

## **Appendix B: Air Toxics Emissions Information**

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### **Introduction**

This appendix describes the sources of air toxics emissions in Minnesota using data from the Minnesota air toxics emission inventory. The Minnesota Pollution Control Agency (MPCA) compiles an air toxics emission inventory every three years to correspond to the national emission inventory cycle. At this time, the most current air toxics emission inventory is for calendar year 2002. The work for the 2005 emission inventory is under way. This report presents the 2002 Minnesota air toxics emission inventory data.

The air toxics emissions inventory includes three principal source categories: point, area, and mobile sources. MPCA staff estimated emissions for point source, majority categories of area sources and mobile sources. The results for certain categories of area sources and mobile sources were obtained from EPA's 2002 National Emission Inventory.<sup>1</sup> The following sections provide a brief description of source categories, emission estimation methods for point and area sources, and results for all three principal source categories.

### **Point Sources**

Unlike some other states, Minnesota does not have comprehensive air toxic emission inventory reporting requirements for industrial sources that go beyond the Toxics Release Inventory reporting requirements. However, for the Minnesota criteria pollutant emission inventory, the MPCA collects emission data annually from facilities that can emit more than a threshold amount of a criteria pollutant. The pollutants inventoried for the criteria pollutant inventory include: carbon monoxide, nitrogen oxides, particulate matter, particulate matter smaller than 10 microns, lead, sulfur dioxide, and volatile organic compounds.

These larger stationary sources are required to obtain a permit from the MPCA and are called point sources. Therefore, for the purpose of the Minnesota air toxics emission inventory, point sources are identified as facilities that are required to submit their annual inventories of criteria pollutants to the MPCA. According to this definition, in 2002 there were a total of 2198 point sources. Examples of point sources include electric utilities, refineries, and manufacturing plants.

Three methods are used to estimate air toxics emissions from point sources: 1) direct reporting by facilities; 2) using emission factors; and 3) incorporating data from the Toxics Release Inventory (TRI) and the National Emission Inventory (NEI). The MPCA received 2002 air toxics emission information reported by 549 facilities, including refineries, iron ores mining, electric services/coal burning facilities, other manufacturing facilities, and facilities holding Option D air quality permits with actual VOC emissions of more than 5 tons. (These Option D facilities are mainly smaller companies using paints and primers, cleaning solvents, printing solutions, and paint thinners, and are required to track monthly hazardous air pollutant emissions.) MPCA staff incorporated TRI emissions information for 133 facilities; including 56 facilities that do not have air emission permits. MPCA also obtained emissions from the NEI for 25 additional facilities. For facilities that did not directly report air toxics emissions, staff used throughput activity data from the Minnesota criteria emission inventory and emission factors to

calculate emissions. (Combustion units were the principal processes for which emissions were calculated at these facilities.) As a result, staff was able to estimate emissions of one or more targeted pollutants from 1258 out of 2198 point sources for year 2002. The 2002 inventory includes point source emissions from 273 distinct standard industrial classification (SIC) codes and 349 distinct source classification codes (SCC).

## Area Sources

Area sources are stationary sources that are not required to submit criteria pollutant data to the MPCA. They are small emission sources, but collectively can release large amounts of toxic air pollutants. The categories of area sources have been determined by reviewing EPA's 1999 and 2002 Nonpoint Source NEIs for Hazardous Air Pollutants, Emission Inventory Improvement Program documents and other available information. The emission data for area sources were obtained from surveys, literature, and the submittals from facilities such as dry cleaners or halogenated solvent cleaners subject to a National Emission Standard for Hazardous Air Pollutants. There are 33 categories and 75 distinct SCCs included in the Minnesota emission inventory for area sources. Table 1 lists all these categories along with activity data and information sources.

## Mobile Sources

Mobile sources typically include any kind of vehicle or equipment with an engine burning a fuel such as gasoline, diesel, or natural gas. They are further sub-categorized to twenty eight types of on-road vehicles (see below) and four types of nonroad sources: airport (including aircraft and ground support equipment), locomotives, commercial marine vessels, and nonroad equipment.

The twenty eight vehicle types are described below.

- Light-Duty Gasoline Vehicles (LDGV) (Passenger Cars)
- Light-Duty Gasoline Trucks 1 (LDGT1) (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
- Light-Duty Gasoline Trucks 2 (LDGT2) (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
- Light-Duty Gasoline Trucks 3 (LDGT3) (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW)
- Light-Duty Gasoline Trucks 4 (LDGT4) (6,001-8,500 lbs. GVWR, greater than 5,751 lbs. ALVW)
- Class 2b Heavy-Duty Gasoline Vehicles (HDGV2b) (8,501-10,000 lbs. GVWR)
- Class 3 Heavy-Duty Gasoline Vehicles (HDGV3) (10,001-14,000 lbs. GVWR)
- Class 4 Heavy-Duty Gasoline Vehicles (HDGV4) (14,001-16,000 lbs. GVWR)
- Class 5 Heavy-Duty Gasoline Vehicles (HDGV5) (16,001-19,500 lbs. GVWR)
- Class 6 Heavy-Duty Gasoline Vehicles (HDGV6) (19,501-26,000 lbs. GVWR)
- Class 7 Heavy-Duty Gasoline Vehicles (HDGV7) (26,001-33,000 lbs. GVWR)
- Class 8a Heavy-Duty Gasoline Vehicles (HDGV8a) (33,001-60,000 lbs. GVWR)
- Class 8b Heavy-Duty Gasoline Vehicles (HDGV8b) (>60,000 lbs. GVWR)
- Light-Duty Diesel Vehicles (LDDV) (Passenger Cars)
- Light-Duty Diesel Trucks 1 & 2 (LDDT12) (0-6,000 lbs. GVWR)
- Class 2b Heavy-Duty Diesel Vehicles (HDDV2b) (8,501-10,000 lbs. GVWR)
- Class 3 Heavy-Duty Diesel Vehicles (HDDV3) (10,001-14,000 lbs. GVWR)

- Class 4 Heavy-Duty Diesel Vehicles (HDDV4) (14,001-16,000 lbs. GVWR)
- Class 5 Heavy-Duty Diesel Vehicles (HDDV5) (16,001-19,500 lbs. GVWR)
- Class 6 Heavy-Duty Diesel Vehicles (HDDV6) (19,501-26,000 lbs. GVWR)
- Class 7 Heavy-Duty Diesel Vehicles (HDDV7) (26,001-33,000 lbs. GVWR)
- Class 8a Heavy-Duty Diesel Vehicles (HDDV8a) (33,001-60,000 lbs. GVWR)
- Class 8b Heavy-Duty Diesel Vehicles (HDDV8b) (>60,000 lbs. GVWR)
- Motorcycles (MC) (Gasoline)
- Gasoline Buses (HDGB) (School, Transit and Urban)
- Diesel Transit and Urban Buses (HDDBT)
- Diesel School Buses (HDDBS)
- Light-Duty Diesel Trucks 3 and 4 (LDDT34) (6,001-8,500 lbs. GVWR).

There are also nine types of nonroad equipment, including:

- Agricultural Equipment
- Commercial Equipment
- Construction and Mining Equipment
- Industrial Equipment
- Lawn and Garden Equipment
- Logging Equipment
- Pleasure Craft
- Railroad Equipment
- Recreational Equipment.

For onroad mobile sources, MPCA staff used the U.S. EPA's vehicle emission modeling software, MOBILE6.2, and vehicle miles traveled data to estimate PM, VOC, and certain air toxics emissions. Then, PM and VOC emissions were speciated to emissions of other individual air toxics. MPCA staff collected activity data and estimated emissions for locomotives, aircraft and airport ground support equipment. For commercial marine vessels, MPCA staff estimated air toxics emissions based on PM and VOC emissions prepared by the Central States Regional Air Planning Association (CenRAP) for 2002.<sup>2</sup> For all nonroad equipment, MPCA used estimates from the EPA's National Mobile Inventory Model (NMIM) prepared by the Lake Michigan Air Directors Consortium (LADCO) except snowmobile and pleasure craft. For those two categories, MPCA revised the results with survey data on fuel usage from the MN Department of Natural Resources.

## Emissions

The MPCA staff attempted to estimate emissions for about 500 target compounds, including 188 Hazardous Air Pollutants listed by EPA, pollutants in the Great Lakes regional air toxics emission inventory project, and pollutants monitored in Minnesota's outdoor air. For a complete list of the compounds in the 2002 inventory go to:

<http://www.pca.state.mn.us/air/toxics/toxicsinventory.html>. However, emissions data were only available for 257 of the targeted compounds. The 257 pollutants were categorized to 172 individual and grouped compounds. For example, chromium, strontium chromate, and zinc

chromate were put into the group called chromium compounds. This grouping method is also applied to dioxin congeners, individual glycol ethers, and polycyclic organic matter. Point and area sources emitted 166 and 137 out of the 172 compounds, respectively, while mobile sources emitted 59 of the 172 compounds. Table 2 shows a summary of emissions by principal source category.

Point sources contributed more than two-thirds of the emissions for 87 out of 172 individual and grouped compounds, dominating emissions of metal compounds. Area sources contribute more than 50 percent emissions of individual PAHs, except for acenaphthene. Emissions of acenaphthene are mainly from point sources. Area sources also emit a significant fraction of total emissions for 48 non-metal compounds, such as atrazine, chlorobenzene, cyanide compounds, o-dichlorobenzene, methylene chloride, tetrachloroethylene, 1,1,1-trichloroethane, and trifluralin. Mobile sources are primary contributors to 15 individual and grouped compounds such as 1,3-butadiene, acetaldehyde, benzene, ethylbenzene, formaldehyde, toluene, and xylenes.

On a mass basis, mobile sources (on-road and nonroad) contributed more than half the total air toxics emitted in Minnesota while area sources contributed 30 percent of the total emissions. Point sources emitted much less than other principal source categories, accounting for only 13 percent of total emissions. Figure 1 shows the contribution of point, area, onroad mobile sources, and nonroad mobile sources to the state total air toxics emissions.

A more detailed categorization of total air toxics emissions is shown in Table 3. The categorization was based on the first two digits of Standard Industrial Classification (SIC) codes for point sources. Category names were used for area and mobile sources. Figure 2 shows the top eleven categories that each contributed more than two percent to the total emissions. The emissions of the remaining categories that had less than two percent contributions were summed to a category called "Other". The "Other" category contributed 26 percent of total air toxics emissions. Among the top eleven categories, light duty gasoline vehicles emitted the most, followed by recreational equipment and light duty gasoline trucks 1 & 2. These three categories were each responsible for more than nine percent of total emissions.

A similar categorization was conducted for two air toxics: benzene and formaldehyde. These two pollutants were further analyzed because their ambient concentrations have been observed above levels of concern at many air monitoring sites. Table 4 and Table 5 provide detailed categorization of total emissions for benzene and formaldehyde, respectively. Figures 3 and 4 show the categories that contributed more than two percent to total emissions of benzene and four percent to total emissions of formaldehyde, respectively. For benzene, light duty gasoline vehicles were estimated to emit a quarter of total emissions. Light duty gasoline vehicles, light duty gasoline trucks 1 & 2, and residential wood burning each contributed more than 10 percent of total benzene emissions. For formaldehyde, agricultural equipment and light duty gasoline vehicles contributed to more than 10 percent of total formaldehyde emissions. It is worthwhile to note that contribution of point sources to benzene emissions was insignificant, less than two percent. It should be noted that the emission inventory only estimated direct formaldehyde emissions from human-made sources. Formaldehyde production also occurs indirectly through the oxidation of hydrocarbons and other formaldehyde precursors. These precursors include combustion byproducts and solvent emissions. During the summer, indirect sources of formaldehyde can be greater than direct sources. Natural sources of formaldehyde such as forest

fires, microbial products of biological processes and plant volatiles also significantly contribute to formaldehyde in ambient air.

## Limitations and Uncertainties

Although quality assurance plans are in place to ensure the best results, there are uncertainties and limitations to consider when evaluating the Minnesota air toxics emission inventory. Some limitations are common to air toxics emission inventories in all states and some are specific to Minnesota. For example, in all inventories not all pollutants are included because some emission factors are missing or emission factors are of poor quality, resulting in unrepresentative emission estimates.

There are uncertainties specific to Minnesota. First, the primary concern in the point source inventory is a lack of source-specific emission information from some facilities holding an individual total facility permit. Since chemical species use varies from one facility to the other, the MPCA prefers to collect material usage and composition data from these facilities to estimate emissions. This is particularly important for those facilities using solvents such as in surface coating, solvent cleaning, and printing processes. Facilities with individual total facility permits are usually large, representing a majority of emissions from point sources. MPCA staff sent a letter to 505 these facilities requesting their emissions. Figure 5 shows responding status of these large facilities. Fifty-five percent of facilities responded to the data request for 2002.

MPCA staff was able to calculate air toxics emissions for about 20 percent of the 505 facilities that didn't respond but only have combustion processes. MPCA also incorporated TRI emissions for another 12 percent of 505 facilities that didn't respond. Although data in TRI report were not complete due to its reporting thresholds, MPCA obtained emissions for those pollutants exceeding thresholds. However, MPCA was unable to estimate air toxics emissions for 41 non-responding facilities. Most of the 41 facilities involved solvent-use processes. Air toxics emission data are needed from them. Among the 41 facilities, five ethanol plants didn't respond due to lack of emission factors. These facilities have performed stack testing since then and are expected to submit source-specific emission data for future emission inventories.

Second, air toxics emission data reported by facilities may be based on the assumption that all purchased or used materials are emitted. Actually, in many cases, these materials largely react or are consumed in the industrial process. For example, MPCA conducted a special quality assurance study for 4,4'-methylenediphenyl diisocyanate (MDI). The MPCA staff contacted facilities that showed MDI emissions in 2002 EI, 2005 EI, and 2002 NEI to verify the emissions. As a result of this effort, the state point source MDI emissions dropped from 20 tons to 3 tons while the emitting sources increased from 20 to 51.

Third, MPCA staff could not estimate point source air toxic emissions for facilities with certain types of registration permits. There are 482 and 814 facilities in the Minnesota criteria emission inventory with registration permits Option B and D, respectively. These facilities do not report process level throughput data and have no SCC assigned to them. Without this information, staff could not estimate air toxics emissions for these facilities. Although the MPCA collected data from some Option D facilities and some other facilities may report to the Toxics Release Inventory, most of these small point sources had to be treated more generally as area sources in

the 2002 emission inventory. For the 2002 emission inventory, 99 percent of the Option D facilities (272) that emitted more than 5 tons of VOC reported their air toxics emissions. Facilities with other types of registration permits cannot as easily provide air toxics emissions data because, unlike the Option D registration permit, their permit does not require tracking of air toxics emissions.

Fourth, uncertainties are introduced due to scarce information on control efficiencies for air toxics.

Fifth, a number of emission factors were developed using detection limits or half of the detection limits when the measurements were lower than detection limits. This approach tends to over-estimate emissions.

Sixth, activity levels for some area sources and nonroad equipment were allocated from national totals which might not represent local activities.

The Minnesota air toxics emission inventory is a progressive inventory that changes over time. Its goal is to contain the most accurate emission data available at the time the inventory is compiled. A meaningful comparison of emissions between different inventory years to describe emission reduction is not possible for the following primary reasons:

1. The number of pollutants in the emission inventories has increased over the years (Figure 6);
2. The number of sources and source categories have expanded with time (Figure 7 and Figure 8); and
3. Emission estimation methods, emission factors, and activity data have changed with each inventory year.

## Information

For more information about Minnesota's air toxics inventory and other information related to air toxics in Minnesota, visit this website:

<http://www.pca.state.mn.us/air/toxics/toxicsinventory.html>

Or contact:

Ms. Chun Yi Wu at 651-282-5855 or [chun.yi.wu@pca.state.mn.us](mailto:chun.yi.wu@pca.state.mn.us)

## References

1. *2002 National Emissions Inventory Data & Documentation*; U.S. Environmental Protection Agency, <http://www.epa.gov/ttn/chief/net/2002inventory.html> accessed in November 2006.
2. Ms. Dana Coe Sullivan, Manager, Emissions Assessment, Sonoma Technology, Inc., Personal communication via e-mail. September 2, 2004. E-mail: [Dana@SonomaTech.com](mailto:Dana@SonomaTech.com)

**Table 1. Area source categories and information sources for their activity data.**

<b>Category Name</b>	<b>Sub-Category Name</b>	<b>Emission Estimation Method</b>	<b>Activity Data Information Source</b>
Architectural Surface Coating	Water-based Paint	Apply speciation profiles to VOC. VOC emissions are obtained from population-based estimation method.	Census data
	Solvent-based Paint	Same as above	Same as above
Asphalt Paving	Asphalt Paving	Use state-specific activity data and emission factors.	Survey of asphalt suppliers
Autobody Refinishing	Autobody Refinishing	Use per capita emission factor for VOC and apply speciation profiles to VOC emissions.	Census data
Commercial/Consumer Solvent Products	Commercial/Consumer Solvent Products	Use national per capita emission factors	Census data
Dry Cleaners	Transfer Machines with Control	Use emission factor based on solvent usage and machine type.	NESHAP submittals and survey letters
	Transfer Machines Uncontrolled	Same as above	Same as above
	Dry-Dry Machine with Control	Same as above	Same as above
	Dry-Dry Machine Uncontrolled	Same as above	Same as above
Fluorescent Lamp Breakage	Fluorescent Lamp Breakage	Apportion national numbers of discarded lamp to county values based on the population census data. Use state-specific fractions for recycling and generic emission factors.	Census data
Fluorescent Lamp Recycling	Fluorescent Lamp Recycling	Same as above	Same as above
Gasoline Service Stations	Stage I: Splash Filling of Gasoline Storage Tanks	Use EPA emission factor for VOC and some air toxics. County activity data are allocated from state fuel consumption based on population. Applied speciation profiles to VOC emissions for air toxics without emission factors.	MD of Revenue
	Stage I: Submerged Filling w/o Control of Underground Tanks	Same as above	Same as above
	Stage I: Gasoline Underground Tank Breathing	Same as above	Same as above
	Stage II: Vapor Loss from Vehicle Refueling	Same as above	Same as above

**Table 1. Area source categories and information sources for their activity data.**

<b>Category Name</b>	<b>Sub-Category Name</b>	<b>Emission Estimation Method</b>	<b>Activity Data Information Source</b>
	Stage II: Spilling Loss w/o controls from vehicle refueling	Same as above	Same as above
	Stage I: Total, Aviation Gasoline	Same as above	Same as above
Gasoline Trucks in Transit	Gasoline Trucks in Transit	Use EPA emission factor for VOC. County activity data are allocated from state fuel consumption based on population. Apply speciation profiles to VOC emissions for air toxics.	MD of Revenue
Grain Elevators	Country Grain Elevators	Apportion state pesticide usage to a county-level based on the amount of grain harvested. Calculate with an emission factor method.	MD of Agricultural, U.S. Department of Agriculture
Graphic Arts	All Printing Processes	Apply state-specific speciation profiles to VOC. VOC emissions are obtained from population-based estimation method.	Census data
Hospital Sterilization	Ethylene Oxide	Use EPA emission factor based on size of hospital which can be obtained from MN Department of Health. Size of Hospital based on number of beds	American Hospital Association, MD of Health
Human Cremation	Human Cremation	Emission factors from the 1999 NEI based on tons cremated. Assume 150 LB per body.	MD of Health
Industrial Surface Coating	General Surface Coatings	Use employee-based emission factors for VOC and apply speciation profiles to VOC emissions.	Census data
	High Performance Coatings, Solvent Based Coatings	Use per capita emission factor for VOC and apply speciation profiles to VOC emissions.	Census data
	High Performance Coatings, Water Based Coatings	Same as above	Same as above
Municipal Solid Waste Landfills	Non-flaring MSW Landfills	Create a model based on AP-42, Section 2.4. Most concentrations of air toxics are obtained from MPCA landfill gas study.	MPCA
	Flaring MSW Landfill gas	Use generic emission factors.	MPCA
POTW facilities	Evap. emissions assoc. with treatment	Survey to gather annual influent flowrate and chlorine consumption. Treat big facilities based on actual processes. Assume a typical plant then use emission factors for small facilities.	MPCA Water Quality Division, WWTR
	Evap. emissions assoc. with chlorination	Same as above	Same as above



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<b>Category Name</b>	<b>Sub-Category Name</b>	<b>Emission Estimation Method</b>	<b>Activity Data Information Source</b>
Pesticides - Agricultural	Herbicides, Corn	Use vapor pressure of the active ingredients to determine per acre emission factors. Consider pesticide application and formulation type. Apportion state pesticide usage to a county-level based on crop acreage.	MD of Agricultural, U.S. Department of Agriculture
	Insecticides, Corn	Same as above	Same as above
	Herbicides, Soy Beans	Same as above	Same as above
Prescribed Burning	Prescribed Burning	Apportion 'region' (6 regions in the state) level data on the acreage of prescribed burns to the county level using the proportion of forested land by county. Calculate with an emission factor method.	MD of Natural Resources
Residential Fossil Fuel Combustion	Combustion of Natural Gas	Use population-based fuel consumption and both state - specific and generic emission factors.	
	Combustion of Bituminous/Subbituminous Coal	Same as above	Same as above
	Combustion of Distillate Oil	Same as above	Same as above
	Combustion of Liquid Petroleum Gas (LPG)	Same as above	Same as above
Residential Wood Burning	Certified, Catalytic Woodstoves	Use survey results for fuel consumption and emission factors.	MPCA
	Certified, Non-Catalytic Woodstoves	Same as above	Same as above
	Conventional Woodstoves	Same as above	Same as above
	Fireplace, Cordwood	Same as above	Same as above
	Fireplace, Firelog	Same as above	Same as above
Solvent Cleaning	Open Top Vapor Degreasing, Trichloroethylene (Misc Control )	Use emission factors and facility-specific data on degreasing and solvent consumption.	type of NESHAP submittals and survey
	Open Top Vapor Degreasing, Trichloroethylene (Uncontrol )	Use emission factors and facility-specific data on degreasing and solvent consumption.	type of NESHAP submittals and survey
	Cold, Vapor, and In-Line Cleaning	Use employee-based emission factors for VOC and apply sepciation profiles to VOC emissions.	Census data
	Solvent Cleanup	Use employee-based emission factors for VOC and apply sepciation profiles to VOC emissions.	Census data

**Table 1. Area source categories and information sources for their activity data.**

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
Structure Fires	Residential Structure Fires	Use emission factors recommended by the EIIP document based on tons of material burned. Assume the average total material burned in each fire is 1.15 ton.	MD of Public Safety
Traffic Markings	Water-based paints	Use emission factor based on pain usage. Apply Minnesota specific information from the MSDS for estimating VOC and air toxics.	MD of Transportation and vendors
	Epoxy	Same as above	Same as above
Animal Cremation	Swine	Used EPA emission factors and determined animal population and mortality rates through census and MD of Agriculture. Animal crematory rates were determined through U of Minnesota research and state animal crematory facilities.	Census of Agriculture, MD of Agriculture Composting Animal Mortalities
	Poultry	Same as Above	Same as Above
	Pets	Same as Above	Same as Above
Commercial Cooking	Charbroiling	Used 2002 NEI Data from EPA*	NEI Data
	Frying	Same as Above	Same as Above
Mineral Processes: SIC 32	Mineral Processes	Used 2002 NEI Data from EPA*	NEI Data
Stationary Fuel Combustion, Commercial/Institutional	Subbituminous Coal	Use emission factors for 2002 Electric Generating Units (EGU) and from the Factor Inventory Retrieval Data System along with state fuel consumption and allocation was based upon Comm/Inst employment	U.S. Department of Energy and U.S. Census
		Same as Above	
		Same as Above	Same as Above
	Distillate Oil	Same as Above	Same as Above
	Residual Oil	Emission factors converted from natural gas emission factors based on heat content	Same as Above
	Natural Gas	Emission factors from FIRE	Same as Above
	Liquefied Petroleum Gas (LPG)	Emission factors converted from distillate oil based on heat content	Same as Above
	Wood		Same as Above
	Kerosene		Same as Above
Stationary Source Fuel Combustion, Industrial	Subbituminous Coal	Use emission factors for 2002 Electric Generating Units (EGU) and from the Factor Inventory Retrieval Data along with state fuel consumption and allocation was based upon Comm/Inst employment	U.S. Department of Energy and U.S. Census

**Table 1. Area source categories and information sources for their activity data.**

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
		Same as Above	
		Same as Above	Same as Above
	Distillate Oil	Same as Above	Same as Above
	Residual Oil	Emission factors converted from natural gas emission factors based on heat content	Same as Above
	Natural Gas	Emission factors from FIRE	Same as Above
	Liquefied Petroleum Gas (LPG)	Emission factors converted from distillate oil based on heat content	Same as Above
	Wood		Same as Above
	Kerosene		Same as Above
Swimming Pools	Residential	Used 2002 NEI Data from EPA*	NEI Data
	Commercial	Same as Above	Same as Above
Tank/Drum Cleaning	Tank Cleaning	Used 2002 NEI Data from EPA*	NEI Data
Unpaved Roads	Unpaved Roads	Used 2002 NEI Data from EPA*	NEI Data
Waste Disposal	Open Burning	Used 2002 NEI Data from EPA*	NEI Data
Waste Incineration	Waste Incineration	Used 2002 NEI Data from EPA*	NEI Data
Wildfires	Wildfires	Used 2002 NEI Data from EPA*	NEI Data

\* The following link will bring you to the EPA Documentation for the Final 2002 Point Source National Emissions Inventory.

[ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/point/2002nei\\_final\\_point\\_source\\_documentation0206.pdf](ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/point/2002nei_final_point_source_documentation0206.pdf)

DC = Department of Climatology, University of Minnesota. It provided heating degree days for adjusting the wood consumption.

DNR = Minnesota Department of Natural Resources

MD = Minnesota Department

NESHAP = National Emission Standards for Hazardous Air Pollutants

WWTIR = Wastewater Treatment Facilities Inventory Report

**Table 2. Summary of the updated 2002 Minnesota air toxics emissions.**

Pollutant Name	Cas No.	Emissions (lb)						Percent (%)			
		Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad	
<b>PAHs</b>											
Acenaphthene	83-32-9	7.08E+04	5.27E+03	8.47E+02	1.60E+03	7.85E+04	90.2	6.71	1.08	2.04	
Acenaphthylene	208-96-8	3.89E+02	1.05E+05	4.45E+03	3.98E+03	1.13E+05	0.343	92.2	3.92	3.51	

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Pollutant Name	Cas No.	Emissions (lb)					Percent (%)			
		Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
Anthracene	120-12-7	8.78E+02	8.79E+03	1.02E+03	8.96E+02	1.16E+04	7.58	75.9	8.83	7.73
Benz[a]Anthracene	56-55-3	7.82E+01	1.18E+04	2.52E+02	2.53E+02	1.24E+04	0.633	95.3	2.04	2.05
Benzo[a]Pyrene	50-32-8	1.00E+02	3.29E+03	1.53E+02	2.00E+02	3.75E+03	2.68	87.9	4.08	5.34
Benzo[b]Fluoranthene	205-99-2	1.45E+01	4.07E+03	1.68E+02	1.52E+02	4.40E+03	0.329	92.4	3.82	3.46
Benzo[g,h,i]Perylene	191-24-2	7.56E+01	4.29E+03	3.04E+02	7.02E+02	5.37E+03	1.41	79.9	5.66	13.1
Benzo[k]Fluoranthene	207-08-9	2.20E+00	1.95E+03	1.68E+02	1.39E+02	2.26E+03	0.097	86.3	7.44	6.15
Chrysene	218-01-9	6.31E+01	8.28E+03	1.32E+02	1.93E+02	8.67E+03	0.727	95.5	1.52	2.22
Dibenzo[a,h]Anthracene	53-70-3	2.86E+01	2.63E+02	9.99E-02	4.97E+00	2.96E+02	9.67	88.6	0.034	1.68
Fluoranthene	206-44-0	3.27E+02	1.31E+04	1.05E+03	2.07E+03	1.66E+04	1.97	79.2	6.32	12.5
Fluorene	86-73-7	8.44E+02	1.38E+04	1.76E+03	3.31E+03	1.97E+04	4.28	70.0	8.93	16.8
Indeno[1,2,3-c,d]Pyrene	193-39-5	1.47E+03	2.07E+03	8.75E+01	2.15E+02	3.84E+03	38.2	53.9	2.28	5.61
Naphthalene	91-20-3	4.82E+04	5.43E+05	1.23E+05	5.91E+04	7.73E+05	6.23	70.3	15.9	7.65
Phenanthrene	85-01-8	1.23E+03	4.47E+04	2.88E+03	6.23E+03	5.50E+04	2.24	81.2	5.24	11.3
Pyrene	129-00-0	6.37E+02	1.59E+04	1.46E+03	2.35E+03	2.04E+04	3.13	78.1	7.17	11.6
Total PAH		4.04E+02	7.02E+03			7.43E+03	5.44	94.6		
16-PAH			6.50E+02		4.75E+00	6.55E+02		99.3		0.726
7-PAH		1.05E-01	1.09E+03		4.69E-02	1.09E+03	0.01	100		0.004
<b>PAH Total</b>		<b>1.25E+05</b>	<b>7.94E+0</b>	<b>1.37E+0</b>	<b>8.15E+0</b>	<b>1.14E+06</b>	<b>11.0</b>	<b>69.8</b>	<b>12.1</b>	<b>7.15</b>
<b>Metal Compounds</b>										
Antimony	7440-36-0	3.50E+03	2.67E+01		2.46E+01	3.55E+03	98.6	0.753		0.693
Arsenic	7440-38-2	1.36E+04	3.22E+02	8.24E+02	6.61E+00	1.47E+04	92.2	2.19	5.60	0.045
Beryllium	7440-41-7	3.39E+02	7.79E+01		4.79E+01	4.65E+02	72.9	16.8		10.3
Cadmium	7440-43-9	2.93E+03	3.93E+02		4.94E+01	3.37E+03	86.9	11.7		1.46
Chromium	7440-47-3	1.43E+04	5.34E+02	1.09E+03	3.67E+01	1.60E+04	89.6	3.35	6.80	0.23
Chromium VI	18540-29-9	1.73E+03	3.44E+01	2.18E+02	1.89E+01	2.00E+03	86.4	1.72	10.9	0.945
Cobalt	7440-48-4	6.54E+03	7.72E+01		2.82E+01	6.65E+03	98.4	1.16		0.425
Copper	7440-50-8	2.59E+04	3.78E+02	7.34E+02	5.81E+00	2.71E+04	95.9	1.40	2.71	0.021
Lead	7439-92-1	5.42E+04	3.10E+03	7.55E+01	2.29E+04	8.03E+04	67.5	3.85	0.094	28.6
Manganese	7439-96-5	1.01E+05	1.54E+03	1.28E+03	5.00E+01	1.04E+05	97.2	1.48	1.23	0.048
Mercury	7439-97-6	3.68E+03	3.67E+02	9.06E+02	5.72E-01	4.96E+03	74.3	7.41	18.3	0.012

**Table 2. Summary of the updated 2002 Minnesota air toxics emissions.**

Pollutant Name	Cas No.	Emissions (lb)					Percent (%)			
		Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
Nickel	7440-02-0	2.85E+04	9.14E+02	8.39E+02	4.12E+02	3.06E+04	92.9	2.98	2.74	1.34
Selenium	7782-49-2	7.13E+03	8.65E+02	1.80E+01	2.77E+00	8.02E+03	88.9	10.8	0.225	0.035
<b>Metal Total</b>		<b>2.63E+05</b>	<b>8.63E+03</b>	<b>5.98E+03</b>	<b>2.36E+03</b>	<b>3.02E+05</b>	<b>87.3</b>	<b>2.86</b>	<b>1.98</b>	<b>7.84</b>
<b>Non-Metal Compounds (Excluding PAHs)</b>										
Acetaldehyde	75-07-0	6.05E+05	8.00E+05	1.58E+06	1.20E+06	4.19E+06	14.5	19.1	37.7	28.8
Acetamide	60-35-5		6.11E-01			6.11E-01		100		
Acetone	67-64-1	7.49E+05	1.26E+06	6.43E+05	3.50E+04	2.69E+06	27.9	46.9	23.9	1.30
Acetonitrile	75-05-8	1.42E+03	2.06E+05			2.07E+05	0.688	99.3		
Acetophenone	98-86-2	4.41E+02	1.48E+03			1.92E+03	22.9	77.1		
Acrolein	107-02-8	1.96E+05	1.20E+05	1.12E+05	1.14E+05	5.42E+05	36.2	22.1	20.6	21.1
Acrylamide	79-06-1	1.51E+02				1.51E+02	100			
Acrylic Acid	79-10-7	1.42E+04	2.12E+01			1.43E+04	99.9	0.149		
Acrylonitrile	107-13-1	5.42E+03	4.67E+03			1.01E+04	53.7	46.3		
Aldehydes		6.23E+04				6.23E+04	100			
Aniline	62-53-3	7.23E-03				7.23E-03	100			
Atrazine	1912-24-9		2.58E+05			2.58E+05		100		
Benzaldehyde	100-52-7	4.53E+03	5.19E-01	1.55E+05	2.11E+04	1.81E+05	2.51	0.000	85.8	11.7
Benzene	71-43-2	2.14E+05	2.94E+06	6.67E+06	2.60E+06	1.24E+07	1.72	23.7	53.7	20.9
Benzyl Chloride	100-44-7	4.01E+03	2.81E+02			4.29E+03	93.5	6.54		
Biphenyl	92-52-4	9.62E+03	9.58E+02			1.06E+04	90.9	9.05		
Bromoform	75-25-2	8.46E+02	1.57E+01			8.62E+02	98.2	1.82		
Methyl Bromide (Bromomethane)	74-83-9	2.19E+04	1.01E+06			1.04E+06	2.11	97.9		
1,3-Butadiene	106-99-0	3.18E+03	8.68E+04	6.56E+05	6.75E+05	1.42E+06	0.224	6.11	46.2	47.5
Butyraldehyde	123-72-8	1.59E+03		9.78E+04	1.58E+04	1.15E+05	1.38		84.9	13.7
Carbon Disulfide	75-15-0	1.50E+03	6.67E+02			2.16E+03	69.2	30.8		
Carbon Tetrachloride	56-23-5	1.50E+03	9.19E+02			2.42E+03	62.0	38.0		
Carbonyl Sulfide	463-58-1	1.63E+03	5.23E+02			2.15E+03	75.7	24.3		
Catechol	120-80-9	1.22E+02				1.22E+02	100			
Trichlorofluoromethane (CFC-11, R-11)	75-69-4	2.20E+03	1.48E+03			3.68E+03	59.8	40.2		

**Table 2. Summary of the updated 2002 Minnesota air toxics emissions.**

Pollutant Name	Cas No.	Emissions (lb)					Percent (%)			
		Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
Trichlorotrifluoromethane (CFC-113, R-113)	76-13-1	1.07E+04	7.20E+05			7.31E+05	1.47	98.5		
Chlorine	7782-50-5	5.19E+04	2.45E+05	1.10E+03		2.98E+05	17.4	82.2	0.371	
Chlorobenzene	108-90-7	2.04E+03	3.27E+05			3.29E+05	0.619	99.4		
Ethyl Chloride	75-00-3	8.83E+03	4.71E+04			5.59E+04	15.8	84.2		
Chloroform	67-66-3	4.23E+03	3.85E+05			3.89E+05	1.09	98.9		
Chloroprene	126-99-8	2.29E+00				2.29E+00	100			
2-Chloroacetophenone	532-27-4	1.52E+02	2.81E+00			1.55E+02	98.2	1.82		
Cresol/Cresylic Acid (Mixed Isomers)	1319-77-3	2.57E+03				2.57E+03	100			
m-Cresol	108-39-4	5.03E+01				5.03E+01	100			
o-Cresol	95-48-7	8.89E+01	1.24E+02			2.12E+02	41.8	58.2		
p-Cresol	106-44-5	1.73E+02	2.50E+02			4.22E+02	40.8	59.2		
Crotonaldehyde	123-73-9	2.94E+03	6.05E+00	5.81E+04	2.56E+04	8.67E+04	3.39	0.007	67.0	29.6
Cumene	98-82-8	2.77E+04	3.40E+04			6.17E+04	44.9	55.1		
Cyanide Compounds	57-12-5	6.20E+04	4.03E+05			4.65E+05	13.3	86.7		
2,4-D (2,4-Dichlorophenoxyacetic Acid)	94-75-7		5.54E+04			5.54E+04		100		
Dibenzofuran	132-64-9	3.92E+02	1.56E+03			1.95E+03	20.1	79.9		
Ethylene Dibromide (Dibromoethane)	106-93-4	1.07E+03	2.14E+01			1.09E+03	98.0	1.95		
Dibutyl Phthalate	84-74-2	1.40E+03	3.54E+02			1.75E+03	79.8	20.2		
Ethylene Dichloride (1,2-Dichloroethane)	107-06-2	3.05E+03	2.41E+03			5.46E+03	55.9	44.1		
Dichlorvos	62-73-7	2.00E+00				2.00E+00	100			
1,4-Dichlorobenzene	106-46-7	1.87E+03	3.75E+05			3.77E+05	0.495	99.5		
M-Dichlorobenzene	541-73-1	1.42E+03	1.84E+03			3.25E+03	43.6	56.4		
O-Dichlorobenzene	95-50-1	5.22E+02	4.27E+05			4.27E+05	0.122	99.9		
Dichlorobenzenes	25321-22-6	7.44E+01	1.79E+02			2.53E+02	29.4	70.6		
Ethylidene Dichloride (1,1-Dichloroethane)	75-34-3	1.32E+03	1.36E+03			2.68E+03	49.2	50.8		
Cis-1,2-Dichloroethylene	156-59-2	8.68E+02				8.68E+02	100			
Cis-1,3-Dichloropropene	10061-01-5	1.86E+02				1.86E+02	100			
1,3-Dichloropropene	542-75-6	9.79E+01	7.27E+05			7.27E+05	0.013	100		
Diethyl Sulfate	64-67-5	1.00E-02				1.00E-02	100			

**Table 2. Summary of the updated 2002 Minnesota air toxics emissions.**

Pollutant Name	Cas No.	Emissions (lb)					Percent (%)			
		Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
Diethanolamine	111-42-2	4.73E+02	1.14E+02			5.86E+02	80.6	19.4		
Dimethyl Phthalate	131-11-3	5.29E+03	2.66E+01			5.32E+03	99.5	0.501		
Dimethyl Sulfate	77-78-1	1.04E+03	1.93E+01			1.06E+03	98.2	1.82		
N,N-Dimethylformamide	68-12-2	2.04E+04	4.07E+04			6.10E+04	33.4	66.6		
Dimethylaniline(N,N-Dimethylaniline)	121-69-7	7.56E+01				7.56E+01	100			
2,4-Dinitrophenol	51-28-5	1.36E+02	1.10E-01			1.36E+02	99.9	0.081		
2,4-Dinitrotoluene	121-14-2	5.36E+01	1.12E-01			5.37E+01	99.8	0.209		
Bis(2-Ethylhexyl)Phthalate (Dehp)	117-81-7	7.08E+03	5.95E+01			7.14E+03	99.2	0.833		
Di-N-Octylphthalate	117-84-0	3.26E+01				3.26E+01	100			
p-Dioxane	123-91-1	2.52E+03	1.37E+02			2.66E+03	94.8	5.16		
Epichlorohydrin	106-89-8	3.04E+01				3.04E+01	100			
Ethyl Acrylate	140-88-5	4.27E+03	5.43E+00			4.27E+03	99.9	0.127		
Ethylbenzene	100-41-4	2.27E+05	4.91E+05	2.15E+06	1.28E+06	4.15E+06	5.49	11.9	51.8	30.8
Ethylene Glycol	107-21-1	6.33E+04	1.87E+05			2.51E+05	25.3	74.7		
Ethylene Oxide	75-21-8	4.09E+03	3.14E+04			3.55E+04	11.5	88.5		
Fine Mineral Fibers		3.38E+03				3.38E+03	100			
Formaldehyde	50-00-0	9.81E+05	6.49E+05	2.31E+06	2.55E+06	6.49E+06	15.1	9.99	35.6	39.3
Glycol Ethers		8.61E+05	2.05E+06			2.91E+06	29.6	70.4		
Hydrochloric Acid (Hydrogen Chloride [Gas	7647-01-0	5.61E+06	7.39E+05			6.35E+06	88.3	11.7		
Hexamethylene Diisocyanate	822-06-0	2.34E+03				2.34E+03	100			
Hexane	110-54-3	1.76E+06	3.36E+06	1.56E+06	1.34E+06	8.03E+06	22.0	41.9	19.5	16.7
Hexachlorobenzene	118-74-1		9.88E+00			9.88E+00		100		
Hydrogen Fluoride (Hydrofluoric Acid)	7664-39-3	9.00E+05	6.04E+04			9.60E+05	93.7	6.29		
Hydroquinone	123-31-9	6.80E+03	9.44E+03			1.62E+04	41.9	58.1		
Isophorone	78-59-1	1.85E+04	1.74E+04			3.59E+04	51.4	48.6		
Lindane, (All Isomers)	58-89-9	3.00E+00				3.00E+00	100			
Maleic Anhydride	108-31-6	7.50E+02				7.50E+02	100			
4,4'-Methylene bis(2-Chloroaniline)	101-14-4	1.10E+01				1.10E+01	100			
Methyl Ethyl Ketone (2-Butanone)	78-93-3	7.53E+05	3.36E+06			4.12E+06	18.3	81.7		
Methylhydrazine	60-34-4	3.69E+03	6.82E+01			3.76E+03	98.2	1.82		

**Table 2. Summary of the updated 2002 Minnesota air toxics emissions.**

Pollutant Name	Cas No.	Emissions (lb)					Percent (%)			
		Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
Methyl Iodide (Iodomethane)	74-88-4	5.90E+00				5.90E+00	100			
Methyl Isobutyl Ketone (Hexone)	108-10-1	2.24E+05	1.62E+06			1.84E+06	12.2	87.8		
Methyl Isocyanate	624-83-9	2.70E+01				2.70E+01	100			
Methyl Methacrylate	80-62-6	6.93E+04	8.57E+00			6.93E+04	100	0.012		
Methyl Tert-Butyl Ether	1634-04-4	7.85E+02	1.22E+02			9.08E+02	86.5	13.5		
Methanol	67-56-1	1.48E+06	3.62E+06			5.10E+06	29.0	71.0		
4,4'-Methylenedianiline	101-77-9	5.60E-03				5.60E-03	100			
4,4'-Methylenediphenyl Diisocyanate (MDI)	101-68-8	5.87E+03				5.87E+03	100			
Methyl Chloride (Chloromethane)	74-87-3	1.63E+04	6.64E+04			8.27E+04	19.7	80.3		
Methylene Chloride (Dichloromethane)	75-09-2	1.86E+05	6.14E+05			8.00E+05	23.2	76.8		
Nitrobenzene	98-95-3	4.86E+02				4.86E+02	100			
4-Nitrophenol	100-02-7	5.91E+02	4.02E+02			9.93E+02	59.5	40.5		
2-Nitropropane	79-46-9	3.29E+00	9.77E+00			1.31E+01	25.2	74.8		
Polychlorinated Biphenyls (Aroclors)	1336-36-3	1.31E+01	1.28E+03			1.30E+03	1.01	99.0		
Polychlorinated Dibenzodioxins, Total		3.31E+01	1.49E+00		5.11E-02	3.47E+01	95.5	4.31		0.148
Polychlorinated Dibenzo-P-Dioxins and Furans, Total		1.31E-01				1.31E-01	100			
Polychlorinated Dibenzofurans, Total		1.04E-01	2.88E-01		9.36E-03	4.02E-01	26.0	71.7		2.33
Pentachlorophenol	87-86-5	2.14E+02	2.38E+01			2.38E+02	90.0	10.0		
Tetrachloroethylene (Perchloroethylene)	127-18-4	1.54E+05	3.17E+05			4.71E+05	32.7	67.3		
Phenol	108-95-2	2.21E+05	6.85E+05		8.49E+01	9.07E+05	24.4	75.6		0.009
p-Phenylenediamine	106-50-3	1.27E+02				1.27E+02	100			
Phosphine	7803-51-2	3.51E+03	9.71E+02			4.48E+03	78.3	21.7		
Phosphorus	7723-14-0	2.62E+03	3.55E+01		4.44E+01	2.70E+03	97.0	1.31		1.64
Phthalic Anhydride	85-44-9	1.48E+03				1.48E+03	100			
Polycyclic Organic Matter		1.09E+04	2.43E+04		5.63E+00	3.52E+04	31.1	68.9		0.016
Propionaldehyde	123-38-6	2.14E+04	6.40E+03	1.26E+05	2.48E+05	4.02E+05	5.33	1.59	31.3	61.8
Propoxur	114-26-1	8.00E-06				8.00E-06	100			
Propylene Dichloride (1,2-Dichloropropane)	78-87-5	9.48E+02	3.03E+02			1.25E+03	75.8	24.2		



**Table 2. Summary of the updated 2002 Minnesota air toxics emissions.**

Pollutant Name	Cas No.	Emissions (lb)					Percent (%)			
		Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
Propylene Oxide	75-56-9	1.24E+03				1.24E+03	100			
Quinone (p-Benzoquinone)	106-51-4	2.22E+03				2.22E+03	100			
Styrene	100-42-5	1.24E+06	3.74E+05	4.47E+05	1.76E+05	2.23E+06	55.4	16.7	20.0	7.87
2,3,7,8-Tetrachlorodibenzo-p-Dioxin	1746-01-6	2.09E-03	2.00E-03		3.12E-04	4.40E-03	47.5	45.4		7.09
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	1.98E-02	2.81E-02		7.93E-04	4.87E-02	40.6	57.7		1.63
Dioxin and Furans (2,3,7,8-TCDD Equivalents)		6.84E-03	1.47E-04	7.76E-03		1.47E-02	46.4	0.996	52.6	
Methyl Chloroform (1,1,1-Trichloroethane)	71-55-6	1.28E+04	1.80E+06		1.11E+00	1.81E+06	0.71	99.3		0.000
1,1,2,2-Tetrachloroethane	79-34-5	1.25E+03	1.50E+03			2.75E+03	45.6	54.4		
Toluene	108-88-3	1.57E+06	9.51E+06	1.44E+07	1.68E+07	4.23E+07	3.72	22.5	34.0	39.7
2,4-Toluene Diisocyanate	584-84-9	2.29E+03				2.29E+03	100			
o-Toluidine	95-53-4	2.07E-01	5.43E-01			7.51E-01	27.6	72.4		
Trichloroethylene	79-01-6	4.05E+05	1.87E+04			4.23E+05	95.6	4.41		
1,2,4-Trichlorobenzene	120-82-1	1.17E+04	4.94E+01			1.18E+04	99.6	0.419		
1,1,2-Trichloroethane	79-00-5	5.31E+02				5.31E+02	100			
2,4,6-Trichlorophenol	88-06-2	4.31E-01	1.34E-02			4.44E-01	97.0	3.03		
Triethylamine	121-44-8	9.43E+03	4.73E+03			1.42E+04	66.6	33.4		
Trifluralin	1582-09-8		3.98E+04			3.98E+04		100		
2,2,4-Trimethylpentane	540-84-1	1.19E+04	4.50E+05	6.00E+06	7.56E+06	1.40E+07	0.085	3.21	42.8	53.9
1,2,4-Trimethylbenzene	95-63-6	1.34E+05	2.26E+04	2.61E+06		2.76E+06	4.86	0.820	94.3	
1,3,5-Trimethylbenzene	108-67-8	7.89E+02		9.35E+05		9.35E+05	0.084		99.9	
Trimethylbenzene	25551-13-7	3.50E+03	5.83E+04			6.18E+04	5.66	94.3		
Vinylidene Chloride (1,1-Dichloroethylene)	75-35-4	4.74E+02	2.64E+03			3.12E+03	15.2	84.8		
Vinyl Acetate	108-05-4	3.45E+04	1.91E+04			5.36E+04	64.3	35.7		
Vinyl Chloride	75-01-4	4.56E+03	1.34E+04			1.79E+04	25.4	74.6		
m-Xylene	108-38-3	1.06E+04	4.36E+03			1.49E+04	70.8	29.2		
o-Xylene	95-47-6	7.26E+03	1.87E+05			1.95E+05	3.73	96.3		
p-Xylene	106-42-3	1.30E+03				1.30E+03	100			
Xylenes (Mixed Isomers)	1330-20-7	1.57E+06	6.84E+06	8.18E+06	8.36E+06	2.49E+07	6.30	27.4	32.8	33.5

**Table 2. Summary of the updated 2002 Minnesota air toxics emissions.**

Pollutant Name	Cas No.	Emissions (lb)					Percent (%)			
		Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
<b>Non-Metal Total</b>		2.08E+07	4.78E+07	4.87E+07	4.30E+07	1.60E+08	13.0	29.8	30.4	26.8
<b>Grand Total</b>		2.11E+07	4.86E+07	4.88E+07	4.31E+07	1.62E+08	13.1	30.0	30.2	26.7

**Table 3. Detailed categorization of the 2002 Minnesota emissions for total air toxics.**

<b>Principal Category</b>	<b>Category</b>	<b>Emissions (lb)</b>	<b>Percent (%)</b>
<b>Area</b>	Industrial Surface Coating	1.33E+07	8.23
	Commercial and Consumer Products Usage	1.23E+07	7.63
	Surface Coatings - Architectural	4.07E+06	2.52
	Solvent Cleaning	3.53E+06	2.19
	Gasoline Service Stations	2.88E+06	1.78
	Residential Wood Burning	2.73E+06	1.69
	Prescribed Burnings	1.43E+06	0.89
	Waste Disposal, Open Burning	1.40E+06	0.87
	Autobody Refinishing	1.37E+06	0.85
	POTW facilities	1.20E+06	0.74
	Stationary Source Fuel Combustion, Industrial	6.50E+05	0.40
	Wildfires	6.35E+05	0.39
	Agricultural Pesticide Use	5.45E+05	0.34
	Swimming Pools	3.74E+05	0.23
	Graphic Arts	3.69E+05	0.23
	Traffic Markings	3.63E+05	0.22
	Structure Fires	3.03E+05	0.19
	Residential Fossil Fuel Combustion	2.87E+05	0.18
	Stationary Fuel Combustion, Commercial/Institutional	1.92E+05	0.12
	Municipal Solid Waste Landfills	1.75E+05	0.11
	Dry Cleaners	1.73E+05	0.11
	Commercial Cooking	1.56E+05	0.10
	Hospital Sterilization	3.14E+04	0.02
	Asphalt Paving	1.83E+04	0.01
	Animal Cremation Cremation	1.71E+04	0.01
	Gasoline Trucks in Transit	9.43E+03	0.01
	Human Cremation	1.72E+03	0.00
	Waste Incineration	1.64E+03	0.00
	Grain Elevators	9.71E+02	0.00
	Mineral Processes: SIC 32	7.33E+02	0.00
	Tank/Drum Cleaning	6.36E+02	0.00
Fluorescent Lamp Breakage	3.32E+01	0.00	
Fluorescent Lamp Recycling	1.82E-02	0.00	
<b>Area Total</b>		<b>4.86E+07</b>	<b>30.0</b>
<b>Nonroad</b>	Recreational Equipment	2.05E+07	12.7
	Pleasure Craft	1.14E+07	7.03
	Lawn and Garden Equipment	4.79E+06	2.96
	Agricultural Equipment	2.21E+06	1.37

**Table 3. Detailed categorization of the 2002 Minnesota emissions for total air toxics.**

<b>Principal Category</b>	<b>Category</b>	<b>Emissions (lb)</b>	<b>Percent (%)</b>
	Commercial Equipment	1.64E+06	1.01
	Construction and Mining Equipment	1.22E+06	0.76
	Airport including ground support equipment	6.40E+05	0.40
	Industrial Equipment	3.04E+05	0.19
	Locomotive Emissions	2.68E+05	0.17
	Logging Equipment	7.06E+04	0.04
	Commercial Marine Vessel	4.95E+04	0.03
	Railway Maintenance	6.54E+03	0.00
<b>Nonroad Total</b>		<b>4.31E+07</b>	<b>26.7</b>
<b>Onroad</b>	Light Duty Gasoline Vehicles (LDGV)	2.41E+07	14.9
	Light Duty Gasoline Trucks 1 & 2	1.47E+07	9.12
	Light Duty Gasoline Trucks 3 & 4	6.65E+06	4.12
	Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV)	1.87E+06	1.16
	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B	7.09E+05	0.44
	Motorcycles (MC)	3.96E+05	0.25
	Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7	1.61E+05	0.10
	Heavy Duty Diesel Vehicles (HDDV) Class 2B	6.78E+04	0.04
	Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5	5.56E+04	0.03
	Heavy Duty Diesel Buses (School & Transit)	3.36E+04	0.02
	Light Duty Diesel Trucks 1 thru 4 (LDDT)	2.49E+04	0.02
	Light Duty Diesel Vehicles (LDDV)	3.93E+03	0.00
<b>Onroad Total</b>		<b>4.88E+07</b>	<b>30.2</b>
<b>Point</b>	Electric, Gas, and Sanitary Services	4.29E+06	2.65
	Paper and Allied Products	3.01E+06	1.86
	Lumber and Wood Products	2.28E+06	1.41
	Food And Kindred Products	2.20E+06	1.36
	Metal Mining	1.71E+06	1.06
	Transportation Equipment	1.61E+06	1.00
	Fabricated Metal Products	1.46E+06	0.90
	Rubber and Misc. Plastics Products	8.01E+05	0.50
	Industrial Machinery and Equipment	6.56E+05	0.41
	Petroleum and Coal Products	5.37E+05	0.33
	Chemicals and Allied Products	4.78E+05	0.30
	Instruments and Related Products	3.02E+05	0.19
	Printing and Publishing	2.64E+05	0.16
	Primary Metal Industries	2.63E+05	0.16
	Stone, Clay, and Glass Products	2.10E+05	0.13
	Electronic & Other Electric Equipment	1.92E+05	0.12
	Furniture and Fixtures	1.61E+05	0.10

**Table 3. Detailed categorization of the 2002 Minnesota emissions for total air toxics.**

<b>Principal Category</b>	<b>Category</b>	<b>Emissions (lb)</b>	<b>Percent (%)</b>
	Educational Services	1.01E+05	0.06
	Leather and Leather Products	9.58E+04	0.06
	Transportation by Air	8.24E+04	0.05
	Business Services	7.38E+04	0.05
	Miscellaneous Manufacturing Industries	6.89E+04	0.04
	Pipelines, Except Natural Gas	5.02E+04	0.03
	Nonmetallic Minerals, Except Fuels	3.74E+04	0.02
	Wholesale Trade Nondurable Goods	3.62E+04	0.02
	Personal Services	3.13E+04	0.02
	Wholesale Trade Durable Goods	2.30E+04	0.01
	Health Services	2.13E+04	0.01
	Miscellaneous Repair Services	1.97E+04	0.01
	Engineering & Management Services	1.69E+04	0.01
	Auto Repair, Services, and Parking	1.54E+04	0.01
	Special Trade Contractors	1.51E+04	0.01
	Automotive Dealers & Service Stations	1.08E+04	0.01
	Textile Mill Products	8.90E+03	0.01
	National Security and Intl. Affairs	8.36E+03	0.01
	Furniture and Homefurnishings Stores	5.07E+03	0.00
	Justice, Public Order, and Safety	1.01E+03	0.00
	Nondepository Institutions	3.49E+02	0.00
	Social Services	3.43E+02	0.00
	Communication	2.94E+02	0.00
	Insurance Carriers	2.45E+02	0.00
	Trucking and Warehousing	2.42E+02	0.00
	Local And Interurban Passenger Transit	2.00E+02	0.00
	Administration of Economic Programs	1.75E+02	0.00
	General Merchandise Stores	1.74E+02	0.00
	Museums, Botanical, Zoological Gardens	1.61E+02	0.00
	Water Transportation	1.39E+02	0.00
	Executive, Legislative, and General	1.27E+02	0.00
	Food Stores	1.18E+02	0.00
	Amusement & Recreation Services	9.79E+01	0.00
	Real Estate	8.17E+01	0.00
	Miscellaneous Retail	8.01E+01	0.00
	Depository Institutions	7.22E+01	0.00
	Services, Nec	1.63E+01	0.00
	Hotels and Other Lodging Places	1.24E+02	0.00
	Forestry	1.30E-03	0.00
<b>Point Total</b>		<b>2.11E+07</b>	<b>13.1</b>

**Table 3. Detailed categorization of the 2002 Minnesota emissions for total air toxics.**

Principal Category	Category	Emissions (lb)	Percent (%)
<b>Grand Total</b>		<b>1.62E+08</b>	<b>100</b>

**Table 4. Detailed categorization of the updated 2002 Minnesota emissions for benzene.**

Principal Category	Category	Emissions (lb)	Percent (%)
<b>Area</b>	Residential Wood Burning	1.46E+06	11.7
	Waste Disposal, Open Burning	5.57E+05	4.48
	Gasoline Service Stations	4.05E+05	3.26
	Solvent Cleaning	1.76E+05	1.41
	Wildfires	1.20E+05	0.96
	Prescribed Burnings	1.19E+05	0.96
	Commercial Cooking	3.98E+04	0.32
	Surface Coatings - Architectural	2.28E+04	0.18
	POTW facilities	2.23E+04	0.18
	Stationary Source Fuel Combustion, Industrial	1.53E+04	0.12
	Stationary Fuel Combustion, Commercial/Instit	4.31E+03	0.03
	Gasoline Trucks in Transit	1.48E+03	0.01
	Municipal Solid Waste Landfills	1.25E+03	0.01
	Residential Fossil Fuel Combustion	3.49E+02	0.00
	Asphalt Paving	4.96E+01	0.00
	Mineral Processes: SIC 32	2.42E+01	0.00
	Commercial and Consumer Products Usage	2.16E+01	0.00
<b>Area Total</b>		<b>2.94E+06</b>	<b>23.7</b>
<b>Nonroad</b>	Pleasure Craft	7.13E+05	5.74
	Recreational Equipment	6.77E+05	5.44
	Lawn and Garden Equipment	5.15E+05	4.14
	Commercial Equipment	2.52E+05	2.02
	Agricultural Equipment	2.15E+05	1.73
	Construction and Mining Equipment	1.14E+05	0.91
	Airport	6.29E+04	0.51
	Industrial Equipment	4.21E+04	0.34
	Railroad Equipment	6.59E+03	0.05
	Logging Equipment	3.83E+03	0.03
	Marine Vessels, Commercial	3.38E+03	0.03
<b>Nonroad Total</b>		<b>2.60E+06</b>	<b>20.9</b>
<b>Onroad</b>	Light Duty Gasoline Vehicles (LDGV)	3.36E+06	27.0
	Light Duty Gasoline Trucks 1 & 2	2.12E+06	17.1
	Light Duty Gasoline Trucks 3 & 4	8.84E+05	7.11
	Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV)	2.03E+05	1.63

**Table 4. Detailed categorization of the updated 2002 Minnesota emissions for benzene.**

<b>Principal Category</b>	<b>Category</b>	<b>Emissions (lb)</b>	<b>Percent (%)</b>
	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B	4.91E+04	0.40
	Motorcycles (MC)	3.64E+04	0.29
	Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7	1.12E+04	0.09
	Light Duty Diesel Trucks 1 thru 4 (LDDT)	3.60E+03	0.03
	Heavy Duty Diesel Vehicles (HDDV) Class 2B	3.04E+03	0.02
	Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5	2.48E+03	0.02
	Heavy Duty Diesel Buses (School & Transit)	2.32E+03	0.02
	Light Duty Diesel Vehicles (LDDV)	5.65E+02	0.00
<b>Onroad Total</b>		<b>6.67E+06</b>	<b>53.7</b>
<b>Point</b>	Paper and Allied Products	4.67E+04	0.38
	Lumber and Wood Products	3.26E+04	0.26
	Metal Mining	3.04E+04	0.24
	Electric, Gas, and Sanitary Services	2.71E+04	0.22
	Petroleum and Coal Products	2.58E+04	0.21
	Primary Metal Industries	2.05E+04	0.16
	Chemicals and Allied Products	1.32E+04	0.11
	Pipelines, Except Natural Gas	8.42E+03	0.07
	Food and Kindred Products	3.83E+03	0.03
	Wholesale Trade Nondurable Goods	2.74E+03	0.02
	Miscellaneous Manufacturing Industries	5.98E+02	0.00
	Stone, Clay, and Glass Products	5.53E+02	0.00
	Nonmetallic Minerals, Except Fuels	3.96E+02	0.00
	Educational Services	2.21E+02	0.00
	Rubber and Misc. Plastics Products	2.09E+02	0.00
	Health Services	1.53E+02	0.00
	Furniture and Fixtures	8.28E+01	0.00
	Wholesale Trade Durable Goods	6.14E+01	0.00
	Transportation Equipment	5.32E+01	0.00
	Industrial Machinery and Equipment	4.58E+01	0.00
	Fabricated Metal Products	1.63E+01	0.00
	Electronic & Other Electric Equipment	1.26E+01	0.00
	Printing and Publishing	9.51E+00	0.00
	Justice, Public Order, and Safety	4.25E+00	0.00
	Transportation By Air	3.12E+00	0.00
	Communication	3.11E+00	0.00
	Nondepository Institutions	2.49E+00	0.00
	Instruments and Related Products	2.33E+00	0.00
	Insurance Carriers	1.55E+00	0.00
	Social Services	1.50E+00	0.00
	Special Trade Contractors	1.45E+00	0.00
	Food Stores	1.26E+00	0.00
	Executive, Legislative, and General	1.23E+00	0.00

**Table 4. Detailed categorization of the updated 2002 Minnesota emissions for benzene.**

<b>Principal Category</b>	<b>Category</b>	<b>Emissions (lb)</b>	<b>Percent (%)</b>
	Amusement & Recreation Services	1.03E+00	0.00
	General Merchandise Stores	9.14E-01	0.00
	Miscellaneous Retail	8.59E-01	0.00
	Local and Interurban Passenger Transit	8.38E-01	0.00
	Business Services	8.20E-01	0.00
	Administration Of Economic Programs	7.57E-01	0.00
	National Security and Intl. Affairs	7.33E-01	0.00
	Miscellaneous Repair Services	6.45E-01	0.00
	Furniture and Homefurnishings Stores	5.11E-01	0.00
	Real Estate	5.11E-01	0.00
	Depository Institutions	5.06E-01	0.00
	Museums, Botanical, Zoological Gardens	2.80E-01	0.00
	Services, Nec	1.75E-01	0.00
	Personal Services	1.13E-01	0.00
	Trucking and Warehousing	1.05E-01	0.00
	Leather and Leather Products	3.10E-02	0.00
	Auto Repair, Services, and Parking	3.08E-02	0.00
	Textile Mill Products	2.96E-02	0.00
	Engineering & Management Services	8.62E-04	0.00
	Automotive Dealers & Service Stations	1.44E-04	0.00
<b>Point Total</b>		<b>2.14E+05</b>	<b>1.72</b>
<b>Grand Total</b>		<b>1.24E+07</b>	<b>100</b>

**Table 5. Detailed categorization of the updated 2002 Minnesota emissions for formaldehyde.**

<b>Principal Category</b>	<b>Category</b>	<b>Emissions (lb)</b>	<b>Percent (%)</b>
<b>Area</b>	Wildfires	2.74E+05	4.21
	Prescribed Burnings	2.73E+05	4.20
	Commercial Cooking	3.18E+04	0.49
	Stationary Source Fuel Combustion, Industrial	2.12E+04	0.33
	Residential Fossil Fuel Combustion	1.50E+04	0.23
	Stationary Fuel Combustion, Commercial/Instit	1.17E+04	0.18
	Residential Wood Burning	6.66E+03	0.10
	Commercial and Consumer Products Usage	6.19E+03	0.10
	Structure Fires	5.53E+03	0.09
	POTW facilities	4.44E+03	0.07
	Animal Cremation Cremation	2.48E-05	0.00
	Human Cremation	2.48E-06	0.00



**Table 5. Detailed categorization of the updated 2002 Minnesota emissions for formaldehyde.**

<b>Principal Category</b>	<b>Category</b>	<b>Emissions (lb)</b>	<b>Percent (%)</b>
	Waste Incineration	2.05E-06	0.00
<b>Area Total</b>		<b>6.49E+05</b>	<b>9.99</b>
<b>Nonroad</b>	Agricultural Equipment	9.44E+05	14.5
	Recreational Equipment	4.96E+05	7.63
	Construction and Mining Equipment	3.79E+05	5.83
	Lawn and Garden Equipment	1.69E+05	2.60
	Airport	1.53E+05	2.35
	Commercial Equipment	1.41E+05	2.17
	Railroad Equipment	1.02E+05	1.57
	Industrial Equipment	7.45E+04	1.15
	Pleasure Craft	6.35E+04	0.98
	Marine Vessels, Commercial	2.50E+04	0.38
	Logging Equipment	5.54E+03	0.09
<b>Nonroad Total</b>		<b>2.55E+06</b>	<b>39.3</b>
	Light Duty Gasoline Vehicles (LDGV)	7.92E+05	12.2
	Light Duty Gasoline Trucks 1 & 2	5.44E+05	8.37
	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B	3.66E+05	5.63
	Light Duty Gasoline Trucks 3 & 4	2.84E+05	4.38
	Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV)	1.51E+05	2.32
	Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7	8.31E+04	1.28
	Motorcycles (MC)	2.68E+04	0.41
	Heavy Duty Diesel Vehicles (HDDV) Class 2B	2.26E+04	0.35
	Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5	1.85E+04	0.28
	Heavy Duty Diesel Buses (School & Transit)	1.73E+04	0.27
	Light Duty Diesel Trucks 1 thru 4 (LDDT)	6.94E+03	0.11
	Light Duty Diesel Vehicles (LDDV)	1.09E+03	0.02
<b>Onroad Total</b>		<b>2.31E+06</b>	<b>35.6</b>
<b>Point</b>	Metal Mining	2.97E+05	4.57
	Lumber and Wood Products	2.95E+05	4.55
	Electric, Gas, and Sanitary Services	1.59E+05	2.45
	Paper and Allied Products	6.86E+04	1.06
	Petroleum and Coal Products	5.43E+04	0.84
	Chemicals and Allied Products	3.18E+04	0.49
	Stone, Clay, and Glass Products	2.47E+04	0.38
	Fabricated Metal Products	1.33E+04	0.20
	Food and Kindred Products	1.16E+04	0.18
	Electronic & Other Electric Equipment	7.63E+03	0.12
	Industrial Machinery and Equipment	6.81E+03	0.10
	Primary Metal Industries	4.01E+03	0.06
	Rubber and Misc. Plastics Products	2.07E+03	0.03
	Furniture and Fixtures	1.24E+03	0.02

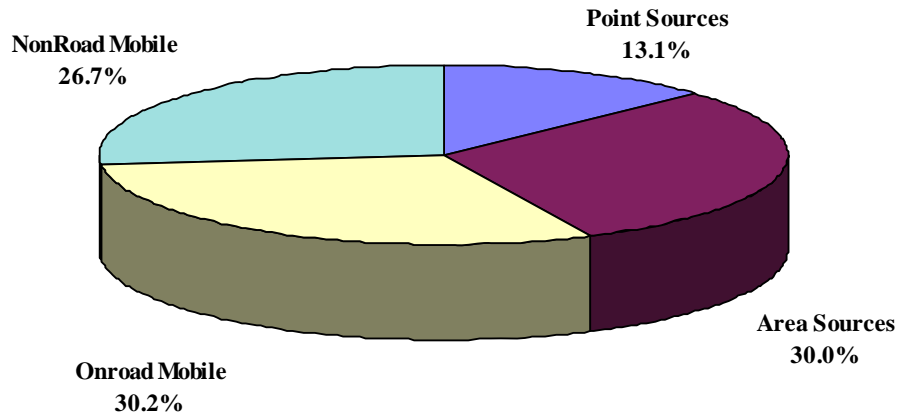
**Table 5. Detailed categorization of the updated 2002 Minnesota emissions for formaldehyde.**

<b>Principal Category</b>	<b>Category</b>	<b>Emissions (lb)</b>	<b>Percent (%)</b>
	Health Services	8.05E+02	0.01
	Miscellaneous Manufacturing Industries	6.28E+02	0.01
	Textile Mill Products	5.05E+02	0.01
	Pipelines, Except Natural Gas	4.63E+02	0.01
	Educational Services	4.59E+02	0.01
	Printing and Publishing	4.19E+02	0.01
	Engineering & Management Services	3.09E+02	0.00
	Wholesale Trade Durable Goods	2.89E+02	0.00
	Wholesale Trade Nondurable Goods	1.51E+02	0.00
	Transportation Equipment	1.09E+02	0.00
	Nonmetallic Minerals, Except Fuels	9.29E+01	0.00
	Instruments and Related Products	6.06E+01	0.00
	Justice, Public Order, and Safety	4.39E+01	0.00
	Transportation By Air	3.30E+01	0.00
	Social Services	6.19E+00	0.00
	Local and Interurban Passenger Transit	5.43E+00	0.00
	Administration Of Economic Programs	4.66E+00	0.00
	Personal Services	4.37E+00	0.00
	Museums, Botanical, Zoological Gardens	4.34E+00	0.00
	National Security and Intl. Affairs	3.40E+00	0.00
	Miscellaneous Repair Services	2.61E+00	0.00
	Furniture and Homefurnishings Stores	2.26E+00	0.00
	Trucking and Warehousing	1.20E+00	0.00
	Insurance Carriers	1.13E+00	0.00
	Leather and Leather Products	1.11E+00	0.00
	Business Services	6.03E-01	0.00
	Communication	3.17E-01	0.00
	Nondepository Institutions	2.63E-01	0.00
	Executive, Legislative, and General	1.71E-01	0.00
	Special Trade Contractors	1.48E-01	0.00
	Food Stores	1.29E-01	0.00
	Amusement & Recreation Services	1.05E-01	0.00
	General Merchandise Stores	9.71E-02	0.00
	Miscellaneous Retail	8.75E-02	0.00
	Real Estate	5.35E-02	0.00
	Depository Institutions	5.26E-02	0.00
	Services, Nec	1.78E-02	0.00
	Auto Repair, Services, and Parking	3.59E-03	0.00
	Automotive Dealers & Service Stations	6.48E-04	0.00
<b>Point Total</b>		<b>9.81E+05</b>	<b>15.1</b>
<b>Grand Total</b>		<b>6.49E+06</b>	<b>100</b>



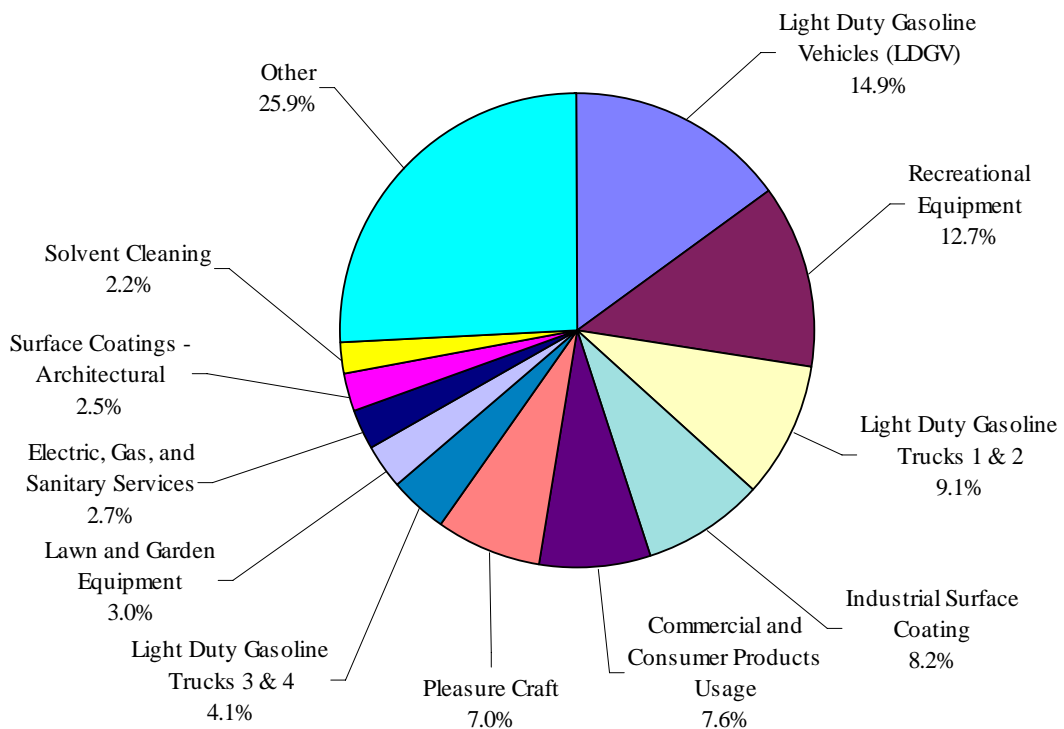
**Figure 1. Contribution of principle source categories to total air toxics emissions**

Total emissions in 2002: 162 million pounds

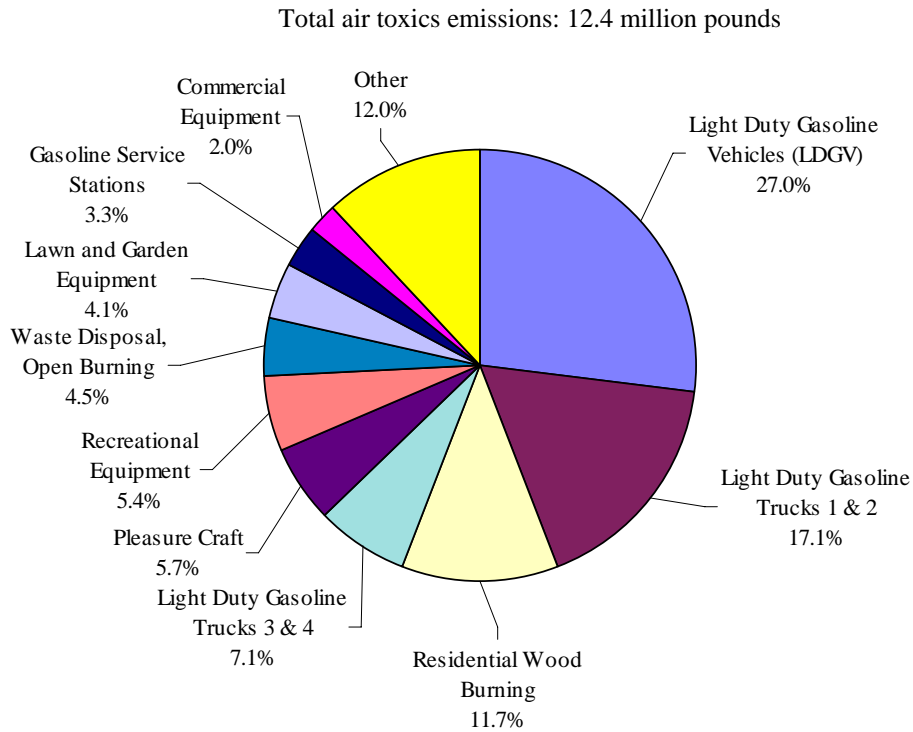


**Figure 2. Contribution of top source categories to state total air toxics emissions**

Total air toxics emissions: 162 million pounds



**Figure 3. Contribution of top source categories to state total benzene emissions**



**Figure 4. Contribution of top source categories to state total formaldehyde emissions**

Total air toxics emissions: 6.49 million pounds

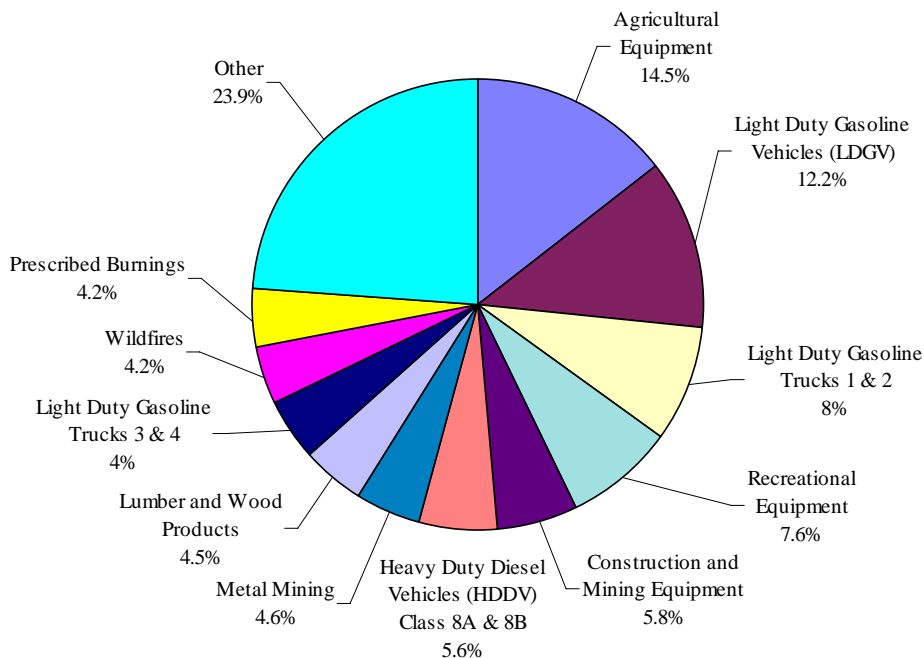


Figure 5. Responding status of large point sources with individual total facility permits.

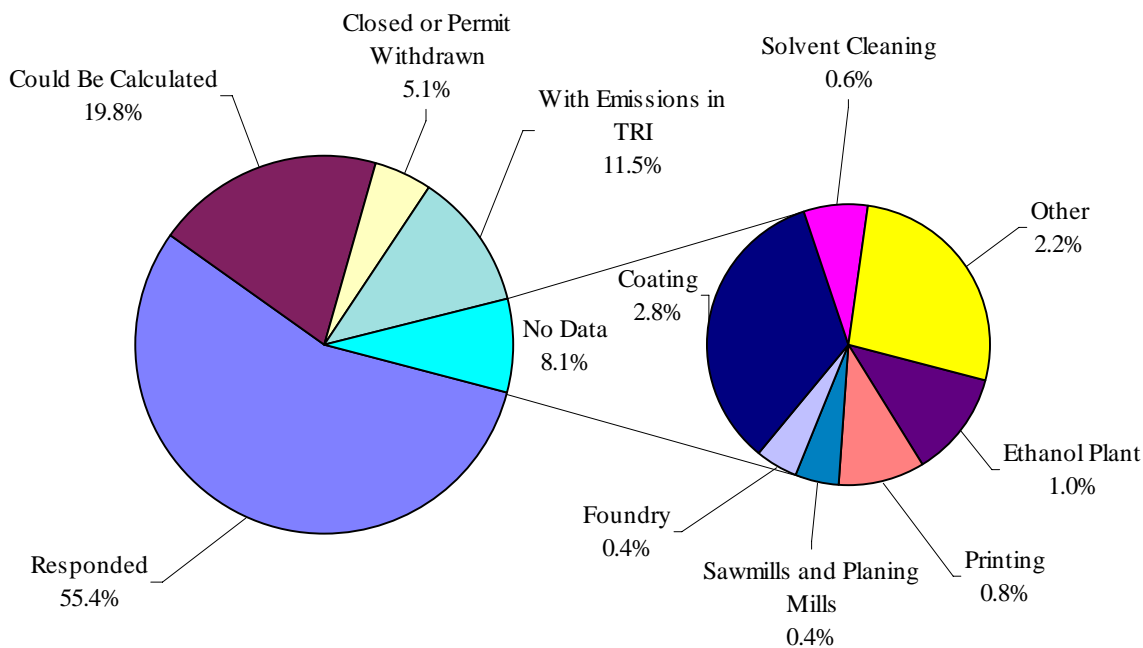
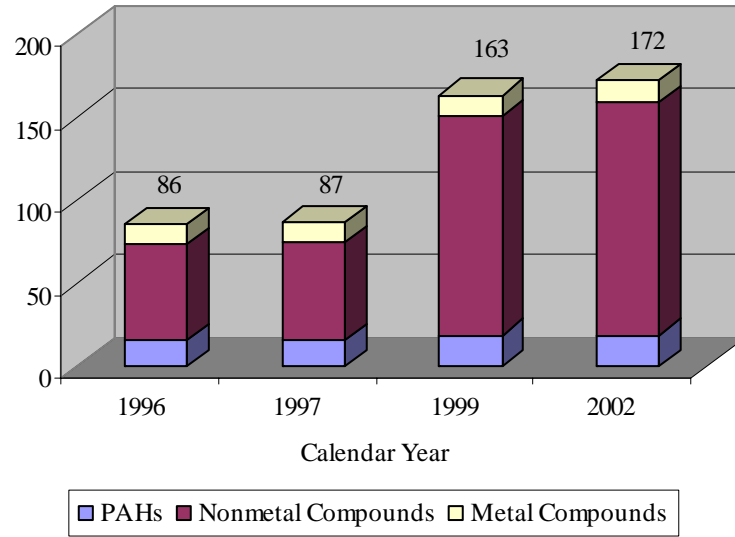
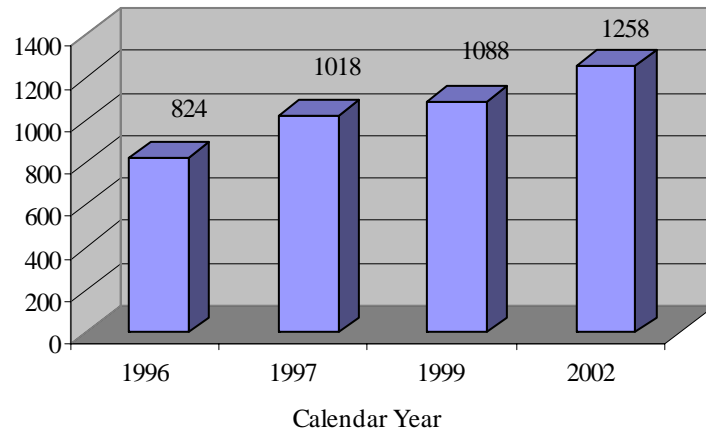


Figure 6. Number of pollutants inventoried with emission estimates.



**Figure 7. Number of point sources with emission estimates.**



**Figure 8. Number of area source categories included in inventories.**

