	0.19	-	-
Stoddard County Cotton Co-Bernie	29207	0018	115111	Cotton Ginning		0.27	0.53	0.00	0.01
Stokes Mayberry Gin Company-Stokes Mayberry Gin Company	29069	0032	115111	Cotton Ginning		-	0.15	-	-
Sullivan Precision Metal Finishing Inc-Sullivan Precision Metal Finishing Inc	29071	0131	332813	Electroplating, Plating, Polishing, Anodizing, and Coloring		-	-	-	18.58
SUN CHEMICAL-KANSAS CITY	29095	2431	325910	Printing Ink Manufacturing			0.01		0.44
Sunnen Products Company-Maplewood	29189	0064	333512	Machine Tool (Metal Cutting Types) Manufacturing	0.04	1.21	0.02	0.01	5.77
Superior Home Products Inc-Superior Home Products Inc	29183	0131	326121	Unlaminated Plastics Profile Shape Manufacturing		-		-	10.79
Superior Maple Hill Landfill-Macon	29121	0027	562212	Solid Waste Landfill		2.22	0.94	0.78	1.43
Superior Solvent & Chemical-St Louis	29510	2300	49311	General Warehousing and Storage					2.94
Superior Solvents & Chemicals-Superior Solvents & Chemicals	29077	0228	42469	Other Chemical and Allied Products Merchant Wholesalers					1.67
Sweetheart Cup-Sweetheart Cup	29077	0021	322215	Nonfolding Sanitary Food Container Manufacturing	0.68	3.11	0.19	0.02	3.38
Systems & Electronics Inc-West Plains	29091	0011	336212	Truck Trailer Manufacturing	0.13	0.74	0.02	0.02	46.22
Table Rock Asphalt Constr Co Inc-Hwy 248 Quarry	29213	0003	212312	Crushed and Broken Limestone Mining and Quarrying		1.71		4.20	0.60

Table Rock Asphalt Constr Co Inc-Quarry #3 & Concrete Plant	29209	0007	212312	Crushed and Broken Limestone Mining and Quarrying					
Tamko Roofing Products Inc-High St Plant	29097	0013	324122	Asphalt Shingle and Coating Materials Manufacturing	-	4.32	7.64	1.60	59.16
Tamko Roofing Products Inc-Rangeline Plant	29097	0094	324122	Asphalt Shingle and Coating Materials Manufacturing		41.01	0.23	59.19	38.00
TEPPCO-Cape Girardeau Terminal	29201	0018	48691	Pipeline Transportation of Refined Petroleum Products					29.84
Tetra Pak Materials-Sikeston	29201	0003	32213	Paperboard Mills	-	-	-	-	27.12
Teva Pharmaceuticals Usa Inc-Mexico	29007	0040	325412	Pharmaceutical Preparation Manufacturing	1.93	4.06	0.33	0.02	23.73
Texas Eastern Transmission Corporation-Oran Facility	29201	0099	48621	Pipeline Transportation of Natural Gas		666.00	3.34	0.10	10.86
Tg Missouri-Perryville	29157	0019	336211	Motor Vehicle Body Manufacturing	0.01	6.57	0.23	0.04	199.52
Tiffany Marble Inc-Lee'S Summit	29095	0244	326121	Unlaminated Plastics Profile Shape Manufacturing	-	-	-	-	0.86
Tnemec Company Inc-Tnemec Company Inc	29047	0075	32551	Paint and Coating Manufacturing					14.34
Tnt Plastics Inc-Perryville	29157	0027	326113	Unlaminated Plastics Film and Sheet (except Packaging) Manufacturing		-	-	-	129.40
Torque Traction Integration Technologies-Columbia	29019	0066	336211	Motor Vehicle Body Manufacturing	0.01	0.41	0.03	0.00	5.21
Tower Rock Stone Co-Ste Genevieve	29186	0022	212312	Crushed and Broken Limestone Mining and Quarrying			0.05		-
Toyota Motor Corporate Services-Bodine Aluminum Inc	29113	0029	331524	Aluminum Foundries (except Die-Casting)		37.23	-	0.06	79.04
Tracker Marine-Bolivar Plant	29167	0028	336612	Boat Building		-	-	-	36.65
Tracker Marine-Clinton Plant	29083	0031	336612	Boat Building		-		-	114.35
Tracker Marine-Lebanon Plant	29105	0046	336612	Boat Building		1.35	0.04	0.00	28.72

Trautman Quarry-Pevely	29099	0012	212312	Crushed and Broken Limestone Mining and Quarrying			-		-
Trenton Municipal Utilities-Trenton Peaking Plant	29079	0027	221112	Fossil Fuel Electric Power Generation	-	1.37	0.02	0.43	0.06
Trigen Energy Corporation-Grand Avenue Station	29095	0021	221112	Fossil Fuel Electric Power Generation	4.41	1,126.55	336.49	6,294.70	3.51
Trigen-St Louis Energy Corp-Ashley Street Station	29510	0038	221112	Fossil Fuel Electric Power Generation	2.13	37.02	5.60	1.18	3.32
Trinity Industries Inc-Trinity Industries Inc	29077	0200	48711	Scenic and Sightseeing Transportation, Land		-		-	5.39
Trinity Marine Products Inc-Caruthersville - Plant #75	29155	0030	336611	Ship Building and Repairing		2.50	0.10	0.02	69.90
Trinity Marine Products Inc-Caruthersville Plant #73	29155	0049	326121	Unlaminated Plastics Profile Shape Manufacturing		0.60		0.00	51.92
True Manufacturing Co-O'Fallon	29183	0184	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing		4.29	0.36	0.03	37.09
Truman Medical Center - East-Truman Medical Center - East	29095	2154	62211	General Medical and Surgical Hospitals	0.00	0.16	0.01	0.04	0.01
Tyson Foods Inc-Sedalia Processing Plant	29159	0037	311615	Poultry Processing	9.76	38.44	1.96	0.23	2.76
U S Dept Of Energy-Kansas City Plant (Alliedsignal)	29095	0005	33422	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	0.97	16.02	0.63	0.22	9.16
U S Ringbinder Corp-Loose Leaf Metals	29510	1123	323116	Manifold Business Forms Printing					2.99
U S Silica Company-Pacific	29189	0021	212322	Industrial Sand Mining	0.13	4.18	2.96	0.03	0.23
U S Paint Div Of Grow Group-U S Paint Div Of Grow Group	29510	0097	32551	Paint and Coating Manufacturing					33.00
Unilever Bestfoods North America-Unilever Bestfoods North America	29095	0178	311421	Fruit and Vegetable Canning	0.23	10.40	0.79	0.06	0.71

Unilever Hpc Usa-Jefferson City Plant	29051	0009	325611	Soap and Other Detergent Manufacturing		3.82	0.29	0.02	0.65
Union Pacific Railroad Co-Desoto Car Shop	29099	0011	336510	Railroad Rolling Stock Manufacturing		1.77	2.52	0.01	17.56
United Cooperative Inc-Osborn Elevator	29063	0013	42451	Grain and Field Bean Merchant Wholesalers		-	-	-	0.60
United Cooperative Inc-Plattsburg Elevator	29049	0016	42472	Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)		-	0.02	-	1.68
University Of Missouri - Columbia-Main Campus Sources	29019	0047	62211	General Medical and Surgical Hospitals	-	-	-	-	2.68
University Of Missouri - Columbia-Power Plant	29019	0004	221112	Fossil Fuel Electric Power Generation	51.75	823.97	90.73	8,884.75	4.78
University Of Mo - Rolla-Rolla Power Plant	29161	0006	61131	Colleges, Universities, and Professional Schools	2.46	43.78	0.49	460.67	0.29
Vance Brothers Inc-Vance Brothers Inc	29095	0037	324121	Asphalt Paving Mixture and Block Manufacturing	0.15	6.97	0.68	0.32	6.69
VANDALIA POWER PLANT-VANDALIA	29007	0041	221112	Fossil Fuel Electric Power Generation		0.39		0.03	0.04
Varco-Pruden Buildings-St Joseph	29021	0095	332311	Prefabricated Metal Building and Component Manufacturing		-			141.49
Versa-Tech Inc-Fredericktown	29123	0022	32614	Polystyrene Foam Product Manufacturing	-	-	-	-	55.27
Vertex Plastics Inc-Kearney	29047	0175	326191	Plastics Plumbing Fixture Manufacturing					1.39
Vessell Mineral Products-Vessell Mineral Products	29187	0002	327124	Clay Refractory Manufacturing		66.25	5.51	4.63	-
Veterans Admin Medical Center-Jefferson Barracks Drive	29189	1052	62211	General Medical and Surgical Hospitals	-	-	-	-	0.89
Von Hoffman Press Inc-Jefferson City	29051	0028	323117	Books Printing					38.88
W R Meadows Inc-Boonville	29053	0003	321219	Reconstituted Wood Product Manufacturing		25.84		2.93	2.01
W W Wood Products-	29207	0019	321113	Sawmills		3.77	0.11	0.02	256.71

Dudley									
Walsworth Publishing Company-Marceline	29115	0001	323110	Commercial Lithographic Printing	0.02	0.21	0.02	0.00	55.68
Warrenton Copper Llc-Warrenton	29219	0028	331314	Secondary Smelting and Alloying of Aluminum	0.77	10.13	0.86	0.06	3.64
Washington Univ Medical School-Boiler Plant	29510	0040	62211	General Medical and Surgical Hospitals	0.18	38.06	2.86	1.58	2.00
WASHINGTON UNIVERSITY-HILLTOP CAMPUS	29510	2833	611310	Colleges, Universities, and Professional Schools	0.01	1.26	0.10	0.01	0.07
Washington University-Millbrook Blvd	29189	0042	61131	Colleges, Universities, and Professional Schools	0.70	22.45	0.45	0.25	1.24
Water Supply Division-Kansas City	29047	2227	22131	Water Supply and Irrigation Systems	0.06	2.31	0.14	0.01	0.12
Waterloo Industries Inc-Waterloo Industries Inc	29159	0012	332117	Powder Metallurgy Part Manufacturing		7.13		0.03	51.32
Wayne B Smith Inc-Wayne B Smith Inc	29163	0008	212312	Crushed and Broken Limestone Mining and Quarrying		0.29	0.29	0.00	0.37
WEST CENTRAL CONCRETE LLC-SNOW RD	29159	0058	327320	Ready-Mix Concrete Manufacturing		-	-	-	-
West Plains City Power Station	29091	0068	221112	Fossil Fuel Electric Power Generation	0.00	0.01	0.00	0.00	0.00
Weyerhaeuser-St Joseph	29021	0046	322211	Corrugated and Solid Fiber Box Manufacturing	0.71	5.06	2.35	0.03	2.32
White Oak Gin Company Inc-White Oak Gin Company Inc	29069	0010	115111	Cotton Ginning		1.22	0.27	0.00	0.06
Whiteman Air Force Base-Whiteman	29101	0009	92811	National Security	0.10	28.25	0.17	3.46	8.55
Whitmire Microgen Research Laboratory-Kirkwood	29189	1204	32532	Pesticide and Other Agricultural Chemical Manufacturing					5.91
Williamsville Materials-Poplar Bluff	29023	0003	212321	Construction Sand and Gravel Mining			0.03		-
Wilson Trailer Sales Inc-Moberly	29175	0061	336212	Truck Trailer Manufacturing	0.01	0.25	0.35	0.00	14.18
Wincup-Higginsville Plant	29107	0010	325211	Plastics Material and Resin Manufacturing	0.21	6.42		0.04	66.83

Wolcott & Lincoln Jackson Llc-Kansas City	29095	0026	42451	Grain and Field Bean Merchant Wholesalers					
Woodbridge Corporation-Kansas City Foam Div	29165	0028	32614	Polystyrene Foam Product Manufacturing	0.01	1.44	0.11	0.01	83.66
Woodbridge Corporation-St Peters	29183	0129	32614	Polystyrene Foam Product Manufacturing	-	-	-		49.74
Woodpro Cabinetry Inc-Cabool	29215	0060	33711	Wood Kitchen Cabinet and Countertop Manufacturing		1.09			36.26
Missouri Total					**1,655.45**	**129,952.55**	**8,997.41**	**367,370.10**	**17,432.49**

Appendix E-2

Nonroad 2008 Inventory Documentation

- Documentation of the EPA Region 7 NonRoad Emissions Modeling Protocol
- Documentation of the Commercial Marine Vessel Component of the National Emissions Inventory Methodology
- Documentation of the Locomotive Component of the National Emissions Inventory Methodology
- Documentation of the Aircraft Component of the National Emissions Inventory Methodology

Ozone and PM2.5 Maintenance Plan Work Share
St. Louis, Missouri-Five County Area
Nonroad modeling for inventory development

For this modeling exercise, the EPA Region 7 utilized the NONROAD2008a model to calculate an ozone and PM2.5 nonroad inventory in five counties in the St. Louis nonattainment area for the 1997 PM2.5 annual and 1997 Ozone NAAQS. The NONROAD2008a model provides the emissions for all nonroad source categories except aircraft, commercial marine vessel, and railroad locomotive.

In running the NONROAD model, the user must specify a modeling scenario by the inventory year, geographic area (nation, state, county), period (annual, seasonal, monthly, daily), and the equipment categories. For all other required variables, the NONROAD model provides default input values. For the following modeling exercises, fuel parameters (Reid Vapor Pressure (RVP), oxygen weight, sulfur content, ethanol volume and market percentage) and temperatures for each geographical area were provided by MDNR in lieu of the modeling default settings for more accurate results (see attachment).

Ozone Precursor Emissions

Ozone Methodology/Input Data
Nonroad mobile source emissions for the years of 2008 and 2022 are calculated using the EPA approved model, NONROAD2008a, and included Franklin County, Jefferson County, St. Charles County, St. Louis County and St. Louis City in St. Louis, Missouri.
For modeling ozone precursor pollutants, temperatures and fuel characteristics representative of each county during an ozone summer weekday, were entered into NONROAD2a and modeled to calculate an ozone season weekday emissions for nonroad sources. Minimum, maximum, and average temperatures for a typical summer season were provided by MDNR (see attachment). Modeling input parameters are as follows:

Table B-38
NONROAD Model Temperature & Fuel Characteristic Input Values by County

County	Oxygen Weight %	RVP psi	Gasoline Sulfur %	Diesel Sulfur	Marine Diesel Sulfur %	CNG / LPG Sulfur %	Temperatures		
							Min.	Max.	Avg.
Franklin	0.35	7	0.0049	0.0355	0.0402	0.003	61.8	90	75.96
Jefferson	0.35	7	0.0049	0.0355	0.0402	0.003	61	88.6	75.16
St. Charles	0.35	7	0.0049	0.0355	0.0402	0.003	62.2	89.2	76.15
St. Louis	0.35	7	0.0049	0.0355	0.0402	0.003	64.1	89.5	77.1
St. Louis City	0.35	7	0.0049	0.0355	0.0402	0.003	65.1	89.8	77.72

Direct $PM_{2.5}$ / $PM_{2.5}$ Precursor Emissions

Methodology/Input Data

Nonroad mobile source emissions for the years of 2008 and 2022 were calculated using the EPA approved model, NONROAD2008a, and included Franklin County, Jefferson County, St. Charles County, St. Louis County and St. Louis City in St. Louis, Missouri.

For modeling $PM_{2.5}$ and $PM_{2.5}$ precursor pollutants, temperatures and fuel characteristics representative of each county for each of the four seasons (winter, spring, summer, and fall) were entered into the NONROAD2008a model as input parameters. The highest temperature and lowest temperature from each three month period (December-February, March-May, June-August, and September-November) were averaged to create a seasonal average temperature. Those seasonal average temperatures, seasonal minimum and seasonal maximum temperatures were then utilized in the model, including the fuel parameters, to calculate the total emissions for each county and season. Summing the emissions of all four seasons for each county gave the total annual emissions. The temperatures and fuel characteristics representative of each county were provided by MDNR. Modeling input parameters are as follows:

Table B-39
NONROAD Model Temperature & Fuel Characteristic Input Values by County & Season

County	Season	Oxygen Weight %	RVP psi	Gasoline Sulfur %	Diesel Sulfur	Marine Diesel Sulfur %	CNG / LPG Sulfur %	Temperatures		
								Min.	Max.	Avg.
Franklin	Winter	0.35	11.5	0.0043	0.0355	0.0402	0.003	19.7	47	33.4
Franklin	Spring	0.35	9	0.0046	0.0355	0.0402	0.003	33.5	76.9	55.2
Franklin	Summer	0.35	7	0.0049	0.0355	0.0402	0.003	61.8	90	75.9
Franklin	Autumn	0.35	9	0.0046	0.0355	0.0402	0.003	34.3	80.9	57.6
Jefferson	Winter	0.35	11.5	0.0043	0.0355	0.0402	0.003	18.6	45.6	32.1
Jefferson	Spring	0.35	9	0.0046	0.0355	0.0402	0.003	32.4	75.8	54.1
Jefferson	Summer	0.35	7	0.0049	0.0355	0.0402	0.003	61	88.6	74.8
Jefferson	Autumn	0.35	9	0.0046	0.0355	0.0402	0.003	33.6	79.8	56.7
St. Charles	Winter	0.35	11.5	0.0043	0.0355	0.0402	0.003	18.7	43.9	31.3
St. Charles	Spring	0.35	9	0.0046	0.0355	0.0402	0.003	32.3	75.8	54.1
St. Charles	Summer	0.35	7	0.0049	0.0355	0.0402	0.003	62.2	89.2	75.7
St. Charles	Autumn	0.35	9	0.0046	0.0355	0.0402	0.003	34.8	80.3	57.6
St. Louis	Winter	0.35	11.5	0.0043	0.0355	0.0402	0.003	19.8	44.2	32
St. Louis	Spring	0.35	9	0.0046	0.0355	0.0402	0.003	34.5	76.1	55.3
St. Louis	Summer	0.35	7	0.0049	0.0355	0.0402	0.003	64.1	89.5	76.8
St. Louis	Autumn	0.35	9	0.0046	0.0355	0.0402	0.003	35.5	80.2	57.9
St. Louis City	Winter	0.35	11.5	0.0043	0.0355	0.0402	0.003	20.7	45.5	32.6
St. Louis City	Spring	0.35	9	0.0046	0.0355	0.0402	0.003	35.7	76.4	56
St. Louis City	Summer	0.35	7	0.0049	0.0355	0.0402	0.003	65.1	89.8	77.5
St. Louis City	Autumn	0.35	9	0.0046	0.0355	0.0402	0.003	36.6	80.4	58.5

QA/QC
Quality control and quality assurance were conducted throughout this nonroad modeling process. Data collected from various data sources were verified and correctly entered or transcribed into the model. In some instances, input values, i.e., temperatures and fuel values were double and/or triple checked for accuracy to insure they corresponded to the data supplied by MDNR. In addition, a spot-checking of the modeling results, including rerunning the model for those results in question, was performed to insure reliability.

Nonroad Modeling Results Summary Tables

Table B-40

Ozone Typical Summer Day Emissions Tons / Day						
County	**NO_X**		**VOC**		**CO**	
	2008	**2022**	**2008**	**2022**	**2008**	**2022**
Franklin	2.93	1.81	3.59	1.55	23.56	19.76
Jefferson	2.89	1.27	3.64	2.06	38.72	34.77
St. Charles	7.61	3.33	7.49	3.95	85.2	73.93
St. Louis CO	20.55	9.08	27.22	17.85	424.3	388.64
St. Louis City	2.86	1.19	3.97	2.2	65.9	56.28
Total	36.84	16.68	45.91	27.61	637.7	573.38

Table B-41

Direct PM2.5 and PM2.5 Precursor Pollutant County Totals (Tons per Year)										
County	**$PM_{2.5}$**		**PM_{10}**		**SO_2**		**NO_X**		**VOC**	
	2008	**2022**	**2008**	**2022**	**2008**	**2022**	**2008**	**2022**	**2008**	**2022**
Franklin	64.73	39.04	67.91	34.72	11.8	10.75	665.82	233.09	945.16	386.31
Jefferson	73.6	52.26	77.19	55.05	14.6	15.33	726.68	319.36	929.83	544.67
St. Charles	171.98	120.7	179.8	126.8	37.1	39.01	1893.6	827.95	1948.52	1031.57
St. Louis	530.64	444.8	558.1	471.3	99.3	106.99	5354.4	2323.2	6470.16	4457.23
St. Louis City	53.25	46.35	55.98	49.02	9.74	10.93	794.9	341.3	1066	628.57

Modeling File Naming Convention
Ozone: pollutant-county-year
PM2.5: pollutant-county-year-season

OZONE Modeling Files Example: 03Frnk08 = **(Ozone Franklin County 2008)**
O3 = Ozone
08 = 2008
22 = 2022
Frnk = Franklin County
Jeff = Jefferson County
StCh = St. Charles County
StLC = St. Louis County
StCi = St. Louis City

<u>PM2.5 Modeling Files</u> Example: PMFr22wi = **(PM2.5 Franklin County 2022 winter)**
PM = PM2.5
08 = 2008
wi = winter
sp = spring
su = summer
au = autumn
Fr = Franklin County
Je = Jefferson County
Ch = St. Charles County
SL = St. Louis County
SC = St. Louis City

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Documentation for Aircraft Component of the National Emissions Inventory Methodology

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TABLE OF CONTENTS

Section **Page No.**

1.0 INTRODUCTION 1-1
- 1.1 What is the National Emission Inventory? 1-1
- 1.2 Why Did the EPA Create the NEI? 1-1
- 1.3 How is the EPA Going to Use This Version of the NEI? 1-1
- 1.4 Report Organization 1-2

2.0 DEVELOPMENT OF THE AIRCRAFT COMPONENT FOR THE NEI 2-1
- 2.1 How does this aircraft study fit into the NEI? 2-1
- 2.2 What are Aircraft Sources? 2-11
- 2.3 What Pollutants are Included in the National Emission Estimates for Aircraft? 2-11
- 2.4 How Were the Aircraft Emissions Estimated? 2-12
- 2.5 How Were Emissions Allocated? 2-17
- 2.6 QA/QC 2-17
- 2.7 What are the Results? 2-17
- 2.8 Aircraft References 2-20

Appendix A – Generic Aircraft Emission Factors

Appendix B – Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory

LIST OF TABLES AND FIGURES

Tables **Page No.**

Table 2-1a. Methods Used to Develop Emission Estimates for Onroad Vehicle Sources 2-2
Table 2-1b. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources 2-4
Table 2-2. Aircraft Pollutant List 2-12
Table 2-3. National-Scale GSE Engine Distribution 2-14
Table 2-4. Aircraft Criteria Emission Estimates 2008 (tons per year) 2-18
Table 2-5. Aircraft HAP Emission Estimates 2008 (tons per year) 2-18

Figures **Page No.**

Figure 2-1. Procedures for Estimating Emissions from Commercial Air Carriers 2-14
Figure 2-2. Procedures for Estimating Emissions from Commercial Air Taxis and General Aviation 2-15

1.0 INTRODUCTION

1.1 What is the National Emission Inventory?

The National Emission Inventory (NEI) is a comprehensive inventory covering all anthropogenic sources of criteria pollutants and hazardous air pollutants (HAPs) for all areas of the United States. The NEI was created by the U.S. Environmental Protection Agency's Emission Inventory and Analysis Group (EIAG) in Research Triangle Park, North Carolina. The NEI will be used to support air quality modeling and other activities. To this end, the EPA established a goal to compile comprehensive emissions data in the NEI for criteria and HAPs for mobile, point, and nonpoint sources. This report presents an overview of how emission estimates for the aircraft component of the NEI were compiled.

1.2 Why Did the EPA Create the NEI?

The Clean Air Act (CAA), as amended in 1990, includes mandates for the EPA related to criteria and hazardous air pollutants. The CAA defines criteria pollutants as being one of the following air pollutants:

- Carbon monoxide (CO);
- Sulfur oxides (SO_x);
- Nitrogen oxides (NO_x);
- Ozone; and
- Particulate matter (PM).

Hazardous air pollutants are also delineated in the CAA, see *http://www.epa.gov/ttn/atw/188polls.html* for a complete list of regulated pollutants and their chemical abstract service [CAS] numbers.

The CAA requires the EPA to identify emission sources of these pollutants, quantify emissions, develop regulations for the identified source categories, and assess the public health and environmental impacts after the regulations are put into effect. The NEI is a tool that EPA can use to meet the CAA mandates. In this report, criteria and HAP emission estimates are discussed for aircraft sources.

1.3 How is the EPA Going to Use This Version of the NEI?

It is anticipated that the emission inventory developed from this effort will have multiple end uses. The data have been formatted according to protocols established for the EPA's NEI submittals. The common data structure on which the NEI platform is based will allow the NEI emission data to be transferred to multiple end-users for a variety of purposes.

The criteria and HAP emission estimates developed for the NEI will be used to evaluate air pollution trends, air quality modeling analysis, and impacts of potential regulations.

1.4 Report Organization

Following this introduction, Section 2.0 provides information on how the national aircraft emission estimates were developed. This inventory effort was coordinated by the EPA's Office of Transportation and Air Quality (OTAQ) and EIAG. The appendixes were created to provide the supporting references from OTAQ.

2.0 DEVELOPMENT OF THE AIRCRAFT COMPONENT FOR THE NEI

2.1 How does this aircraft study fit into the NEI?

The NEI was developed to include all point, nonpoint (sometimes referenced as “area”), and mobile sources. The approaches used in the point and nonpoint source categories are documented in other reports. Table 2-1 summarizes the approaches used to estimate emissions from all nonroad sources included in the NEI program. Those source categories and years that are included in this report are noted in bold.

The scope of this inventory component of the NEI was to compile criteria and HAP emissions data for aircraft operating in United States air space. In this effort, national emission estimates were often developed as point sources for each airport. The methodologies used to estimate emissions are discussed in this report.

The target inventory area includes every state in the United States and every county within a state, including Washington, DC, Puerto Rico, and US Virgin Islands. There are no boundary limitations pertaining to traditional criteria pollutant nonattainment areas or to designated urban areas. The pollutants inventoried included all criteria pollutants (and the 188 HAPs identified in Section 112(b) of the CAA).

In addition to numerous specific chemical compounds, the list of 188 HAPs includes several compound groups [e.g., individual metals and their compounds, polycyclic organic matter (POM)]; the NEI includes emission estimates for the individual compounds wherever possible. Many of the uses of the NEI depend upon data (e.g., toxicity) for individual compounds within these groups rather than aggregated data on each group as a whole.

The intent in presenting the following emission inventory approach is to provide sufficient and transparent documentation such that states and local agencies can use these approaches, in conjunction with their specific local activity data to develop more accurate and comparable emission estimates in future submittals.

This documentation is not meant to provide an exhaustive analysis on the derivation of all the inputs. For example, an emission factor used for a national estimate may be given in the appendix, but the source test data that were evaluated to obtain this factor may not be presented or discussed. The goal of the documentation provided is to show in a brief and concise manner how a given estimate was derived.

Table 2-1a. Methods Used to Develop Emission Estimates for Onroad Vehicle Sources
(Years addressed in this report are noted in bold print)

Base Year(s)	Pollutant(s)	Geographic Area	Emission Estimation Method
2008	All Criteria, HAPs	US, Puerto Rico, Virgin Islands	Emission estimates for all pollutants were developed using EPA's National Mobile Inventory Model (NMIM), which uses MOBILE6 (specifically, M6203ChcOxFixNMIM.exe) to calculate onroad emission factors. Where States provided alternate onroad MOBILE6 inputs or VMT, these data replaced EPA default inputs. Default VMT is based on FHWA 2008 data and 2008 Census population estimates.
2005	All Criteria, HAPs	US, Puerto Rico, Virgin Islands	Emission estimates for all pollutants were developed using EPA's NMIM, which uses MOBILE6 to calculate onroad emission factors. Where States provided alternate onroad MOBILE6 inputs or VMT, these data replaced EPA default inputs. Default VMT is based on FHWA 2005 data and 2005 Census population estimates.
2002	All Criteria, HAPs	US, Puerto Rico, Virgin Islands	Emission estimates for all pollutants were developed using EPA's NMIM, which uses MOBILE6 to calculate onroad emission factors. Where States provided alternate onroad MOBILE6 inputs or VMT, these data replaced EPA default inputs. California-supplied emissions data which replaced default EPA emission estimates for this state. Default VMT is based on FHWA 2002 data and population data from 2000 Census.
2001	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	California	Emissions and VMT provided by California at county/vehicle type level; State-provided emissions expanded to county/SCC level by EPA.
2001	NH_3	California	Calculated at State/county/SCC level by month using MOBILE6 emission factors with State-provided VMT data.
2001	All Criteria	AL; CO; ME; MA; MS; OR; UT; VA; WV; Maricopa County, AZ; Hamilton County, TN	State-provided VMT grown to 2001; emissions calculated by EPA using MOBILE6 emission factors.
2001	All Criteria	Rest of US	Calculated at State/county/SCC level by month using MOBILE6 and FHWA-based VMT.
1999	All Criteria	AL; ME; MA; MS; UT; VA; WV; Maricopa County, AZ; Hamilton County, TN	Calculated at State/county/SCC level by month using MOBILE6; State-provided VMT data used.
1999	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	California	Emissions and VMT provided by California at county/vehicle type level; State-provided emissions expanded to county/SCC level by EPA.
1999	NH_3	California	Calculated at State/county/SCC level by month using MOBILE6 emission factors with State-provided VMT data.
1999	PM_{10} Exhaust	Colorado	PM_{10} emissions and VMT provided by State.

Table 2-1a. Methods Used to Develop Emission Estimates for Onroad Vehicle Sources
(Years addressed in this report are noted in bold print)

Base Year(s)	Pollutant(s)	Geographic Area	Emission Estimation Method
1999	VOC, NO_x, CO, SO_2, PM_{10} brake and tire wear, $PM_{2.5}$, NH_3	Colorado	Calculated at State/county/SCC level by month using MOBILE6; State-provided VMT data used.
1999	All Criteria	Oregon	Emissions and VMT provided by Oregon at county/vehicle type level; State-provided emissions expanded to county/SCC level by EPA.
1999	All Criteria	Rest of US, Puerto Rico, and US Virgin Islands	Calculated at State/county/SCC level by month using MOBILE6 and FHWA-based VMT.
1999	HAPs	California	HAP emissions and VMT provided by California at county/vehicle type level; emissions allocated to SCC level by EPA.
1999	HAPs	Rest of US, Puerto Rico, and US Virgin Islands	MOBILE6 emission factors calculated at State/county/SCC level by season; applied to FHWA-based VMT.
1997-1998	All Criteria	US	2-step linear interpolation at State/count/SCC level based on 1996 and 1999 State/count/SCC level data.
1990, 1996	HAPs	US	MOBILE6 emission factors calculated at State/county/SCC level by season; applied to Federal Highway Administration (FHWA)-based vehicle miles traveled (VMT).
1991-1995	All Criteria	US	Linear interpolation at State/count/SCC level based on 1990 and 1996 State/count/SCC level data.
1988-1989	All Criteria	US	Linear interpolation at State/count/SCC level based on 1987 and 1990 State/count/SCC level data.
1979-1986	All Criteria	US	Linear interpolation at State/count/SCC level based on 1978 and 1987 State/count/SCC level data.
1978, 1987, 1990, 1996, 2000	All Criteria	US	Calculated at State/county/source classification code (SCC) level by month using MOBILE6, no State data incorporated.
1970, 1975	All Criteria	US	Linear extrapolation at national vehicle type level based on 1978 and 1987 national data.

Table 2-1b. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
NONROAD Categories			
Nonroad Gasoline, Diesel, LPG, CNG	2008	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3, & HAPs	Emission estimates for NONROAD model engines were developed using EPA's National Mobile Inventory Model (NMIM), which incorporates NONROAD2008. Where states provided alternate NMIM nonroad inputs, these data replaced EPA default inputs.
	2005	VOC, NO_x, CO, SO_2, , PM_{10}, $PM_{2.5}$, NH_3, & HAPs	Emission estimates for NONROAD model engines were developed using EPA's NMIM, which incorporates NONROAD2005. Where States provided alternate nonroad inputs, these data replaced EPA default inputs.
	2002	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3, & HAPs	Emission estimates for NONROAD model engines were developed using EPA's NMIM, which incorporates NONROAD2004. Where states provided alternate nonroad inputs, these data replaced EPA default inputs. State-supplied emissions data also replaced default EPA emission estimates.
	1999	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) an updated 1999 national inventory, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model. Replaced State-submitted data for California for all NONROAD model categories; Pennsylvania for recreational marine and aircraft ground support equipment, and Texas for select equipment categories.
	1996, 1997, 1998, 2000 & 2001	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) updated year-specific national and California inventories, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios and California county-to-state ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model. California results replace the diesel equipment emissions generated from prior application of county-to-national ratios.

Table 2-1b. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Nonroad Gasoline, Diesel, LPG, and CNG (Continued)	1991-1995	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3	Using 1990 and 1996 county-level emissions inventories, estimated emissions using linear interpolation of national emissions between 1990 and 1996. From these emissions, calculated the average annual growth rate for each pollutant/SCC combination for each year, and then applied the growth factors to 1990 county-level emissions to estimate 1991-1995 emissions.
	1990	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) updated 1990 national inventory, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model.
	1986, 1988, & 1989	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3	Using 1985 and 1990 county-level emissions inventories, estimated emissions using linear interpolation of national emissions between 1985 and 1990. From these emissions, calculated the average annual growth rate for each pollutant/SCC combination for each year, and then applied the growth factors to 1985 county-level emissions to estimate 1986-1989 emissions.
	1987	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using EPA's draft Lockdown C NONROAD model (dated May 2002), developed updated national emissions for 1987 by running 4 seasonal NONROAD model runs to estimate annual criteria pollutant emissions. Also performed national NONROAD model runs to estimate typical summer weekday emissions.
	1985	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) updated 1985 national inventory, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model.
	1970, 1975, 1978, & 1980	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using EPA's draft Lockdown C NONROAD model (dated May 2002), developed updated national emissions for all years by running 4 seasonal NONROAD model runs to estimate annual criteria pollutant emissions. Also performed national NONROAD model runs to estimate typical summer weekday emissions.

Table 2-1b. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Nonroad Gasoline, Diesel, LPG, and CNG (Continued)	1996, 1997, 1998, 1999, 2000, & 2001	NH_3	Obtaining national fuel consumption estimates from the Lockdown C NONROAD model, multiplying by NH_3 emission factors, and distributing to counties using 1996 inventory, based on October 2001 draft NONROAD. NH_3 emissions for California were also recalculated using updated diesel fuel consumption values generated for California-specific runs, and assuming the 1996 county-level distribution.
	1985 & 1990	NH_3	Obtaining national fuel consumption estimates from the Lockdown C NONROAD model, multiplying by NH_3 emission factors, and distributing to counties using 1996 inventory, based on October 2001 draft NONROAD.
	1987	NH_3	Obtaining 1987 national fuel consumption estimates from Lockdown C NONROAD model and multiplying by NH_3 emission factors.
	1970, 1975, 1978, & 1980	NH_3	Obtaining national fuel consumption estimates from the Lockdown C NONROAD model and multiplying by NH_3 emission factors.
	1990, 1996, & 1999	HAPs	Speciation profiles applied to county VOC and PM estimates. Metal HAPs were calculated using fuel and activity-based emission factors. Some state data were provided and replaced national estimates. (2003)
Aircraft			
Commercial Aircraft	**2008**	**Criteria and HAPs**	**Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System (EDMS) - Version 5.1.was run using BTS T-100 LTO data. (2009)**
	2002 and 2005	Criteria and HAPs	Federal Aviation Administration (FAA) Emissions and Dispersion and Modeling System (EDMS) was run for criteria pollutants, VOC and PM emissions were speciated into HAP components. (2004)
	1990, 1996, 1999, 2000, 2001	VOC, NO_x, CO, SO_x	Input landing and take-off (LTO) data into FAA EDMS. National emissions were assigned to airports based on airport specific LTO data and BTS GIS data. State data replaced national estimates. (2003)
	1970-1998	VOC, NO_x, CO, SO_x	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999	HAPs	Speciation profiles were applied to VOC estimates to get national HAP estimates. State data replaced national estimates. (2003)
General Aviation, Air Taxis	**2008**	**Criteria and HAPs**	**Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System (EDMS) - Version 5.1.was run using BTS T-100 LTO for aircraft identified as Air taxis. (2010)** **Used FAA LTO data from TAF and OTAQ provided activity data for smaller airports derived from FAA 5010 master plans. EPA approved generic emission factors for criteria estimates. Speciation profiles were applied to VOC and PM estimates to get national HAP estimates. (2010)**

Table 2-1b. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
General Aviation, Air Taxis (Continued)	2005	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	2002 emissions for approximately 4,000 largest airports were calculated via EDMS and SIP guidance and included in the 2005 NEI as point sources. Only airports in FAA's T100 and TAF databases were included. State point source submittals were incorporated.
	1978, 1987, 1990, 1996, 1999, 2000, 2001, & 2002	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Used FAA LTO data and EPA approved emission factors for criteria estimates. Speciation profiles were applied to VOC estimates to get national HAP estimates. State data replaced national estimates. (2004)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999, & 2002	HAPs	Used FAA LTO data and EPA approved emission factors for criteria estimates. Speciation profiles were applied to VOC estimates to develop national HAP estimates. (2004)
	1990, 1996, 1999, & 2002	Pb	Used Department of Energy (DOE) aviation gasoline usage data with lead concentration of aviation gasoline. (2004)
	1996	NH_3	Applied NH_3 emissions factors to 1996 national jet fuel and aviation gasoline consumption estimates.
Military Aircraft	**2008**	**VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$**	**Used FAA LTO data as reported in TAF and EPA approved emission factors for criteria estimates. Representative HAP profiles were not readily available, therefore HAP estimates were not developed. (2010)**
	2005	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	2002 emissions were included in the 2005 NEI as point sources similar to other TAF reported data.
	1978, 1987, 1990, 1996, 1999, 2000, 2001, 2002, 2008	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Used FAA LTO data as reported in TAF and EPA approved emission factors for criteria estimates. Representative HAP profiles were not readily available, therefore HAP estimates were not developed.
	1970-1998	VOC, NO_x, CO, SO_X, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
Auxiliary Power Units and Ground Support Equipment	**2008**	**VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, HAPs**	**Federal Aviation Administration (FAA) Emissions and Dispersion and Modeling System (EDMS) - Version 5.1.was run using BTS T-100 LTO data. (2009)**
	2002 and 2005	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, HAPs	Computed via NONROAD2005 model runs.
	1985-2001	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Grew 1996 emissions to each year using LTO operations data from the FAA. Estimation methods prior to 1996 reported in EPA, 1998.

Table 2-1b. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Unpaved Airstrips[1]	1985-2001	PM_{10}, $PM_{2.5}$	Grew 1996 emissions to each year using SIC 45-Air Transportation growth factors, consistent with the current draft version of EGAS. Estimation methods prior to 1996 reported in EPA, 1998.
Aircraft Refueling[1]	1985-2001	VOC	Grew 1996 emissions to each year using SIC 45-Air Transportation growth factors, consistent with the current draft version of EGAS. Estimation methods prior to 1996 reported in EPA, 1998.
Commercial Marine Vessel (CMV)			
All CMV Categories	2008	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	OTAQ provided CAP emission estimates for all CMV categories. Note that the SCCs for this category have changed such that the Diesel category refers to smaller vessels (Category 1 and 2) using distillate fuels and the Residual category refers to larger (Category 3) vessels using a blend of residual fuels. Emissions were allocated to segments using GIS shapefiles and adjusted based on limited state data (2010)
	2008	HAPs	OTAQ's 2008 estimates were speciated into HAP components using SEPA profiles (2009)
CMV Diesel	2002 and 2005	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	2001 Estimates carried over. Used state data when provided. (2004)
		HAPs	1999 Estimates carried over. Used state data when provided. (2004)
	1978, 1987, 1990, 1996, 1999, 2000, & 2001	VOC, NO_x, CO, SO_x, PM_{10}, & $PM_{2.5}$	Used criteria emission estimates in the background document for marine diesel regulations for 2000. Adjusted 2000 criteria emission estimates for other used based on fuel usage. Emissions were disaggregated into port traffic and underway activities. Port emissions were assigned to specific ports based on amount of cargo handled. Underway emissions were allocated based on Army Corp of Engineering waterway data. State data replaced national estimates. (2003)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999	HAPs	VOC and PM emission estimates were speciated into HAP components. State data replaced national estimates. (2003)
	1996	NH_3	Applied NH_3 emissions factors to 1996 distillate and residual fuel oil estimates (i.e., as reported in EIA, 1996).
	1990-1995	NH_3	Estimation methods reported in EPA, 1998.

Table 2-1b. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
CMV Steam Powered	2005	VOC, NO_x, CO, SO_x, PM_{10}, & $PM_{2.5}$, HAPs	2002 estimates grown to 2005 (2008).
	2002	VOC, NO_x, CO, SO_x, PM_{10}, & $PM_{2.5}$, HAPs	2002 based estimates were developed for port and underway category 3 (C3) vessels as part of a rulemaking effort. Emissions were developed separately for near port and underway emissions. For near port emissions, inventories for 2002 were developed for 89 deep water and 28 Great Lake ports in the U.S. The Waterway Network Ship Traffic, Energy, and Environmental Model (STEEM) was used to provide emissions from ships traveling in shipping lanes between and near individual ports (2008)
	1978, 1987, 1990, 1996, 1999, 2000, & 2001	VOC, NO_x, CO, SO_x, PM_{10}, & $PM_{2.5}$	Calculated criteria emissions based on EPA SIP guidance. Emissions were disaggregated into port traffic and under way activities. Port emissions were assigned to specific ports based on amount of cargo handled. Underway emissions were allocated based on Army Corp of Engineering waterway data. State data replaced national estimates. (2003)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, & 1999	HAPs	VOC and PM emission estimates were speciated into HAP components. State data replaced national estimates. (2003)
Military Marine	1997-2001	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Applied EGAS growth factors to 1996 emissions estimates for this category.
CMV Coal,[2] CMV, Steam powered, CMV Gasoline[2]	1997-1998	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Applied EGAS growth factors to 1996 emissions estimates for this category.
CM Coal, CMV, Steam powered, CMV Gasoline, Military Marine	1991-1995	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Estimation methods reported in EPA, 1998.
Locomotives			
Class I, II, III and Yard operations	2008	VOC, NO_x, CO, PM_{10}, $PM_{2.5}$, SO_x & HAPs	Criteria emission estimates were provided to EPA by ERTAC. These data were assigned to individual railway segments using DOT shapefiles and guidance from ERTAC. HAP emissions were calculated by applying speciation profiles to VOC and PM estimates. (2010)

Table 2-1b. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Class I, Class II, Commuter, Passenger, and Yard Locomotives	1978, 1987, 1990, 1996, 1999, 2000, 2000, 2002, & 2005	VOC, NO_x, CO, PM_{10}, $PM_{2.5}$	Criteria pollutants were estimated by using locomotive fuel use data from DOE EIA and available emission factors. County-level estimates were obtained by scaling the national estimates with the rail GIS data from DOT. State data replaced national estimates. (2004)
	1978, 1987, 1990, 1996, 1999, 2000, 2001, 2002, & 2005	SO_2	SO_x emissions were calculated by using locomotive fuel use and fuel sulfur concentration data from EIA. County-level estimates were obtained by scaling the national estimates with the county level rail activity data from DOT. State data replaced national estimates. (2004)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999, & 2002	HAPs	HAP emissions were calculated by applying speciation profiles to VOC and PM estimates. County-level estimates were obtained by scaling the national estimates with the county level rail activity from DOT. State data replaced national estimates. (2004)
	1997-1998	NH_3	Grew 1996 base year emissions using EGAS growth indicators.
	1996	NH_3	Applied NH_3 emissions factors to diesel consumption estimates for 1996.
	1990-1995	NH_3	Estimation methods reported in EPA, 1998.

Notes:

* Dates included at the end of Estimation Method represent the year that the section was revised.

1 Emission estimates for unpaved airstrips and aircraft refueling are included in the area source NEI, since they represent non-engine emissions.

2 National Emission estimates for CMV Coal and CMV Gasoline were not developed though states and local agencies may have submitted estimates for these source categories.

EPA, 1998. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Factors and Inventory Group, National Air Pollutant Emission Trends, Procedures Document, 1900–1996, EPA-454/R-98-008. May 1998.

2.2 What are Aircraft Sources?

The aircraft source category includes all aircraft types used for public, private, and military purposes. This includes four types of aircraft (EPA, 1992): 1) Commercial; 2) Air Taxis; 3) General Aviation; and 4) Military.

Commercial aircraft include those used for transporting passengers, freight, or both. Commercial aircraft tend to be larger aircraft powered with jet engines. Air Taxis (AT) carry passengers, freight, or both, but usually are smaller aircraft and operate on a more limited basis than the commercial carriers. General Aviation (GA) includes most other aircraft used for recreational flying and personal transportation. Aircraft that support business travel, usually on an unscheduled basis, are included in the category of general aviation.

The national AT and GA fleet includes both jet and piston-powered aircraft. Most of the AT and GA fleet are made up of piston powered aircraft, though smaller business jets can also be found in these categories. According to a 2008 Federal Aviation Administration GA and AT Activity Survey, 66% of all GA and AT activity are powered by piston-powered aircraft and 34% are jet (or turbine) driven. EPA has used this estimate as a national-scale default value in recently published studies investigating lead emissions from aviation sources (EPA, 2008). The piston powered aircraft tend to have higher VOC, PM, and CO emissions and lower NO_X emissions than larger jet-powered aircraft (EPA, 1992). Military aircraft cover a wide range of aircraft types such as training aircraft, fighter jets, helicopters, and jet- and a small number of piston powered planes of varying sizes.

It should be noted that this inventory effort also includes criteria and Hazardous Air Pollutants (HAP) emission estimates for aircraft Auxiliary Power Units (APU) and aircraft Ground Support Equipment (GSE) typically found at airports, such as aircraft refueling vehicles, baggage handling vehicles, and equipment, aircraft towing vehicles, and passenger buses.

2.3 What Pollutants are Included in the National Emission Estimates for Aircraft?

Emissions estimates were developed for all criteria pollutants including volatile organic compounds (VOC), nitrogen oxides (NO_x), carbon monoxide (CO), sulfur oxides (SO_x), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$) and hazardous air pollutants (HAP) (Cook, 1997; Cook, 1998; EPA/FAA, 2009). The HAPs that are included in the national aircraft inventory are shown in Table 2-2 and are based on available test data and accepted emission estimation procedures.

Table 2-2. Aircraft Pollutant List

1,3-Butadiene	Carbon Dioxide	Naphthalene
1-Methylnaphthalene*	Carbon Monoxide	Nitrogen Oxides
2,2,4-Trimethylpentane	Chrysene*	O-xylene*
2-Methylnaphthalene*	Cumene*	Phenanthrene*
Acenaphthene*	Dibenzo[a,h]Anthracene*	Phenol
Acenaphthylene*	Ethyl Benzene	PM_{10} Primary
Acetaldehyde	Fluoranthene*	$PM_{2.5}$ Primary
Acrolein	Fluorene*	Propionaldehyde
Anthracene*	Formaldehyde	Pyrene*
Benz[a]Anthracene*	Hexane*	Styrene
Benzene	Indeno[1,2,3-c,d]Pyrene*	Sulfur Dioxide
Benzo[a]Pyrene*	Lead	Toluene
Benzo[b]Fluoranthene*	Methane*	VOCs
Benzo[g,h,i,]Perylene*	Methanol*	Xylene
Benzo[k]Fluoranthene*	M-xylene*	

* Added to 2008 Inventory

2.4 How Were the Aircraft Emissions Estimated?

EPA has developed guidance for inventorying aircraft emissions associated with an aircraft's landing and takeoff (LTO) cycle. The cycle begins when the aircraft approaches the airport on its descent from cruising altitude, lands, taxis to the gate, and idles during passenger deplaning. It continues as the aircraft idles during passenger boarding, taxis back out onto the runway for subsequent takeoff, and ascent (climbout) to cruising altitude. Thus, the five specific operating modes in an LTO are (EPA, 1992): 1) Approach; 2) Taxi/idle-in; 3) Taxi/idle-out; 4) Takeoff; and 5) Climbout.

The LTO cycle provides a basis for calculating aircraft emissions. During each mode of operation, an aircraft engine operates at a fairly standard power setting for a given aircraft category. Emissions for one complete cycle are calculated using emission factors for each operating mode for each specific aircraft engine combined with the typical period of time the aircraft is in the operating mode.

On March 20, 2009, the EPA posted preliminary LTO data intended to be will use to calculate emissions for review prior to developing the aircraft inventory. State and local agencies were encouraged to review the materials posted at ftp://ftp.epa.gov/EmisInventory/2008_nei/ and provide comments on any necessary corrections to:

- Airport names and locations for approximately 20,000 airports to be included in the Emission Inventory System (EIS) facility inventory;

- Landing and Takeoff (LTO) information that will be used to estimate emissions for each airport;

- Aircraft/engine combinations to link to FAA LTO data including default assumptions and AircraftEngineCodeTypes for EIS submittals; and

- Lead estimates and lead estimation methodology.

This preliminary review by state, local, and tribal groups provided information that EPA used to improve EPA's work. EPA received comments from four states (i.e., Minnesota Pollution Control Agency - Environmental Analysis and Outcomes Division; New Jersey Department of Environmental Protection; Bureau of Air Management, Connecticut Department of Environmental Protection; and Wisconsin Department of Natural Resources (specifically related to Volk Field Air National Guard Base (VOK) in Juneau County Wittman Regional Airport (OSH)) and three local agencies (i.e., Mecklenburg County North Carolina; Ventura County California Air Pollution Control District (Specifically related to Oxnard (OXR), Camarillo (CMA) and Santa Paula (SZP); and - Regional Air Pollution Control Agency (Dayton and Montgomery County Ohio)).

Criteria emission estimates are presented here for four different aircraft types: commercial air carrier, air taxis, general aviation, and military. HAP emission estimates were developed for all aircraft types.

Emissions for commercial air carriers for which detailed aircraft-specific activity data were available, were calculated differently than the other three aircraft categories (See Figure 2-1). Criteria and HAP emissions were estimated for commercial aircraft by applying aircraft make and model (e.g., Boeing 747-200 series) specific LTO activity data from *FAA's Form 41, Schedules T100 and T100(f) Air Carrier Data to the FAA's Emissions and Dispersion Modeling System (EDMS), Version 5.1* (DOT, 2008). It should be noted that due to the reporting requirements of T-100, only commercial activities are included in the dataset, and therefore does not include activity data for non-air carrier applications such as general aviation and military. This distinction lead to a revision to EPA's original aircraft crosswalk table, also known as the aircraft engine type code, used to match aircraft to EDMS aircraft and to account for double counting between the T-100 data and the TAF data. In the revised crosswalk, aircraft that were previously considered general aviation and military based on aircraft model were changed to air taxi and commercial air carrier aircraft types based on the definition of air taxis (i.e., any aircraft that was not considered an air taxi was classified as an air carrier aircraft). The FAA reviewed the cross walk tables and made additional changes that moved some of the larger air taxis to the commercial air carrier category and some of the smaller commercial air carriers to the air taxi category. The revised crosswalk table is provided in an electronic file as supporting data for this study.

Emissions were calculated for each airport individually using airport specific mixing height. The national-scale default values for taxi in and out are seven and nineteen minutes, respectfully. It should be noted that EDMS incorporates the latest aircraft engine emission factors from the International Civil Aviation Organization Engine Exhaust Emissions Data Bank. The EDMS output includes organic HAPs, but not metals.

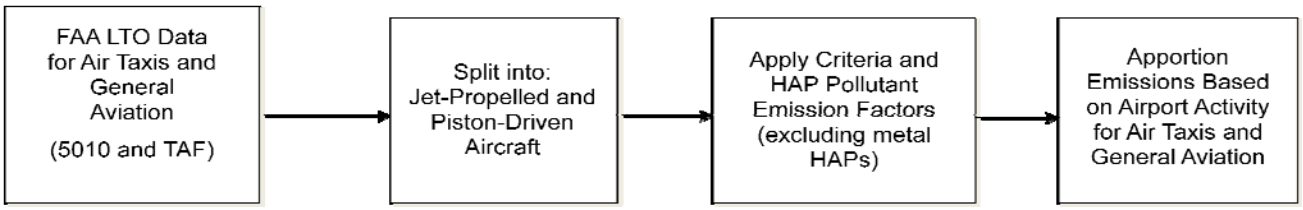

Figure 2-1. Procedures for Estimating Emissions from Commercial Air Carriers

Emissions for GSE and APU associated with commercial air carriers and air taxis for which T-100 data were available were estimated by EDMS, using the assumptions and defaults incorporated in the model. This is significant change from previous NEI year's emissions where GSE estimates came from the NONROAD model and APUs were not included in EPA's estimates. With EDMS, GSE that are assigned to an aircraft are given times (minutes per arrival, minutes per departure) based upon the type of service. For example, a fuel truck servicing a large commercial aircraft will have a different operating time than the same fuel truck servicing a commuter aircraft. All EDMS defaults for GSE duration and type (e.g., fuel truck, cabin service truck, baggage belt loader) were used. GSE emission factors used by EDMS are derived from EPA's NONROAD2005 model and are based on the following variables: fuel, brake horsepower and load factor. GSE engines burn gasoline, diesel, compressed natural gas (CNG), and liquefied petroleum gas (LPG). EPA has used a national-scale value to characterize engines type. The GSE engine distribution is shown below in Table 2-3. Like GSE, APU emissions are the product of operating time. The purpose of an aircraft APU is to provide power to start the main engines and run the heating, cooling, and ventilation systems prior to starting the main engines.

Table 2-3. National-Scale GSE Engine Distribution

GSE Engines Type	Percent of Total
Gasoline Fired, 4-Stroke	16.9
Liquefied Petroleum Gas (LPG) Fired	1.65
Compressed Natural Gas (CNG) Fired	1.25
Diesel Fired	80.2

Emissions of criteria pollutants for air taxis, general aviation, and military aircraft were calculated by combining aircraft operations data from FAA's *Terminal Area Forecasts (TAF) and 5010 Forms.* To avoid double counting between the T-100 data set and the TAF/5010 data,

LTOs by airport and aircraft type were summed in the T-100 data and compared with data in the TAF/5010 data. If the TAF/5010 LTO estimates were larger than the T-100 estimates for a specified aircraft type then the T-100 values were subtracted from the TAF/5010 values. If the T-100 values were larger than the TAF values, then the TAF values were set to zero. A data set of adjusted TAF/5010 LTOs were provided to OTAQ where additional adjustments were made to address older data in the TAF and 5010 datasets and to incorporate other insights provided by FAA reviewers.

The TAF/5010 LTO data were dividing into jet and piston powered fractions based on the national observation that 66 percent of all general aviation and air taxi activities are associated with piston powered aircraft and the remaining 34 percent of general aviation and air taxi activities are associated with jet powered aircraft. The adjusted and split TAF/5010 activity data were applied to emission factors as appropriate (See Figure 2-2). It should be noted that EDMS calculates organic HAP emissions in the model (metal HAPs are currently not included in the EDMS output). HAP emission estimates for air taxis, general aviation, and military aircraft were estimated by applying speciation profiles to VOC or PM_{10} emissions estimates. The following equation was used (emission factor are included as Appendix A).

$$E_{ixj} = LTO_i \times FR_{pro\text{-}i} \times EF_{ij}$$

Where:

E_{ixj} = Emission estimate for aircraft type i equipped with engine type x and pollutant j (lbs/year)
LTO_i = Annual count of LTO cycles for aircraft type i
FR_x = Fraction of LTOs equipped with engine type x
EF_{ij} = Generic emission factor for aircraft type i equipped with engine type x and pollutant j (lbs/LTO)
i = Aircraft type (i.e., air taxi, general aviation, and military)
x = Engine type (i.e., jet or turboprop, and piston engine)
j = Criteria pollutant j

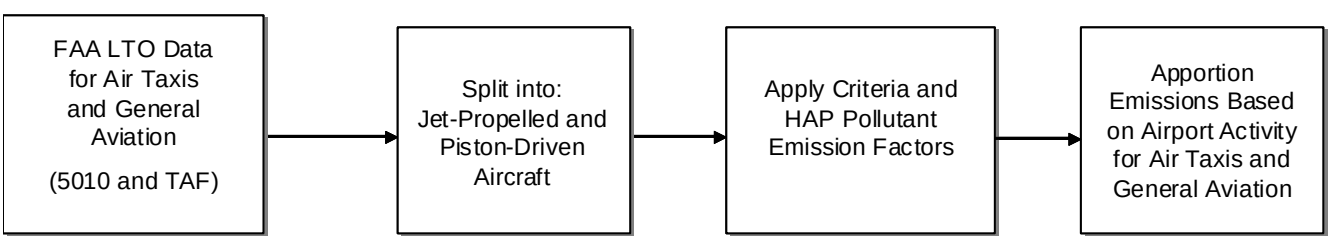

Figure 2-2. Procedures for Estimating Emissions from Commercial Air Taxis and General Aviation

Lead emission estimates were handled differently. Lead emissions are associated with leaded aviation fuel used in piston driven aircraft associated with general aviation. Lead emissions per LTO are calculated using the following equation:

$$Pb(tons) = (piston\text{-}engine\ LTO)\ (7.34\ g\ Pb/LTO)\ (0.95) / 907{,}180\ (g/ton)$$

Where the lead content of aviation gasoline is assumed to be 0.56 grams per liter or 2.12 grams per gallon.

In flight lead emissions were calculate based on national aviation gasoline consumption and similar assumptions noted above about lead fuel content and retention rates. Lead emissions associated with airport LTO activities were subtracted from the national fuel based lead emissions to approximate in flight lead emissions which were allocated to individual counties and noted with the code 777.

For additional details on EPA lead emission calculation procedures see Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory (included in Appendix B).

HAP Emission Estimates

As noted earlier, EDMS calculates organic HAP emissions for aircraft activity reported in the T-100 dataset. Representative HAP speciation profiles were used to estimate the individual chemical species for each aircraft type included in the TAF/5010 dataset. Profiles are used to split (or speciate) organic gases, hydrocarbons, and particulate matter emissions estimates into more individual HAP compounds using the following equation:

$$E_{ixj} = LTO_{ix} \times SP_{ixj}$$

Where:

E_{ixj}	= Emission estimate for aircraft type i equipped with engine type x and pollutant j (tons/year)
LTO_{ix}	= Annual count of LTO cycles for aircraft type i and engine type x
SP_{ixj}	= Generic speciation profiles for aircraft type i equipped with engine type x and pollutant j (tons/LTO)
i	= Aircraft type (i.e., air taxi, general aviation, and military)
x	= Engine type (i.e., jet or turboprop, and piston engine)
j	= Pollutant j

Appendix A contains the HAP profiles converted to emissions factors used for this 2008 inventory. In this version of the NEI aircraft emissions inventory the following corrections to the HAP emission estimates were made:

- Acenpthylene was removed from this inventory for SCC 2275050012.

- To avoid double counting total xylene emissions were removed if speciated xylene factors were also available.

2.5 How Were Emissions Allocated?

For the 2008 inventory, emissions were individually estimated for each airport. A GIS database obtained from the Bureau of Transportation Statistics (BTS) contained airport level data with latitude and longitude coordinates.

2.6 QA/QC

Given the significant methodological changes over previous inventory efforts, several quality checks were implemented to ensure that these data were developed and allocated in a clear and reproducible manner. Some of the quality checks implemented include the following:

Emissions allocations and estimations

- All original data importations and transcriptions into the database were double-checked for errors.
- All calculation methods and approaches were evaluated for technical soundness.
- All unit conversions and equations used to generate results were double-checked for errors.
- All sources of original data are referenced in the spreadsheet.
- Emission factors were compiled from a variety of sources. Each emission factor development methodologies were evaluated to identify the most accurate emission factor for use in this inventory effort.
- Emission sums were evaluated across activity types (e.g., Aircraft, APU, and GSE) to ensure they consistently mirror LTO activity levels.
- 2008 pollutants and emissions were checked against the 2005 inventory to identify any missing pollutants or major changes compared to previous inventories. Discrepancies were investigated and revisions were made as needed.
- The validity of SCC codes, FIP county codes, and pollutant codes were confirmed.
- The validity of Airport and plane identification codes were confirmed.

2.7 What are the Results?

Table 2-4 summarizes the emission estimates for Aircraft, ground support equipment and APUs for criteria pollutants. Table 2-5 summarizes the emission estimates for individual HAPs. Both tables aggregate the data for all states, including the District of Columbia. Note that the 2008 estimates do not include state submitted emissions data.

Table 2-4. Aircraft Criteria Emission Estimates 2008 (tons per year)

Pollutant	2008										
	Military (2275001000)	Commercial (2275020000)	GA, Piston (2275050011)	GA, Turbine (2275050012)	AT, Piston (2275060011)	AT, Turbine (2275060012)	GSE, Gas (2265008005)	GSE, LPG (2267008005)	GSE, CNG (2268008005)	GSE, Diesel (2270008005)	APU (2275070000)
CO	33,161.20	75,463.61	192,510.69	56,532.07	19,116.38	10,180.90	18,005.13	1,768.69	1,398.67	85,607.61	4,072.84
NO_X	284.92	102,561.46	1,041.55	1,911.11	465.64	2,274.10	1,927.90	189.38	149.76	9,166.44	2,841.72
PM_{10}-PRI	709.12	1,782.43	3,792.85	1,397.21	242.12	797.03	55.87	5.49	4.34	265.62	457.11
$PM_{2.5}$-PRI	92.60	1,776.37	493.07	181.64	44.81	103.65	53.63	5.27	4.17	254.97	457.11
SO_2	27.32	10,179.67	160.24	434.33	53.76	439.43	53.21	5.23	4.13	252.99	443.04
VOC	1,652.02	13,608.67	2,399.79	3,223.93	310.48	2,610.94	615.80	60.49	47.84	2,927.89	313.72

Table 2-5. Aircraft HAP Emission Estimates 2008 (tons per year)

Pollutant	2008										
	Military (2275001000)	Commercial (2275020000)	GA, Piston (2275050011)	GA, Turbine (2275050012)	AT, Piston (2275060011)	AT, Turbine (2275060012)	GSE, Gas (2265008005)	GSE, LPG (2267008005)	GSE, CNG (2268008005)	GSE, Diesel (2270008005)	APU (2275070000)
1,3-Butadiene	0.87	184.14	29.75	61.04	5.01	44.44					5.32
1-Methylnaphthalene	0.13	26.96		8.94	0.23	6.20					0.78
2,2,4-Trimethylpentane		0.69	1.09	1.55	0.03	0.51	8.95	0.88	0.69	42.54	
2-methylnaphthalene	0.11	22.48		7.45	0.20	5.17					0.65
Acenaphthene			0.36		0.17						
Acenaphthylene			2.03		0.93						
Acetaldehyde	2.21	466.29	18.82	154.57	11.97	113.00	2.43	0.24	0.19	11.57	13.47
Acrolein	0.02	37.70	1.82	88.61	0.04	32.72					
Anthracene			0.42	6.16E-04	0.19	3.52E-04					
Benz[a]Anthracene		6.09E-04	0.05	9.33E-05	0.02	5.32E-05					
Benzene	0.87	183.48	122.97	60.82	7.58	44.59	10.44	1.03	0.81	49.62	5.30
Benzo[a]Pyrene		4.52E-04	0.05	5.11E-05	0.02	2.91E-05					
Benzo[b]Fluoranthene		8.89E-04	0.06		0.03						
Benzo[g,h,i,]Perylene		8.11E-06	0.13	8.47E-06	0.06	4.83E-06					
Benzo[k]Fluoranthene		8.89E-04	0.06		0.03						
Chrysene		6.17E-04	0.05	8.69E-05	0.02	4.96E-05					

Table 2-5. Aircraft HAP Emission Estimates 2008 (tons per year) (Continued)

Pollutant	2008										
	Military (2275001000)	Commercial (2275020000)	GA, Piston (2275050011)	GA, Turbine (2275050012)	AT, Piston (2275060011)	AT, Turbine (2275060012)	GSE, Gas (2265008005)	GSE, LPG (2267008005)	GSE, CNG (2268008005)	GSE, Diesel (2270008005)	APU (2275070000)
Cumene	2.68E-05	0.05		0.11		0.04					
Ethyl Benzene	1.55E-03	2.68	44.63	6.30	1.05	2.32					
Fluoranthene		1.17E-03	0.45	1.29E-03	0.21	7.35E-04					
Fluorene			0.74		0.34						
Formaldehyde	6.36	1,343.45	81.67	445.41	38.06	327.87	7.20	0.71	0.56	34.23	38.82
Hexane			21.25		0.50						
Indeno[1,2,3-c,d]Pyrene		0.00	0.04		0.02						
Lead **			245.48		8.97						
Methane	0.01				18.96	14.79	14.61	1.44	1.14	69.47	
Methanol	0.02	27.78		65.31		24.11					
m-Xylene	0.14	26.44	0.36	1.58E-04	0.88	3.66	11.09	1.09	0.86	52.74	0.89
Naphthalene	0.28	54.17	21.11	20.42	5.05	13.86					1.71
O-xylene	0.08	15.56	2.03	9.30E-05	1.40	2.19	5.43	0.53	0.42	25.80	0.52
Phenanthrene		0.01	1.25	0.01	0.58	3.27E-03					
Phenol	0.01	11.17		26.27		9.70					
Propionaldehyde	0.38	79.35	1.82	26.30	2.29	19.45	1.48	0.15	0.11	7.04	2.29
Pyrene		1.42E-03	0.61	1.58E-03	0.28	8.99E-04					
Styrene	0.16	33.73	10.32	11.18	1.18	8.25					0.97
Toluene	0.33	70.07	315.76	23.23	8.87	16.77	17.77	1.75	1.38	84.50	2.02
Xylenes (Mixed Isomers)		4.85	177.92	19.04	4.18	6.21					

** The lead estimated provided above represent emissions at individual airports, for 2008, there is an additional 296 tons of lead emitted associated with the combustion of leaded aviation gasoline during in flight operations which is not attributed to airports.

2.8 Aircraft References

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Appendix A

Generic Aircraft Emission Factors/ Speciation Profiles

Commercial Aircraft Emission Factors			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
THC			2.680E-03
VOC			2.934E-03
TOG			3.276E-03
NO_x			9.288E-03
CO			1.119E-02
SO_x			8.910E-04
PM_{10}			5.385E-04
$PM_{2.5}$			5.256E-04
Acetaldehyde	75070	CAA	1.400E-04
Acetone	67641		1.025E-05
Acetylene	74862		1.290E-04
Acrolein	107028	CAA	8.023E-05
Benzaldehyde	100527	IRIS	1.540E-05
Benzene	71432	CAA	5.507E-05
Benzo(a)anthracene	56553		1.297E-09
Benzo(a)pyrene	50328		9.621E-10
Benzo(b)fluoranthene	205992		1.892E-09
Benzo(ghi)perylene	191242		1.726E-11
Benzo(k)fluoranthene	207089		1.892E-09
1,3-Butadiene	101314	CAA	5.527E-05
1-Butene	101389		5.746E-05
Butyraldehyde	123728		3.899E-06
C14-Alkane	No CAS		6.094E-06
C15-Alkane	No CAS		5.799E-06
C16 Branched Alkane	No CAS		4.783E-06
C18-Alkane	No CAS		6.552E-08
C4-Benzene + C3-Aroald	No CAS		2.149E-05
C5-Benzene+C4-Aroald	No CAS		1.061E-05
Chrysene	218019		1.313E-09
Cis-2-Butene	514181		6.880E-06
Cis-2-Pentene	627203		9.042E-06
Crotonaldehyde	4170303		3.384E-05
1-Decene	872059		6.061E-06
Dibenzo(ah)anthracene	53703		2.551E-09
Dimethylnapthalenes	28804888		2.949E-06
Ethane	74840		1.707E-05
Ethylbenzene	100414	CAA	5.701E-06
Ethylene	74851		5.065E-04
Fluoranthene	206440		2.492E-09

Commercial Aircraft Emission Factors			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
Formaldehyde	50000	CAA	4.033E-04
Glyoxal	107222		5.950E-05
Heptene	25339564		1.435E-05
Hexadecane	544763		1.605E-06
1-Hexene	592416		2.411E-05
Indeno(1,2,3-cd)pyrene	193395		2.050E-09
Isopropylbenzene	98828	CAA	9.829E-08
Isovaleraldehyde	514863		1.048E-06
Methacrolein	78853		1.405E-05
Methanol	67561	CAA	5.913E-05
Methyl Glyoxal	78988		4.924E-05
1-Methyl Naphthalene	14120		8.092E-06
2-Methyl Naphthalene	91576	IRIS	6.749E-06
3-Methyl-1-Butene	563451		3.669E-06
4-Methyl-1-Pentene	131372		4.259E-07
2-Methyl-1-Butene	563462		4.587E-06
2-Methyl-2-Butene	513359		6.061E-06
2-Methylpentane	107835		1.337E-05
2-Methyl-1-Pentene	763291		1.114E-06
M-Ethyltoluene	620144		5.045E-06
M-Tolualdehyde	620235		9.108E-06
Naphthalene (gas phase)	91203	CAA	6.084E-06
Naphthalene (solid phase)	91203	CAA	1.260E-06
Napthalene	91203	CAA	1.772E-05
N-Decane	124185		1.048E-05
N-Dodecane	112403		1.514E-05
N-Heptadecane	629787		2.949E-07
N-Heptane	142825		2.097E-06
N-Nonane	111842		2.031E-06
N-Octane	111659		2.031E-06
1-Nonene	124118		8.059E-06
N-Pentadecane	629629		5.668E-06
N-Pentane	109660		6.487E-06
N-Propylbenzene	103651		1.736E-06
N-Tetradecane	629594		1.363E-05
N-Tridecane	629505		1.753E-05
N-Undecane	1120214		1.455E-05
Octene	111660		9.042E-06
O-Ethyltoluene	611143		2.130E-06

Commercial Aircraft Emission Factors			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
O-Tolualdehyde	529204		7.535E-06
1-Pentene	109671		2.542E-05
P-Ethyltoluene	622968		2.097E-06
Phenanthrene	85018		1.112E-08
Phenol	108952	CAA	2.378E-05
Propane	74986		2.555E-06
Propionaldehyde	123386	CAA	2.382E-05
Propylene	115071		1.485E-04
P-Tolualdehyde	104870		1.573E-06
Pyrene	121400		3.028E-09
Styrene	100425	CAA	1.012E-05
Toluene	108883	CAA	2.103E-05
Trans-2-Hexene	4050457		9.829E-07
Trans-2-Pentene	646048		1.176E-05
1,2,3-Trimethylbenzene	526738		3.473E-06
1,2,4-Trimethylbenzene	95636		1.147E-05
1,3,5-Trimethylbenzene	108678		1.769E-06
2,2,4-Trimethylpentane	540841	CAA	1.466E-06
Valeraldehyde	110623		8.027E-06
Xylene	1330207	CAA	1.032E-05

Air Taxi Emission Factors - Jet			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
THC			4.37E-04
VOC			5.03E-04
TOG			5.06E-04
NO_x			3.88E-04
CO			1.81E-03
SO_x			8.12E-05
PM_{10}			3.017E-04
$PM_{2.5}$			3.922E-05
Acetaldehyde	75070	CAA	2.160E-05
Acetone	67641		1.583E-06
Acetylene	74862		1.992E-05
Acrolein	107028	CAA	1.238E-05
Anthracene	120127		1.331E-10
Benzaldehyde	100527	IRIS	2.377E-06
Benzene	71432	CAA	8.500E-06
Benzo(a)anthracene	56553		2.014E-11
Benzo(a)pyrene	50328		1.103E-11
Benzo(ghi)perylene	191242		1.829E-12
1,3-Butadiene	101314	CAA	8.531E-06
1-Butene	101389		8.869E-06
Butyraldehyde	123728		6.017E-07
C14-Alkane	No CAS		9.405E-07
C15-Alkane	No CAS		8.950E-07
C16 Branched Alkane	No CAS		7.383E-07
C18-Alkane	No CAS		1.011E-08
C4-Benzene + C3-Aroald	No CAS		3.317E-06
C5-Benzene+C4-Aroald	No CAS		1.638E-06
Chrysene	218019		1.876E-11
Cis-2-Butene	514181		1.062E-06
Cis-2-Pentene	627203		1.396E-06
Crotonaldehyde	4170303		5.224E-06
1-Decene	872059		9.355E-07
Dimethylnapthalenes	28804888		4.551E-07
Ethane	74840		2.635E-06
Ethylbenzene	100414	CAA	8.799E-07
Ethylene	74851		7.818E-05
Fluoranthene	206440		2.784E-10
Formaldehyde	50000	CAA	6.225E-05
Glyoxal	107222		9.183E-06

Air Taxi Emission Factors - Jet			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
Heptene	25339564		2.215E-06
Hexadecane	544763		2.478E-07
1-Hexene	592416		3.722E-06
Isopropylbenzene	98828	CAA	1.517E-08
Isovaleraldehyde	514863		1.618E-07
Methacrolein	78853		2.169E-06
Methanol	67561	CAA	9.127E-06
Methyl Glyoxal	78988		7.600E-06
1-Methyl Naphthalene	14120		1.249E-06
2-Methyl Naphthalene	91576	IRIS	1.042E-06
3-Methyl-1-Butene	563451		5.663E-07
4-Methyl-1-Pentene	131372		6.574E-08
2-Methyl-1-Butene	563462		7.079E-07
2-Methyl-2-Butene	513359		9.355E-07
2-Methylpentane	107835		2.063E-06
2-Methyl-1-Pentene	763291		1.719E-07
M-Ethyltoluene	620144		7.787E-07
M-Tolualdehyde	620235		1.406E-06
Napthalene	91203	CAA	2.736E-06
N-Decane	124185		1.618E-06
N-Dodecane	112403		2.336E-06
N-Heptadecane	629787		4.551E-08
N-Heptane	142825		3.236E-07
N-Nonane	111842		3.135E-07
N-Octane	111659		3.135E-07
1-Nonene	124118		1.244E-06
N-Pentadecane	629629		8.748E-07
N-Pentane	109660		1.001E-06
N-Propylbenzene	103651		2.680E-07
N-Tetradecane	629594		2.104E-06
N-Tridecane	629505		2.705E-06
N-Undecane	1120214		2.245E-06
Octene	111660		1.396E-06
O-Ethyltoluene	611143		3.287E-07
O-Tolualdehyde	529204		1.163E-06
1-Pentene	109671		3.924E-06
P-Ethyltoluene	622968		3.236E-07
Phenanthrene	85018		1.238E-09
Phenol	108952	CAA	3.671E-06

Air Taxi Emission Factors - Jet			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
Propane	74986		3.944E-07
Propionaldehyde	123386	CAA	3.676E-06
Propylene	115071		2.293E-05
P-Tolualdehyde	104870		2.427E-07
Pyrene	121400		3.401E-10
Styrene	100425	CAA	1.563E-06
Toluene	108883	CAA	3.246E-06
Trans-2-Hexene	4050457		1.517E-07
Trans-2-Pentene	646048		1.815E-06
1,2,3-Trimethylbenzene	526738		5.360E-07
1,2,4-Trimethylbenzene	95636		1.770E-06
1,3,5-Trimethylbenzene	108678		2.731E-07
2,2,4-Trimethylpentane	540841	CAA	1.915E-07
Valeraldehyde	110623		1.239E-06
Xylene	1330207	CAA	2.352E-06

Air Taxi Emission Factors - Piston			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
THC			7.750E-05
VOC			8.484E-05
TOG			9.474E-05
NO_x			7.900E-05
CO			1.407E-02
SO_x			7.500E-06
PM_{10}			3.015E-04
$PM_{2.5}$			3.920E-05
Acenaphthene	83329		2.201E-07
Acenaphthylene	208968		1.242E-06
Acetaldehyde	75070	CAA	5.874E-07
Acrolein	107028	CAA	5.684E-08
Anthracene	120127		2.563E-07
Benzene	71432	CAA	3.837E-06
Benzo(a)anthracene	56553		3.015E-08
Benzo(a)pyrene	50328		3.015E-08
Benzo(b)fluoranthene	205992		3.618E-08
Benzo(ghi)perylene	191242		7.839E-08
Benzo(k)fluoranthene	207089		3.618E-08
1,3-Butadiene	101314	CAA	9.285E-07
Chrysene	218019		3.015E-08
Ethylbenzene	100414	CAA	1.393E-06
Fluoranthene	206440		2.744E-07
Fluorene	86737		4.553E-07
Formaldehyde	50000	CAA	2.548E-06
Indeno(1,2,3-cd)pyrene	193395		2.412E-08
M-Xylene and P-Xylene	108383	CAA	2.201E-07
Naphthalene (gas phase)	91203	CAA	4.327E-07
Naphthalene (solid phase)	91203	CAA	4.432E-06
N-Hexane	110543		6.632E-07
O-Xylene	95476	CAA	1.242E-06
Phenanthrene	85018		7.658E-07
Propionaldehyde	123386	CAA	5.684E-08
Pyrene	121400		3.739E-07
Styrene	100425	CAA	3.221E-07
Toluene	108883	CAA	9.853E-06
2,2,4-Trimethylpentane	540841	CAA	3.394E-08

General Aviation Emission Factors - Jet			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
THC			3.00E-04
VOC			2.73E-04
TOG			3.06E-04
NO_x			1.62E-04
CO			4.79E-03
SO_x			3.68E-05
PM_{10}			1.184E-04
$PM_{2.5}$			1.539E-05
Acetaldehyde	75070	CAA	1.309E-05
Acetone	67641		9.593E-07
Acetylene	74862		1.207E-05
Acrolein	107028	CAA	7.506E-06
Anthracene	120127		5.221E-11
Benzaldehyde	100527	IRIS	1.440E-06
Benzene	71432	CAA	5.152E-06
Benzo(a)anthracene	56553		7.903E-12
Benzo(a)pyrene	50328		4.327E-12
Benzo(ghi)perylene	191242		7.178E-13
1,3-Butadiene	101314	CAA	5.170E-06
1-Butene	101389		5.376E-06
Butyraldehyde	123728		3.647E-07
C14-Alkane	No CAS		5.700E-07
C15-Alkane	No CAS		5.425E-07
C16 Branched Alkane	No CAS		4.475E-07
C18-Alkane	No CAS		6.130E-09
C4-Benzene + C3-Aroald	No CAS		2.010E-06
C5-Benzene+C4-Aroald	No CAS		9.930E-07
Chrysene	218019		7.359E-12
Cis-2-Butene	514181		6.436E-07
Cis-2-Pentene	627203		8.459E-07
Crotonaldehyde	4170303		3.166E-06
1-Decene	872059		5.670E-07
Dimethylnapthalenes	28804888		2.758E-07
Ethane	74840		1.597E-06
Ethylbenzene	100414	CAA	5.333E-07
Ethylene	74851		4.738E-05
Fluoranthene	206440		1.092E-10
Formaldehyde	50000	CAA	3.773E-05
Glyoxal	107222		5.566E-06

General Aviation Emission Factors - Jet			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
Heptene	25339564		1.342E-06
Hexadecane	544763		1.502E-07
1-Hexene	592416		2.256E-06
Isopropylbenzene	98828	CAA	9.194E-09
Isovaleraldehyde	514863		9.807E-08
Methacrolein	78853		1.315E-06
Methanol	67561	CAA	5.532E-06
Methyl Glyoxal	78988		4.606E-06
1-Methyl Naphthalene	14120		7.570E-07
2-Methyl Naphthalene	91576	IRIS	6.313E-07
3-Methyl-1-Butene	563451		3.433E-07
4-Methyl-1-Pentene	131372		3.984E-08
2-Methyl-1-Butene	563462		4.291E-07
2-Methyl-2-Butene	513359		5.670E-07
2-Methylpentane	107835		1.250E-06
2-Methyl-1-Pentene	763291		1.042E-07
M-Ethyltoluene	620144		4.720E-07
M-Tolualdehyde	620235		8.520E-07
Naphthalene (gas phase)	91203	CAA	1.674E-06
Naphthalene (solid phase)	91203	CAA	5.571E-08
Napthalene	91203	CAA	1.658E-06
N-Decane	124185		9.807E-07
N-Dodecane	112403		1.416E-06
N-Heptadecane	629787		2.758E-08
N-Heptane	142825		1.961E-07
N-Nonane	111842		1.900E-07
N-Octane	111659		1.900E-07
1-Nonene	124118		7.539E-07
N-Pentadecane	629629		5.302E-07
N-Pentane	109660		6.068E-07
N-Propylbenzene	103651		1.624E-07
N-Tetradecane	629594		1.275E-06
N-Tridecane	629505		1.640E-06
N-Undecane	1120214		1.361E-06
Octene	111660		8.459E-07
O-Ethyltoluene	611143		1.992E-07
O-Tolualdehyde	529204		7.049E-07
1-Pentene	109671		2.378E-06
P-Ethyltoluene	622968		1.961E-07
Phenanthrene	85018		4.858E-10

General Aviation Emission Factors - Jet			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
Phenol	108952	CAA	2.225E-06
Propane	74986		2.391E-07
Propionaldehyde	123386	CAA	2.228E-06
Propylene	115071		1.390E-05
P-Tolualdehyde	104870		1.471E-07
Pyrene	121400		1.334E-10
Styrene	100425	CAA	9.470E-07
Toluene	108883	CAA	1.968E-06
Trans-2-Hexene	4050457		9.194E-08
Trans-2-Pentene	646048		1.100E-06
1,2,3-Trimethylbenzene	526738		3.249E-07
1,2,4-Trimethylbenzene	95636		1.073E-06
1,3,5-Trimethylbenzene	108678		1.655E-07
2,2,4-Trimethylpentane	540841	CAA	1.313E-07
Valeraldehyde	110623		7.509E-07
Xylene	1330207	CAA	1.612E-06

General Aviation Emission Factors - Piston			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
THC			7.750E-05
VOC			7.524E-05
TOG			8.537E-05
NO_x			3.250E-05
CO			6.007E-03
SO_x			5.000E-06
PM_{10}			1.184E-04
$PM_{2.5}$			1.539E-05
Acenaphthene	83329		1.123E-08
Acenaphthylene	208968		6.339E-08
Acetaldehyde	75070	CAA	5.874E-07
Acrolein	107028	CAA	5.684E-08
Anthracene	120127		1.308E-08
Benzene	71432	CAA	3.837E-06
Benzo(a)anthracene	56553		1.539E-09
Benzo(a)pyrene	50328		1.539E-09
Benzo(b)fluoranthene	205992		1.846E-09
Benzo(ghi)perylene	191242		4.000E-09
Benzo(k)fluoranthene	207089		1.846E-09
1,3-Butadiene	101314	CAA	9.285E-07
Chrysene	218019		1.539E-09
Ethylbenzene	100414	CAA	1.393E-06
Fluoranthene	206440		1.400E-08
Fluorene	86737		2.323E-08
Formaldehyde	50000	CAA	2.548E-06
Indeno(1,2,3-cd)pyrene	193395		1.231E-09
M-Xylene and P-Xylene	108383	CAA	1.123E-08
Naphthalene (gas phase)	91203	CAA	4.327E-07
Naphthalene (solid phase)	91203	CAA	2.262E-07
N-Hexane	110543		6.632E-07
O-Xylene	95476	CAA	6.339E-08
Phenanthrene	85018		3.908E-08
Propionaldehyde	123386	CAA	5.684E-08
Pyrene	121400		1.908E-08
Styrene	100425	CAA	3.221E-07
Toluene	108883	CAA	9.853E-06
2,2,4-Trimethylpentane	540841	CAA	3.394E-08

Military Emission Factor			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
THC			6.170E-04
VOC			6.815E-04
TOG			7.597E-04
NO_x			7.900E-05
CO			1.407E-02
SO_x			7.500E-06
PM_{10}			3.017E-04
$PM_{2.5}$			3.922E-05
Acetaldehyde	75070	CAA	3.245E-05
Acetone	67641		2.378E-06
Acetylene	74862		2.993E-05
Acrolein	107028	CAA	1.861E-05
Benzaldehyde	100527	IRIS	3.571E-06
Benzene	71432	CAA	1.277E-05
1,3-Butadiene	101314	CAA	1.282E-05
1-Butene	101389		1.333E-05
Butyraldehyde	123728		9.041E-07
C14-Alkane	No CAS		1.413E-06
C15-Alkane	No CAS		1.345E-06
C16 Branched Alkane	No CAS		1.109E-06
C18-Alkane	No CAS		1.519E-08
C4-Benzene + C3-Aroald	No CAS		4.984E-06
C5-Benzene+C4-Aroald	No CAS		2.461E-06
Cis-2-Butene	514181		1.595E-06
Cis-2-Pentene	627203		2.097E-06
Crotonaldehyde	4170303		7.848E-06
1-Decene	872059		1.405E-06
Dimethylnapthalenes	28804888		6.837E-07
Ethane	74840		3.958E-06
Ethylbenzene	100414	CAA	1.322E-06
Ethylene	74851		1.175E-04
Formaldehyde	50000	CAA	9.352E-05
Glyoxal	107222		1.380E-05
Heptene	25339564		3.328E-06
Hexadecane	544763		3.723E-07
1-Hexene	592416		5.591E-06
Isopropylbenzene	98828	CAA	2.279E-08
Isovaleraldehyde	514863		2.431E-07
Methacrolein	78853		3.259E-06

Military Emission Factor			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
Methanol	67561	CAA	1.371E-05
Methyl Glyoxal	78988		1.142E-05
1-Methyl Naphthalene	14120		1.876E-06
2-Methyl Naphthalene	91576	IRIS	1.565E-06
3-Methyl-1-Butene	563451		8.509E-07
4-Methyl-1-Pentene	131372		9.876E-08
2-Methyl-1-Butene	563462		1.064E-06
2-Methyl-2-Butene	513359		1.405E-06
2-Methylpentane	107835		3.100E-06
2-Methyl-1-Pentene	763291		2.583E-07
M-Ethyltoluene	620144		1.170E-06
M-Tolualdehyde	620235		2.112E-06
Napthalene	91203	CAA	4.110E-06
N-Decane	124185		2.431E-06
N-Dodecane	112403		3.510E-06
N-Heptadecane	629787		6.837E-08
N-Heptane	142825		4.862E-07
N-Nonane	111842		4.710E-07
N-Octane	111659		4.710E-07
1-Nonene	124118		1.869E-06
N-Pentadecane	629629		1.314E-06
N-Pentane	109660		1.504E-06
N-Propylbenzene	103651		4.026E-07
N-Tetradecane	629594		3.160E-06
N-Tridecane	629505		4.064E-06
N-Undecane	1120214		3.373E-06
Octene	111660		2.097E-06
O-Ethyltoluene	611143		4.938E-07
O-Tolualdehyde	529204		1.747E-06
1-Pentene	109671		5.895E-06
P-Ethyltoluene	622968		4.862E-07
Phenol	108952	CAA	5.515E-06
Propane	74986		5.926E-07
Propionaldehyde	123386	CAA	5.523E-06
Propylene	115071		3.445E-05
P-Tolualdehyde	104870		3.647E-07
Styrene	100425	CAA	2.348E-06
Toluene	108883	CAA	4.877E-06
Trans-2-Hexene	4050457		2.279E-07
Trans-2-Pentene	646048		2.727E-06

Military Emission Factor			
Pollutant	**CAS No.**	**CAA "187" or IRIS HAP?**	**Emission Factors (tons/LTO)**
1,2,3-Trimethylbenzene	526738		8.053E-07
1,2,4-Trimethylbenzene	95636		2.659E-06
1,3,5-Trimethylbenzene	108678		4.102E-07
Valeraldehyde	110623		1.861E-06

Appendix B

Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory

Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory

December 2010

Section 1. Introduction

The main purpose of this document is to describe the methods the Environmental Protection Agency (EPA) used to calculate airport lead (Pb) inventories for the 2008 National Emissions Inventory (NEI).[1] These methods focus on the development of approaches to estimate piston-engine aircraft activity at airports in the U.S. since the activity of this fleet is reported to the Federal Aviation Administration (FAA) as general aviation (GA) or air taxi (AT) activity – categories that also include jet-engine aircraft activity. The methods described here reflect improvements to the methods used in developing the airport-specific piston-engine aircraft inventories in the 2002 NEI and the 2005 NEI.

Background information regarding the use of leaded aviation gasoline (avgas) in piston-engine powered aircraft is available in other documents.[2,3] Briefly, most piston-engine aircraft operations fall into the categories of either GA or AT. Aircraft used in GA and AT activities include a diverse set of aircraft types and engine models and are used in a wide variety of applications.[4] Lead emissions associated with GA and AT aircraft stem from the use of one hundred octane low lead (100LL) avgas. The lead is added to the fuel in the form of tetraethyl lead (TEL). This lead additive helps boost fuel octane, prevent engine knock, and prevent valve seat recession and subsequent loss of compression for engines without hardened valves. Today, 100LL is the most commonly available type of aviation gasoline in the United States.[5] Lead is not added to jet fuel that is used in commercial aircraft, most military aircraft, or other turbine-engine powered aircraft. Lead emissions from the use of leaded avgas comprised 45% of the national inventory for emissions of lead in 2002.[6]

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[1] In this document '2008 NEI' refers to 2008 NEI version 1 (January 2011), available at http://www.epa.gov/ttn/chief/net/2008inventory.html

[2] EPA (2007) Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information. OAQPS Staff Paper. EPA-452/R-07-013 November 2007. pp 2-8 and 2-9.

[3] FAA William J. Hughes Technical Center http://www.tc.faa.gov/act4/insidethefence/2006/0609_06_AvFuels.htm

[4] Commercial aircraft include those used for scheduled service transporting passengers, freight, or both. Air taxis fly scheduled and for-hire service carrying passengers, freight or both, but they usually are smaller aircraft than those operated by commercial air carriers. General aviation includes most other aircraft (fixed and rotary wing) used for personal transportation, business, instructional flying, and aerial application.

[5] ChevronTexaco (2005) Aviation Fuels Technical Review. FTR-3. http://www.chevronglobalaviation.com/docs/aviation_tech_review.pdf

[6] U.S. Environmental Protection Agency (2008) EPA's Report on the Environment EPA/600/R-07/045F. Available at: http://www.epa.gov/roe

This document is organized into eight sections. Section 2 describes the data we use to calculate the national inventory for the amount of lead released to the air from the combustion of leaded avgas. Section 3 describes the landing and takeoff data we use to calculate airport-specific inventories for lead. Section 4 describes how we estimate landing and takeoff data for the airport facilities that do not report it to the FAA. Section 5 describes the estimate of landing and takeoff activity occurring at heliports in the U.S. Section 6 describes the methods used to calculate the airport-specific inventories for lead. Section 7 describes data that would be needed to improve the estimates of airport-specific inventories for lead and Section 8 describes the estimates of the amount of lead emitted in-flight that are in the 2008 NEI.

In this document, units of tons (i.e., U.S. short tons) are used when discussing the national and airport-specific lead inventory in order to be consistent with the manner in which the NEI reports inventories for lead and other pollutants. The unit of grams is used in describing the concentration of lead in avgas and in describing emission factors. Conversion factors are provided for clarity.

Section 2. Calculating the National Avgas Lead Inventory

Because lead is a persistent pollutant and accumulates in the environment, we include all lead emissions from piston-engine aircraft in the NEI – emissions occurring during the landing and take-off cycle at airports as well as emissions occurring at altitude.[7] To calculate the national avgas lead inventory, we use information provided by the U.S. Department of Transportation's (DOT's) Federal Aviation Administration (FAA) regarding the volume of leaded avgas consumed in the U.S. in 2008.[8] The U.S. Department of Energy's (DOE's) Energy Information Administration (EIA) provides information regarding the volume of leaded avgas produced in a given year. EPA has historically used the DOE EIA avgas fuel volume produced to calculate national lead inventories from the consumption of leaded avgas. However, since EPA uses DOT airport activity and aircraft data, we are using the DOT fuel volume data in the 2008 NEI to calculate the national lead inventory in order to use a consistent data source. In this document, when we refer to avgas fuel volume data it is data supplied by DOT, except where noted.

As demonstrated in the equation below, to calculate the annual emission of lead from the consumption of leaded avgas, we multiply the volume of avgas used by the concentration of lead in the avgas, minus the small amount of lead that is retained in the engine, engine oil and/or exhaust system. The volume of avgas used in the U.S. in 2008

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[7] U.S. EPA, 2006. Air Quality: Criteria for Lead: 2006; EPA/600/R-5/144aF; U.S. Government Printing Office, Washington, DC, October, 2006.

[8] U.S. Department of Transportation Federal Aviation Administration Aviation Policy and Plans. FAA Aerospace Forecast Fiscal Years 2010-2030. p.99. Available at: http://www.faa.gov/data_research/aviation/aerospace_forecasts/2010-2030/media/2010%20Forecast%20Doc.pdf This document provides historical data for 2000-2008 as well as forecast data.

was 248,100,000 gallons.[9] The concentration of lead in avgas ([Pb] in the equation below) can be one of four levels (ranging from 0.14 to 1.12 grams of lead per liter) as specified by the American Society for Testing and Materials (ASTM). By far the most common avgas supplied is "100 Low Lead" or 100LL.[10,11] The maximum lead concentration specified by ASTM for 100LL is 0.56 grams per liter or 2.12 grams per gallon.[12] A fraction of lead is retained in the engine, engine oil and/or exhaust system which we currently estimate at 5%.[13]

For the 2008 NEI, the national estimate of lead emissions from the consumption of avgas was 551 tons (see equation below).

$$\frac{(248{,}100{,}000\ \text{gal})(2.12\ \text{g Pb/gal})(0.95)}{907{,}180\ \text{g/ton}} = 551\ \text{tons Pb}$$

As described above, DOE's EIA also provides estimates of the annual volume of leaded avgas produced in a given year. For 2008, the volume of avgas produced in the U.S. was 5,603 thousand barrels or 235,326,000 gallons.[14] Consumption of this volume of avgas equates to a national lead emissions estimate for this source of 522 short tons.

Section 3. Landing and Takeoff Data Sources and Uses

Airport-specific inventories require information regarding landing and takeoff (LTO) activity by aircraft type.[15] According to FAA records, there are approximately 20,000 airport facilities in the U.S., the vast majority of which are expected to have activity by piston-engine aircraft that operate on leaded avgas. Of these facilities, EPA's NEI has in the past, reported emissions of lead (and other criteria pollutants and

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[9] U.S. Department of Transportation Federal Aviation Administration Aviation Policy and Plans. FAA Aerospace Forecast Fiscal Years 2010-2030. p.99. Available at: http://www.faa.gov/data_research/aviation/aerospace_forecasts/2010-2030/media/2010%20Forecast%20Doc.pdf This document provides historical data for 2000-2008 as well as forecast data.

[10] ChevronTexaco (2005) Aviation Fuels Technical Review. FTR-3.

[11] The 2008 General Aviation Statistical Databook & Industry Outlook report by General Aviation Manufactures Association (GAMA) found that over 90% of avgas is 100LL.

[12] ASTM International (2005) Annual Book of ASTM Standards Section 5: Petroleum Products, Lubricants, and Fossil Fuels Volume 05.01 Petroleum Products and Lubricants (I): D 56 – D 3230.

[13] The information used to develop this estimate is from the following references: (a) Todd L. Petersen, Petersen Aviation, Inc, *Aviation Oil Lead Content Analysis*, Report # EPA 1-2008, January 2, 2008, available at William J. Hughes Technical Center Technical Reference and Research Library at http://actlibrary.tc.faa.gov/ and (b) E-mail from Theo Rindlisbacher of Switzerland Federal Office of Civil Aviation to Bryan Manning of U.S. EPA, regarding lead retained in engine, September 28, 2007.

[14] DOE Energy Information Administration. Fuel production volume data obtained from http://tonto.eia.doe.gov/dnav/pet/hist/mgaupus1A.htm accessed November 2006.

[15] An aircraft operation is defined as any landing or takeoff event, therefore, to calculate LTOs, operations are divided by two. Most data sources from FAA report aircraft activity in numbers of operations which, for the purposes of calculating lead emissions using the method described in this document, need to be converted to LTO events.

hazardous air pollutants) at 3,410 airports.[16] While the 3,410 airport facilities are among the most active in the U.S., they comprise only a small fraction of the total airport facilities where leaded avgas is used.

FAA's Office of Air Traffic provides a complete listing of operational airport facilities in the National Airspace System Resources (NASR) database. The electronic NASR data report, referred to here as the 5010 airport data report, can be generated from the NASR database and is available for download from the FAA website.[17] This report is updated every 56 days. EPA obtains airport information (including operations) for a subset of the facilities in the NASR database from FAA's Terminal Area Forecast (TAF) database that is prepared by FAA's Office of Aviation Policy and Plans.[18] The TAF database currently includes information for airports in FAA's National Plan of Integrated Airport Systems (NPIAS), which identifies airports that are significant to national air transportation. Approximately 500 of the airports that are in the TAF database have either an FAA air traffic control tower or an FAA contract tower where controllers count operations. The operations data from the control towers is reported to The Operations Network (OPSNET)[19] which is publically available in the Air Traffic Activity System (ATADS) database.[20] The operations data for the towered airports that is reported in OPSNET and ATADS is then reported to the TAF database. The operations data for the airports in the TAF database that do not have control towers represent estimates.[21] The operations supplied in the 5010 airport data report for facilities not reported in the TAF may be self-reported by airport operators through data collection accomplished by airport inspectors who work for the State Aviation Agency, or operations data can be obtained through other means.[22]

The 5010 airport data report supplies the date that the associated operations data represents.[23] Because airports that are not in the TAF database submit data voluntarily to FAA for the 5010 data report, many of the airports have operations data that represent data for years earlier than 2008. Nationally, GA and AT piston-engine operations have decreased in recent years,[24] therefore EPA did not use operations data from years prior to 2008 as it is reported. Instead, EPA multiplied the older GA and AT piston-engine data (Section 6 describes the method EPA used to calculate the number of piston-engine

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[16] These 3,410 facilities are the facilities for which the FAA's Terminal Area Forecast (TAF) database provides information regarding aircraft activity. The TAF database is prepared by FAA's Office of Aviation Policy and Plans and includes information for the airports in FAA's National Plan of Integrated Airport Systems (NPIAS). One of the goals of the NPIAS is to identify airports that are significant to national air transportation.
[17] http://www.faa.gov/airports_airtraffic/airports/airport_safety/airportdata_5010/
[18] http://aspm.faa.gov/main/taf.asp
[19] http://aspm.faa.gov/opsnet/sys/
[20] http://aspm.faa.gov/opsnet/sys/Airport.asp
[21] FAA's Terminal Area Forecast Summary (Fiscal Years 2009 – 2030), Appendix A (page 28) http://www.faa.gov/data_research/aviation/taf_reports/media/TAF%20Summary%20Report%20FY%202009%20-%202030.pdf
[22] In the absence of updated information from States, local authorities or Tribes, we are using the LTO data provided in the FAA database.
[23] The 12-month ending date on which annual operations data in the report is based.
[24] http://www.faa.gov/data_research/aviation_data_statistics/general_aviation/

operations from total GA and AT activity data) by scaling factors that were calculated by dividing the 2008 national amount of avgas produced by the national amount of avgas produced in the year the operations data represents.[25] A table with the scaling factors is provided in Appendix A. The national volume of avgas produced data comes from the DOE, EIA website and is available for 1981 – 2009.[26] For operations data older than 1981, EPA divided the 2008 national amount of avgas produced by the average of the national amount of avgas produced from 1981 – 1989. Jet engines do not use avgas, therefore EPA did not apply scaling factors to the turbine operations for data from years prior to 2008.

EPA also obtains operations data from the T-100 segment data from the Bureau of Transportation Statistics (BTS). The aircraft in the T-100 data are matched to aircraft in the FAA's Emission and Dispersion Modeling System (EDMS) using the crosswalk table developed for earlier versions of the NEI. Generally the T-100 data covers commercial air carrier operations, but some AT activities are included in the data set that would double count with the TAF data at the same airport. To correct for possible double counting, first the AT LTOs included in the T-100 data were compiled using the aircraft type data included in the aircraft make/models crosswalk.[27] The resulting aggregated LTOs were compared with the reported TAF LTOs for airports where there were overlaps. The T-100 AT LTOs were then subtracted from the TAF AT data to ensure that double counting was minimized. Note that if the T-100 AT value was larger than the TAF value, the TAF value was set to zero to eliminate the possibility of negative LTOs in the dataset.

The 2008 draft NEI was developed using the January 15, 2009 version of the 5010 airport data report. In that version of the report there were 19,925 airport facilities in the U.S. that had submitted data to the FAA. Among these 19,925 facilities, 99 facilities were not relevant for the purposes of estimating lead emissions because they were either listed as closed (85) or they were balloonports (14).[28] Therefore, lead inventories were needed for 19,826 facilities. In the January 15, 2009 version of the 5010 airport data report there were 5,654 airport facilities for which operations data were provided (many of which are facilities in FAA's TAF database).[29] There were 14,172 facilities in the 5010 airport data report for which there were no operations data.[30] As a

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[25] The FAA General Aviation and Air Taxi (Part 135) Activity Surveys (source of national level piston-engine operations data) are only available annually, starting in 1999. Because there are airports with operations data older than 1999, EPA used avgas product supplied data as a surrogate for piston-engine operations to estimate the change in piston-engine activity over the last three decades.

[26] http://tonto.eia.doe.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=mgaupus1&f=A. DOT recently changed the way they estimate fuel consumption data, so while EPA used DOT data to determine the 2008 national avgas lead inventory, for the purpose of calculating these scaling factors EPA used DOE's data in order to have historical fuel data that is calculated in a consistent manner.

[27] The T-100 data does not specify that the operations data is air taxi in nature; however, in discussions with FAA, EPA determined that these flights are air taxi in nature and has assigned them in the 2008 NEI as such.

[28] Balloon craft do not use avgas

[29] Either Commuter, GA Itinerant, GA Local, or Air Taxi operations data, as these operations can be performed by piston-engine aircraft.

[30] No Commuter, GA Itinerant, GA Local, or Air Taxi operations data.

part of the review process for the draft 2008 NEI, EPA received updated airport data from states and also looked at more recent versions of the 5010 airport data report to update the status of airports, so the number of airports for which EPA estimated activity is slightly lower in the 2008 NEI than in the draft 2008 NEI. The following section of this document describes the method EPA used to estimate operations for the 14,132 airport facilities in the 2008 NEI that do not have reported activity data.

As described in Section 1, most piston-engine aircraft fall into the categories of either GA or AT. Some GA and AT activity is conducted by turboprop and turbojet aircraft which do not used leaded avgas. There are no national databases that provide airport-specific LTO activity data for piston-engine aircraft separately from turbojet and turboprop aircraft. The databases described above report total GA and AT activity conducted by both piston-engine and jet-engine aircraft. Part *(a)* in Section 6 describes how we estimate piston-engine LTOs at airports in the 2008 NEI.

Section 4. Estimating LTOs at the 14,132 Airport Facilities with No LTO Data

FAA has used regression models to estimate operations at facilities where operations data are not available.[31,32] In this work and other work, FAA identified characteristics of small towered airports for which there were statistically significant relationships with operations at these airports.[33] Regression models based on the airport characteristics were then used to estimate general aviation operations for a set of non-towered airports. The airport characteristics identified by FAA and used to estimate general aviation operations at small airports include: the number of aircraft based at a facility (termed 'based aircraft'), population in the vicinity of the airport, airport regional prominence, per capita income, region, and the presence of certificated flight schools.

In the 2000 report titled 'Model for Estimating General Aviation Operations at Non-towered Airports,' a model of GA annual activity was developed using information from small towered airports to explain GA activity at towered and non-towered airports. The model explained GA activity at the towered airports well (R^2 of 0.75) but produced higher estimates than state-supplied estimates for non-towered airports.[34]

The relevant data available in the 5010 airport data report for the purposes of estimating airport operations include: facility type (airport, balloonport, seaplane base, gliderport, heliport, stolport,[35] ultralight); number of GA aircraft based at each airport by

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[31] Federal Aviation Administration, Office of Aviation Policy and Plans, Statistics and Forecast Branch. July 2001. Model for Estimating General Aviation Operations at Non-towered Airports Using Towered and Non-towered Airport Data. Prepared by GRA, Inc.
[32] Mark Hoekstra, "Model for Estimating General Aviation Operations at Non-Towered Airports" prepared for FAA Office of Aviation Policy and Plans, April 2000.
[33] GRA, Inc. "Review of TAF Methods," Final Report, prepared for FAA Office of Aviation Policy and Plans under Work Order 45, Contract No. DTFA01-93-C-00066, February 25, 1998.
[34] The mean absolute difference between the model operations estimate and the state operations estimate was 16,940 operations.
[35] Stolport is an airport designed with STOL (Short Take-Off and Landing) operations in mind, normally having a short single runway.

type (glider, helicopter, jet engine, military, multi-engine, single engine, ultralight); operations data (air taxi, commercial, commuter, GA itinerant, GA local, military)[36]; and operations date (12-month ending date on which annual operations data is based). Census data was also merged with the 5010 airport data report to give population data for each airport's county.

Using the FAA work referenced above, we explored relationships among the airport data variables that best predicted aircraft activity (LTOs). We found that based aircraft was a highly significant and positive regressor to LTOs. Table 1 shows that for facilities that did not have LTO data in the January 15, 2009 version of the 5010 airport data report, 7,856 had based aircraft data while 6,316 did not have based aircraft data.[37, 38] Therefore, as described below, LTO estimates were derived using different methods depending on data availability.

Table 1: Contingency table describing the numbers of airport facilities that have or do not have LTO data and/or based aircraft data for airport facilities in the January 15, 2009 version of the 5010 airport data report

		HAVE LTO DATA		
		YES	**NO**	
HAVE BASED AIRCRAFT DATA	**YES**	4,872	7,856	**12,728**
	NO	782	6,316	**7,098**
		5,654	**14,172**	**19,826**

[36] As explained in footnote 15, an aircraft operation is defined as any landing or takeoff event, therefore, to calculate LTOs, operations are divided by two. The 5010 airport data report from FAA reports aircraft activity in numbers of operations which, for the purposes of calculating Pb emissions using the method described in the TSD, are converted to LTO events.

[37] As described in Section 3, the number of facilities with no LTO data changed slightly from the draft 2008 NEI to the 2008 NEI. In the 2008 NEI, of the facilities that did not have reported activity data, 7,837 facilities reported based aircraft data and 6,295 did not report based aircraft data.

[38] These numbers include data for the following types of facilities: airports, balloonports, seaplane bases, gliderports, heliports, stolports, and ultralights.

(a) Estimating LTOs at Facilities with Based Aircraft Data, but No LTO Data:

There are 6,414 facilities in the 2008 NEI (not including heliports) for which the 5010 airport data report supplies the number of based aircraft[39] but not activity data to which the regression equation (based aircraft vs. LTOs) could be applied. Using the 4,872 airports for which both LTO and aircraft data is known, the initial relationship found between based aircraft and LTOs was:

Equation 1:
LTOs = 2494 + 208*aircraft $R^2 = 0.55$

The FAA models found population to be another significant regressor. We used the population of the county in which the airport is located as the population variable. Adding county population to the model gave the following relationship:

Equation 2:
LTOs = 2204 + 194*aircraft + 0.0038*county population $R^2 = 0.56$

EPA received numerous comments to the docket on its Advance Notice of Proposed Rulemaking on Lead Emissions from Piston-Engine Aircraft Using Leaded Aviation Gasoline[40] indicating that aviation in Alaska is different than it is in the continental U.S. Commenters pointed out that in Alaska, 82% of communities are not accessible by road and rely on air transport for life sustaining goods and services.[41] Commenters also noted that Alaskans travel by air eight times more often per capita than those in the continental U.S. For those reasons, we added a dummy variable in equation 3 to identify whether or not an airport is located in Alaska. Because the relationship between based aircraft and LTOs is likely different for Alaskan airports than it is for airports that aren't in Alaska, we also added an interaction term to equation 3 (interaction of an airport being in Alaska and its sum of based aircraft).

Equation 3:
LTOs = 1937 + 205*aircraft + 0.0038*county population + 566*Alaska – 108*(AlaskaXaircraft)

$R_2 = 0.58$

After analyzing the data and plot for the data underlying equation 3, we found many airport facilities identified as commercial airports for which based aircraft was extremely low (i.e., less than 10), yet LTOs were quite high (i.e., anywhere from 100,000

[39] Based aircraft for this purpose was limited to single- and multi-engine aircraft, helicopters, and ultralights since these aircraft types can use leaded avgas.
[40] U.S. Environmental Protection Agency (2010) Advance Notice of Proposed Rulemaking on Lead Emissions From Piston-Engine Aircraft Using Leaded Aviation Gasoline. 75 FR 22440 (April 28, 2010).
[41] Comments to the docket on EPA's Advance Notice of Proposed Rulemaking on Lead Emissions from Piston-Engine Aircraft Using Leaded Aviation Gasoline from the Alaska Air Carriers Association (dated 18 June 2010; comment number OAR-2007-0294-0323.1) and Alaska Governor Parnell (dated 25 August 2010; comment number OAR-2007-0294-0403.1).

to more than 200,000 LTOs/year).[42] These facilities were removed from the regression analysis. Additionally, for reasons described below, heliports were also removed from the regression. The resulting relationship was:

Equation 4:

LTOs = 1293 + 203*aircraft + 0.0019*county population - 473*Alaska – 144*(AlaskaXaircraft) $R^2 = 0.65$

When equation 4 was applied to the 6,414 airport facilities that report based aircraft data but not LTO activity, the resulting sum of LTOs was almost 15 million. EPA estimates that the number of LTOs at the airports that do not report activity data should approximate the number of LTOs from the bottom of the distribution of the set of airports that report activity data to the 5010 airport data report but that are not in the TAF database. The average number of LTOs per year from airports in the bottom 30% of the set of airports that report activity data to the 5010 airport data report but that are not in the TAF database is ~63 LTOs/year. Multiplying 63 by the number of airports that do not report activity data equals 549,050 LTOs.[43] Therefore, EPA used equation 4 to generate the distribution of LTOs at the individual airports that report based aircraft data but not activity data and then applied a scaling factor of 0.0356 to those LTOs to obtain the LTOs that are reported in the 2008 NEI.[44] The sum of the LTOs from this set of airports plus the sum of the LTOs at the airports that do not report either based aircraft or activity data (described below in section *(b)*) sum to 549,050 LTOs. These LTOs are all assigned to the GA, piston-engine category since they are assigned to smaller general aviation airports that are assumed to have little to no air taxi or jet aircraft activity.

Equation 4 and the scaling factor were used to estimate LTO activity for the 2008 NEI at airport facilities that report based aircraft data but not activity data.

(b) Estimating LTOs at Facilities with Neither Based-Aircraft Data nor LTO Data:

There are 2,260 facilities (not including heliports) for which the 5010 airport data report supplies neither the number of based aircraft nor activity data. In the absence of data to establish a relationship to airport activity, we assign a default value of LTOs to the GA, piston-engine category for each of these facilities.

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[42] From FAA's website, "Addresses for Commercial Service Airports", available at: http://www.faa.gov/airports_airtraffic/airports/planning_capacity/passenger_allcargo_stats/addresses/media/commercial_service_airports_addresses.xls

[43] This rounded number is calculated by multiplying 63.298 LTOs/year by 8,674, which is the number of airports that don't report activity data (6,414 don't report activity data and 2,260 facilities don't report activity or based aircraft data).

[44] The scaling factor was calculated by dividing 528,710 LTOs by 14,862,767 LTOS; the 528,710 LTOs are equal to 549,050 LTOs minus 20,340 LTOs (20,340 LTOs represent the sum of LTOs assigned to the 2,260 facilities that don't report either activity data or based aircraft data - the derivation of LTO estimates for these facilities is described in Section 4 *(b)*). The 14,862,767 LTOs are the sum of LTOs that result from applying equation 4 to the 6,414 facilities with based aircraft data but no activity data.

The default value was determined by evaluating GA LTOs that are reported at the set of 2,471 facilities that report activity data to the 5010 airport data report but that are not in the TAF set of airports. The average number of LTOs reported to the bottom ten percent of these facilities (when sorted by total GA LTOs) was 9. These facilities are assumed to most closely approximate the set of 2,260 facilities that do not report any based aircraft or LTO data; therefore, we assigned 9 LTOs to the GA, piston-engine category for these airport facilities for purposes of developing inventory estimates.

Section 5. Calculating LTOs at Heliports:

There were 5,559 heliport facilities in the January 15, 2009 FAA 5010 data report that were operational. Of those, only 92 (or 2%) reported LTO data, and of those, only 31 reported both based aircraft and LTO data. Because of the limited information regarding activity at heliports, some municipalities have hired contractors to survey activity in their local area.[45, 46]

The summary statistics for LTO data provided at the 92 operational heliports is presented in Table 2. These facilities report a wide range in activity from 3 LTOs/year to more than 18,000 LTOs/year. Some facilities clearly have significant helicopter traffic (i.e., thousands of LTOs/year) which is supported by the contractor summaries of heliport activity in the Washington Metropolitan area. The little data available to us suggests that the median helicopter activity is less than 200 LTOs/year. In the absence of more information on which to base estimates of LTO activity, we assigned 141 LTOs (the median of the reported heliport LTOs) to the GA category at all of the heliports which do not report LTO data. The piston-engine fraction developed in Section 6 is applied to the 141 LTOs resulting in 51 LTOs assigned to the GA, piston-engine category and 90 assigned to the GA, turbine-engine category. This is an area of significant uncertainty in the inventory and one for which EPA is seeking information from local agencies.

Table 2: Heliport LTO Data for those Reporting LTO Data in the January 15, 2009 Version of the 5010 Airport Data Report

18,250	Maximum LTOs
3	Minimum LTOs
1,123	Average LTOs
141	Median LTOs
50	Mode LTOs

[45] Executive Summary: Regional Helicopter System Plan, Metropolitan Washington Area, prepared by Edwards and Kelcey for the Metropolitan Washington Council of Governments, 2005.
[46] Alaska Aviation Emission Inventory, prepared by Sierra Research, Inc. for Western Regional Air Partnership, 2005.

Section 6. Methodology for Estimating Airport-Specific Lead Emissions

In 2008, EPA developed a method to calculate lead emissions at airports where piston-engine powered aircraft operate. [47] This method brings lead inventories into alignment with the manner in which other criteria pollutants emitted by aircraft are calculated. This method is described here with changes that were made from previous methods (i.e., the method used to develop the 2002 inventory) and applied in developing airport lead inventories for the 2008 NEI. In this section we first present the equation used to calculate lead emitted during the LTO cycle then we describe each of the components of the input data: we describe how we calculate piston-engine LTOs from data available in FAA databases, we describe the derivation of the emission factor for the amount of lead emitted during the LTO cycle, and we describe the estimate of the amount of lead retained in the engine and oil that we do not include in the amount of lead released to the air.

Historically, where aircraft specific activity data are available (such as T-100), aircraft gaseous and particulate matter (PM) emissions have been calculated through the FAA's EDMS.[48] This modeling system was designed to develop emission inventories for the purpose of assessing potential air quality impacts of airport operations and proposed airport development projects. However, EDMS has a limited number of piston-engine aircraft in its aircraft data and is currently not set up to calculate metal emissions and thus, it is not a readily available tool for determining airport lead inventories related to aircraft operations. In developing this approach to determine piston-engine aircraft lead emissions, EPA relied upon the basic methodology employed in EDMS. This requires as input the activity of piston-engine aircraft at a facility, fuel consumption rates by these aircraft during the various modes of the LTO cycle and time in each mode (taxi/idle-out, takeoff, climb-out, approach, and taxi/idle-in), the concentration of lead in the fuel and the retention of lead in the engine and oil. The equation used to calculate airport-specific lead emissions during the LTO cycle is below, followed by a description of each of the input parameters.

$$\text{LTO Pb (tons)} = \frac{(\text{piston-engine LTO})(\text{avgas Pb g/LTO})(1\text{-Pb retention})}{907{,}180 \text{ g/ton}}$$

(a) Calculating Piston-engine LTO:

Piston-engine LTOs are used to calculate emissions of lead that are assigned to the airport facility where the aircraft operations occur. An aircraft operation is defined as any landing or takeoff event, therefore, to calculate LTOs, operations are divided by two. Most data sources from FAA report aircraft activity in numbers of operations which, for the purposes of calculating lead emissions, need to be converted to LTO events. We

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[47] U.S. EPA (2008) Lead Emissions from the Use of Leaded Aviation Gasoline in the United States, Technical Support Document. EPA420-R-08-020. Available at: www.epa.gov/otaq/aviation.htm.
[48] EDMS available from http://www.faa.gov/about/office_org/headquarters_offices/aep/models/edms_model/

describe here the method used to estimate the fraction of GA and AT LTOs at an airport that are conducted by piston-engine aircraft. These fractions are calculated separately (one fraction for GA and one for AT). These fractions are multiplied by total LTOs reported separately for GA and AT and then summed to arrive at the total LTOs conducted by piston-engine aircraft at an airport.

One use of the 2008 NEI is to identify sources of lead, including airports, that have inventories of 0.50 tons per year or more for the purposes of identifying locations where lead monitoring may be required to evaluate compliance with the National Ambient Air Quality Standard for Lead. To calculate the most airport-specific inventories for airports that may potentially exceed this inventory threshold, we used a more airport-specific surrogate for this subset of airports than the remainder of the airports where we applied national default averages described below.

We used the fraction of based aircraft at an airport that are single- or multi-engine to calculate the number of GA LTOs at an airport that were conducted by piston-engine aircraft. The data regarding the population of based aircraft at an airport is available for a subset of airports in the FAA 5010 master records data report described in Section 3. For example, if an airport reports 150 single-engine aircraft, 20 multi-engine aircraft and a total of 180 aircraft based at that facility, then the fraction of based aircraft we would use as a surrogate for piston-engine aircraft is 94% ((150+20)/180). We then multiply the total GA LTOs for that facility by 0.94 to calculate piston-engine LTOs.

We evaluated this surrogate by comparing the results of using it with piston-engine aircraft operations reported for airports that supply this information in master plans, airport layout plans, noise abatement studies and/or land use compatibility plans. We could rarely find data from the same year for comparison purposes; however, for the majority of airports, based aircraft and actual observed piston-engine aircraft activity agreed within ten percent.[49]

For the majority of airports in the 2008 NEI we used national average fractions of GA and AT LTOs conducted by piston-engine aircraft that were derived using FAA's General Aviation and Part 135[50] Activity Surveys – CY 2008 (GAATA).[51] Table 2.4 in the 2008 GAATA Survey reports that approximately sixty-six percent (66%) of all GA and AT LTOs are from piston-engine aircraft which use avgas, and about thirty-four

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[49] Documents used to evaluate the use of based aircraft include the following:
Airport Master Plan Update Prescott Municipal Airport (Ernest A Love Field) (2009) Available at: www.cityof**prescott**.net/_d/amp_tablecontents.pdf
Gillespie field Airport Layout Plan Update Narrative Report (2005) Available at: www.co.san-diego.ca.us/dpw/**airport**s/powerpoints/pdalp.pdf
Land Use Compatibility Plan for the Grand Forks International Airport (2006) Available at: www.gfk**airport**.com/authority/pdf/**land_use**.pdf
McClellan-Palomar Land Use Compatibility Plan (Amended March 4, 2010) Available at: www.ci.oceanside.ca.us/.../**McClellan-Palomar**_ALUCP_03-4-10_amendment.pdf
[50] On-demand (air taxi) and commuter operations not covered by Part 121
[51] The FAA GAATA is a database collected from surveys of pilots flying aircraft used for general aviation and air taxi activity. For more information on the 2008 GAATA, see Appendix A at http://www.faa.gov/data_research/aviation_data_statistics/general_aviation/CY2008/

percent (34%) are turboprop and turbojet powered which use jet fuel, such as Jet A. The LTO data in Table 2.4 in the 2008 GAATA Survey does not distinguish LTOs as GA or AT, and thus does not allow us derive separate piston activity fractions for GA and AT.

We are using the number of hours flown by piston versus turboprop or turbojet aircraft (reported in Table 1.4 in the 2008 GAATA Survey) to allow us to make separate estimates of the fraction of GA activity conducted by piston aircraft and the fraction of AT activity conducted by piston aircraft. We chose to use the fraction of hours flown by piston-engine aircraft as a surrogate to calculate the fraction of LTOs flown by piston aircraft since the overall (i.e., for GA and AT combined) piston percent of hours flown (66.4%) is very close to the percent of LTOs that are piston (65.7%). Table 1.4 of the 2008 GAATA presents the total hours flown by aircraft type and separates GA from AT. Seventy-three percent (73%) of all GA hours flown are by piston-engine aircraft while twenty-eight percent (28%) of all GA hours flown are by turboprop and turbojet powered aircraft.[52] Twenty-three percent (23%) of all AT hours flown are by piston-engine aircraft while seventy-seven percent (77%) of all AT hours flown are by turboprop and turbojet powered aircraft. Approximately 5,000 of the total 20,000 airport facilities in the U.S. are heliports at which only helicopters (rotocraft) operate. Therefore, EPA also calculated the percent of rotocraft hours flown that are conducted by piston-engine aircraft. Thirty-six percent (36%) of all GA rotocraft hours flown are by piston-engine rotocraft while sixty-four percent (64%) of all GA rotocraft hours flown are by turboprop and turbojet powered rotocraft. Two percent (2%) of all AT rotocraft hours flown are by piston-engine rotocraft while ninety-eight percent (98%) of all AT rotocraft hours flown are by turboprop and turbojet powered rotocraft. Table 3 identifies the piston and turbine fractions that were used in the absence of airport-specific information to calculate piston-engine operations at airports and heliports in the 2008 NEI.

Table 3: Piston and Turbine Activity Fractions used in the 2008 NEI

	Airports		**Heliports**	
	GA	**AT**	**GA**	**AT**
Piston Powered	72.5%	23.1%	36.1%	2%
Turbine Powered	27.5%	76.9%	63.9%	98%

[52] Numbers in the text may not add to 100% due to rounding; the percentages in Table 3 are the values we used to calculate the 2008 NEI.

(b) Calculating the Piston-engine Aircraft Emission Factor: Grams of Lead Emitted per LTO:

Piston-engine aircraft can have either one or two engines. EDMS version 5.0.2 contains information on the amount of avgas used per LTO for some single and twin-engine aircraft. The proportion of piston-engine LTOs conducted by single- versus twin-engine aircraft was taken from the FAA's GAATA Survey for 2008 (90% of LTOs are conducted by aircraft having one engine and 10% of LTOs by aircraft having two engines).[53] Since twin-engine aircraft have higher fuel consumption rates than those with single engines, a weighted-average LTO fuel usage rate was calculated to apply to the population of piston-engine aircraft as a whole. For the single-engine aircraft, the average amount of fuel consumed per LTO was determined from the six types of single piston-engine aircraft within EDMS.[54] This was calculated by averaging the single-engine EDMS outputs for fuel consumed per LTO using the EDMS scenario property of ICAO/USEPA Default - Times in Mode (TIM), with a 16 minute taxi-in/taxi-out time according to EPA's *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources*, 1992.[55] This gives a value of 16.96 pounds of fuel per LTO (lbs/LTO). The average single-engine fuel consumption rate was divided by the average density of 100LL avgas, 6 pounds per gallon (lbs/gal), producing an average fuel usage rate for single-engine piston aircraft of 2.83 gallons per LTO (gal/LTO). This same calculation was performed for the two twin-engine piston aircraft within EDMS, producing an average LTO fuel usage rate for twin-engine piston aircraft of 9.12 gal/LTO.

Using these single- and twin-engine piston aircraft fuel consumption rates, a weighted average fuel usage rate per LTO was computed by multiplying the average fuel usage rate for single-engine aircraft (2.83 gal/LTO) by the fleet percentage of single-engine aircraft LTOs (90%). Next, the twin-engine piston aircraft average fuel usage rate (9.12 gal/LTO) was multiplied by the fleet percentage of twin-engine aircraft LTOs (10%). By summing the results of the single- and twin-engine aircraft usage rates, the overall weighted-average fuel usage rate per LTO of 3.46 gal/LTO was obtained.

To calculate the emission factor, the concentration of lead in fuel is multiplied by the fuel consumption per LTO. The maximum lead concentration specified by ASTM for 100LL is 0.56 grams per liter or 2.12 grams per gallon. This amount of lead is normally added to assure that the required lean and rich mixture knock values are achieved. Multiplying this lead concentration in avgas by the weighted average fuel usage rate produces an overall average value of 7.34 grams of lead per LTO (g Pb/LTO) for piston-engines: 3.46 gal/LTO x 2.12 g Pb/gal = 7.34 g Pb/LTO.

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[53] The LTOs from the categories of 1-engine fixed wing piston, piston rotocraft, experimental total, and light sport were summed to determine the total number of single-engine piston aircraft LTOs.
[54] EPA understands that EDMS 5.0.2 has a limited list of piston-engines, but these are currently the best data available.
[55] U.S. EPA, *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources*, EPA-450/4-81026d (Revised), 1992.

(c) Retention of Lead in Engine and Oil (1-Pb Retention):

Data collected from aircraft piston-engines operating on leaded avgas suggests that about 5% of the lead from the fuel is retained in the engine and engine oil.[56] Thus the emitted fraction is 0.95. This information is used in calculating airport-specific lead inventories and will be used to develop future national estimates of lead emitted from the consumption of leaded avgas.

Applying these parameters in the equation above yields the following equation:

$$\text{Pb(tons)} = \frac{\text{(piston-engine LTO) (7.34 g Pb/LTO) (0.95)}}{\text{907,180 g/ton}}$$

which simplifies to:

$$\text{Pb(tons)} = \text{(piston-engine LTO)} \ (7.7 \times 10^{-6})$$

Where piston-engine LTO[57] = (GA LTO x 0.725) + (AT LTO x 0.231)

(d) Estimating Lead Emissions from Piston-Engine Helicopters:

The emission factor for helicopters (g Pb/LTO) was determined in the same manner as described above for piston-engine fixed-wing aircraft. The concentration of lead in avgas (2.12 g/gal) was multiplied by the weighted average fuel usage rate for four types of Robinson helicopter engines.[58] This produced an overall average emission factor of 6.60 grams of lead per LTO (g Pb/LTO) for piston-engine powered helicopters.

There are no national databases that provide heliport-specific LTO activity data for piston-engine powered helicopters separately from turbine-engine powered helicopters. The 2008 FAA GA and Part 135 Activity (GAATA) Survey reports that approximately 36% of all GA helicopter hours flown are by piston-engine aircraft which use avgas, and about 64% are by turbine-engine powered which use jet fuel (which does

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[56] The information used to develop this estimate is from the following references: (a) Todd L. Petersen, Petersen Aviation, Inc, *Aviation Oil Lead Content Analysis*, Report # EPA 1-2008, January 2, 2008, available at William J. Hughes Technical Center Technical Reference and Research Library at http://actlibrary.tc.faa.gov/ and (b) E-mail from Theo Rindlisbacher of Switzerland Federal Office of Civil Aviation to Bryan Manning of U.S. EPA, regarding lead retained in engine, September 28, 2007.

[57] This equation for piston-engine LTOs only applies to non-heliport facilities. See the text immediately below for equations for calculating piston-engine LTOs and Pb emissions at heliports.

[58] This was done using the following 4 engine types in EDMS 5.1: Robinson R22 IO-320-D1AD; Robinson R22 IO-360-B; Robinson R22 O-320; Robinson R22 TSIO-360C. The fuel consumption rates were: Robinson R22 IO-320-D1AD – 5.546 g Pb/LTO; Robinson R22 IO-360-B – 5.973 g Pb/LTO; Robinson R22 O-320 – 6.276 g Pb/LTO; Robinson R22 TSIO-360C – 8.604 g Pb/LTO.

not contain lead).[59] The 2008 FAA GAATA Survey reports that approximately 2% of all AT helicopter hours flown are by piston-engine aircraft which use avgas, and about 98% are by turbine-engine powered rotocraft. We expect the fraction of helicopter activity conducted by piston-engines to vary by heliport with some facilities having no piston-engine powered helicopter activity and some hosting mainly or only piston-engine powered helicopters. However, in the absence of heliport-specific data, the national default estimates of 36% for GA and 2% for AT from the GAATA Survey were used. Therefore, to calculate piston-engine aircraft LTO as input for this equation, the helicopter GA LTOs were multiplied by 0.36 and helicopter AT LTOs were multiplied by 0.02.

Lead emitted at the heliport facility was calculated for the 2008 NEI using either the LTO data provided in FAA databases or the estimate LTO activity in the following equation (i.e., 141 LTOs):

$$\text{Pb(tons)} = \frac{\text{(piston-engine helicopter LTO) (6.60 g Pb/LTO) (0.95)}}{\text{907,180 g/ton}}$$

which simplifies to:

$$\text{Pb(tons)} = \text{(piston-engine helicopter LTO)} \ (6.9 \times 10^{-6})$$

Where piston-engine helicopter LTO = (Helicopter GA LTO x 0.36) + (Helicopter AT LTO x 0.02)

Section 7. Improving Airport-specific Lead Emissions Estimates

There are refinements to the methods described here that would improve airport-specific inventories, most of which involve acquiring airport- and aircraft-specific input data. The following information describes data inputs that could be used to generate airport lead inventories tailored to specific airports or otherwise improve the estimates using currently available data. State and local authorities might have, or be able to collect, better information for some of these key data inputs.

State and local agencies might have access to airport-specific data that would improve the national estimates of lead emissions per LTO. These improvements largely involve replacing national average or default values with airport-specific data on the activity of piston-engine aircraft. Three key data inputs are:

[59] The FAA GAATA is a database collected from surveys of pilots flying aircraft used for general aviation and air taxi activity. For more information on the GAATA, see Appendix A at http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/

1) Airport-specific LTO activity for piston-powered aircraft, including the fraction of piston-engine activity conducted by single- versus twin-engine aircraft. Some airport facilities collect this information and states may use these data to calculate airport-specific lead inventories. The activity data should be current and updated on a regular schedule so that the data represents the inventory year as closely as possible.
2) The time spent in each mode of the LTO cycle. EPA uses the EDMS scenario property of ICAO/USEPA Default - Times in Mode, with a 16 minute taxi-in/taxi-out time according to EPA's Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources, 1992. While some local authorities have confirmed that these are the relevant times in mode at their airports for piston aircraft, the applicability of these times in mode will vary by airport. EPA has learned that one of the important factors in piston aircraft operation that is currently not included in the time in mode or emissions estimates is the time and fuel consumption during the pre-flight run-up checks conducted by piston-engine aircraft prior to takeoff.
3) Other data inputs for the airport-specific lead inventory calculation for which states or local authorities may provide airport-specific information include the concentration of lead in the avgas supplied at an airport, and the fraction of lead in fuel that is retained in the engine and oil, and aircraft-specific fuel consumption rates by the piston-engine aircraft in specific modes of operation.

The accuracy of the based aircraft data on which equation 4 is modeled can be improved. FAA recognizes the need to improve the integrity of the 5010 data report based-aircraft counts for all of the GA airports and reliever airports in the NPIAS and is currently in the process of improving the data collection and submission methods to accomplish this task.[60]

Section 8. Lead emitted in flight (i.e., outside the LTO cycle):

Lead emissions, especially those at altitude, undergo dispersion and eventually deposit to surfaces, and lead deposited to soil and water can remain available for uptake by plants, animals and humans for long periods of time. Because lead is a persistent pollutant, we are including all lead emissions – at airports and in-flight – in the NEI.[61]

For inventory purposes, lead emitted outside the LTO cycle occurs during aircraft cruise mode and portions of the climb-out and approach modes above the mixing height (typically 3,000 ft[62]). This part of an aircraft operation emits lead at various altitudes as well as close to and away from airports. Because the precise area of lead emission and deposition is not known for these flights, EPA is using a simplistic approach to allocate

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[60] National Based Aircraft Inventory Program: http://www.basedaircraft.com/public/FrequentlyAskedQuestions.aspx, accessed 2/17/2009
[61] U.S. EPA, 2006. Air Quality: Criteria for Lead: 2006; EPA/600/R-5/144aF; U.S. Government Printing Office, Washington, DC, October, 2006.
[62] According to EPA's *Procedurees for Emission Inventory Preparation, Volume IV: Mobile Sources, 1992.*

these emissions for the purposes of the 2008 NEI. A brief explanation of the nature of GA flights is provided here for context regarding emissions of lead in-flight.

FAA categorizes GA flights as either local area or itinerant operations and this distinction plays a role in the area over which lead is emitted. Local operations are those activities performed by aircraft operating in the local traffic pattern or within sight of the airport, aircraft executing simulated instrument approaches or low passes at the airport, and/or aircraft operating to or from the airport in a designated practice area located within a 20-mile radius of the airport. Local operations are common for GA aircraft. This includes applications such as recreational, proficiency and instructional flying as well as many common general aerial support tasks. Emissions during local flying are more likely to influence air and soil concentrations of lead in the vicinity of the airport because they occur near the airport, often at altitudes below the mixing height.

Itinerant operations are all operations other than those described above as local operations. An itinerant aircraft operation usually is one in which the aircraft departs from one airport and lands at a different airport. Depending on air time and distance, an itinerant flight is much more likely to involve departing the local flying area of the originating airport and climbing to altitudes above the mixing height. It is reasonable then, to generally expect that lead emitted outside the LTO cycle during itinerant operations, in contrast with local operations, will be more widely dispersed and at greater distances from the airport.

The portion of the national avgas lead emitted in flight (i.e., outside the LTO cycle) is calculated by subtracting the sum of airport facility lead inventories from the national avgas lead inventory. Even though FAA collects and reports information regarding the fraction of GA operations that are local and itinerant, there is no practical method to assign in-flight lead emissions to small geographic areas such as airports or census tracts. And similar data is not available for AT operations, a portion of which are conducted by piston-engine aircraft. Since the average duration of a piston-engine aircraft flight is approximately an hour, an itinerant flight can traverse county lines. Therefore, given the current data available, the best approach is to assign the out-of-LTO cycle lead to the state where the flight originated.

In the 2008 NEI EPA allocated lead emissions that are calculated as being outside the LTO cycle to states based on the state-specific fraction of national GA and AT piston-engine LTO activity. The state-specific fractions were calculated by multiplying the percent of GA and AT piston-engine LTO activity in each state by 296 tons, which is the amount of lead we currently estimate is emitted outside of the LTO cycle nationwide. Table 4 presents the total GA and AT piston-engine LTOs by state, the state-specific faction of national GA and AT piston-engine LTO activity, and the out-of-LTO lead emissions assigned to each state.

Table 4: Out-of-LTO Lead Emissions by State

STATE	Total GA and AT Piston LTOs	Percent of National GA and AT Piston LTOs (by state)	Out of LTO Pb emissions (tons)
AK	660,133	2.0%	5.86
AL	671,026	2.0%	5.96
AR	638,875	1.9%	5.68
AZ	1,430,302	4.3%	12.71
CA	3,881,357	11.6%	34.48
CO	780,426	2.3%	6.93
CT	226,807	0.7%	2.01
DC	28,833	0.1%	0.26
DE	84,617	0.3%	0.75
FL	2,751,015	8.3%	24.44
GA	750,876	2.3%	6.67
HI	138,432	0.4%	1.23
IA	281,961	0.8%	2.50
ID	430,812	1.3%	3.83
IL	920,908	2.8%	8.18
IN	566,583	1.7%	5.03
KS	459,720	1.4%	4.08
KY	280,378	0.8%	2.49
LA	622,011	1.9%	5.53
MA	714,159	2.1%	6.34
MD	436,861	1.3%	3.88
ME	228,302	0.7%	2.03
MI	880,818	2.6%	7.82
MN	647,876	1.9%	5.76
MO	389,551	1.2%	3.46
MS	461,383	1.4%	4.10
MT	270,311	0.8%	2.40
NC	743,004	2.2%	6.60
ND	214,139	0.6%	1.90
NE	221,681	0.7%	1.97
NH	173,355	0.5%	1.54
NJ	466,961	1.4%	4.15
NM	309,657	0.9%	2.75
NV	298,712	0.9%	2.65
NY	999,738	3.0%	8.88
OH	1,180,583	3.5%	10.49
OK	575,402	1.7%	5.11
OR	596,730	1.8%	5.30
PA	954,839	2.9%	8.48

PR	80,728	0.2%	0.72
RI	45,348	0.1%	0.40
SC	506,650	1.5%	4.50
SD	228,198	0.7%	2.03
TN	535,913	1.6%	4.76
TX	2,422,722	7.3%	21.52
UT	299,471	0.9%	2.66
VA	502,559	1.5%	4.46
VI	25,763	0.1%	0.23
VT	88,318	0.3%	0.78
WA	1,189,142	3.6%	10.56
WI	778,320	2.3%	6.91
WV	143,393	0.4%	1.27
WY	106,190	0.3%	0.94

For additional information or if you have questions regarding the methods described in this document, please contact Meredith Pedde (pedde.meredith@epa.gov) or Marion Hoyer (hoyer.marion@epa.gov).

Supplemental Table 1

Table A-1: Scaling factors

Year	U.S. Product Supplied of Aviation Gasoline (Thousand Barrels)[63]	Ratio of 2008 to Year X
Before 1981[64]		0.57
1981	11,147	0.50
1982	9,307	0.60
1983	9,444	0.59
1984	8,692	0.64
1985	9,969	0.56
1986	11,673	0.48
1987	9,041	0.62
1988	9,705	0.58
1989	9,427	0.59
1990	8,910	0.63
1991	8,265	0.68
1992	8,133	0.69
1993	7,606	0.74
1994	7,555	0.74
1995	7,841	0.71
1996	7,400	0.76
1997	7,864	0.71
1998	7,032	0.80
1999	7,760	0.72
2000	7,188	0.78
2001	6,921	0.81
2002	6,682	0.84
2003	5,987	0.94
2004	6,189	0.91
2005	7,006	0.80
2006	6,626	0.85
2007	6,258	0.90
2008	5,603	1.00

[63] Data from the Energy Information Administration's (EIA's) table, "U.S. Product Supplied of Aviation Gasoline (Thousand Barrels)." Available at: http://tonto.eia.doe.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=mgaupus1&f=A Accessed August 25, 2010.

[64] EIA does not have data for volumes of avgas product supplied for years earlier than 1981. To calculate the scaling factor to use for activity data from years before 1981, we used the ratio of 2008 avgas volume product supplied to the average avgas volume supplied from 1981 to 1989.

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Documentation for the Commercial Marine Vessel Component of the National Emissions Inventory

Methodology

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TABLE OF CONTENTS

Section **Page No.**

1.0 INTRODUCTION 1-1
- 1.1 What is the National Emission Inventory? 1-1
- 1.2 Why Did the EPA Create the NEI? 1-1
- 1.3 How is the EPA Going to Use This Version of the NEI? 1-1
- 1.4 Report Organization 1-2

2.0 DEVELOPMENT OF THE COMMERCIAL MARINE VESSEL COMPONENT FOR THE NEI 2-1
- 2.1 How Does This CMV Study Fit into the NEI? 2-1
- 2.2 What are Commercial Marine Vessels? 2-10
- 2.3 What Pollutants are Included in the National Emission Estimates for CMVs? 2-11
- 2.4 How Were the CMV Emissions Estimated? 2-11
- 2.5 How Were Emissions Allocated? 2-14
- 2.6 How Were Port Emissions Allocated? 2-14
- 2.7 How Were Underway Emissions Allocated? 2-15
  - 2.7.1 Category 1 and 2 Underway 2-15
  - 2.7.2 Category 3 Reduced Speed Zones (RSZ) 2-15
  - 2.7.3 Category 3 Approach 2-15
  - 2.7.4 Category 3 Interport 2-16
- 2.8 QA/QC 2-16
- 2.9 What are the Results? 2-17
- 2.10 Commercial Marine Vessel References 2-19

Appendix A – 2008 Category 3 Commercial Marine Vessel Inventory Methodology

Appendix B – 2008 Commercial Marine Vessel HAP Speciation Profiles

LIST OF TABLES AND FIGURES

Tables **Page No.**

Table 2-2. Commercial Marine Vessel Pollutant List 2-12
Table 2-3. Commercial Marine Vessel Criteria and Greenhouse Gas Emission Estimates 2008 (TPY) 2-17
Table 2-4. Commercial Marine Vessel HAP Emission Estimates 2008 (TPY) 2-18

Figures **Page No.**

Figure 2-1. General Approach Used to Develop Marine Vessel Component of the 2008 National Emission Inventory 2-13

1.0 INTRODUCTION

1.1 What is the National Emission Inventory?

The National Emission Inventory (NEI) is a comprehensive inventory covering all anthropogenic sources of criteria pollutants and hazardous air pollutants (HAPs) for all areas of the United States. The NEI was created by the U.S. Environmental Protection Agency's Emission Inventory and Analysis Group (EIAG) in Research Triangle Park, North Carolina. The NEI will be used to support air quality modeling and other activities. To this end, the EPA established a goal to compile comprehensive emissions data in the NEI for criteria and HAPs for mobile, point, and nonpoint sources. This report presents an overview of how emission estimates for the commercial marine vessel (CMV) component of the 2008 NEI was compiled.

1.2 Why Did the EPA Create the NEI?

The Clean Air Act (CAA), as amended in 1990, includes mandates for the EPA related to criteria and hazardous air pollutants. The CAA defines criteria pollutants as being one of the following air pollutants:

- Carbon monoxide (CO);
- Sulfur oxides (SO_x);
- Nitrogen oxides (NO_x);
- Ozone; and
- Particulate matter (PM).

Where emission factors and activity data permit, ammonia (NH_3) estimates are also included as an important precursor to PM. Hazardous air pollutants are also delineated in the CAA, see *http://www.epa.gov/ttn/atw/188polls.html* for a complete list of regulated pollutants and their chemical abstract service [CAS] numbers.

The CAA requires the EPA to identify emission sources of these pollutants, quantify emissions, develop regulations for the identified source categories, and assess the public health and environmental impacts after the regulations are put into effect. The NEI is a tool that EPA can use to meet the CAA mandates. In this report, criteria and HAP emission estimates are discussed for CMV sources.

1.3 How is the EPA Going to Use This Version of the NEI?

It is anticipated that the emission inventory developed from this effort will have multiple end uses. The data have been formatted according to protocols established for the EPA's NEI submittals. The common data structure on which the NEI platform is based will allow the NEI emission data to be transferred to multiple end-users for a variety of purposes.

The criteria and HAP emission estimates developed for the NEI will be used to evaluate air pollution trends, air quality modeling analysis and impacts of potential regulations.

1.4 Report Organization

Following this introduction, Section 2.0 provides information on how the national CMV, emission estimates were developed. This inventory effort was coordinated by the EPA's Office of Transportation and Air Quality (OTAQ) and EIAG.

The appendix were created to provide technical details on how the national emissions were developed and how state and local inventory data (when provided) were incorporated into the national estimates. Appendix A provides a copy of the report documenting how the 2002 data were adjusted to reflect marine vessel activity and emissions for 2008.

2.0 DEVELOPMENT OF THE COMMERCIAL MARINE VESSEL COMPONENT FOR THE NEI

2.1 How Does This CMV Study Fit into the NEI?

The NEI was developed to include all point, nonpoint (sometimes referenced as "area"), and mobile sources. The approaches used in the point and nonpoint source categories are documented in other reports. Table 1 summarizes the approaches used to estimate emissions from all nonroad sources included in the NEI program. Those source categories and years that are included in this report are noted in bold.

The scope of this inventory component of the NEI was to compile criteria and HAP emissions data for CMVs operating in United States waters and federal waters extending 200 nautical miles from the United States' coastline. In this effort, national emission estimates were often developed and allocated to counties based on available Geographic Information System (GIS) data. The methodologies used to estimate emissions and the procedures used to spatially allocate them to the county-level are discussed in this report.

Table 2-1. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources
(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
NONROAD Categories			
Nonroad Gasoline, Diesel, LPG, CNG	2002	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3, & HAPs	Emission estimates for NONROAD model engines were developed using EPA's National Mobile Inventory Model (NMIM), which incorporates NONROAD2004. Where states provided alternate nonroad inputs, these data replaced EPA default inputs. State-supplied emissions data also replaced default EPA emission estimates.

Table 2-1. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
	1999	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) an updated 1999 national inventory, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model. Replaced State-submitted data for California for all NONROAD model categories; Pennsylvania for recreational marine and aircraft ground support equipment, and Texas for select equipment categories.
	1996, 1997, 1998, 2000 & 2001	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) updated year-specific national and California inventories, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios and California county-to-state ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model. California results replace the diesel equipment emissions generated from prior application of county-to-national ratios.

Table 2-1. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Nonroad Gasoline, Diesel, LPG, and CNG (Continued)	1991-1995	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3	Using 1990 and 1996 county-level emissions inventories, estimated emissions using linear interpolation of national emissions between 1990 and 1996. From these emissions, calculated the average annual growth rate for each pollutant/SCC combination for each year, and then applied the growth factors to 1990 county-level emissions to estimate 1991-1995 emissions.
	1990	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) updated 1990 national inventory, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model.
	1986, 1988, & 1989	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3	Using 1985 and 1990 county-level emissions inventories, estimated emissions using linear interpolation of national emissions between 1985 and 1990. From these emissions, calculated the average annual growth rate for each pollutant/SCC combination for each year, and then applied the growth factors to 1985 county-level emissions to estimate 1986-1989 emissions.
	1987	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using EPA's draft Lockdown C NONROAD model (dated May 2002), developed updated national emissions for 1987 by running 4 seasonal NONROAD model runs to estimate annual criteria pollutant emissions. Also performed national NONROAD model runs to estimate typical summer weekday emissions.

Table 2-1. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Nonroad Gasoline, Diesel, LPG, and CNG (Continued)	1985	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) updated 1985 national inventory, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model.
	1970, 1975, 1978, & 1980	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using EPA's draft Lockdown C NONROAD model (dated May 2002), developed updated national emissions for all years by running 4 seasonal NONROAD model runs to estimate annual criteria pollutant emissions. Also performed national NONROAD model runs to estimate typical summer weekday emissions.
	1996, 1997, 1998, 1999, 2000, & 2001	NH_3	Obtaining national fuel consumption estimates from the Lockdown C NONROAD model, multiplying by NH_3 emission factors, and distributing to counties using 1996 inventory, based on October 2001 draft NONROAD. NH_3 emissions for California were also recalculated using updated diesel fuel consumption values generated for California-specific runs, and assuming the 1996 county-level distribution.
	1985 & 1990	NH_3	Obtaining national fuel consumption estimates from the Lockdown C NONROAD model, multiplying by NH_3 emission factors, and distributing to counties using 1996 inventory, based on October 2001 draft NONROAD.
	1987	NH_3	Obtaining 1987 national fuel consumption estimates from Lockdown C NONROAD model and multiplying by NH_3 emission factors.

Table 2-1. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)
(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Nonroad Gasoline, Diesel, LPG, and CNG (Continued)	1970, 1975, 1978, & 1980	NH_3	Obtaining national fuel consumption estimates from the Lockdown C NONROAD model and multiplying by NH_3 emission factors.
	1990, 1996, & 1999	HAPs	Speciation profiles applied to county VOC and PM estimates. Metal HAPs were calculated using fuel and activity-based emission factors. Some state data were provided and replaced national estimates. (2003)
Aircraft			
Commercial Aircraft	2008	Criteria and HAPs	Federal Aviation Administration (FAA) Emissions and Dispersion and Modeling System (EDMS) - Version 5.1.was run using BTS T-100 LTO data. (2009)
	2002	Criteria and HAPs	Federal Aviation Administration (FAA) Emissions and Dispersion and Modeling System (EDMS) was run for criteria pollutants, VOC and PM emissions were speciated into HAP components. (2004)
	1990, 1996, 1999, 2000, 2001	VOC, NO_x, CO, SO_x	Input landing and take-off (LTO) data into FAA EDMS. National emissions were assigned to airports based on airport specific LTO data and BTS GIS data. State data replaced national estimates. (2003)
	1970-1998	VOC, NO_x, CO, SO_x	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999	HAPs	Speciation profiles were applied to VOC estimates to get national HAP estimates. State data replaced national estimates. (2003)
General Aviation, Air Taxis	2008	Criteria and HAPs	Used FAA LTO data from TAF and OTAQ provided activity data for smaller airports derived from FAA 5010 master plans. EPA approved generic emission factors for criteria estimates. Speciation profiles were applied to VOC and PM estimates to get national HAP estimates. (2009)

Table 2-1. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)
(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
General Aviation, Air Taxis (Continued)	1978, 1987, 1990, 1996, 1999, 2000, 2001, & 2002	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Used FAA LTO data and EPA approved emission factors for criteria estimates. Speciation profiles were applied to VOC estimates to get national HAP estimates. State data replaced national estimates. (2004)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999, & 2002	HAPs	Used FAA LTO data and EPA approved emission factors for criteria estimates. Speciation profiles were applied to VOC estimates to develop national HAP estimates. (2004)
	1990, 1996, 1999, & 2002	Pb	Used Department of Energy (DOE) aviation gasoline usage data with lead concentration of aviation gasoline. (2004)
	1996	NH_3	Applied NH_3 emissions factors to 1996 national jet fuel and aviation gasoline consumption estimates.
Military Aircraft	1978, 1987, 1990, 1996, 1999, 2000, 2001, 2002, 2008	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Used FAA LTO data as reported in TAF and EPA approved emission factors for criteria estimates. Representative HAP profiles were not readily available, therefore HAP estimates were not developed. (2009)
	1970-1998	VOC, NO_x, CO, SO_X, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
Auxiliary Power Units	2008	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Federal Aviation Administration (FAA) Emissions and Dispersion and Modeling System (EDMS) - Version 5.1.was run using BTS T-100 LTO data. (2009)
	1985-2001	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Grew 1996 emissions to each year using LTO operations data from the FAA. Estimation methods prior to 1996 reported in EPA, 1998.

Table 2-1. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)
(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Unpaved Airstrips[1]	1985-2001	PM_{10}, $PM_{2.5}$	Grew 1996 emissions to each year using SIC 45-Air Transportation growth factors, consistent with the current draft version of EGAS. Estimation methods prior to 1996 reported in EPA, 1998.
Aircraft Refueling[1]	1985-2001	VOC	Grew 1996 emissions to each year using SIC 45-Air Transportation growth factors, consistent with the current draft version of EGAS. Estimation methods prior to 1996 reported in EPA, 1998.
Commercial Marine Vessel (CMV)			
All CMV Categories	**2008**	**VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$**	**2002 estimates were adjusted by OTAQ to reflect 2008 activity levels., note that the SCCs for this category have changed such that the Diesel category refers to smaller vessels (Category 1 and 2) using distillate fuels and the Residual category refers to larger (Category 3) vessel using a blend of residual fuels (2009)**
	2008	**HAPs**	**OTAQ's 2008 estimates were speciated into HAP components using SEPA profiles**
	2002	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	2001 Estimates carried over. Used state data when provided. (2004)
		HAPs	1999 Estimates carried over. Used state data when provided. (2004)
CMV Diesel	1978, 1987, 1990, 1996, 1999, 2000, & 2001	VOC, NO_x, CO, SO_x, PM_{10}, & $PM_{2.5}$	Used criteria emission estimates in the background document for marine diesel regulations for 2000. Adjusted 2000 criteria emission estimates for other used based on fuel usage. Emissions were disaggregated into port traffic and underway activities. Port emissions were assigned to specific ports based on amount of cargo handled. Underway emissions were allocated based on Army Corp of Engineering waterway data. State data replaced national estimates. (2003)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999	HAPs	VOC and PM emission estimates were speciated into HAP components. State data replaced national estimates. (2003)

Table 2-1. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
	1996	NH_3	Applied NH_3 emissions factors to 1996 distillate and residual fuel oil estimates (i.e., as reported in EIA, 1996).
	1990-1995	NH_3	Estimation methods reported in EPA, 1998.
CMV Steam Powered	1978, 1987, 1990, 1996, 1999, 2000, & 2001	VOC, NO_x, CO, SO_x, PM_{10}, & $PM_{2.5}$	Calculated criteria emissions based on EPA SIP guidance. Emissions were disaggregated into port traffic and under way activities. Port emissions were assigned to specific ports based on amount of cargo handled. Underway emissions were allocated based on Army Corp of Engineering waterway data. State data replaced national estimates. (2003)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, & 1999	HAPs	VOC and PM emission estimates were speciated into HAP components. State data replaced national estimates. (2003)
Military Marine	1997-2001	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Applied EGAS growth factors to 1996 emissions estimates for this category.
CMV Coal,[2] CMV, Steam powered, CMV Gasoline[2]	1997-1998	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Applied EGAS growth factors to 1996 emissions estimates for this category.
CM Coal, CMV, Steam powered, CMV Gasoline, Military Marine	1991-1995	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Estimation methods reported in EPA, 1998.
Locomotives			
Class I, Class II, Commuter, Passenger, and Yard Locomotives	1978, 1987, 1990, 1996, 1999, 2000, 2000, & 2002	VOC, NO_x, CO, PM_{10}, $PM_{2.5}$	Criteria pollutants were estimated by using locomotive fuel use data from DOE EIA and available emission factors. County-level estimates were obtained by scaling the national estimates with the rail GIS data from DOT. State data replaced national estimates. (2004)

Table 2-1. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Class I, Class II, Commuter, Passenger, and Yard Locomotives (Continued)	1978, 1987, 1990, 1996, 1999, 2000, 2001, & 2002	SO_2	SO_x emissions were calculated by using locomotive fuel use and fuel sulfur concentration data from EIA. County-level estimates were obtained by scaling the national estimates with the county level rail activity data from DOT. State data replaced national estimates. (2004)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999, & 2002	HAPs	HAP emissions were calculated by applying speciation profiles to VOC and PM estimates. County-level estimates were obtained by scaling the national estimates with the county level rail activity from DOT. State data replaced national estimates. (2004)
	1997-1998	NH_3	Grew 1996 base year emissions using EGAS growth indicators.
	1996	NH_3	Applied NH_3 emissions factors to diesel consumption estimates for 1996.
	1990-1995	NH_3	Estimation methods reported in EPA, 1998.

Notes:

* Dates included at the end of Estimation Method represent the year that the section was revised.

1 Emission estimates for unpaved airstrips and aircraft refueling are included in the area source NEI, since they represent non-engine emissions.

2 National Emission estimates for CMV Coal and CMV Gasoline were not developed though states and local agencies may have submitted estimates for these source categories.

EPA, 1998. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Factors and Inventory Group, National Air Pollutant Emission Trends, Procedures Document, 1900–1996, EPA-454/R-98-008. May 1998.

The target inventory area includes every state in the United States and every county within a state. There are no boundary limitations pertaining to traditional criteria pollutant nonattainment areas or to designated urban areas. The pollutants inventoried included all criteria pollutants (except for the other nonroad source category which addressed only HAPs in this report) and the 188 HAPs identified in Section 112(b) of the CAA. Some state or local agencies provided emissions information on more HAPs than those delineated in the CAA, only the federally regulated HAPs are included in the NEI.

In addition to numerous specific chemical compounds, the list of 188 HAPs includes several compound groups [e.g., individual metals and their compounds, polycyclic organic matter (POM)]; the NEI includes emission estimates for the individual compounds wherever possible. Many of the uses of the NEI depend upon data (e.g., toxicity) for individual compounds within these groups rather than aggregated data on each group as a whole.

The intent in presenting the following emission inventory approach is to provide sufficient and transparent documentation such that states and local agencies can use these approaches, in conjunction with their specific local activity data to develop more accurate and comparable emission estimates in future submittals.

2.2 What are Commercial Marine Vessels?

The CMV source category includes all boats and ships used either directly or indirectly in the conduct of commerce or military activity. These vessels range from 20-foot charter boats to large tankers which can exceed 1,000 feet in length (EPA, 1989). In spite of the broad range of vessels represented by this category, a number of common characteristics allow for the use of simple emission estimation methods. The majority of vessels in this category are powered by diesel engines that are either fueled with distillate or residual fuel oil blends. For the purpose of this inventory it is assumed that Category 3 vessels primarily use residual blends while Category 1 and 2 vessels typically used distillate fuels.

The Category 3 (C3) inventory developed by OTAQ includes vessels which use C3 engines for propulsion. C3 engines are defined as having displacement above 30 liters per cylinder (U.S. EPA, 2003). The resulting inventory includes emissions from both propulsion and auxiliary engines used on these vessels, as well as those on gas and steam turbine vessels. Geographically, the inventories include port and interport emissions that occur within the area that extends 200 nautical miles (nm) from the official U.S. baseline, which is roughly equivalent to the border of the U.S. Exclusive Economic Zone (EEZ).

Category 1 and 2 vessels tend to be smaller ships that operate closer to shore, and along inland and intercoastal waterways. Naval vessels are not included in this inventory, though Coast Guard vessels are included as Category 1 and 2 vessels.

The CMV source category does not include recreational marine vessels, which are generally less than 100 feet in length, most being less than 30 feet, and powered by either inboard or outboard engines (EPA, 1989). Emissions from recreational marine vessels are included in the nonroad source category.

2.3 What Pollutants are Included in the National Emission Estimates for CMVs?

The EPA's Office of Transportation and Air Quality (OTAQ) provided estimates for all criteria pollutants including volatile organic compounds (VOC), nitrogen oxides (NO_x), carbon monoxide (CO), sulfur oxides (SO_x), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$) and carbon dioxide (CO_2). Criteria emissions were provided for Category 1 and 2 vessels (Carey, 2009b); Category 3 port, reduced speed zone, and cruising activities (Carey, 2009a and Carey, 2009c); and Category 3 interport activities (Carey, 2009d).

The VOC and PM estimates were speciated into hazardous air pollutants (HAP) components based on available data sources. The Swedish Environmental Protection Agency (SEPA) document *Methodology for Calculating Emissions from Ships: 1. Update of emission factors* served as the primary source of HAP emission factors which were converted into speciation profiles (Cooper and Gustafsson, 2004). Ammonia emission factors were also obtained from the SEPA, but as these factors require activity data, and such data were not available for Category 3 vessels operating in Federal waters, ammonia was estimated as a ratio of PM_{10} using the SEPA emission factors. Similar ratios were developed for Category 1 and 2 vessels, assuming that this fleet primarily operates on marine diesel fuel with 80.5 percent of the fleet equipped with medium speed engines and the remaining 19.5 percent were high speed engines. This provided a weighted NH_3 emission factor of 4.61E-03 g/kw-hr for operations at-sea and in-port. The PM_{10} factors vary for at-sea (0.2 g/kw-hr) and in-port (0.4 g/kw-hr), so our NH_3 / PM_{10} ratios were different for at-sea (2.31E-02) and in-port (1.15E-02).

While the SEPA document was used as the primary speciation source, other resources were investigated for potential inclusion in this effort. Recent BTEX data from Moldanova et al. were examined, but it included inconsistent benzene factors, some over 20% of hydrocarbon (HC) factors, were much higher than others found in recent publications and, as a result, were not included (Cook, 2009). CE-CERT metals data was also reviewed as it pertained to slow speed residual fuel engines (Cook, 2009). The CE-CERT emission factors were in line with the Swedish factors for nickel and lead, but they were an order of magnitude different for chromium, cadmium, and selenium. As a result, the Swedish factors were retained over the CE-CERT data based on the larger study sample size, while CE-CERT's manganese emission factors were added as these factors were not included in the Swedish study (Cook, 2009).

The complete pollutant list for CMVs is shown in Table 2-2.

2.4 How Were the CMV Emissions Estimated?

As noted above, the CMV criteria and CO_2 emission estimates were provided for this inventory by OTAQ. Category 3 commercial marine inventories were developed for a base year of 2002 then projected to 2008 applying regional adjustment factors to account for growth. In addition, NO_X adjustment factors were applied to account for implementation of the NO_X Tier 1 standard. Details about adjustments and growth factors can be found in the Category 3 documentation (Appendix A). For Category 1 and 2 marine diesel engines, the emission estimates were consistent with the 2008 Locomotive and Marine federal rule making (Carey, 2009b).

Table 2-2. Commercial Marine Vessel Pollutant List

2,2,4 Trimethylpentane	Carbon Monoxide*	Naphthalene
Acenaphthene	Chromium(VI)	Nickel
Acenaphthylene	Chromium (III)	Nitrogen Oxides*
Acetaldehyde	Chrysene	PAH, total
Acrolein	Cobalt	Phenanthrene
Ammonia	Dibenzo[a,h]Anthracene	Phosphorus
Anthracene	Dioxins/Furans	PM10 Primary*
Arsenic	Ethyl benzene	PM2.5 Primary+
Benz(a)anthracene	Fluoranthene	Polychlorinated Biphenyls
Benzene	Fluorene	Propionaldehyde
Benzo(a)pyrene	Formaldehyde	Pyrene
Benzo(b)fluoranthene	Hexachlorobenzene	Selenium
Benzo(g,h,i)perylene	Hexane	Styrene
Benzo(k)fluoranthene	Indeno(1,2,3-cd)pyrene	Sulfur Dioxide*
Beryllium	Lead	Toluene
Cadmium	Manganese	VOCs*
Carbon Dioxide*	Mercury	Xylene

* Provided by OTAQ

\+ $PM_{2.5}$ was provided by OTAQ for all vessels and modes except for Category 3 Interport, where it was calculated using OTAQ guidance.

OTAQ's emissions were then allocated to individual GIS polygons using appropriate methods that varied by operating mode (i.e., hotelling, maneuvering, reduced speed zone, and underway). HAP emissions were estimated by applying speciation profiles to each polygon's VOC and PM estimates. Figure 2-1 provides an overview of the approach used to estimate and spatially allocate CMV emissions.

Speciation profiles were applied to the VOC, PM_{10}, and $PM_{2.5}$ emission estimates to calculate the associated HAP emissions using the following equation.

$$VOC\text{-}PM_{10/2.5} * speciation\ profile_i = HAP\ emission\ estimate:$$

Where:

HAP emission estimate	= HAP Emission estimate (tons/year) for pollutant:
$VOC\text{-}PM_{10/2.5}$	= VOC or PM emission estimate (tons/year)
Speciation $Profile_i$	= VOC or PM speciation fraction for HAP i

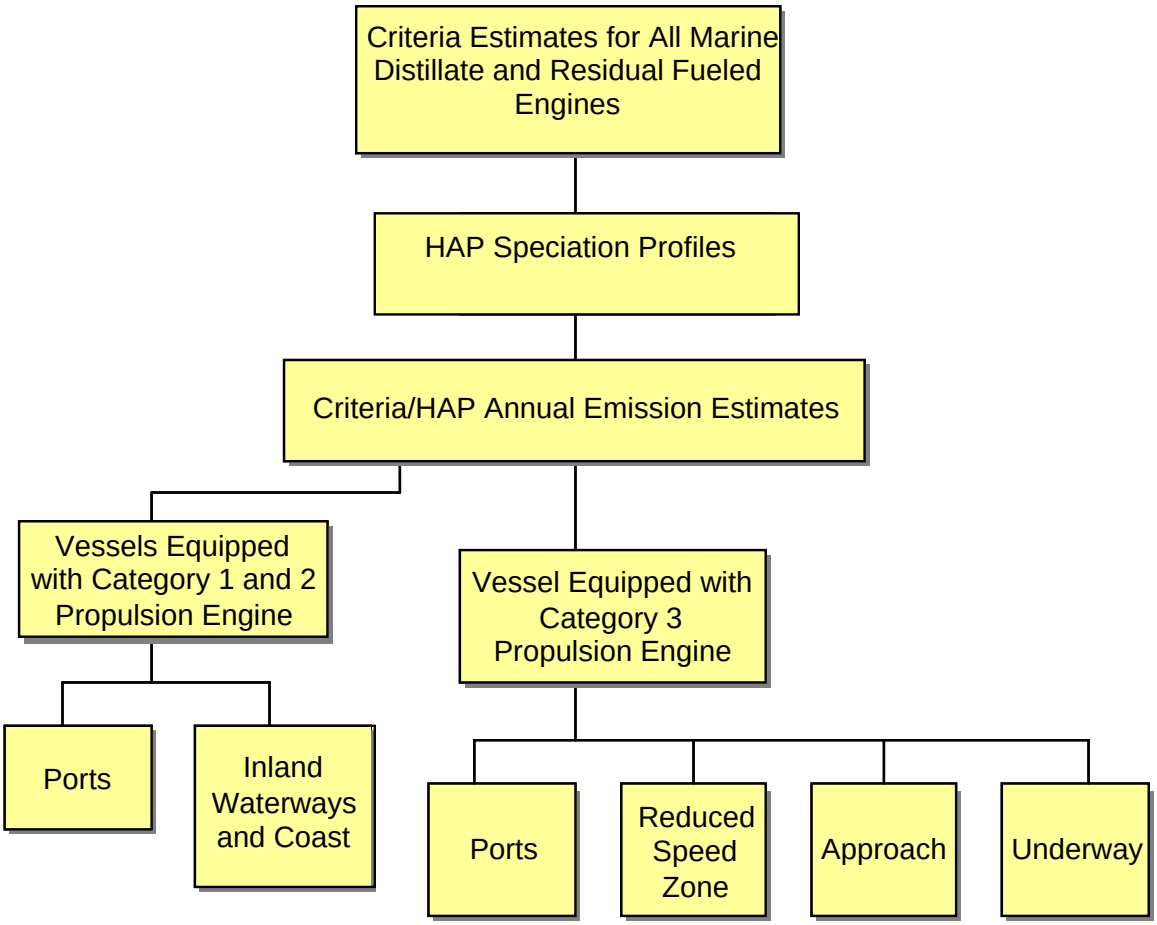

Figure 2-1. General Approach Used to Develop Marine Vessel Component of the 2008 National Emission Inventory

For Category I diesel-powered vessels, the speciation profiles were based on high-speed diesel vehicle (HSDV) factors obtained from information in the SEPA's *Methodology for Calculating Emissions from Ships: 1. Update of emission factors* (Cooper and Gustafsson, 2004). For Category 2 diesel-powered vessels, the speciation profiles were developed from medium-speed diesel vehicles (MSDV). Since emissions and activity data were provided as a combined value for all Category 1 and 2 vessels, the Category 1 and Category 2 emission factors were averaged to obtain a single emission factor for all diesel vessels. All port activities for Category 1 and 2 vessels were assumed to be maneuvering.

For Category 3 vessels, speciation profiles were developed using data from *Methodology for Calculating Emissions from Ships: 1. Update of emission factors* and assuming 80.5% of Category 3 vessels were equipped with slow-speed engines and 19.5% of vessels were equipped with medium speed engines based on vessel census data reported in the International Maritime Organization's (IMO) recent greenhouse gas (GHG) study (IMO 2009). Separate speciation profiles were created for Category 3 vessels for underway, maneuvering, and hotelling activities. Chromium emissions were split into hexavalent and trivalent chromium based on an assumption that 34% of total chromium was hexavalent and the remaining 66% was trivalent.

2.5 How Were Emissions Allocated?

Previous emissions allocations were based on waterway length and port county assignment. In this effort, spatial accuracy was greatly enhanced via the creation of GIS polygons representing port and waterway boundaries. GIS polygons allowed the estimation/allocation of emissions to defined port, waterway, and coastal areas, leading to improved spatial resolution compared to 2002's county-level emissions. Methodologies for both port and underway emissions are described in detail in the sections that follow.

2.6 How Were Port Emissions Allocated?

Port boundaries were developed using a variety of resources to identify the most accurate port boundaries. First, GIS data or maps provided directly from the port were used. Next, maps or port descriptions from local port authorities, port districts, etc. were used in combination with existing GIS data to identify port boundaries. Finally, satellite imagery from tools such as Google Earth and street layers from StreetMap USA were used to delineate port areas. Emphasis was placed on mapping the 117 ports with Category 3 vessel activity using available shape files of the port area. The Port of Huntington was developed differently given its large extent and limited available map data. The state of West Virginia provided a revised file of US Army Corps of Engineers *port terminals* reported to be part of the Port of Huntington-Tristate area. A 200 meter buffer of the water features near these port terminals was created to identify port area.

In all cases, polygons were created on land, bordering waterways and coastal areas, and were split by county boundary. Each polygon was identified by the port name and state and county FIPS in addition to a unique ShapeID. Smaller ports with Category 1 and 2 activities were mapped as small circles. Note that no Category 3 emissions were mapped to small circles. The final shapefile contained 159 ports and 196 polygons.

OTAQ provided Category 1 and 2 criteria emissions and activity as a single national number. These emissions and activity were allocated to ports based on total commodity tonnage

data obtained from the U.S. Army Corps of Engineers (USACE) Principal Ports file for 2007 (U.S. ACE, 2009). Emissions were then assigned to polygons within a port based on port area.

OTAQ developed port-level emissions for 117 of the largest U.S. ports with Category 3 activity. Activity in megawatt hours (MWh) and resulting criteria and CO_2 emissions were provided by port for maneuvering and hotelling modes. Emissions were then assigned to polygons within a port based on port area. HAP emissions were then speciated from VOC and PM estimates for each polygon using the methodology described in Section 3.0.

2.7 How Were Underway Emissions Allocated?

For this inventory, a GIS polygon layer was created to more accurately represent the location of CMV-related activity and emissions. Inland waterway polygons were obtained from the Bureau of Transportation Statistics' National Transportation Atlas Database hydro polygon layer (U.S. DOT, 2007). These polygons were further divided by county boundary and waterway ID. Coastal waters were drawn using Mineral Management Service state-federal boundary files and were also divided to indicate county boundaries. Federal waters were included as large area blocks outlined by the Exclusive Economic Zone (EEZ) boundary provided by EPA, which extends to approximately 200 nautical miles from the coastline. The final product is a polygon layer that includes all inland and coastal state waters and federal waters along with FIP, polygon area, and a unique ShapeID. Underway emissions were allocated differently by vessel category and mode, as outlined below.

2.7.1 *Category 1 and 2 Underway*

OTAQ provided Category 1 and 2 criteria emissions and activity as a single national number. These emissions and activity were allocated to underway polygons in state waters based on total commodity movements (in tons) data obtained from USACE (U.S. ACE, 2001). These data were waterway-specific, so waterways that crossed into multiple FIPs had emissions assigned by waterway length in each polygon. HAP emissions were then speciated from VOC and PM estimates using the methodology described in Section 3.0 for each polygon.

2.7.2 *Category 3 Reduced Speed Zones (RSZ)*

OTAQ provided polyline shapefiles indicating location of RSZ activities along with port-specific RSZ emissions and activity. These polylines were intersected with existing shipping lane polygons, and emissions were allocated to polygons based on the approach segment length on a per-port basis. HAP emissions were then speciated from VOC and PM estimates using the methodology described in Section 3.0 for each polygon.

2.7.3 *Category 3 Approach*

OTAQ provided polyline shapefiles indicating location of cruising activities along with port-specific cruising emissions and activity. These polylines were intersected with our existing polygons, and emissions were allocated to polygons based on the approach segment length on a per-port basis. HAP emissions were then speciated from VOC and PM estimates using the methodology described in Section 3.0 for each polygon.

2.7.4 *Category 3 Interport*

OTAQ provided 4km grids for interport-only emissions for CO, CO_2, HC, NO_x, SO_x, and PM_{10}. These grids were provided in a customized projection which, without a custom geographic transformation, could not be converted to match the polygon layer's projection. Furthermore, the emission estimates provided by OTAQ were developed using EEZs which were in the GCS Arc Sphere projection. Per OTAQ's direction, the interport polygons were converted from North American Equidistant Conic to GCS Arc Sphere by using the data frame projections tool as the a transformation method. This approach was recommended by OTAQ in order to mirror previous methodology and provide emission estimates consistent with the recent Category 3 Commercial Marine Inventory. Zonal statistics tools were used to sum the gridded emissions within each underway polygon**.** HAP emissions were then speciated from VOC and PM estimates using the methodology described in Section 3.0 for each polygon.

2.8 QA/QC

Given the significant methodological changes over previous inventory efforts, several quality checks were implemented to ensure that these data were developed and allocated in a clear and reproducible manner. Some of the quality checks implemented include the following:

GIS shapefiles

- Topology was created and validated through several rounds or revisions to remove gaps or overlapping features both within and between polygon layers.
- Boundaries derived from Google Earth imagery were validated against Street Map network, port-provided map images, USACE ports points, and other online mapping resources to improve boundary accuracy.
- All final shapefiles and polygon characteristics (such as area, etc.) were managed and evaluated in a single projection to ensure quality area and distance measurements, consistent results across CMV activity types, and maximum accuracy across the study area. The only exception to this was in the case of the interport criteria emissions, as described in Section 4.2.4.

Emissions allocations and estimations

- Emission factors were compiled from a variety of sources, and emission factor development methodologies evaluated to identify the most accurate emission factor for use in this inventory effort.
- National emission sums were checked both before and after allocation to ensure no emissions were dropped or grown.
- HAP speciation profiles were checked for accuracy, and speciated emissions were checked on both the polygon and national level to ensure accuracy.
- All unit conversions were double-checked for errors.
- Emission sums were evaluated across activity types (i.e., hotelling, maneuvering, cruising, reduced speed zones, and interport) to ensure they consistently mirror activity levels.
- Port and underway emissions were examined across SCCs to ensure consistency with activity levels and vessel populations.

- 2008 pollutants and emissions were checked against the 2005 inventory to identify any missing pollutants or major changes compared to previous inventories. Discrepancies were investigated and revisions were made as needed.

2.9 What are the Results?

Table 2-3 summarizes the emission estimates for CMVs for criteria pollutants. Table 2-4 summarizes the emission estimates for individual HAPs. Note that for the purposes of this inventory vessels equipped with category 1 and 2 propulsion engines are assumed to operate on Distillate diesel, while vessels equipped with Category 3 propulsion engines are assumed to used a residual blend. Both tables provide data for all states; these 2008 estimates do not include state submitted data.

Table 2-3. Commercial Marine Vessel Criteria and Greenhouse Gas Emission Estimates 2008 (TPY)

Pollutant	Diesel Port	Diesel Underway	Diesel Total	Residual Port	Residual Underway	Residual Total	CMV Total
CO	113,452	37,817	151,269	5,871	68,588	74,459	**225,728**
CO_2	39,221,848	13,073,950	52,295,798	3,703,169	30,986,332	34,689,501	**86,985,299**
NH_3	210	140	350	64	323	387	**737**
NO_X	588,844	196,281	785,125	70,044	813,908	883,952	**1,669,077**
PM10-PRI	20,954	6,985	27,939	6,730	67,702	74,432	**102,371**
PM25-PRI	20,325	6,775	27,100	6,081	62,318	68,399	**95,499**
SO_2	34,803	11,601	46,404	52,512	522,327	574,839	**621,243**
VOC	12,752	4,251	17,003	2,412	28,711	31,123	**48,126**

* Note that for the purposes of this inventory vessels equipped with category 1 and 2 propulsion engines are assumed to operate on Distillate diesel, while vessels equipped with Category 3 propulsion engines are assumed to used a residual blend.

Table 2-4. Commercial Marine Vessel HAP Emission Estimates 2008 (TPY)

Pollutant	Diesel Port	Residual Port	Diesel Underway	Residual Underway
2,2,4-Trimethylpentane	3.825675	NA	1.062688	NA
Acenaphthene	0.36585	0.002068	0.101625	0.021188
Acenaphthylene	0.564019	0.003193	0.156672	0.032717
Acetaldehyde	710.6	0.552315	197.388896	6.574751
Acrolein	33.47466	NA	9.298516	NA
Anthracene	0.564019	0.003193	0.156672	0.032717
Arsenic	0.366686	2.358644	0.209535	11.836005
Benz[a]Anthracene	0.60975	0.003448	0.169375	0.035334
Benzene	194.5738	0.023636	54.048288	0.281365
Benzo[a]Pyrene	0.052384	0.011793	0.034923	0.059180
Benzo[b]Fluoranthene	0.104768	0.023586	0.069845	0.118360
Benzo[g,h,i,]Perylene	0.137194	0.000778	0.038109	0.007977
Benzo[k]Fluoranthene	0.052384	0.011793	0.034923	0.059180
Beryllium	NA	0.003674	NA	0.036965
Cadmium	0.059298	0.057506	0.035970	1.530064
Chromium (VI)	0.178105	1.224973	0.118737	4.419583
Chromium III	0.345733	2.377888	0.230489	8.579191
Chrysene	0.106706	0.000604	0.029641	0.006188
Cobalt	NA	1.717108	NA	10.426100
Dioxins/Furans as 2,3,7,8-TCDD TEQs	1.57E-06	1.18E-06	0.000001	0.000006
Ethyl Benzene	19.12838	NA	5.313438	NA
Fluoranthene	0.335363	0.001897	0.093156	0.019443
Fluorene	0.746944	0.004227	0.207484	0.043311
Formaldehyde	1430.802	3.786611	397.445137	45.075801
Hexachlorobenzene	0.000419	9.43E-05	0.000279	0.000473
Hexane	52.60303	NA	14.611954	NA
Indeno[1,2,3-c,d]Pyrene	0.104768	0.023586	0.069845	0.118360
Lead	1.571513	0.354705	1.047675	1.773791
Manganese	0.032059	0.385606	0.008905	3.879322
Mercury	0.000524	0.008218	0.000349	0.035508
Naphthalene	21.35649	0.121021	5.932360	1.240126
Nickel	10.47675	90.68502	6.984500	398.764466
PAH, total	26.5488	0.154501	7.496895	1.584859
Phenanthrene	0.85365	0.004829	0.237125	0.049480
Phosphorus		26.71489	NA	387.932155
Polychlorinated Biphenyls	0.005238	0.001179	0.003492	0.005918
Propionaldehyde	58.34154	NA	16.205985	NA
Pyrene	0.594506	0.003363	0.165141	0.034462
Selenium	0.000593	0.053465	0.000360	0.235603
Styrene	20.08479	NA	5.579110	NA
Toluene	30.6054	NA	8.501500	NA
Xylenes (Mixed Isomers)	45.9081	NA	12.752250	NA

* Note that for the purposes of this inventory vessels equipped with category 1 and 2 propulsion engines are assumed to operate on Distillate diesel, while vessels equipped with Category 3 propulsion engines are assumed to used a residual blend.
NA – Not Applicable.

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Appendix A
2008 Category 3 Commercial Marine Vessel Inventory Methodology

Citation: U.S. Environmental Protection Agency. *Development of 2008CY Category 3 Commercial Marine Inventory*. Office of Transportation and Air Quality, Ann Arbor, MI. 2009.

Development of 2008CY Category 3 Commercial Marine Inventory

The Category 3 (C3) inventory includes vessels which use C3 engines for propulsion. C3 engines are defined as having displacement above 30 liters per cylinder. The resulting inventory includes emissions from both propulsion and auxiliary engines used on these vessels, as well as those on gas and steam turbine vessels.

Geographically, the inventories include port and interport emissions that occur within the area that extends 200 nautical miles (nm) from the official U.S. baseline, which is roughly equivalent to the border of the U.S. Exclusive Economic Zone (EEZ). The U.S. region was clipped to the boundaries of the U.S. EEZ in areas where the 200nm boundary extended beyond the EEZ.

Category 3 commercial marine inventories were developed for a base year of 2002. [1] These were then projected to 2008. Regional adjustment factors were applied to account for growth. In addition, NO_X adjustment factors were applied to account for implementation of the NO_X Tier 1 standard. The methodology for each type of adjustment is described below.

Growth Factors by Geographic Region

The emissions inventory is calculated for nine geographic regions: Alaska East, Alaska West, East Coast, Gulf Coast, Hawaii East, Hawaii West, North Pacific, South Pacific, and the Great Lakes. Average annual growth rates from 2002-2020 were calculated for five regions: East Coast, Gulf Coast, North Pacific, South Pacific, and the Great Lakes. The Alaska regions were assigned the growth factor for the North Pacific region, while the Hawaii regions were assigned the growth factor for the South Pacific region. Each regional growth rate was then compounded over the inventory projection time period for 2008 (i.e., 6 years). The average annual growth rates and resulting multiplicative growth factors for each emission inventory region is presented in Table 1 below.

Table 1. Regional Emission Inventory Growth Factors for 2008

Emission Inventory Region	2002-2020 Average Annualized Growth Rate (%)	Multiplicative Growth Factor for 2008 Relative to 2002
Alaska East (AE)	3.3	1.2151
Alaska West (AW)	3.3	1.2151
East Coast (EC)	4.5	1.3023
Gulf Coast (GC)	2.9	1.1871
Hawaii East (HE)	5.0	1.3401
Hawaii West (HW)	5.0	1.3401
North Pacific (NP)	3.3	1.2151
South Pacific (SP)	5.0	1.3401
Great Lakes (GL)	1.7	1.1064

NO_x Adjustment Factors

The 2008 calendar year baseline inventory includes pre-control (Tier 0) engines and those subject to the NO_X Tier 1 standard that became effective in 2000. The NO_X emission factors (EFs) by tier and engine/ship type are given in Table 2.

Table 2. NO_X Emission Factors by Tier

Engine/Ship Type	NO_X EF (g/kW-hr)	
	Tier 0	Tier 1
Main		
Slow-Speed Diesel (SSD)	18.1	16.1
Medium-Speed Diesel (MSD)	14	12.5
Steam Turbine (ST)	2.1	n/a
Gas Turbine	6.1	n/a
Auxiliary		
Passenger Ship	14.6	13.0
Other Ships	14.5	12.9

The NO_X EFs by tier were then used with age distributions to generate calendar year NO_X EFs by engine/ship type for 2008. For 2002, Tier 0 EFs were used for simplicity. These calendar year NO_X EFs are provided in Table 3. Since the age distributions are different for vessels in the Great Lakes, NO_X EFs were determined separately for the Great Lakes.

Table 3. NO_X Emission Factors by Calendar Year

Engine/Ship Type	CY NO_X EF (g/kW-hr)		
		2008	
	2002	DSP[a]	GL[b]
Main			
Slow-Speed Diesel (SSD)	18.1	17.07	17.50
Medium-Speed Diesel (MSD)	14	13.01	13.74
Steam Turbine (ST)	2.1	2.1	2.1
Gas Turbine	6.1	6.1	n/a
Auxiliary			
Passenger Ship	14.6	13.76	14.32
Other Ships	14.5	13.60	14.16

[a]DSP = Deep sea ports and areas other than the Great Lakes
[b]GL = Great Lakes

Emission adjustment factors for NO_X were then calculated. Adjustment factors are ratios of the 2008 calendar year EFs to the 2002 calendar year EFs. The adjustment factors by engine/ship type are provided in Table 4.

Table 4. NO_X EF Adjustment Factors for 2008CY

Engine/Ship Type	2008 NO_X Adj (unitless)	
	DSP[a]	GL[b]
Main		
Slow-Speed Diesel (SSD)	0.9433	0.9670
Medium-Speed Diesel (MSD)	0.9293	0.9815
Steam Turbine (ST)	1.0000	1.0000
Gas Turbine	1.0000	n/a
Auxiliary		
Passenger Ship	0.9403	0.9784
Other Ships	0.9403	0.9784

Methodology for Development of 2008CY Port Inventories

For the non-California ports, 2002 emissions for each port are summed by engine/ship type. Propulsion and auxiliary emissions are summed separately, since the EF adjustment factors differ. The appropriate regional growth factor, as provided in Table 1, is then applied, along with the NO_X EF adjustment factors by engine/ship type in Table 4 to calculate the 2008 port inventories.

For the California ports, 2002 emissions for each port are summed by ship type. Propulsion and auxiliary emissions are summed separately, since the EF adjustment factors differ. The EF adjustment factors by engine/ship type in Table 4 are consolidated by ship type, using the CARB assumption that engines on all ships except passenger ships are 95 percent slow speed diesel (SSD) engines and 5 percent medium speed diesel engines (MSD) based upon a 2005 CARB survey. All passenger ships were assumed to be MSD engines. Steam turbines (ST) and gas turbines (GT) are not included in the CARB inventory. The NO_X EF adjustment factors by ship type are then applied, along with ship-specific growth factors used by CARB, to calculate the 2008 California port inventories. The ship-specific growth factors for 2008 relative to 2002 are provided in Table 5 below.

Table 5. Growth Factors by Ship Type for California Ports

Ship Type	Calendar Year	
	2002	2008
Auto	1.0000	1.1525
Bulk	1.0000	0.7412
Container	1.0000	1.4023
General	1.0000	0.9071
Passenger	1.0000	1.9823
Reefer	1.0000	1.0112
RoRo	1.0000	1.1525
Tanker	1.0000	1.3005

Methodology for Development of 2008CY Interport Inventories

The interport portion of the inventory is not segregated by engine or ship type. As a result, regional NO_X EF adjustment factors were developed based on the assumed mix of main (propulsion) engine types in each region. The mix of main engine types by region was developed using the ship call and power data and is presented in Table 6. Main engines are considered a good surrogate for interport emissions, since the majority of emissions while underway are due to the main engines. The NO_X EF adjustment factors by main engine type in Table 4 were used together with the mix of main engine types by region in Table 6 to develop the regional adjustment factors. The resulting NO_X EF regional adjustment factors are provided in Table 7. These NO_X EF regional adjustment factors, together with the regional growth factors in Table 1, were applied to calculate the 2008 interport inventories.

Table 6. Installed Power by Main Engine Type

Region	2008 Installed Power (%)			
	MSD	SSD	GT	ST
Alaska East (AE)	19.1%	18.4%	0.3%	62.2%
Alaska West (AW)	19.1%	18.4%	0.3%	62.2%
East Coast (EC)	25.6%	72.5%	0.9%	1.0%
Gulf Coast (GC)	13.7%	85.5%	0.0%	0.8%
Hawaii East (HE)	66.2%	18.5%	7.4%	8.0%
Hawaii West (HW)	66.2%	18.5%	7.4%	8.0%
North Pacific (NP)	5.1%	83.5%	1.6%	9.7%
South Pacific (SP)	17.8%	82.2%	0.0%	0.0%
Great Lakes (GL)	47.9%	43.7%	0.0%	8.4%

Table 7. NO_X EF Regional Adjustment Factors

Region	2002	2008
Alaska East (AE)	1.0000	0.9761
Alaska West (AW)	1.0000	0.9761
East Coast (EC)	1.0000	0.9408
Gulf Coast (GC)	1.0000	0.9419
Hawaii East (HE)	1.0000	0.9428
Hawaii West (HW)	1.0000	0.9428
North Pacific (NP)	1.0000	0.9490
South Pacific (SP)	1.0000	0.9408
Great Lakes (GL)	1.0000	0.9767

The resulting 2008 Category 3 emission inventories are shown in Table 8 for each of the nine geographic regions and the nation.

Table 8. 2008 Regional and National Emissions from Category 3 Vessel Main and Auxiliary Engines

Region	Metric Tonnes						
	NO_X	PM_{10}	$PM_{2.5}$ [a]	HC	CO	SO_2	CO_2
Alaska East (AE)	21,590	1,749	1,609	733	1,730	13,032	807,159
Alaska West (AW)	71,901	5,755	5,294	2,441	5,750	42,694	2,631,081
East Coast (EC)	271,707	23,021	21,180	9,573	22,665	190,767	10,696,360
Gulf Coast (GC)	195,240	16,839	15,492	6,903	16,990	125,728	7,604,870
Hawaii East (HE)	28,837	2,403	2,211	1,013	2,390	17,843	1,108,047
Hawaii West (HW)	40,573	3,381	3,110	1,426	3,362	25,105	1,559,016
North Pacific (NP)	30,248	2,647	2,435	1,153	2,568	18,790	1,216,723
South Pacific (SP)	132,669	10,982	10,103	4,692	11,368	81,896	5,145,632
Great Lakes (GL)	16,395	1,318	1,212	557	1,312	9,797	605,001
Total Metric Tonnes	**809,160**	**68,094**	**62,646**	**28,492**	**68,136**	**525,651**	**31,373,889**
Total Short Tons [b]	**891,946**	**75,061**	**69,056**	**31,407**	**75,107**	**579,431**	**34,583,792**

[a] Estimated from PM_{10} using a multiplicative adjustment factor of 0.92.

Reference (for 2002 inventory development)

1) U.S. Environmental Protection Agency, "Draft Regulatory Impact Analysis: Control of Emissions of Air Pollution from Category 3 Marine Diesel Engines," Office of Transportation and Air Quality, EPA-420-D-09-002, June 2009.

Appendix B

2008 Commercial Marine Vessel Hazardous Air Pollutant Speciation Profiles

Table 1. Category 1 and 2 Hazardous Air Pollutant Speciation Profile for Port Activities

Pollutant Code	Pollutant	Speciation Basis	2008 Emission Factor
540841	2,2,4-trimethylpentane	VOC	3.00E-04
83329	Acenaphthene	$PM_{2.5}$	1.80E-05
208968	Acenaphthylene	$PM_{2.5}$	2.78E-05
75070	Acetaldehyde	VOC	5.57E-02
107028	Acrolein	VOC	2.63E-03
NH3	Ammonia	PM_{10}	1.15E-02
120127	Anthracene	$PM_{2.5}$	2.78E-05
7440382	Arsenic	PM_{10}	1.75E-05
56553	Benz[a]Anthracene	$PM_{2.5}$	3.00E-05
71432	Benzene	VOC	1.53E-02
50328	Benzo[a]Pyrene	PM_{10}	2.50E-06
205992	Benzo[b]Fluoranthene	PM_{10}	5.00E-06
191242	Benzo[g,h,I,]Perylene	$PM_{2.5}$	6.75E-06
207089	Benzo[k]Fluoranthene	PM_{10}	2.50E-06
7440439	Cadmium	PM_{10}	2.83E-06
16065831	Chromium III	PM_{10}	1.65E-05
18540299	Chromium VI	PM_{10}	8.50E-06
218019	Chrysene	$PM_{2.5}$	5.25E-06
600	Dioxin	PM_{10}	2.50E-09
100414	Ethylbenzene	VOC	1.50E-03
206440	Fluoranthene	$PM_{2.5}$	1.65E-05
86737	Fluorene	$PM_{2.5}$	3.68E-05
50000	Formaldehyde	VOC	1.12E-01
118741	Hexachlorobenzene	PM_{10}	2.00E-08
193395	Indeno[1,2,3-c,d]Pyrene	PM_{10}	5.00E-06
439921	Lead	PM_{10}	7.50E-05
7439965	Manganese	PM_{10}	1.53E-06
7439976	Mercury	PM_{10}	2.50E-08
91203	Naphthalene	$PM_{2.5}$	1.05E-03
110543	n-Hexane	VOC	4.13E-03
7440020	Nickel	PM_{10}	5.00E-04
1336363	Polychlorinated Biphenyls	PM_{10}	2.50E-07
85018	Phenanthrene	$PM_{2.5}$	4.20E-05
123386	Propionaldehyde	VOC	4.58E-03
129000	Pyrene	$PM_{2.5}$	2.93E-05
7782492	Selenium	PM_{10}	2.83E-08
100425	Styrene	VOC	1.58E-03
108883	Toluene	VOC	2.40E-03

Table 2. Category 1 and 2 Hazardous Air Pollutant Speciation Profile for Underway Activities

Pollutant Code	Pollutant	Speciation Basis	2008 Emission Factor
1330207	Xylene	VOC	3.60E-03
540841	2,2,4-trimethylpentane	VOC	2.50E-04
83329	Acenaphthene	$PM_{2.5}$	1.50E-05
208968	Acenaphthylene	$PM_{2.5}$	2.31E-05
75070	Acetaldehyde	VOC	4.64E-02
107028	Acrolein	VOC	2.19E-03
NH3	Ammonia	PM_{10}	2.31E-02
120127	Anthracene	$PM_{2.5}$	2.31E-05
7440382	Arsenic	PM_{10}	3.00E-05
56553	Benz[a]Anthracene	$PM_{2.5}$	2.50E-05
71432	Benzene	VOC	1.27E-02
50328	Benzo[a]Pyrene	PM_{10}	5.00E-06
205992	Benzo[b]Fluoranthene	PM_{10}	1.00E-05
191242	Benzo[g,h,I,]Perylene	$PM_{2.5}$	5.63E-06
207089	Benzo[k]Fluoranthene	PM_{10}	5.00E-06
7440439	Cadmium	PM_{10}	5.15E-06
16065831	Chromium III	PM_{10}	3.30E-05
18540299	Chromium VI	PM_{10}	1.70E-05
218019	Chrysene	$PM_{2.5}$	4.38E-06
600	Dioxin	PM_{10}	5.00E-09
100414	Ethylbenzene	VOC	1.25E-03
206440	Fluoranthene	$PM_{2.5}$	1.38E-05
86737	Fluorene	$PM_{2.5}$	3.06E-05
50000	Formaldehyde	VOC	9.35E-02
118741	Hexachlorobenzene	PM_{10}	4.00E-08
193395	Indeno[1,2,3-c,d]Pyrene	PM_{10}	1.00E-05
7439921	Lead	PM_{10}	1.50E-04
7439965	Manganese	PM_{10}	1.28E-06
7439976	Mercury	PM_{10}	5.00E-08
91203	Naphthalene	$PM_{2.5}$	8.76E-04
110543	n-Hexane	VOC	3.44E-03
7440020	Nickel	PM_{10}	1.00E-03
1336363	Polychlorinated Biphenyls	PM_{10}	5.00E-07

Table 2. Category 1 and 2 Hazardous Air Pollutant Speciation Profile for Underway Activities (Continued)

Pollutant Code	Pollutant	Speciation Basis	2008 Emission Factor
85018	Phenanthrene	$PM_{2.5}$	3.50E-05
123386	Propionaldehyde	VOC	3.81E-03
129000	Pyrene	$PM_{2.5}$	2.44E-05
7782492	Selenium	PM_{10}	5.15E-08
100425	Styrene	VOC	1.31E-03
108883	Toluene	VOC	2.00E-03
1330207	Xylene	VOC	3.00E-03

Table 3. Category 3 Hazardous Air Pollutant Speciation Profile for Hotelling Activities

Pollutant Code	Pollutant	Speciation Basis	2008 Emission Factor
83329	Acenaphthene	$PM_{2.5}$	3.40E-07
208968	Acenaphthylene	$PM_{2.5}$	5.25E-07
75070	Acetaldehyde	VOC	2.29E-04
NH3	Ammonia	PM_{10}	1.08E-02
120127	Anthracene	$PM_{2.5}$	5.25E-07
7440382	Arsenic	PM_{10}	4.00E-04
56553	Benz[a]Anthracene	$PM_{2.5}$	5.67E-07
71432	Benzene	VOC	9.80E-06
50328	Benzo[a]Pyrene	PM_{10}	2.00E-06
205992	Benzo[b]Fluoranthene	PM_{10}	4.00E-06
191242	Benzo[g,h,I,]Perylene	$PM_{2.5}$	1.28E-07
207089	Benzo[k]Fluoranthene	PM_{10}	2.00E-06
7440417	Beryllium	PM_{10}	5.46E-07
7440439	Cadmium	PM_{10}	5.90E-06
16065831	Chromium III	PM_{10}	3.96E-04
18540299	Chromium VI	PM_{10}	2.04E-04
218019	Chrysene	$PM_{2.5}$	9.93E-08
7440484	Cobalt	PM_{10}	2.92E-04
53703	Dibenzo[a,h]Anthracene	$PM_{2.5}$	0.00E+00
600	Dioxin	PM_{10}	2.00E-09

Table 3. Category 3 Hazardous Air Pollutant Speciation Profile for Hotelling Activities (Continued)

Pollutant Code	Pollutant	Speciation Basis	2008 Emission Factor
206440	Fluoranthene	$PM_{2.5}$	3.12E-07
86737	Fluorene	$PM_{2.5}$	6.95E-07
50000	Formaldehyde	VOC	1.57E-03
118741	Hexachlorobenzene	PM_{10}	1.60E-08
193395	Indeno[1,2,3-c,d]Pyrene	PM_{10}	4.00E-06
7439921	Lead	PM_{10}	6.00E-05
7439965	Manganese	PM_{10}	5.73E-05
7439976	Mercury	PM_{10}	1.40E-06
91203	Naphthalene	$PM_{2.5}$	1.99E-05
7440020	Nickel	PM_{10}	1.54E-02
1336363	Polychlorinated Biphenyls	PM_{10}	2.00E-07
85018	Phenanthrene	$PM_{2.5}$	7.94E-07
7723140	Phosphorous	PM_{10}	4.38E-03
130498292	POM as 16-PAH	$PM_{2.5}$	2.49E-05
130498292	POM as 7-PAH	PM_{10}	4.50E-07
129000	Pyrene	$PM_{2.5}$	5.53E-07
7782492	Selenium	PM_{10}	9.08E-06

Table 4. Category 3 Hazardous Air Pollutant Speciation Profile for Maneuvering Activities

Pollutant Code	Pollutant	Speciation Basis	2008 Emission Factor
83329	Acenaphthene	$PM_{2.5}$	3.40E-07
208968	Acenaphthylene	$PM_{2.5}$	5.25E-07
75070	Acetaldehyde	VOC	2.29E-04
NH3	Ammonia	PM_{10}	2.38E-03
120127	Anthracene	$PM_{2.5}$	5.25E-07
7440382	Arsenic	PM_{10}	8.74E-05
56553	Benz[a]Anthracene	$PM_{2.5}$	5.67E-07
71432	Benzene	VOC	9.80E-06
50328	Benzo[a]Pyrene	PM_{10}	4.37E-07
205992	Benzo[b]Fluoranthene	PM_{10}	8.74E-07

Table 4. Category 3 Hazardous Air Pollutant Speciation Profile for Maneuvering Activities (Continued)

Pollutant Code	Pollutant	Speciation Basis	2008 Emission Factor
191242	Benzo[g,h,I,]Perylene	$PM_{2.5}$	1.28E-07
207089	Benzo[k]Fluoranthene	PM_{10}	4.37E-07
7440417	Beryllium	PM_{10}	5.46E-07
7440439	Cadmium	PM_{10}	2.26E-05
16065831	Chromium III	PM_{10}	1.27E-04
18540299	Chromium VI	PM_{10}	6.53E-05
218019	Chrysene	$PM_{2.5}$	9.93E-08
7440484	Cobalt	PM_{10}	5.94E-05
53703	Dibenzo[a,h]Anthracene	$PM_{2.5}$	0.00E+00
600	Dioxin	PM_{10}	4.37E-10
206440	Fluoranthene	$PM_{2.5}$	3.12E-07
86737	Fluorene	$PM_{2.5}$	6.95E-07
50000	Formaldehyde	VOC	1.57E-03
118741	Hexachlorobenzene	PM_{10}	3.50E-09
193395	Indeno[1,2,3-c,d]Pyrene	PM_{10}	8.74E-07
7439921	Lead	PM_{10}	1.40E-05
7439965	Manganese	PM_{10}	5.73E-05
7439976	Mercury	PM_{10}	2.71E-07
91203	Naphthalene	$PM_{2.5}$	1.99E-05
7440020	Nickel	PM_{10}	3.25E-03
1336363	Polychlorinated Biphenyls	PM_{10}	4.37E-08
85018	Phenanthrene	$PM_{2.5}$	7.94E-07
7723140	Phosphorous	PM_{10}	1.79E-03
130498292	POM as 16-PAH	$PM_{2.5}$	2.49E-05
130498292	POM as 7-PAH	PM_{10}	4.90E-07
129000	Pyrene	$PM_{2.5}$	5.53E-07
7782492	Selenium	PM_{10}	1.91E-06

Table 5. Category 3 Hazardous Air Pollutant Speciation Profile for Underway Activities

Pollutant Code	Pollutant	Speciation Basis	2008 Emission Factor
83329	Acenaphthene	$PM_{2.5}$	3.40E-07
208968	Acenaphthylene	$PM_{2.5}$	5.25E-07

Table 5. Category 3 Hazardous Air Pollutant Speciation Profile for Underway Activities (Continued)

Pollutant Code	Pollutant	Speciation Basis	2008 Emission Factor
75070	Acetaldehyde	VOC	2.29E-04
NH3	Ammonia	PM_{10}	4.77E-03
120127	Anthracene	$PM_{2.5}$	5.25E-07
7440382	Arsenic	PM_{10}	1.75E-04
56553	Benz[a]Anthracene	$PM_{2.5}$	5.67E-07
71432	Benzene	VOC	9.80E-06
50328	Benzo[a]Pyrene	PM_{10}	8.74E-07
205992	Benzo[b]Fluoranthene	PM_{10}	1.75E-06
191242	Benzo[g,h,I,]Perylene	$PM_{2.5}$	1.28E-07
207089	Benzo[k]Fluoranthene	PM_{10}	8.74E-07
7440417	Beryllium	PM_{10}	5.46E-07
7440439	Cadmium	PM_{10}	2.26E-05
7440473	Chromium	PM_{10}	1.92E-04
16065831	Chromium III	PM_{10}	1.27E-04
18540299	Chromium VI	PM_{10}	6.53E-05
218019	Chrysene	$PM_{2.5}$	9.93E-08
7440484	Cobalt	PM_{10}	1.54E-04
53703	Dibenzo[a,h]Anthracene	$PM_{2.5}$	0.00E+00
600	Dioxin	PM_{10}	8.74E-10
206440	Fluoranthene	$PM_{2.5}$	3.12E-07
86737	Fluorene	$PM_{2.5}$	6.95E-07
50000	Formaldehyde	VOC	1.57E-03
118741	Hexachlorobenzene	PM_{10}	6.99E-09
193395	Indeno[1,2,3-c,d]Pyrene	PM_{10}	1.75E-06
7439921	Lead	PM_{10}	2.62E-05
7439965	Manganese	PM_{10}	5.73E-05
7439976	Mercury	PM_{10}	5.24E-07
91203	Naphthalene	$PM_{2.5}$	1.99E-05
7440020	Nickel	PM_{10}	5.89E-03
1336363	Polychlorinated Biphenyls	PM_{10}	8.74E-08
85018	Phenanthrene	$PM_{2.5}$	7.94E-07
7723140	Phosphorus	PM_{10}	5.73E-03
130498292	POM as 16-PAH	$PM_{2.5}$	2.49E-05
130498292	POM as 7-PAH	PM_{10}	4.90E-07
129000	Pyrene	$PM_{2.5}$	5.53E-07
7782492	Selenium	PM_{10}	3.48E-06

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Documentation for Locomotive Component of the National Emissions Inventory Methodology

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TABLE OF CONTENTS

Section **Page No.**

1.0 INTRODUCTION 1-1
1.1 What are Locomotive Sources? 1-1

2.0 DEVELOPMENT OF THE LOCOMOTIVE COMPONENT FOR THE NEI 2-1
2.1 What Pollutants are Included in the National Emission Estimates for Locomotives? 2-1

3.0 HOW WERE LOCOMOTIVE EMISSIONS ESTIMATED? 3-1
3.1 Line Haul Criteria Emissions Estimates 3-1
3.2 Rail Yard Criteria Emissions Estimates 3-1
3.3 Hazardous Air Pollutant Emissions Estimates 3-2

4.0 HOW WERE COUNTY LINE HAUL EMISSIONS REALLOCATED TO INDIVIDUAL RAIL SEGMENTS? 4-1
4.1 Class I Line Haul Emissions Allocation 4-1
4.2 Class II/III Line Haul Emissions Allocation 4-2
4.3 Rail Yard Emissions Allocation 4-3
4.4 State Provided Data 4-3
4.5 What are the Results? 4-3

5.0 REFERENCES 5-1

Appendix A – ERTAC Class I Line Haul Documentation

Appendix B – ERTAC Class II/III Line Haul Documentation

Appendix C – ERTAC Rail Yard Documentation

LIST OF TABLES AND FIGURES

Tables **Page No.**

Table 2-1. Locomotive Pollutant List 2-1
Table 2-2. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources 2-2
Table 3-1. Hazardous Air Pollutant Speciation Profile for 2008 Locomotive Emission Estimation 3-2
Table 4-1. Line Haul Segment Activity (MGTM/Mi) Categories 4-1

1.0 INTRODUCTION

1.1 What are Locomotive Sources?

The locomotive source category includes railroad locomotives powered by diesel-electric engines. A diesel-electric locomotive uses 2-stroke or 4-stroke diesel engines and an alternator or a generator to produce the electricity required to power its traction motors. The locomotive source category does not include locomotives powered by electricity or steam. Emissions associated with the operation of electric locomotives would be included in the point source utility emission estimate. It is believed that the number of wood or coal driven steam locomotives is currently very small; therefore, these types of locomotives are not included in this inventory.

The locomotive source category is further divided up into three categories: Class I line haul, Class II/III line haul, and Class I yard. The national rail estimates were developed by the Eastern Regional Technical Advisory Committee hereafter referenced as ERTAC Rail. This group is comprised of eastern states' regulatory agencies in collaboration with the rail industry. ERTAC Rail developed emissions estimates based on fuel data obtained from the American Association of Railroads for each subcategory. California locomotive emission estimates were handled separately from the rest of the United States because of their use of low sulfur locomotive diesel fuels.

2.0 DEVELOPMENT OF THE LOCOMOTIVE COMPONENT FOR THE NEI

2.1 What Pollutants are Included in the National Emission Estimates for Locomotives?

All of the criteria pollutants, VOC, CO, NO_x, SO_x, PM, and $PM_{2.5}$, are included in the locomotive component of the NEI. OTAQ identified the HAPs for which data were available to develop inventory estimates (Scarbro, 2001). The hazardous air pollutants (HAPs), listed below, were identified based on available test data and accepted emission estimation procedures. Emission estimation methods have changed over the history of the NEI, as outlined briefly in Table 2-2 for nonroad sources.

Table 2-1. Locomotive Pollutant List

1,3-Butadiene	Beryllium	Napthalene
2,2,4-Trimethylpentane	Cadmium	n-Hexane
Acenaphthene	Chromium (Hexavalent)	Nickel
Acenaphthylene	Chromium (Trivalent)	Phenanthrene
Acetaldehyde	Chrysene	PAH Propionaldehyde
Acrolein	Dibenz(a,h) anthracene	Pyrene
Anthracene	Ethyl Benzene	Styrene
Arsenic	Fluoranthene	Toluene
Benzene	Fluorene	Xylene
Benzo(a)anthracene	Formaldehyde	
Benzo[a]pyrene	Indeno(1,2,3-cd) pyrene	
Benzo[b]fluoranthene	Lead	
Benzo[g,h,i,]perylene	Manganese	
Benzo[k]fluoranthene	Mercury	

Table 2-2. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
NONROAD Categories			
Nonroad Gasoline, Diesel, LPG, CNG	2008	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3, & HAPs	Emission estimates for NONROAD model engines were developed using EPA's National Mobile Inventory Model (NMIM), which incorporates NONROAD2008. Where states provided alternate NMIM nonroad inputs, these data replaced EPA default inputs.
	2005	VOC, NO_x, CO, SO_2, , PM_{10}, $PM_{2.5}$, NH_3, & HAPs	Emission estimates for NONROAD model engines were developed using EPA's NMIM, which incorporates NONROAD2005. Where States provided alternate nonroad inputs, these data replaced EPA default inputs.
	2002	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3, & HAPs	Emission estimates for NONROAD model engines were developed using EPA's NMIM, which incorporates NONROAD2004. Where states provided alternate nonroad inputs, these data replaced EPA default inputs. State-supplied emissions data also replaced default EPA emission estimates.
	1999	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) an updated 1999 national inventory, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model. Replaced State-submitted data for California for all NONROAD model categories; Pennsylvania for recreational marine and aircraft ground support equipment, and Texas for select equipment categories.
	1996, 1997, 1998, 2000 & 2001	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) updated year-specific national and California inventories, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios and California county-to-state ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model. California results replace the diesel equipment emissions generated from prior application of county-to-national ratios.

Table 2-2. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Nonroad Gasoline, Diesel, LPG, and CNG (Continued)	1991-1995	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3	Using 1990 and 1996 county-level emissions inventories, estimated emissions using linear interpolation of national emissions between 1990 and 1996. From these emissions, calculated the average annual growth rate for each pollutant/SCC combination for each year, and then applied the growth factors to 1990 county-level emissions to estimate 1991-1995 emissions.
	1990	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) updated 1990 national inventory, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model.
	1986, 1988, & 1989	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3	Using 1985 and 1990 county-level emissions inventories, estimated emissions using linear interpolation of national emissions between 1985 and 1990. From these emissions, calculated the average annual growth rate for each pollutant/SCC combination for each year, and then applied the growth factors to 1985 county-level emissions to estimate 1986-1989 emissions.
	1987	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using EPA's draft Lockdown C NONROAD model (dated May 2002), developed updated national emissions for 1987 by running 4 seasonal NONROAD model runs to estimate annual criteria pollutant emissions. Also performed national NONROAD model runs to estimate typical summer weekday emissions.
	1985	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using emission estimates from two emission inventories including: 1) a 1996 county-level inventory, developed using EPA's October 2001 draft NONROAD model; and 2) updated 1985 national inventory, based on EPA's draft Lockdown C NONROAD model (dated May 2002). Using the 1996 county-level emission estimates, seasonal and daily county-to-national ratios were then developed for application to updated national estimates per season estimated from the Lockdown C model.
	1970, 1975, 1978, & 1980	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Using EPA's draft Lockdown C NONROAD model (dated May 2002), developed updated national emissions for all years by running 4 seasonal NONROAD model runs to estimate annual criteria pollutant emissions. Also performed national NONROAD model runs to estimate typical summer weekday emissions.

Table 2-2. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Nonroad Gasoline, Diesel, LPG, and CNG (Continued)	1996, 1997, 1998, 1999, 2000, & 2001	NH_3	Obtaining national fuel consumption estimates from the Lockdown C NONROAD model, multiplying by NH_3 emission factors, and distributing to counties using 1996 inventory, based on October 2001 draft NONROAD. NH_3 emissions for California were also recalculated using updated diesel fuel consumption values generated for California-specific runs, and assuming the 1996 county-level distribution.
	1985 & 1990	NH_3	Obtaining national fuel consumption estimates from the Lockdown C NONROAD model, multiplying by NH_3 emission factors, and distributing to counties using 1996 inventory, based on October 2001 draft NONROAD.
	1987	NH_3	Obtaining 1987 national fuel consumption estimates from Lockdown C NONROAD model and multiplying by NH_3 emission factors.
	1970, 1975, 1978, & 1980	NH_3	Obtaining national fuel consumption estimates from the Lockdown C NONROAD model and multiplying by NH_3 emission factors.
	1990, 1996, & 1999	HAPs	Speciation profiles applied to county VOC and PM estimates. Metal HAPs were calculated using fuel and activity-based emission factors. Some state data were provided and replaced national estimates. (2003)
Aircraft			
Commercial Aircraft	2008	Criteria and HAPs	Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System (EDMS) - Version 5.1.was run using BTS T-100 LTO data. (2009)
	2002 and 2005	Criteria and HAPs	Federal Aviation Administration (FAA) Emissions and Dispersion and Modeling System (EDMS) was run for criteria pollutants, VOC and PM emissions were speciated into HAP components. (2004)
	1990, 1996, 1999, 2000, 2001	VOC, NO_x, CO, SO_x	Input landing and take-off (LTO) data into FAA EDMS. National emissions were assigned to airports based on airport specific LTO data and BTS GIS data. State data replaced national estimates. (2003)
	1970-1998	VOC, NO_x, CO, SO_x	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999	HAPs	Speciation profiles were applied to VOC estimates to get national HAP estimates. State data replaced national estimates. (2003)
General Aviation, Air Taxis	2008	Criteria and HAPs	Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System (EDMS) - Version 5.1.was run using BTS T-100 LTO for aircraft identified as Air taxis. (2010) Used FAA LTO data from TAF and OTAQ provided activity data for smaller airports derived from FAA 5010 master plans. EPA approved generic emission factors for criteria estimates. Speciation profiles were applied to VOC and PM estimates to get national HAP estimates. (2010)

Table 2-2. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
General Aviation, Air Taxis (Continued)	2005	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	2002 emissions for approximately 4,000 largest airports were calculated via EDMS and SIP guidance and included in the 2005 NEI as point sources. Only airports in FAA's T100 and TAF databases were included. State point source submittals were incorporated.
	1978, 1987, 1990, 1996, 1999, 2000, 2001, & 2002	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Used FAA LTO data and EPA approved emission factors for criteria estimates. Speciation profiles were applied to VOC estimates to get national HAP estimates. State data replaced national estimates. (2004)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999, & 2002	HAPs	Used FAA LTO data and EPA approved emission factors for criteria estimates. Speciation profiles were applied to VOC estimates to develop national HAP estimates. (2004)
	1990, 1996, 1999, & 2002	Pb	Used Department of Energy (DOE) aviation gasoline usage data with lead concentration of aviation gasoline. (2004)
	1996	NH_3	Applied NH_3 emissions factors to 1996 national jet fuel and aviation gasoline consumption estimates.
Military Aircraft	2008	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Used FAA LTO data as reported in TAF and EPA approved emission factors for criteria estimates. Representative HAP profiles were not readily available, therefore HAP estimates were not developed. (2010)
	2005	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	2002 emissions were included in the 2005 NEI as point sources similar to other TAF reported data.
	1978, 1987, 1990, 1996, 1999, 2000, 2001, 2002, 2008	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Used FAA LTO data as reported in TAF and EPA approved emission factors for criteria estimates. Representative HAP profiles were not readily available, therefore HAP estimates were not developed.
	1970-1998	VOC, NO_x, CO, SO_X, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
Auxiliary Power Units and Ground Support Equipment	2008	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, HAPs	Federal Aviation Administration (FAA) Emissions and Dispersion and Modeling System (EDMS) - Version 5.1.was run using BTS T-100 LTO data. (2009)
	2002 and 2005	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, HAPs	Computed via NONROAD2005 model runs
	1985-2001	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Grew 1996 emissions to each year using LTO operations data from the FAA. Estimation methods prior to 1996 reported in EPA, 1998.

Table 2-2. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Unpaved Airstrips[1]	1985-2001	PM_{10}, $PM_{2.5}$	Grew 1996 emissions to each year using SIC 45-Air Transportation growth factors, consistent with the current draft version of EGAS. Estimation methods prior to 1996 reported in EPA, 1998.
Aircraft Refueling[1]	1985-2001	VOC	Grew 1996 emissions to each year using SIC 45-Air Transportation growth factors, consistent with the current draft version of EGAS. Estimation methods prior to 1996 reported in EPA, 1998.
Commercial Marine Vessel (CMV)			
All CMV Categories	2008	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	OTAQ provided CAP emission estimates for all CMV categories. Note that the SCCs for this category have changed such that the Diesel category refers to smaller vessels (Category 1 and 2) using distillate fuels and the Residual category refers to larger (Category 3) vessels using a blend of residual fuels. Emissions were allocated to segments using GIS shapefiles and adjusted based on limited state data (2010)
	2008	HAPs	OTAQ's 2008 estimates were speciated into HAP components using SEPA profiles (2009)
CMV Diesel	2002 and 2005	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	2001 Estimates carried over. Used state data when provided. (2004)
		HAPs	1999 Estimates carried over. Used state data when provided. (2004)
	1978, 1987, 1990, 1996, 1999, 2000, & 2001	VOC, NO_x, CO, SO_x, PM_{10}, & $PM_{2.5}$	Used criteria emission estimates in the background document for marine diesel regulations for 2000. Adjusted 2000 criteria emission estimates for other used based on fuel usage. Emissions were disaggregated into port traffic and underway activities. Port emissions were assigned to specific ports based on amount of cargo handled. Underway emissions were allocated based on Army Corp of Engineering waterway data. State data replaced national estimates. (2003)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999	HAPs	VOC and PM emission estimates were speciated into HAP components. State data replaced national estimates. (2003)
	1996	NH_3	Applied NH_3 emissions factors to 1996 distillate and residual fuel oil estimates (i.e., as reported in EIA, 1996).
	1990-1995	NH_3	Estimation methods reported in EPA, 1998.

Table 2-2. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
CMV Steam Powered	2005	VOC, NO_x, CO, SO_x, PM_{10}, & $PM_{2.5}$, HAPs	2002 estimates grown to 2005 (2008).
	2002	VOC, NO_x, CO, SO_x, PM_{10}, & $PM_{2.5}$, HAPs	2002 based estimates were developed for port and underway category 3 (C3) vessels as part of a rulemaking effort. Emissions were developed separately for near port and underway emissions. For near port emissions, inventories for 2002 were developed for 89 deep water and 28 Great Lake ports in the U.S. The Waterway Network Ship Traffic, Energy, and Environmental Model (STEEM) was used to provide emissions from ships traveling in shipping lanes between and near individual ports (2008)
	1978, 1987, 1990, 1996, 1999, 2000, & 2001	VOC, NO_x, CO, SO_x, PM_{10}, & $PM_{2.5}$	Calculated criteria emissions based on EPA SIP guidance. Emissions were disaggregated into port traffic and under way activities. Port emissions were assigned to specific ports based on amount of cargo handled. Underway emissions were allocated based on Army Corp of Engineering waterway data. State data replaced national estimates. (2003)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, & 1999	HAPs	VOC and PM emission estimates were speciated into HAP components. State data replaced national estimates. (2003)
Military Marine	1997-2001	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Applied EGAS growth factors to 1996 emissions estimates for this category.
CMV Coal,[2] CMV, Steam powered, CMV Gasoline[2]	1997-1998	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Applied EGAS growth factors to 1996 emissions estimates for this category.
CM Coal, CMV, Steam powered, CMV Gasoline, Military Marine	1991-1995	VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$	Estimation methods reported in EPA, 1998.
Locomotives			
Class I, II, III and Yard operations	**2008**	**VOC, NO_x, CO, PM_{10}, $PM_{2.5}$, SO_x & HAPs**	**Criteria emission estimates were provided to EPA by ERTAC. These data were assigned to individual railway segments using DOT shapefiles and guidance from ERTAC. HAP emissions were calculated by applying speciation profiles to VOC and PM estimates. (2010)**

Table 2-2. Methods Used to Develop Annual Emission Estimates for Nonroad Mobile Sources (Continued)

(Categories included in this report are noted in bold print)

Category	Base Year	Pollutant(s)	Estimation Method*
Class I, Class II, Commuter, Passenger, and Yard Locomotives	1978, 1987, 1990, 1996, 1999, 2000, 2000, 2002, & 2005	VOC, NO_x, CO, PM_{10}, $PM_{2.5}$	Criteria pollutants were estimated by using locomotive fuel use data from DOE EIA and available emission factors. County-level estimates were obtained by scaling the national estimates with the rail GIS data from DOT. State data replaced national estimates. (2004)
	1978, 1987, 1990, 1996, 1999, 2000, 2001, 2002, & 2005	SO_2	SO_x emissions were calculated by using locomotive fuel use and fuel sulfur concentration data from EIA. County-level estimates were obtained by scaling the national estimates with the county level rail activity data from DOT. State data replaced national estimates. (2004)
	1970-1998	VOC, NO_x, CO, SO_x, PM_{10}, $PM_{2.5}$	Estimated emissions for interim years using linear interpolation between available base years. (2003)
	1990, 1996, 1999, & 2002	HAPs	HAP emissions were calculated by applying speciation profiles to VOC and PM estimates. County-level estimates were obtained by scaling the national estimates with the county level rail activity from DOT. State data replaced national estimates. (2004)
	1997-1998	NH_3	Grew 1996 base year emissions using EGAS growth indicators.
	1996	NH_3	Applied NH_3 emissions factors to diesel consumption estimates for 1996.
	1990-1995	NH_3	Estimation methods reported in EPA, 1998.

Notes:

* Dates included at the end of Estimation Method represent the year that the section was revised.

1 Emission estimates for unpaved airstrips and aircraft refueling are included in the area source NEI, since they represent non-engine emissions.

2 National Emission estimates for CMV Coal and CMV Gasoline were not developed though states and local agencies may have submitted estimates for these source categories.

EPA, 1998. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Factors and Inventory Group, National Air Pollutant Emission Trends, Procedures Document, 1900–1996, EPA-454/R-98-008. May 1998.

3.0 HOW WERE LOCOMOTIVE EMISSIONS ESTIMATED?

ERTAC Rail used confidential railroad-provided data to generate railroad-specific criteria emission estimates for line haul and rail yards at the rail segment and rail yard level, respectively. Appendices A-C provide more detail on how emissions were developed and includes critical data used in calculating these estimates. This section of the report describes the emission estimating methods used in general terms as well as the approach for reallocating the emissions to protect confidential data. The data and documentation provided with respect to ERTAC Rail's emission estimates pertain to the version that was incorporated into the NEI and does not reflect recent revisions.

3.1 Line Haul Criteria Emissions Estimates

Criteria pollutant emissions were estimated by applying emission factors to the total amount of distillate fuel oil used by line haul locomotives. Fuel usage was obtained from publically available Class I Railroad Annual Reports (Form R-1). The R-1 reports are submitted to the Surface Transportation Board annually and include financial and operations data to be used in monitoring rail industry health and identifying changes that may affect national transportation policy. Additionally, each railroad provided fleet mix information that allowed ERTAC Rail to calculate railroad-specific emission factors. Weighted Emission Factors (EF) per pollutant for each gallon of fuel used (gm/gal or lbs/gal) were calculated for each Class I railroad fleet based on its fraction of line haul locomotives at each regulated Tier level. EPA emission factors were used for $PM_{2.5}$, SO_2, and NH_3.

The weighted emission factors were then applied to the link-specific fuel consumption to obtain emissions for each rail segment. Given the confidentiality of the activity data, emissions for criteria pollutants were provided to EPA by ERTAC Rail by county for Class I line haul. Class II/III rail was provided by railroad company and county. Appendices A and B provide more detail on the Class I and Class II/III line haul emission development, respectively.

3.2 Rail Yard Criteria Emissions Estimates

Rail yard locations were identified using a database from the Federal Railroad Administration. Criteria pollutant emissions were estimated by applying emission factors to the total amount of distillate fuel used by locomotives. Each railroad provided fleet mix information that allowed ERTAC to calculate railroad-specific emission factors. The company-specific, system wide fleet mix was used to calculate weighted average emissions factors for switchers operated by each Class I railroad. EPA emission factors were used for $PM_{2.5}$, SO_2, and NH_3.

R-1 report-derived fuel use was allocated to rail yards using an approximation of line haul activity data within the yard; see Appendix C for more details. These fuel consumption values were further revised by direct input from the Class I railroads. The weighted emission factors were then applied to the yard-specific fuel consumption to obtain emissions for each yard. Since the rail yard inventory was based on publically-available data, the final criteria emission estimates were provided per rail yard.

3.3 Hazardous Air Pollutant Emissions Estimates

HAP emissions were estimated by applying speciation profiles to the VOC or PM estimates. The speciation profiles were derived from *Evaluation of Factors that Affect Diesel Exhaust Toxicity* (Truex and Norbeck, 1998), and data provided by OTAQ (Scarbro, 2001 and 2002). It should be noted that since California uses low sulfur diesel fuel and emission factors specific for California railroad fuels were available, calculations of the state's emissions were done separately from the other states. The HAP speciation profile used in this effort is shown in Table 3-1. HAP estimates were calculated at the yard and link level, after the criteria emissions had been allocated.

Table 3-1. Hazardous Air Pollutant Speciation Profile for 2008 Locomotive Emission Estimation

Pollutant Name	California	All Other States	Speciation Base
1,3 Butadiene	0.0000615	0.0047735	PM_{10}
2-2-4 Trimethylpentane	0.0022425	0.0022425	VOC
Acenaphthene	0.0000080	0.0000306	PM_{10}
Acenaphthylene	0.0002182	0.0004275	PM_{10}
Acetaldehyde	0.0004492	0.0276274	PM_{10}
Acrolein	0.0000855	0.0045943	PM_{10}
Anthracene	0.0000535	0.0001009	PM_{10}
Arsenic	0.0000004	0.0000004	PM_{10}
Benzene	0.0000517	0.0038020	PM_{10}
Benzo(a)anthracene	0.0000121	0.0000160	PM_{10}
Benzo(a)pyrene	0.0000044	0.0000027	PM_{10}
Benzo(b)fluoranthene	0.0000044	0.0000064	PM_{10}
Benzo(ghi)perylene	0.0000044	0.0000031	PM_{10}
Benzo(k)fluoranthene	0.0000044	0.0000052	PM_{10}
Beryllium	0.0000280	0.0000280	PM_{10}
Cadium	0.0000280	0.0000280	PM_{10}
Chromium (III)	0.0000001	0.0000040	PM_{10}
Chromium (VI)	0.0000000	0.0000021	PM_{10}
Chrysene	0.0000092	0.0000119	PM_{10}
Dibenz(a,h)anthracene	0.0000000	0.0000000	PM_{10}
Ethylbenzene	0.0020000	0.0020000	VOC
Fluoranthene	0.0000601	0.0000746	PM_{10}
Fluorene	0.0000619	0.0001407	PM_{10}
Formaldehyde	0.0009451	0.0636582	PM_{10}
Indeno(1,2,3-cd)pyrene	0.0000033	0.0000027	PM_{10}
Lead	0.0000840	0.0000840	PM_{10}
Manganese	0.0000020	0.0000020	PM_{10}
Mercury	0.0000280	0.0000280	PM_{10}
Napthalene	0.0018505	0.0025756	PM_{10}
n-Hexane	0.0055000	0.0055000	VOC

Table 3-1. Hazardous Air Pollutant Speciation Profile for 2008 Locomotive Emission Estimation (Cont.)

Pollutant Name	California	All Other States	Speciation Base
Nickel	0.0000066	0.0000066	PM_{10}
Phenanthrene	0.0002822	0.0005671	PM_{10}
Propionaldehyde	0.0061000	0.0061000	VOC
Pyrene	0.0000771	0.0001054	PM_{10}
Styrene	0.0021000	0.0021000	VOC
Toluene	0.0032000	0.0032000	VOC
Xylene	0.0048000	0.0048000	VOC

4.0 HOW WERE COUNTY LINE HAUL EMISSIONS REALLOCATED TO INDIVIDUAL RAIL SEGMENTS?

4.1 Class I Line Haul Emissions Allocation

Class I line haul emissions were allocated to rail segments based on segment-specific railroad traffic data (ton miles) obtained from the Department of Transportation (BTS, 2009). This dataset categorizes the segments' level of activity into ranges of MGTM and is populated by FRA. Emissions were divided between all mainline segments using these activity ranges as a proxy to allocate more emissions to segments with higher activity.

Since the activity data were provided as ranges, a single "allocation value", typically the midpoint of the range, was selected for use in the emissions allocation. The exception to this was the "0" activity category, which by definition had "unknown" activity. As a result, most mainline segments with the "0" activity category were not included in the emissions calculation/allocation. However, there was a small subset of segments that did have known activity values in the confidential data set but were labeled as "unknown" in the publically available data set. Those segment IDs were provided by ERTAC Rail for inclusion in the emission allocation; however, the activity of these segments was averaged to protect confidential data. Table 4-1 lists the activity categories along with their ranges in MGTM/mi and the allocation value used in the emissions spatial allocation.

Table 4-1. Line Haul Segment Activity (MGTM/Mi) Categories

Category	Range Minimum	Range Maximum	Allocation Value Used
0*	0.0003	0.09	0.01233
1	0.1	4.9	2.5
2	5	9.9	7.45
3	10	19.9	14.95
4	20	39.9	29.95
5	40	59.9	49.95
6	60	99.9	79.95
7	100	1000000	100

* The "0" category has "unknown" activity in the publically available segment data. As a result, this table lists the minimum, maximum, and average of the confidential activity data greater than zero that were categorized as "unknown" in the public data.

The county emission sums were reallocated to the segments by multiplying the county emissions by the segment's allocation value divided by the sum of the allocation values for all links within the county.

$$E_{iL} = E_{iC} * \frac{A_L}{\sum_{C=1}^{N} A_{LC}}$$

Where:

E_{iL} = Emissions of pollutant i per link L (tons/year).
E_{iC} = Emissions of pollutant i per county C (tons/year).
A_L = Allocation value for link L per activity category from public BTS dataset
A_{LC} = Sum of allocation values for all links in county C from public BTS dataset

Note that rail line data for Puerto Rico, U.S. Virgin Islands, and Hawaii data were not included in ERTAC Rail's shapefile and were developed separately; however, since these areas have exclusively Class II/III railroads present, these efforts are discussed in the following section.

4.2 Class II/III Line Haul Emissions Allocation

ERTAC Rail created a shapefile of Class II/III mainline rail segments from their FRA-provided proprietary shapefile as described in Appendix B for the contiguous 48 states and Alaska. Raw rail line data for Puerto Rico were obtained from USGS (Scanlon and Briere, 2000), and rail line data for Hawaii was obtained from ESRI's Digital Chart of the World (ESRI 2010). The U.S. Virgin Islands have no rail lines. Because Class II/III railroads are less likely to use rail segments that are heavily traveled by Class I railroads, the activity-based approach used for Class I lines was not appropriate. Instead, Class II/III line haul emissions were allocated to rail segments using segment length as a proxy.

The county emission sums were reallocated to the segments by multiplying the county emissions by the segment's length divided by the sum of the length for all links within the county.

$$E_{iL} = E_{iC} * \frac{l_L}{\sum_{C=1}^{N} l_{LC}}$$

Where:

E_{iL} = Emissions of pollutant i per link L (tons/year).
E_{iC} = Emissions of pollutant i per county C (tons/year).
l_L = Allocation value for link L per activity category from public BTS dataset
l_{LC} = Sum of allocation values for all links in county C from public BTS dataset

Since ERTAC Rail used proprietary data to develop the shapefile, some segment IDs were not found in the EIS data set. These segments were manually identified, and their emissions were allocated to the nearest segment within the EIS data set.

4.3 Rail Yard Emissions Allocation

Rail yard emissions were developed based on yard name and ownership properties. As a result, unique yards needed to be identified and emissions summed. Unfortunately, the yard data lacked detail necessary for confident duplicate checks and yard matching such as address, detailed yard name, etc. As a result, a GIS was used to find the centroid of the yards based on the latest public BTS rail network, using the yard name and FIPS. The list of unique yards was further examined against ERTAC's data and within Google Earth to identify any yards that required further revision. A crosswalk of original ERTAC data to new, consolidated yard IDs facilitated the summing of activity and emissions. 753 unique yards were identified nationwide. This underestimate of the total number of yards is most likely due to using line-haul-focused data to identify locations and develop rail yard emissions.

Once the unique yards were identified and criteria emissions were summed at the yard, the PM and VOC-based HAP speciation profile was applied to estimate HAP emissions at each yard.

4.4 State Provided Data

In this version of NEI, state and local agencies were invited to provide locomotive data that replaced the estimates based on national fuel consumption. However, only a small rail yard dataset was received from Kentucky. Their rail yard list was compared with the ERTAC/ERG yard list, and 2 yards were found in both sets. These yards were merged so as to avoid duplication in activity or emissions.

4.5 What are the Results?

Table 3 summarizes the 2008 locomotive mobile source emission estimates.

Table 3. 2008 Locomotive Emissions Data

2008 Locomotive Criteria Emissions				
Pollutant Name	**Class I Line Haul**	**Class II/III Line Haul**	**Rail Yard**	**TOTAL**
CO	110,969	5,055	9,152	125,176
NH_3	347	16	27	390
NO_X	754,433	51,342	73,741	879,516
PM_{10}-PRI	25,477	1,264	2,086	28,827
PM_{25}-PRI	23,439	1,163	2,024	26,626
SO_2	7,836	357	619	8,811
VOC	37,941	1,896	4,824	44,661
2008 Locomotive Hazardous Air Pollutant Emissions				
Pollutant Name	**Class I Line Haul**	**Class II/III Line Haul**	**Rail Yard**	**TOTAL**
1,3 Butadiene	116.7941	5.7969	9.3296	131.9206
2-2-4 Trimethylpentane	85.0832	4.2511	10.8178	100.1521
Acenaphthene	0.7569	0.0376	0.0609	0.8554

Table 3. 2008 Locomotive Emissions Data (Cont.)

2008 Locomotive Hazardous Air Pollutant Emissions				
Pollutant Name	**Class I Line Haul**	**Class II/III Line Haul**	**Rail Yard**	**TOTAL**
Acenaphthylene	10.6772	0.5298	0.8639	12.0709
Acetaldehyde	676.0572	33.5552	54.0089	763.6213
Acrolein	112.4351	5.5806	8.9828	126.9985
Anthracene	2.5231	0.1252	0.2042	2.8525
Arsenic	0.0091	0.0005	0.0007	0.0103
Benzene	93.0272	4.6173	7.4312	105.0757
Benzo(a)anthracene	0.4047	0.0201	0.0329	0.4577
Benzo(a)pyrene	0.0717	0.0036	0.0059	0.0812
Benzo(b)fluoranthene	0.1607	0.0079	0.0131	0.1817
Benzo(ghi)perylene	0.0798	0.0040	0.0066	0.0904
Benzo(k)fluoranthene	0.1312	0.0065	0.0107	0.1484
Beryllium	0.7138	0.0354	0.0584	0.8076
Cadium	0.7138	0.0354	0.0584	0.8076
Chromium (III)	0.0985	0.0049	0.0079	0.1113
Chromium (VI)	0.0508	0.0025	0.0041	0.0574
Chrysene	0.2998	0.0149	0.0244	0.3391
Ethylbenzene	75.8814	3.7914	9.6479	89.3207
Fluoranthene	1.8868	0.0936	0.1538	2.1342
Fluorene	3.5039	0.1739	0.2830	3.9608
Formaldehyde	1,557.66	77.3124	124.4335	1759.4059
Indeno(1,2,3-cd)pyrene	0.0684	0.0034	0.0056	0.0774
Lead	2.1413	0.1062	0.1753	2.4228
Manganese	0.0520	0.0026	0.0043	0.0589
Mercury	0.7138	0.0354	0.0584	0.8076
Napthalene	64.8766	3.2187	5.2765	73.3718
n-Hexane	208.6739	10.4263	26.5317	245.6319
Nickel	0.1669	0.00983	0.0137	0.19043
Phenanthrene	14.1555	0.7024	1.1450	16.0029
Propionaldehyde	231.4383	11.5637	29.4261	272.4281
Pyrene	2.6566	0.1318	0.2161	3.0045
Styrene	79.6755	3.9809	10.1303	93.7867
Toluene	121.4103	6.0662	15.4366	142.9131
Xylene	182.1154	9.0993	23.1549	214.3696

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Appendix A

ERTAC Class I Line Haul Documentation

DRAFT
ERTAC Rail Emissions Inventory
Part 1: Class I Line-Haul Locomotives

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Introduction

Air protection agencies from twenty-seven states, coordinated through the Eastern Regional Technical Advisory Committee (ERTAC) and headed by the Lake Michigan Air Directors Consortium (LADCO), identified a need to better quantify and characterize rail-related emissions inventories. Traditional locomotives largely utilize diesel engines, resulting in emissions of NO_x, diesel PM, hydrocarbons, greenhouse gases, and other pollutants. These emissions are sometimes concentrated in areas exceeding National Ambient Air Quality Standards. No cohesive nationwide railroad emission estimates based on local operations are known to have been made previously. Inventory development methods for locomotive emissions estimates vary from state to state and, in general, lack the spatial or temporal resolution needed to support air quality modeling and planning [1-5].

The ERTAC Rail Subcommittee (ERTAC Rail) was established with active representatives from twelve member states, three regional planning offices, and the US EPA. The subcommittee's goals are to (1) standardize agencies' inventory development methods through a collaborative effort, (2) improve the quality of data received and the resulting emission inventories, and (3) reduce the administrative burden on railroad companies of providing data.

With support from the Rail industry and assistance from the ERTAC Rail Data Workgroup (Appendix A), ERTAC Rail has developed 3 inventories of locomotive emissions (Table 1); from Class I line-haul, Shortline and Regional Railroads (Class II and III operations), and Class I railyard switchers. Because of the difficulty in obtaining data and differences in states' needs for inventory years, sources from both 2007 and 2008 were utilized (Appendix B.) Due to the variability and uncertainty in much of the data, the results are considered applicable for either 2007 or 2008.

The Surface Transportation Board (STB) defines Class I Railroads as having had minimum carrier operating revenues of $401.4 million (USD) in 2008. There are 8 Class I Railroads operating in the United States (Table 2), about 12 Regional Railroads (Class II), and approximately 530 Class III Railroads (Shortlines). While categorized as a Class I Railroad, Amtrak was excluded from these inventories because of significant differences in equipment and operation characteristics. Line-haul locomotives travel long distances (e.g. between cities) while switcher locomotives largely operate in railyards, splitting and joining rail cars with varying destinations. Passenger and Commuter Rail (including Amtrak), industrial locomotives, and associated non-locomotive equipment are not included in these inventories.

This paper documents the data sources and methodologies used for calculating the Class I line-haul emissions inventory. Class I line-haul activities are the largest source of rail-related emissions, with estimates of Class I line-haul fuel consumption totals to be from 74 to 84% of all rail sources combined[4, 5]. For this reason, characterizing Class I line-haul emissions were a focal point of ERTAC Rail's inventory development efforts. Information on ERTAC Rail, Railroad participation, the Rail industry, and effects of rail on air quality are available elsewhere[6].

Table 1. Summary of ERTAC Rail Inventories: U.S. Locomotive Emissions and Fuel Use for either 2007 or 2008*.

	Fuel Use** (gal/yr)	Emissions (tons/yr)					
		NO_x	$PM_{2.5}$	HC	SO_2	CO	NH_3
Class I*** line-haul	3,770,914,002	754,443	23,439	37,941	7,836	110,969	347
Class I switcher	300,492,223	73,741	2,024	4,824	619	9,152	27
Class II and III	157,800,000	51,367	1,163	1,897	357	5,058	16

*See Appendix B for a description of the year and source of data utilized for each inventory.
**Locomotive grade diesel
***Excluding Amtrak and including work train fuel use

Table 2. Class I Railroads, Reported Locomotive Fuel Use, and Railroad Fuel Consumption Index (RFCI) [7].

Class I Railroads*	R-1 Reported Locomotive Fuel Use (gal/yr)		RFCI (ton-miles/gal)
	Line-Haul (2007)**	Switcher (2008)	
BNSF	1,393,874,954	52,497,057	883.14
Canadian National	93,830,751	12,290,022	1190.79
Canadian Pacific***	50,320,233	4,594,067	1096.28
CSX	514,687,186	53,717,674	963.81
Kansas City Southern	69,787,071	1,816,759	785.89
Norfolk Southern	463,267,278	32,317,375	865.75
Union Pacific	1,185,146,529	143,470,336	974.64
Total	**3,770,914,002**	**300,492,223**	**929.47**

* Excluding Amtrak
** Includes work trains
*** CP's line-haul fuel use values include 2008 data (rather than 2007) for their Delaware and Hudson subsidiary.

Method

Earlier efforts to characterize line-haul railroad emissions relied on highly aggregated activity data (Figure 1), and generally apportioned annual system-wide fuel use equally across all route miles of track operated by a Class I railroad. However, the majority of freight tonnage carried by Class I railroads is concentrated on a disproportionately small number of route miles. In addition, emissions calculations were previously based on an estimate of annual nationwide-average locomotive fleet mix to create one set of emissions factors.

For this inventory, the Class I Railroads allowed ERTAC Rail access under a confidentiality agreement to a link-level (single lengths of track) line-haul GIS layer activity dataset managed by the Federal Railroad Administration[9]. Each railroad also provided fleet mix information that allowed ERTAC Rail to calculate weighted emission factors based on the fraction of their line-haul fleet meeting each Tier level category. The use of this data, largely following a line-haul inventory methodology recommended by Sierra Research[2, 3], resulted in a link-level line-haul locomotive emission inventory using railroad-specific emission factors. This segment-level inventory is nationwide, aggregated to state and county level files, and will be released as gridded emissions files for use in photochemical and dispersion modeling. Link-level emissions may be provided for special study requests pending approval of any Class I railroads operating in the study domain. The calculations are described below as a two-part process, calculating railroad-specific factors and emissions per rail link.

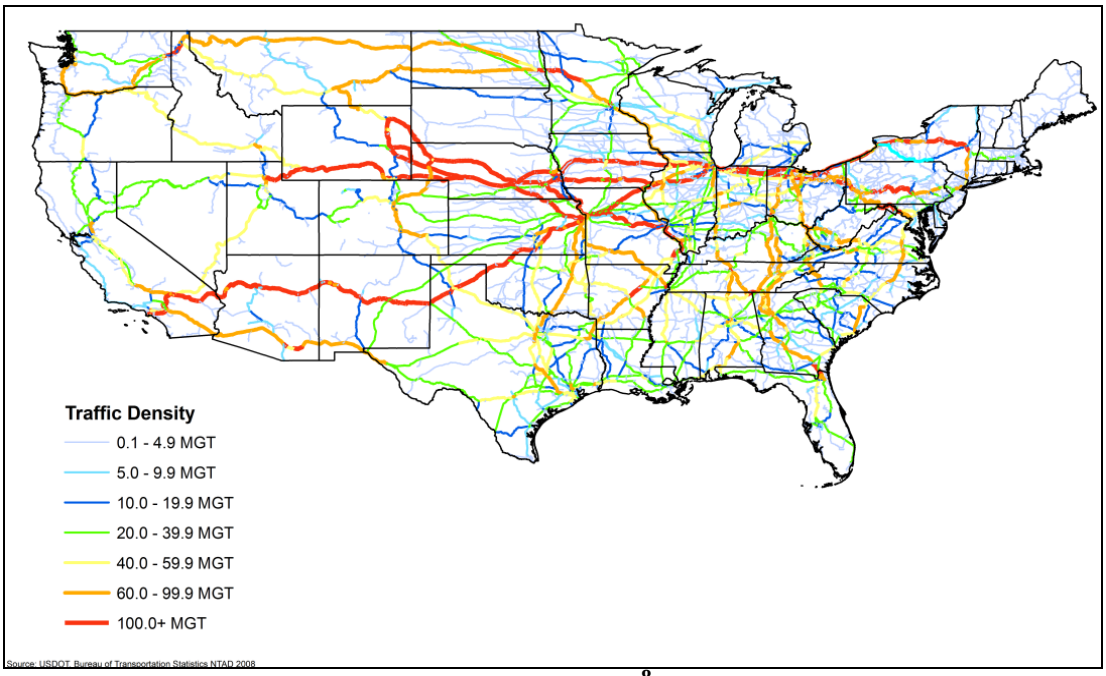

Figure 1. US Railroad Traffic Density in 2006.[8] MGT is million gross tons.

1. Calculate Railroad-Specific Factors.

The EPA provides annual default Emission Factors for locomotives based on characteristic operating cycles ('duty cycles') and the estimated nationwide fleet mixes for both switcher and line-haul locomotives. However, fleet mixes vary from railroad to railroad and, as can be seen in Figure 2, Class I railroad activity is highly regionalized in nature and subject to issues of local terrain such as operation on plains vs. mountainous areas, which can have a significant impact on fuel consumption and emissions.

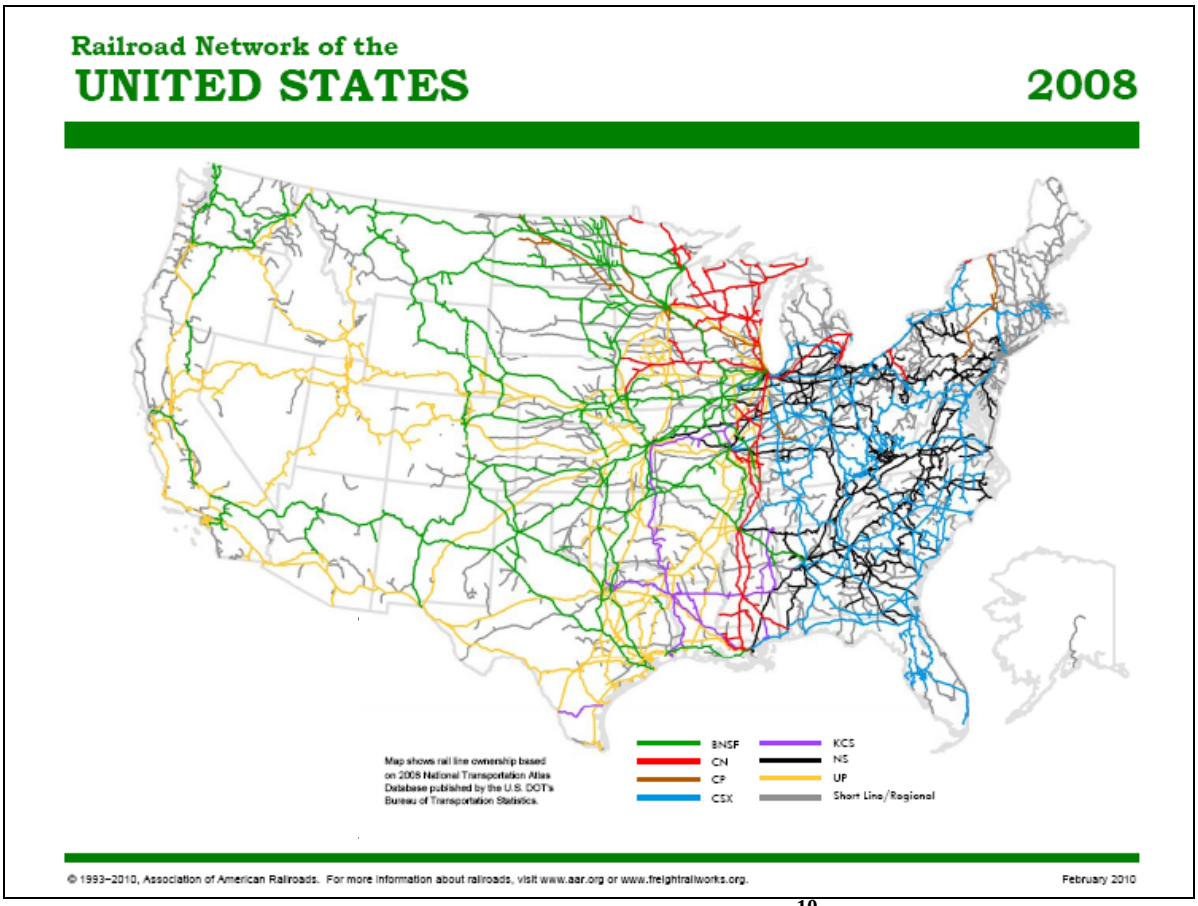

Figure 2. Class I Railroad Territories in the United States[10].

As an alternative approach to using a single nationwide set of emission factors, ERTAC Rail requested each Class I company to provide a description of their line-haul fleet mix based on Tier rating, which each company provided under a confidentiality agreement. An engine's Tier level is based on the year the engine was built and determines allowable emission limits (Table 3).

Table 3. EPA line-haul locomotive Emission Factors by Tier, 1997 standards (grams/gal). Note that the new standards released in 2008 did not apply to fleets in the year 2008. [11]

	PM_{10}	HC	NO_x	CO
Uncontrolled (pre-1973)	6.656	9.984	270.4	26.624
Tier 0 (1973-2001)	6.656	9.984	178.88	26.624
Tier 1 (2002-2004)	6.656	9.776	139.36	26.624
Tier 2 (2005 +)	3.744	5.408	102.96	26.624

Based on values in EPA Technical Highlights: Emission Factors for Locomotives, EPA Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009.

Weighted Emission Factors (EF) per pollutant for each gallon of fuel used (gm/gal or lbs/gal) were calculated for each Class I railroad fleet based on its fraction of line-haul locomotives at each regulated Tier level (Eqn 1; Table 3).

$$EF_{iRR} = \sum_{T=1}^{4} (EF_{iT} * f_{TRR}) \qquad \text{Equation 1}$$

EF_{iRR} = Weighted Emission Factor for pollutant i for Class I railroad RR (gm/gal).
EF_{iT} = Emission Factor for pollutant i for locomotives in Tier T (gm/gal) (Table 3). There were 4 Tiers of locomotives in the 2008 fleets.
f_{TRR} = Fraction of railroad RR fleet in Tier T.

While engine emissions are variable within Tier categories, this approach likely provides better regional estimates than uniformly applying the nationwide average emission factors. This approach likely provides conservative emission estimates as locomotive engines are certified to meet or exceed the emissions standard for each Tier, although emission levels may increase after certification.

Other emission factors are not engine specific. For locomotives, $PM_{2.5}$ is assumed to be 97% of PM_{10} [11], and emission factors applied for SO_2 and NH_3 are 1.88 g/gal [11] and 83.3 mg/gal [12] respectively. Greenhouse gases are estimated using emission factors shown in Table 4.

Table 4. EPA greenhouse gas emission factors for locomotive diesel fuel (grams/gal). [13]

	CO_2	N_2O	CH_4
Locomotive diesel	1.015E4	0.26	0.80

A Railroad Fuel Consumption Index (RFCI) was also calculated for each Class I railroad using their system-wide line-haul fuel consumption (FC) and gross ton-mile (GTM) data reported in their annual R-1 reports submitted to the Surface Transportation Board[7] (Eqn 2). This value represents the average number of GTM produced per gallon of diesel fuel used over their system in a year, and varies between railroad carriers depending on factors such as fleet mix, system

terrain, speeds, loading/weight of cargo, train type (e.g., intermodal, unit, and manifest), and operating practices. (Table 2).

$$RFCI_{RR} = \frac{GTM_{RR}}{FC_{RR}} \qquad \text{Equation 2}$$

$RFCI_{RR}$ = Railroad Fuel Consumption Index (gross ton-miles/gal) per Class I railroad (RR).
GTM_{RR} = Gross Ton-Miles (GTM), annual system-wide gross ton miles of freight transported per RR. (R-1 Report Schedule 755, Line 104)
FC_{RR} = Annual system-wide fuel consumption by line-haul and work trains per RR (gal) (R-1 Report Schedule 750, Lines 1 and 6).

2. Calculate Emissions per Link.

Emissions of pollutant i per link L (E_{iL}) are then calculated by multiplying the gallons of diesel fuel consumed by each Class I railroad on the link by that railroad's weighted Emission Factor for the pollutant, and summed over all railroads operating on the link (Eqn 3). This approach splits the activity on each link (represented by MGT) evenly between all railroads operating on the link. Note that the weighted Emission Factors are converted to tons/gal for these calculations, and that variables with units in tons may represent tons of freight hauled (MGT, RFCI) or tons of pollutants (EF, E).

$$E_{iL} = \sum_{RR=1}^{N} \frac{\left(\frac{MGT_L * 10^6}{N}\right) * l_L}{RFCI_{RR}} * EF_{iRR} \qquad \text{Equation 3}$$

E_{iL} = Emissions of pollutant i per link L (tons/year).
N = Number of Class I railroads operating on link L.
MGT_L = Millions of Gross Tons hauled per link per year from the FRA database (10^6 tons/yr)[9].
l_L = Link length from the FRA database (miles).
EF_{iRR} = Weighted Emission Factor for pollutant i per railroad RR (Eqn 1; tons/gal).
$RFCI_{RR}$ = Railroad Fuel Consumption Index per railroad RR (Eqn 2; gross ton-miles/gal).

Note that approximately 36% of Class I route miles in the United States are shared by more than one Class I carrier, a fraction that drops to 26% when neglecting track only shared between one Class I freight railroad and Amtrak. Accurately apportioning the specific fractions of tonnage (MGT) per carrier per link was considered, but after comparing likely worst-case areas, the difficultly of merging carrier-specific MGT with the aggregated FRA MGT dataset was considered too great considering the potential gain in accuracy. Where warranted, MGT data may be apportioned more accurately in the future.

Limitations, Conclusions, and Future Work

Rail-related emissions can be important components of emissions inventories used to support effective air quality management practices, at local, state, regional, and national levels. This line-haul inventory, as well as the companion Class I railyard inventory and Class II/III inventory, greatly improve our estimates of rail-related emissions. However, a systematic study of variability and uncertainty in line-haul locomotive emissions and activity, by fleets, locations, and through time, would give valuable information for identifying how to best improve this inventory as well provide an indication of how representative the inventory may be. An uncertainty study on the data used for this inventory, including the R-1 reported fuel use and the confidential link-level tonnage data, would also help in evaluating the quality of this inventory. Localized studies should also examine how shared tracks are apportioned between multiple carriers.

Early ERTAC Rail discussions concluded that link-level tonnage was the most important data to obtain, while other variables such as track grade and track speed could not be addressed at this time. ERTAC Rail calculated railroad-specific fleet-averaged emission factors rather than applying the estimated national average; however, it is recognized that emissions from individual engines are highly variable even within Tier categories depending on variables such as the specific locomotive model, operation cycle, and conditions of operation. Future evaluation of emission variability within Tiers and between certain types of operation and locations would also be valuable.

Emissions inventory preparation guidance from the U.S. EPA describes locomotive activity as relatively constant throughout the year (e.g. no daily, weekly, or seasonal variability); however, actual activity levels do vary seasonally and annual averaging may dilute or exaggerate concentrations during pollution episodes. ERTAC Rail and the Class I railroad community had some discussions addressing if incorporating more specific fleet mix or monthly or seasonal variation may be worthwhile, and these topics should be looked into further.

Finally, it is important to reiterate that the link-level MGT data maintained by the FRA is proprietary and can only be released to agencies/groups outside the FRA with the express permission of each Class I railroad. It is possible that one or more Class I railroads could withhold permission for access, but data for specialized studies may be provided if requested. This database can also be improved by better distinguishing between haulage and trackage rights, and by apportioning tonnage hauled on links to specific carriers.

We would like to thank the Class I Railroads and their representatives for their assistance and support in the development of this inventory.

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Appendix A: ERTAC Rail Data Workgroup

REPRESENTATIVE	ORGANIZATION
Matt Harrell	IL EPA
Michelle Bergin (Co-Chair) and Byeong Kim	GA EPD
Mark Janssen (Co-Chair)	LADCO
Julie McDill and Patrick Davis	MARAMA
Laurel Driver	US EPA OAQPS
Robert Fronczak	AAR
Steven Sullivan	ASLRRA
Rick Nath	CSX
David Seep and Lyle Staley	BNSF
Ken Roberge	CPR
Carl Akins and Peter Conlon	KCS
Erika Akkerman	CN
M. John Germer	UP
Brent Mason and Richard Russell	NS
Joanne Maxwell	Amtrak

Appendix B: Source and Year of Data Utilized for Each Inventory

Data	Year	Source
Class I Line-Haul		
Annual Line-Haul Fuel Use and Gross Ton-Miles	2007	STB R-1 Reports (CP data for D&H is for 2008.)
Line-haul fleet mix for emission factors	2008	Each Class I railroad
Link-level tonnage	2007	FRA confidential database
Class I Railyards (Switcher Locomotives)		
Annual Switcher Fuel Use	2008	R-1 Reports
Switcher fleet mix for emission factors	2008	Each Class I railroad
Link-level tonnage or Density Code (for activity estimate)	2007	FRA confidential database
Class II and III Locomotives		
Annual Total Fuel Use	2008	ASLRRA Annual Report (2008)
Track length and railroad	2008	ASLRRA Annual Report (2008)
Estimated fleet mix for emission factors		Discussions with ASLRRA and Class II and III representatives.

Appendix B

ERTAC Class II/III Line Haul Documentation

DRAFT

ERTAC – Class 2/3 Shapefile Documentation

13 Jul 2009

Introduction

This document outlines the methods and procedures used to compile a shapefile representing the links in the FRA 1:100,000 railroad dataset that are owned or operated by Class II and III railroad companies. It is important to note that there is a considerable amount of overlap between the Class II's and III's and the Class I and passenger railroads. Class II's and III's can operate on Class I or passenger rail links and vice versa. Although the final shapefile specifically represents Class II and III links, there are many Class I and passenger railroads represented as well.

Procedure

1. Started with all proprietary FRA links where "NET = 'M' and "STCNTYFIPS" <> ' ' (this definition query selects all active mainline links located within the United States).
2. Ran 12 queries, one for each ownership and trackage rights field, to select all links not associated with a Class I freight railroad or Amtrak and not containing a null value (e.g., "RROWNER1" <> 'AMTK' AND "RROWNER1" <> 'BNSF' AND "RROWNER1" <> 'CN' AND "RROWNER1" <> 'CPRS' AND "RROWNER1" <> 'CSXT' AND "RROWNER1" <> 'KCS' AND "RROWNER1" <> 'NS' AND "RROWNER1" <> 'UP' AND "RROWNER1" <> ' '). The first query was setup as a new selection. Each of the 11 subsequent queries were setup to add records to initial set of records. 26,261 links were selected and exported to a new shapefile.
3. Due to the multitude of railroad codes used to represent commuter rail operations across the country, additional processing was required to remove any links that were not operated by a Class II or III freight railroad. Each commuter railroad was queried out of the new shapefile and the links analyzed to eliminate all links where no Class II or III operations were occurring. The following commuter rail operations were evaluated: NJT (New Jersey Transit), MNCW (Metro-North Commuter Railroad), LI (Long Island Railroad), CDOT (Connecticut DOT), MBTA (Massachusetts Bay Transportation Authority), SEPA (Southeastern Pennsylvania Transportation Authority), MARC (Maryland Area Rail Commuter), VRE (Virginia Railway Express), MTRA (Northeastern Illinois Regional Commuter Railroad), CSS (Northern Indiana Commuter Transportation District), DART (Dallas Area Rapid Transit), SCRA (Southern California Regional Rail Authority – including also SCAX, LACM, LAPT, and LATC), TCRA (South Florida Regional Transportation Authority), PJPB (Caltrain), and ACE (Altamont Commuter Express).

Approximately 1581 links were identified with no Class II or III operations and were deleted from the Class 2/3 shapefile.

4. The remaining Class II and III links were then compared to the regional maps contained in the July-August issue of The Official Railway Guide to assess the completeness of the Class 2/3 shapefile. Six specific edits were made to the shapefile to correct the most glaring errors: 1) BMLP links deleted (Black Mesa & Lake Powell, an electric coal hauling railway in Arizona); 2) DSNG links deleted (Durango & Silverton steam tourist railroad in Colorado; 3) CIC haulage rights links on CN from Chicago to Omaha deleted; 4) DMIR links deleted (Duluth, Missabe & Iron Range, now owned and operated by CN in Minnesota; 5) EVWR's ex-CSXT links coded from Evansville, IN to Okawville, IL (Evansville Western Railroad); 6) INRD ex-CP links coded from Chicago, IL to Louisville, IN (Indiana Rail Road).
5. During the course of reviewing the FRA dataset, 555 "active" links were found to have no ownership or trackage rights codes. 1005 links have no codes listed in the 3 ownership fields. In most cases these links are very short and scattered across the country. Only the links representing the EVWR and INRD spanned large distances and were fixed. The other problem links were deemed to be insignificant. A listing of these links will be provided back to the FRA to assist with their coding in 1:100K railway shapefile.

Appendix C

ERTAC Rail Yard Documentation

DRAFT
ERTAC Rail Emissions Inventory
Part 2: Class I Railyard Switcher Locomotives

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Introduction

Air protection agencies from twenty-seven states, coordinated through the Eastern Regional Technical Advisory Committee (ERTAC) and headed by the Lake Michigan Air Directors Consortium (LADCO), identified a need to better quantify and characterize rail-related emissions inventories. Traditional locomotives largely utilize diesel engines, resulting in emissions of NO_x, diesel PM, hydrocarbons, greenhouse gases, and other pollutants. These emissions are sometimes concentrated in areas exceeding National Ambient Air Quality Standards. No cohesive nationwide railroad emission estimates are known to have been made previously. Inventory development methods for locomotive emissions estimates vary from state to state and, in general, lack the spatial or temporal resolution needed to support air quality modeling and planning [1-5].

The ERTAC Rail Subcommittee (ERTAC Rail) was established with active representatives from twelve member states, three regional planning offices, and the US EPA. The subcommittee's goals are to (1) standardize agencies' inventory development methods through a collaborative effort, (2) improve the quality of data received and the resulting emission inventories, and (3) reduce the administrative burden on railroad companies of providing data. With support from the Rail industry and assistance from the ERTAC Rail Data Workgroup (Appendix), ERTAC Rail has developed 3 inventories of locomotive emissions; from Class I line-haul, Shortline and Regional Railroads, and Class I railyard switchers, for the year 2008 (Table 1).

The Surface Transportation Board (STB) defines Class I Railroads as having had minimum carrier operating revenues of $401.4 million (USD) in 2008. There are 8 Class I Railroads operating in the United States (Table 2), about 12 Regional Railroads (Class II), and approximately 530 Class III Railroads (Shortlines). While categorized as a Class I Railroad, Amtrak was excluded from these inventories because of significant differences in equipment and operation characteristics. Line-haul locomotives travel long distances (e.g. between cities) while switcher locomotives largely operate in railyards, splitting and joining rail cars with varying destinations. Passenger and Commuter Rail (including Amtrak), industrial locomotives, and associated non-locomotive equipment are not included in these inventories.

Table 1. Summary of ERTAC Rail Inventories: U.S. Locomotive Emissions and Fuel Use for either 2007 or 2008*.

	Fuel Use** (gal/yr)	Emissions (tons/yr)					
		NO_x	$PM_{2.5}$	HC	SO_2	CO	NH_3
Class I*** line-haul	3,770,914,002	754,443	23,439	37,941	7,836	110,969	347
Class I switcher	300,492,223	73,741	2,024	4,824	619	9,152	27
Class II and III	157,800,000	51,367	1,163	1,897	357	5,058	16

*See Appendix B for a description of the year and source of data utilized for each inventory.
**Locomotive grade diesel
***Excluding Amtrak and including work train fuel use

Table 2. Class I Railroads and Reported Locomotive Fuel Use[7].

Class I Railroads*	R-1 Reported Locomotive Fuel Use (gal/yr)	
	Line-Haul (2007)**	Switcher (2008)
BNSF	1,393,874,954	52,497,057
Canadian National	93,830,751	12,290,022
Canadian Pacific***	50,320,233	4,594,067
CSX	514,687,186	53,717,674
Kansas City Southern	69,787,071	1,816,759
Norfolk Southern	463,267,278	32,317,375
Union Pacific	1,185,146,529	143,470,336
Total	**3,770,914,002**	**300,492,223**

* Excluding Amtrak
** Includes work trains
*** CP's line-haul fuel use values include 2008 data (rather than 2007) for their Delaware and Hudson subsidiary.

This paper documents the data sources and methodologies used for calculating the Class I switcher ("Railyard") inventory. Information on ERTAC Rail, Railroad participation, the Rail industry, and effects of rail on air quality are available elsewhere[6].

Method

Switcher locomotives are expected to be the single largest source of air emissions in railyards. Therefore, as a starting point for a comprehensive railyard inventory, a Class I switcher emission inventory was developed. It is assumed that estimates for yards of interest, associated equipment and activity, and smaller railroads could be refined later.

While ERTAC Rail represents states east of the Mississippi River, the railroad companies specified they wanted this effort to result in a consistent nationwide inventory. ERTAC Rail agreed to calculate emissions for all states when the data was available and when additional

significant effort was not required. Because both the dataset of railyards and switcher fuel use was nationwide in scope, the resulting initial railyard inventory is a nationwide, 'top-down' derivation. However, railroad companies may have different levels and quality of data available, and may have interpreted some data requests differently. Also, states are requested to update yards they have detailed information on when possible, and a few states (i.e. California) have unique railroad operations and equipment. Therefore, data for some areas will be more accurate than for others, and locally-derived inventories may be more accurate.

This documentation describes development of the initial top-down inventory, which consisted of three main activities:

1. Locate Class I Railyards
2. Select/Calculate Emission Factors
3. Estimate Locomotive Activity
4. Improve Estimates

1. Locate Class I Railyards.

Identification and correct placement of railyards was an important first step, requiring a comprehensive electronic dataset. A confidential database was obtained from the Federal Railroad Administration (FRA) with permission from the Class I Railroads (FRA database). A similar public database compiled by the Bureau of Transportation Statistics is also available[7] . Data from this source will not match the confidential data exactly, but will be very similar. The FRA database has rail links (track lengths) individually identified as parts of specific railyards. While there may be discrepancies in how each railroad defined railyard links, this dataset appears to identify most Class I railyards in the U.S., and shows a high density of yards in the eastern states (Figure 1). The database gives length, up to 3 owners and 3 operators, and a Federal Density Code (explained below) for each railyard link.

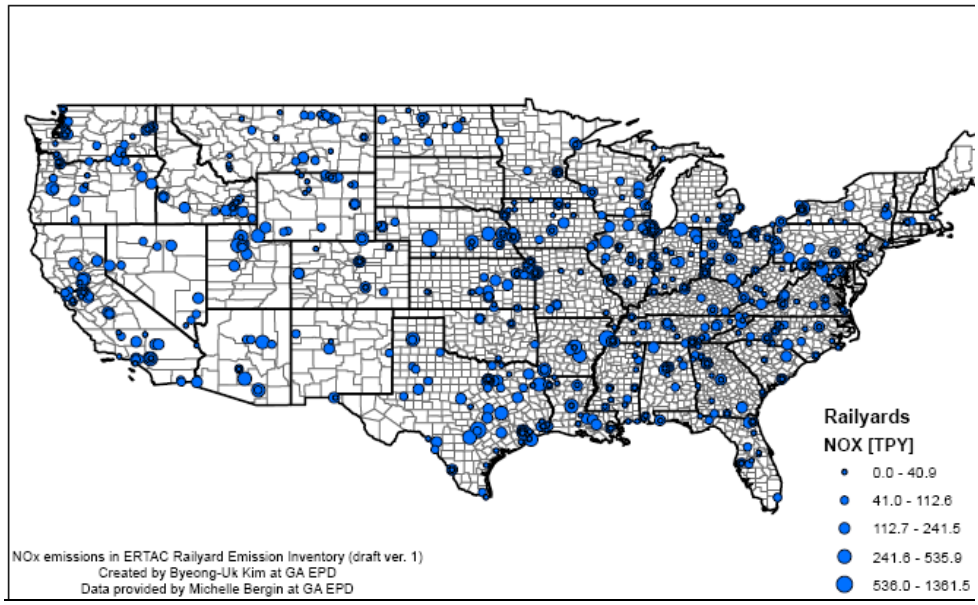

Figure 1. Class I Railyards in the United States and estimates of Annual NOx emissions from switcher locomotives (tons/yr in 2008).

2. Select/Calculate Emission Factors.

The EPA provides annual default emission factors based on characteristic operating cycles ('duty cycles') and the estimated nationwide fleet mix for both switcher and line-haul locomotives. However, switcher fleet mix is not uniform from company to company and, as can be seen in Figure 2, Class I railroad activity is highly regional.

As an alternative approach, ERTAC Rail requested each Class I rail company to provide a description of their switcher fleet mix based on Tier rating, which each company provided under a confidentiality agreement. An engine's Tier determines allowable emission limits based on the year the engine was built (Table 3). While engine emissions are variable within Tier categories, this estimate likely provides a better regional estimate than the nationwide average. The company-specific systemwide fleet mix was used to calculate weighted average emissions factors for switchers operated by each Class I railroad.

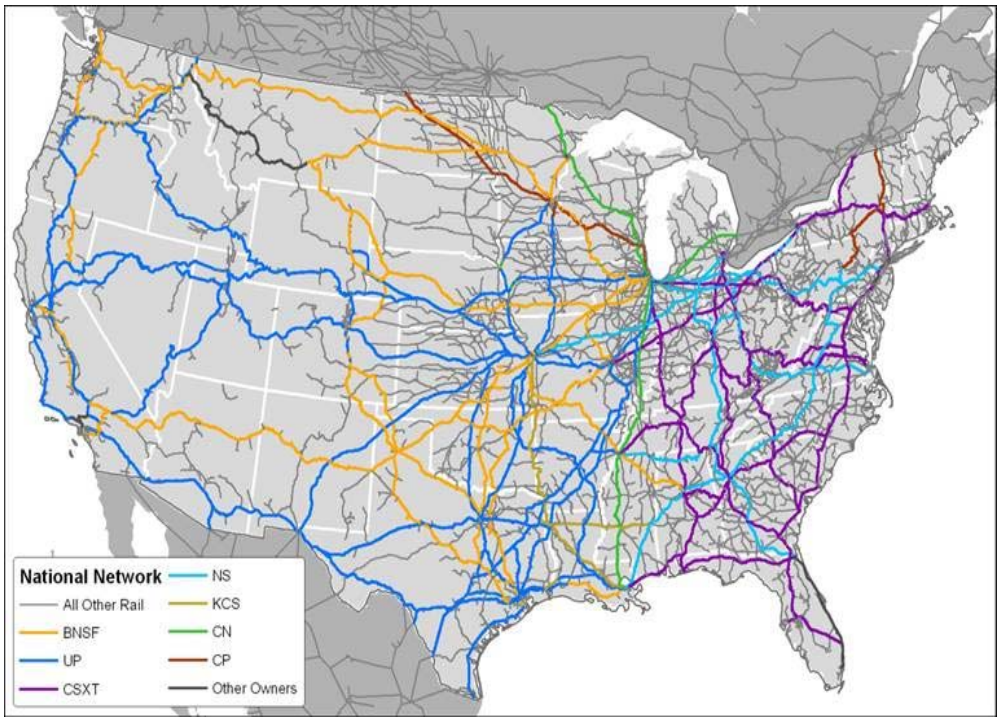

Figure 2. Class I Railroad Territories in the United States.

Table 3. EPA switcher locomotive emission factors by Tier, 1997 standards (grams/gal).

	PM_{10}	HC	NO_x	CO
Uncontrolled (pre-1973)	6.688	15.352	264.48	27.816
Tier 0 (1973-2001)	6.688	15.352	191.52	27.816
Tier 1 (2002-2004)	6.536	15.352	150.48	27.816
Tier 2 (2005 +)	2.888	7.752	110.96	27.816

Listed years apply to the year the engine was built. Table based on values from [8]. Note that the new standards released in 2008 did not apply to existing fleets in the year 2008.

For locomotives, $PM_{2.5}$ is assumed to be 97% of PM_{10} [8], and emission factors for SO_2 and NH_3 are 1.88 g/gal and 83.3 mg/gal respectively (add cites). Greenhouse gases are also estimated using emission factors shown in Table 4.

Table 4. EPA greenhouse gas emission factors for locomotive diesel fuel (grams/gal).

	CO_2	**N_2O**	**CH_4**
Locomotive diesel	1.015E4	0.26	0.80

Source: U.S. Environmental Protection Agency. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005, EPA 430-R-07-002, Annex 3.2, (April 2007), web site: http://www.epa.gov/climatechange/emissions/usinventoryreport.html

These emission factors are based on a characteristic duty cycle for switchers which assumes operation over 24-hour per day 365 days per year. An evaluation of the effect of variability in railyards and switching duties on emissions would be useful for future inventories.

3. Estimate Locomotive Activity.

Class I railroads report total annual switcher locomotive fuel use to the STB, which is reported in publicly available 'R-1' reports (Table 2). There may be inconsistencies between railroads in how fuel use is estimated to be apportioned between line-haul and switcher locomotive use, and possibly in the total locomotive fuel use, so these values may be adjusted in the future. However, the use of these values provides a starting point for estimating total U.S. Class I locomotive-related emissions segregated by Class I carrier. The R-1 report was used by ERTAC for both the line-haul and switcher locomotive emissions inventories.

The next step for inventory development is to allocate switcher fuel use to each railyard. Two methods were applied, one that relies on publicly available line-haul activity (the 'Dencode' method), and the other using confidential line-haul activity (the 'MGT' method.) At this time, Norfolk Southern and Kansas City Southern have provided input for use of the MGT method and the Dencode method is applied for the other five railroads.

The Dencode Method – Publicly available data

Each link in both the publicly available BTS database and the confidential FRA database has a 'Federal Density Code' (Dencode) ranging from 1 to 7 assigned based on the cumulative annual freight tonnage hauled on the link (track). Total Switcher Fuel Use in each railyard Y (SFU_Y) is estimated as follows:

First the Switcher Activity Indicator per yard (SAI_Y) is estimated by multiplying the average dencode of the links identified as part of the same railyard by the sum of the length of the links for that railyard (Eqn 1).

$$SAI_Y = \sum (l_{nY} * FDC_{nY}) \qquad \text{Equation 1}$$

SAI_Y = Switcher Activity Indicator in Railyard Y

n_Y = number of links identified as part of railyard Y
l_{nY} = length of link n in miles
FDC_n = Federal Density Code (1 to 7) of link n

Next, this value is then weighted (SAI_Y') based on an ownership factor (OF) set between 0 and 1. The OF depends on the number of owners listed for each railyard: if there is one owner the OF is set to 1, if there are two owners the primary owner is set to 0.8 and the secondary is 0.2, and if there are 3 owners the primary is 0.6, the secondary is 0.2, and the tertiary is 0.1.

$SAI_Y' = OF_Y * SAI_Y$ Equation 2

Next, the SAI_Y' of all railyards belonging to a Class I railroad (RR) were summed, and the fraction of the railroads total SAI associated with each railyard was multiplied by the railroads total annual switcher fuel use reported in the R-1 (TFU_{RR}), resulting in the total Switcher Fuel Use for each railyard Y (Eqn 2).

$$SFU_Y = \frac{SAI_Y'}{\sum_{RR} SAI_Y'} * TFU_{RR}$$ Equation 3

SFU_Y = Switcher Fuel Use at railyard Y

Finally, the SFU_Y is multiplied by the emission factors described in the previous section to obtain annual switcher emissions at each railyard.

The MGT Method – Confidential data

Two railroads, Norfolk Southern and Kansas City Southern, provided confidential link-level tonnage information and weighting factors to correct skewed estimates to improve estimated switcher activity at important yards. Other railroads may also allow the use of this technique for their inventories in the future.

The MGT Method also uses the FRA database for railyard identification and link lengths. However, rather than using the average dencode per link, confidential annual gross tonnage (MGT) hauled per link in the railyard was used to calculate the railyard switcher activity (SAI_Y). This is calculated by replacing FDC_n in Equation 2 with link-specific tonnage MGT_n (Equation 4).

$$SAI_Y = \sum (l_{nY} * MGT_{nY})$$ Equation 4

SAI_Y = Switcher Activity Indicator in Railyard Y
n_Y = number of links identified as part of railyard Y

l_{nY} = length of link n in miles
MGT_{nY} = million gross tons on link n

This method provides a more refined comparison between railyards than the use of the 7-category dencodes; however, is more susceptible to errors for yards where tonnage is not correlated to switching activity. For example, a yard with large coal trains pulling through used for crews to change over would be assigned an overly high level of emissions for switching activity. To account for this, a discretionary Switching Activity Factor (SAF) was introduced to allow railroads to roughly weight yards with clearly higher or lower levels of switching activity than what results from the mathematical allocation. Therefore, SAI_Y is weighted based on both the ownership factor (OF) as well as the SAF (Equation 5). For example, a yard used for crew changes and not switching may have an SAF of 0, while a yard at a major interchange between cities may have an SAF of 3.

$$SAI_Y' = OF_Y * SAF_Y * SAI_Y \qquad \text{Equation 5}$$

Again, the SAI_Y' of all railyards belonging to a Class I railroad (RR) are summed, and the fraction of the railroads total SAI associated with each railyard was multiplied by the railroads total annual switcher fuel use reported in the R-1 (TFU_{RR}), resulting in the total Switcher Fuel Use for each railyard Y (Eqn 6).

$$SFU_Y = \frac{SAI_Y'}{\sum_{RR} SAI_Y'} * TFU_{RR} \qquad \text{Equation 6}$$

While the SAF allows estimates of yard-specfic emissions to be adjusted, the total level of emissions for each railroad, which is based on systemwide fuel use and systemwide emission factors, remains unchanged. The MGT method SFU_Y is also later multiplied by the emission factors described in the previous section to obtain annual switcher emissions at each railyard.

4. Improve estimates.

In addition to the Switching Activity Factor described above, direct input was also used to improve emission estimates for important railyards. Each Class I railroad provided an estimate of annual average switcher fuel use (generally much lower than the EPA default of 82,490 gal/yr) as well as the name, location, and number of operating switchers for railyards with 8 or more switchers operating in ozone or PM2.5 nonattainment areas. This data was used to overwrite the dencode or MGT derived emissions estimates for those railyards.

The difference in estimated fuel use for those railyards was re-allocated (added or removed) between the remaining railyards belonging to that Class I railroad. It is important to note that there are some discrepancies in how this data was reported for the large railyards by each railroad. For example, some railroads reported all switchers located at a railyard while others reported ‘full time equivalent’ switchers, meaning the number of switchers normalized to a full working cycle (24-hours per day year-round.) This process should be standardized for future inventory versions.

States also have the option of updating specific railyard emissions estimates. Because this inventory is derived 'top-down', local studies and familiarity with specific railyards is expected to provide better estimates, which can be used to adjust this inventory. Care must be taken to ensure the other railyard estimates are adjusted to account for increases or decreases in estimated fuel use per yard.

Limitations, Conclusions, and Future Work

What this ERTAC Rail railyard inventory does well is provide a comprehensive overview of where railyards are, who owns them, and gives a geographical allocation of switcher emissions bounded by what is reported as nationwide switcher fuel usage by the Class I railroads. These sources can be important for air quality management in nonattainment areas, as well as in regional analysis and for future transportation planning. This inventory will be useful for regional and some local modeling, helps identify where railyards need to be better characterized, and provides a strong foundation for future development of a meaningful nationwide Class I switcher emissions inventory.

There are important uncertainties associated with estimates from this method, including, but not limited to, the use of tonnage hauled as an indicator of the amount of switching activity, and, for a few of the railroads, how the amount of switcher fuel use was determined to be reported in the R-1. The R-1 reported values are currently under examination.

There is also likely significant variability in actual switching duty-cycles and, potentially, in the number of switchers operating at some railyards at different times of the year. 'Road-switching', or the use of what are considered switching locomotives to move between nearby yards, should be addressed in either this or the ERTAC line-haul inventory.

It must be noted that freight-related rail activity is not always routine and no annual emissions inventory will ever be able to capture the innate variability of the source. However, as other large emission sources are reduced, and if rail activity increases as expected, it is important to include our best estimates of these sources in air quality analysis. In the future, on-line data loggers and other tracking technologies, combined with ambient studies and detailed modeling, will hopefully provide more insight to the emissions of locomotives and other railyard sources.

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Appendix: ERTAC Rail Data Workgroup

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Appendix E-3

Nonpoint Industrial and Commercial/Institutional (ICI) Fuel Combustion Category Documentation

AREA COMBUSTION SOURCE EMISSIONS INVENTORY IMPROVEMENT METHODOLOGY

TECHNICAL MEMORANDUM

Contract No. 07-0901-RPO-036

March 20, 2009

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CONTENTS

Page

A. INTRODUCTION 1
B. METHODOLOGY 1
1. Total ICI Energy Consumption 3
2. Non-Fuel Energy Consumption 3
3. Nonroad Source Energy Consumption 4
4. Point Source Energy Consumption 11
5. Emission Factors 23
6. Coal Sulfur Content 25
7. County Allocation Data 26
8. Temporal Allocation Data 32
C. CALCULATION TEMPLATES 34
D. REFERENCES 35
ATTACHMENT: PRELIMINARY SUMMARY OF 2002 POINT SOURCE ANNUAL THROUGHPUT DATA 37

TABLES

Table 1. ICI Combustion Area Source Classification Codes 2
Table 2. Industrial Sector Energy Consumption from Non-Fuel Uses 4
Table 3. Nonroad Sector Subtraction SCCs 5
Table 4. Industrial Fuel Combustion Crosswalk for Point Source Subtractions 12
Table 5. Commercial/Institutional Fuel Combustion Crosswalk for Point Source Subtractions 20
Table 6. Criteria Pollutant Emission Factors for ICI Combustion Area Source Categories 24
Table 7. Carbon Dioxide Emission Factors for Industrial and Commercial/Institutional Coal Combustion (lb/MMBtu) 25
Table 8. Additional Greenhouse Gas Emission Factors for ICI Combustion Area Source Categories (lb/MMBtu) 25
Table 9. Comparison of County Allocation Approaches for Missouri 30
Table 10. EPA Default Commercial Fuel Combustion Sector Allocation 33

A. INTRODUCTION

The objective of this project is to estimate area source emissions from Industrial and Commercial/Institutional (ICI) fuel combustion for the CENRAP region, which encompasses the States and tribal areas of Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Oklahoma, and Texas. This project will result in the development of a set of revised 2002 ICI area source emission inventories for sulfur dioxide (SO_2), nitrogen oxides (NO_x), non-methane volatile organic compounds (VOCs), particulate matter (specifically, PM_{10} and primary/direct $PM_{2.5}$), ammonia (NH_3), carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The emission inventories will be developed at the county level and will provide emissions for the following time periods: annual; monthly; and average weekly, weekday, and weekend day emissions for each month.

This technical memorandum is one of two components for documenting the methodology that E.H. Pechan & Associates, Inc. (Pechan) will follow in preparing CENRAP's 2002 ICI area source emissions inventory. The second component is a set of Microsoft® Excel workbook templates that Pechan will use to implement the methodology described in this document. This memorandum is organized into four sections: this section (Introduction), Section B (Methodology) , which describes the emission estimation methodology, Section C (Calculation Templates), which summarizes the content of the calculation templates, and Section D (References), which identifies the information sources that were consulted in preparing this document.

B. METHODOLOGY

This section documents the emission inventory development methodology that Pechan will use to prepare an ICI combustion area source emission inventory for the CENRAP States. Table 1 identifies the source classification codes (SCCs) for which Pechan plans to prepare ICI combustion area source emission estimates. It is important to note that some of these SCCs may not ultimately appear in each CENRAP State's inventory. If it is determined that all of an individual State's consumption of a particular fuel is already accounted for in the State's nonroad and/or point source inventory, then the SCC for that fuel will not be included in the area source inventory for that State.

The key data inputs in the emissions estimation methodology are:

1. Total Industrial and total Commercial/Institutional energy consumption by fuel type and CENRAP State for the year 2002;
2. Industrial energy consumption used for non-fuel purposes by fuel type and State in 2002;
3. ICI distillate fuel and liquefied petroleum gas (LPG) consumption for nonroad sources by State in year 2002;
4. ICI energy consumption by fuel type for point sources by CENRAP State in year 2002;
5. Emission factors relating emission rates to volume of energy consumed by fuel type for the ICI sectors;
6. Sulfur content of coal consumed in the ICI sectors by State in year 2002;

Table 1. ICI Combustion Area Source Classification Codes

SCC	DESCRIPTION
2102001000	Stationary Source Fuel Combustion; Industrial; Anthracite Coal; Total: All Boiler Types
2102002000	Stationary Source Fuel Combustion; Industrial; Bituminous/Subbituminous Coal; Total: All Boiler Types
2102004000	Stationary Source Fuel Combustion; Industrial; Distillate Oil; Total: Boilers and IC Engines
2102005000	Stationary Source Fuel Combustion; Industrial; Residual Oil; Total: All Boiler Types
2102006000	Stationary Source Fuel Combustion; Industrial; Natural Gas; Total: Boilers and IC Engines
2102007000	Stationary Source Fuel Combustion; Industrial; Liquid Petroleum Gas; Total: All Boiler Types
2102008000	Stationary Source Fuel Combustion; Industrial; Wood; Total: All Boiler Types
2102011000	Stationary Source Fuel Combustion; Industrial; Kerosene; Total: All Boiler Types
2103001000	Stationary Source Fuel Combustion; Commercial/Institutional; Anthracite Coal; Total: All Boiler Types
2103002000	Stationary Source Fuel Combustion; Commercial/Institutional; Bituminous/Subbituminous Coal; Total: All Boiler Types
2103004000	Stationary Source Fuel Combustion; Commercial/Institutional; Distillate Oil; Total: Boilers and IC Engines
2103005000	Stationary Source Fuel Combustion; Commercial/Institutional; Residual Oil; Total: All Boiler Types
2103006000	Stationary Source Fuel Combustion; Commercial/Institutional; Natural Gas; Total: Boilers and IC Engines
2103007000	Stationary Source Fuel Combustion; Commercial/Institutional; Liquid Petroleum Gas; Total: All Combustor Types
2103008000	Stationary Source Fuel Combustion; Commercial/Institutional; Wood; Total: All Boiler Types
2103011000	Stationary Source Fuel Combustion; Commercial/Institutional; Kerosene; Total: All Combustor Types

7. County-level employment in the ICI sectors by State for the year 2002; and
8. Temporal allocation data for estimating the proportion of annual fuel combusted by month, as well as data for estimating the volume of fuel combusted in each month for the following time-frames: average week, average week day; and average weekend day.

The following sections describe the methodology/data source(s) for developing each of these data inputs. The following identifies the planned source(s) of information for each of these data elements. In selecting the information sources for each of these data elements, Pechan evaluated the representativeness and level of confidence criteria identified in the Quality Assurance Project Plan (QAPP) for this project. For example, information sources that provide data specific to the source category/geography/inventory period were selected over those that are less specific.

1. Total ICI Energy Consumption

For total Industrial and total Commercial/Institutional energy consumption by fuel type/State, Pechan will use the same source that EPA uses in developing ICI combustion emission estimates for the National Emissions Inventory (NEI) – the Energy Information Administration (EIA)'s State Energy Data System (SEDS) (EIA, 2009a). The SEDS reports total energy consumption estimates by sector, State, fuel type, and year. To facilitate use with the criteria pollutant and GHG emission factors, Pechan will compile the SEDS energy consumption data in both sets of units provided by the SEDS: physical units and British thermal units (Btus).

2. Non-Fuel Energy Consumption

Some Industrial sector energy is consumed for non-fuel purposes. For example, natural gas is used as a feedstock in chemical manufacturing plants and to make nitrogenous fertilizer, and LPG is used to create intermediate products that are made into plastics. To estimate the volume of fuel that is associated with ICI combustion, it is necessary to subtract the volume of fuel consumption for non-energy uses from the volume of total fuel consumption. The EPA's State Inventory Tool (SIT) provides national defaults representing the percentage of total Industrial fuel consumption from non-energy uses.[1] These default values have an additional limitation beyond their lack of geographic detail - they represent the EIA's definition of the Industrial sector, which includes fuel use that is accounted for in other inventory source categories. In particular, the EIA Industrial sector includes fuel consumption from Farm, Mining, Construction, and Commercial sectors that is accounted for in the nonroad inventory. Because of these limitations, Pechan plans to use regional non-fuel use percentages computed from energy consumption data from the EIA's *2002 Manufacturing Energy Consumption Survey* (MECS) for all fuel types except coal (EIA, 2007). There are two reasons why MECS provides a more representative data set for use in this study: (1) MECS provides data specific to the regions of interest; and (2) MECS focuses solely on the Manufacturing sector. The latter characteristic is particularly important for fuel types which consume significant amounts of non-Manufacturing sector energy that is already included elsewhere (e.g., distillate fuel used by the Construction sector, which is included in the nonroad inventory). The MECS non-fuel consumption data treat

[1] Although the SIT also develops CO_2 emission estimates associated with non-fuel energy use, such estimates are not developed here because they are not associated with industrial fuel combustion.

coal that is used to produce coke as a feedstock. However, available data indicate that none of the CENRAP States produce coke (Pechan, 2006). In addition, the 2002 MECS data treat "synthetic coal" that is ultimately combusted as regular coal, as a non-fuel (feedstock) use. Because of these data limitations, Pechan contacted EIA for assistance in obtaining a reasonable estimate of the percentage of non-coking coal that is used for non-fuel purposes (treating "synthetic coal" as a fuel use). Based on the EIA's estimate that 5-10 percent of 2002 non-coke coal was used for non-fuel purposes, Pechan plans to assume that 7 percent of CENRAP Industrial sector coal consumption is for non-fuel purposes (Lorenz, 2009).

Table 2 presents the available non-fuel use percentages by type of energy. It was not possible to develop percentages by region for each fuel type because some regional MECS data are withheld. For this study, Pechan plans to use the most geographic-specific data reported in Table 2. States are encouraged to provide available State-specific estimates to replace the defaults below.

Table 2. Industrial Sector Energy Consumption from Non-Fuel Uses

Energy Type	2002 MECS % Energy Consumption from Non-Fuel Use			
	Midwest	South	Midwest+South	National
Residual	not available	not available	25%	17%
Distillate	not available	not available	9%	7%
Natural Gas	6%	15%	12%	10%
LPG/NGL	88%	98%	97%	97%
Coal	not available	not available	not available	7%

Sources: EIA, 2007 and Lorenz, 2009.
Midwest region includes Iowa, Kansas, Minnesota, Missouri, and Nebraska.
South region includes Arkansas, Louisiana, Oklahoma, and Texas.

3. Nonroad Source Energy Consumption

To avoid double-counting with the nonroad inventory, it is necessary to subtract 2002 year diesel and LPG consumption estimates for Industrial, Farm, Logging, Mining, and Construction sector nonroad equipment. For the Commercial sector SEDS data, it is necessary to subtract 2002 year diesel and LPG consumption for Commercial sector nonroad equipment. Pechan plans to run the NONROAD model for 2002 for the CENRAP States to obtain State-level diesel and LPG consumption estimates to perform these subtractions. Table 3 identifies the SCCs for which Pechan will compile NONROAD fuel consumption estimates.

Table 3. Nonroad Sector Subtraction SCCs

SCC	Description_2	Description_3	Description_4
Industrial Sector-Distillate			
2270000000	Off-highway Vehicle Diesel	Compression Ignition Equipment except Rail and Marine	Total
2270001000	Off-highway Vehicle Diesel	Recreational Equipment	Total
2270001010	Off-highway Vehicle Diesel	Recreational Equipment	Motorcycles: Off-road
2270001020	Off-highway Vehicle Diesel	Recreational Equipment	Snowmobiles
2270001030	Off-highway Vehicle Diesel	Recreational Equipment	All Terrain Vehicles
2270001040	Off-highway Vehicle Diesel	Recreational Equipment	Minibikes
2270001050	Off-highway Vehicle Diesel	Recreational Equipment	Golf Carts
2270001060	Off-highway Vehicle Diesel	Recreational Equipment	Specialty Vehicles/Carts
2270002000	Off-highway Vehicle Diesel	Construction and Mining Equipment	Total
2270002003	Off-highway Vehicle Diesel	Construction and Mining Equipment	Pavers
2270002006	Off-highway Vehicle Diesel	Construction and Mining Equipment	Tampers/Rammers
2270002009	Off-highway Vehicle Diesel	Construction and Mining Equipment	Plate Compactors
2270002012	Off-highway Vehicle Diesel	Construction and Mining Equipment	Concrete Pavers
2270002015	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rollers
2270002018	Off-highway Vehicle Diesel	Construction and Mining Equipment	Scrapers
2270002021	Off-highway Vehicle Diesel	Construction and Mining Equipment	Paving Equipment
2270002024	Off-highway Vehicle Diesel	Construction and Mining Equipment	Surfacing Equipment
2270002027	Off-highway Vehicle Diesel	Construction and Mining Equipment	Signal Boards/Light Plants
2270002030	Off-highway Vehicle Diesel	Construction and Mining Equipment	Trenchers
2270002033	Off-highway Vehicle Diesel	Construction and Mining Equipment	Bore/Drill Rigs
2270002036	Off-highway Vehicle Diesel	Construction and Mining Equipment	Excavators
2270002039	Off-highway Vehicle Diesel	Construction and Mining Equipment	Concrete/Industrial Saws
2270002042	Off-highway Vehicle Diesel	Construction and Mining Equipment	Cement and Mortar Mixers
2270002045	Off-highway Vehicle Diesel	Construction and Mining Equipment	Cranes
2270002048	Off-highway Vehicle Diesel	Construction and Mining Equipment	Graders

SCC	Description_2	Description_3	Description_4
2270002051	Off-highway Vehicle Diesel	Construction and Mining Equipment	Off-Highway Trucks
2270002054	Off-highway Vehicle Diesel	Construction and Mining Equipment	Crushing/Processing Equipment
2270002057	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rough Terrain Forklifts
2270002060	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rubber Tired Loaders
2270002063	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rubber Tire Tractor/Dozers
2270002066	Off-highway Vehicle Diesel	Construction and Mining Equipment	Tractors/Loaders/Backhoes
2270002069	Off-highway Vehicle Diesel	Construction and Mining Equipment	Crawler Tractor/Dozers
2270002072	Off-highway Vehicle Diesel	Construction and Mining Equipment	Skid Steer Loaders
2270002075	Off-highway Vehicle Diesel	Construction and Mining Equipment	Off-Highway Tractors
2270002078	Off-highway Vehicle Diesel	Construction and Mining Equipment	Dumpers/Tenders
2270002081	Off-highway Vehicle Diesel	Construction and Mining Equipment	Other Construction Equipment
2270003000	Off-highway Vehicle Diesel	Industrial Equipment	Total
2270003010	Off-highway Vehicle Diesel	Industrial Equipment	Aerial Lifts
2270003020	Off-highway Vehicle Diesel	Industrial Equipment	Forklifts
2270003030	Off-highway Vehicle Diesel	Industrial Equipment	Sweepers/Scrubbers
2270003040	Off-highway Vehicle Diesel	Industrial Equipment	Other General Industrial Equipment
2270003050	Off-highway Vehicle Diesel	Industrial Equipment	Other Material Handling Equipment
2270003060	Off-highway Vehicle Diesel	Industrial Equipment	AC/Refrigeration
2270003070	Off-highway Vehicle Diesel	Industrial Equipment	Terminal Tractors
2270005000	Off-highway Vehicle Diesel	Agricultural Equipment	Total
2270005010	Off-highway Vehicle Diesel	Agricultural Equipment	2-Wheel Tractors
2270005015	Off-highway Vehicle Diesel	Agricultural Equipment	Agricultural Tractors
2270005020	Off-highway Vehicle Diesel	Agricultural Equipment	Combines
2270005025	Off-highway Vehicle Diesel	Agricultural Equipment	Balers
2270005030	Off-highway Vehicle Diesel	Agricultural Equipment	Agricultural Mowers
2270005035	Off-highway Vehicle Diesel	Agricultural Equipment	Sprayers
2270005040	Off-highway Vehicle Diesel	Agricultural Equipment	Tillers > 6 HP
2270005045	Off-highway Vehicle Diesel	Agricultural Equipment	Swathers
2270005050	Off-highway Vehicle Diesel	Agricultural Equipment	Hydro-power Units

SCC	Description_2	Description_3	Description_4
2270005055	Off-highway Vehicle Diesel	Agricultural Equipment	Other Agricultural Equipment
2270005060	Off-highway Vehicle Diesel	Agricultural Equipment	Irrigation Sets
2270007000	Off-highway Vehicle Diesel	Logging Equipment	Total
2270007005	Off-highway Vehicle Diesel	Logging Equipment	Chain Saws > 6 HP
2270007010	Off-highway Vehicle Diesel	Logging Equipment	Shredders > 6HP
2270007015	Off-highway Vehicle Diesel	Logging Equipment	Forest Eqp – Fellers/Bunch/Skidder
2270007020	Off-highway Vehicle Diesel	Logging Equipment	Fellers/Bunchers ** (see 22-70-007-015)
2270009000	Off-highway Vehicle Diesel	Underground Mining Equipment	All
2270009010	Off-highway Vehicle Diesel	Underground Mining Equipment	Other Underground Mining Equipment
2270010000	Off-highway Vehicle Diesel	Industrial Equipment	All
2270010010	Off-highway Vehicle Diesel	Industrial Equipment	Other Oil Field Equipment
Industrial Sector-LPG			
2267002000	LPG	Construction and Mining Equipment	All
2267002003	LPG	Construction and Mining Equipment	Pavers
2267002006	LPG	Construction and Mining Equipment	Tampers/Rammers
2267002009	LPG	Construction and Mining Equipment	Plate Compactors
2267002015	LPG	Construction and Mining Equipment	Rollers
2267002018	LPG	Construction and Mining Equipment	Scrapers
2267002021	LPG	Construction and Mining Equipment	Paving Equipment
2267002024	LPG	Construction and Mining Equipment	Surfacing Equipment
2267002027	LPG	Construction and Mining Equipment	Signal Boards/Light Plants
2267002030	LPG	Construction and Mining Equipment	Trenchers
2267002033	LPG	Construction and Mining Equipment	Bore/Drill Rigs
2267002036	LPG	Construction and Mining Equipment	Excavators
2267002039	LPG	Construction and Mining Equipment	Concrete/Industrial Saws
2267002042	LPG	Construction and Mining Equipment	Cement and Mortar Mixers
2267002045	LPG	Construction and Mining Equipment	Cranes
2267002048	LPG	Construction and Mining Equipment	Graders
2267002051	LPG	Construction and Mining Equipment	Off-highway Trucks

SCC	Description_2	Description_3	Description_4
2267002054	LPG	Construction and Mining Equipment	Crushing/Processing Equipment
2267002057	LPG	Construction and Mining Equipment	Rough Terrain Forklifts
2267002060	LPG	Construction and Mining Equipment	Rubber Tire Loaders
2267002063	LPG	Construction and Mining Equipment	Rubber Tire Tractors/Dozers
2267002066	LPG	Construction and Mining Equipment	Tractors/Loaders/Backhoes
2267002069	LPG	Construction and Mining Equipment	Crawler Tractor/Dozers
2267002072	LPG	Construction and Mining Equipment	Skid Steer Loaders
2267002075	LPG	Construction and Mining Equipment	Off-Highway Tractors
2267002078	LPG	Construction and Mining Equipment	Dumpers/Tenders
2267002081	LPG	Construction and Mining Equipment	Other Construction Equipment
2267003000	LPG	Industrial Equipment	All
2267003010	LPG	Industrial Equipment	Aerial Lifts
2267003020	LPG	Industrial Equipment	Forklifts
2267003030	LPG	Industrial Equipment	Sweepers/Scrubbers
2267003040	LPG	Industrial Equipment	Other General Industrial Equipment
2267003050	LPG	Industrial Equipment	Other Material Handling Equipment
2267003060	LPG	Industrial Equipment	AC\Refrigeration
2267003070	LPG	Industrial Equipment	Terminal Tractors
2267005000	LPG	Agricultural Equipment	All
2267005010	LPG	Agricultural Equipment	2-Wheel Tractors
2267005015	LPG	Agricultural Equipment	Agricultural Tractors
2267005020	LPG	Agricultural Equipment	Combines
2267005025	LPG	Agricultural Equipment	Balers
2267005030	LPG	Agricultural Equipment	Agricultural Mowers
2267005035	LPG	Agricultural Equipment	Sprayers
2267005040	LPG	Agricultural Equipment	Tillers >6 HP
2267005045	LPG	Agricultural Equipment	Swathers
2267005050	LPG	Agricultural Equipment	Hydro-power Units
2267005055	LPG	Agricultural Equipment	Other Agricultural Equipment

SCC	Description_2	Description_3	Description_4
2267005060	LPG	Agricultural Equipment	Irrigation Sets
2267007000	LPG	Logging Equipment	All
2267007005	LPG	Logging Equipment	Chain Saws > 6 HP
2267007010	LPG	Logging Equipment	Shredders > 6 HP
2267007015	LPG	Logging Equipment	Forest Eqp – Feller/Bunch/Skidder
2267009000	LPG	Underground Mining Equipment	All
2267009010	LPG	Underground Mining Equipment	Other Underground Mining Equipment
2267010000	LPG	Industrial Equipment	All
2267010010	LPG	Industrial Equipment	Other Oil Field Equipment
Commercial Sector-Distillate			
2270004000	Off-highway Vehicle Diesel	Lawn and Garden Equipment	All
2270004011	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Lawn Mowers (Commercial)
2270004016	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Rotary Tillers < 6HP (Commercial)
2270004021	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Chain Saws < 6 HP (Commercial)
2270004026	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)
2270004031	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)
2270004036	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Snowblowers (Commercial)
2270004041	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Rear Engine Riding Mowers (Commercial)
2270004046	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Front Mowers (Commercial)
2270004051	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Shredders < 6 HP (Commercial)
2270004056	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)
2270004061	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Wood Splitters (Commercial)
2270004066	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)
2270004070	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Commercial Turf Equipment ** (use 22-70-004-71)
2270004071	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Turf Equipment (Commercial)
2270004076	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)
2270006000	Off-highway Vehicle Diesel	Commercial Equipment	Total
2270006005	Off-highway Vehicle Diesel	Commercial Equipment	Generator Sets
2270006010	Off-highway Vehicle Diesel	Commercial Equipment	Pumps

SCC	Description_2	Description_3	Description_4
2270006015	Off-highway Vehicle Diesel	Commercial Equipment	Air Compressors
2270006020	Off-highway Vehicle Diesel	Commercial Equipment	Gas Compressors
2270006025	Off-highway Vehicle Diesel	Commercial Equipment	Welders
2270006030	Off-highway Vehicle Diesel	Commercial Equipment	Pressure Washers
2270008000	Off-highway Vehicle Diesel	Airport Ground Support Equipment	Total
2270008005	Off-highway Vehicle Diesel	Airport Ground Support Equipment	Airport Ground Support Equipment
2270008010	Off-highway Vehicle Diesel	Airport Ground Support Equipment	Terminal Tractors
Commercial Sector-LPG			
22670004011	LPG	Lawn and Garden Equipment	Lawn Mowers (Commercial)
22670004016	LPG	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Commercial)
22670004021	LPG	Lawn and Garden Equipment	Chain Saws < 6 HP (Commercial)
22670004026	LPG	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)
22670004031	LPG	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)
22670004036	LPG	Lawn and Garden Equipment	Snowblowers (Commercial)
22670004041	LPG	Lawn and Garden Equipment	Rear Engine Riding Mowers (Commercial)
22670004046	LPG	Lawn and Garden Equipment	Front Mowers (Commercial)
22670004051	LPG	Lawn and Garden Equipment	Shredders < 6 HP (Commercial)
22670004056	LPG	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)
22670004061	LPG	Lawn and Garden Equipment	Wood Splitters (Commercial)
22670004066	LPG	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)
22670004071	LPG	Lawn and Garden Equipment	Turf Equipment (Commercial)
22670004076	LPG	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)
22670006000	LPG	Commercial Equipment	All
22670006005	LPG	Commercial Equipment	Generator Sets
22670006010	LPG	Commercial Equipment	Pumps
22670006015	LPG	Commercial Equipment	Air Compressors
22670006020	LPG	Commercial Equipment	Gas Compressors
22670006025	LPG	Commercial Equipment	Welders
22670006030	LPG	Commercial Equipment	Pressure Washers

4. Point Source Energy Consumption

To ensure that energy consumption is not double-counted in the point source inventory, it will also be necessary to subtract point source inventory fuel use from the fuel consumption estimates developed from the aforementioned data sources. To assist in the point source subtractions, Pechan has developed two crosswalks: one between each Industrial fuel combustion area SCC and associated point SCCs (Table 4), and an analogous crosswalk for Commercial/Institutional fuel combustion (Table 5). Pechan requests CENRAP comments on the point SCCs included in these crosswalks.

In addition, a summary analysis was performed on the throughput data reported in the 2002 point source inventory compiled for CENRAP (Pechan/CEP, 2005). The Attachment to this memorandum provides a summary of the 2002 annual point source throughput data associated with the ICI area source categories (reflecting use of the Table 4 and 5 crosswalks). As indicated by this summary, there appear to be numerous potential reporting errors in the CENRAP point source inventory throughput information. These errors include throughput reported using inappropriate units (e.g., reporting natural gas throughput in tons and distillate fuel throughput in million cubic feet), and throughput reported using an inappropriate material code (e.g., reporting a distillate fuel combustion category's throughput as water). There are also records with emissions that report throughput as zero and throughput data reported without any unit identifiers. Pechan requests guidance from CENRAP States as to revisions to the throughput information to ensure the validity of the data that are used in the point source subtractions. For States/source categories with suspect values for which revisions are not available, Pechan will estimate throughput by dividing point source emissions by the carbon monoxide (CO) emission factors listed in the next section. The CO-based approach will also be used for all States that do not report any throughput data for ICI point source fuel combustion categories (i.e., Louisiana and Texas).

To ensure that the methodology results in accurate estimates of point source throughput, Pechan will supply States with the SEDS energy consumption estimates by fuel type and the point source energy consumption by fuel type computed using the throughput or CO emissions-based approach. Pechan will wait for State approval of these estimates before final use in the point source subtraction procedure.

Table 4. Industrial Fuel Combustion Crosswalk for Point Source Subtractions

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC	SCC8 DESC
2102001000 & 2102002000 – Industrial; Anthracite Coal; Total: All Boiler Types and Bituminous/Subbituminous Coal; Total: All Boiler Types				
10200101	External Combustion Boilers	Industrial	Anthracite Coal	Pulverized Coal
10200104	External Combustion Boilers	Industrial	Anthracite Coal	Traveling Grate (Overfeed) Stoker
10200107	External Combustion Boilers	Industrial	Anthracite Coal	Hand-fired
10200117	External Combustion Boilers	Industrial	Anthracite Coal	Fluidized Bed Boiler Burning Anthracite-Culm Fuel
39000189	Industrial Processes	In-process Fuel Use	Anthracite Coal	General
39000199	Industrial Processes	In-process Fuel Use	Anthracite Coal	General
10200201	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Pulverized Coal: Wet Bottom
10200202	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Pulverized Coal: Dry Bottom
10200203	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Cyclone Furnace
10200204	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Spreader Stoker
10200205	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Overfeed Stoker
10200206	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Underfeed Stoker
10200210	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Overfeed Stoker **
10200212	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Pulverized Coal: Dry Bottom (Tangential)
10200213	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Wet Slurry
10200217	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Atmospheric Fluidized Bed Combustion: Bubbling Bed (Bituminous Coal)
10200218	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Atmospheric Fluidized Bed Combustion: Circulating Bed (Bitum. Coal)
10200219	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Cogeneration (Bituminous Coal)
10200221	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Pulverized Coal: Wet Bottom (Subbituminous Coal)
10200222	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Pulverized Coal: Dry Bottom (Subbituminous Coal)
10200223	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Cyclone Furnace (Subbituminous Coal)
10200224	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Spreader Stoker (Subbituminous Coal)
10200225	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Traveling Grate (Overfeed) Stoker (Subbituminous Coal)
10200226	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Pulverized Coal: Dry Bottom Tangential (Subbituminous Coal)
10200229	External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal	Cogeneration (Subbituminous Coal)
10500102	External Combustion Boilers	Space Heaters	Industrial	Coal **
39000201	Industrial Processes	In-process Fuel Use	Bituminous Coal	Cement Kiln/Dryer (Bituminous Coal)
39000203	Industrial Processes	In-process Fuel Use	Bituminous Coal	Lime Kiln (Bituminous)
39000288	Industrial Processes	In-process Fuel Use	Bituminous Coal	General (Subbituminous)
39000289	Industrial Processes	In-process Fuel Use	Bituminous Coal	General (Bituminous)
39000299	Industrial Processes	In-process Fuel Use	Bituminous Coal	General (Bituminous)
50390002	Waste Disposal	Solid Waste Disposal - Industrial	Auxiliary Fuel/No Emissions	Coal

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC	SCC8 DESC
2102004000 – Industrial; Distillate Oil; Total: Boilers and IC Engines				
10200501	External Combustion Boilers	Industrial	Distillate Oil	Grades 1 and 2 Oil
10200502	External Combustion Boilers	Industrial	Distillate Oil	10-100 Million Btu/hr **
10200503	External Combustion Boilers	Industrial	Distillate Oil	< 10 Million Btu/hr **
10200504	External Combustion Boilers	Industrial	Distillate Oil	Grade 4 Oil
10200505	External Combustion Boilers	Industrial	Distillate Oil	Cogeneration
10201403	External Combustion Boilers	Industrial	CO Boiler	Distillate Oil
10500105	External Combustion Boilers	Space Heaters	Industrial	Distillate Oil
20200101	Internal Combustion Engines	Industrial	Distillate Oil (Diesel)	Turbine
20200102	Internal Combustion Engines	Industrial	Distillate Oil (Diesel)	Reciprocating
20200103	Internal Combustion Engines	Industrial	Distillate Oil (Diesel)	Turbine: Cogeneration
20200104	Internal Combustion Engines	Industrial	Distillate Oil (Diesel)	Reciprocating: Cogeneration
20200105	Internal Combustion Engines	Industrial	Distillate Oil (Diesel)	Reciprocating: Crankcase Blowby
20200106	Internal Combustion Engines	Industrial	Distillate Oil (Diesel)	Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
20200107	Internal Combustion Engines	Industrial	Distillate Oil (Diesel)	Reciprocating: Exhaust
20200108	Internal Combustion Engines	Industrial	Distillate Oil (Diesel)	Turbine: Evaporative Losses (Fuel Storage and Delivery System)
20200109	Internal Combustion Engines	Industrial	Distillate Oil (Diesel)	Turbine: Exhaust
20200401	Internal Combustion Engines	Industrial	Large Bore Engine	Diesel
20200405	Internal Combustion Engines	Industrial	Large Bore Engine	Crankcase Blowby
20200406	Internal Combustion Engines	Industrial	Large Bore Engine	Evaporative Losses (Fuel Storage and Delivery System)
20200407	Internal Combustion Engines	Industrial	Large Bore Engine	Exhaust
27000320	Internal Combustion Engines	Off-highway Diesel Engines	Industrial Equipment	Industrial Fork Lift: Diesel
30190001	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment	Distillate Oil (No. 2): Process Heaters
30190011	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment	Distillate Oil (No. 2): Incinerators
30190021	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment	Distillate Oil (No. 2): Flares
30290001	Industrial Processes	Food and Agriculture	Fuel Fired Equipment	Distillate Oil (No. 2): Process Heaters
30390001	Industrial Processes	Primary Metal Production	Fuel Fired Equipment	Distillate Oil (No. 2): Process Heaters
30390011	Industrial Processes	Primary Metal Production	Fuel Fired Equipment	Distillate Oil (No. 2): Incinerators
30390021	Industrial Processes	Primary Metal Production	Fuel Fired Equipment	Distillate Oil (No. 2): Flares
30400406	Industrial Processes	Secondary Metal Production	Lead	Pot Furnace Heater: Distillate Oil
30490001	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Distillate Oil (No. 2): Process Heaters
30490011	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Distillate Oil (No. 2): Incinerators
30490021	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Distillate Oil (No. 2): Flares
30490031	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Distillate Oil (No. 2): Furnaces
30500208	Industrial Processes	Mineral Products	Asphalt Concrete	Asphalt Heater: Distillate Oil
30505022	Industrial Processes	Mineral Products	Asphalt Processing (Blowing)	Asphalt Heater: Distillate Oil
30590001	Industrial Processes	Mineral Products	Fuel Fired Equipment	Distillate Oil (No. 2): Process Heaters
30590011	Industrial Processes	Mineral Products	Fuel Fired Equipment	Distillate Oil (No. 2): Incinerators
30590021	Industrial Processes	Mineral Products	Fuel Fired Equipment	Distillate Oil (No. 2): Flares

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC	SCC8 DESC
30600901	Industrial Processes	Petroleum Industry	Flares	Distillate Oil
30609901	Industrial Processes	Petroleum Industry	Incinerators	Distillate Oil (No. 2)
30790001	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment	Distillate Oil (No. 2): Process Heaters
30790011	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment	Distillate Oil (No. 2): Incinerators
30790021	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment	Distillate Oil (No. 2): Flares
30890001	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment	Distillate Oil (No. 2): Process Heaters
30890011	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment	Distillate Oil (No. 2): Incinerators
30890021	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment	Distillate Oil (No. 2): Flares
30990001	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment	Distillate Oil (No. 2): Process Heaters
30990011	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment	Distillate Oil (No. 2): Incinerators
31000401	Industrial Processes	Oil and Gas Production	Process Heaters	Distillate Oil (No. 2)
31000411	Industrial Processes	Oil and Gas Production	Process Heaters	Distillate Oil (No. 2): Steam Generators
31390001	Industrial Processes	Electrical Equipment	Process Heaters	Distillate Oil (No. 2)
39000501	Industrial Processes	In-process Fuel Use	Distillate Oil	Asphalt Dryer **
39000502	Industrial Processes	In-process Fuel Use	Distillate Oil	Cement Kiln/Dryer
39000503	Industrial Processes	In-process Fuel Use	Distillate Oil	Lime Kiln
39000589	Industrial Processes	In-process Fuel Use	Distillate Oil	General
39000598	Industrial Processes	In-process Fuel Use	Distillate Oil	Grade 4 Oil: General
39000599	Industrial Processes	In-process Fuel Use	Distillate Oil	General
39900501	Industrial Processes	Miscellaneous Manufacturing Industries	Process Heater/Furnace	Distillate Oil
39990001	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries	Distillate Oil (No. 2): Process Heaters
39990011	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries	Distillate Oil (No. 2): Incinerators
39990021	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries	Distillate Oil (No. 2 Oil): Flares
40201002	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven Heater	Distillate Oil
40290011	Petroleum and Solvent Evaporation	Surface Coating Operations	Fuel Fired Equipment	Distillate Oil: Incinerator/Afterburner
49090011	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment	Distillate Oil (No. 2): Incinerators
49090021	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment	Distillate Oil (No. 2): Flares
50390005	Waste Disposal	Solid Waste Disposal - Industrial	Auxiliary Fuel/No Emissions	Distillate Oil
2102005000 – Industrial; Residual Oil; Total: All Boiler Types				
10200401	External Combustion Boilers	Industrial	Residual Oil	Grade 6 Oil

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC	SCC8 DESC
10200402	External Combustion Boilers	Industrial	Residual Oil	10-100 Million Btu/hr **
10200403	External Combustion Boilers	Industrial	Residual Oil	< 10 Million Btu/hr **
10200404	External Combustion Boilers	Industrial	Residual Oil	Grade 5 Oil
10200405	External Combustion Boilers	Industrial	Residual Oil	Cogeneration
10201404	External Combustion Boilers	Industrial	CO Boiler	Residual Oil
20200501	Internal Combustion Engines	Industrial	Residual/Crude Oil	Reciprocating
20200505	Internal Combustion Engines	Industrial	Residual/Crude Oil	Reciprocating: Crankcase Blowby
20200506	Internal Combustion Engines	Industrial	Residual/Crude Oil	Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
20200507	Internal Combustion Engines	Industrial	Residual/Crude Oil	Reciprocating: Exhaust
30190002	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment	Residual Oil: Process Heaters
30190012	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment	Residual Oil: Incinerators
30190022	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment	Residual Oil: Flares
30290002	Industrial Processes	Food and Agriculture	Fuel Fired Equipment	Residual Oil: Process Heaters
30390002	Industrial Processes	Primary Metal Production	Fuel Fired Equipment	Residual Oil: Process Heaters
30390012	Industrial Processes	Primary Metal Production	Fuel Fired Equipment	Residual Oil: Incinerators
30390022	Industrial Processes	Primary Metal Production	Fuel Fired Equipment	Residual Oil: Flares
30490002	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Residual Oil: Process Heaters
30490012	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Residual Oil: Incinerators
30490022	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Residual Oil: Flares
30490032	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Residual Oil: Furnaces
30500207	Industrial Processes	Mineral Products	Asphalt Concrete	Asphalt Heater: Residual Oil
30505021	Industrial Processes	Mineral Products	Asphalt Processing (Blowing)	Asphalt Heater: Residual Oil
30590002	Industrial Processes	Mineral Products	Fuel Fired Equipment	Residual Oil: Process Heaters
30590012	Industrial Processes	Mineral Products	Fuel Fired Equipment	Residual Oil: Incinerators
30600111	Industrial Processes	Petroleum Industry	Process Heaters	Oil-fired (No. 6 Oil) > 100 Million Btu Capacity
30600902	Industrial Processes	Petroleum Industry	Flares	Residual Oil
30609902	Industrial Processes	Petroleum Industry	Incinerators	Residual Oil
30790002	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment	Residual Oil: Process Heaters
30790012	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment	Residual Oil: Incinerators
30790022	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment	Residual Oil: Flares
30890002	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment	Residual Oil: Process Heaters
30890012	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment	Residual Oil: Incinerators
30890022	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment	Residual Oil: Flares
30990002	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment	Residual Oil: Process Heaters
30990012	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment	Residual Oil: Incinerators
31000402	Industrial Processes	Oil and Gas Production	Process Heaters	Residual Oil

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC	SCC8 DESC
31000412	Industrial Processes	Oil and Gas Production	Process Heaters	Residual Oil: Steam Generators
31390002	Industrial Processes	Electrical Equipment	Process Heaters	Residual Oil
39000402	Industrial Processes	In-process Fuel Use	Residual Oil	Cement Kiln/Dryer
39000403	Industrial Processes	In-process Fuel Use	Residual Oil	Lime Kiln
39000489	Industrial Processes	In-process Fuel Use	Residual Oil	General
39000499	Industrial Processes	In-process Fuel Use	Residual Oil	General
39990002	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries	Residual Oil: Process Heaters
39990012	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries	Residual Oil: Incinerators
39990022	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries	Residual Oil: Flares
40201003	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven Heater	Residual Oil
40290012	Petroleum and Solvent Evaporation	Surface Coating Operations	Fuel Fired Equipment	Residual Oil: Incinerator/Afterburner
49090012	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment	Residual Oil: Incinerators
49090022	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment	Residual Oil: Flares
2102006000 – Industrial; Natural Gas; Total: Boilers and IC Engines				
10200601	External Combustion Boilers	Industrial	Natural Gas	> 100 Million Btu/hr
10200602	External Combustion Boilers	Industrial	Natural Gas	10-100 Million Btu/hr
10200603	External Combustion Boilers	Industrial	Natural Gas	< 10 Million Btu/hr
10200604	External Combustion Boilers	Industrial	Natural Gas	Cogeneration
10201401	External Combustion Boilers	Industrial	CO Boiler	Natural Gas
10500106	External Combustion Boilers	Space Heaters	Industrial	Natural Gas
20200201	Internal Combustion Engines	Industrial	Natural Gas	Turbine
20200202	Internal Combustion Engines	Industrial	Natural Gas	Reciprocating
20200203	Internal Combustion Engines	Industrial	Natural Gas	Turbine: Cogeneration
20200204	Internal Combustion Engines	Industrial	Natural Gas	Reciprocating: Cogeneration
20200205	Internal Combustion Engines	Industrial	Natural Gas	Reciprocating: Crankcase Blowby
20200206	Internal Combustion Engines	Industrial	Natural Gas	Reciprocating: Evaporative Losses (Fuel Delivery System)
20200207	Internal Combustion Engines	Industrial	Natural Gas	Reciprocating: Exhaust
20200208	Internal Combustion Engines	Industrial	Natural Gas	Turbine: Evaporative Losses (Fuel Delivery System)
20200209	Internal Combustion Engines	Industrial	Natural Gas	Turbine: Exhaust
20200252	Internal Combustion Engines	Industrial	Natural Gas	2-cycle Lean Burn
20200253	Internal Combustion Engines	Industrial	Natural Gas	4-cycle Rich Burn
20200254	Internal Combustion Engines	Industrial	Natural Gas	4-cycle Lean Burn
20200255	Internal Combustion Engines	Industrial	Natural Gas	2-cycle Clean Burn
20200256	Internal Combustion Engines	Industrial	Natural Gas	4-cycle Clean Burn
30190003	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment	Natural Gas: Process Heaters

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC	SCC8 DESC
30190013	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment	Natural Gas: Incinerators
30190023	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment	Natural Gas: Flares
30290003	Industrial Processes	Food and Agriculture	Fuel Fired Equipment	Natural Gas: Process Heaters
30291001	Industrial Processes	Food and Agriculture	Fuel Fired Equipment	Broiling Food: Natural Gas
30390003	Industrial Processes	Primary Metal Production	Fuel Fired Equipment	Natural Gas: Process Heaters
30390013	Industrial Processes	Primary Metal Production	Fuel Fired Equipment	Natural Gas: Incinerators
30390023	Industrial Processes	Primary Metal Production	Fuel Fired Equipment	Natural Gas: Flares
30400407	Industrial Processes	Secondary Metal Production	Lead	Pot Furnace Heater: Natural Gas
30490003	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Natural Gas: Process Heaters
30490013	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Natural Gas: Incinerators
30490023	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Natural Gas: Flares
30490033	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Natural Gas: Furnaces
30500206	Industrial Processes	Mineral Products	Asphalt Concrete	Asphalt Heater: Natural Gas
30505020	Industrial Processes	Mineral Products	Asphalt Processing (Blowing)	Asphalt Heater: Natural Gas
30590003	Industrial Processes	Mineral Products	Fuel Fired Equipment	Natural Gas: Process Heaters
30590013	Industrial Processes	Mineral Products	Fuel Fired Equipment	Natural Gas: Incinerators
30590023	Industrial Processes	Mineral Products	Fuel Fired Equipment	Natural Gas: Flares
30790003	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment	Natural Gas: Process Heaters
30790013	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment	Natural Gas: Incinerators
30790023	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment	Natural Gas: Flares
30890003	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment	Natural Gas: Process Heaters
30890013	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment	Natural Gas: Incinerators
30890023	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment	Natural Gas: Flares
30990003	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment	Natural Gas: Process Heaters
30990013	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment	Natural Gas: Incinerators
30990023	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment	Natural Gas: Flares
31000404	Industrial Processes	Oil and Gas Production	Process Heaters	Natural Gas
31000414	Industrial Processes	Oil and Gas Production	Process Heaters	Natural Gas: Steam Generators
31390003	Industrial Processes	Electrical Equipment	Process Heaters	Natural Gas
39000602	Industrial Processes	In-process Fuel Use	Natural Gas	Cement Kiln/Dryer
39000603	Industrial Processes	In-process Fuel Use	Natural Gas	Lime Kiln
39000605	Industrial Processes	In-process Fuel Use	Natural Gas	Metal Melting **
39000689	Industrial Processes	In-process Fuel Use	Natural Gas	General
39000699	Industrial Processes	In-process Fuel Use	Natural Gas	General
39900601	Industrial Processes	Miscellaneous Manufacturing Industries	Process Heater/Furnace	Natural Gas
39990003	Industrial Processes	Miscellaneous Manufacturing	Miscellaneous Manufacturing	Natural Gas: Process Heaters

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC	SCC8 DESC
		Industries	Industries	
39990013	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries	Natural Gas: Incinerators
39990023	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries	Natural Gas: Flares
40201001	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven Heater	Natural Gas
40290013	Petroleum and Solvent Evaporation	Surface Coating Operations	Fuel Fired Equipment	Natural Gas: Incinerator/Afterburner
40290023	Petroleum and Solvent Evaporation	Surface Coating Operations	Fuel Fired Equipment	Natural Gas: Flares
49090013	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment	Natural Gas: Incinerators
49090023	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment	Natural Gas: Flares
50390006	Waste Disposal	Solid Waste Disposal - Industrial	Auxiliary Fuel/No Emissions	Natural Gas
2102007000 – Industrial; Liquified Petroleum Gas (LPG); Total: All Boiler Types				
10201001	External Combustion Boilers	Industrial	Liquified Petroleum Gas (LPG)	Butane
10201002	External Combustion Boilers	Industrial	Liquified Petroleum Gas (LPG)	Propane
10201003	External Combustion Boilers	Industrial	Liquified Petroleum Gas (LPG)	Butane/Propane Mixture: Specify Percent Butane in Comments
10500110	External Combustion Boilers	Space Heaters	Industrial	Liquified Petroleum Gas (LPG)
20201001	Internal Combustion Engines	Industrial	Liquified Petroleum Gas (LPG)	Propane: Reciprocating
20201002	Internal Combustion Engines	Industrial	Liquified Petroleum Gas (LPG)	Butane: Reciprocating
20201005	Internal Combustion Engines	Industrial	Liquified Petroleum Gas (LPG)	Reciprocating: Crankcase Blowby
20201006	Internal Combustion Engines	Industrial	Liquified Petroleum Gas (LPG)	Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
20201007	Internal Combustion Engines	Industrial	Liquified Petroleum Gas (LPG)	Reciprocating: Exhaust
20201008	Internal Combustion Engines	Industrial	Liquified Petroleum Gas (LPG)	Turbine: Evaporative Losses (Fuel Storage and Delivery System)
20201009	Internal Combustion Engines	Industrial	Liquified Petroleum Gas (LPG)	Turbine: Exhaust
20201011	Internal Combustion Engines	Industrial	Liquified Petroleum Gas (LPG)	Turbine
20201012	Internal Combustion Engines	Industrial	Liquified Petroleum Gas (LPG)	Reciprocating Engine
20201013	Internal Combustion Engines	Industrial	Liquified Petroleum Gas (LPG)	Turbine: Cogeneration
20201014	Internal Combustion Engines	Industrial	Liquified Petroleum Gas (LPG)	Reciprocating Engine: Cogeneration
27300320	Internal Combustion Engines	Off-highway LPG-fueled Engines	Industrial Equipment	Industrial Fork Lift: Liquified Petroleum Gas (LPG)
30290005	Industrial Processes	Food and Agriculture	Fuel Fired Equipment	Liquified Petroleum Gas (LPG): Process Heaters
30490035	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment	Propane: Furnaces
30500209	Industrial Processes	Mineral Products	Asphalt Concrete	Asphalt Heater: LPG
30505023	Industrial Processes	Mineral Products	Asphalt Processing (Blowing)	Asphalt Heater: LP Gas
30590005	Industrial Processes	Mineral Products	Fuel Fired Equipment	Liquified Petroleum Gas (LPG): Process Heaters
30600107	Industrial Processes	Petroleum Industry	Process Heaters	LPG-fired
30600905	Industrial Processes	Petroleum Industry	Flares	Liquified Petroleum Gas

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC	SCC8 DESC
30609905	Industrial Processes	Petroleum Industry	Incinerators	Liquified Petroleum Gas
30890004	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment	Liquified Petroleum Gas (LPG): Process Heaters
31000406	Industrial Processes	Oil and Gas Production	Process Heaters	Propane/Butane
39001089	Industrial Processes	In-process Fuel Use	Liquified Petroleum Gas	General
39001099	Industrial Processes	In-process Fuel Use	Liquified Petroleum Gas	General
39901001	Industrial Processes	Miscellaneous Manufacturing Industries	Process Heater/Furnace	LPG
40201004	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven Heater	Liquified Petroleum Gas (LPG)
50390010	Waste Disposal	Solid Waste Disposal - Industrial	Auxiliary Fuel/No Emissions	Liquified Petroleum Gas (LPG)
2102008000 – Industrial; Wood; Total: All Boiler Types				
10200902	External Combustion Boilers	Industrial	Wood/Bark Waste	Wood/Bark-fired Boiler
10200903	External Combustion Boilers	Industrial	Wood/Bark Waste	Wood-fired Boiler - Wet Wood (>=20% moisture)
10200905	External Combustion Boilers	Industrial	Wood/Bark Waste	Wood/Bark-fired Boiler (< 50,000 Lb Steam) **
10200906	External Combustion Boilers	Industrial	Wood/Bark Waste	Wood-fired Boiler (< 50,000 Lb Steam) **
10200907	External Combustion Boilers	Industrial	Wood/Bark Waste	Wood Cogeneration
10200908	External Combustion Boilers	Industrial	Wood/Bark Waste	Wood-fired Boiler - Dry Wood (<20% moisture)
10200910	External Combustion Boilers	Industrial	Wood/Bark Waste	Fuel cell/Dutch oven boilers **
10200911	External Combustion Boilers	Industrial	Wood/Bark Waste	Stoker boilers **
10200912	External Combustion Boilers	Industrial	Wood/Bark Waste	Fluidized bed combustion boiler
39000989	Industrial Processes	In-process Fuel Use	Wood	General
39000999	Industrial Processes	In-process Fuel Use	Wood	General: Wood
2102011000 – Industrial; Kerosene; Total: All Boiler Types				
20200901	Internal Combustion Engines	Industrial	Kerosene/Naphtha (Jet Fuel)	Turbine
20200902	Internal Combustion Engines	Industrial	Kerosene/Naphtha (Jet Fuel)	Reciprocating
20200905	Internal Combustion Engines	Industrial	Kerosene/Naphtha (Jet Fuel)	Reciprocating: Crankcase Blowby
20200906	Internal Combustion Engines	Industrial	Kerosene/Naphtha (Jet Fuel)	Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
20200907	Internal Combustion Engines	Industrial	Kerosene/Naphtha (Jet Fuel)	Reciprocating: Exhaust
20200908	Internal Combustion Engines	Industrial	Kerosene/Naphtha (Jet Fuel)	Turbine: Evaporative Losses (Fuel Storage and Delivery System)
20200909	Internal Combustion Engines	Industrial	Kerosene/Naphtha (Jet Fuel)	Turbine: Exhaust

Table 5. Commercial/Institutional Fuel Combustion Crosswalk for Point Source Subtractions

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC	SCC8 DESC
2103001000 & 2103002000 -- Commercial/Institutional; Anthracite Coal; Total: All Boiler Types and Bituminous/Subbituminous Coal; Total: All Boiler Types				
10300101	External Combustion Boilers	Commercial/Institutional	Anthracite Coal	Pulverized Coal
10300102	External Combustion Boilers	Commercial/Institutional	Anthracite Coal	Traveling Grate (Overfeed) Stoker
10300103	External Combustion Boilers	Commercial/Institutional	Anthracite Coal	Hand-fired
10300203	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Cyclone Furnace (Bituminous Coal)
10300205	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Pulverized Coal: Wet Bottom (Bituminous Coal)
10300206	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Pulverized Coal: Dry Bottom (Bituminous Coal)
10300207	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Overfeed Stoker (Bituminous Coal)
10300208	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Underfeed Stoker (Bituminous Coal)
10300209	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Spreader Stoker (Bituminous Coal)
10300211	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Overfeed Stoker **
10300214	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Hand-fired (Bituminous Coal)
10300216	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Pulverized Coal: Dry Bottom (Tangential) (Bituminous Coal)
10300217	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Atmospheric Fluidized Bed Combustion: Bubbling Bed (Bituminous Coal)
10300218	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Atmospheric Fluidized Bed Combustion: Circulating Bed (Bitum. Coal)
10300221	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Pulverized Coal: Wet Bottom (Subbituminous Coal)
10300222	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Pulverized Coal: Dry Bottom (Subbituminous Coal)
10300223	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Cyclone Furnace (Subbituminous Coal)
10300224	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Spreader Stoker (Subbituminous Coal)
10300225	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Traveling Grate (Overfeed) Stoker (Subbituminous Coal)
10300226	External Combustion Boilers	Commercial/Institutional	Bituminous/Subbituminous Coal	Pulverized Coal: Dry Bottom Tangential (Subbituminous Coal)
10500202	External Combustion Boilers	Space Heaters	Commercial/Institutional	Coal **
50190002	Waste Disposal	Solid Waste Disposal - Government	Auxiliary Fuel/No Emissions	Coal
50290002	Waste Disposal	Solid Waste Disposal - Commercial/Institutional	Auxiliary Fuel/No Emissions	Coal
2103004000 -- Commercial/Institutional; Distillate Oil; Total: Boilers and IC Engines				
10300501	External Combustion Boilers	Commercial/Institutional	Distillate Oil	Grades 1 and 2 Oil
10300502	External Combustion Boilers	Commercial/Institutional	Distillate Oil	10-100 Million Btu/hr **
10300503	External Combustion Boilers	Commercial/Institutional	Distillate Oil	< 10 Million Btu/hr **
10300504	External Combustion Boilers	Commercial/Institutional	Distillate Oil	Grade 4 Oil
10500205	External Combustion Boilers	Space Heaters	Commercial/Institutional	Distillate Oil
20300101	Internal Combustion Engines	Commercial/Institutional	Distillate Oil (Diesel)	Reciprocating
20300102	Internal Combustion Engines	Commercial/Institutional	Distillate Oil (Diesel)	Turbine

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC	SCC8 DESC
20300105	Internal Combustion Engines	Commercial/Institutional	Distillate Oil (Diesel)	Reciprocating: Crankcase Blowby
20300106	Internal Combustion Engines	Commercial/Institutional	Distillate Oil (Diesel)	Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
20300107	Internal Combustion Engines	Commercial/Institutional	Distillate Oil (Diesel)	Reciprocating: Exhaust
20300108	Internal Combustion Engines	Commercial/Institutional	Distillate Oil (Diesel)	Turbine: Evaporative Losses (Fuel Storage and Delivery System)
20300109	Internal Combustion Engines	Commercial/Institutional	Distillate Oil (Diesel)	Turbine: Exhaust
50190005	Waste Disposal	Solid Waste Disposal - Government	Auxiliary Fuel/No Emissions	Distillate Oil
50290005	Waste Disposal	Solid Waste Disposal - Commercial/Institutional	Auxiliary Fuel/No Emissions	Distillate Oil
2103005000 -- Commercial/Institutional; Residual Oil; Total: All Boiler Types				
10300401	External Combustion Boilers	Commercial/Institutional	Residual Oil	Grade 6 Oil
10300402	External Combustion Boilers	Commercial/Institutional	Residual Oil	10-100 Million Btu/hr **
10300403	External Combustion Boilers	Commercial/Institutional	Residual Oil	< 10 Million Btu/hr **
10300404	External Combustion Boilers	Commercial/Institutional	Residual Oil	Grade 5 Oil
2103006000 -- Commercial/Institutional; Natural Gas; Total: Boilers and IC Engines				
10300601	External Combustion Boilers	Commercial/Institutional	Natural Gas	> 100 Million Btu/hr
10300602	External Combustion Boilers	Commercial/Institutional	Natural Gas	10-100 Million Btu/hr
10300603	External Combustion Boilers	Commercial/Institutional	Natural Gas	< 10 Million Btu/hr
10500206	External Combustion Boilers	Space Heaters	Commercial/Institutional	Natural Gas
20300201	Internal Combustion Engines	Commercial/Institutional	Natural Gas	Reciprocating
20300202	Internal Combustion Engines	Commercial/Institutional	Natural Gas	Turbine
20300203	Internal Combustion Engines	Commercial/Institutional	Natural Gas	Turbine: Cogeneration
20300204	Internal Combustion Engines	Commercial/Institutional	Natural Gas	Cogeneration
20300205	Internal Combustion Engines	Commercial/Institutional	Natural Gas	Reciprocating: Crankcase Blowby
20300206	Internal Combustion Engines	Commercial/Institutional	Natural Gas	Reciprocating: Evaporative Losses (Fuel Delivery System)
20300207	Internal Combustion Engines	Commercial/Institutional	Natural Gas	Reciprocating: Exhaust
20300208	Internal Combustion Engines	Commercial/Institutional	Natural Gas	Turbine: Evaporative Losses (Fuel Delivery System)
20300209	Internal Combustion Engines	Commercial/Institutional	Natural Gas	Turbine: Exhaust
50190006	Waste Disposal	Solid Waste Disposal - Government	Auxiliary Fuel/No Emissions	Natural Gas
50290006	Waste Disposal	Solid Waste Disposal - Commercial/Institutional	Auxiliary Fuel/No Emissions	Natural Gas
2103007000 -- Commercial/Institutional; Liquid Petroleum Gas; Total: All Combustor Types				
10301001	External Combustion Boilers	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Butane
10301002	External Combustion Boilers	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Propane
10301003	External Combustion Boilers	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Butane/Propane Mixture: Specify Percent Butane in Comments
10500210	External Combustion Boilers	Space Heaters	Commercial/Institutional	Liquified Petroleum Gas (LPG)
20301001	Internal Combustion Engines	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Propane: Reciprocating
20301002	Internal Combustion Engines	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Butane: Reciprocating

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC	SCC8 DESC
20301005	Internal Combustion Engines	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Reciprocating: Crankcase Blowby
20301006	Internal Combustion Engines	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
20301007	Internal Combustion Engines	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Reciprocating: Exhaust
50190010	Waste Disposal	Solid Waste Disposal - Government	Auxiliary Fuel/No Emissions	Liquified Petroleum Gas (LPG)
50290010	Waste Disposal	Solid Waste Disposal - Commercial/Institutional	Auxiliary Fuel/No Emissions	Liquified Petroleum Gas (LPG)
2103008000 -- Commercial/Institutional; Wood; Total: All Boiler Types				
10300902	External Combustion Boilers	Commercial/Institutional	Wood/Bark Waste	Wood/Bark-fired Boiler
10300903	External Combustion Boilers	Commercial/Institutional	Wood/Bark Waste	Wood-fired Boiler - Wet Wood (>=20% moisture)
10300908	External Combustion Boilers	Commercial/Institutional	Wood/Bark Waste	Wood-fired Boiler - Dry Wood (<20% moisture)
10300910	External Combustion Boilers	Commercial/Institutional	Wood/Bark Waste	Fuel cell/Dutch oven boilers **
10300911	External Combustion Boilers	Commercial/Institutional	Wood/Bark Waste	Stoker boilers **
10300912	External Combustion Boilers	Commercial/Institutional	Wood/Bark Waste	Fluidized bed combustion boilers
10500209	External Combustion Boilers	Space Heaters	Commercial/Institutional	Wood
2103011000 -- Commercial/Institutional; Kerosene; Total: All Combustor Types				
20300901	Internal Combustion Engines	Commercial/Institutional	Kerosene/Naphtha (Jet Fuel)	Turbine: JP-4
20300908	Internal Combustion Engines	Commercial/Institutional	Kerosene/Naphtha (Jet Fuel)	Turbine: Evaporative Losses (Fuel Storage and Delivery System)
20300909	Internal Combustion Engines	Commercial/Institutional	Kerosene/Naphtha (Jet Fuel)	Turbine: Exhaust
50100603	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Kerosene

5. Emission Factors

Table 6 presents the criteria pollutant emission factors that will be applied to fuel consumption estimates to calculate ICI combustion area source emissions. Except as noted below, all criteria air pollutant emission factors were from an EPA database of emission factors that will be used in preparing the 2008 nonpoint source NEI (Huntley, 2009).[2] Wood combustion emission factors were compiled from *AP-42* (EPA, 2003). Because there are no NH_3 emission factors for ICI fuel combustion available in the 2008 NEI emission factor database, *AP-42,* or EPA's WebFIRE, Pechan will use emission factors reported in an NH_3 emissions Emission Inventory Improvement Program (EIIP) guidance document (Pechan, 2004). Pechan compared the 2008 NEI emission factors with those used to develop the last area source NEI (2002), as well as those listed by the Eastern Regional Technical Advisory Committee (ERTAC) for potential use by States in developing their area source inventories (ERTAC, 2009). With a few notable exceptions, the 2008 NEI emission factors are the same as those used for the 2002 NEI.[3] The PM emission factors for natural gas and LPG combustion are the major exceptions. Because the 2002 emission factors were deemed too high because of artifact formation in the test method (method 202) during stack testing, EPA developed a set of SCC-specific adjustment factors to apply to the 2002 NEI to better reflect PM emissions from these fuels.[4] In preparation for the 2008 NEI, EPA developed revised natural gas and LPG PM emission factors by applying these adjustment factors to the 2002 NEI emission factors.

Pechan does not plan to use the ERTAC emission factors that differ from the 2008 NEI factors because of the lack of documentation as to the source of the ERTAC factors. For PM emissions from ICI bituminous coal combustion, ERTAC specifically notes that their proposed emission factors reflect combustion in an uncontrolled overfeed stoker. The EPA PM emission factors for these categories, which were obtained from *AP-42*, reflect coal-fired boilers with controls (specifically, multiple cyclones with or without fly ash reinjection). Because an analysis of an EPA boiler database indicates that most small coal-fired boilers have PM controls (with cyclones as the most common type of control), EPA's PM emission factors will be used in preparing the CENRAP emission inventory (ERG, 2002).

For greenhouse gases (GHGs), Pechan will use the emission factors from EPA's State Greenhouse Gas Inventory Tool, which incorporates the EIIP's GHG emissions inventory guidelines for States (EPA, 2009). Table 7 displays the State-specific CO_2 emission factors for each ICI combustion area source category, and Table 8 presents the N_2O and CH_4 emission factors by source category. Because SIT assumes that CO_2 emissions from U.S. biomass combustion need not be inventoried, the SIT does not provide CO_2 emission factors for ICI wood combustion.[5] Therefore, Pechan will use the wood combustion CO_2 emission factors reported in *AP-42* (EPA, 2003).

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[2] All criteria pollutant emission factors were rounded to two decimal places.

[3] The 2002 NEI documentation provides citations to the *AP-42* source for each emission factor (Pechan, 2006).

[4] These factors reduce PM emissions by more than 90 percent.

[5] As stated in the EIIP fossil fuel combustion CO_2 emissions guidance: "…biomass fuels are generally grown on a sustainable basis. … In cases where biomass fuels are not grown sustainably, GHG emissions are captured as a land use change."

Table 6. Criteria Pollutant Emission Factors for ICI Combustion Area Source Categories

SCC	Description	Emission Factor Units	VOC	NO_x	CO	SO_2	PM2.5-FIL	PM10-FIL	PM-CON	NH_3
2102001000	Industrial Anthracite Coal	lb/ton	0.3	9	0.6	39 * S%	0.48 * A%	1.1 * A%	0.08	0.03
2102002000	Industrial Bitum/Subbitum Coal	lb/ton	0.05	11	5	38 * S%	1.4	12	1.04	0.03
2102004000	Industrial Distillate Oil	lb/1000 gal	0.2	20	5	142 * S%	0.25	1	1.3	0.8
2102005000	Industrial Residual Oil	lb/1000 gal	0.28	55	5	157 * S%	4.67 * (1.12 * S% + 0.37)	7.17 * (1.12 * S% + 0.37)	1.5	0.8
2102006000	Industrial Natural Gas	lb/MMcf	5.5	100	84	0.6	0.11	0.13	0.32	3.2
2102007000	Industrial LPG [1]	lb/1000 bbl	20.09	365.32	306.87	2.19	0.39	0.47	1.18	1.79
2102008000	Industrial Wood [2]	lb/MMBtu	0.017	0.22	0.6	0.025	0.43	0.5	0.017	0.086[3]
2102011000	Industrial Kerosene	lb/1000 gal	0.19	19.29	4.82	142 * S%	0.24	0.96	1.25	0.771
2103001000	Comm/Inst Anthracite Coal	lb/ton	0.3	9	0.6	39 * S%	0.48 * A%	1.1 * A%	0.08	0.03
2103002000	Comm/Inst Bitum/Subbitum Coal	lb/ton	0.05	11	5	38 * S%	1.4	12	1.04	0.03
2103004000	Comm/Inst Distillate Oil	lb/1000 gal	0.34	20	5	142 * S%	0.83	1.08	1.3	0.8
2103005000	Comm/Inst Residual Oil	lb/1000 gal	1.13	55	5	157 * S%	1.92 * (1.12 * S% + 0.37)	5.17 * (1.12 * S% + 0.37)	1.5	0.8
2103006000	Comm/Inst Natural Gas	lb/MMcf	5.5	100	84	0.6	0.11	0.13	0.32	0.49
2103007000	Comm/Inst LPG	lb/1000 bbl	20.09	365.32	306.87	2.19	0.39	0.47	1.18	1.79
2103008000	Comm/Inst Wood [1]	lb/MMBtu	0.017	0.22	0.6	0.025	0.43	0.5	0.017	0.086[3]
2103011000	Comm/Inst Kerosene	lb/1000 gal	0.33	19.29	4.82	142 * S%	0.8	1.04	1.25	0.771

Source: Unless otherwise noted, 2008 nonpoint source NEI (Huntley, 2009).

Notes: [1] Emission factors from Commercial/Institutional LPG.
[2] Emission factors from *AP-42*, Section 1.6 (Wood Residue Combustion in Boilers).
[3] Emission factor from Pechan, 2004; reported in lb/tons.
In addition to above, PM2.5-PRI and PM10-PRI will be computed as the sum of condensable PM emissions and PM25-FIL/PM10-FIL emissions.
lb = ton
gal = gallon
MMcf = million cubic feet
MMBtu = million British thermal units
bbl = barrels
S = sulfur content
A = ash content

Table 7. Carbon Dioxide Emission Factors for Industrial and Commercial/Institutional Coal Combustion (lb/MMBtu)

State	Industrial CO_2	Commercial/Institutional CO_2
Arkansas	205.70	227.41
Iowa	207.72	204.42
Kansas	203.02	204.89
Louisiana	204.78	227.41
Minnesota	209.70	208.27
Missouri	203.98	204.53
Nebraska	209.66	212.70
Oklahoma	205.99	205.92
Texas	210.39	206.25

Source: EPA State Greenhouse Gas Inventory Tool (EPA, 2009).

Table 8. Additional Greenhouse Gas Emission Factors for ICI Combustion Area Source Categories (lb/MMBtu)

SCC	Description	CO_2	CH_4	N_2O
2102001000	Industrial Anthracite Coal	see above	0.02210	0.00331
2102002000	Industrial Bitum/Subbitum Coal	see above	0.02210	0.00331
2102004000	Industrial Distillate Oil	161.11	0.00663	0.00133
2102005000	Industrial Residual Oil	173.54	0.00663	0.00133
2102006000	Industrial Natural Gas	116.86	0.00209	0.00021
2103007000	Industrial LPG	137.32	0.00663	0.00133
2102008000	Industrial Wood [1]	195	0.06280	0.00837
2102011000	Industrial Kerosene	159.28	0.00663	0.00133
2103001000	Comm/Inst Anthracite Coal	see above	0.02210	0.00331
2103002000	Comm/Inst Bitum/Subbitum Coal	see above	0.02210	0.00331
2103004000	Comm/Inst Distillate Oil	161.11	0.02210	0.00133
2103005000	Comm/Inst Residual Oil	173.54	0.02210	0.00133
2103006000	Comm/Inst Natural Gas	116.86	0.01047	0.00021
2103007000	Comm/Inst LPG	139.00	0.02210	0.00133
2103008000	Comm/Inst Wood [1]	195	0.62802	0.00837
2103011000	Comm/Inst Kerosene	159.28	0.02210	0.00133

Source: Unless otherwise noted, EPA State Greenhouse Gas Inventory Tool (EPA, 2009).
[1] CO_2 emission factors from *AP-42*, Section 1.6 - Wood Residue Combustion in Boilers.

6. Coal Sulfur Content

Under a forthcoming task (Task 4), Pechan will evaluate the reliability of various data sources for coal sulfur content before identifying the source(s) that will be used to estimate emissions in this project. Pechan will review potential coal sulfur content data sources, including:

(1) information reported in the point source inventories of each State;[6] (2) the USGS' U.S. Coal Quality Database (this is the ICI coal sulfur content source used in the 2002 NEI); (3) plant-level data from the Federal Energy Regulatory Commission's (FERC) Form 423;[7] and (4) State-level data reported in EIA's "Monthly Report of Cost and Quality of Fuels for Electric Plants." Pechan will evaluate these and any other identified alternative data sources for use in this project to ensure that the data are as representative as possible with respect to consuming sector, geography, and time-frame. Any data sets that are deemed equally representative will next be evaluated with respect to level of confidence (i.e., a data source for which estimated coal content is based on more data points than other data sources will be deemed to have higher confidence, and therefore, the preferred data source). Pechan will prepare a memorandum identifying the coal content data sources that were reviewed and a priority ranking of preferred sources based on an evaluation of the aforementioned criteria. The memorandum will identify the preferred approach for characterizing the sulfur content of coal consumption for each ICI area source combustion source category, which will be incorporated into the Excel calculation templates.

7. County Allocation Data

After computing State-level emissions using the data described above, the project requires allocating these emissions to individual counties. There are two allocation approaches that CENRAP is evaluating for this step. The first, which has been used in past inventory efforts including the 2002 NEI, is based on each county's proportion of total State employment for the energy-consuming sectors for each source category. The second is based on estimates of total energy consumption for each sector. For both approaches, the initial step is to identify the economic sectors associated with Industrial fuel combustion, and the economic sectors associated with Commercial/Institutional fuel combustion.

Commercial/Institutional

For area source Commercial/Institutional fuel combustion, the 2002 NEI used employment data in North American Industrial Classification System (NAICS) codes 42, 44-45, 51-54, 56, 61-62, 71-72, and 81 to allocate EIA State Commercial sector energy consumption data to counties.[8] These NAICS codes suggest that fuel combustion emissions for the following sectors are covered elsewhere in the NEI: Agriculture, Forestry, Fishing and Hunting; Mining; Construction; Manufacturing; Transportation and Warehousing; Management of Companies and Enterprises; and Public Administration. Meanwhile the EIIP area source method abstracts for Commercial/Institutional fuel combustion categories identify Standard Industrial Classification (SIC) codes 50-99 as representing the Commercial/Institutional sector. These SIC codes indicate that the following is the comprehensive list of non-Commercial sectors: Agriculture, Forestry, Fishing and Hunting; Mining; Construction; Manufacturing; and Transportation, Communications, Electric, Gas, and Sanitary Services.

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[6] Iowa has stated that they did not report coal sulfur content information in their 2002 point source inventory.

[7] Note that these data include Commercial and Industrial combined heat and power producers whose total fossil-fueled nameplate generating capacity is 50 or more megawatts.

[8] These NAICS codes are also listed in ERTAC's area source methodology worksheet (ERTAC, 2009).

Documentation for the SEDS is not entirely clear on the NAICS codes associated with the Commercial sector, defining the Commercial sector as "an energy-consuming sector that consists of service-providing facilities and equipment of: businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups. The Commercial sector includes institutional living quarters. It also includes sewage treatment facilities." In an attempt to further clarify the NAICS codes associated with this sector, Pechan performed additional research into the original data sources that are used to create the SEDS.

Because data for the SEDS originates with data collected from EIA fuel sector-specific surveys of energy suppliers,[9] Pechan reviewed these survey forms/instructions for further details on what SEDS considers Commercial sector use of each fuel. This review found that the surveys/guidance do not always provide further clarity. In addition, the EIA has admitted that energy suppliers may use their own account classifications as well as EIA guidance in determining whether a particular account belongs in the Residential, Commercial, Industrial, or Transportation sector. The only source of NAICS-code based EIA definitions of the Commercial energy sector is a "rough crosswalk" between Commercial building types and NAICS codes developed for EIA's Commercial Building Energy Consumption Survey (CBECS). With the exception of NAICS code 814 (Private Households), this crosswalk links all NAICS codes between 42 and 92 with Commercial building energy consumption, suggesting that both the EIIP guidance and NEI definitions of the Commercial fuel combustion source category are missing some sectors, while also including one sector that should not be included (Private Households). In lieu of additional information, data for the CBECS-identified NAICS codes (42 though 92 with exception of 814) will be used to allocate SEDS energy consumption data to individual counties.

Industrial

Although there are no EIIP guidance documents for area source Industrial fuel combustion, the 2002 NEI used the Manufacturing sector NAICS codes (31-33) to represent this category. Unlike the Commercial sector, the SEDS documentation provides a clear listing of the NAICS codes associated with SEDS Industrial energy consumption data: "the industrial sector encompasses the following types of activity: Manufacturing (NAICS codes 31–33); Agriculture, Forestry, Fishing and Hunting (NAICS code 11); Mining, including Oil and Gas Extraction (NAICS code 21); and Construction (NAICS code 23)." As noted earlier, this indicates that a portion of Industrial sector consumption is already accounted for in other emission inventory sectors. It is expected that non-Manufacturing sector Industrial fuel consumption will largely be eliminated via the nonroad subtractions described earlier. Therefore, Pechan will not expand the list of NAICS codes used to represent the area source Industrial fuel combustion category beyond the Manufacturing sector NAICS codes (31-33).

<u>Standard Employment-Based Approach</u>

[9] For natural gas, for example – EIA-176 "Annual Report of Natural and Supplemental Gas Supply and Disposition."

In keeping with EIIP guidance and past EPA practice, employment data can be used to allocate State-level emission estimates to counties. Each year the Census Bureau releases *County Business Patterns* (CBP), a county level data set of employment by NAICS code (Census, 2009). The CBP county-level employment estimates for 2002 can be compiled for the appropriate NAICS codes noted above. Due to concerns with releasing confidential business information, the CBP withholds values for a given county/NAICS code if it would be possible to identify individual businesses from these values. In such cases, the CBP reports a letter code, representing a particular employment size range. To estimate data for withheld counties/NAICS codes, Pechan used the following procedure.

1. County-level employment for counties with reported values are totaled by State for the applicable NAICS code.
2. Value from step 1 is subtracted from the State employment value for the NAICS code.
3. Each of the withheld counties is assigned an initial employment estimate reflecting the midpoint of the CBP range code (e.g., code A, which reflects 1-19 employees, is assigned an estimate of 10 employees).
4. The initial employment estimates from step 3 are then summed to the State level.
5. The value from step 2 is divided by the value from step 4 to yield an adjustment factor to apply to the initial employment estimates to yield employment values that will sum to the State employment total for the applicable NAICS code.
6. The final county-level employment values are estimated by multiplying the initial employment estimates from step 3 by the step 5 adjustment factors.

Example: NAICS 31-33 (Manufacturing)

fipsstate	fipscty	naics	empflag	emp
23	001	31----		6,774
23	003	31----		3,124
23	005	31----		10,333
23	007	31----		1,786
23	009	31----		1,954
23	011	31----		2,535
23	013	31----		1,418
23	015	31----	F	0
23	017	31----		2,888
23	019	31----		4,522
23	021	31----		948
23	023	31----	I	0
23	025	31----		4,322
23	027	31----		1,434
23	029	31----		1,014
23	031	31----		9,749

1. The total of employees not including counties 015 and 023 is 52,801.
2. The State-level CBP reports 59,322 employees in NAICS 31----the difference is 6,521.
3. County 015 is given a midpoint of 1,750 (since range code F is 1,000-2,499) and County 023 is given a midpoint of 17,500.

4. State total for these two counties is 19,250.
5. 6,521/19,250 = 0.33875.
6. The final employment estimate for county 015 is 1,750 * 0.33875 = 593. The county 023 final employment estimate is computed as 17,500 * 0.33875 = 5,928.

Energy Intensity-Adjusted Approach

Employment-based county allocation methods lead to overrepresentation of energy consumption in counties with sectors that have high employment but low energy intensities (measured on a Btu per employee basis), and vice-versa. Therefore, Pechan recommended that CENRAP consider utilizing energy use per employee values by NAICS code to refine the employment-based county allocation approach. Because State/NAICS code-level energy use data are not available, this approach relies on 2002 national energy consumption data by NAICS code as reported by EIA in *Annual Energy Outlook* (EIA, 2005). Energy intensity values are computed by dividing these Btu-based energy consumption estimates by 2002 national employment data by NAICS code. The resulting intensity values are then multiplied by county/NAICS code-level employment estimates to estimate total county energy consumption by NAICS code. These values are then summed for the appropriate Industrial and Commercial/Institutional fuel combustion NAICS codes. The resulting county-level total Industrial and total Commercial/Institutional energy consumption estimates can then be used to apportion State-level Industrial fuel combustion emissions and State-level Commercial/Institutional fuel combustion emissions to each county.

Table 9 displays a comparison of the county-level allocation percentages computed for Missouri from the two methods. This table is sorted in descending order based on each county's Industrial fuel combustion employment-based allocation percentage. The cells shaded in green indicate that the energy intensity-adjusted approach reflects a greater than 50 percent higher allocation of activity/emissions to the given county versus the employment-based approach. Similarly, cells shaded in tan indicate that the energy-based approach reflects an allocation that is more than 50 percent lower than that resulting from the employment-based approach. The table shows that the Industrial sector allocations differ more substantially between the two methods in Missouri. Focusing on the Industrial sector allocation percentages for Jackson county, for example, overall Manufacturing sector employment is approximately 10 percent of the Missouri total. However, a much higher percentage of Missouri total Industrial sector energy consumption is estimated for this county (~17 percent). A closer look at the underlying data indicates that this county has a relatively high proportion of total State employment in the Chemicals and Paper industries that are the third and fifth highest energy-intensive manufacturing sector industries. Pechan will provide the information in Table 9 for all CENRAP States when it submits the Task 3 State-level fuel consumption estimates, which are due by April 17.

Table 9. Comparison of County Allocation Approaches for Missouri

County	Industrial				Commercial/Institutional		
	Employment	Energy	Ratio		Employment	Energy	Ratio
St. Louis	17.3%	14.9%	0.9		25.2%	21.8%	0.9
Jackson	10.3%	16.5%	1.6		16.2%	15.2%	0.9
City of St. Louis	8.3%	8.9%	1.1		11.9%	11.4%	1.0
Greene	5.2%	4.5%	0.9		6.0%	6.1%	1.0
St. Charles	4.6%	2.3%	0.5		4.0%	4.1%	1.0
Clay	4.6%	3.4%	0.7		3.3%	3.6%	1.1
Jasper	3.4%	2.5%	0.7		2.0%	2.0%	1.0
Franklin	3.2%	2.5%	0.8		1.0%	1.1%	1.1
Buchanan	2.3%	5.1%	2.2		1.5%	1.5%	1.0
Barry	2.0%	1.3%	0.6		0.4%	0.4%	1.0
Boone	1.7%	0.7%	0.4		2.8%	2.7%	0.9
Pettis	1.6%	1.6%	1.0		0.6%	0.7%	1.2
Cape Girardeau	1.6%	5.5%	3.4		1.6%	1.5%	1.0
Laclede	1.6%	0.4%	0.3		0.3%	0.4%	1.1
Jefferson	1.4%	2.4%	1.7		1.5%	1.8%	1.2
Newton	1.4%	1.2%	0.9		0.5%	0.6%	1.2
Howell	1.2%	0.3%	0.3		0.5%	0.6%	1.2
Cole	1.1%	0.5%	0.4		1.6%	1.5%	0.9
Butler	1.1%	0.4%	0.4		0.6%	0.6%	1.1
Perry	0.9%	0.5%	0.5		0.2%	0.2%	1.0
McDonald	0.9%	0.7%	0.7		0.1%	0.1%	1.3
Marion	0.8%	1.5%	1.8		0.4%	0.5%	1.1
St. Francois	0.8%	1.0%	1.3		0.7%	0.8%	1.0
New Madrid	0.8%	1.7%	2.1		0.1%	0.2%	1.6
Scott	0.8%	0.5%	0.6		0.6%	0.7%	1.1
Stoddard	0.8%	0.4%	0.5		0.3%	0.4%	1.3
Christian	0.7%	0.3%	0.4		0.4%	0.5%	1.2
Nodaway	0.6%	0.6%	1.0		0.3%	0.3%	1.1
Platte	0.6%	0.3%	0.5		1.8%	1.6%	0.9
Audrain	0.6%	0.3%	0.5		0.3%	0.3%	1.1
Phelps	0.6%	0.3%	0.4		0.6%	0.7%	1.3
Linn	0.6%	0.2%	0.4		0.1%	0.2%	1.1
Henry	0.5%	0.3%	0.5		0.2%	0.3%	1.3
Johnson	0.5%	0.3%	0.5		0.4%	0.5%	1.3
Crawford	0.5%	0.2%	0.4		0.2%	0.2%	1.3
Warren	0.5%	0.5%	0.9		0.2%	0.2%	1.1
Ste. Genevieve	0.5%	0.4%	0.8		0.1%	0.2%	1.2
Sullivan	0.5%	0.6%	1.2		0.0%	0.1%	1.4
Barton	0.5%	0.3%	0.6		0.1%	0.2%	1.4
Cass	0.5%	0.5%	1.1		0.7%	0.8%	1.2
Gasconade	0.5%	0.2%	0.5		0.1%	0.2%	1.3
Saline	0.5%	0.4%	0.8		0.3%	0.3%	1.2

County	Industrial				Commercial/Institutional		
	Employment	Energy	Ratio		Employment	Energy	Ratio
Lawrence	0.5%	0.2%	0.5		0.2%	0.4%	1.5
Randolph	0.5%	0.2%	0.5		0.3%	0.4%	1.1
Grundy	0.4%	0.3%	0.7		0.1%	0.2%	1.5
Adair	0.4%	0.2%	0.6		0.3%	0.4%	1.1
Lincoln	0.3%	0.1%	0.4		0.3%	0.4%	1.3
Vernon	0.3%	0.2%	0.4		0.2%	0.3%	1.4
Camden	0.3%	0.1%	0.4		0.6%	0.6%	1.1
Dunklin	0.3%	0.3%	0.8		0.3%	0.4%	1.2
Lafayette	0.3%	0.3%	0.9		0.3%	0.4%	1.2
Osage	0.3%	0.1%	0.4		0.1%	0.1%	1.4
Texas	0.3%	0.2%	0.5		0.2%	0.2%	1.5
Monroe	0.3%	0.1%	0.4		0.1%	0.1%	1.9
Miller	0.3%	0.1%	0.2		0.2%	0.3%	1.2
Webster	0.3%	0.6%	2.2		0.2%	0.2%	1.3
Moniteau	0.3%	0.2%	0.8		0.1%	0.1%	1.3
Callaway	0.3%	0.1%	0.4		0.4%	0.5%	1.2
Pemiscot	0.3%	0.3%	1.2		0.2%	0.2%	1.3
Polk	0.3%	0.1%	0.4		0.3%	0.4%	1.3
Dent	0.2%	0.6%	2.6		0.1%	0.2%	1.2
Livingston	0.2%	0.2%	0.9		0.2%	0.2%	1.2
Washington	0.2%	0.3%	1.3		0.1%	0.2%	1.6
Montgomery	0.2%	0.2%	0.9		0.1%	0.1%	1.4
Pike	0.2%	2.3%	10.5		0.2%	0.2%	1.4
Ripley	0.2%	0.1%	0.6		0.1%	0.1%	1.4
Wright	0.2%	0.1%	0.3		0.1%	0.2%	1.3
Morgan	0.2%	0.1%	0.3		0.1%	0.1%	1.3
Douglas	0.2%	0.1%	0.3		0.1%	0.1%	1.6
Ray	0.2%	0.4%	2.3		0.1%	0.2%	1.4
Cooper	0.2%	0.1%	0.5		0.2%	0.2%	1.3
Taney	0.2%	0.3%	1.5		0.9%	0.9%	1.0
Shannon	0.2%	0.1%	0.5		0.0%	0.0%	1.4
Macon	0.2%	0.3%	1.8		0.1%	0.2%	1.9
Ralls	0.2%	1.6%	10.4		0.1%	0.1%	1.6
Madison	0.2%	0.1%	0.6		0.1%	0.1%	1.3
Wayne	0.1%	0.1%	0.6		0.1%	0.1%	1.3
Dallas	0.1%	0.1%	0.8		0.1%	0.1%	1.0
Carroll	0.1%	0.1%	0.4		0.1%	0.1%	1.4
Bates	0.1%	0.1%	1.3		0.1%	0.2%	1.4
Lewis	0.1%	0.1%	0.5		0.1%	0.1%	1.5
Shelby	0.1%	0.1%	0.7		0.0%	0.1%	2.0
Benton	0.1%	0.1%	1.2		0.1%	0.1%	1.4
Reynolds	0.1%	0.1%	0.8		0.0%	0.1%	1.6
Oregon	0.1%	0.1%	0.8		0.1%	0.1%	1.4
Iron	0.1%	0.0%	0.4		0.1%	0.1%	1.4

County	Industrial				Commercial/Institutional		
	Employment	Energy	Ratio		Employment	Energy	Ratio
Mississippi	0.1%	0.0%	0.3		0.1%	0.1%	1.2
Gentry	0.1%	0.0%	0.3		0.1%	0.1%	1.3
Howard	0.1%	0.2%	2.1		0.1%	0.1%	1.4
Stone	0.1%	0.0%	0.3		0.2%	0.2%	1.2
Carter	0.1%	0.2%	2.7		0.0%	0.0%	1.4
Dade	0.1%	0.0%	0.5		0.1%	0.1%	1.6
Clinton	0.1%	0.0%	0.5		0.2%	0.2%	1.1
Pulaski	0.1%	0.0%	0.2		0.3%	0.4%	1.2
Cedar	0.1%	0.0%	0.5		0.1%	0.1%	1.4
Maries	0.1%	0.5%	8.7		0.1%	0.1%	1.4
Ozark	0.1%	0.0%	0.6		0.0%	0.1%	1.7
Daviess	0.0%	0.0%	0.2		0.0%	0.1%	1.6
Bollinger	0.0%	0.1%	2.3		0.1%	0.1%	1.5
Scotland	0.0%	0.0%	0.5		0.0%	0.1%	2.5
Holt	0.0%	0.2%	4.8		0.0%	0.1%	1.7
Clark	0.0%	0.0%	0.4		0.0%	0.1%	1.8
DeKalb	0.0%	0.2%	4.6		0.1%	0.1%	1.3
Putnam	0.0%	0.0%	1.7		0.0%	0.1%	2.0
Harrison	0.0%	0.0%	0.5		0.1%	0.1%	1.4
Chariton	0.0%	0.0%	0.5		0.1%	0.1%	1.5
Andrew	0.0%	0.0%	0.5		0.1%	0.1%	1.7
Atchison	0.0%	0.0%	0.5		0.1%	0.1%	1.3
Knox	0.0%	0.0%	0.5		0.0%	0.1%	1.8
Hickory	0.0%	0.0%	0.4		0.0%	0.1%	1.7
Worth	0.0%	0.0%	0.4		0.0%	0.0%	2.0
Caldwell	0.0%	0.0%	0.4		0.0%	0.1%	2.1
St. Clair	0.0%	0.0%	0.3		0.1%	0.1%	1.5
Mercer	0.0%	0.0%	0.5		0.0%	0.0%	1.5
Schuyler	0.0%	0.0%	0.2		0.0%	0.0%	2.1

8. Temporal Allocation Data

The EPA provides national default temporal allocation data via the "temporal allocation" section of their Emissions Modeling Clearinghouse (EMCH). For all Industrial sector fuel types, the EPA default is for an equal distribution of annual activity across months. For the Commercial sector, the EPA default is for an equal distribution of annual activity across months for LPG and kerosene, but the EPA default distribution for all other fuel types is as displayed in Table 10.

Table 10. EPA Default Commercial Fuel Combustion Sector Allocation

Month	% Allocation
January	11.7
February	11.7
March	8.3
April	8.3
May	8.3
June	5
July	5
August	5
September	8.3
October	8.3
November	8.3
December	11.7

Note: Excludes LPG and kerosene (equal distribution assumed throughout year).

Pechan researched the availability of more representative (sector, geographic, and/or time-specific) energy consumption data than that used to develop the EMCH's temporal allocation factors. The following summarizes the available information:

- Natural Gas – State-level volume delivered data are available by month and sector (Industrial versus Commercial) for 2002;
- Coal – national consumption data are available by month and sector (Industrial versus Commercial) for 2002; and
- Petroleum products (i.e., distillate, residual, LPG, kerosene) – regional level product supplied data are available by month for 2002.

Pechan was unable to identify a source reporting sub-annual consumption estimates for wood.

Pechan plans to use EIA's State-level natural gas deliveries data for 2002 to allocate the annual SEDS data to each month (EIA, 2009b). Given the limitations of the available coal and petroleum product data, and the lack of data for wood, Pechan plans to apply EPA's monthly default profiles to allocate annual activity/emissions for these fuel types. Because Pechan was unable to identify any source of sub-monthly estimates of ICI energy consumption, the EPA default allocation profiles will be used to develop average weekday, average weekend day, and average weekly emission estimates for each month.

C. CALCULATION TEMPLATES

This section summarizes the draft templates that Pechan has produced to develop the ICI combustion area source emission estimates for CENRAP. CENRAP should not review the actual data in these draft templates at this time because some entries are currently missing or represent "dummy" placeholder values. Pechan will provide completed templates for CENRAP review by April 17 as required under Task 5.

Template 1 – Adjust SEDS Fuel Consumption – this workbook, which reflects the discussion in sections B.1 through B.4, performs the following tasks:

- Computes Industrial sector State-level non-fuel energy consumption estimates by fuel type by applying MECS-based non-fuel percentages to the SEDS total Industrial sector energy consumption estimates;
- Subtracts Industrial and Commercial sector State-level distillate and LPG consumption estimates from a (forthcoming) NONROAD model run for 2002.
- Converts the result of the steps above from their original units to the emission factor units;
- Performs the point source subtractions using 2002 CENRAP point source inventory data and the ICI area source combustion SCC to point source SCC crosswalk;

Template 2 – Apply Emission Factors – this workbook accompanies the discussion in Sections B.5 and B.6 of criteria pollutant and GHG emission factors and associated coal sulfur content assumptions. Reflecting the fact that some emission factors differ by type of coal, this template also estimates the proportion of Industrial and Commercial/Institutional coal that is anthracite versus bituminous/subbituminous in each State. This template will ultimately report the estimated sulfur content of coal consumed in each State.

Template 3 – County Allocations – this workbook, which reflects the Section B.7 discussion, contains the data used to compute both sets of county allocation data (i.e., the county employment data and the total county energy consumption data). This template currently develops actual allocation data for Missouri counties. Ultimately, this template will only include county data for the allocation method that CENRAP chooses to implement in this project. This template also calculates county-level emissions from the Template 2 State-level emission estimates.

Template 4 – Temporal Allocation – this workbook, which reflects the discussion in Section B.8, provides the data that will be used to allocate annual county emissions to monthly, average weekly, average weekday, and average weekend day time periods. It will ultimately perform the necessary calculations to estimate emissions in each period.

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ATTACHMENT: PRELIMINARY SUMMARY OF 2002 POINT SOURCE ANNUAL THROUGHPUT DATA

The following table reports 2002 annual point source throughput data associated with the ICI area source categories. The table is sorted in descending order by CENRAP State and area SCC. Cells that are shaded in light blue indicate potentially suspect entries.

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2102001000	Industrial	Anthracite Coal	ARKANSAS	1,167,890	TON	640	Anthracite
2102002000	Industrial	Bituminous/Subbituminous Coal	ARKANSAS	3,153,027	TON	663	Bituminous Coal
2102004000	Industrial	Distillate Oil	ARKANSAS	8,255,280	E3GAL	44	Diesel
2102004000	Industrial	Distillate Oil	ARKANSAS	0	E3GAL	57	Distillate Oil (Diesel)
2102004000	Industrial	Distillate Oil	ARKANSAS		E3GAL	58	Distillate Oil (No. 2)
2102004000	Industrial	Distillate Oil	ARKANSAS	2,136,217	E3GAL	823	Distillate Oil (No. 1 & 2)
2102004000	Industrial	Distillate Oil	ARKANSAS	6,408,642	E3GAL	825	Distillate Oil (No. 4)
2102005000	Industrial	Residual Oil	ARKANSAS	224,941	E3GAL	279	Residual Oil
2102005000	Industrial	Residual Oil	ARKANSAS	13,587,658	E3GAL	923	Residual Oil (No. 6)
2102005000	Industrial	Residual Oil	ARKANSAS		E3GAL	924	Residual/Crude Oil
2102006000	Industrial	Natural Gas	ARKANSAS	184,838,095	E6FT3	209	Natural Gas
2102006000	Industrial	Natural Gas	ARKANSAS				
2102007000	Industrial	Liquified Petroleum Gas (LPG)	ARKANSAS		E3GAL	178	Liquified Petroleum Gas (LPG)
2102008000	Industrial	Wood	ARKANSAS	56,092,213	TON	15	Wood
2102008000	Industrial	Wood	ARKANSAS	21,798,710	TON	943	Wood/Bark
2103004000	Commercial/Institutional	Distillate Oil	ARKANSAS		E3GAL	57	Distillate Oil (Diesel)
2103006000	Commercial/Institutional	Natural Gas	ARKANSAS	23,912,086	E6FT3	209	Natural Gas
2103008000	Commercial/Institutional	Wood	ARKANSAS	7,655,765	TON	15	Wood
2102001000	Industrial	Anthracite Coal	IOWA	24	E3GAL	255	Propane
2102001000	Industrial	Anthracite Coal	IOWA	98,368	TON	645	Ash
2102002000	Industrial	Bituminous/Subbituminous Coal	IOWA	30,950,000	LB	561	Sludge
2102002000	Industrial	Bituminous/Subbituminous Coal	IOWA	87,110	TON	323	Subbituminous Coal
2102002000	Industrial	Bituminous/Subbituminous Coal	IOWA	3,741,706	TON	717	Coal
2102004000	Industrial	Distillate Oil	IOWA	1,039	E3GAL	44	Diesel
2102004000	Industrial	Distillate Oil	IOWA	0	E3GAL	56	Distillate Oil
2102004000	Industrial	Distillate Oil	IOWA	926	E3GAL	58	Distillate Oil (No. 2)
2102004000	Industrial	Distillate Oil	IOWA	2	E3GAL	255	Propane
2102004000	Industrial	Distillate Oil	IOWA	42	E3GAL	823	Distillate Oil (No. 1 & 2)
2102004000	Industrial	Distillate Oil	IOWA	0	E3LB	44	Diesel
2102004000	Industrial	Distillate Oil	IOWA	5,599	E6BTU	44	Diesel
2102004000	Industrial	Distillate Oil	IOWA	0	E6BTU	56	Distillate Oil
2102004000	Industrial	Distillate Oil	IOWA	0	E6BTU	209	Natural Gas
2102004000	Industrial	Distillate Oil	IOWA	42	E6BTU	823	Distillate Oil (No. 1 & 2)
2102004000	Industrial	Distillate Oil	IOWA	90	E6FT3	209	Natural Gas

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2102004000	Industrial	Distillate Oil	IOWA	8	E6GAL	58	Distillate Oil (No. 2)
2102004000	Industrial	Distillate Oil	IOWA	2	E6GAL	823	Distillate Oil (No. 1 & 2)
2102004000	Industrial	Distillate Oil	IOWA	341,800,000	FT3	209	Natural Gas
2102004000	Industrial	Distillate Oil	IOWA	4,758	GAL	5	Water
2102004000	Industrial	Distillate Oil	IOWA	35,967	GAL	44	Diesel
2102004000	Industrial	Distillate Oil	IOWA	613	GAL	56	Distillate Oil
2102004000	Industrial	Distillate Oil	IOWA	459	GAL	58	Distillate Oil (No. 2)
2102004000	Industrial	Distillate Oil	IOWA	330	GAL	209	Natural Gas
2102004000	Industrial	Distillate Oil	IOWA	10,262	GAL	255	Propane
2102004000	Industrial	Distillate Oil	IOWA	339	GAL	823	Distillate Oil (No. 1 & 2)
2102004000	Industrial	Distillate Oil	IOWA	14,123	HP-HR	58	Distillate Oil (No. 2)
2102004000	Industrial	Distillate Oil	IOWA	2,681	HR	44	Diesel
2102004000	Industrial	Distillate Oil	IOWA	29	HR	209	Natural Gas
2102004000	Industrial	Distillate Oil	IOWA	138	HR	268	Raw Material
2102004000	Industrial	Distillate Oil	IOWA	0	KL	44	Diesel
2102004000	Industrial	Distillate Oil	IOWA	0	TON	44	Diesel
2102004000	Industrial	Distillate Oil	IOWA	0	TON	58	Distillate Oil (No. 2)
2102004000	Industrial	Distillate Oil	IOWA	1,628	TON	268	Raw Material
2102004000	Industrial	Distillate Oil	IOWA				
2102005000	Industrial	Residual Oil	IOWA	14	E3GAL	44	Diesel
2102005000	Industrial	Residual Oil	IOWA	0	E3GAL	923	Residual Oil (No. 6)
2102005000	Industrial	Residual Oil	IOWA	438	E3GAL		
2102005000	Industrial	Residual Oil	IOWA	0	GAL	127	Gasoline
2102005000	Industrial	Residual Oil	IOWA	978,215	GAL	279	Residual Oil
2102005000	Industrial	Residual Oil	IOWA	6,000	GAL	823	Distillate Oil (No. 1 & 2)
2102005000	Industrial	Residual Oil	IOWA	188,565	GAL	923	Residual Oil (No. 6)
2102005000	Industrial	Residual Oil	IOWA				
2102006000	Industrial	Natural Gas	IOWA	6,690	E3FT3	209	Natural Gas
2102006000	Industrial	Natural Gas	IOWA	11	E3GAL	58	Distillate Oil (No. 2)
2102006000	Industrial	Natural Gas	IOWA	18,353,512	E6BTU	209	Natural Gas
2102006000	Industrial	Natural Gas	IOWA	248,378	E6BTU	268	Raw Material
2102006000	Industrial	Natural Gas	IOWA	69,899	E6FT3	127	Gasoline
2102006000	Industrial	Natural Gas	IOWA	2,851,074	E6FT3	209	Natural Gas
2102006000	Industrial	Natural Gas	IOWA	0	E6FT3	225	Paint
2102006000	Industrial	Natural Gas	IOWA	21	E6FT3	268	Raw Material

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2102006000	Industrial	Natural Gas	IOWA	119	E6FT3	315	Starch
2102006000	Industrial	Natural Gas	IOWA	0	E6LB	268	Raw Material
2102006000	Industrial	Natural Gas	IOWA	0	E6LB	281	Resin
2102006000	Industrial	Natural Gas	IOWA	1,818,653,437	FT3	209	Natural Gas
2102006000	Industrial	Natural Gas	IOWA	1,335,666,448	FT3S	209	Natural Gas
2102006000	Industrial	Natural Gas	IOWA	1,320	GAL	189	Material
2102006000	Industrial	Natural Gas	IOWA	73,408	GAL	225	Paint
2102006000	Industrial	Natural Gas	IOWA	46	GAL	255	Propane
2102006000	Industrial	Natural Gas	IOWA	0	GAL	268	Raw Material
2102006000	Industrial	Natural Gas	IOWA	4	GAL	952	Solvents: All
2102006000	Industrial	Natural Gas	IOWA	0	GAL	973	ABS Polymer
2102006000	Industrial	Natural Gas	IOWA	30,621	HR	516	Metal
2102006000	Industrial	Natural Gas	IOWA	7,000	LB	189	Material
2102006000	Industrial	Natural Gas	IOWA	0	LB	225	Paint
2102006000	Industrial	Natural Gas	IOWA	13,848	LB	268	Raw Material
2102006000	Industrial	Natural Gas	IOWA	0	LB	281	Resin
2102006000	Industrial	Natural Gas	IOWA	317	LB	516	Metal
2102006000	Industrial	Natural Gas	IOWA	344,238	TON	209	Natural Gas
2102006000	Industrial	Natural Gas	IOWA	14	TON	225	Paint
2102006000	Industrial	Natural Gas	IOWA	40,230	TON	268	Raw Material
2102006000	Industrial	Natural Gas	IOWA	0	TON	289	Sand
2102006000	Industrial	Natural Gas	IOWA	54	TON	303	Soil
2102006000	Industrial	Natural Gas	IOWA	162	TON	315	Starch
2102006000	Industrial	Natural Gas	IOWA	0	TON	561	Sludge
2102006000	Industrial	Natural Gas	IOWA	0	TON	580	Sulfur Dioxide
2102006000	Industrial	Natural Gas	IOWA			209	Natural Gas
2102006000	Industrial	Natural Gas	IOWA				
2102007000	Industrial	Liquified Petroleum Gas (LPG)	IOWA	0	E3GAL	178	Liquified Petroleum Gas (LPG)
2102007000	Industrial	Liquified Petroleum Gas (LPG)	IOWA	0	E3GAL	255	Propane
2102007000	Industrial	Liquified Petroleum Gas (LPG)	IOWA	2,977	E6BTU	209	Natural Gas
2102007000	Industrial	Liquified Petroleum Gas (LPG)	IOWA	0	E6BTU	255	Propane
2102007000	Industrial	Liquified Petroleum Gas (LPG)	IOWA	0	E6FT3	209	Natural Gas
2102007000	Industrial	Liquified Petroleum Gas (LPG)	IOWA	0	E6LB	268	Raw Material
2102007000	Industrial	Liquified Petroleum Gas (LPG)	IOWA	3	E6LB	281	Resin
2102007000	Industrial	Liquified Petroleum Gas (LPG)	IOWA	7,399	GAL	255	Propane

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2102007000	Industrial	Liquified Petroleum Gas (LPG)	IOWA				
2102008000	Industrial	Wood	IOWA	13,154	HR	124	Fuel
2102008000	Industrial	Wood	IOWA	6,497	TON	268	Raw Material
2102008000	Industrial	Wood	IOWA	0	TON-YR	717	Coal
2102011000	Industrial	Kerosene	IOWA	0	E3GAL	162	Kerosene
2102011000	Industrial	Kerosene	IOWA	13,717	TON	189	Material
2103002000	Commercial/Institutional	Bituminous/Subbituminous Coal	IOWA	142,485	TON	717	Coal
2103004000	Commercial/Institutional	Distillate Oil	IOWA	26	E3GAL	44	Diesel
2103004000	Commercial/Institutional	Distillate Oil	IOWA	0	E3GAL	56	Distillate Oil
2103004000	Commercial/Institutional	Distillate Oil	IOWA	0	E3GAL	58	Distillate Oil (No. 2)
2103004000	Commercial/Institutional	Distillate Oil	IOWA	18	E3GAL	268	Raw Material
2103004000	Commercial/Institutional	Distillate Oil	IOWA	162	E3GAL	823	Distillate Oil (No. 1 & 2)
2103004000	Commercial/Institutional	Distillate Oil	IOWA	1,033	GAL	44	Diesel
2103004000	Commercial/Institutional	Distillate Oil	IOWA	34,758	GAL	58	Distillate Oil (No. 2)
2103004000	Commercial/Institutional	Distillate Oil	IOWA	0	TON	44	Diesel
2103004000	Commercial/Institutional	Distillate Oil	IOWA				
2103005000	Commercial/Institutional	Residual Oil	IOWA	1	E3GAL	58	Distillate Oil (No. 2)
2103005000	Commercial/Institutional	Residual Oil	IOWA	21	E3GAL		
2103005000	Commercial/Institutional	Residual Oil	IOWA	332,184	GAL	279	Residual Oil
2103005000	Commercial/Institutional	Residual Oil	IOWA	4,340	GAL	923	Residual Oil (No. 6)
2103006000	Commercial/Institutional	Natural Gas	IOWA	51,606	BTU	209	Natural Gas
2103006000	Commercial/Institutional	Natural Gas	IOWA	719,333	E3FT3	209	Natural Gas
2103006000	Commercial/Institutional	Natural Gas	IOWA	1	E3GAL	58	Distillate Oil (No. 2)
2103006000	Commercial/Institutional	Natural Gas	IOWA	6	E3GAL	209	Natural Gas
2103006000	Commercial/Institutional	Natural Gas	IOWA	0	E6BTU	209	Natural Gas
2103006000	Commercial/Institutional	Natural Gas	IOWA	28	E6FT3	127	Gasoline
2103006000	Commercial/Institutional	Natural Gas	IOWA	28	E6FT3	189	Material
2103006000	Commercial/Institutional	Natural Gas	IOWA	465,334	E6FT3	209	Natural Gas
2103006000	Commercial/Institutional	Natural Gas	IOWA	16	E6FT3	268	Raw Material
2103006000	Commercial/Institutional	Natural Gas	IOWA	0	E6GAL	823	Distillate Oil (No. 1 & 2)
2103006000	Commercial/Institutional	Natural Gas	IOWA	8,169,622	FT3	209	Natural Gas
2103006000	Commercial/Institutional	Natural Gas	IOWA	576	GAL	58	Distillate Oil (No. 2)
2103006000	Commercial/Institutional	Natural Gas	IOWA	0	GAL	209	Natural Gas
2103006000	Commercial/Institutional	Natural Gas	IOWA	831	GAL	255	Propane
2103006000	Commercial/Institutional	Natural Gas	IOWA	24	HR	44	Diesel

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2103006000	Commercial/Institutional	Natural Gas	IOWA	13,632	TON	209	Natural Gas
2103006000	Commercial/Institutional	Natural Gas	IOWA	0	TON	225	Paint
2103006000	Commercial/Institutional	Natural Gas	IOWA	16,178	TON	724	Coke
2103006000	Commercial/Institutional	Natural Gas	IOWA				
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	IOWA	0	E3GAL	178	Liquified Petroleum Gas (LPG)
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	IOWA	0	E3GAL	255	Propane
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	IOWA	0	E3GAL	268	Raw Material
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	IOWA	15	E6FT3	209	Natural Gas
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	IOWA	0	E6GAL	268	Raw Material
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	IOWA	88,575	GAL	255	Propane
2103008000	Commercial/Institutional	Wood	IOWA	7,142	TON	15	Wood
2102004000	Industrial	Distillate Oil	KANSAS	1,148	E3GAL	44	Diesel
2102004000	Industrial	Distillate Oil	KANSAS	92,275	E3GAL	56	Distillate Oil
2102004000	Industrial	Distillate Oil	KANSAS	83	E3GAL	823	Distillate Oil (No. 1 & 2)
2102004000	Industrial	Distillate Oil	KANSAS	2,437	E3HP-HR	945	Work
2102004000	Industrial	Distillate Oil	KANSAS	22,979	E6BTU	44	Diesel
2102004000	Industrial	Distillate Oil	KANSAS	488	E6BTU	58	Distillate Oil (No. 2)
2102004000	Industrial	Distillate Oil	KANSAS	1,082,040	HP-HR	945	Work
2102004000	Industrial	Distillate Oil	KANSAS	233	HR	209	Natural Gas
2102004000	Industrial	Distillate Oil	KANSAS	716	HR	945	Work
2102004000	Industrial	Distillate Oil	KANSAS	10,248,064	KW-HR	828	Electricity
2102004000	Industrial	Distillate Oil	KANSAS	0			
2102005000	Industrial	Residual Oil	KANSAS	380	E3GAL	922	Residual Oil (No. 5)
2102005000	Industrial	Residual Oil	KANSAS	3,402	E3GAL	923	Residual Oil (No. 6)
2102005000	Industrial	Residual Oil	KANSAS	48	E6BTU	923	Residual Oil (No. 6)
2102006000	Industrial	Natural Gas	KANSAS	287	E3FT3	209	Natural Gas
2102006000	Industrial	Natural Gas	KANSAS	19	E3GAL	189	Material
2102006000	Industrial	Natural Gas	KANSAS	2,594,753	E3HP-HR	945	Work
2102006000	Industrial	Natural Gas	KANSAS	17,010,214	E6BTU	209	Natural Gas
2102006000	Industrial	Natural Gas	KANSAS	282,631	E6FT3	209	Natural Gas
2102006000	Industrial	Natural Gas	KANSAS	39	EACH	189	Material
2102006000	Industrial	Natural Gas	KANSAS	288,425,458	HP-HR	945	Work
2102006000	Industrial	Natural Gas	KANSAS	100	HR	127	Gasoline
2102006000	Industrial	Natural Gas	KANSAS	856,039	HR	209	Natural Gas
2102006000	Industrial	Natural Gas	KANSAS	100,217	HR	945	Work

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2102006000	Industrial	Natural Gas	KANSAS	269	LB	209	Natural Gas
2102006000	Industrial	Natural Gas	KANSAS	10,000	LB	635	Ammonia
2102006000	Industrial	Natural Gas	KANSAS	7	TON	209	Natural Gas
2102006000	Industrial	Natural Gas	KANSAS	25	TON	305	Solvent
2102006000	Industrial	Natural Gas	KANSAS	0			
2102007000	Industrial	Liquified Petroleum Gas (LPG)	KANSAS	5	E3GAL	178	Liquified Petroleum Gas (LPG)
2102007000	Industrial	Liquified Petroleum Gas (LPG)	KANSAS	54	E3GAL	178	Liquified Petroleum Gas (LPG)
2102007000	Industrial	Liquified Petroleum Gas (LPG)	KANSAS	0	E3GAL	189	Material
2102007000	Industrial	Liquified Petroleum Gas (LPG)	KANSAS	99	E3GAL	255	Propane
2103004000	Commercial/Institutional	Distillate Oil	KANSAS	22	E3GAL	44	Diesel
2103004000	Commercial/Institutional	Distillate Oil	KANSAS	29	E3GAL	823	Distillate Oil (No. 1 & 2)
2103004000	Commercial/Institutional	Distillate Oil	KANSAS	0			
2103006000	Commercial/Institutional	Natural Gas	KANSAS	3,150	E6FT3	209	Natural Gas
2103006000	Commercial/Institutional	Natural Gas	KANSAS	0	EACH	189	Material
2103006000	Commercial/Institutional	Natural Gas	KANSAS	107,768	HR	209	Natural Gas
2103006000	Commercial/Institutional	Natural Gas	KANSAS	7,200	HR	945	Work
2103006000	Commercial/Institutional	Natural Gas	KANSAS	0			
2102002000	Industrial	Bituminous/Subbituminous Coal	LOUISIANA				
2102004000	Industrial	Distillate Oil	LOUISIANA				
2102005000	Industrial	Residual Oil	LOUISIANA				
2102006000	Industrial	Natural Gas	LOUISIANA				
2102007000	Industrial	Liquified Petroleum Gas (LPG)	LOUISIANA				
2102008000	Industrial	Wood	LOUISIANA				
2103004000	Commercial/Institutional	Distillate Oil	LOUISIANA				
2103005000	Commercial/Institutional	Residual Oil	LOUISIANA				
2103006000	Commercial/Institutional	Natural Gas	LOUISIANA				
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	LOUISIANA				
2102002000	Industrial	Bituminous/Subbituminous Coal	MINNESOTA	6,138,274	E6BTU	142	Heat
2102002000	Industrial	Bituminous/Subbituminous Coal	MINNESOTA	10,584	HR	830	Equipment
2102002000	Industrial	Bituminous/Subbituminous Coal	MINNESOTA	582,249	TON	323	Subbituminous Coal
2102002000	Industrial	Bituminous/Subbituminous Coal	MINNESOTA	81,870	TON	663	Bituminous Coal
2102004000	Industrial	Distillate Oil	MINNESOTA	232	E3GAL	44	Diesel
2102004000	Industrial	Distillate Oil	MINNESOTA	4,003	E3GAL	57	Distillate Oil (Diesel)
2102004000	Industrial	Distillate Oil	MINNESOTA	1,071	E3GAL	823	Distillate Oil (No. 1 & 2)
2102004000	Industrial	Distillate Oil	MINNESOTA	535	E3GAL	825	Distillate Oil (No. 4)

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2102004000	Industrial	Distillate Oil	MINNESOTA	586	E6BTU	142	Heat
2102004000	Industrial	Distillate Oil	MINNESOTA	1,353,017	GAL	57	Distillate Oil (Diesel)
2102004000	Industrial	Distillate Oil	MINNESOTA	342,565	GAL	823	Distillate Oil (No. 1 & 2)
2102004000	Industrial	Distillate Oil	MINNESOTA				
2102005000	Industrial	Residual Oil	MINNESOTA	362	E3GAL	279	Residual Oil
2102005000	Industrial	Residual Oil	MINNESOTA	370	E3GAL	922	Residual Oil (No. 5)
2102005000	Industrial	Residual Oil	MINNESOTA	21,526	E3GAL	923	Residual Oil (No. 6)
2102005000	Industrial	Residual Oil	MINNESOTA	34,637	E6BTU	142	Heat
2102006000	Industrial	Natural Gas	MINNESOTA	6,400,498	E6BTU	142	Heat
2102006000	Industrial	Natural Gas	MINNESOTA	39,046	E6FT3	209	Natural Gas
2102006000	Industrial	Natural Gas	MINNESOTA	7,395,200	FT3	209	Natural Gas
2102006000	Industrial	Natural Gas	MINNESOTA	19,936,121,225	GAL	209	Natural Gas
2102006000	Industrial	Natural Gas	MINNESOTA	155,328	HR	830	Equipment
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MINNESOTA	94,000	BTU	142	Heat
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MINNESOTA	1,212	E3GAL	255	Propane
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MINNESOTA	209	E3GAL	675	Butane
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MINNESOTA	274	E6BTU	142	Heat
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MINNESOTA	266,584	GAL	255	Propane
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MINNESOTA	626	HR	830	Equipment
2102008000	Industrial	Wood	MINNESOTA	4,675,962	E6BTU	142	Heat
2102008000	Industrial	Wood	MINNESOTA	16,467	HR	830	Equipment
2102008000	Industrial	Wood	MINNESOTA	120,057	TON	15	Wood
2102008000	Industrial	Wood	MINNESOTA	89,216	TON	943	Wood/Bark
2102011000	Industrial	Kerosene	MINNESOTA	12	E3GAL	159	Jet Fuel
2103001000	Commercial/Institutional	Anthracite Coal	MINNESOTA				
2103002000	Commercial/Institutional	Bituminous/Subbituminous Coal	MINNESOTA	2,648	E6BTU	142	Heat
2103002000	Commercial/Institutional	Bituminous/Subbituminous Coal	MINNESOTA	184,324	TON	323	Subbituminous Coal
2103002000	Commercial/Institutional	Bituminous/Subbituminous Coal	MINNESOTA	51,658	TON	663	Bituminous Coal
2103004000	Commercial/Institutional	Distillate Oil	MINNESOTA	1,197	E3GAL	57	Distillate Oil (Diesel)
2103004000	Commercial/Institutional	Distillate Oil	MINNESOTA	1,334	E3GAL	823	Distillate Oil (No. 1 & 2)
2103004000	Commercial/Institutional	Distillate Oil	MINNESOTA	29	E3GAL	825	Distillate Oil (No. 4)
2103005000	Commercial/Institutional	Residual Oil	MINNESOTA	1,695	E3GAL	922	Residual Oil (No. 5)
2103005000	Commercial/Institutional	Residual Oil	MINNESOTA	3,303	E3GAL	923	Residual Oil (No. 6)
2103006000	Commercial/Institutional	Natural Gas	MINNESOTA	8,623,850	E6BTU	142	Heat
2103006000	Commercial/Institutional	Natural Gas	MINNESOTA	19,921	E6FT3	209	Natural Gas

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2103006000	Commercial/Institutional	Natural Gas	MINNESOTA	174,979	HR	830	Equipment
2103006000	Commercial/Institutional	Natural Gas	MINNESOTA				
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	MINNESOTA	3,033	E3GAL	255	Propane
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	MINNESOTA	4,614	E6BTU	142	Heat
2103008000	Commercial/Institutional	Wood	MINNESOTA	1,096	TON	15	Wood
2103008000	Commercial/Institutional	Wood	MINNESOTA	246,551	TON	943	Wood/Bark
2102002000	Industrial	Bituminous/Subbituminous Coal	MISSOURI	20,843	TON	174	Lime
2102002000	Industrial	Bituminous/Subbituminous Coal	MISSOURI	0	TON	189	Material
2102002000	Industrial	Bituminous/Subbituminous Coal	MISSOURI	271,022	TON	663	Bituminous Coal
2102002000	Industrial	Bituminous/Subbituminous Coal	MISSOURI				
2102004000	Industrial	Distillate Oil	MISSOURI	0	E2LB	253	Product
2102004000	Industrial	Distillate Oil	MISSOURI	77,335	E3GAL	44	Diesel
2102004000	Industrial	Distillate Oil	MISSOURI	1,146	E3GAL	56	Distillate Oil
2102004000	Industrial	Distillate Oil	MISSOURI	3,922	E3GAL	57	Distillate Oil (Diesel)
2102004000	Industrial	Distillate Oil	MISSOURI	1,462,931	E3GAL	58	Distillate Oil (No. 2)
2102004000	Industrial	Distillate Oil	MISSOURI	0	E3GAL	352	Toluene
2102004000	Industrial	Distillate Oil	MISSOURI	641	E3GAL	823	Distillate Oil (No. 1 & 2)
2102004000	Industrial	Distillate Oil	MISSOURI	0	E3GAL	825	Distillate Oil (No. 4)
2102004000	Industrial	Distillate Oil	MISSOURI	0	E3GAL	868	Liquid
2102004000	Industrial	Distillate Oil	MISSOURI	0	E3GAL	908	Petroleum Distillate
2102004000	Industrial	Distillate Oil	MISSOURI	27	E3GAL-YR	58	Distillate Oil (No. 2)
2102004000	Industrial	Distillate Oil	MISSOURI	0	E3GAL-YR	127	Gasoline
2102004000	Industrial	Distillate Oil	MISSOURI	10	E3GAL-YR	192	Methanol
2102004000	Industrial	Distillate Oil	MISSOURI	20	E6FT3	209	Natural Gas
2102004000	Industrial	Distillate Oil	MISSOURI	1	E6GAL	4	Wastewater
2102004000	Industrial	Distillate Oil	MISSOURI	0	EACH	364	Unit
2102004000	Industrial	Distillate Oil	MISSOURI	235	MILE	368	Vehicle
2102004000	Industrial	Distillate Oil	MISSOURI	24	TON	133	Grain
2102004000	Industrial	Distillate Oil	MISSOURI	0	TON	174	Lime
2102004000	Industrial	Distillate Oil	MISSOURI	1,462,933	TON	189	Material
2102004000	Industrial	Distillate Oil	MISSOURI	1	TON	189	Material
2102004000	Industrial	Distillate Oil	MISSOURI	13	TON	253	Product
2102004000	Industrial	Distillate Oil	MISSOURI	226	TON	268	Raw Material
2102004000	Industrial	Distillate Oil	MISSOURI	0	TON	311	Soybean Meal
2102004000	Industrial	Distillate Oil	MISSOURI	5	TON	849	Hot Mix Asphalt

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2102004000	Industrial	Distillate Oil	MISSOURI				
2102005000	Industrial	Residual Oil	MISSOURI	345	E3GAL	279	Residual Oil
2102005000	Industrial	Residual Oil	MISSOURI	9	E3GAL	922	Residual Oil (No. 5)
2102005000	Industrial	Residual Oil	MISSOURI	1,512	E3GAL	923	Residual Oil (No. 6)
2102005000	Industrial	Residual Oil	MISSOURI	2	E3GAL	924	Residual/Crude Oil
2102005000	Industrial	Residual Oil	MISSOURI	30	TON	174	Lime
2102005000	Industrial	Residual Oil	MISSOURI	0	TON	189	Material
2102005000	Industrial	Residual Oil	MISSOURI	0	TON	849	Hot Mix Asphalt
2102005000	Industrial	Residual Oil	MISSOURI				
2102006000	Industrial	Natural Gas	MISSOURI	84	ACRE-YR	320	Storage Area
2102006000	Industrial	Natural Gas	MISSOURI	0	BALE	740	Cotton
2102006000	Industrial	Natural Gas	MISSOURI	25	E2LB	253	Product
2102006000	Industrial	Natural Gas	MISSOURI	16	E3EACH	654	Batteries
2102006000	Industrial	Natural Gas	MISSOURI	0	E3FT3	189	Material
2102006000	Industrial	Natural Gas	MISSOURI	15	E3GAL	44	Diesel
2102006000	Industrial	Natural Gas	MISSOURI	63	E3GAL	56	Distillate Oil
2102006000	Industrial	Natural Gas	MISSOURI	233	E3GAL	57	Distillate Oil (Diesel)
2102006000	Industrial	Natural Gas	MISSOURI	56	E3GAL	58	Distillate Oil (No. 2)
2102006000	Industrial	Natural Gas	MISSOURI	21	E3GAL	178	Liquified Petroleum Gas (LPG)
2102006000	Industrial	Natural Gas	MISSOURI	24	E3GAL	189	Material
2102006000	Industrial	Natural Gas	MISSOURI	133	E3GAL	255	Propane
2102006000	Industrial	Natural Gas	MISSOURI	123	E3GAL	823	Distillate Oil (No. 1 & 2)
2102006000	Industrial	Natural Gas	MISSOURI	0	E3GAL-YR	58	Distillate Oil (No. 2)
2102006000	Industrial	Natural Gas	MISSOURI	79	E3GAL-YR	127	Gasoline
2102006000	Industrial	Natural Gas	MISSOURI	2	E3GAL-YR	374	Crude Oil
2102006000	Industrial	Natural Gas	MISSOURI	11	E3GAL-YR	865	Jet Kerosene
2102006000	Industrial	Natural Gas	MISSOURI	190	E3GAL-YR	868	Liquid
2102006000	Industrial	Natural Gas	MISSOURI	5,202	E3GAL-YR	908	Petroleum Distillate
2102006000	Industrial	Natural Gas	MISSOURI	254,692	E6FT3	209	Natural Gas
2102006000	Industrial	Natural Gas	MISSOURI	0	EACH	364	Unit
2102006000	Industrial	Natural Gas	MISSOURI	206	EACH	368	Vehicle
2102006000	Industrial	Natural Gas	MISSOURI	97	EACH	712	Circuit Boards
2102006000	Industrial	Natural Gas	MISSOURI	26	GAL	151	Ink
2102006000	Industrial	Natural Gas	MISSOURI	12	GAL	189	Material
2102006000	Industrial	Natural Gas	MISSOURI	9	GAL	305	Solvent

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2102006000	Industrial	Natural Gas	MISSOURI	375	GAL	720	Coating
2102006000	Industrial	Natural Gas	MISSOURI	5	MILE	368	Vehicle
2102006000	Industrial	Natural Gas	MISSOURI	32	TON	93	Ethylene Oxide
2102006000	Industrial	Natural Gas	MISSOURI	59	TON	133	Grain
2102006000	Industrial	Natural Gas	MISSOURI	153	TON	174	Lime
2102006000	Industrial	Natural Gas	MISSOURI	1,780	TON	189	Material
2102006000	Industrial	Natural Gas	MISSOURI	456	TON	189	Material
2102006000	Industrial	Natural Gas	MISSOURI	15	TON	224	P2O5
2102006000	Industrial	Natural Gas	MISSOURI	121	TON	253	Product
2102006000	Industrial	Natural Gas	MISSOURI	73	TON	268	Raw Material
2102006000	Industrial	Natural Gas	MISSOURI	2	TON	289	Sand
2102006000	Industrial	Natural Gas	MISSOURI	293	TON	305	Solvent
2102006000	Industrial	Natural Gas	MISSOURI	348	TON	306	Solvent in Coating
2102006000	Industrial	Natural Gas	MISSOURI	65	TON	311	Soybean Meal
2102006000	Industrial	Natural Gas	MISSOURI	0	TON	315	Starch
2102006000	Industrial	Natural Gas	MISSOURI	6	TON	516	Metal
2102006000	Industrial	Natural Gas	MISSOURI	116	TON	516	Metal
2102006000	Industrial	Natural Gas	MISSOURI	0	TON	673	Brick
2102006000	Industrial	Natural Gas	MISSOURI	1	TON	699	Charge
2102006000	Industrial	Natural Gas	MISSOURI	13	TON	723	Coating Mix
2102006000	Industrial	Natural Gas	MISSOURI				
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	4,610	E3GAL	178	Liquified Petroleum Gas (LPG)
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	12,560	E3GAL	255	Propane
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	9	E3GAL-YR	374	Crude Oil
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	122	E3GAL-YR	908	Petroleum Distillate
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	2	E3LB	77	Electrode
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	9	GAL	305	Solvent
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	39	GAL	720	Coating
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	186	MILE	368	Vehicle
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	0	TON	15	Wood
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	0	TON	133	Grain
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	37	TON	189	Material
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	29	TON	268	Raw Material
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	10	TON	291	Sawdust
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	0	TON	306	Solvent in Coating

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	0	TON	723	Coating Mix
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI	0	TON	849	Hot Mix Asphalt
2102007000	Industrial	Liquified Petroleum Gas (LPG)	MISSOURI				
2102008000	Industrial	Wood	MISSOURI	13,640	MILE	368	Vehicle
2102008000	Industrial	Wood	MISSOURI	435,597	TON	15	Wood
2102008000	Industrial	Wood	MISSOURI	366	TON	18	Wood Waste
2102008000	Industrial	Wood	MISSOURI	133,848	TON	943	Wood/Bark
2102011000	Industrial	Kerosene	MISSOURI	115	E3GAL	159	Jet Fuel
2102011000	Industrial	Kerosene	MISSOURI	0	GAL	305	Solvent
2102011000	Industrial	Kerosene	MISSOURI	0	MILE	368	Vehicle
2102011000	Industrial	Kerosene	MISSOURI				
2103002000	Commercial/Institutional	Bituminous/Subbituminous Coal	MISSOURI	20,339	TON	663	Bituminous Coal
2103002000	Commercial/Institutional	Bituminous/Subbituminous Coal	MISSOURI				
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	0	E3GAL	44	Diesel
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	423	E3GAL	56	Distillate Oil
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	1,295	E3GAL	57	Distillate Oil (Diesel)
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	8	E3GAL	127	Gasoline
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	26,744	E3GAL	823	Distillate Oil (No. 1 & 2)
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	6	E3GAL	825	Distillate Oil (No. 4)
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	12	E6FT3	209	Natural Gas
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	0	MILE	368	Vehicle
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	1	TON	180	Logs
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	0	TON	253	Product
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	1	TON	291	Sawdust
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI	0	TON	306	Solvent in Coating
2103004000	Commercial/Institutional	Distillate Oil	MISSOURI				
2103005000	Commercial/Institutional	Residual Oil	MISSOURI	719	E3GAL	279	Residual Oil
2103005000	Commercial/Institutional	Residual Oil	MISSOURI	11	E3GAL	922	Residual Oil (No. 5)
2103005000	Commercial/Institutional	Residual Oil	MISSOURI	32	E3GAL	923	Residual Oil (No. 6)
2103005000	Commercial/Institutional	Residual Oil	MISSOURI	4	E3GAL-YR	58	Distillate Oil (No. 2)
2103005000	Commercial/Institutional	Residual Oil	MISSOURI	2	E6FT3	209	Natural Gas
2103005000	Commercial/Institutional	Residual Oil	MISSOURI				
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	8	ACRE-YR	320	Storage Area
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	125	E3GAL	57	Distillate Oil (Diesel)
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	60	E3GAL	58	Distillate Oil (No. 2)

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	1	E3GAL	127	Gasoline
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	1	E3GAL	305	Solvent
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	282	E3GAL-YR	58	Distillate Oil (No. 2)
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	69	E3GAL-YR	127	Gasoline
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	40,033	E6FT3	209	Natural Gas
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	62	GAL	189	Material
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	141	GAL	720	Coating
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	95	MILE	368	Vehicle
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	30	TON	65	Dried Sludge
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	5	TON	129	Glaze
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	29	TON	133	Grain
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	17	TON	151	Ink
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	0	TON	180	Logs
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	41	TON	189	Material
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	6	TON	224	P2O5
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	16	TON	253	Product
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	355	TON	306	Solvent in Coating
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	39	TON	308	Solvent in Ink
2103006000	Commercial/Institutional	Natural Gas	MISSOURI	8	TON	874	Medical Waste
2103006000	Commercial/Institutional	Natural Gas	MISSOURI				
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	MISSOURI	25	E3GAL	178	Liquified Petroleum Gas (LPG)
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	MISSOURI	24,781	E3GAL	255	Propane
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	MISSOURI	9	E6FT3	209	Natural Gas
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	MISSOURI	1	TON	253	Product
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	MISSOURI				
2103008000	Commercial/Institutional	Wood	MISSOURI	25,448	TON	15	Wood
2103008000	Commercial/Institutional	Wood	MISSOURI	128	TON	943	Wood/Bark
2102002000	Industrial	Bituminous/Subbituminous Coal	NEBRASKA	45,820	TON		
2102004000	Industrial	Distillate Oil	NEBRASKA	137,269	E3GAL		
2102004000	Industrial	Distillate Oil	NEBRASKA				
2102005000	Industrial	Residual Oil	NEBRASKA	268	E3GAL		
2102006000	Industrial	Natural Gas	NEBRASKA	319,058	E3FT3		
2102006000	Industrial	Natural Gas	NEBRASKA	7,733,748	E6FT3		
2102006000	Industrial	Natural Gas	NEBRASKA	232	MASS	1	Waste Material
2102006000	Industrial	Natural Gas	NEBRASKA				

Area_SCC	SCC_2	Area SCC_3	StateName	Throughput	ThroughputUnits	Material Code	Material
2102007000	Industrial	Liquified Petroleum Gas (LPG)	NEBRASKA	48	E3GAL		
2102008000	Industrial	Wood	NEBRASKA	1,141	TON		
2103004000	Commercial/Institutional	Distillate Oil	NEBRASKA	0	E3GAL		
2103006000	Commercial/Institutional	Natural Gas	NEBRASKA	168,142	E6FT3		
2103006000	Commercial/Institutional	Natural Gas	NEBRASKA	22	MASS	1	Waste Material
2103006000	Commercial/Institutional	Natural Gas	NEBRASKA				
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	NEBRASKA	4,866	E3GAL		
2103008000	Commercial/Institutional	Wood	NEBRASKA	9,398	TON		
2102001000	Industrial	Anthracite Coal	OKLAHOMA	645			
2102002000	Industrial	Bituminous/Subbituminous Coal	OKLAHOMA	2,181,492			
2102004000	Industrial	Distillate Oil	OKLAHOMA	25,021			
2102005000	Industrial	Residual Oil	OKLAHOMA	1,463			
2102006000	Industrial	Natural Gas	OKLAHOMA	10,908,513			
2102007000	Industrial	Liquified Petroleum Gas (LPG)	OKLAHOMA	0			
2102008000	Industrial	Wood	OKLAHOMA	114,619			
2103004000	Commercial/Institutional	Distillate Oil	OKLAHOMA	21			
2103006000	Commercial/Institutional	Natural Gas	OKLAHOMA	228,899			
2102002000	Industrial	Bituminous/Subbituminous Coal	TEXAS				
2102004000	Industrial	Distillate Oil	TEXAS				
2102005000	Industrial	Residual Oil	TEXAS				
2102006000	Industrial	Natural Gas	TEXAS				
2102007000	Industrial	Liquified Petroleum Gas (LPG)	TEXAS				
2102008000	Industrial	Wood	TEXAS				
2102011000	Industrial	Kerosene	TEXAS				
2103004000	Commercial/Institutional	Distillate Oil	TEXAS				
2103006000	Commercial/Institutional	Natural Gas	TEXAS				
2103007000	Commercial/Institutional	Liquified Petroleum Gas (LPG)	TEXAS				
2103008000	Commercial/Institutional	Wood	TEXAS				
2103011000	Commercial/Institutional	Kerosene	TEXAS				