Air Quality in Minnesota: Emerging Trends

2009 Report to the Legislature

Minnesota Pollution Control Agency

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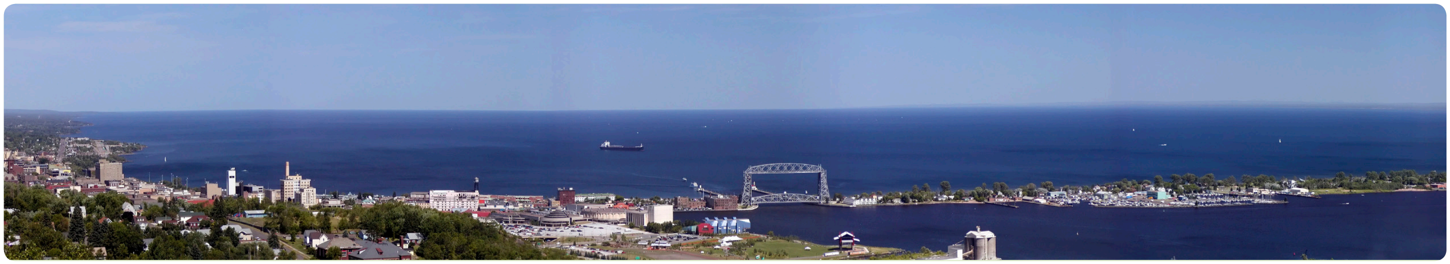

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2009 Report to the Legislature

January 2009

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Starting in 1995, the Minnesota Pollution Control Agency (MPCA) has had a statutory requirement (Minnesota Statute §115D.15 and §116.925) to report every two years to the Minnesota Legislature on the status of toxic air contaminants and to analyze the MPCA's strategies to reduce the emissions of air pollutants. The MPCA uses this report as an opportunity to present the most pressing outdoor air quality issues facing Minnesota and to explore the opportunities available for emission reductions.

Foreword

Traditional air pollutants such as fine particles, ozone and toxic air contaminants contribute to serious health effects, particularly among the young and elderly and Minnesotans with heart and lung conditions. Air pollutants, such as mercury, also affect Minnesota ecosystems. Mercury settles out of the air into lakes and streams where it accumulates in fish, resulting in consumption advisories. Fine particles also reduce visibility in both urban areas and in pristine places such as the Boundary Waters Canoe Area Wilderness.

In 1970, the United States began seriously dealing with air pollution through the Clean Air Act. This commitment was reinforced when the Act was amended in 1977 and 1990. The Clean Air Act Amendments required issuance of technology-based standards for major sources and certain smaller non-point sources. It also paved the way for cleaner vehicles and vehicle fuels.

Since the enactment of the Clean Air Act and Clean Air Act Amendments, concentrations of traditional air pollutants have generally decreased. However, as scientists learn more about the health effects of these pollutants, standards have also become stricter resulting in more air alert days.

As the understanding of air pollution continues to evolve, new methods of environmental protection must be explored. It is increasingly obvious that it is not enough to control single pollutants from individual sources. There is growing recognition of the need to reduce air pollution emissions from scattered, less regulated sources such as transportation and residential burning.

In addition, climate change is an on-going challenge that is expected to have significant health and ecological costs. A more holistic view that includes tools such as conservation, efficiency and cleaner technologies — as well as traditional regulatory tools — will be needed to continue to improve Minnesota's air resources.

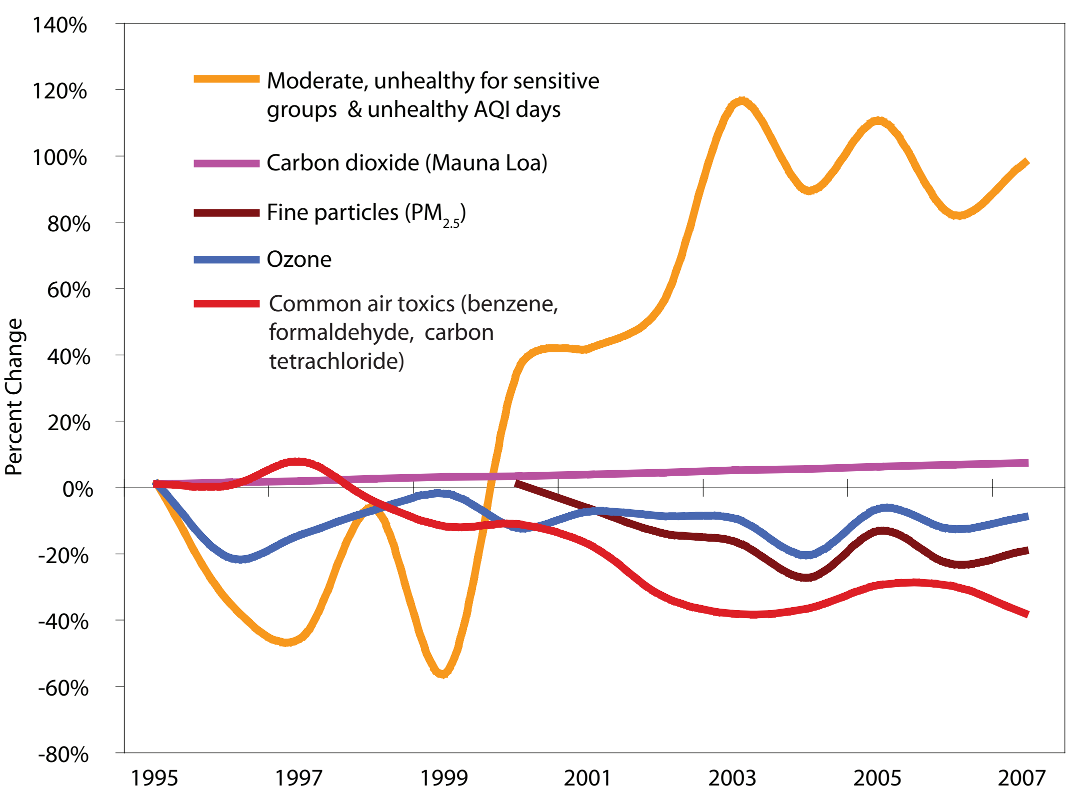
Air quality in Minnesota

Minnesota's air quality is generally good and has been improving for most pollutants. Minnesota has been in compliance with all national ambient air quality standards since 2002. Also, concentrations of most toxic air pollutants of concern have gradually decreased until, individually, they are below levels of health concern. Much of this decline can be attributed to lowered emissions from major facilities and cleaner cars and fuels due to enforcement of the Clean Air Act and Clean Air Act Amendments, as well as voluntary reductions undertaken at some facilities.

However, even as air programs have contributed to the decrease in emissions and concentrations of many air pollutants, increased understanding of serious health effects has resulted in stricter national ambient air quality standards. In 2006, the daily fine particle national standard was lowered by nearly half. In early 2008, the ozone standard was lowered from 0.08 parts per million (ppm) to 0.075 ppm. In October 2008, the quarterly lead standard was made 10 times stricter than the previous standard.

As a result, even as emissions and concentrations of key pollutants have decreased, the number of poor air quality days has increased. Air Pollution Health Alerts are called when the air is expected to be unhealthy for sensitive groups or higher according to the air quality index (AQI). These days are almost always the result of high levels of fine particles or ozone. Since the AQI is a main communication tool for Minnesota air quality, the increase in alert days leads to a dichotomy in public perception, with many Minnesotans believing that air quality is worsening, when in fact improvements are being made.

Trends of key air pollutants in Minnesota

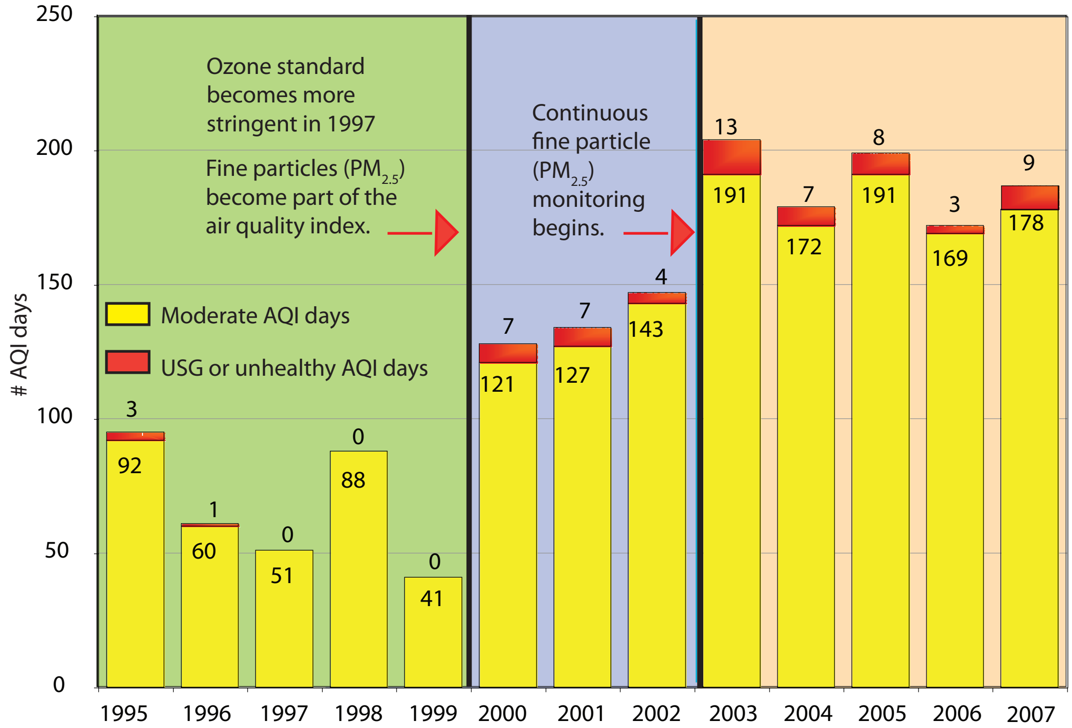


Concentrations of many pollutants such as fine particles, ozone and many air toxics have decreased since 1995. However concentrations of carbon dioxide (a major greenhouse gas) and the number of moderate, unhealthy for sensitive group (USG), and unhealthy air quality days has continued to increase.

Sources: MPCA Air Quality Index; Carbon Dioxide Information Analysis Center, ***http://cdiac.ornl.gov****; and MPCA air monitoring data.*

Concern over air pollution continues to evolve. Until 2000, MPCA only measured larger particles. Now fine particles are one of Minnesota's main outdoor air quality health concerns. Increasing knowledge of the health effects of air pollutants continues to ratchet down standards and lower acceptable concentrations. Further understanding of air pollution also underscores that it is not enough to look at pollutants in isolation. Instead, there is a growing understanding that chemicals interact in complex ways in the body and levels of air pollutants that may be acceptable from a single chemical may not be acceptable when examined cumulatively.

Moderate, unhealthy for sensitive groups and unhealthy AQI days in the Twin Cities metro area — 1995–2007



Source: MPCA Air Quality Index

MPCA did not monitor fine particles until 2000. At that time the number of moderate, unhealthy for sensitive group (USG), and unhealthy days increased substantially. Another increase occurred in 2003 when fine particles began to be monitored continuously instead of once every three days.

Traditional point sources of air pollution, such as factories, have been relatively well-regulated; however, these new concerns highlight the role of sources over which MPCA has limited control, such as transportation and non-point sources such as residential burning. Also, newer concerns — such as the growing concentrations of greenhouse gases in the upper atmosphere — may ultimately supersede more traditional air pollutants.

Trends in major air pollutants

Greenhouse gases

Most climate change results from emissions of greenhouse gases that build up in the atmosphere.

While it is difficult to determine exactly how much human activity contributes to climate change, scientists agree that the most important greenhouse gas is CO_2, which comes mainly from the combustion of fossil fuels such as coal, oil, and gas. Other greenhouse gases, such as methane, contribute an additional 25 percent to climate change. Minnesota emissions of CO_2 increased 50 percent between 1970 and 2006.

Climate change will affect Minnesota by impacting natural ecosystems, agriculture, forestry, outdoor recreation, infrastructure like wastewater treatment and flood control, and human comfort. There is strong evidence that current Minnesota ecosystems will be affected by a changing climate and may not be able to persist in warmer conditions. For example, some species, such as those in the boreal forest, that are currently at the southern edge of their range, may move northward as suitable habitat is lost. How these changes occur will change the face of Minnesota landscapes.

To date, mean annual temperature in Minnesota has increased about one degree Fahrenheit over the last 100 years. Besides changes in temperature, precipitation is expected to occur in more frequent, intense storms with fewer light and moderate storms.

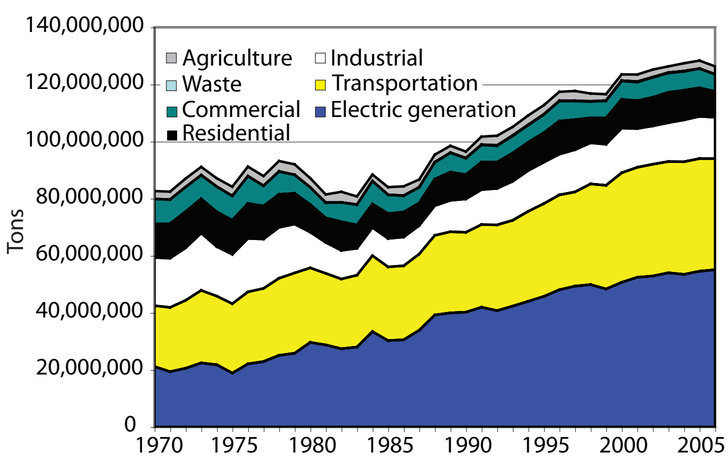
The legislature passed and Governor Pawlenty signed the Next Generation Energy Act in 2007. The act includes strategies to increase renewable energy use, increase energy conservation and decrease carbon emissions from Minnesota. The Act set greenhouse gas emission reduction goals, to reduce statewide greenhouse gas emissions across all sectors at least 15 percent below 2005 levels by 2015, at least 30 percent below 2005 levels by 2025, and at least 80 percent below 2005 levels by 2050.

The Governor also signed the Midwestern Greenhouse Gas Accord. It will design a market-based multi-sector regional cap and trade system with other states and establish emissions tracking, management and credits, and develop other policies to achieve the target reductions.

Also, should the state fail to adopt a greenhouse gas control plan, the Next Generation Energy Act prohibits increased emissions from new large energy facilities through construction, import of electricity, or power purchase agreements, unless emissions are offset.

A detailed inventory of emissions through 2007, and current progress towards reaching these reduction goals, will be completed in January 2009.

CO_2 emissions from fossil fuel combustion in and net electricity imports into Minnesota



Eighty percent of greenhouse gases and nearly all CO_2 emissions in Minnesota are the result of energy production and usage. Transportation and electricity generation account for about one-third each of all CO_2 produced in Minnesota. Industry accounts for another eighth of emissions. Residential heating accounts for less than one-tenth of all CO_2 emissions.

Emissions of CO_2 from fossil fuel combustion in Minnesota increased over 50 percent between 1970 and 2006. Much of the increase in CO_2 emissions derives from increasing dependence on coal as an energy source. Emissions of CO_2 from coal combustion more than doubled between 1970 and 2006, increasing about 23 million tons.

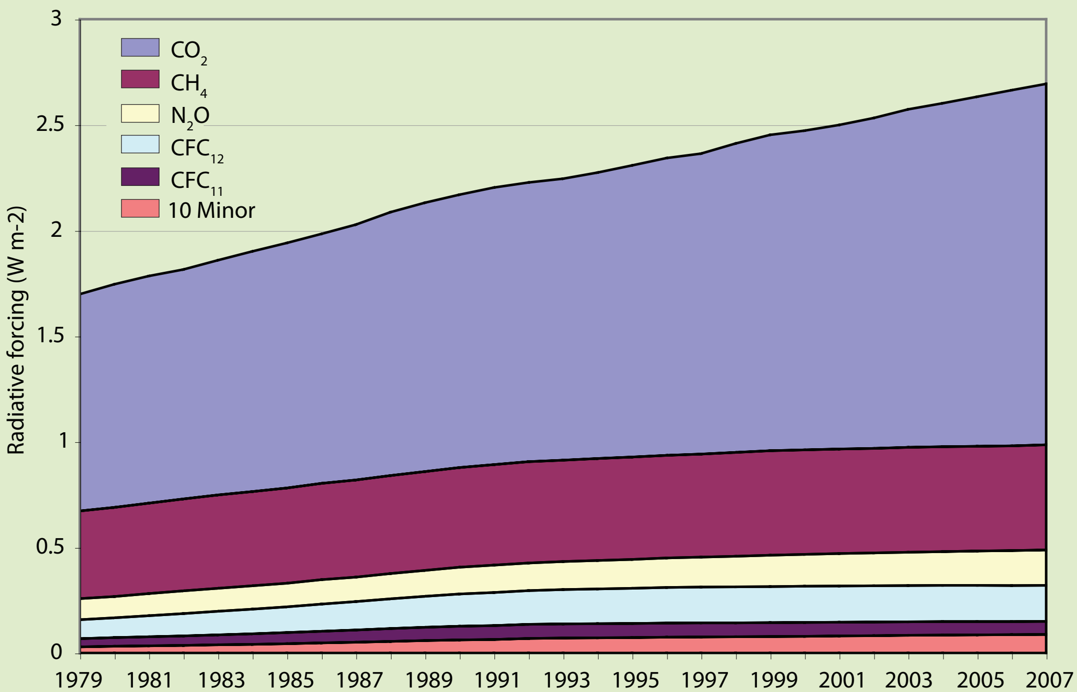
Source: MPCA Greenhouse Gas Inventory

High global warming potential greenhouse gases

While CO_2 and methane are the best known greenhouse gases, other high global warming potential greenhouse gases such as nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride cause much more warming in the atmosphere than the same amount of carbon dioxide. These chemicals are commonly used as refrigerants, propellants, flame-retardants or extinguishants, and solvents.

The MPCA has been collecting information from companies that purchase these chemicals in Minnesota, or manufacture them for sale in Minnesota. All automobile manufacturers that offer vehicles for sale in Minnesota must report the mobile air conditioner leakage rates. A report to the legislature identifying the uses of these chemicals, options to reduce or eliminate their use, and costs of these options will be completed in February 2009.

Global contribution of greenhouse gases to climate change



Source: National Oceanic and Atmospheric Administration, ***www.esrl.noaa.gov/gmd/aggi***

Fine particles

Particles have been regulated by national ambient air quality standards since 1971. Some particles are seen as soot or smoke while others are so small they can only be detected with an electron microscope. The original national standard was for total suspended particulate, however, through the years, as researchers have learned more about the health effects of fine particles, there has been a growing recognition that smaller particles pose a greater health risk. In response, the standard was changed to focus on particles with an aerodynamic diameter less than 10 microns (PM_{10}) in 1987, and in 1997 a standard for fine particles with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$) was put into place. The short term $PM_{2.5}$ standard was made more stringent in 2006.

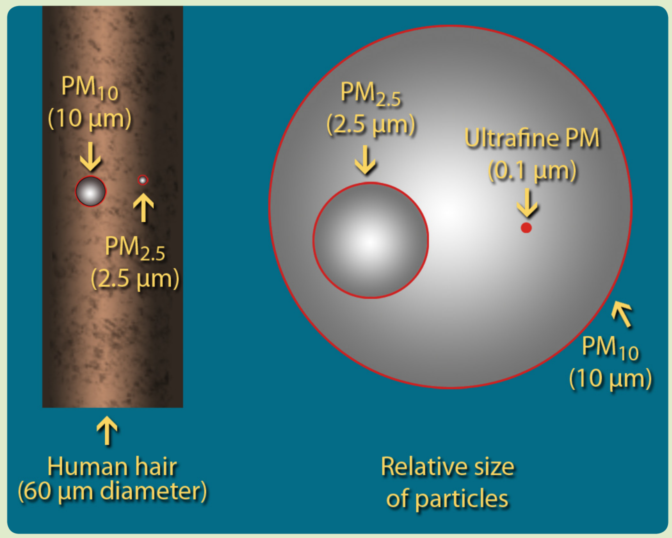
Fine particles can be inhaled deeply into the lung. These particles then accumulate in the respiratory system, where they can result in a range of serious health effects. Specifically, elevated fine particles are associated with a rise in heart attacks; acute and chronic bronchitis; asthma episodes; other respiratory symptoms; and reduced lung function growth and increased respiratory illness in young children.

Minnesota currently meets all national standards for particles. However, levels are high enough on some days to result in air quality alerts for sensitive people such as children, the elderly, athletes and people with heart or lung diseases. As a result, lowering concentrations of $PM_{2.5}$ remains a MPCA priority. **MPCA seeks to reduce direct man-made emissions of fine particles by 15 percent from 2002 levels by 2012.**

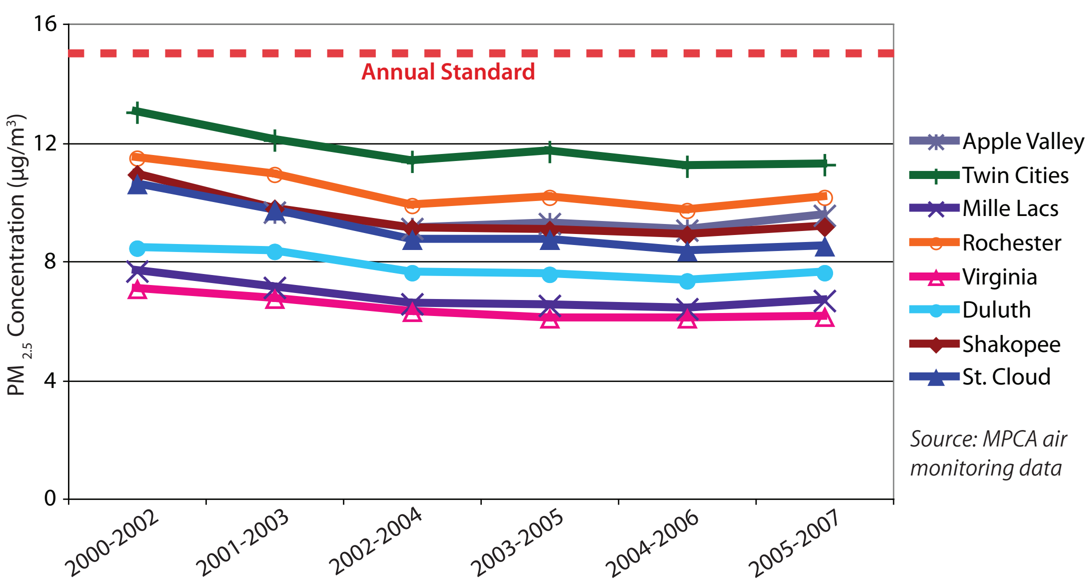
Ultrafine particles

As researchers continue to focus on smaller particles, some believe that further regulatory emphasis should be placed on ultrafine particles. Ultrafine particles have a diameter of less than 0.1 microns. They are a small portion of $PM_{2.5}$ mass, so they may not be affected by emission reduction efforts for $PM_{2.5}$. However, they are numerous near combustion sources such as traffic and wood combustion before quickly combining into larger particles. Due to their size, some ultrafines are able to pass effectively into the blood-stream compared to larger particles and may have body-wide effects. Further research is needed on the health affects and potential concerns of ultrafine particles.

Comparison of PM_{10}, $PM_{2.5}$ and Ultrafine PM



Minnesota fine particle trends — 2000–2007



Source: MPCA air monitoring data

$PM_{2.5}$ has both a daily 24-hour standard and an annual standard. To meet the annual standard, the average annual concentration over three years must be less than or equal to 15 ug/m^3. Concentrations are highest in the Twin Cities Metropolitan area, intermediate in suburban and mid-size cities, and lowest in smaller cities such as Virginia. Particles are regional pollutants, with similar concentrations over large parts of Minnesota. Concentrations have decreased slightly at all locations since monitoring began in 2000.

Fine particle sources

MPCA recently hired Desert Research Institute (DRI) to investigate the sources of fine particles in Minnesota. DRI compared the results of several modeling approaches to estimate fine particle sources using monitoring data, directly measured emission profiles from likely sources and meteorological data. The study found differences in fine particle concentrations and sources between urban and rural locations and between southern and northern Minnesota. This study is preliminary and additional work is needed to answer some important questions and refine some of the conclusions.

On average, urban concentrations of fine particles are 30 percent to 60 percent higher than rural concentrations. This study found that gasoline and diesel combustion (mobile) sources contribute one-third to one-half of fine particle concentrations in highly populated urban areas. Much of the other half of the urban fine particle concentrations are from ammonium sulfate and ammonium nitrate which are created when sulfur dioxide and nitrogen oxides react with ammonia in the atmosphere. Coal burning in boilers (primarily power plants) is the major source of sulfur dioxide; coal burning and mobile sources are major sources of nitrogen dioxide; and fertilizers and livestock are important sources of ammonia. Soil and road dust at the urban monitoring locations were roughly double the concentrations in the rural areas. The contribution of wood smoke and other biomass combustion was less certain. The identified sources may also include other sources with similar chemical emissions.

Concentrations in rural areas in northern Minnesota are about half of the concentrations found in rural southern Minnesota. Ammonium sulfate and ammonium nitrate make up at least three-quarters of average rural fine particle concentrations. Smaller amounts of rural fine particles were from biomass combustion and soil dust. Mobile source contributions to fine particles were small at these rural sites. A major difference between northern and southern fine particles is that there is significantly less ammonium nitrate and slightly less ammonium sulfate in the north compared to the south.

Ozone

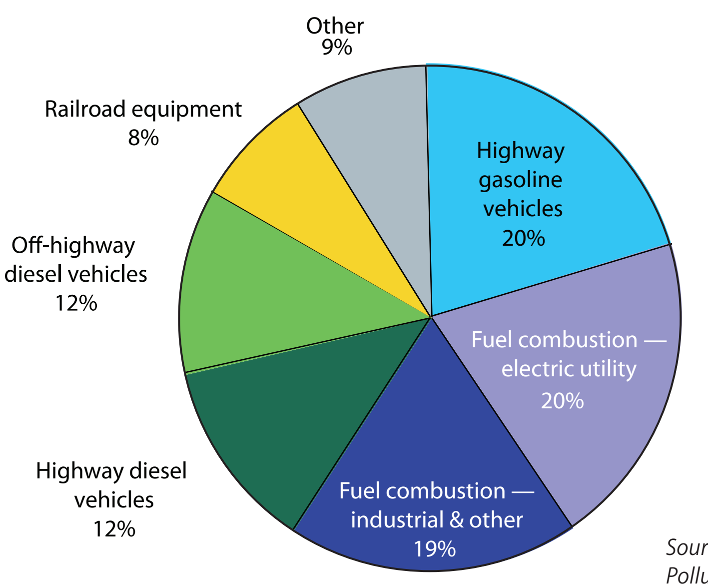
Ozone is colorless gas composed of three atoms of oxygen. Ground-level ozone is not emitted directly into the air, but is created through a reaction of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) mixing in the presence of sunlight.

Breathing air containing elevated ozone concentrations can reduce lung function, thereby aggravating asthma or other existing respiratory conditions. Ozone exposure has also been associated with increases in respiratory infection susceptibility, medicine use by asthmatics, doctor and emergency room visits and hospital admissions. Ozone exposure may also contribute to premature death in people with heart and lung disease. In addition, repeated exposure to low levels of ozone damages vegetation, trees and crops, leading to increased susceptibility to disease, damaged foliage, and reduced yields.

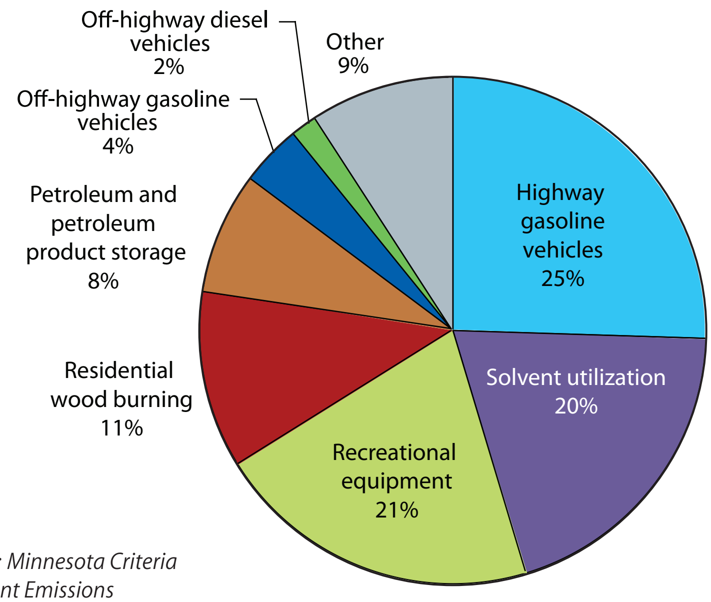
Ozone concentrations tend to be highest just outside urban areas, since pollutants emitted in urban centers actually destroy ground-level ozone. As a result, MPCA does not monitor directly in urban centers such as Minneapolis and St. Paul, but in surrounding suburban areas.

Trends for ozone are difficult to determine since ozone is affected not only by emissions, but also by weather

Nitrogen oxides emissions

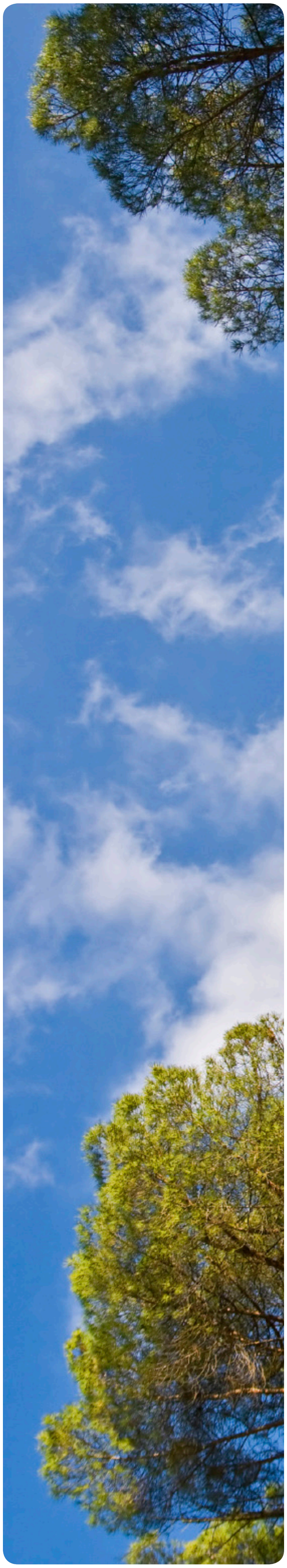


VOC emissions



Source: Minnesota Criteria Pollutant Emissions Inventory, 2005

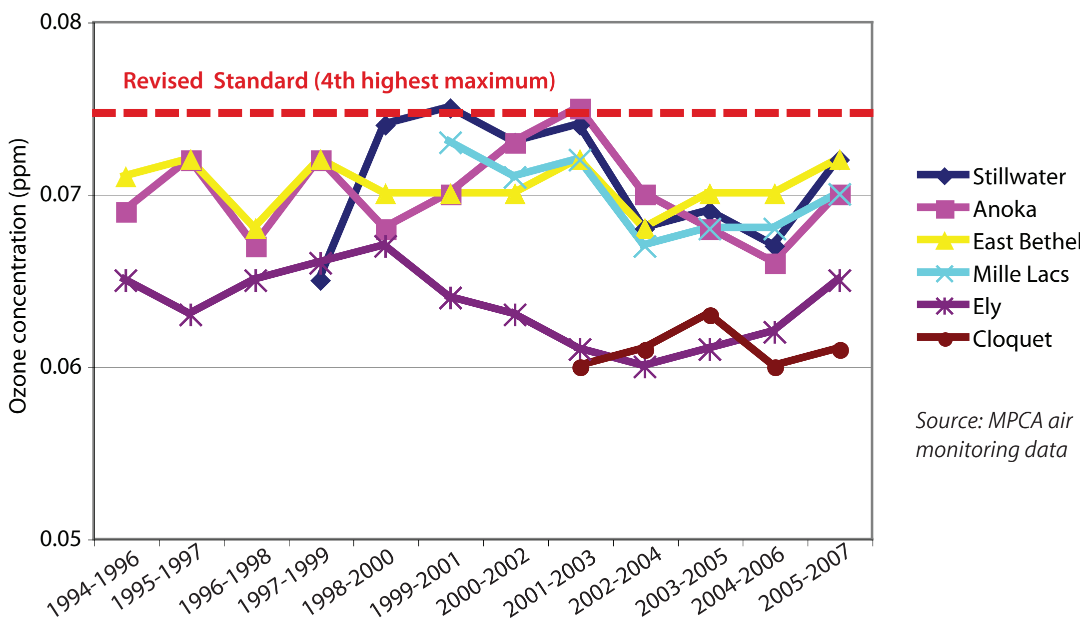
Ozone concentrations are dependent on sunlight, heat and emissions of NO_X and VOCs. The main source of NO_X is emissions from burning fuels. Stationary sources such as electric utilities account for nearly 40 percent of NO_X emissions. Another 32 percent comes from gasoline and diesel highway vehicles. Major sources of VOCs include evaporation from and combustion of gasoline in highway and recreational vehicles (46 percent), use of solvents (20 percent) and residential wood burning (11 percent).



conditions such as heat and humidity. Advanced modeling by EPA indicates that ozone concentrations have been decreasing in Minnesota.

Minnesota currently meets all national standards for ozone. However, since the national standard was decreased from 0.08 ppm to 0.075 ppm in 2008, Minnesota is now closer to the standard and ozone can still result in moderate or even unhealthy for sensitive group alert days. **As a result, MPCA seeks to reduce levels of NO_x by 30 percent and VOC levels by 20 percent from 2002 levels by 2012.**

Minnesota ozone trends — 1994–2007



To meet the national ozone standard revised in 2008, the three year average of the fourth highest daily maximum eight-hour concentration must be less than or equal to 0.075 ppm. Concentrations of ozone are similar in central Minnesota, with lower concentrations in northern cities such as Ely and Cloquet.

Air Toxics

Toxic air contaminates or "air toxics" is the name of a category of hundreds of chemicals that, at high enough concentrations, cause or are suspected of causing cancer or other serious health problems. Many are difficult to measure; others rapidly change or combine with other chemicals in the air.

The MPCA compares concentrations of air toxics in the ambient air to inhalation health benchmarks, which are concentrations in ambient air at or below which a chemical is unlikely to cause an adverse health effect. Unlike the federal ambient air standards, health benchmarks are guidelines rather than enforceable standards.

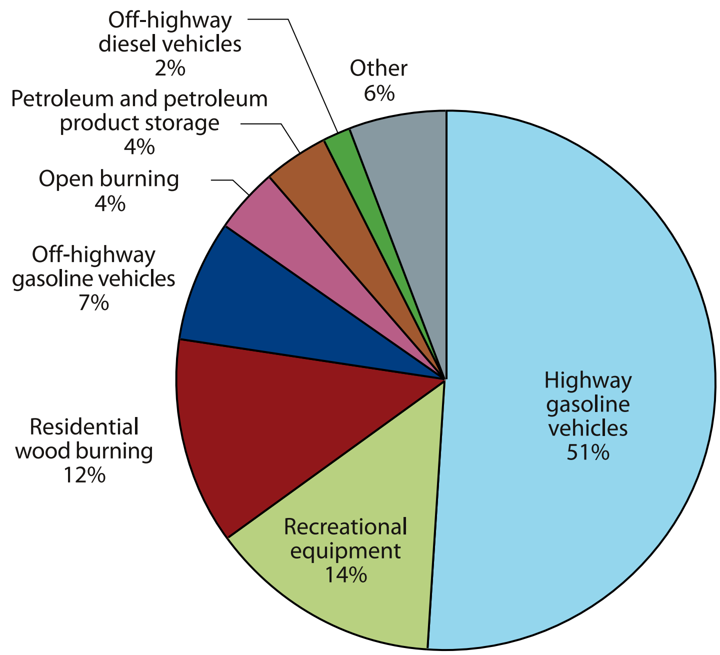
The MPCA monitors three types of air toxics: 56 volatile organic compounds (VOCs), seven carbonyl compounds, and 15 metals. Of these, only a few are near their health benchmarks. They include compounds such as benzene, carbon tetrachloride, formaldehyde, manganese and arsenic.

Most air toxics have decreased in concentration during the period they have been monitored, although some have remained unchanged. They come from a variety of sources including fuel combustion, solvent usage and metal processing. More facility controls, cleaner gasoline and cleaner running vehicles have all resulted in lower emissions and concentrations of air toxics.

The MPCA seeks to target reductions in statewide risk from air toxics by identifying the pollutants that largely contribute to cancer and other serious health problems and by developing strategies by 2010 to further reduce emissions and concentrations of these compounds.

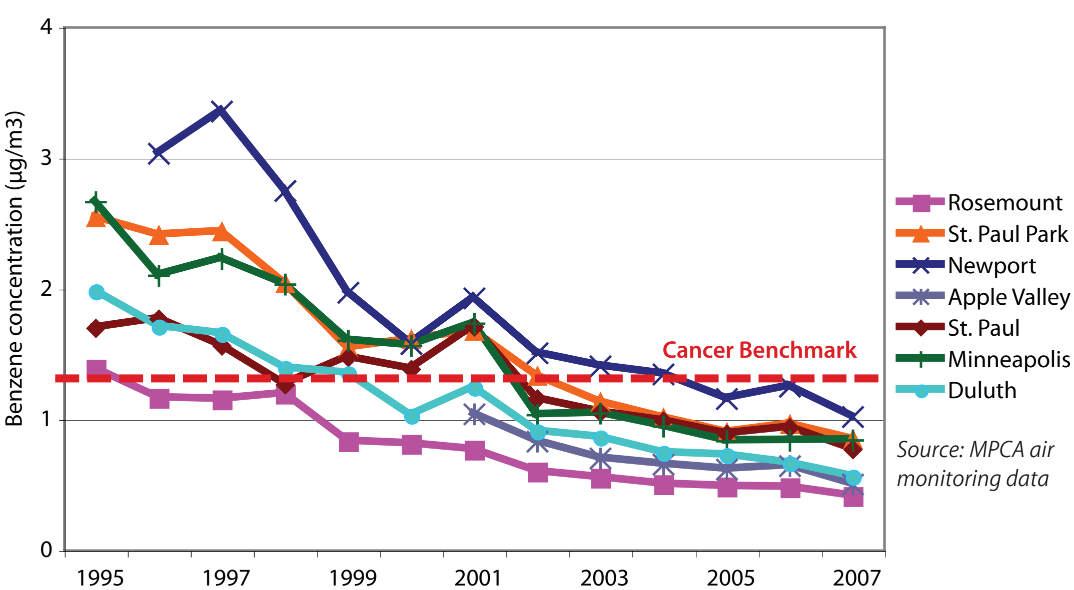
More information on air toxics emissions can be found in appendix B of this report.

Benzene emissions



Source: Minnesota Air Toxics Emissions Inventory, 2005

Minnesota benzene trends — 1995-2007

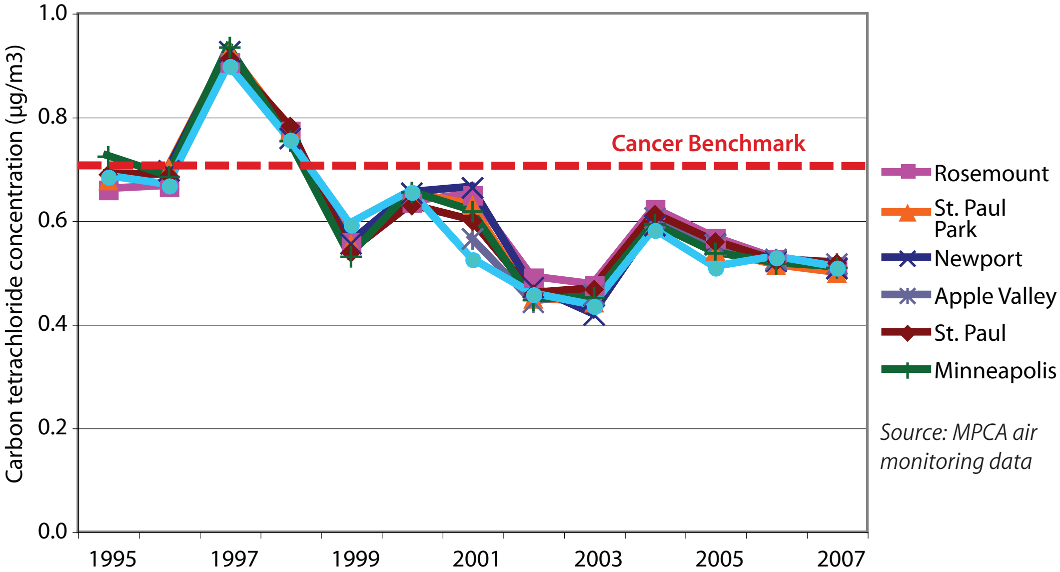


Source: MPCA air monitoring data

Benzene

Benzene is primarily a concern due to its potential to cause leukemia. The major source of benzene is vehicle fuel with some emissions resulting from residential wood and open burning. Benzene concentrations have gone down dramatically since 1995 due to decreased levels of benzene in fuel, better containment of gasoline fumes at fueling stations and cleaner burning vehicles.

Minnesota carbon tetrachloride trends — 1995–2007



Source: MPCA air monitoring data

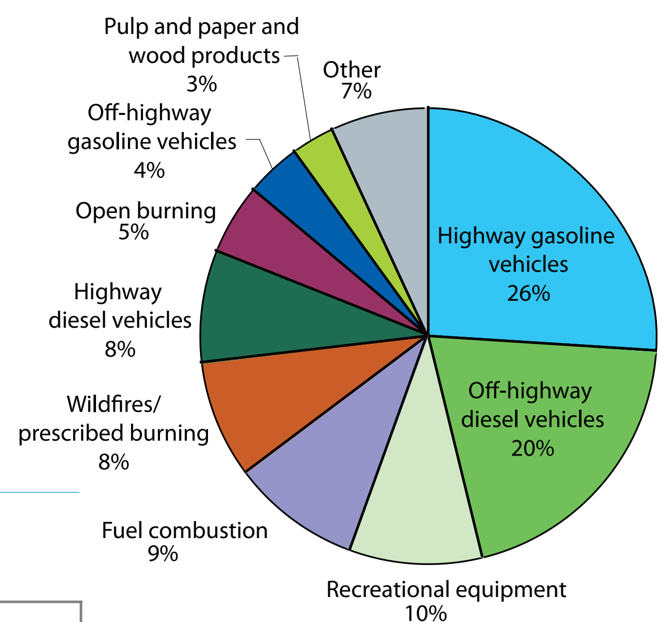
Carbon tetrachloride

The health benchmark for carbon tetrachloride is for liver cancer. Most production of carbon tetrachloride was phased out in 1996 as part of the Montreal Protocol. Current concentrations are a result of past emissions and a total atmospheric lifetime of about 50 years. Carbon tetrachloride concentrations have been decreasing since 1995 as the pollutant gradually breaks down in the atmosphere.

Formaldehyde

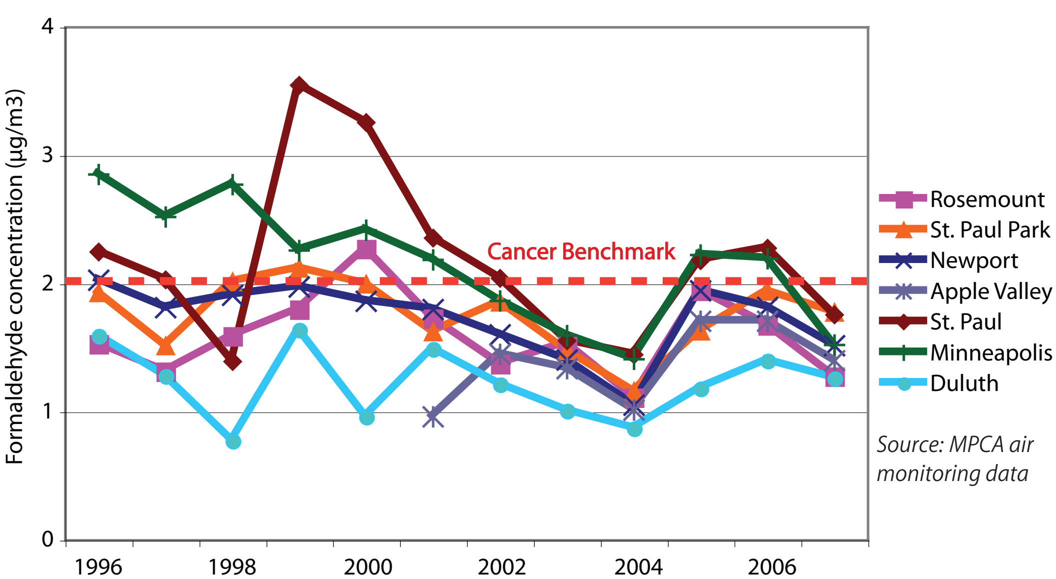
Formaldehyde is a concern both for its potential to cause cancer and its concern as an airway irritant. Formaldehyde has many sources, including direct emissions from combustion sources, emissions from natural sources such as vegetation and being produced as other pollutants break down. As a result, formaldehyde has not decreased in concentration as much as many other air toxics and is more difficult to manage through regulations.

Formaldehyde emissions



Source: Minnesota Air Toxics Emissions Inventory, 2005

Minnesota formaldehyde trends — 1996–2007

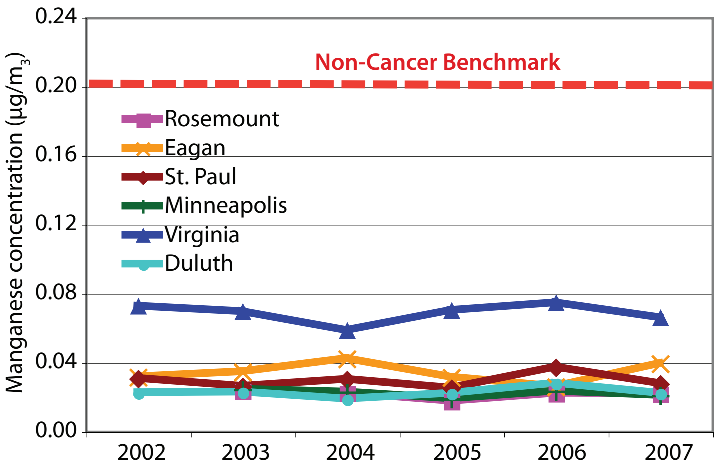


Source: MPCA air monitoring data

Manganese

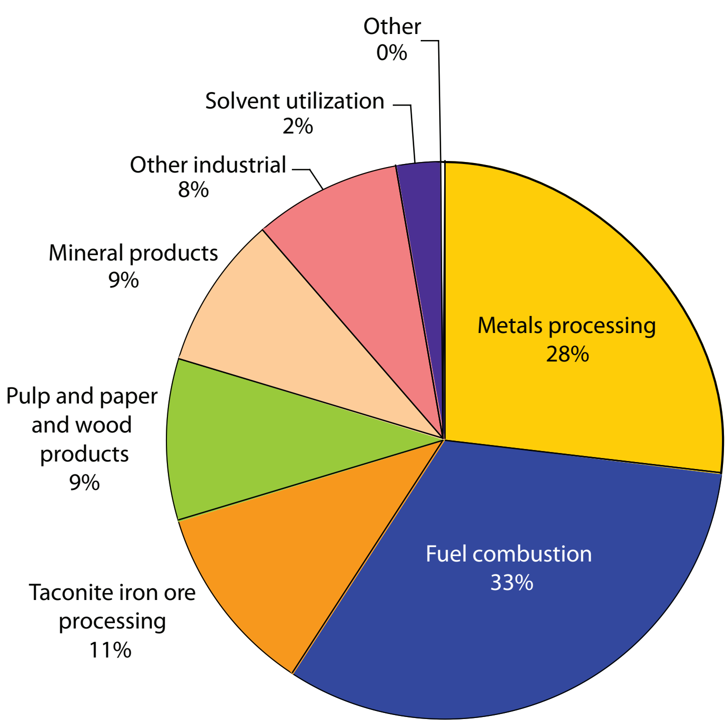
Manganese is a potential neurotoxin. Currently monitored concentrations are below the Minnesota Department of Health benchmark of 0.2 μg/m^3; however, the EPA has a benchmark of 0.05 μg/m^3 and sites such as Virginia are over the EPA benchmark. Levels of manganese have remained unchanged since 2002. Manganese is part of a fuel additive used in Canada called methylcyclopentadienyl manganese tricarbonyl (MMT). There is a concern that the use of manganese additives in gasoline could increase inhalation manganese exposures if added to U.S. fuel. Currently, the main sources of manganese in Minnesota are metal processing and fuel combustion.

Minnesota manganese trends — 2002–2007



Source: MPCA air monitoring data

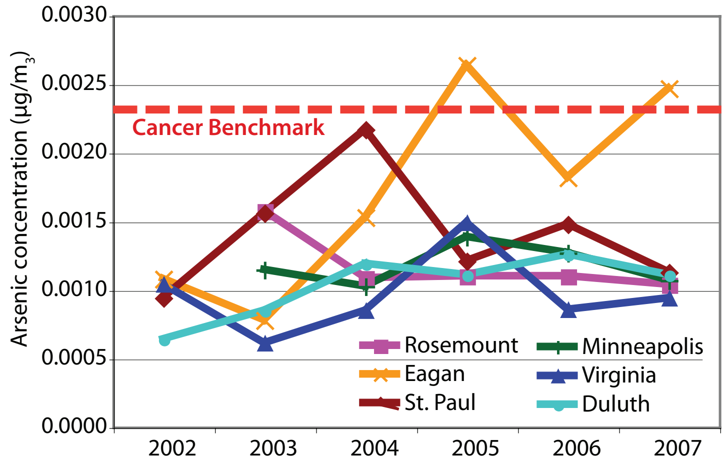
Manganese emissions



Arsenic

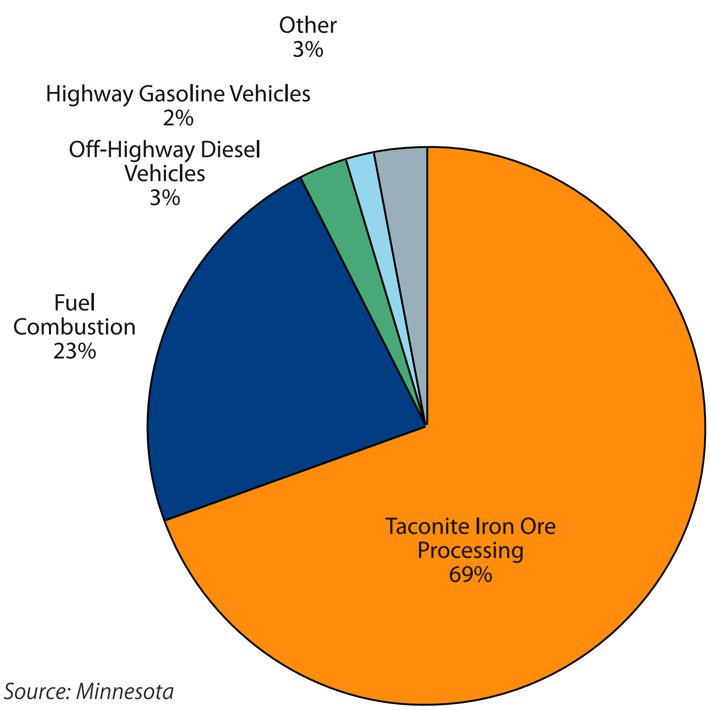
Arsenic is mainly a concern due to its potential to cause cancer. Its primary sources are taconite iron ore processing and the combustion of fuels. Arsenic concentrations have been generally level or increasing in Minnesota. The Eagan site has recently been over the health benchmark, but most of the data is near or below MPCA's instrument detection level.

Minnesota arsenic trends — 2002–2007



Source: MPCA air monitoring data

Arsenic emissions



Source: Minnesota Air Toxics Emissions Inventory, 2005

Mercury

Mercury is a neurotoxin, a substance that damages the central nervous system of people and other animals. For most Minnesotans, eating fish contaminated with too much mercury poses the greatest risk for exposure. Because mercury is bioaccumulative, we are advised to restrict our consumption of larger fish from Minnesota lakes, rivers and streams.

The vast majority of mercury in Minnesota's environment comes from air pollution, deposited by rain and snow and attached to dry particles. Only about 10 percent of mercury deposited from the air in Minnesota comes from sources in the state. The remainder is emitted by sources in the rest of world, including some from other states.

MPCA scientists calculate that for larger fish, such as walleye and northern pike, to be safely eaten more often, airborne mercury pollution sources worldwide will need to reduce their emissions by about 93 percent from 1990 levels. This includes substantial declines in product-related sources between 1990 and 2005 attributable to decreased use of mercury in a variety of products as well as better controls on waste combustors. **Accordingly, MPCA has established a goal of reducing emissions from sources within the state from current levels of about 3,300 pounds per year to below 800 pounds by 2025.**

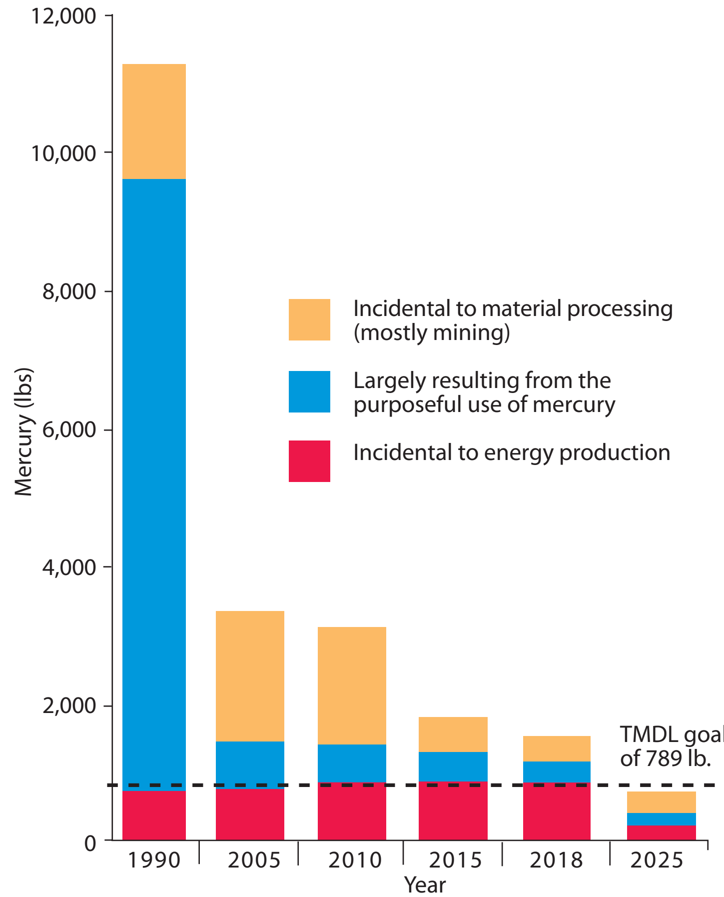
In May 2008, a diverse group of stakeholders recommended a comprehensive set of strategies to meet this ambitious target. The MPCA is implementing these recommendations by using its authority to compel sources in the state to reduce their mercury emissions accordingly. This includes reductions from coal-burning power plants, taconite processing and a variety of mercury-added product uses.

Coal-fired electricity generation is currently the largest source of mercury pollution in Minnesota. Emission reductions mandated by the 2006 legislature will eliminate about 1,200 pounds of mercury emissions per year from three large plants by the end of 2014. Progress in meeting this requirement is ahead of schedule with approved plans at three of the six affected units. Installation of mercury controls at one unit is expected three years ahead of schedule. For most of the remaining coal-fired power plants in the state, stakeholder-recommended strategies will achieve similar reductions by 2025, mostly sooner. Appendix A quantifies mercury emissions related to electricity consumption in Minnesota.

Taconite processing plants, challenged by the lack of proven pollution-control technologies, are striving to achieve a 75 percent reduction in mercury emissions by 2025. Recent research findings will be tested on plant operations while furthering initial research.

Finally, an array of stakeholder-recommended strategies to reduce emissions resulting from mercury-added products is also being implemented by the MPCA and affected sectors. These include smelters that recycle cars and appliances, mercury recyclers, crematories and solid waste handling.

Actual and projected Mercury emissions 1990-2025
Based on reduction targets established by the Strategy Work Group



Source: 1990 and 2005 estimates from the Minnesota Criteria Pollutant Emissions Inventory.

2010-2025 emissions projections prepared by MPCA incorporating stakeholder recommendations and emission trends.

For more information on mercury, see the MPCA's Web site: **www.pca.state.mn.us/air/mercury.html**

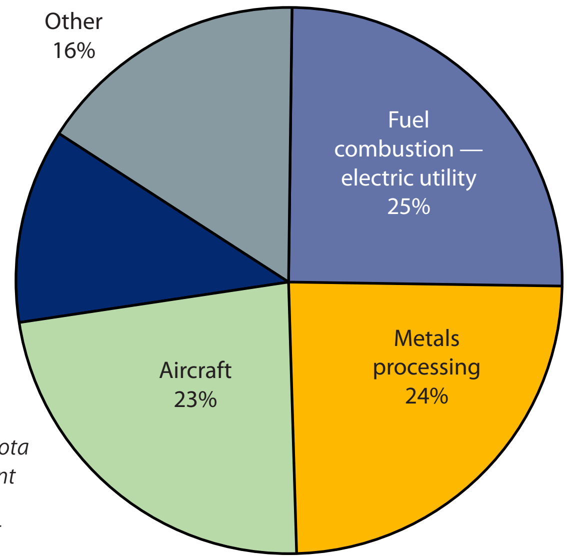
Lead

Lead is a metal found naturally in the environment as well as in manufactured products. In the past, the major sources of lead emissions were leaded gasoline and industrial sources. Since lead in gasoline was phased out in the late 1970s, air emissions and ambient concentrations have decreased dramatically.

Scientific evidence about health effects of lead has expanded significantly in the last 30 years. Exposures to low levels of lead early in life have been linked to effects on IQ, learning, memory, and behavior. There is no known safe level of lead in the body.

As a result of this better understanding of lead, the Environmental Protection Agency revised the national ambient air quality standard for lead from 1.5 µg/m^3 to 0.15µg/m^3 — 10 times stricter than the previous standard from 1978.

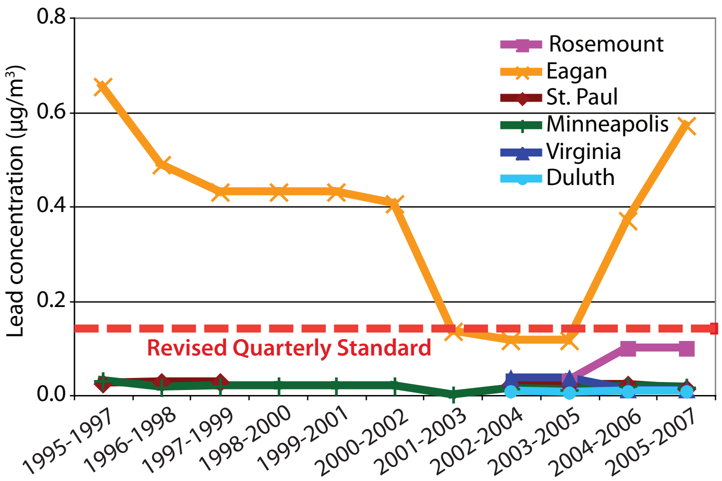
Lead emissions



Source: Minnesota Criteria Pollutant Emissions Inventory, 2005

Currently, fuel combustion in electric utilities, metals processing (lead and other metal smelters) and aircraft using leaded fuel are the primary sources of lead emissions in Minnesota. MPCA has monitors near the Minneapolis St. Paul Metropolitan Airport as well as smaller airports and has not measured elevated lead concentrations. The high stacks on coal burning electric utilities would likely disperse lead over a wide area and prevent high levels near the facilities. Metal processors may continue to be a concern. Lead monitors will be added in Minnesota to monitor facilities that emit more than one-ton of lead per year to ensure that those locations meet the new national lead standard.

Minnesota lead trends — 1995–2007



Source: MPCA air monitoring data

All lead concentrations measured at Minnesota monitoring sites are well below the 1978 lead standard; however, a monitoring site near a secondary lead smelter in Eagan currently shows readings above the revised standard of 0.15 µg/m^3. The revised standard uses the highest three month rolling average over a three year period. In 2006, the Eagan monitor was moved to a location closer to the smelter, resulting in higher measured lead concentrations.

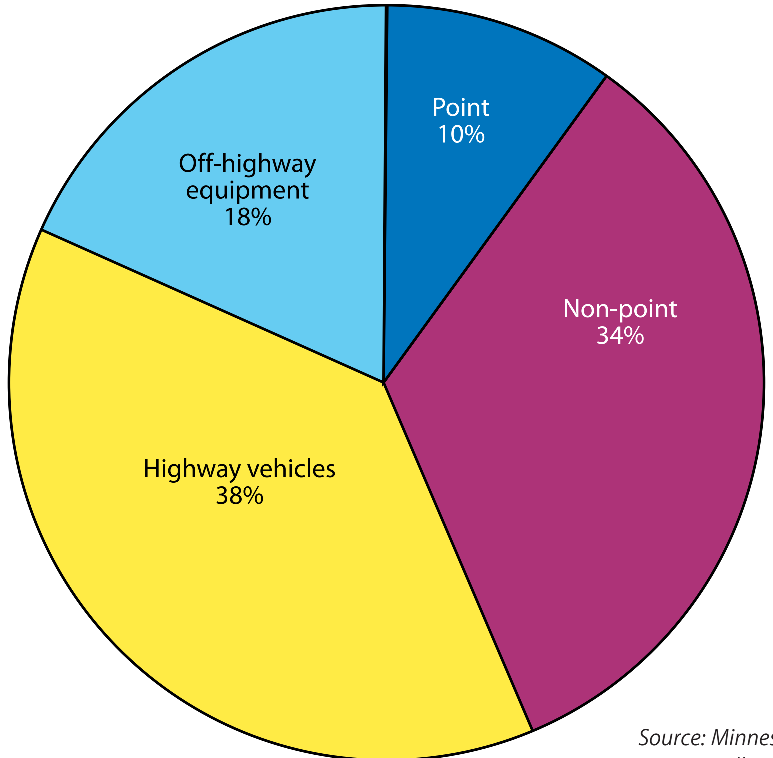
MPCA is committed to meeting all National Ambient Air Quality Standard and has already begun work to bring Eagan and Dakota County into attainment with the new lead standard.

Air quality challenges

As discussed in earlier sections of this report, concentrations of many pollutants have been decreasing in part as a result of controls put in place due to the Clean Air Act and Clean Air Amendments, including cleaner operations at facilities and businesses, cleaner vehicles and cleaner fuels. Today, large facility sources called point sources only contribute around 10 percent to emissions of major air pollutants. The remaining emissions come from small non-point sources such as gasoline stations and residential heating; on-road cars and trucks and non-road sources such as construction equipment, boats and other recreational and lawn equipment.

The MPCA has limited regulatory authority over many of these sources, but these non-point sources have major impacts on air pollution. A few sources that pose big challenges for future reductions of traditional air pollutants include transportation and residential burning. Another challenge is the growing understanding that air pollution can not continue to be dealt with on a pollutant by pollutant or facility by facility basis. Instead, a more holistic view reflects that the air Minnesotans ultimately breathe is a combination of many pollutants from many places. Only by dealing with this multiplicity can Minnesota reach its goal of cleaner air.

2005 Minnesota emissions of major air pollutants by principal source



Source: Minnesota Criteria Pollutant Emissions Inventory, 2005

Only 10 percent of emissions of major air pollutants come from major facilities. Transportation, off-highway equipment and smaller non-point stationary sources are now larger sources of overall pollution. Chart includes ammonia, carbon monoxide (CO), NO_X, PM_{10}, SO_2 and VOCs.

Clean Air Interstate Rule and Clean Air Mercury Rule

MPCA's 2007 legislative report highlighted EPA's rules adopted in 2005 that affected Minnesota's electric generating units, the Clean Air Interstate Rule and the Clean Air Mercury Rule. These rules set up a cap-and-trade system to help lower emissions of NO_X, SO_2 (CAIR) and mercury (CAMR) from coal fired power plants.

In the spring and summer of 2008, both rules were vacated by the U.S. Court of Appeals for the D.C. Circuit. EPA petitioned for rehearing of CAIR. On December 23, 2008, the Court determined that the vacatur would impair protection of the environment. It therefore kept the rule in place, but is requiring the EPA to fix the flaws identified in the previous ruling.

One key issue is whether Minnesota should continue to be included in CAIR due to impacts on a non-attainment area of Chicago. Regardless of Minnesota's CAIR status, Minnesota will still see pollution control projects continue at electric generating stations in Minnesota due to controls required under EPA's regional haze rules. Over long distances, NO_X and SO_2 from power plants react in the atmosphere to form fine particulates, which cause regional haze and have significant health impacts.

This regional haze rule requires controls of NO_X and SO_2 from all types of sources in Minnesota to address visibility impacts in the Boundary Waters Canoe Area Wilderness and Voyageurs National Park. First, the MPCA will have to make determinations of feasible control technology for older power plants (built between 1962 and 1977), which will result in emission reductions from specific plants. In some cases, these reductions may be greater at any given plant than would have occurred under CAIR.

Subsequently, emission reductions from power plants may be required in order to continue to improve visibility. However, in general, the reductions will likely not be as great and certainly will not occur as swiftly as under the requirements of CAIR.

As part of Xcel Energy's Metropolitan Emissions Reduction Project (MERP), the High Bridge coal fired power plant was replaced by a new natural gas fired generating facility in 2008. The conversion of High Bridge from coal to natural gas significantly reduced all air emissions from the plant including PM_{10} by 82 percent, nitrogen oxide by 95 percent, sulfur dioxide by over 99 percent and 100 percent of mercury emissions.

Photographs used with permission from Xcel Energy

Mercury control projects at coal fired power plants continue under Minnesota's Mercury Emissions Reduction Act of 2006 as well as the mercury TMDL to address fish contamination throughout Minnesota.

Transportation

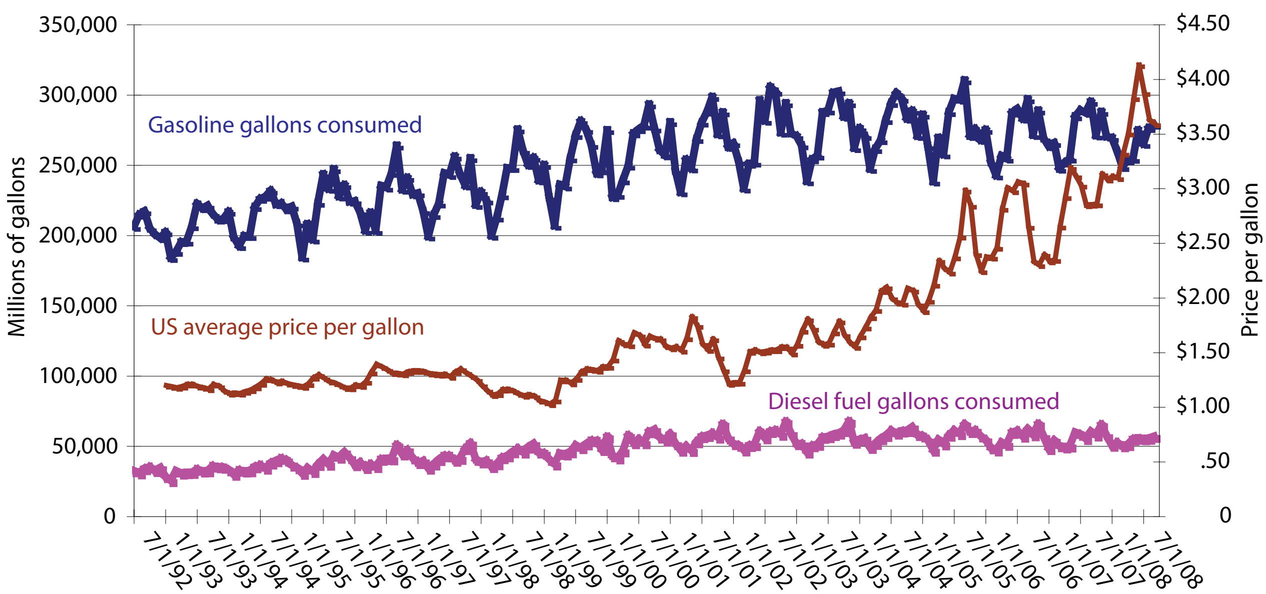
Despite cleaner fuels and cleaner burning vehicle technology, transportation remains a major source of air pollution. This sector contributes nearly a third of carbon dioxide emissions from fossil fuel combustion in Minnesota. Transportation is a big contributor of the two key ozone-forming pollutants because it creates a quarter of all VOC emissions, and nearly a third of all NO_X emissions (which also contributes to secondary fine particle creation). This sector is also a major contributor to direct fine particle emissions and air toxics, including over half of benzene emissions and a third of direct formaldehyde emissions.

The MPCA has little direct control over transportation sources. However, several voluntary efforts are underway to decrease the impact of mobile sources. For example, the MPCA is a major partner of Clean Air Minnesota (CAM) and its school bus retrofit program called Project Green Fleet (PGF). The project began in October 2005 and met its initial goal of retrofitting 500 buses with pollution reducing technology by the end of 2007 and completed over 1,000 total retrofits by the end of 2008. Tailpipe retrofits installed on school buses not only reduce particulate matter, carbon monoxide, and hydrocarbon contributions to the atmosphere, they also reduce school children's direct exposure to pollutants inside the bus. In 2008, both MPCA and PGF have expanded retrofit work to other heavy-duty diesel vehicles, such as snow plows, waste haulers, and transit buses.

In addition, the MPCA has been working over the last two years with small trucking businesses and independent truckers and has provided low interest loans to help them purchase idle reduction equipment such as Auxiliary Power Units (APUs). A typical long haul truck idles for an average of 1700 hours per year, to provide driver comfort and safety during mandatory rest periods. Once installed, APUs reduce diesel fuel use from one to 1.5 gallons per hour of idling down to just two-tenths of a gallon per hour. This reduced consumption not only saves the driver in fuel costs, it also lowers carbon dioxide, NO_X, particulate matter, and hydrocarbon emissions.

Federal action has also resulted in cleaner transportation emissions. These initiatives include ultra low sulfur diesel fuel, phased in late in 2006, and cleaner diesel technology mandated in 2007 highway vehicles. The sulfur content in diesel fuel went from 300-500 parts per million (ppm) down to just 15 ppm, resulting in a 10 percent particulate emission reduction in old diesel engines. In 2007 or newer diesel engines, the particulate emissions are expected to be reduced by 90 percent.

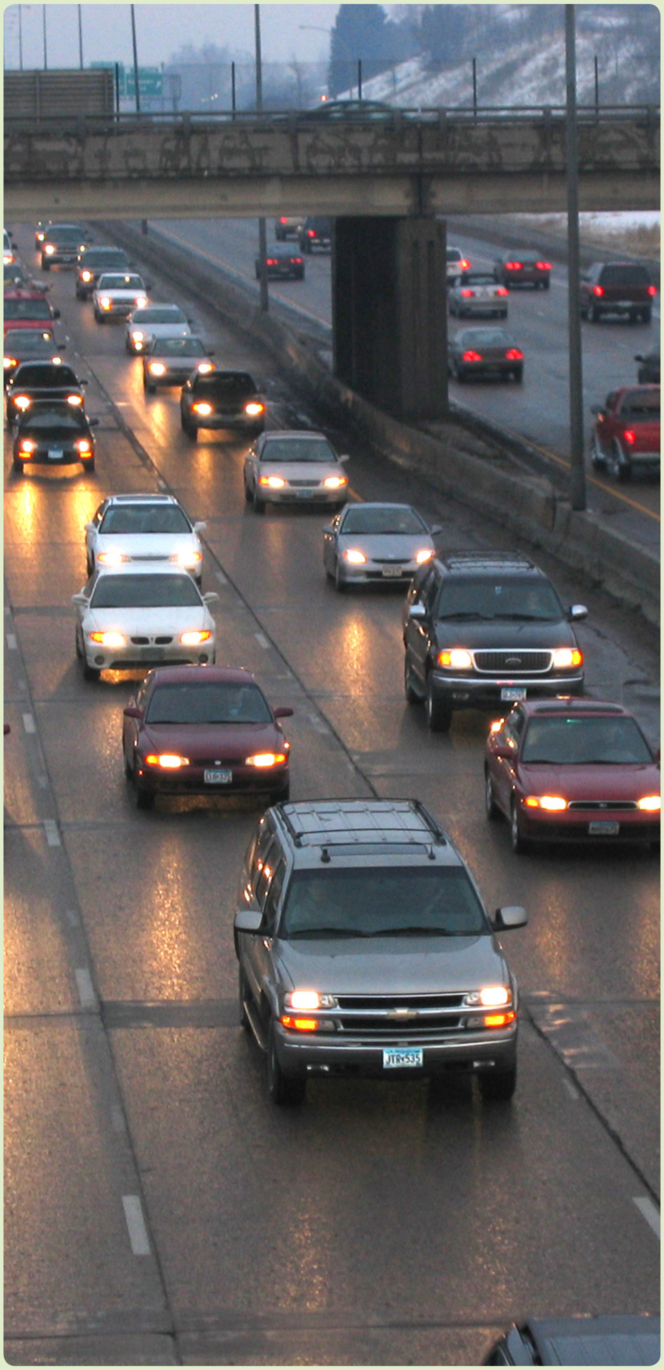
Minnesota fuel consumption compared to price per gallon



Source: Minnesota Department of Transportation, 2008

Only recently with record high gas prices in the past few years has VMT and consumption of gasoline and diesel fuel begun to stabilize. Minnesota VMT normally increases a billion or more miles per year, or about two percent. But from 2004 to 2007 Minnesota VMTs were static. Meanwhile, during the same period, highway gasoline fuel use showed a two percent decline from 2004 to 2007.

Fuel consumption did not start to decrease much until gasoline rose above $2.50 per gallon. Prices have fallen dramatically starting in the fall of 2008 to as low as $1.50 per gallon in Minnesota. Perhaps as a result of lower prices, a December 2008 national report by MasterCard showed the first slight increase in weekly national gasoline consumption in eight months. Though for the 2008 calendar year, Minnesota's gasoline consumption is still projected to be less than in 2007.



Biofuel

Biofuels are transportation fuels such as ethanol, methanol, biodiesel, syngas, biocrude, and methane. Federal and state mandates require increased production of renewable biofuels and bioenergy as alternative energy sources. For these reasons, the development of a more robust national biofuel industry and infrastructure for the production and distribution of such fuels is likely.

Transportation is the second largest producer of green house gas (GHG) emissions after electric utilities. In an effort to reduce carbon dioxide (a primary GHG), biofuels serve as an alternative to traditional petroleum-based fossil fuel, particularly as the transition is made from conventional corn-based ethanol and soybean or palm oil seed biodiesel to advanced biofuels, cellulosic biofuels and biomass-based diesel.

Minnesota is uniquely positioned to support the growth and development of biofuels. Key biomass resources for our region could include agricultural residues from food crops, and energy crops from switchgrass and short rotation woody crops. However, industry, state and federal agencies and academia must work together to meet demand for alternative fuels, share knowledge, and expand production while simultaneously protecting our environmental, economic and social resources.

To promote the next generation of biofuels and emerging technologies, as we transition from conventional feedstocks and technology, Minnesota should strive to be at the forefront of policy and legislation, continuously improve our efficiencies and processes, overcome challenges and embrace the opportunities before us.

The MPCA has created an alternative fuel website to provide environmental review, air and water quality permitting, legislation and answers to frequently asked questions information for citizens and facilities alike at **www.pca.state.mn.us/energy/fuels/index.html**.

Residential combustion

Residential wood burning

Minnesotans burn wood for multiple reasons. Many in urban areas use fireplaces and fire pits for ambience and community gatherings. While usage might be occasional, exposure is high due to the population density. According to the 2005 Minnesota Emissions Inventory, residential wood burning contributed 12 percent of statewide benzene emissions, 19 percent of direct emissions of fine particles and 39 percent of polycyclic aromatic hydrocarbon emissions. In fact, wood smoke contains many of the same chemicals as tobacco smoke.

Photograph used with permission from Vermont Department of Environmental Conservation

In many parts of the state, particularly rural areas, wood stoves and furnaces are used for supplemental or primary home heating. As other traditional heating methods such as electricity, natural gas and fuel oil have substantially increased in price, more Minnesotans have begun installing outdoor wood boilers. Many of these boilers cause a disproportionate amount of air emissions and generate a disproportionate level of complaints relative to their numbers due to their often short stacks and relative inefficiency which can create dense smoke.

The MPCA has conducted a wood use survey in cooperation with the Minnesota Department of Natural Resources nearly every five years since 1986. The 2003 survey showed that wood use had continued to decrease since the 1986 survey. However, the recently completed 2008 survey indicates that rising fuel prices may be causing a shift back to wood. The new survey shows that fuel wood demand has increased nearly 50 percent from 2003, with an estimated 0.7 million cords of fuel wood used in Minnesota in 2003 and nearly 1 million cords used in 2008.

The MPCA has limited ability to enforce existing regulations for small sources such as residential wood burning. Controlling small sources that collectively result in large air pollutant emissions remains a challenge. In the past, the MPCA has sponsored voluntary retrofits or change outs of inefficient wood burning devices. In the future, more customized regulatory approaches may be appropriate. These could include manufacturer certification of new outdoor boilers and manufactured fireplaces and more vigorous attempts to limit discretionary burning on predicted air alerts days.

Residential Garbage Burning

Besides burning wood for heat and entertainment, 45 percent of rural Minnesotans burn garbage in burn barrels, fire pits and stoves according to a 2005 study of backyard garbage burning in Minnesota.

The Environmental Protection Agency (EPA) estimates that residential garbage burning is the number one source of known dioxin in the United States, more than all other known sources combined. Dioxin is a human carcinogen that can build up to toxic levels in animal meat and milk. Backyard garbage burning also produces smoke that contains fine particles, toxic metals, and air toxics.

Through education, outreach, grants, enforcement, and local assistance, the MPCA is actively working with interested parties to phase out backyard garbage burning in Minnesota with a statewide elimination goal of 2010. The MPCA believes that as Minnesotans better understand the impacts of residential garbage burning and garbage management alternatives, they will be proactive in phasing out this practice to better safe-guard their health and environment.

Cumulative potential effects

As the MPCA and other environmental and health organizations learn more about the effects of air pollution, it becomes increasingly obvious that it is not enough to control single pollutants from individual sources. The ultimate concern is the air Minnesotans breathe consisting of hundreds of chemicals from many sources.

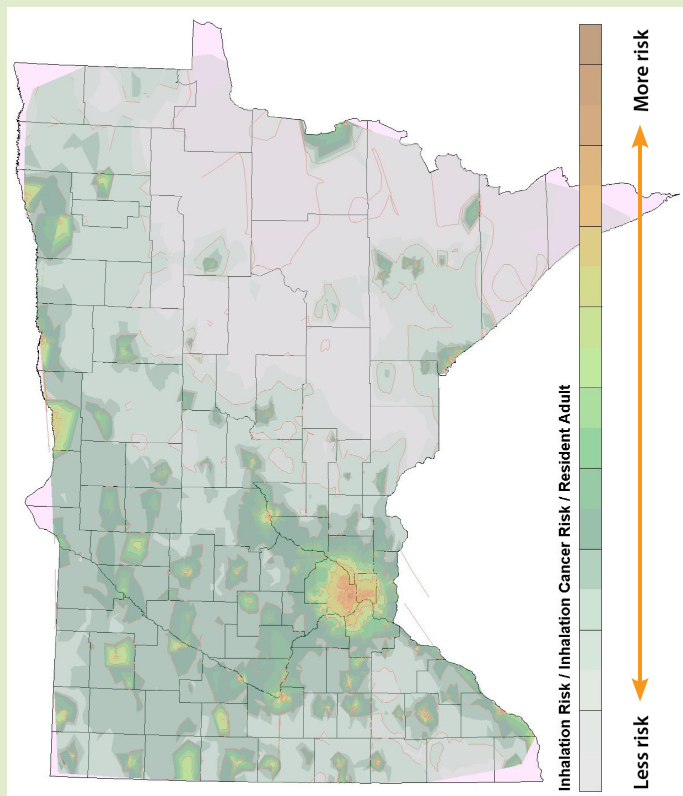
One way the MPCA is dealing with these increasing concerns is by conducting a "cumulative potential effects" evaluation as part of the Environmental Review process. The air quality portion of the "cumulative potential effects" evaluation can in part be fulfilled with risk results from Air Emissions Risk Analyses (AERAs). AERAs are performed to evaluate the potential effects of facility air toxics emissions associated with a specific project going through the permitting process. Information on potential effects of air toxics emissions from other sources in the area can be obtained by completing a Cumulative Air Emissions Risk Analysis (CAERA).

Due to the complexity of evaluating "cumulative potential effects", it remains a challenging process. Off-site air emissions sources can be derived from either modeled or measured air concentrations. Modeling often provides the most complete evaluation, however, the models are often complex and the data needed for accurate results is often unavailable. For this reason, ambient monitoring data is frequently exclusively used to assess off-site risks. However, monitoring data is inherently limited by the relatively low number of monitoring sites and pollutants evaluated, resulting in an under-prediction of risk. It can also be difficult to identify historical and potential future projects for consideration in the cumulative air emissions risk analysis.

The MPCA continues to explore ways to better evaluate the cumulative potential effects to human health and the environment from air pollution emissions.

MNRiskS model

MNRiskS is a Minnesota Risk Screening tool developed by MPCA that models statewide, multipathway, multipollutant human health risks from air toxics. For some projects, MNRiskS could be used to represent off-site sources based on estimates from MPCA's 2002 emissions inventory. Each source category can be distinguished and added or subtracted at will. In addition to off-site point sources, MNRiskS modeling includes mobile source and area source emissions. The mobile and area source emissions included in MNRiskS are from general flowing traffic and non-point sources included in the 2002 Minnesota emissions inventory. The MPCA expects that modeled cumulative air risk results from MNRiskS will help better inform CAERAs and help identify priority air pollutants such as air toxics to target for risk reductions



Source: Preliminary inhalation cancer risk results from the MNRiskS model using 2002 emissions from the Minnesota Criteria Pollutant Emissions Inventory

Conclusions

Minnesota and the MPCA have had great success in decreasing the emissions and concentrations of many traditional air pollutants since the Clean Air Act was enacted in 1970. Emissions from large facilities have decreased dramatically, resulting in lower concentrations of many pollutants including fine particles, ozone and air toxics.

However, increased health concerns and stricter standards for many of these traditional air toxics means that an increased focus on more disperse sources of air pollution such as transportation and residential burning is needed. Better understanding and management of the health and environmental effects of exposure to multiple pollutants and sources is needed to further improve the impact of air quality on Minnesotans' quality of life.

Along with continued work to decrease levels of traditional pollutants, the MPCA must also be prepared for new air quality issues. The impacts of climate change on levels of traditional air pollutants, as well as other anticipated effects on human health and the environment remains a major air quality challenge Minnesota must be prepared to address.

Appendix A: Mercury Emissions Associated with Electricity Production and Consumption in Minnesota, 2006-2007

Introduction

In accordance with Minnesota Statute §116.925, this appendix reports mercury emissions associated with electricity production and consumption in Minnesota. In addition to electricity, mercury emissions are associated with other energy production activities, taconite processing and releases from the use of mercury in products. Emissions sources and impacts are summarized at the end of this document. In 2007, the Minnesota Pollution Control Agency (MPCA) established an emissions reduction goal and is now implementing stakeholder recommendations to meet the goal. More information about Minnesota's mercury emissions and reduction strategies can be found at http://www.pca.state.mn.us/air/mercury.html.

Mercury Emissions from Electricity Generation

Minnesota Statutes section 116.925 requires producers and retailers of electricity to report the amount of mercury emitted through the generation of electricity. This law also requires the MPCA to summarize this information in its biennial air toxics report to the legislature. Emissions from 2006 and 2007 are summarized in Tables 1 and 2.

Minnesota law exempts certain electric-generation facilities from reporting mercury emissions: (1) those that operate less than 240 hours per year, (2) combustion units that generate fewer than 150 British thermal units (Btu) per hour, (3) generation units with a maximum output of 15 megawatts or less, and (4) combustion facilities that emit less than three pounds of mercury in a given year. Therefore, generation facilities that do not emit any mercury, such as nuclear, wind and hydroelectric, are not reported here.

Although not required to annually report to the MPCA, Tables 1 and 2 include some combustion facilities that emit less than three pounds per year because of excellent pollution control or because they use low-mercury fuel, such as natural gas. In addition, because of variation in operating conditions, some facilities may emit more than three pounds one year and less than three pounds in another. When emissions are less than three pounds, the actual emissions are either given or listed as exempt, depending on the wishes of the facility's management.

Submissions from 62 generation units in Minnesota are summarized in Table 1. The major fuel for most units was coal, although some facilities depend on municipal solid waste, oil or natural gas for fuel.

The law also requires Minnesota retailers and wholesalers of electricity produced outside the state to report mercury emissions associated with production; this information is summarized in Table 2.

Included in Table 2 are Minnesota distribution cooperatives that distribute electricity to consumers but do not generate any electricity. All retailers of electricity are required to report mercury emissions associated with the generation of the electricity they distribute. In the case of Minnesota's distribution cooperatives, most of their electricity was generated in North Dakota, South Dakota and Wisconsin. The information is provided to the distribution cooperatives by their suppliers, Great River Energy, Dairyland Power, Minnkota Power and East River Electric Power Cooperative. The calculated mercury emissions, in milligrams per megawatt-hour (mg/MWh) from each supplier may vary because of varying amounts of electricity purchased from the grid and because of the varying amounts of hydroelectric power used by each distribution cooperative.

For 2006, facilities in Minnesota reported the emission of 1,746 pounds of mercury in the production of 36,566,484 MWh of electricity and a median release rate of 15 mg/MWh. For 2007, reported emissions decreased to 1,302 pounds in the production of 35,557,082 MWh, an average emission rate of 16 mg/MWh.

Reports of electricity consumed in Minnesota, but produced outside the state, in 2006 totaled 18,467,858 MWh associated with mercury-emitting facilities. These facilities emitted 1,491 pounds of mercury, with a median emission rate of 33 mg/MWh. Reports for 2007 were similar, totaling 18,865,932 MWh and 1,475 pounds of mercury emitted. The median emission rate for 2007 was 32 mg/MWh. The use of lignite coal as a fuel at power-generating facilities outside the state appears to be largely responsible for the higher ratio of mercury emissions to MWh for out-of-state producers (32 to 33 mg/MWh) compared to Minnesota producers (15 to 16 mg/MWh). Lignite coal contains more mercury per Btu than other types of coal.

Summing Tables 1 and 2 yields estimates of mercury emissions associated with electricity production and consumption in Minnesota. In 2006, 3,237 pounds of mercury were reported as emitted in the production of 57,034,342 megawatt MWh. In 2007, 2,777 pounds of mercury were reported as emitted in the production of 54,423,014 MWh. A significant proportion of mercury emissions associated with Minnesota's electrical production and consumption occurred outside the state: about 46 percent in 2006 and 53 percent in 2007.

Minnesota Mercury Emission Sources

In addition to electricity generation, mercury emissions are associated with a variety of other activities in Minnesota which the MPCA divides into three categories: (1) emissions incidental to energy production (including electricity), (2) emissions due to purposeful use and (3) emissions due to material processing. The MPCA estimates that in 2005, emissions from Minnesota sources totaled 3,341 pounds.

In 2007, the MPCA established a goal of reducing mercury emissions by about 76 percent from 2005 levels to below 800 pounds. This target was established through the development of a Total Maximum Daily Load (TMDL) study as part of Clean Water Act requirements to address impaired waters in the state. Achieving this target will reduce Minnesota's contribution to mercury contamination of fish. The MPCA is currently implementing stakeholder developed strategies to reach this goal by 2025. More on Minnesota's plan for reducing mercury is available at http://www.pca.state.mn.us/air/mercury-reductionplan.html.

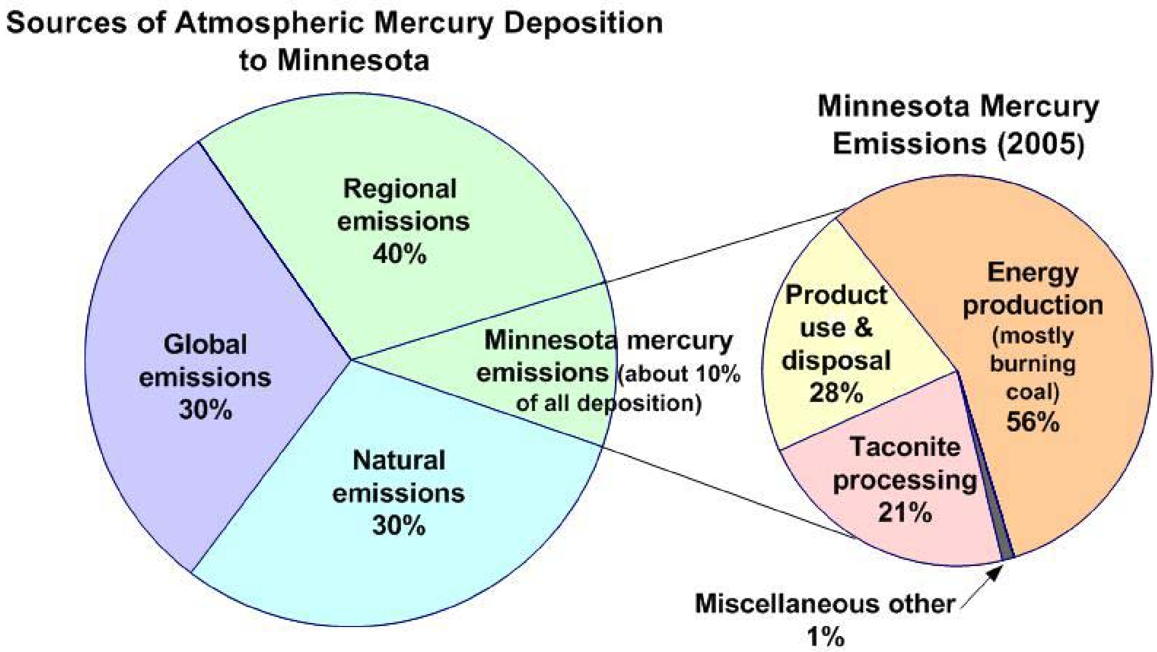


Figure 1. Sources of Atmospheric Deposition to Minnesota, 2005 Minnesota Emissions

Mercury Deposition and Fish Contamination

Mercury contamination of fish is a well documented problem in Minnesota. The Minnesota Department of Health advises people to restrict their consumption of sport fish due to mercury contamination on virtually every lake tested. Nearly all — more than 95 percent — of the mercury in Minnesota lakes and rivers comes from the atmosphere. About 30 percent of mercury in the atmosphere is the result of the natural cycling of mercury. But 70 percent of the mercury is a result of human activities that have increased the release of mercury from the geological materials in which it had been locked up. Because mercury vapor can be transported long distances by the atmosphere, most of Minnesota's emissions are deposited in other states and countries, and Minnesota receives some of their emissions. Only about 10 percent of mercury deposition in Minnesota is the result of emissions within the state.

Table 1. Reported 2006 and 2007 emissions of mercury from electrical production facilities in Minnesota

Company	Generating Facility	Major Fuel Type(s)	2006 Electricity Produced (MWh)	2006 Mercury Emissions (lb)	2006 Mercury Emissions per Megawatt-hour (mg/MWh)	2007 Electricity Produced (MWh)	2007 Mercury Emissions (lb)	2007 Mercury Emissions per Megawatt-hour (mg/MWh)
Austin NE Power Plant	Unit 1	coal, gas	126,652	6.72	24	81,729	4.51	25
Covanta Hennepin Energy Resource Co	Unit 1[c]	MSW[a]	129,314	3.29	12	126,675	2.44	9
Covanta Hennepin Energy Resource Co	Unit 2[c]	MSW[a]	129,159	2.26	8	130,904	3.45	12
Great River Energy	Cambridge Station[c,d]	oil	150	0.00	0	81,957	0.00	0
Great River Energy	Elk River Station[c]	oil, gas, MSW[a]	181,973	1.78	4	196,296	2.01	5
Great River Energy	Lakefield Station [c,d]	oil, gas	265,322	0.00	0	396,806	0.00	0
Great River Energy	Maple Lake Station[c,d]	oil	289	0.00	0	190	0.00	0
Great River Energy	Pleasant Valley Station[c,d]	oil, gas	327,571	0.00	0	270,395	0.00	0
Great River Energy	Rock Lake Station[c,d]	oil	206	0.00	0	308	0.00	0
Great River Energy	St. Bonifacius Station[c]	oil	NA	NA	0.00	NA	NA	0.00
Hibbing Public Utilities	Unit 1A[h,c]	coal, oil	see unit 3A	2.13		see unit 3A	3.07	
Hibbing Public Utilities	Unit 2A[h,c]	coal, oil	see unit 3A	1.75		see unit 3A	3.07	
Hibbing Public Utilities	Unit 7A[h,c]	wood	0	0.00		see unit 3A	1.67	
Hibbing Public Utilities	Unit 3A[h]	coal, oil	65,649	5.39	37	126,621	6.99	25
Interstate Power and Light Company, Sherburn, MN	Fox lake Power Station #3[f]	oil, gas	49,501	0.10	exempt[g]	69,431	0.30	exempt[g]
Minnesota Power(Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 1	coal, oil	523,774	19.00	16	507,073	20.00	18
Minnesota Power(Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 2	coal, oil	497,428	17.00	16	460,783	18.00	18
Minnesota Power(Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 3	coal, oil	522,512	19.00	16	524,081	21.00	18
Minnesota Power	Boswell Unit 1	coal, oil	560,769	16.00	13	493,392	15.00	14
Minnesota Power	Boswell Unit 2	coal, oil	540,866	9.00	8	426,171	8.00	9
Minnesota Power	Boswell unit 3	coal, oil	2,568,880	81.00	14	2,271,522	80.00	16
Minnesota Power	Boswell Unit 4[e]	coal, oil	4,072,175	171.00	19	3,522,886	164.00	21
Minnesota Power	Hibbard 3-4	coal, gas	79,731	6.00	34	53,354	4.00	34
Minnesota Power	Laskin Unit 1 & 2	coal, oil	688,548	24.00	16	280,759	11.00	18
Minnesota Power (Rapids Energy Center)	Rapids Energy Center 5-6[c]	coal, wood	NA	2.00		NA	2.00	
Northshore Mining Company	Silver Bay Power Plant PB 1[c]	coal, oil, gas	341,163	1.30	2	330,171	1.30	2
Northshore Mining Company	Silver Bay Power Plant PB 2[c]	coal, gas	438,198	1.60	2	500,032	1.80	2
Xcel Energy	AS King 1	coal, gas, petroleum coke	1,665,905	36.50	10	814,620	5.40	3

Company	Generating Facility	Major Fuel Type(s)	2006 Electricity Produced (MWh)	2006 Mercury Emissions (lb)	2006 Mercury Emissions per Megawatt-hour (mg/MWh)	2007 Electricity Produced (MWh)	2007 Mercury Emissions (lb)	2007 Mercury Emissions per Megawatt-hour (mg/MWh)
Xcel Energy	Black Dog 3	coal, gas	539,591	33.70	28	512,650	28.80	25
Xcel Energy	Black Dog 4	coal, gas	1,062,386	60.30	26	1,074,710	56.80	24
Xcel Energy	Black Dog 5[c,d]	gas	486,015	0.00	0	692,938	0.00	0
Xcel Energy	Blue Lake 1-3[c]	oil, gas	9,360	0.10	5	19,143	0.10	2
Xcel Energy	Blue Lake 7-8[c,d]	gas	136,788	0.00	0	123,186	0.00	0
Xcel Energy	Granite City 1-4[c,d]	oil, gas	2,889	0.00	0	3,744	0.00	0
Xcel Energy	High Bridge 5	coal, gas	488,779	24.10	22	248,585	11.40	21
Xcel Energy	High Bridge 6	coal, gas	722,219	31.70	20	558,651	23.20	19
Xcel Energy	Inver Hills 1-6[c]	oil, gas	61,134	0.02	0	133,652	0.20	1
Xcel Energy	Key City 1-4[c,d]	gas	2,988	0.00	0	3,717	0.00	0
Xcel Energy	Minnesota Valley 4[c,d]	coal, oil, gas	0	0.00	0	0	0.00	0
Xcel Energy	Red Wing 1 Waste-to-Energy	gas, RDF[b]	51,155	3.40	30	63,072	3.60	26
Xcel Energy	Red Wing 2 Waste-to-Energy	gas, RDF[b]	59,160	4.80	37	57,609	3.80	30
Xcel Energy	Riverside 6/7	coal, oil, gas	727,965	36.90	23	920,476	20.70	10
Xcel Energy	Riverside 8	coal, oil, coke	1,033,588	45.10	20	1,432,175	58.50	19
Xcel Energy	Sherburne 1	coal, oil	4,823,259	325.30	31	3,879,590	183.90	22
Xcel Energy	Sherburne 2	coal, oil	4,101,904	276.60	31	5,091,550	239.70	21
Xcel Energy	Sherburne 3 (Xcel owned portion)	coal, oil	3,947,613	249.50	29	4,327,541	148.40	16
Xcel Energy	Wilmarth 1 Waste-to-Energy[c]	RDFb, gas	53,856	2.30	19	63,395	2.90	21
Xcel Energy	Wilmarth 2 Waste-to-Energy[c]	RDFb, gas	57,822	1.90	15	67,502	2.40	16
Otter Tail Power	Hoot Lake #2 & 3	coal, oil	870,558	27.37	14	493,860	17.56	16
Rochester Public Utilities	Silver Lake 3	coal, gas	82,295	2.28	exempt[g]	88,591	2.96	exempt[g]
Rochester Public Utilities	Silver Lake 4	coal, gas	156,652	1.65	exempt[g]	224,405	2.64	exempt[g]
Rochester Public Utilities	Cascade Creek Station 1	oil, gas	5	0.01	exempt[g]	457	0.01	exempt[g]
Rochester Public Utilities	Cascade Creek Station 2-3	oil, gas	4,247	0.01	exempt[g]	6,466	0.01	exempt[g]
Sappi-Cloquet	Power Boiler 7[h]	oil, gas, wood	126,552	0.76	exempt[g]	125,680	0.76	exempt[g]
Sappi-Cloquet	Power Boiler 8[h]	gas	171,784	0.00	exempt[g]	182,192	0.00	exempt[g]
Sappi-Cloquet	Power Boiler 9[h]	oil, gas, wood	101,810	2.94	exempt[g]	111,182	2.98	exempt[g]
Sappi-Cloquet	Power Boiler 10[h]	gas		1.00	exempt[g]		1.06	exempt[g]

Company	Generating Facility	Major Fuel Type(s)	2006 Electricity Produced (MWh)	2006 Mercury Emissions (lb)	2006 Mercury Emissions per Megawatt-hour (mg/MWh)	2007 Electricity Produced (MWh)	2007 Mercury Emissions (lb)	2007 Mercury Emissions per Megawatt-hour (mg/MWh)
Southern Minnesota Municipal Power Agency	Faribault Energy Park	oil, gas			exempt[g]	229,362	0.02	exempt[g]
Southern Minnesota Municipal Power Agency	Sherburne 3 (SMMPA owned portion)	coal, oil	2,777,484	178.50	29	3,008,779	101.30	15
Southern Minnesota Municipal Power Agency	Minnesota River Station Combustion Turbine[d]	oil, gas			exempt[g]	12,446	0.01	exempt[g]
Verso Paper- Sartell	BBC Turbine/Boiler	coal, oil, wood, sludge	89,681	5.81	29	87,642	5.75	30
Willmar Municipal Utilities	Boiler 3	coal, natural gas	41210	3.48	38	45,978	3.53	35
		Summary of Reports	**36,566,484**	**1,746**	**median = 15**	**35,557,082**	**1,302**	**median = 16**
			Total Reported 2006 Electricity Produced (MWh)	Total Reported 2006 Mercury Emissions (lb)	Median Reported 2006 Mercury Emissions per Megawatt-hour (mg/MWh)	Total Reported 2007 Electricity Produced (MWh)	Total Reported 2007 Mercury Emissions (lb)	Median Reported 2007 Mercury Emissions per Megawatt-hour (mg/MWh)

Notes

[a]MSW is Municipal Solid Waste.

[b]RDF is Refuse-Derived Fuel, which is sorted and processed municipal solid waste.

[c]Facility has agreed to include for reporting mercury emissions of less than 3 pounds.

[d]Mercury emissions round to less than 0.00 pounds mercury for one or both years.

[e]34 pounds of mercury in 2006 and 33 pounds mercury in 2007 associated with electricity sold out of state.

[f]5.21% for 2006 and 5.23% for 2007 of total energy production for all facilities is sold to Minnesota customers.

[g]Exempt from reporting. (Facilities emitting under 3 pounds of mercury or less than 240 hours of operation per year.)

[h]Due to common steam headers, calculation of mercury per electrical generation is not possible, electrical generation is from each individual turbine not from each boiler

Table 2. Reported 2006 and 2007 emissions of mercury from electrical production facilities outside of Minnesota for which the electricity was likely consumed in Minnesota.

Company	Electrical Supplier, if not generated by the Reporting Company	Generating Facility	Major Fuel Type(s)	2006 Electricity Consumed in Minnesota (MWh)	2006 Mercury Emissions (lb)	2006 Mercury Emissions per Megawatt-hour (mg/MWh)	2007 Electricity Consumed in Minnesota (MWh)	2007 Mercury Emissions (lb)	2007 Mercury Emissions per Megawatt-hour (mg/MWh)
Interstate Power and Light Company, Dubuque, IA (Alliant Energy)		Dubuque 1, Dubuque IA	coal, nat gas	8,031	0.21	12	8,825	0.23	12
Interstate Power and Light Company, Dubuque, IA (Alliant Energy)		Dubuque 5, Dubuque IA	coal, nat gas	7,882	0.38	22	7,709	0.36	21
Interstate Power and Light Company, Dubuque, IA (Alliant Energy)		Dubuque 6, Dubuque IA	coal, nat gas	24	0.03	501	17	0.02	552
Interstate Power and Light Company, Lansing, IA (Alliant Energy)		Lansing 3, Lansing IA	coal, oil	6,136	0.07	5	8,081	0.10	6
Interstate Power and Light Company, Lansing, IA (Alliant Energy)		Lansing 4, Lansing IA	coal, oil	61,802	8.53	63	76,035	10.46	62
Interstate Power and Light Company, Clinton, IA (Alliant Energy)		ML Kapp 2, Clinton IA	coal, gas	47,941	5.65	53	55,312	6.44	53
Interstate Power and Light Company, Louisa County, IA (Alliant Energy)		Louisa 1/Louisa Co. IA	coal, gas	232,747	0.70	1	192,532	0.52	1
Interstate Power and Light Company, Sioux City, IA (Alliant Energy)		Neal 3, Sioux City IA	coal, gas	187,988	3.16	8	188,301	3.00	7
Interstate Power and Light Company, Sioux City, IA (Alliant Energy)		Neal 4, Sioux City IA	coal, oil	235,588	3.53	7	238,995	3.45	7
Interstate Power and Light Company, Burlington, IA (Alliant Energy)		Burlington Station #1	coal, nat gas	60,078	5.92	45	64,609	6.33	44
Interstate Power and Light Company, Ottumwa, IA (Alliant Energy)		Ottumwa Station #1	coal, oil	95,999	6.61	31	99,356	7.54	34
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Prairie Creek Station #1a-2	coal, gas	4,179	0.38	41	2,459	0.37	68
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Prairie Creek Station #3	coal, oil, gas	4,798	0.06	6	5,175	0.58	50
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Prairie Creek Station #4	coal, gas	31,001	1.24	18	35,499	1.37	18
Interstate Power and Light Company, Marshalltown, IA (Alliant Energy)		Sutherland Station #1	coal, gas	10,582	0.39	17	11,240	0.41	17
Interstate Power and Light Company, Marshalltown, IA (Alliant Energy)		Sutherland Station #2	coal, gas	10,669	0.42	18	11,362	0.45	18
Interstate Power and Light Company, Marshalltown, IA (Alliant Energy)		Sutherland Station #3	coal, gas	31,042	0.29	4	30,492	0.25	4
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #2	coal, oil, gas	NA	NA	NA	NA	NA	NA
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #3-4	coal, gas	346	0.08	109	375	0.11	127
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #5-6	coal, gas	678	0.50	335	1,086	0.26	107
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #7-8	coal, gas	3,670	0.19	24	2,563	0.30	53
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #9-10	coal, gas	1,340	1.01	341	1,762	0.96	248
Minnesota Power	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	2,069,699	294.00	64	1,533,185	210.00	62
Marshall Municipal Utilities	Heartland Power		sub coal	422,630	20.96	22	421,114	20.89	22

Company	Electrical Supplier, if not generated by the Reporting Company	Generating Facility	Major Fuel Type(s)	2006 Electricity Consumed in Minnesota (MWh)	2006 Mercury Emissions (lb)	2006 Mercury Emissions per Megawatt-hour (mg/MWh)	2007 Electricity Consumed in Minnesota (MWh)	2007 Mercury Emissions (lb)	2007 Mercury Emissions per Megawatt-hour (mg/MWh)
Marshall Municipal Utilities	Missouri River Energy		sub coal	65,816	3.26	22	76,478	3.79	22
Northern Municipal Power Agency, Thief River Falls	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	139,009	18.20	59	154,293	20.10	59
Northern Municipal Power Agency, Thief River Falls	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	86,073	12.80	67	79,289	10.80	62
Northern Municipal Power Agency, Thief River Falls	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal	71,264	6.80	43	72,158	8.50	53
People's Cooperative Services	Dairyland Power Cooperative	Alma 1-5	Bit/Sub Coal	42,450	1.56	17	42,302	1.70	18
People's Cooperative Services	Dairyland Power Cooperative	JP Madgett	Sub bituminous coal	91,640	7.81	39	97,633	6.71	31
People's Cooperative Services	Dairyland Power Cooperative	Genoa	Bit/Sub Coal	93,527	3.96	19	88,447	2.24	11
People's Cooperative Services	Dairyland Power Cooperative, Great River Energy/G3	Great River Energy/G3	Bit/Sub Coal	503	0.02	18	659	0.02	14
People's Cooperative Services	Dairyland Power Cooperative,	Seven Mile Creek	Landfill gas	747	0.00	NA	579	0.00	0
Tri-County Electric Cooperative	Dairyland Power Cooperative	Alma 1-5	Sub Coal	58,806	2.16	17	59,769	2.41	18
Tri-County Electric Cooperative	Dairyland Power Cooperative	JP Madgett	Bit/Sub coal	127,037	10.83	39	137,948	9.49	31
Tri-County Electric Cooperative	Dairyland Power Cooperative	Genoa	Bit/Sub Coal	129,653	5.48	19	124,968	3.16	11
Tri-County Electric Cooperative	Dairyland Power Cooperative	Great River Energy/G3	Bit/Sub Coal	697	0.03	20	931	0.02	10
Tri-County Electric Cooperative	Dairyland Power Cooperative	Seven Mile Creek	Landfill gas	1,036	0.00	NA	818	0.00	0
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	Alma 1-5	Bit/Sub Coal	35,012	1.29	17	35,516	1.43	18
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	JP Madgett	Sub bituminous coal	75,635	6.45	39	81,972	5.64	31
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	Genoa 3	Bit/Sub Coal	77,193	3.26	19	74,259	1.88	11
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	Great River Energy/G3	Bit/Sub Coal	415	0.02	22	553	0.01	8
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	Seven Mile Creek	Landfill gas	617	0.00	NA	486	0.00	0
Agralite Electric Cooperative	Great River Energy		lignite coal	146,778	10.63	33	159,966	11.27	32
Arrowhead Electric Cooperative	Great River Energy		lignite coal	66,666	4.83	33	70,478	4.97	32
Benco Electric Cooperative	Great River Energy		lignite coal	248,555	18.01	33	279,404	19.69	32
Brown County Rural Electrical Ass'n	Great River Energy		lignite coal	86,550	6.27	33	115,369	8.13	32
Connexus Energy	Great River Energy		lignite coal	2,259,138	163.66	33	2,386,500	168.17	32
Cooperative Light and Power	Great River Energy		lignite coal	86,614	6.27	33	95,339	6.72	32
Crow Wing Power	Great River Energy		lignite coal	508,850	36.86	33	585,880	41.29	32
Dakota Electric Ass'n	Great River Energy		lignite coal	1,857,635	134.58	33	1,958,956	138.04	32
East Central Energy	Great River Energy		lignite coal	895,667	64.89	33	938,888	66.16	32
Federated Rural Electric	Great River Energy		lignite coal	136,812	9.91	33	153,316	10.80	32
Goodhue County Cooperative Electric Ass'n	Great River Energy		lignite coal	81,970	5.94	33	92,340	6.51	32

Company	Electrical Supplier, if not generated by the Reporting Company	Generating Facility	Major Fuel Type(s)	2006 Electricity Consumed in Minnesota (MWh)	2006 Mercury Emissions (lb)	2006 Mercury Emissions per Megawatt-hour (mg/MWh)	2007 Electricity Consumed in Minnesota (MWh)	2007 Mercury Emissions (lb)	2007 Mercury Emissions per Megawatt-hour (mg/MWh)
Itasca-Mantrap Co-op. Electrical Ass'n	Great River Energy		lignite coal	172,337	12.48	33	196,540	13.85	32
Kandiyohi Power Cooperative	Great River Energy		lignite coal	112,471	8.15	33	130,119	9.17	32
Lake Country Power	Great River Energy		lignite coal	627,754	45.48	33	706,366	49.78	32
Lake Region Electric Cooperative	Great River Energy		lignite coal	280,820	20.34	33	325,093	22.91	32
McLeod Cooperative Power Ass'n	Great River Energy		lignite coal	160,097	11.60	33	181,531	12.79	32
Meeker Cooperative Light & Power Ass'n	Great River Energy		lignite coal	128,045	9.28	33	147,074	10.36	32
Mille Lacs Electric Cooperative	Great River Energy		lignite coal	182,239	13.20	33	205,512	14.48	32
Minnesota Valley Electric Cooperative	Great River Energy		lignite coal	593,992	43.03	33	613,111	43.20	32
Nobles Electric Cooperative	Great River Energy		lignite coal	136,812	9.91	33	111,995	7.89	32
North Itasca Electric Cooperative, Inc.	Great River Energy		lignite coal	49,487	3.03	28	55,639	3.36	27
Redwood Electric Cooperative	Great River Energy		lignite coal	26,206	1.90	33	30,164	2.13	32
Runestone Electric Ass'n	Great River Energy		lignite coal	158,673	11.50	33	181,916	12.82	32
South Central Electric Ass'n	Great River Energy		lignite coal	136,336	9.88	33	147,965	10.43	32
Stearns Electric Ass'n	Great River Energy		lignite coal	370,485	26.84	33	423,484	29.84	32
Steele-Waseca Cooperative Electric	Great River Energy		lignite coal	226,532	16.41	33	245,423	17.29	32
Todd-Wadena Electric Cooperative	Great River Energy		lignite coal	121,976	8.84	33	139,591	9.84	32
Wright-Hennepin Cooperative Electric Ass'n	Great River Energy		lignite coal	796,099	57.67	33	819,870	57.77	32
Clearwater-Polk Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	33,457	4.40	60	31,120	4.10	60
Clearwater-Polk Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	20,716	3.10	68	15,992	2.20	62
Clearwater-Polk Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal	17,152	1.60	42	14,554	1.70	53
North Star Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	42,986	5.60	59	48,346	6.30	59
North Star Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	26,616	4.00	68	24,845	3.40	62
North Star Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal	22,037	2.10	43	22,610	2.60	52
PKM Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	33,305	4.40	60	40,938	5.30	59
PKM Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	20,662	3.10	68	21,038	2.90	63
PKM Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal	17,074	1.60	43	24,001	2.20	42
Red Lake Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	43,641	5.70	59	50,314	6.60	60
Red Lake Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	27,022	4.00	67	25,856	3.50	61
Red Lake Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal	22,373	2.10	43	23,531	2.80	54
Red River Valley Cooperative Power Ass'n	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	44,279	5.80	59	51,321	6.70	59
Red River Valley Cooperative Power Ass'n	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	27,417	4.10	68	26,373	3.60	62
Red River Valley Cooperative Power Ass'n	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal	22,700	2.20	44	24,001	2.80	53
Roseau Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	58,570	7.70	60	65,831	8.60	59
Roseau Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	36,266	5.40	68	33,830	4.60	62

Company	Electrical Supplier, if not generated by the Reporting Company	Generating Facility	Major Fuel Type(s)	2006 Electricity Consumed in Minnesota (MWh)	2006 Mercury Emissions (lb)	2006 Mercury Emissions per Megawatt-hour (mg/MWh)	2007 Electricity Consumed in Minnesota (MWh)	2007 Mercury Emissions (lb)	2007 Mercury Emissions per Megawatt-hour (mg/MWh)
Roseau Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal	30,027	2.90	44	30,787	3.60	53
Wild Rice Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	89,408	11.70	59	103,117	13.40	59
Wild Rice Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	55,361	8.20	67	52,991	7.20	62
Wild Rice Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal	45,836	4.40	44	48,225	5.60	53
Beltrami Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	172,106	22.50	59	190,119	24.80	59
Beltrami Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	106,566	15.90	68	97,700	13.30	62
Beltrami Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal	88,231	8.40	43	88,913	10.40	53
Sioux Valley-Southwestern Electric Coop	L & O Electric (Purchases from Basin Elec.)		coal	59,571	4.04	30.79	69,889	6.07	39.38
Lyon-Lincoln Electric Cooperative	East River Electric Power Cooperative		lignite coal	61,772	4.20	31	66,713	5.27	36
Minnesota Valley Coop. Light & Power Ass'n	Basin Electric		lignite coal	14,434	0.91	29	146,374	11.56	36
Traverse Electric Cooperative	Basin Electric		lignite coal	29,232	1.99	31	31,309	2.47	36
Wright-Hennepin Cooperative Electric Ass'n	Basin Electric		lignite coal	20,730	1.72	38	108,037	8.53	36
Renville Sibley Cooperative Ass'n	East River Electric Power Cooperative		lignite coal	117,953	8.02	31	123,045	9.72	36
Minnesota Valley Electric Cooperative	Utilities Plus		lignite, sub coal	54,990	3.74	31	95,339	6.72	32
Stearns Electric Association	Utilities Plus		sub coal, lignite	26,280	1.79	31	0	0.00	0
Wright-Hennepin Cooperative Electric Ass'n	Utilities Plus		lignite, sub coal	65,989	4.49	31	0	0.00	0
Willmar Municipal Utilities	Coal Creek, ND		sub coal	238,809	17.29	33	231,179	16.30	32
Otter Tail Power		Big Stone Power, Big Stone, SD	coal, oil	873,400	39.46	20	681,254	34.53	23
Otter Tail Power		Coyote Station, Beulah, ND	coal, oil	513,313	52.91	47	533,467	63.38	54
			Summary of Reports	**18,467,858**	**1,491**	**33**	**18,865,932**	**1,475**	**32**
				Total Reported 2006 Electricity Produced (MWh)	Total Reported 2006 Mercury Emissions (lb)	Median Reported 2006 Mercury Emissions per Megawatt-hour (mg/MWh)	Total Reported 2007 Electricity Produced (MWh)	Total Reported 2007 Mercury Emissions (lb)	Median Reported 2007 Mercury Emissions per Megawatt-hour (mg/MWh)

Notes

NA indicates data was either not available or not submitted to MPCA

[a]used Basin Electric lb Hg/MWh emission factor to calculate estimated emissions

Appendix B: Air Toxics Emissions Information, 2005

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 2005. This report presents the 2005 Minnesota air toxics emission inventory data.

The air toxics emissions inventory includes three principal source categories: point, nonpoint, and mobile sources. MPCA staff estimated emissions for point source, majority categories of nonpoint sources and some mobile sources. The results for certain categories of nonpoint sources and mobile sources were obtained from EPA’s 2005 or 2002 National Emission Inventories. [1, 2] 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 (PM_{10}), particulate matter smaller than 2.5 microns ($PM_{2.5}$), ammonia, 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, there were a total of 2202 point sources in Minnesota in calendar year 2005. 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 2005 air toxics emission information reported by 636 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 104 facilities; including 51 facilities that do not have air emission permits. 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 1284 out of 2201 point sources for year 2005. The 2005 inventory includes point source emissions from 269 distinct standard industrial classification (SIC) codes and 399 distinct source classification codes (SCC).

Nonpoint Sources

Nonpoint 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 nonpoint 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 38 categories and 79 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 twelve 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 twelve vehicle types are described below.

- Light Duty Gas Vehicles
- Light Duty Gas Trucks 1 & 2
- Light Duty Gas Trucks 3 & 4
- Heavy Duty Gas Vehicles 2B thru 8B & Buses
- Light Duty Diesel Vehicles
- Light Duty Diesel Trucks 1 thru 4
- Heavy Duty Diesel Vehicles Class 2B
- Heavy Duty Diesel Vehicles Class 3, 4, & 5
- Heavy Duty Diesel Vehicles Class 6 & 7
- Heavy Duty Diesel Vehicles Class 8A & 8B
- Heavy Duty Diesel Buses (School & Transit)
- Motorcycles

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 2005 emission estimates that were calculated from the vehicle emission modeling software, MOBILE6.2, and vehicle miles traveled data. MPCA staff collected activity data and estimated emissions for locomotives, aircraft, airport ground support equipment, and aircraft auxiliary power units. For commercial marine vessels, MPCA adjusted the 2002 commercial marine vessel emissions with port activities in 2005 and 2002. The 2002 emissions for PM_{10} and VOC were produced by

SonomaTech, Inc. for the Central Regional Air Planning Association (CENRAP).[3] Air toxics emissions were speciated from PM_{10} and VOC emissions. For all nonroad equipment, MPCA also obtained estimates from the EPA who used the NONROAD 2005 model.

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 2005 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 287 pollutants were categorized to 180 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 nonpoint sources emitted 161 and 133 out of the 180 compounds, respectively, while mobile sources emitted 56 of the 180 compounds. Table 2 shows a summary of emissions by principal source category.

Point sources contributed more than 50 percent emissions for 105 out of 180 individual and grouped compounds, dominating emissions of metal compounds. Nonpoint sources contribute more than 50 percent emissions of individual PAHs, except for acenaphthene. Emissions of acenaphthene are mainly from point sources. Nonpoint sources also emit more than half of total emissions for 44 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 nine individual and grouped compounds such as 1,3-butadiene, acetaldehyde, benzene, ethylbenzene, formaldehyde, toluene, and xylenes.

On a mass basis, mobile sources (onroad and nonroad) contributed about two thirds of the total air toxics emitted in Minnesota, while nonpoint sources contributed 22 percent of the total emissions. Point sources emitted much less that other principal source categories, accounting for only 14 percent of total emissions. Figure 1 shows the contribution of point, nonpoint, 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 the 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 28 percent of total air toxics emissions. Among the top eleven categories, recreational equipment emitted the most, followed by light duty gasoline vehicles and light duty gasoline trucks 1 & 2. These three categories were each responsible for more than 10 percent of total emissions.

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.

However, Minnesota does not have a rule to require these point sources to report air toxics emissions. To overcome the deficiency, MPCA staff sent a letter to 477 of these facilities requesting their emissions. A total of 330 facilities responded, including refineries, large utilities, and other manufacturing facilities. The majority of non-responding facilities only had combustion processes/hot asphalt mixing processes and did not have any source-specific information. Although five taconite ore processing facilities didn't report air toxics emissions, the emission estimation methods and templates were established based on source-specific stack tests and data analyses. Air toxics emissions could be calculated with the throughput data reported to the emissions inventory. Besides facilities that were either closed or changed permit status, there are 17 facilities whose emissions could not be estimated without reporting.

Second, the MPCA recognizes that air toxics emission data reported by facilities may be based on an incorrect 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, we conducted a special QA/QC study for 4,4'-methylenediphenyl diisocyanate (MDI). The MPCA staff contacted facilities that showed MDI emissions in the 2002 EI, 2005 EI, or that showed MDI emissions in the EPA's 2002 National Emission Inventory (NEI) to verify the emissions. As a result of this investigation, the state point source MDI emissions dropped from nearly 20 tons to three 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 450 Option B and 865 Option D registration permit criteria emission inventory facilities in the Minnesota. These facilities do not report process level throughput data and have no source classification code (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 nonpoint sources in the 2005 emission inventory. For the 2005 emission inventory, 99 percent of the Option D facilities (261) that emitted more than five 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 nonpoint sources and nonroad equipment were allocated from national totals which might not represent the actual 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 3);
2. The number of sources and source categories have expanded with time (Figure 4 and Figure 5); 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:

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Mr. Nathaniel Edel at 651-757-2332 or nathaniel.edel@pca.state.mn.us

References

1. E-mail List Archive for the Great Lakes Regional Toxic Air Pollutant Emissions Inventory Steering Committee. December 2007. http://www.glin.net/lists/airtoxics/2007-12/msg00000.html
2. *2002 National Emissions Inventory Data & Documentation*; U.S. Environmental Protection Agency, http://www.epa.gov/ttn/chief/net/2002inventory.html accessed in November 2006.
3. Ms. Dana Coe Sullivan, Manager, Emissions Assessment, Sonoma Technology, Inc., Personal communication via e-mail. September 2, 2004. E-mail: Dana@SonomaTech.com

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

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
Agricultural Pesticide Use	Corn	Apply emission factors from EIIP to the amount of pesticide applied in each county	United States Department of Agriculture & Minnesota Department of Agriculture
	Soybeans	Same as above	Same as above
	Hay	Same as above	Same as above
	Wheat	Same as above	Same as above
Animal Cremation	Livestock & Pets	Apply WebFIRE and 1999 NEI emission factors based on estimated weight of cremated animals.	Census of Agriculture and survey of pet crematoria.
Architectural Surface Coating	Architectural Surface Coating	Use per capita emission factor from 2002 NEI to estimate VOC emissions. Apply EPA's VOC speciation profiles to estimate HAP emissions.	Census data
Asphalt Paving	Cutback Asphalt	Use 2002 estimated emissions	MPCA
Autobody Refinishing	Autobody Refinishing	Use per capita emission factor from 2002 NEI to estimate VOC emissions. Apply EPA's VOC speciation profiles to estimate HAP emissions.	Census data
Commercial & Consumer Product Use	Personal Care Products	Use per capita emission factors from 2002 NEI documentation	Census data
	Household Products	Same as above	Same as above
	Automotive Aftermarket Products	Same as above	Same as above
	Coating & Related Products	Same as above	Same as above
	Adhesives & Sealants	Same as above	Same as above
	FIFRA-Regulated Products	Same as above	Same as above
	Miscellaneous	Same as above	Same as above

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
Commercial Cooking	Conveyorized Charbroiling	Update 2002 emissions based on 2005/2002 county population change	Census Data
	Under-fired Charbroiling	Same as above	Same as above
	Deep Fat Frying	Same as above	Same as above
	Flat Griddle Frying	Same as above	Same as above
Degreasing	Cold, Vapor, & In-Line Cleaning	Use 2002 NEI per employee emission factor to estimate VOC emissions. Adjust for point sources. Use VOC speciation profiles from SPECIATE to estimate HAPs.	Census data and MCEI
Dental Preparations	Volatilization of Mercury	Use state specific per capita emission factor	MPCA & Census Data
Dry Cleaning	Dry Cleaning	Use state specific emission factors based on solvent usage and machine type.	NESHAP submittals and survey letters
Fluorescent Lamp Breakage	Fluorescent Lamp Breakage	Use state specific per capita emission factor	MPCA & Census Data
Fluorescent Lamp Recycling	Fluorescent Lamp Recycling	Apportion state estimate of recycling emissions to counties based upon location of recyclers	MPCA & Census Data
Forest Wildfires	Forest Wildfires	Use 2002 U.S. EPA estimates	U.S. EPA
Gasoline Service Stations	Stage I - Submerged Fill without Control	Allocate state fuel usage to counties based on vehicle registrations. Use emission factors from WebFIRE to estimate VOC emissions. Apply 2002 NEI VOC speciation profiles to estimate HAP emissions.	Minnesota Department of Revenue & Minnesota Department of Public Safety:
	Stage I - Splash Fill	Same as above	Same as above
	Stage I - Submerged Fill with Control	Same as above	Same as above
	Stage II - Vapor Loss	Same as above	Same as above
	Stage II - Spill Loss	Same as above	Same as above

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
	Stage I - Tank Breathing	Same as above	Same as above
	Stage I - Aviation Gasoline	Allocate state fuel usage to counties based on LTOs. Use 2002 NEI emission factor to estimate VOC emissions. Apply 2002 NEI VOC speciation profiles to estimate HAP emissions.	Same as above
	Stage II - Aviation Gasoline	Same as above	Same as above
Gasoline Trucks in Transit	Gasoline Trucks in Transit	Allocate state fuel usage to counties based on vehicle registrations. Use emission factors from WebFIRE to estimate VOC emissions. Apply 2002 NEI VOC speciation profiles to estimate HAP emissions.	Minnesota Department of Revenue & Minnesota Department of Public Safety:
General Laboratory Activities	Volatilization of Mercury	Use state specific per capita emission factor	MPCA & Census Data
Grain Elevators	Grain Elevators	Apply state specific emission factor based on crop production	U.S. Department of Agriculture Data
Graphic Arts	Graphic Arts	Use per capita emission factor from 2002 NEI to calculate VOC emissions. Apply state specific speciation profiles to VOC estimates to get HAP emissions	Census Data
Hospital Sterilization	Hospital Sterilization	Use EPA's ethylene oxide emission factor based on number of hospital beds. Apply VOC emission factor based on EO emissions to estimate VOC emissions.	MPCA and Minnesota Department of Health
Human Cremation	Human Cremation	Apply WebFIRE and 1999 NEI emission factors based on estimated weight of cremated individuals.	Minnesota Department of Health
Industrial Surface Coating	General Surface Coating	Apply 2002 NEI VOC emission factor to county employee population. Use 2002 NEI speciation profiles to calculate emissions for air toxics.	Census data and MCEI

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
Mercury Volatilization	Volatilization from Dissipative Use	Use state specific per capita emission factor to calculate mercury emissions	MPCA & Census Data
	Volatilization from Spills and Land Dumping	Same as above	Same as above
	Volatilization during Solid Waste Collection/Processing	Same as above	Same as above
	Land Application of Sludge	Use emission factor based on tons of sludge produced	MPCA
	Land Application of Compost	Same as above	Same as above
Mineral Processes	Mineral Processes	Update 2002 data based on 2005/2002 state employee population change	Census Data
Municipal Solid Waste Landfills	Flaring MSW Landfill gas	Use emission factors from WebFIRE.	MPCA
	Non-flaring MSW Landfills	Use model based on AP-42, Section 2.4. Most concentrations of air toxics are obtained from MPCA landfill gas study.	MPCA
On-site Incineration	Commercial/Institutional	Use 2002 U.S. EPA estimate	U.S. EPA
Public Owned Treatment Works (POTW)	Entire Plant	Apply emission factor to throughput data	MPCA
Prescribed Burning for Forest Management	Prescribed Forest Fires	Use 2002 U.S. EPA estimate	U.S. EPA
Prescribed Burning for Rangeland	Prescribed Rangeland Fires	Use 2002 U.S. EPA estimate	U.S. EPA
Residential Fossil Fuel Combustion	Bituminous/ Subbituminous Coal	Apply emission factors from WebFIRE and 2002 NEI to the estimated fuel consumption	U.S. Department of Energy and Census Data
	Distillate Oil	Same as above	Same as above
	Natural Gas	Same as above	Same as above
	Liquified Petroleum Gas	Same as above	Same as above

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
	(LPG)		
	Kerosene	Same as above	Same as above
Residential Wood Burning	Fireplaces: General	Update 2002 data based on 2005/2002 household population change	Minnesota Department of Natural Resources & Minnesota State Demographic Center
	Fireplaces: Insert; non-EPA certified	Same as above	Same as above
	Fireplaces: Insert; EPA certified; non-catalytic	Same as above	Same as above
	Fireplaces: Insert; EPA certified; catalytic	Same as above	Same as above
	Woodstoves: General	Same as above	Same as above
	Catalytic Woodstoves: General	Same as above	Same as above
	Non-catalytic Woodstoves: EPA certified	Same as above	Same as above
Stationary Source Fuel Combustion - Commercial/Institutional	Coal Boiler	Apply emission factors from 2002 NEI & EGU documents and WebFIRE to the estimated fuel consumption	U.S. Department of Energy & MCEI
	Distillate Oil Boiler & IC Engine	Use composite emission factors based on percentage of oil throughput for each engine type. Original boiler & IC factors obtained from 2002 NEI, WebFIRE, and FIRE 6.24	Same as above
	Residual Oil Boiler	Apply emission factors from 2002 NEI & EGU documents and WebFIRE to the estimated fuel consumption	Same as above
	Natural Gas Boiler	Apply emission factors from 2002 NEI and WebFIRE to the estimated fuel consumption	Same as above

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
	LPG Boiler	Apply emission factors from 2002 NEI & EGU documents and WebFIRE to the estimated fuel consumption	Same as above
	Kerosene Boiler	Same as above	Same as above
Stationary Source Fuel Combustion - Industrial	Coal Boiler	Apply emission factors from 2002 NEI & EGU documents and WebFIRE to the estimated fuel consumption	U.S. Department of Energy & MCEI
	Distillate Oil Boiler & IC Engine	Use composite emission factors based on percentage of oil throughput for each engine type. Original boiler & IC factors obtained from 2002 NEI, WebFIRE, and FIRE 6.24	Same as above
	Residual Oil Boiler	Apply emission factors from 2002 NEI & EGU documents and WebFIRE to the estimated fuel consumption	Same as above
	Natural Gas Boiler	Apply emission factors from 2002 NEI and WebFIRE to the estimated fuel consumption	Same as above
	LPG Boiler	Apply emission factors from 2002 NEI & EGU documents and WebFIRE to the estimated fuel consumption	Same as above
	Kerosene Boiler	Same as above	Same as above
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.	Minnesota Department of Public Safety
Swimming Pools	Swimming Pools	Update 2002 data based on 2005/2002 county population change	Census Data
Tank & Drum Cleaning	Tank & Drum Cleaning	Use 2002 U.S. EPA estimate	U.S. EPA
Traffic Markings	White Latex Paint	Apportion state usage data to counties based on lane miles and use state specific emission factors.	Minnesota Department of Transportation

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
	Yellow Latex Paint	Same as above	Same as above
Unpaved Roads	Unpaved Roads	Use 2002 U.S. EPA estimate	U.S. EPA
Waste Disposal - Open Burning	Yard Waste - Leaf Species Unspecified	Update 2002 data based on 2005/2002 county population change	U.S. EPA
	Yard Waste - Brush Species Unspecified	Same as above	Same as above
	Land Clearing Debris	Same as above	Same as above
	Household Waste	Use state specific per capita emission factors	MPCA, survey of state residents, Census Data

* The following link will bring you to the EPA Documentation for the Final 2002 Point Source National Emissions Inventory.
http://www.epa.gov/ttn/chief/net/2002inventory.html

Table 2. Summary of the 2005 Minnesota air toxics emissions.

		Emissions (lb)					Percent (%)			
Pollutant Name	**Cas No.**	**Point**	**Nonpoint**	**Onroad**	**Nonroad**	**Total**	**Point**	**Nonpoint**	**Onroad**	**Nonroad**
PAHs										
Acenaphthene	83-32-9	9.73E+03	5.42E+03	7.22E+02	1.51E+03	1.74E+04	55.99	31.19	4.15	8.67
Acenaphthylene	208-96-8	3.93E+02	1.08E+05	3.79E+03	3.96E+03	1.16E+05	0.34	93.00	3.26	3.40
Anthracene	120-12-7	8.66E+02	8.96E+03	8.67E+02	8.52E+02	1.15E+04	7.51	77.60	7.51	7.38
Benz[a]Anthracene	56-55-3	6.63E+01	1.20E+04	2.13E+02	2.17E+02	1.25E+04	0.53	96.04	1.70	1.73
Benzo[a]Pyrene	50-32-8	1.59E+02	3.26E+03	1.31E+02	1.69E+02	3.72E+03	4.28	87.64	3.53	4.54
Benzo[b]Fluoranthene	205-99-2	1.59E+01	4.05E+03	1.44E+02	1.38E+02	4.34E+03	0.37	93.16	3.31	3.17
Benzo[g,h,i,]Perylene	191-24-2	4.51E+01	4.28E+03	2.56E+02	5.75E+02	5.16E+03	0.87	83.02	4.96	11.14
Benzo[k]Fluoranthene	207-08-9	1.38E+01	1.93E+03	1.44E+02	1.27E+02	2.22E+03	0.62	87.18	6.48	5.72
Chrysene	218-01-9	5.55E+01	8.39E+03	1.14E+02	1.70E+02	8.73E+03	0.64	96.11	1.30	1.95
Dibenzo[a,h]Anthracene	53-70-3	2.85E+01	2.44E+02	6.07E-02	4.37E+00	2.77E+02	10.30	88.10	0.02	1.58
Fluoranthene	206-44-0	1.45E+02	1.32E+04	8.90E+02	1.77E+03	1.60E+04	0.90	82.53	5.55	11.02
Fluorene	86-73-7	9.12E+02	1.37E+04	1.50E+03	2.97E+03	1.91E+04	4.77	71.86	7.84	15.54
Indeno[1,2,3-c,d]Pyrene	193-39-5	1.36E+03	1.98E+03	7.18E+01	1.78E+02	3.59E+03	37.79	55.26	2.00	4.95
Naphthalene	91-20-3	3.29E+04	4.48E+05	1.07E+05	5.90E+04	6.46E+05	5.09	69.29	16.49	9.13
Phenanthrene	85-01-8	9.90E+02	4.56E+04	2.45E+03	5.80E+03	5.48E+04	1.81	83.14	4.47	10.58
Pyrene	129-00-0	2.93E+02	1.61E+04	1.24E+03	2.03E+03	1.96E+04	1.49	81.87	6.32	10.31
Total PAH		8.94E+02	8.06E+03			8.95E+03	9.99	90.01		
16-PAH		2.16E+03	6.18E+02		3.96E+00	2.78E+03	77.65	22.21		0.14
7-PAH		1.11E+02	1.09E+03		3.91E-02	1.20E+03	9.22	90.77		0.00
PAH Total		**5.11E+04**	**7.05E+05**	**1.19E+05**	**7.94E+04**	**9.55E+05**	**5.36**	**73.84**	**12.48**	**8.32**
Metal Compounds										
Antimony	7440-36-0	2.29E+03	9.90E+01		2.05E+01	2.41E+03	95.05	4.10		0.85
Arsenic	7440-38-2	1.46E+04	3.52E+02	2.79E+02	5.89E+02	1.59E+04	92.30	2.22	1.76	3.71
Beryllium	7440-41-7	4.31E+02	6.51E+01		4.94E+01	5.45E+02	79.00	11.95		9.05
Cadmium	7440-43-9	1.92E+03	4.16E+02		5.06E+01	2.39E+03	80.47	17.41		2.12
Chromium	7440-47-3	1.45E+04	5.80E+02	4.67E+02	4.02E+01	1.56E+04	93.03	3.72	2.99	0.26
Chromium VI	18540-29-9	1.65E+03	4.35E+01	1.03E+02	2.07E+01	1.82E+03	90.84	2.39	5.63	1.14
Cobalt	7440-48-4	5.42E+03	1.71E+02		2.35E+01	5.62E+03	96.53	3.05		0.42
Copper	7440-50-8	1.57E+04	3.77E+02		4.84E+00	1.60E+04	97.62	2.35		0.03
Lead	7439-92-1	5.81E+04	1.28E+03		1.78E+04	7.72E+04	75.31	1.66		23.03

		Emissions (lb)					Percent (%)			
Pollutant Name	**Cas No.**	**Point**	**Nonpoint**	**Onroad**	**Nonroad**	**Total**	**Point**	**Nonpoint**	**Onroad**	**Nonroad**
Manganese	7439-96-5	9.15E+04	6.40E+02	1.95E+02	5.27E+01	9.24E+04	99.04	0.69	0.21	0.06
Mercury	7439-97-6	2.92E+03	6.78E+02	1.32E+01	1.52E+00	3.62E+03	80.85	18.75	0.36	0.04
Nickel	7440-02-0	3.47E+04	2.25E+03	4.31E+02	3.63E+02	3.77E+04	91.93	5.96	1.14	0.96
Selenium	7782-49-2	6.90E+03	9.27E+02		2.31E+00	7.83E+03	88.13	11.84		0.03
Metal Total		**2.51E+05**	**7.88E+03**	**1.49E+03**	**1.90E+04**	**2.79E+05**	**89.84**	**2.82**	**0.53**	**6.81**
Non-Metal Compounds (Excluding PAHs)										
Acetaldehyde	75-07-0	3.39E+05	1.11E+06	1.70E+06	1.17E+06	4.32E+06	7.84	25.63	39.37	27.16
Acetamide	60-35-5		6.31E-01			6.31E-01		100.00		
Acetone	67-64-1	1.03E+06	7.34E+05		5.95E+04	1.83E+06	56.58	40.16		3.25
Acetonitrile	75-05-8	5.00E+03	2.06E+05			2.11E+05	2.37	97.63		
Acetophenone	98-86-2	3.89E+02	2.48E+02			6.37E+02	61.04	38.96		
Acrolein	107-02-8	1.14E+05	1.19E+05	1.12E+05	1.00E+05	4.45E+05	25.72	26.65	25.15	22.49
Acrylamide	79-06-1	5.96E+02				5.96E+02	100.00			
Acrylic Acid	79-10-7	2.53E+04	1.88E-02			2.53E+04	100.00	0.00		
Acrylonitrile	107-13-1	3.72E+03	5.93E+03			9.65E+03	38.57	61.43		
Aldehydes		8.49E+04				8.49E+04	100.00			
Allyl Chloride	107-05-1	1.10E+01				1.10E+01	100.00			
Aniline	62-53-3	9.12E-02				9.12E-02	100.00			
Atrazine	1912-24-9		1.94E+05			1.94E+05		100.00		
Benzaldehyde	100-52-7	2.31E+03	1.12E+05		2.61E+04	1.41E+05	1.64	79.76		18.60
Benzene	71-43-2	1.93E+05	2.83E+06	6.30E+06	2.86E+06	1.22E+07	1.58	23.22	51.73	23.47
Benzyl Chloride	100-44-7	3.62E+03	3.49E+02			3.97E+03	91.21	8.79		
Biphenyl	92-52-4	2.19E+03	9.90E+02			3.18E+03	68.91	31.09		
Dichloroethyl Ether (Bis[2-Chloroethyl]Ether)	111-44-4	9.70E-02				9.70E-02	100.00			
Bromoform	75-25-2	8.08E+02	1.95E+01			8.27E+02	97.65	2.35		
Methyl Bromide (Bromomethane)	74-83-9	1.59E+04	1.05E+06			1.06E+06	1.49	98.51		
1,3-Butadiene	106-99-0	4.86E+03	1.54E+05	6.61E+05	7.48E+05	1.57E+06	0.31	9.82	42.18	47.69
Butyraldehyde	123-72-8	1.52E+03			2.57E+04	2.72E+04	5.58			94.42
Carbon Disulfide	75-15-0	2.90E+03	8.44E+02			3.74E+03	77.42	22.58		

Pollutant Name	Cas No.	Emissions (lb)					Percent (%)			
		Point	Nonpoint	Onroad	Nonroad	Total	Point	Nonpoint	Onroad	Nonroad
Carbon Tetrachloride	56-23-5	1.64E+04	7.98E+02			1.72E+04	95.37	4.63		
Carbonyl Sulfide	463-58-1	1.28E+04	6.33E+02			1.34E+04	95.28	4.72		
Catechol	120-80-9	9.38E+02				9.38E+02	100.00			
Trichlorofluoromethane (CFC-11, R-11)	75-69-4	1.39E+03	1.84E+03			3.23E+03	42.99	57.01		
Trichlorotrifluoromethane (CFC-113, R-113)	76-13-1	2.01E+01	1.92E+05			1.92E+05	0.01	99.99		
Chlorine	7782-50-5	2.14E+04	4.09E+05			4.31E+05	4.96	95.04		
Chloroacetic Acid	79-11-8	3.11E+02				3.11E+02	100.00			
Chlorobenzene	108-90-7	1.45E+03	3.39E+05			3.40E+05	0.43	99.57		
Ethyl Chloride	75-00-3	4.63E+03	1.77E+03			6.40E+03	72.30	27.70		
Chloroform	67-66-3	1.11E+04	3.97E+05			4.09E+05	2.72	97.28		
2-Chloroacetophenone	532-27-4	1.45E+02	3.49E+00			1.48E+02	97.65	2.35		
Cresol/Cresylic Acid (Mixed Isomers)	1319-77-3	2.27E+03				2.27E+03	100.00			
m-Cresol	108-39-4	3.25E+01				3.25E+01	100.00			
o-Cresol	95-48-7	5.05E+03	1.27E+02			5.18E+03	97.54	2.46		
p-Cresol	106-44-5	8.44E+02	2.58E+02			1.10E+03	76.62	23.38		
Crotonaldehyde	123-73-9	2.79E+02			2.68E+04	2.70E+04	1.03			98.97
Cumene	98-82-8	1.83E+04	2.42E+04			4.26E+04	43.06	56.94		
Cyanide Compounds	57-12-5	5.69E+04	3.92E+05			4.49E+05	12.69	87.31		
2,4-D (2,4-Dichlorophenoxyacetic Acid)	94-75-7		4.35E+04			4.35E+04		100.00		
Dibenzofuran	132-64-9	3.09E+02	1.64E+03			1.95E+03	15.89	84.11		
Ethylene Dibromide (Dibromoethane)	106-93-4	1.96E+03	2.56E+01			1.99E+03	98.71	1.29		
Dibutyl Phthalate	84-74-2	6.81E+03	4.25E+02			7.24E+03	94.13	5.87		
Ethylene Dichloride (1,2-Dichloroethane)	107-06-2	1.23E+04	2.52E+03			1.48E+04	83.03	16.97		
Dichlorvos	62-73-7	2.80E+02				2.80E+02	100.00			
1,4-Dichlorobenzene	106-46-7	2.82E+03	3.88E+05			3.90E+05	0.72	99.28		
M-Dichlorobenzene	541-73-1	3.19E+01	2.34E+03			2.37E+03	1.35	98.65		
O-Dichlorobenzene	95-50-1	3.41E+02	8.86E+02			1.23E+03	27.82	72.18		
Dichlorobenzenes	25321-22-6	7.10E+01	1.76E+02			2.47E+02	28.78	71.22		
Ethylidene Dichloride (1,1-Dichloroethane)	75-34-3	1.43E+03	1.72E+03			3.15E+03	45.28	54.72		
Cis-1,2-Dichloroethylene	156-59-2	4.61E+02				4.61E+02	100.0			

		Emissions (lb)					Percent (%)			
Pollutant Name	Cas No.	Point	Nonpoint	Onroad	Nonroad	Total	Point	Nonpoint	Onroa d	Nonroa d
							0			
Cis-1,3-Dichloropropene	10061-01-5	1.77E+02				1.77E+02	100.0 0			
1,3-Dichloropropene	542-75-6	1.08E+02	7.51E+05			7.52E+05	0.01	99.99		
Diethyl Sulfate	64-67-5	4.00E+00				4.00E+00	100.0 0			
Diethanolamine	111-42-2	9.82E+02	1.90E+03			2.88E+03	34.09	65.91		
Dimethyl Phthalate	131-11-3	1.11E+04	1.40E+02			1.12E+04	98.75	1.25		
Dimethyl Sulfate	77-78-1	9.94E+02	2.40E+01			1.02E+03	97.65	2.35		
N,N-Dimethylformamide	68-12-2	4.19E+04	1.64E+02			4.21E+04	99.61	0.39		
Dimethylaniline(N,N-Dimethylaniline)	121-69-7	1.08E+02				1.08E+02	100.0 0			
4,6-Dinitro-o-Cresol (Including Salts)	534-52-1	2.19E-01				2.19E-01	100.0 0			
2,4-Dinitrophenol	51-28-5	2.27E+01				2.27E+01	100.0 0			
2,4-Dinitrotoluene	121-14-2	1.76E+02	1.40E-01			1.76E+02	99.92	0.08		
Bis(2-Ethylhexyl)Phthalate (Dehp)	117-81-7	4.89E+03	4.56E+02			5.34E+03	91.46	8.54		
Di-N-Octylphthalate	117-84-0	1.70E+02				1.70E+02	100.0 0			
p-Dioxane	123-91-1	2.20E+03	2.06E+03			4.27E+03	51.63	48.37		
Epichlorohydrin	106-89-8	1.87E+01				1.87E+01	100.0 0			
1,2-Epoxybutane	106-88-7	3.64E+01				3.64E+01	100.0 0			
Ethyl Acrylate	140-88-5	9.94E+02				9.94E+02	100.0 0			
Ethyl Carbamate (Urethane) Chloride (Chloroeth	51-79-6	1.55E+02				1.55E+02	100.0 0			
Ethylbenzene	100-41-4	2.11E+05	2.63E+05	2.26E+06	1.35E+06	4.08E+06	5.18	6.45	55.36	33.02
Ethylene Glycol	107-21-1	1.32E+05	8.05E+05			9.37E+05	14.09	85.91		
Ethylene Oxide	75-21-8	5.24E+02	3.10E+04			3.15E+04	1.66	98.34		
Formaldehyde	50-00-0	9.90E+05	9.69E+05	2.29E+06	2.44E+06	6.68E+06	14.81	14.50	34.20	36.49
Glycol Ethers		3.54E+05	7.04E+05			1.06E+06	33.44	66.56		
Hydrochloric Acid (Hydrogen Chloride [Gas	7647-01-0	6.16E+06	8.48E+05			7.01E+06	87.89	12.11		
Hexachlorocyclopentadiene	77-47-4	9.40E-02				9.40E-02	100.0			

Pollutant Name	Cas No.	Emissions (lb) Point	Emissions (lb) Nonpoint	Emissions (lb) Onroad	Emissions (lb) Nonroad	Emissions (lb) Total	Percent (%) Point	Percent (%) Nonpoint	Percent (%) Onroad	Percent (%) Nonroad
							0			
Hexamethylene Diisocyanate	822-06-0	3.18E+03				3.18E+03	100.00			
Hexane	110-54-3	2.99E+06	1.72E+06	1.62E+06	1.54E+06	7.88E+06	37.97	21.87	20.55	19.61
Hexachloroethane	67-72-1	1.80E-01				1.80E-01	100.00			
Hexachlorobutadiene	87-68-3	2.18E+02				2.18E+02	100.00			
Hexachlorobenzene	118-74-1	9.80E-02	8.68E+00			8.78E+00	1.12	98.88		
Hydrogen Fluoride (Hydrofluoric Acid)	7664-39-3	1.09E+06	7.50E+04			1.16E+06	93.55	6.45		
Hydroquinone	123-31-9	3.16E+03				3.16E+03	100.00			
Isophorone	78-59-1	3.05E+04	5.23E+03			3.57E+04	85.33	14.67		
Maleic Anhydride	108-31-6	5.40E+02				5.40E+02	100.00			
Methyl Ethyl Ketone (2-Butanone)	78-93-3	5.15E+05	8.75E+05			1.39E+06	37.05	62.95		
Methylhydrazine	60-34-4	3.52E+03	8.48E+01			3.61E+03	97.65	2.35		
Methyl Iodide (Iodomethane)	74-88-4	1.91E+01				1.91E+01	100.00			
Methyl Isobutyl Ketone (Hexone)	108-10-1	2.09E+05	1.45E+05			3.54E+05	59.15	40.85		
Methyl Isocyanate	624-83-9	2.00E+00				2.00E+00	100.00			
Methyl Methacrylate	80-62-6	8.82E+04	1.69E+03			8.99E+04	98.12	1.88		
Methyl Tert-Butyl Ether	1634-04-4	1.55E+03	1.29E+02	8.40E-03		1.68E+03	92.30	7.70	0.00	
Methanol	67-56-1	1.17E+06	3.73E+06			4.90E+06	23.82	76.18		
4,4'-Methylenediphenyl Diisocyanate (MDI)	101-68-8	5.96E+03	1.96E+03			7.92E+03	75.25	24.75		
Methyl Chloride (Chloromethane)	74-87-3	1.24E+04	1.03E+05			1.16E+05	10.69	89.31		
Methylene Chloride (Dichloromethane)	75-09-2	1.23E+05	2.93E+05			4.17E+05	29.63	70.37		
Nitrobenzene	98-95-3	6.31E+01				6.31E+01	100.00			
4-Nitrophenol	100-02-7	5.84E+01	4.14E+02			4.72E+02	12.36	87.64		
2-Nitropropane	79-46-9		1.01E+01			1.01E+01		100.00		
N-Nitrosodimethylamine	62-75-9	8.98E+00				8.98E+00	100.00			
Parathion	56-38-2	1.79E+02				1.79E+02	100.00			

		Emissions (lb)					Percent (%)			
Pollutant Name	**Cas No.**	**Point**	**Nonpoint**	**Onroad**	**Nonroad**	**Total**	**Point**	**Nonpoint**	**Onroad**	**Nonroad**
Polychlorinated Biphenyls (Aroclors)	1336-36-3	9.52E-01	1.13E+03			1.13E+03	0.08	99.92		
Polychlorinated Dibenzodioxins, Total		2.95E+01	4.92E-01	9.91E-02	5.80E-02	3.02E+01	97.85	1.63	0.33	0.19
Polychlorinated Dibenzo-P-Dioxins and Furans, Total		1.27E+00				1.27E+00	100.00			
Polychlorinated Dibenzofurans, Total		1.06E+00	2.79E-01	2.03E-02	1.06E-02	1.37E+00	77.43	20.32	1.48	0.77
Pentachlorophenol	87-86-5	5.44E+02	2.09E+01			5.65E+02	96.29	3.71		
Tetrachloroethylene (Perchloroethylene)	127-18-4	1.84E+05	3.11E+05			4.95E+05	37.25	62.75		
Phenol	108-95-2	1.76E+05	6.79E+05		7.36E+02	8.56E+05	20.58	79.34		0.09
Phosphine	7803-51-2	1.14E+03	8.38E+02			1.98E+03	57.58	42.42		
Phosphorus	7723-14-0	3.77E+03	1.55E+02		3.70E+01	3.97E+03	95.17	3.90		0.93
Phthalic Anhydride	85-44-9	2.64E+02				2.64E+02	100.00			
Polycyclic Organic Matter		1.72E+04	3.20E+04		4.69E+00	4.92E+04	34.97	65.02		0.01
1,2-Propylenimine (2-Methylaziridine)	75-55-8	1.76E+01				1.76E+01	100.00			
Propionaldehyde	123-38-6	1.08E+04	9.34E+04	1.31E+05	2.45E+05	4.80E+05	2.26	19.46	27.34	50.95
Propoxur	114-26-1	1.70E+01				1.70E+01	100.00			
Propylene Dichloride (1,2-Dichloropropane)	78-87-5	8.98E+02	3.59E+02			1.26E+03	71.44	28.56		
Propylene Oxide	75-56-9	1.64E+03				1.64E+03	100.00			
Quinoline	91-22-5	2.00E+00				2.00E+00	100.00			
Quinone (p-Benzoquinone)	106-51-4	1.90E+03				1.90E+03	100.00			
Styrene	100-42-5	1.25E+06	3.48E+05	4.75E+05	1.94E+05	2.27E+06	55.20	15.34	20.92	8.54
2,3,7,8-Tetrachlorodibenzo-p-Dioxin	1746-01-6	1.00E-03	1.91E-03	6.52E-04	3.54E-04	3.92E-03	25.61	48.69	16.65	9.04
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	1.82E-02	2.88E-02	1.72E-03	9.00E-04	4.96E-02	36.65	58.07	3.46	1.81
Dioxin and Furans (2,3,7,8-TCDD Equivalents)		3.59E-03	8.00E-11			3.59E-03	100.00	0.00		
Methyl Chloroform (1,1,1-Trichloroethane)	71-55-6	4.23E+03	1.98E+06		9.22E-01	1.98E+06	0.21	99.79		0.00
1,1,2,2-Tetrachloroethane	79-34-5	4.19E+03	1.90E+03			6.09E+03	68.83	31.17		
Toluene	108-88-3	1.34E+06	4.67E+06	1.52E+07	1.90E+07	4.02E+07	3.34	11.62	37.82	47.22
2,4-Toluene Diisocyanate	584-84-9	1.79E+03	2.80E+02			2.07E+03	86.49	13.51		
o-Toluidine	95-53-4	6.00E-02				6.00E-02	100.00			

Pollutant Name	Cas No.	Emissions (lb) Point	Nonpoint	Onroad	Nonroad	Total	Percent (%) Point	Nonpoint	Onroad	Nonroad
Trichloroethylene	79-01-6	2.80E+05	1.85E+04			2.99E+05	93.82	6.18		
1,2,4-Trichlorobenzene	120-82-1	1.82E+04	1.95E+01			1.83E+04	99.89	0.11		
1,1,2-Trichloroethane	79-00-5	9.42E+02				9.42E+02	100.00			
2,4,5-Trichlorophenol	95-95-4	1.01E-01				1.01E-01	100.00			
2,4,6-Trichlorophenol	88-06-2	6.13E-01				6.13E-01	100.00			
Triethylamine	121-44-8	2.36E+03	6.76E+03			9.11E+03	25.85	74.15		
Trifluralin	1582-09-8		1.21E+04			1.21E+04		100.00		
2,2,4-Trimethylpentane	540-84-1	1.15E+04	4.15E+05	6.16E+06	8.81E+06	1.54E+07	0.07	2.70	39.99	57.23
1,2,4-Trimethylbenzene	95-63-6	1.31E+05	1.47E+04			1.46E+05	89.92	10.08		
1,3,5-Trimethylbenzene	108-67-8	4.03E+03				4.03E+03	100.00			
Trimethylbenzene	25551-13-7	2.27E+03	1.45E+04			1.68E+04	13.56	86.44		
Vinylidene Chloride (1,1-Dichloroethylene)	75-35-4	1.80E+02	3.08E+03			3.26E+03	5.52	94.48		
Vinyl Acetate	108-05-4	4.80E+04	1.68E+03			4.97E+04	96.61	3.39		
Vinyl Chloride	75-01-4	4.19E+03	1.38E+04			1.80E+04	23.27	76.73		
m-Xylene	108-38-3	8.20E+03	5.53E+03			1.37E+04	59.73	40.27		
o-Xylene	95-47-6	3.77E+03	1.73E+05			1.76E+05	2.14	97.86		
p-Xylene	106-42-3	3.96E+03				3.96E+03	100.00			
Xylenes (Mixed Isomers)	1330-20-7	1.05E+06	2.10E+06	8.64E+06	9.34E+06	2.11E+07	4.98	9.95	40.89	44.19
Non-Metal Total		**2.07E+07**	**3.09E+07**	**4.56E+07**	**4.79E+07**	**1.45E+08**	**14.29**	**21.31**	**31.38**	**33.02**
Grand Total		**2.10E+07**	**3.17E+07**	**4.57E+07**	**4.80E+07**	**1.46E+08**	**14.37**	**21.62**	**31.20**	**32.81**

Table 3. Detailed categorization of the 2005 Minnesota emissions for total air toxics.

Principal Category	Category	Emissions (lb)	Percent (%)
Point	Electric, Gas, and Sanitary Services	4.83E+06	3.30
	Food and Kindred Products	3.64E+06	2.49
	Paper and Allied Products	2.12E+06	1.45
	Metal Mining	1.88E+06	1.29
	Lumber and Wood Products	1.50E+06	1.02
	Transportation Equipment	1.39E+06	0.95
	Rubber and Misc. Plastics Products	1.12E+06	0.77
	Fabricated Metal Products	9.50E+05	0.65
	Industrial Machinery and Equipment	6.48E+05	0.44
	Petroleum and Coal Products	5.90E+05	0.40
	Chemicals and Allied Products	4.90E+05	0.33
	Stone, Clay, and Glass Products	2.68E+05	0.18
	Electronic & Other Electric Equipment	2.29E+05	0.16
	Printing and Publishing	2.01E+05	0.14
	Instruments and Related Products	1.86E+05	0.13
	Furniture and Fixtures	1.67E+05	0.11
	Primary Metal Industries	1.06E+05	0.07
	Miscellaneous Manufacturing Industries	9.26E+04	0.06
	Special Trade Contractors	6.99E+04	0.05
	Pipelines, Except Natural Gas	6.47E+04	0.04
	Nonmetallic Minerals, Except Fuels	4.65E+04	0.03
	Leather and Leather Products	4.33E+04	0.03
	Wholesale Trade Nondurable Goods	3.95E+04	0.03
	Personal Services	3.90E+04	0.03
	Engineering & Management Services	3.74E+04	0.03
	Educational Services	3.55E+04	0.02
	Auto Repair, Services, and Parking	3.54E+04	0.02
	Trucking and Warehousing	3.15E+04	0.02
	Transportation By Air	3.12E+04	0.02
	Miscellaneous Repair Services	3.03E+04	0.02
	No Description	2.97E+04	0.02
	Wholesale Trade Durable Goods	2.59E+04	0.02
	Automotive Dealers & Service Stations	1.97E+04	0.01
	Textile Mill Products	1.82E+04	0.01
	Health Services	1.15E+04	0.01
	Local and Interurban Passenger Transit	7.46E+03	0.01
	Furniture and Homefurnishings Stores	5.48E+03	0.00
	National Security and Intl. Affairs	2.95E+03	0.00
	Justice, Public Order, and Safety	9.19E+02	0.00
	Amusement & Recreation Services	5.83E+02	0.00
	Social Services	5.83E+02	0.00

Principal Category	Category	Emissions (lb)	Percent (%)
	Communication	3.65E+02	0.00
	Real Estate	3.63E+02	0.00
	Railroad Transportation	1.73E+02	0.00
	General Merchandise Stores	1.66E+02	0.00
	Water Transportation	1.55E+02	0.00
	Insurance Carriers	1.53E+02	0.00
	Business Services	1.47E+02	0.00
	Executive, Legislative, and General	1.24E+02	0.00
	Museums, Botanical, Zoological Gardens	1.08E+02	0.00
	Administration Of Economic Programs	7.92E+01	0.00
	Depository Institutions	7.79E+01	0.00
	Nondepository Institutions	5.85E+01	0.00
	Services, Nec	2.25E+01	0.00
	Agricultural Production Crops	2.00E+01	0.00
	Transportation Services	9.45E+00	0.00
	Food Stores	2.50E+00	0.00
	Miscellaneous Retail	1.67E-01	0.00
Point Total		**2.10E+07**	**14.37**
Nonpoint	Commercial and Consumer Products Usage	1.23E+07	8.40
	Residential Wood Burning	2.85E+06	1.94
	Surface Coating - Architectural	2.83E+06	1.93
	Waste Disposal - Open Burning	2.61E+06	1.78
	Gasoline Service Stations	2.60E+06	1.78
	Prescribed Burning for Forest Management	1.43E+06	0.98
	Public Owned Treatment Works (POTWs)	1.28E+06	0.88
	Degreasing	9.40E+05	0.64
	Stationary Source Fuel Combustion - Industrial	7.63E+05	0.52
	Forest Wildfires	6.36E+05	0.43
	Graphic Arts	5.99E+05	0.41
	Swimming Pools	3.86E+05	0.26
	Agricultural Pesticide Use	3.37E+05	0.23
	Structure Fires	3.25E+05	0.22
	Municipal Solid Waste Landfills	2.98E+05	0.20
	Residential Fossil Fuel Combustion	2.90E+05	0.20
	Traffic Markings	2.34E+05	0.16
	Autobody Refinishing	2.31E+05	0.16
	Stationary Source Fuel Combustion - Commercial/Insti	1.88E+05	0.13
	Dry Cleaners	1.61E+05	0.11
	Commercial Cooking	1.61E+05	0.11
	Bulk Stations/Terminals	7.93E+04	0.05
	Industrial Surface Coating	3.72E+04	0.03
	Hospital Sterilization	3.10E+04	0.02
	Asphalt Paving	1.83E+04	0.01
	Animal Cremation	1.73E+04	0.01

Principal Category	Category	Emissions (lb)	Percent (%)
	Gasoline Trucks in Transit	1.00E+04	0.01
	Prescribed Burning of Rangeland	4.44E+03	0.00
	Human Cremation	2.23E+03	0.00
	On-site Incineration	1.64E+03	0.00
	Grain Elevators	8.38E+02	0.00
	Mineral Processes	6.97E+02	0.00
	Tank/Drum Cleaning	6.36E+02	0.00
	Mercury Volatilization	1.96E+02	0.00
	Dental Preparations	6.24E+01	0.00
	Fluorescent Lamp Breakage	3.47E+01	0.00
	General Laboratory Activities	1.00E+01	0.00
	Fluorecent Lamp Recycling	1.90E-02	0.00
Nonpoint Total		**3.17E+07**	**21.62**
Onroad	Light Duty Gasoline Vehicles (LDGV)	2.22E+07	15.17
	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5)	1.45E+07	9.90
	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5)	6.04E+06	4.12
	Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDG	1.51E+06	1.03
	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B	7.17E+05	0.49
	Motorcycles (MC)	3.88E+05	0.26
	Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7	1.82E+05	0.12
	Heavy Duty Diesel Vehicles (HDDV) Class 2B	4.49E+04	0.03
	Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5	4.21E+04	0.03
	Heavy Duty Diesel Buses (School & Transit)	3.54E+04	0.02
	Light Duty Diesel Trucks 1 thru 4 (M6) (LDDT)	1.84E+04	0.01
	Light Duty Diesel Vehicles (LDDV)	1.71E+03	0.00
Onroad Total		**4.57E+07**	**31.20**
Nonroad	Recreational Equipment	2.45E+07	16.71
	Pleasure Craft	1.35E+07	9.21
	Lawn and Garden Equipment	4.09E+06	2.79
	Agricultural Equipment	1.97E+06	1.34
	Commercial Equipment	1.58E+06	1.08
	Construction and Mining Equipment	1.13E+06	0.77
	Airport including ground support equipment	5.63E+05	0.38
	Railroad Equipment	2.89E+05	0.20
	Industrial Equipment	2.70E+05	0.18
	Logging Equipment	1.38E+05	0.09
	Marine Vessels, Commercial	4.10E+04	0.03
	Railway Maintenance	2.27E+02	0.00
Nonroad Total		**4.80E+07**	**32.81**
Grand Total		**1.46E+08**	**100.00**

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

Total emissions in 2005: 146 million pounds

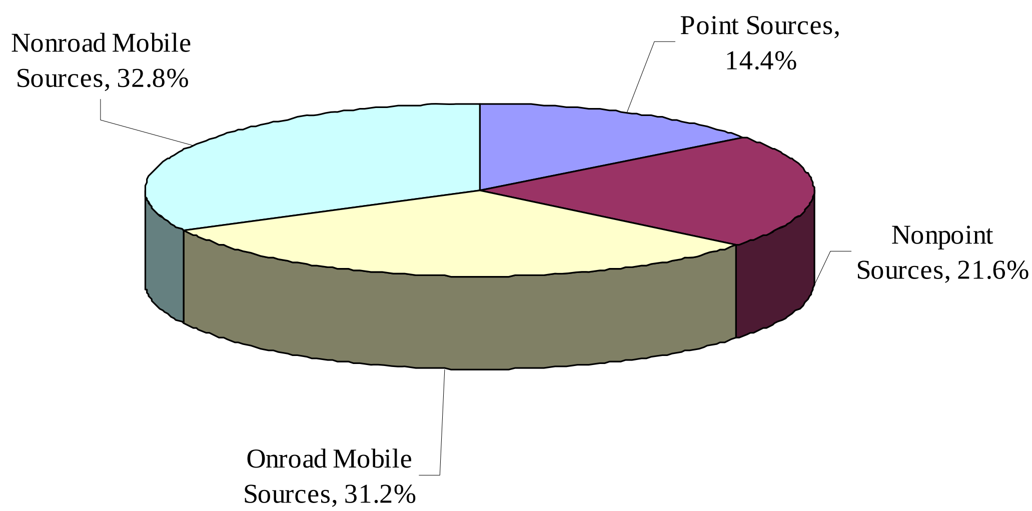

Figure 2. Contribution of top source categories to state total air toxics emissions

Total air toxics emissions: 146 million pounds

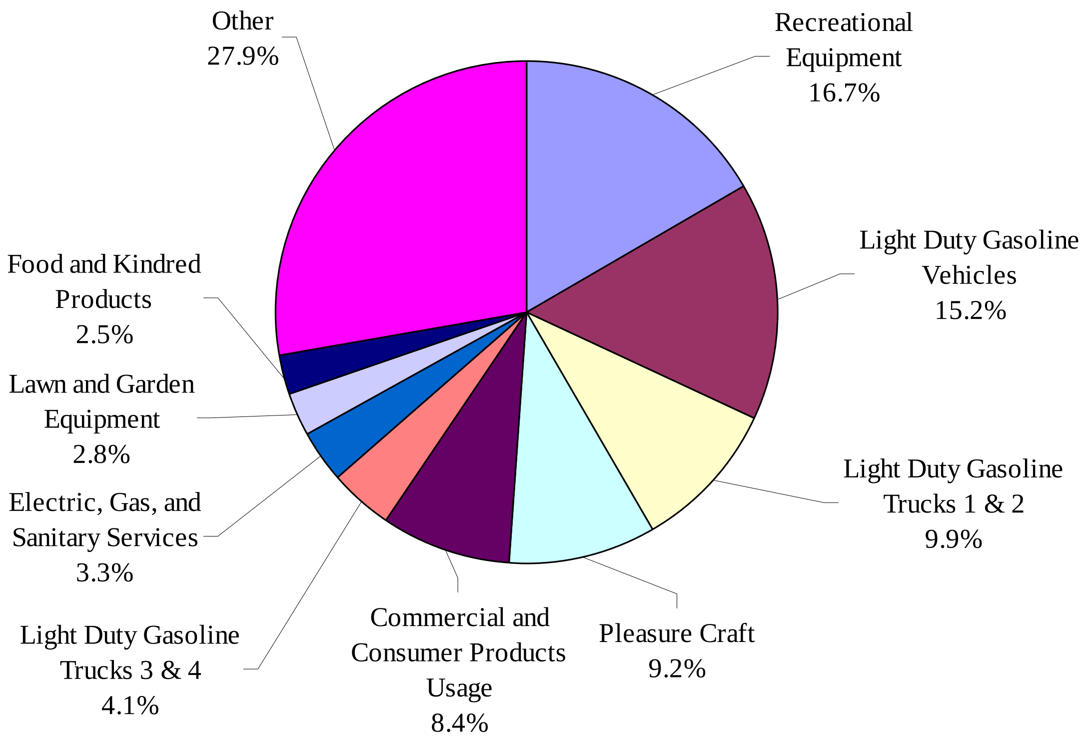

Figure 3. Number of pollutants inventoried with emission estimates.

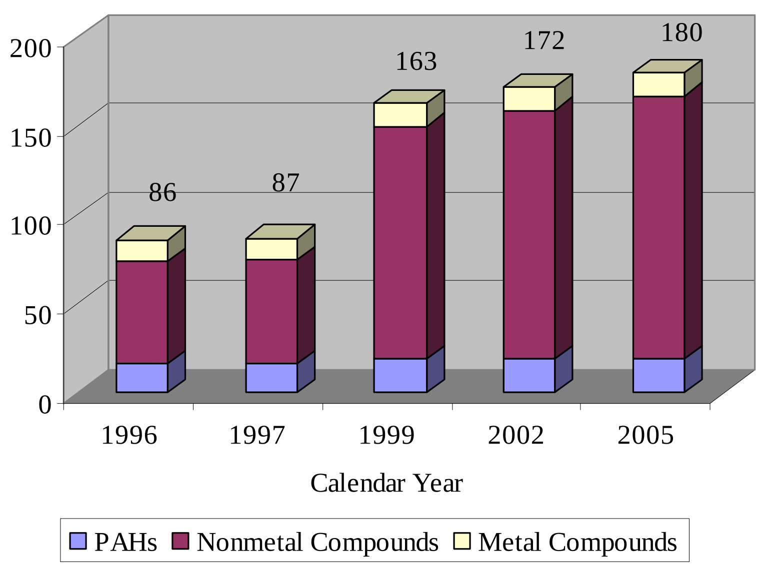

Figure 4. Number of point sources with emission estimates.

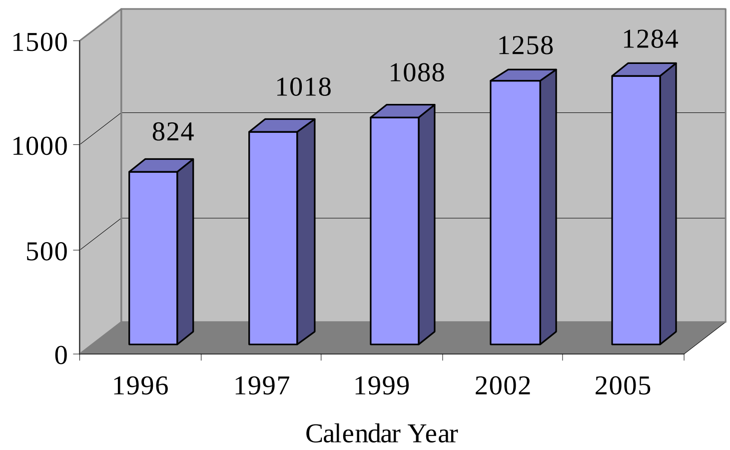

Figure 5. Number of nonpoint source categories included in inventories.