

2. Results

The following results represent emissions from point, area, and mobile sources in the Great Lakes region for calendar year 1999. The regional emission inventory includes emissions from 699 distinct source categories and 2023 distinct source classification codes (SCC/AMS). Definitions of point and area sources are dependent on data collection methods, as reporting requirements for air toxics emissions are different from state to state, one emission source defined as an area source in one state may be covered as a point source in other states. Mobile sources are subcategorized into onroad and nonroad sources. Onroad source emissions are from 12 vehicle types and 12 roadway types. Nonroad sources include 10 equipment types (such as Agricultural Equipment and Recreational Equipment), aircraft, locomotives, and commercial marine vessels.

Emissions from All Sources

The 1999 emissions were estimated for 213 target compounds, however, data were only available to obtain emissions for 197 air toxics, including 16 polycyclic aromatic hydrocarbons (PAHs), 14 metal compounds, and 167 non-metal compounds. Table 2-1 shows pollutant names and estimated emissions from point and area sources.

Point sources emitted 196 out of 197 pollutants while area sources emitted 133 pollutants. Pollutant emissions from onroad and nonroad mobile sources numbered 46 and 50, respectively. Figure 2-1 shows the number of pollutants emitted from each source category in 1999.

Area sources contributed more than 50% of the total emissions for 14 PAHs and 29 non-metal compounds. Point sources were responsible for more than 73% of total emissions for all metal compounds with an exception of chromium VI and alkylated lead. About 39% of chromium VI emissions were from area sources, mainly chromium electroplating. A total of 0.68 pounds of alkylated lead were reported from an area source category, petroleum storage. Point sources contributed more than 50% of total emissions for 2 PAH, and 124 non-metal compounds. Onroad and nonroad mobile sources together emitted a significant portion (more than 70%) of regional total emissions for acetaldehyde, acrolein, benzene, 1,3-butadiene, ethylbenzene, formaldehyde, methyl tert butyl ether, propionaldehyde, 2,2,4-trimethylpentane, and m-xylene.

Although point sources emitted much more pollutants than area and mobile sources, the amount of emissions from point sources was 17.87% of total emissions in the region, much less than contributions of area sources and mobile sources (36.77% and 45.36%, respectively). Figure 2-2 provides percentage contributions from each principal source category.

Among the 197 pollutants, toluene was estimated to have the highest emissions at 809,883,118 pounds, while chloroacetic acid emissions were the lowest recorded at about 0.22 pounds.

Specific Pollutants

A closer look was taken at the top five non-metal compounds and the top five metal compounds according to the emission totals. The source contribution to emissions for the selected 10 pollutants was analyzed by the first two digits of the SIC codes for point sources, sub-category for area and nonroad mobile sources, and vehicle types for onroad mobile sources. The most significant source categories and their contributions are shown in Tables 2-2 and 2-3. The selected pollutants are toluene, xylenes (includes o, m, and p), hydrochloric acid, benzene, 1,1,1-trichloroethane, manganese, copper, lead, nickel, and chromium.

Light Duty Gasoline Vehicles are the most significant sources for three out of the five top non-metal compounds, toluene, xylenes (includes o, m, and p), and benzene. Electric, Gas, and Sanitary Services (SIC code 49xx), a sub-category of point sources, contribute a substantial fraction of hydrochloric acid emissions, 89.7%. More than three quarters of the emissions of 1,1,1-trichloroethane are from the area source sub-category, Degreasing Equipment.

In contrast to the top five non-metal compounds, point sources dominate the emissions of the top five metal compounds, accounting for about more than 80% of total regional emissions. As shown in Table 2-3, the most significant source category for these metal compounds is Primary Metal Industries (SIC code 33xx). More than one-half of emissions of manganese, copper, lead and nickel and 40.5% of chromium emissions are attributed to Primary Metal Industries.

Detailed emission distributions by standard industrial classification (SIC) codes and source classification codes (SCC) are shown in tables 2-5 and figures 2-6 through 2-202.

Progressive Emission Changes

The 1999 inventory is the fourth one since the 1996 inventory. Eighty two pollutants were included in the regional emission inventories in 1996 - 1998 while 213 pollutants are included for 1999. The overall regional emissions from principal sources for 1996 - 1999 are summarized in Table 2-4. The emission differences among years are mainly due to the following factors:

1. increased number of pollutants in the emission inventories,
2. an expansion of area sources, and
3. improvements of emission estimation methods, emission models, emission factors, and activity data

For example, the chromium emission factor for residential natural gas combustion used in the 1996 inventory is 45 times higher than the revised one used in the 1997-99 inventories. The sum of emission factors for 16 PAHs in the 1999 inventory is 35% of the value in the 1997 and 1998 inventories for residential wood burning - certified, catalytic stoves. Also, the 1999 inventory contains emissions from 27 more distinct source categories and 491 more SCCs than the 1998 inventory.

Therefore, **the results should not be viewed as a trend analysis**. A back-calculation using the 1999 approaches for 1996 to 1998 could provide emission trends, however, this is a resource intensive effort.

Figures 2-3 to 2-5 show emissions of three groups of pollutants estimated from 1996 to 1999. The pollutants in PAH and metal compound groups have not changed with calendar years, so that the difference among calendar years reflects factors 2, 3, and 4 listed above. Factors 2, 3, and 4 also influenced emissions of non-metal compound (excluding PAHs) group. However, the primary cause of the increase of total regional emissions of non-metal compounds in 1999 is due to addition of pollutants. Some of new inventoried pollutants showing high emissions are hydrochloric acid, trimethylpentane, hexane, methanol, and methyl ethyl ketone. These pollutants are ranked in the top twelve with regard to the total emissions in 1999.

Data summaries of the 1999 inventory and all previous inventories are available at the Great Lakes Commission (<http://www.glc.org>) and the Great Lakes Information Network (<http://www.great-lakes.net>) web sites. Additional information, including background documents, the emission protocol document and lists of products for the project, is located on the emission inventory project's web site (<http://www.glc.org/air>).