Air Quality in Minnesota:
Challenges and Opportunities

2007 Report to the Legislature

January 2007

Minnesota Pollution Control Agency

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FORWARD

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 air quality issues facing Minnesota and to explore the opportunities available for emission reductions. Because the MPCA's authority extends only to the outdoor environment, indoor pollutants are not addressed.

The 2005 air quality legislative report, Air Quality in Minnesota: Progress and Priorities discussed all of the MPCA programs and detailed the strategies of each. It can be found on the MPCA Web site at: **www.pca.state.mn.us/publications/reports/lr-airqualityreport-2005.html**. This 2007 air quality report is more focused on pollutants and climate change issues relating to energy production and use, with an update of the 2005 emission data.

MPCA's air program has largely focused on controlling emissions of traditional air pollutants from facilities. As a result, Minnesota has met federal air standards and maintained relatively low levels of toxic air pollutants. However, as our population, economic activity and energy use have increased, so have emissions of carbon dioxide. Carbon dioxide is the main greenhouse gas whose build-up leads to climate change. Through conservation, efficiency and the use of cleaner, renewable energy sources, not only can emissions of carbon dioxide be reduced, but further reductions of pollutants such as fine particles, sulfur dioxide, nitrogen oxides and toxic air contaminants can be achieved.

WHY DOES CLEAN AIR MATTER?

Clean air means healthier people

Air pollution causes breathing problems, itchy throats, burning eyes, and triggers asthma and bronchitis attacks. It contributes to cancer, heart attacks and other serious illnesses. Even healthy, athletic adults can be harmed by breathing air pollutants. Because of their small size and rapid breathing, young children may be even more susceptible. The elderly and people with heart and lung conditions are also at increased risk of harm from air pollution. Cleaner air translates into lower health care costs, fewer doctor visits, fewer hospitalizations, and fewer days absent from school or work.

Clean air means healthier ecosystems

Some air pollutants, such as mercury, settle out of the air into Minnesota's lakes and streams. Once there, mercury can accumulate in fish. Consumption advisories for mercury in most of the state's lakes limit the type and amount of fish Minnesota anglers can safely eat.

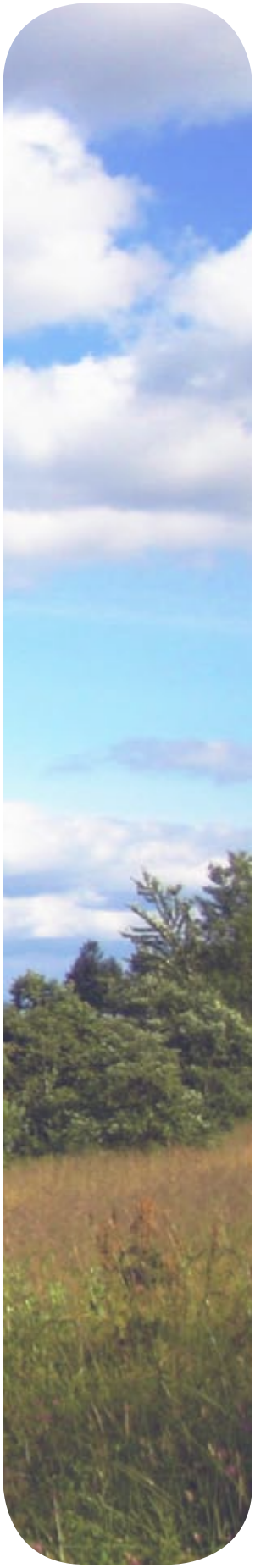
Pollutants in Minnesota's air also reduce visibility, creating a haze that can affect scenic views in pristine places such as the Boundary Waters Canoe Area as well as in the state's urban areas. In addition, emissions of greenhouse gases such as carbon dioxide contribute to climate change which will cause serious changes to Minnesota's ecosystems.

Clean Air means a more secure future

Clean air yields benefits that add to the value of a region's economy. Crops damaged or weakened by air pollution produce lower yields, and forests weakened by air pollution succumb more easily to pests and disease. Minnesota's tourism industry depends on fishable, swimmable waters; limits on fish consumption due to mercury can discourage tourists. Minnesota tourism may also be affected by hazy vistas in scenic areas.

Cleaning up the air reduces future health and ecological costs. The EPA estimates that nationally the new fine particle standards will yield 9 to 76 billion dollars a year in health and visibility benefits by 2020.[1]

It is difficult to estimate the potential costs of a warming climate on Minnesota, but possible effects include increased damage from floods and violent storms, shifts in the location of forests and grasslands, loss of species that cannot adapt quickly to new climates and more poor air quality days.



[1] *United States Environmental Protection Agency. 2006. Regulatory Impact Analysis for the Review of the Particulate Matter National Ambient Air Quality Standards. EPA-HQ-OAR-2006-0834. www.epa.gov/ttn/ecas/ria.html*

HOW ARE WE DOING IN MINNESOTA?

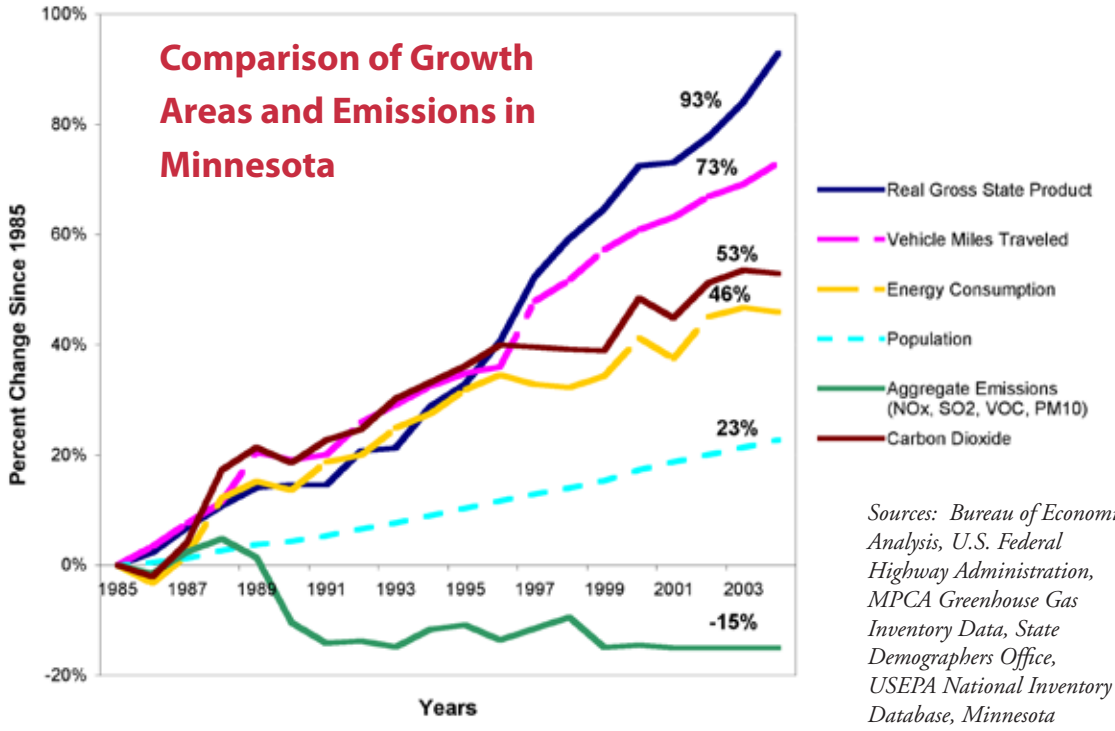
Minnesota has changed in many ways since 1985. Our population has grown 23 percent; we use 46 percent more energy and drive 73 percent more miles than we did in 1985.

Despite these sizeable increases in population, energy use, vehicle miles traveled and gross state product in Minnesota, emissions of regulated pollutants have generally declined since 1985. Controls on factory emissions, improved pollution equipment on cars and trucks and the removal of lead from gasoline contributed to this decline.

However, climate change poses a special challenge. Carbon dioxide (CO_2) is the primary greenhouse gas contributing to climate change. Since CO_2 has not been considered an air pollutant, most pollution control requirements for transportation and facility sources do not reduce CO_2 emissions. As a result, total emissions of CO_2 have increased by 53 percent since 1985.

Even among the regulated pollutants, concerns remain. The standards may not protect all the citizens of Minnesota. In addition, standards exist for only a small fraction of air pollutants and the impact of breathing multiple pollutants is not well understood.

With CO_2 emissions increasing and the serious long-term consequences of climate change, the MPCA believes CO_2 emission reductions are needed. In addition, the MPCA seeks reductions in emissions of other pollutants such as fine particles, mercury and some air toxics which can have a direct and immediate affect on human health and ecosystems.



Sources: Bureau of Economic Analysis, U.S. Federal Highway Administration, MPCA Greenhouse Gas Inventory Data, State Demographers Office, USEPA National Inventory Database, Minnesota Criteria Pollutant Emissions Inventory

AIR ISSUES OF PRIMARY CONCERN

Carbon Dioxide (CO_2)

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 like coal, oil, and gas. Other greenhouse gases, such as methane, contribute an additional 25 percent to climate change. Climate change has the potential to have devastating consequences to Minnesota's economy and environment.

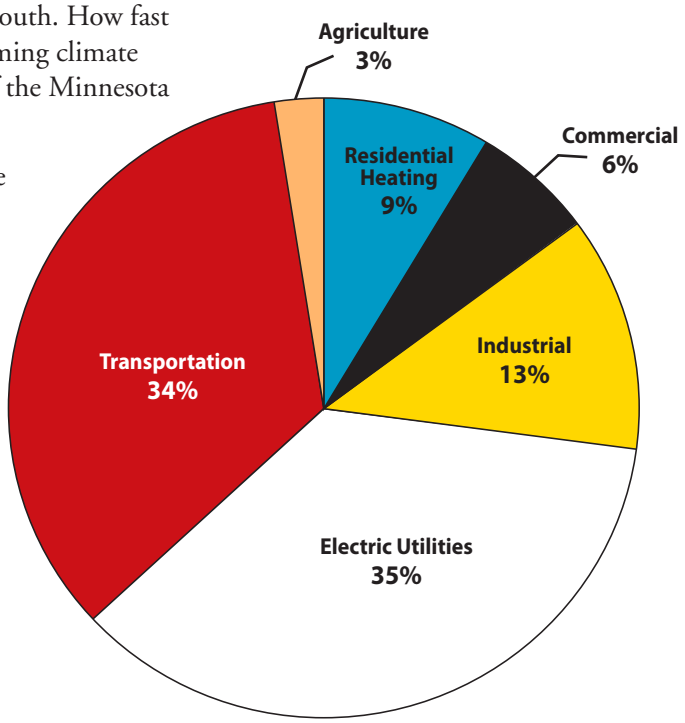
It will affect Minnesota by impacting natural ecosystems, agriculture, forestry, outdoor recreation, infrastructure like wastewater treatment and flood control, and human comfort. It is thought that in the long-run, the ecosystems now found in Minnesota will migrate northward into Canada, to be replaced by ecosystems now found to our south. How fast they migrate in response to a warming climate will determine the future shape of the Minnesota landscape.

To date, mean annual temperature in Minnesota has increased about one degree Fahrenheit over the last 100 years. The temperature change has been most pronounced in the winter and spring. On average, the winter season is about four degrees Fahrenheit warmer than in the late 19th century.

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 by about 30 percent between 1990 and 2004. 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 2004, increasing about 24 million tons.

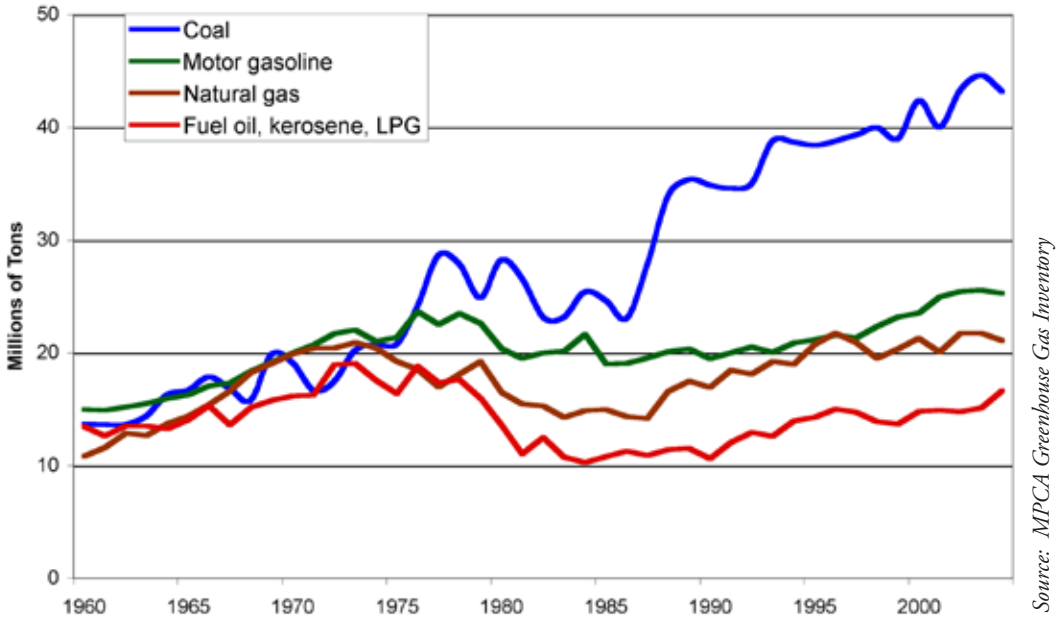
The main strategies for decreasing CO_2 emissions in Minnesota involve switching away from fossil fuels to renewable fuel choices for electricity, heating and transportation; increasing energy conservation; and lowering carbon emissions through carbon offsets and trading.



Emission Sources of Carbon Dioxide

Nearly all CO_2 emissions in Minnesota are the result of fossil fuel combustion for transportation, electricity generation and heating.

Source: MPCA Greenhouse Gas Inventory, 2004



Source: MPCA Greenhouse Gas Inventory

Trends in CO_2 Emissions in Minnesota by Major Fuel Types

Emissions of CO_2 from fossil fuel combustion in Minnesota increased by 30 percent between 1990 and 2004, primarily due to increasing dependence on coal as an energy source.

These strategies are discussed in greater detail in the Future Directions and Challenges section of this report on page 14.

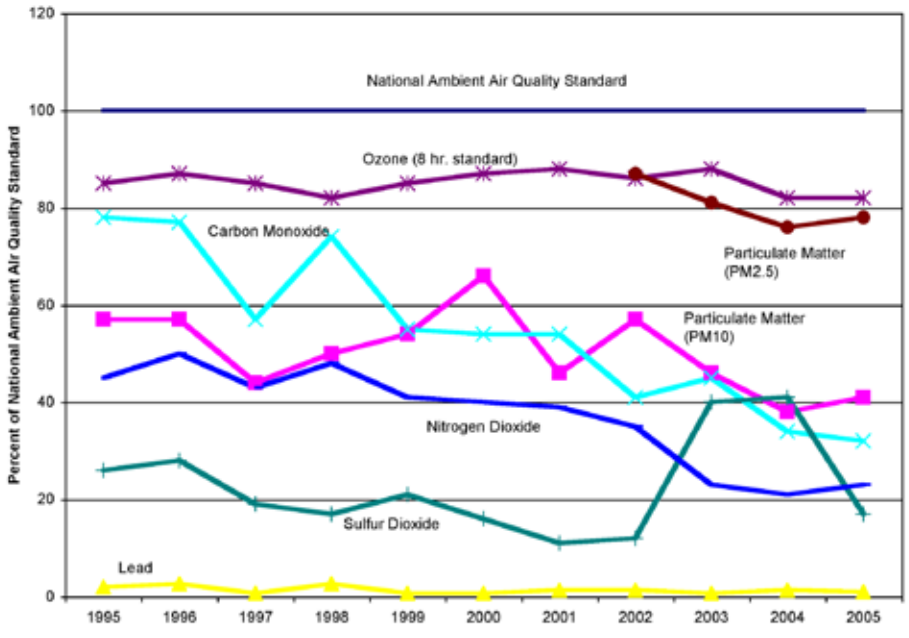
Pollutants with standards

Ambient or outdoor air standards exist for six common air pollutants: Ozone, particulate matter ($PM_{2.5}$ and PM_{10}), carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2) and lead. All of these pollutants except ozone and $PM_{2.5}$ are currently less than 50 percent of their respective standards in Minnesota.

Ozone and $PM_{2.5}$ are both near 80 percent of the standard. Concern remains for these pollutants since there is evidence that health effects exist below the standards. In addition, while average concentrations of ozone and $PM_{2.5}$ are below the standards, on several days every year, levels are high enough to potentially cause health effects in sensitive individuals.

NO_x and SO_2 emissions are important as components and precursors to fine particulate matter while NO_x is also a precursor to ozone formation.

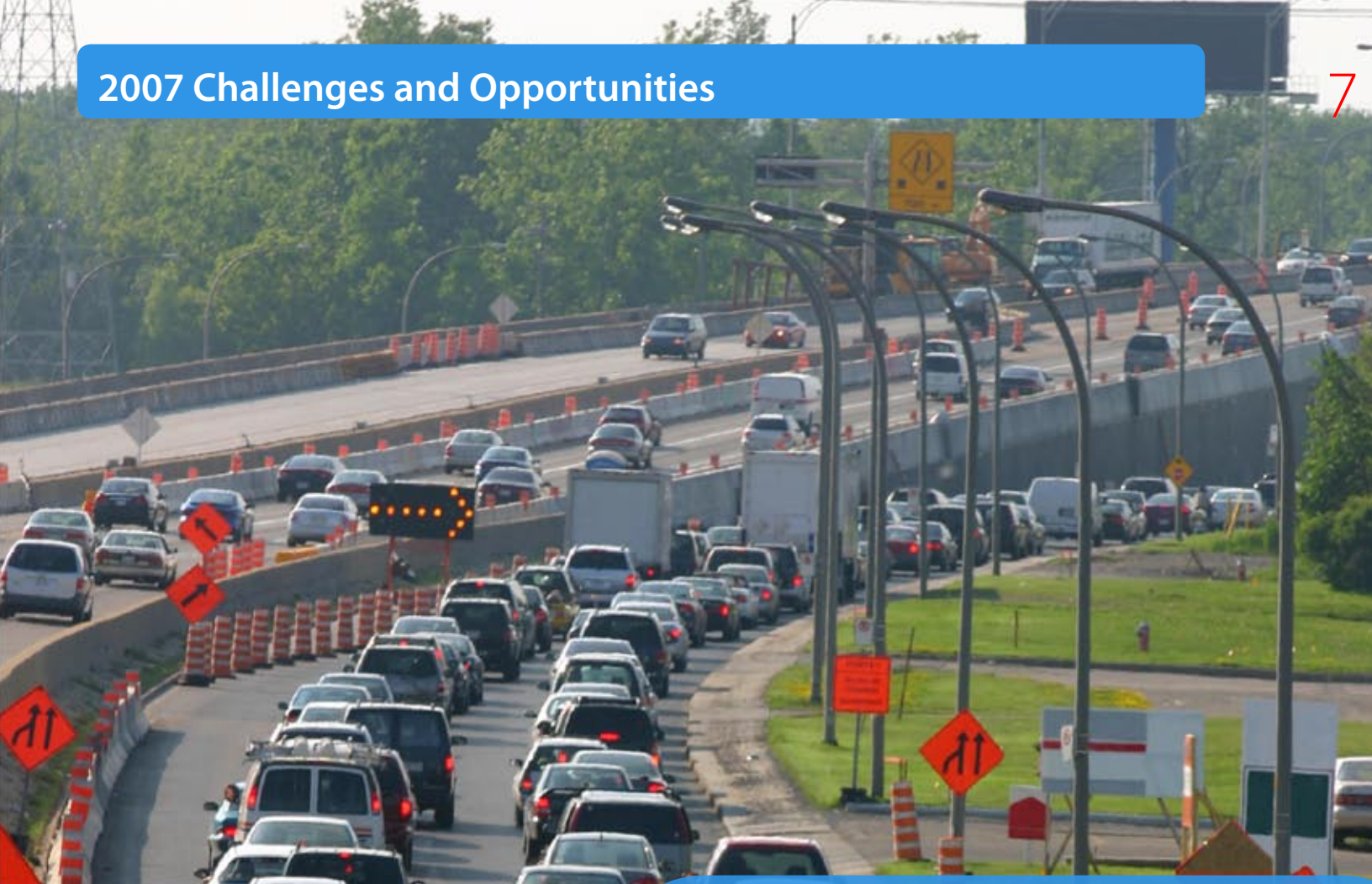
Almost all emissions of NO_x (96 percent) and SO_2 (93 percent) in Minnesota come from energy production. Nearly half of NO_x emissions result from burning fuel for transportation while industrial energy



Source: MPCA Air Monitoring Data

Trends in Criteria Air Pollutants in the Twin Cities Area

Minnesota currently meets all National Ambient Air Quality Standards.



Clean Air Interstate Rule

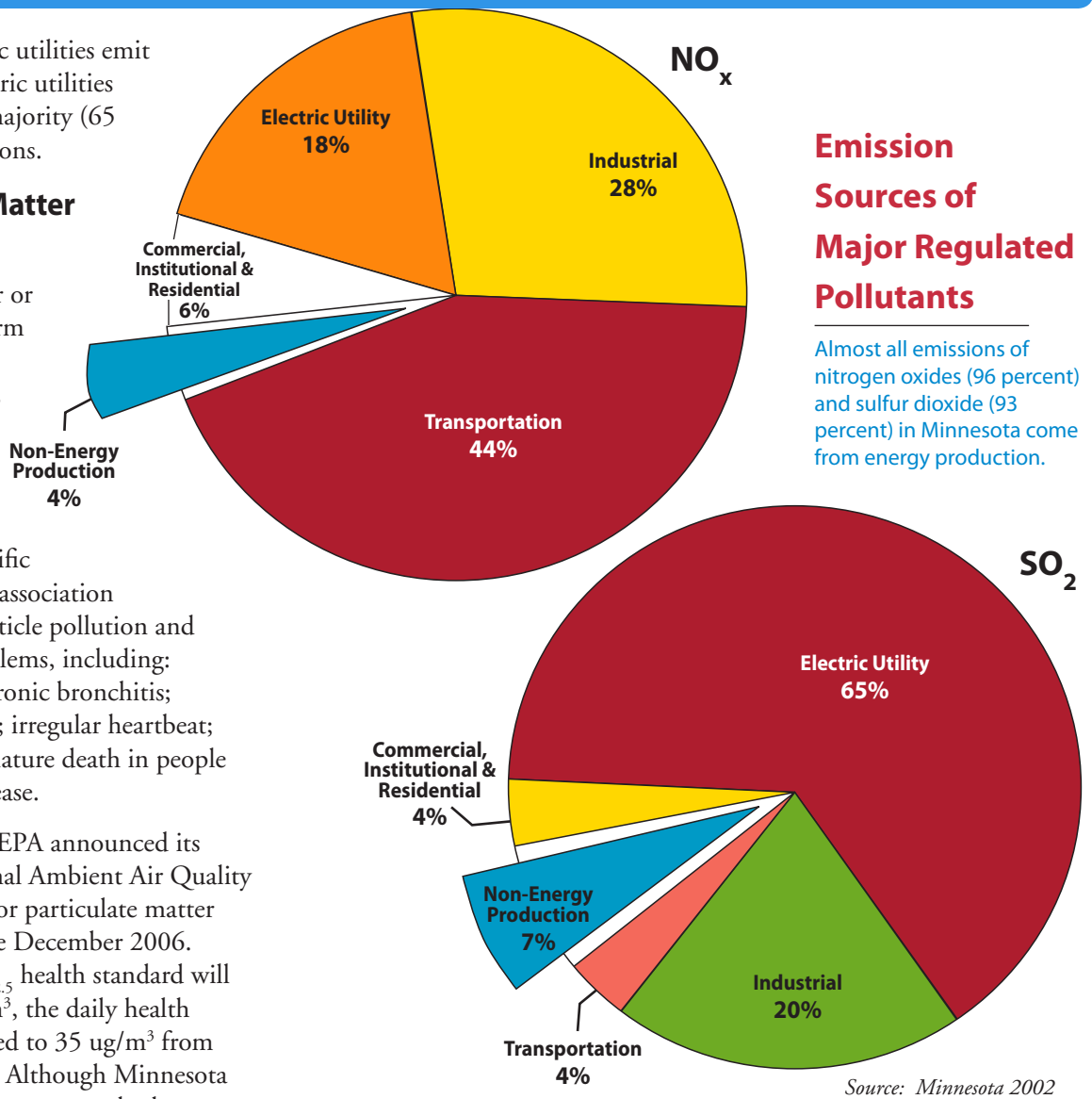
In 2005, the EPA adopted its Clean Air Interstate Rule, known as CAIR. This rule sets up a cap-and-trade system for 28 states in the eastern half of the country to help lower emissions of NO_x and SO_2 which are implicated in acid rain, particle and ozone formation, and visibility issues. Minnesota has more than 60 electrical generating units with a capacity greater than 25 megawatts which will be affected. These units will get "allowances" that permit the emissions of set levels of NO_x and SO_2. If the unit has higher emissions than its "allowance", it must buy additional allowances. If it has lower emissions, the utility can sell the excess allowances. EPA models predict that CAIR will result in a significant decrease in SO_2 and NO_x in Minnesota.

production and electric utilities emit most of the rest. Electric utilities are the source of the majority (65 percent) of SO_2 emissions.

Fine Particulate Matter ($PM_{2.5}$)

Fine particulate matter or $PM_{2.5}$ is the general term for particles found in the air, including dust, dirt, soot, smoke and liquid droplets with a diameter less than or equal to 2.5 microns. Many scientific studies have found an association between breathing particle pollution and significant health problems, including: aggravated asthma; chronic bronchitis; reduced lung function; irregular heartbeat; heart attack; and premature death in people with heart or lung disease.

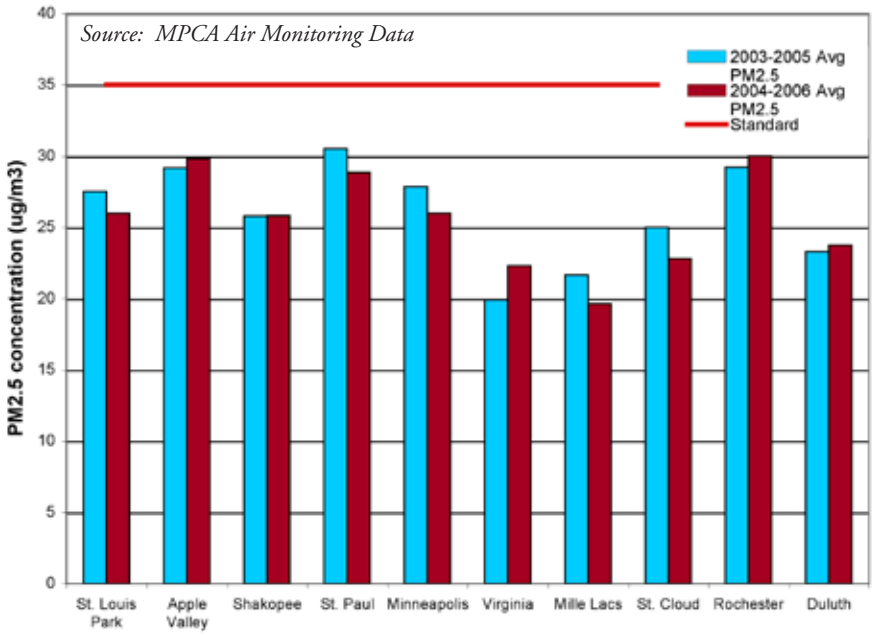
In October 2006, the EPA announced its revisions to the National Ambient Air Quality Standards (NAAQS) for particulate matter which became effective December 2006. While the annual $PM_{2.5}$ health standard will be retained at 15 ug/m^3, the daily health standard will be lowered to 35 ug/m^3 from the current 65 ug/m^3. Although Minnesota is expected to meet this new standard,



Emission Sources of Major Regulated Pollutants

Almost all emissions of nitrogen oxides (96 percent) and sulfur dioxide (93 percent) in Minnesota come from energy production.

Source: Minnesota 2002 Criteria Pollutant Emissions Inventory



Daily fine particle concentrations compared to new standards

The $PM_{2.5}$ standard is a three year average of the 98th percentile of monitored concentrations. Current MPCA monitoring data indicates that Minnesota will meet the new 35 µg/m^3 daily $PM_{2.5}$ standard; however, certain locations in the Twin Cities and Rochester are at greater risk of exceeding it in the future.

Diesel Emissions

Diesel exhaust emissions contribute to many of the priority air issues in Minnesota such as fine particles, regional haze and ozone formation. Burning diesel fuel also emits CO_2 which contributes to climate change.

Three approaches being used to lower diesel emissions include: limiting idling of diesel vehicles, burning cleaner diesel fuel, and building and retrofitting engines so they run more cleanly.

SmartWay Transport Partnership

The MPCA partners with EPA through a National SmartWays Program to provide trucking companies with technical and financial assistance to voluntarily reduce emissions from diesel engines. Currently, Small Business Environmental Improvement Loans are available to purchase fuel-saving technologies including idle reduction devices, single-wide tires, trailer aerodynamics and emission control devices. SmartWay's goal is to cut annual CO_2 emissions by 33 to 66 million tons and nitrogen oxide emissions by 200,000 tons nationally by 2012.

Cleaner Diesel

The EPA's Clean Air Highway Diesel rule requires a 97 percent reduction in the sulfur content of highway diesel fuel, from its current level of 500 parts per million (ppm), to 15 ppm. As of October 15, 2006, Ultra-Low Sulfur Diesel (ULSD) is available at most retail stations. ULSD is necessary for advanced pollution control technology to work on heavy-duty trucks and buses so that engine and vehicle manufacturers can meet the 2007 emission standards. As a result, each 2007 and newer truck and bus will be more than 90 percent cleaner than current models. This will result in reductions of 2.6 million tons of smog-causing nitrogen oxide (NO_x) emissions and 110,000 tons of PM emissions each year nationally once the diesel fleet is replaced with 2007 or newer vehicles.

Blue Skyways

The Blue Skyways Collaborative was created to improve air quality by encouraging voluntary air emissions reduction in North America's heartland. The project, launched in February 2006, includes U.S. EPA Regions 6 and 7, other federal, state, and local governments, private businesses, and non-profit and environmental groups along the I-35 corridor, from Minnesota to Texas. Participants collaborate in planning and implementing projects that use innovations in diesel engines, alternative fuels and renewable energy technologies.

Through Blue Skyways, the State recently received a grant from EPA Regions 6 and 7 to fund "Project Green Fleet", which is overseen by the Minnesota Environmental Initiative's Clean Air Minnesota (CAM). "Project Green Fleet" works to reduce emissions from diesel school buses by installing control equipment. These retrofits can reduce the tailpipe emissions of certain outdoor air pollutants by 40 to 90 percent and dramatically reduce the level of pollution inside the bus. Thanks to funding from Blue Skyways and other sponsors, Project Green Fleet will retrofit over 500 school buses by the end of 2007.

For more information on Project Green Fleet, see the Web site at **www.projectgreenfleet.org/background/index.html**

Emissions from diesel vehicles can contribute to health effects on riders as well as polluting the ambient air.

monitored concentrations are currently within 85-90 percent of the new standard and Minnesota will be at greater risk of exceeding it.

While standards may be protective for the majority of Minnesotans, levels are high enough on certain days to call alerts for sensitive individuals. People such as children, the elderly, athletes and people with heart or lung diseases are at risk for adverse health effects on those days and lowering concentrations of $PM_{2.5}$ remains a goal.

The main source of $PM_{2.5}$ is a result of fuel burning. Fine particles are both emitted directly and formed from other pollutants released during combustion. Sources of $PM_{2.5}$ include power plants, wood burning stoves, cars and trucks, agricultural sources (such as fertilizers) and forest fires. SO_2 and NO_x are major contributors to the formation of fine particles. The MPCA's goal is to reduce these pollutants by 30 percent. New MPCA modeling completed in 2006 estimates that SO_2 will decrease by 16 percent, and NO_x will decrease by 27 percent by 2012 from 2002 levels.

Mercury

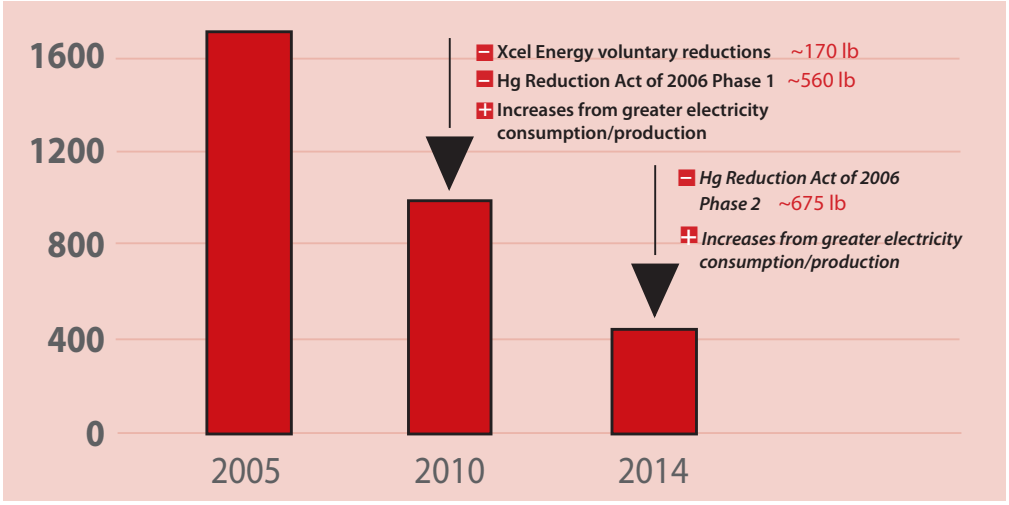
Mercury accumulates in fish and can adversely affect the health of people and wildlife that eat fish. More than 95 percent of the mercury in Minnesota's environment comes from the atmosphere, deposited by rain, snow and attached to dry particles. About 10 percent of mercury deposited in Minnesota comes from air emission sources within the state, with the remainder made up of equal shares from regional, global and natural sources.

Because of the mercury in fish, the Minnesota Department of Health advises people to limit consumption of some species, especially larger walleye and northern pike, from all lakes and rivers in Minnesota.

The MPCA estimates that a 93 percent reduction in world-wide emissions contributing to deposition in the state is needed (from a 1990 baseline) in order for fish mercury to be decreased to levels that would remove consumption advice. To do our part in reducing mercury in the environment, the MPCA has established a goal of reducing mercury emissions in the state by 93 percent from 1990 levels to a final target of 789 pound per year.

The MPCA estimates that air sources in Minnesota emitted about 3,340 pounds of mercury in 2005. Energy related sources, mostly coal-fired power plants, currently contribute the greatest share of these emissions, about 58 percent of the total. Releases from product-related mercury use and emissions from taconite production account for 22 and 20 percent of Minnesota's emissions respectively.

To address the state's largest emissions sources, the Mercury Reduction Act of 2006 requires three large electric power plants in the state to reduce emissions by 90 percent by 2014. This will result in a decrease of about 1200 pounds from current levels. This reduction, added to cuts pledged at other coal-fired plants in the state, means that emissions in the state will continue to decline overall despite anticipated increases from new



Source: MPCA estimates

Mercury Emissions from Coal-fired Electricity Generation

The Mercury Reduction Act of 2006 will result in a decrease of about 1200 pounds.

mining and power generation and increases from electric generation at remaining coal plants. Planning for these reductions is currently underway and decreases will occur in two phases beginning in 2010.

For more information on past and current mercury releases, see Appendix A and the MPCA's 2006 Mercury Report to the Legislature at **www.pca.state.mn.us/air/mercury.html**

Air Toxics

"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 to determine at what concentrations toxics may cause health concerns. Unlike the federal ambient air standards, health benchmarks are guidelines rather than enforceable regulatory standards.

In 2005, the MPCA reported the results of its Minnesota Statewide Air Toxics Monitoring Study. The study found that out of 73 air toxics monitored, only benzene, carbon tetrachloride and formaldehyde were regularly found above health benchmarks from 1995 to 2001 in Minnesota. Of these three, current monitoring indicates that benzene and carbon tetrachloride concentrations have dropped below benchmarks since 2001. Overall, Minnesota concentrations appear to be lower than or similar to air toxic concentrations found nationwide.

For further information on air toxic concentrations see the complete Statewide Air Toxics Monitoring Report at **www.pca.state.mn.us/air/toxics/at-monitoringstudy-9601.html** or the summary Environmental Bulletin at **www.pca.state.mn.us/publications/environmentalbulletin/tdr-eb05-07.pdf**

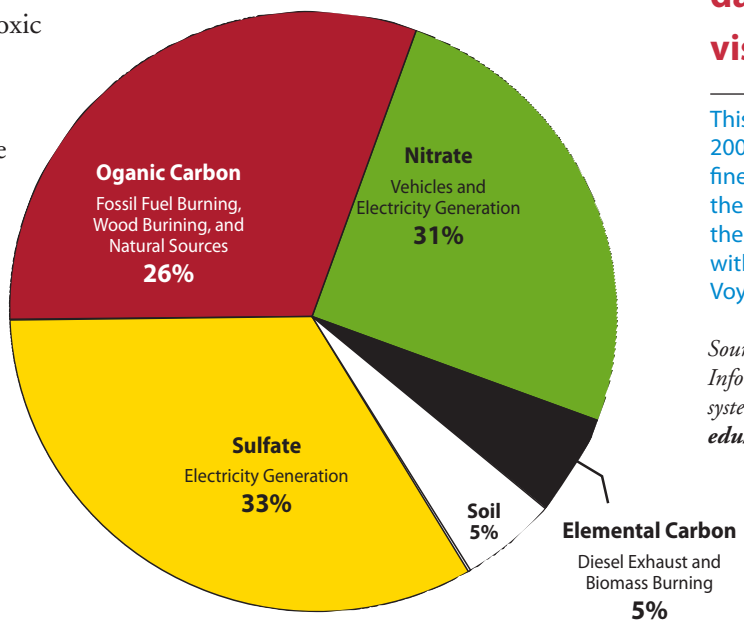
Backyard garbage burning (burn barrels, fire pits, stoves, etc.) can be a significant source of air toxics such as dioxins, furans, polyaromatic hydrocarbons, and heavy metals as well as particulate matter. Garbage burning is still practiced by many rural residents statewide and presents a significant health and environmental concern. Through education, outreach, grants, and local assistance, the MPCA is actively working with all interested parties to phase out backyard garbage burning in Minnesota by 2010.

Visibility

Not only can air pollution result in serious health and environmental problems in populated areas, it can also affect visibility in some of the most pristine and remote parts of our state such as the Boundary Waters Canoe Area and Voyageurs National Park

Air pollution that reduces visibility is called haze. Haze is caused when sunlight encounters fine particles in the air which absorb and scatter light. Fine particles are a regional pollutant and can be carried by the wind hundreds of miles from where they were emitted or formed.

In 1999, EPA issued new rules to implement the national goal in the Clean Air Act to prevent any future and remedy any ongoing impairment of visibility in the national parks and wilderness areas (Class I areas). The requirements of the Regional Haze rules are directed at achieving natural visibility conditions in the Class I areas by 2064.

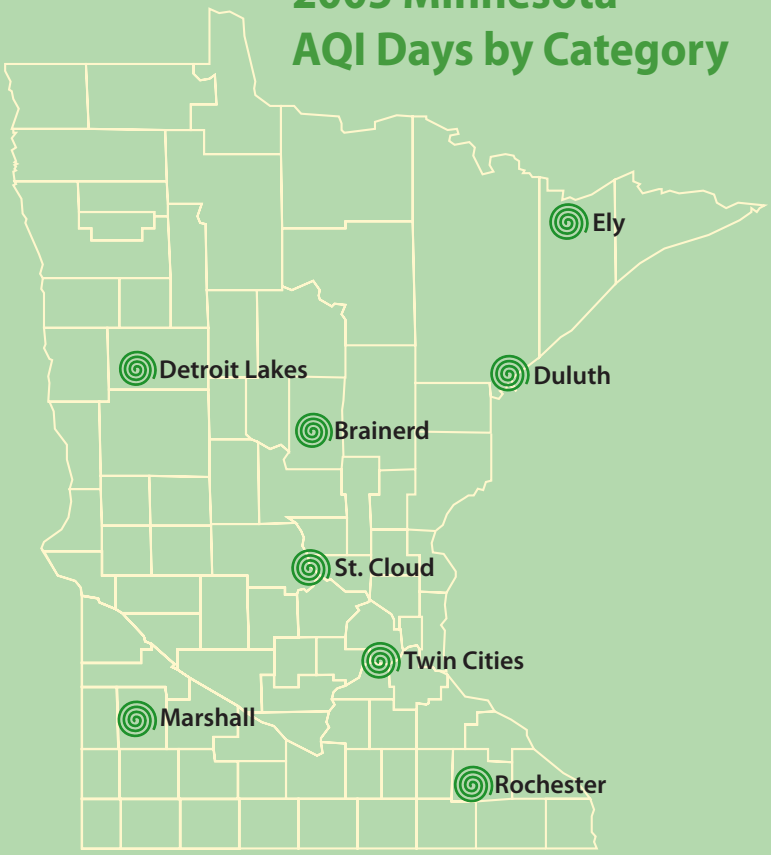


Components of fine particles that contribute to regional haze on the days with worst visibility

This chart shows the 2004 components of fine particles that have the greatest impact on the 20 percent of days with worst visibility at Voyageurs National Park.

Source: Visibility Information Exchange web system ***vista.cira.colostate.edu/views/***

2005 Minnesota AQI Days by Category



The AQI is measured at locations across Minnesota. In most of the state, the majority of days have Good air quality although the Twin Cities has more Moderate air quality days. Some regions do not show a total of 365 days due to monitoring problems or the phase in timing for new regions

Air Quality Index

The Air Quality Index (AQI) was developed by the EPA to provide a simple, uniform way to report daily air quality conditions. An AQI number is determined by hourly measurements of four pollutants: ground-level ozone, SO_2, CO and $PM_{2.5}$. The pollutant with the highest value determines the AQI for that hour. AQI values are updated hourly and posted on the MPCA's Web site at **aqi.pca.state.mn.us/** .

Air quality in Minnesota is usually ranked as Good, Moderate or Unhealthy for Sensitive Groups with an occasional Unhealthy for all ranking. If it is suspected through forecasting or monitoring that one of the four pollutants (most commonly $PM_{2.5}$ or ozone) may be unhealthy for sensitive groups or higher, the MPCA issues an Air Pollution Health Alert to the media and to individuals who have signed up to receive e-mail alerts. Alerts allow the public to be proactive about protecting their health and reducing their own contributions to emissions.

More alerts for Unhealthy for Sensitive Groups and Unhealthy days are expected in the future as a result of the tightening of the daily $PM_{2.5}$ standard.

The AQI is measured at several locations across Minnesota. In 2005, the cleanest air was in Ely with nearly all Good air days and only 19 Moderate days. The worst air quality was in the Twin Cities with more Moderate days than Good, five Unhealthy for Sensitive Group days and three days that were considered Unhealthy for everyone. The rest of the state fell somewhere in between.

Minnesota has two Class I areas - the Boundary Water Canoe Area Wilderness and Voyageurs National Park. By December 2007, Minnesota must submit a Regional Haze State Implementation Plan (SIP) to U.S. EPA that identifies sources that cause or contribute to visibility impairment in these areas. The Regional Haze SIP must also include a demonstration of reasonable progress toward reaching the visibility goal for the state's two Class I areas. The December 2007 SIP focuses on progress to be achieved by 2018.

The U.S. EPA's 1999 Regional Haze Rule singles out certain emission sources built between 1962 and 1977 that have not been regulated under other provisions of the Clean Air Act. Those older sources that could contribute to visibility impairment in Class I areas are required to install Best Available Retrofit Technology (BART) to reduce emissions.

All Minnesota taconite facilities and a handful of power plants were asked by MPCA to evaluate additional controls in a BART analysis.

In order to achieve reasonable progress toward the visibility goal, Minnesota may need to implement control measures on other sources in addition to the ones included in the BART analysis. Additional reductions may also be required in nearby states that contribute to visibility impairment in Minnesota's Class I areas.

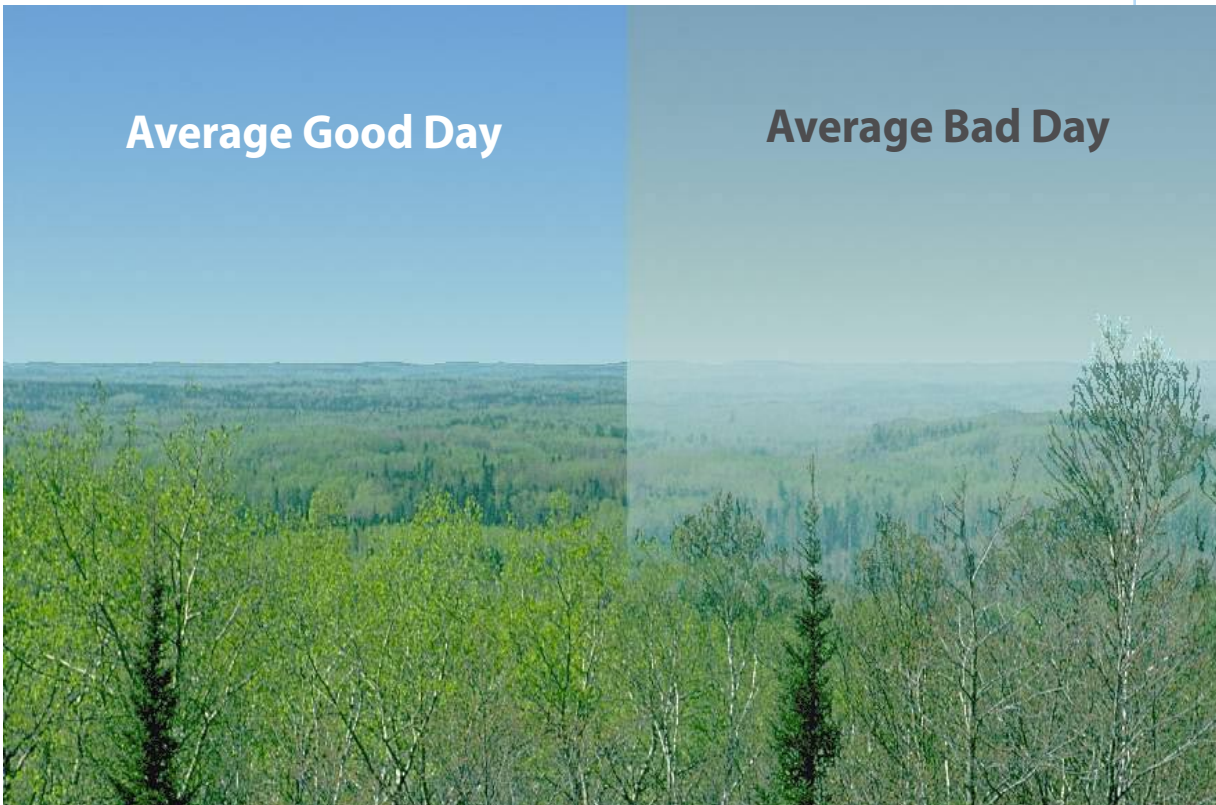
When developing control measures, the MPCA needs to consider the components of fine particles which primarily contribute to haze. Certain pollutants such as sulfate and nitrate tend to have a greater impact on visibility than other components such as soil and organic and elemental carbon. Sulfate and nitrate are considered to be the components most easily controlled, while organic carbon is less well understood and has significant natural sources.

The MPCA is working with other northern states (Michigan, North Dakota, Iowa, Wisconsin and others) to protect the Class I areas in Minnesota and Michigan. This group is working to first achieve consensus on what states and sources are contributing to visibility problems and secondly, to develop cost-effective regional control strategy options and predicted visibility improvements.

For more information on Regional Haze check the MPCA Web site at **www.pca.state.mn.us/air/regionalhaze.html**.

Visibility at the Boundary Waters Canoe Area Wilderness

This photo shows the view from the Boundary Water Canoe Area Wilderness visibility monitor. The left side illustrates average visibility conditions for the 20 percent best days. The right side simulates the view for the 20 percent worst days in BWCA as a result of higher levels of fine particles.



FUTURE DIRECTIONS AND CHALLENGES

When it comes to protecting Minnesota's air, the MPCA's traditional role has been to implement federal and state air regulatory programs. This includes our on-going work permitting and inspecting facilities and active involvement with federal rules and programs addressing power plant emissions, regional haze, fine particles and mercury. Using these and clean energy production tools and programs have helped contribute to significant improvements in air quality in Minnesota and the United States over the past two decades despite increases in population, driving, energy consumption and economic growth. Recently established programs and regulations discussed in previous sections of this report should continue to maintain or improve air quality.

However, for some pollutants and sources the MPCA's traditional regulatory tools fall short. Rising emissions of certain unregulated compounds such as carbon dioxide are a concern. In recognition of this, the MPCA will develop new approaches and partnerships to support on-going work in the state. One example is the Next Generation Energy Initiative (see text box) recently announced by Governor Pawlenty to encourage more renewable energy use, increased energy conservation and decreased carbon emissions. The MPCA will be working with other departments to encourage and expedite the availability and use of renewable energy and to inform the state of our options for carbon reduction.

Opportunities for Renewable and Cleaner Energy Choices

Since the major source of air pollution is the burning of fossil fuels to generate energy, a main challenge is to reduce fossil fuel use. Conservation and increased efficiency are primary strategies. Therefore, MPCA is working to help ensure that more of our energy comes from clean, renewable, sustainable and carbon-neutral sources. This "green energy" includes the fuels that we burn in our vehicles, the types of vehicles we drive and the sources of our electricity.

The use of energy in Minnesota for transportation, electricity, heating and industrial processes has been steadily increasing since the mid 1980s and this increase is expected to continue into the foreseeable future. The current mix of energy sources in the state is dominated by coal, refined petroleum products and natural gas, which together account for about 85 percent of all energy used in Minnesota. The

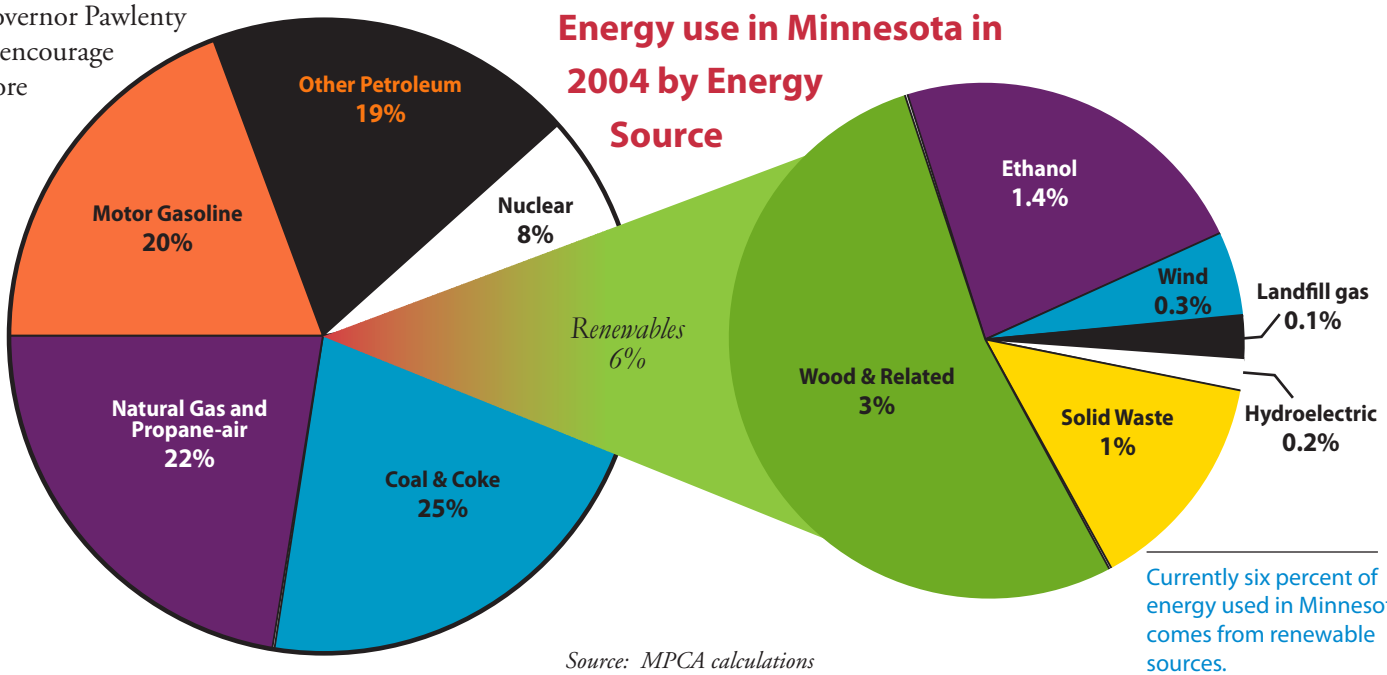
Next Generation Energy Initiative

In December 2006, the Pawlenty Administration's Next Generation Energy Initiative re-focused attention on energy issues. It proposes expanded conservation and renewable energy strategies to help reduce climate change. The Initiative outlines three major strategies.

- More Renewable Energy
- More Energy Conservation
- Fewer Carbon Emissions

For more information on the Next Generation Energy Initiative see the news release at **www.governor.state.mn.us/mediacenter/pressreleases/2006/december/PROD007863.html**

Energy use in Minnesota in 2004 by Energy Source



Source: MPCA calculations

Currently six percent of energy used in Minnesota comes from renewable sources.

production of electricity through nuclear power accounts for another eight percent of Minnesota energy use. Renewable sources of energy, such as ethanol, wind, biomass and hydro-electricity account for the remaining six percent of Minnesota's total energy use.

In 2006, the Pawlenty Administration adopted a renewable energy goal for Minnesota of 25 x'25 so that 25 percent of all types of our energy use come from renewable sources by 2025. This goal involves transitioning all sectors of Minnesota's economy: transportation, electricity, heating, and industrial processes, to renewable energy sources. If this goal is realized, most future growth in energy consumption in Minnesota would involve renewable energy, which would roughly have the effect of stabilizing Minnesota's CO_2 emissions near present levels.

To support the implementation of this goal, the MPCA is working closely with the Department of Commerce to effectively integrate energy and environmental management into one system.

Minnesota's Renewable Energy Objective (REO)

The legislature established a Renewable Energy Objective for electric utilities in the state to generate or procure electricity generated from renewable sources with the goal of achieving 10 percent by 2015. As part of the Next Generation Energy Initiative, it is proposed that 25 percent of the electricity Minnesotans use should come from renewable sources by 2025.

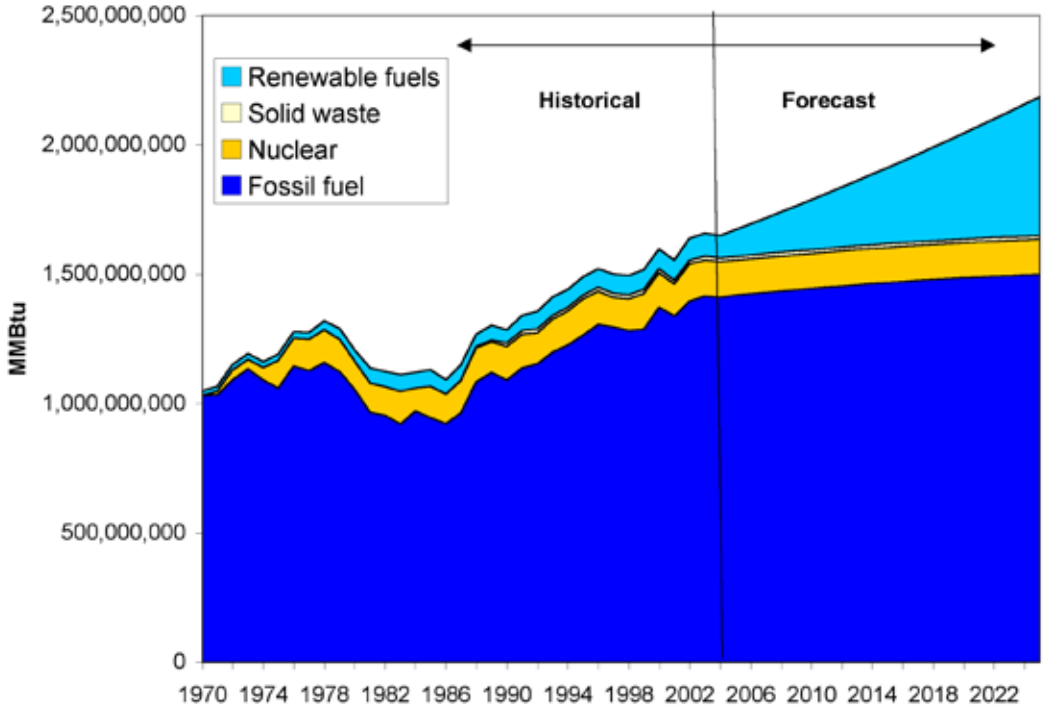
In 2004, five percent of the energy used to produce electricity in Minnesota was renewable in origin-primarily biomass, wind and hydroelectric generation. Fossil fuels (mostly coal) produce 70 percent of electricity in Minnesota, while 25 percent was produced from nuclear power.

The use of renewable energy sources to generate electricity in Minnesota has been increasing in recent years through the efforts of government, electric utilities and developers of renewable energy sources. For Xcel Energy, the state's largest utility, specific mandates apply.

Individual customers are also influencing this growth in renewable electricity production by directing their electric utility to supply all or a portion of their monthly electricity use from renewable or "green" sources.

For more information on the production and use of electricity from renewable energy sources in Minnesota, see the Minnesota Renewable Energy Web site at **search.state.mn.us/renewable** .

Source: MPCA calculatons



Minnesota State Energy Use: 25x25 Scenario

If the 25 percent renewables by 2025 goal is realized, most future growth in energy consumption would involve renewable energy, which would roughly have the effect of stabilizing Minnesota's CO_2 emissions near present levels.

Green Transportation Fuels

Reduced reliance on fossil fuels, particularly imported petroleum, is an important part of the Governor's energy strategy. Two renewable transportation fuels produced in Minnesota, ethanol and biodiesel, will play a key role in this transition.

Ethanol

Ethanol is a Minnesota-produced biofuel, most commonly produced by distilling corn. Ethanol yields at least 25[2,3] percent more energy than the energy invested in its production. It is currently blended into Minnesota's gasoline at about a ten percent rate to improve complete fuel combustion and reduce harmful tailpipe emissions such as carbon monoxide.

Ethanol is also blended into a fuel formulation called E85, which is a blend of 85 percent ethanol and just 15 percent petroleum. This fuel can be used by a growing number of vehicles called Flexible Fuel Vehicles (FFVs) designed to run on any blend of ethanol and gasoline, up to 85 percent ethanol.

Since E85 has a high oxygen content, it burns cleaner than petroleum based gasoline. E85 is expected to reduce ozone-forming tailpipe emissions by 15 percent[4] and greenhouse gas emissions by 16 to 33 percent depending on the process and fuel used at the plant.

More than 150,000 FFVs are registered in Minnesota, about 10 percent of all vehicles on the road. This number is expected to increase significantly in the next decade as vehicle manufacturers increase the number of models sold as FFVs.

Currently, Minnesota leads the nation with an E85 fueling network of 300 pumps in the state. As part of the Next Generation Energy Initiative, Governor Pawlenty proposed an *E85 Everywhere* program which would increase the number of E85 pumps in the state to 1800 by 2010. If 1800 E85 pumps were utilized in combination with the 10 percent ethanol contained in all Minnesota gasoline, Minnesota would be able to reach its goal that all non-diesel motor fuel sold in Minnesota collectively average 20 percent ethanol by 2013.

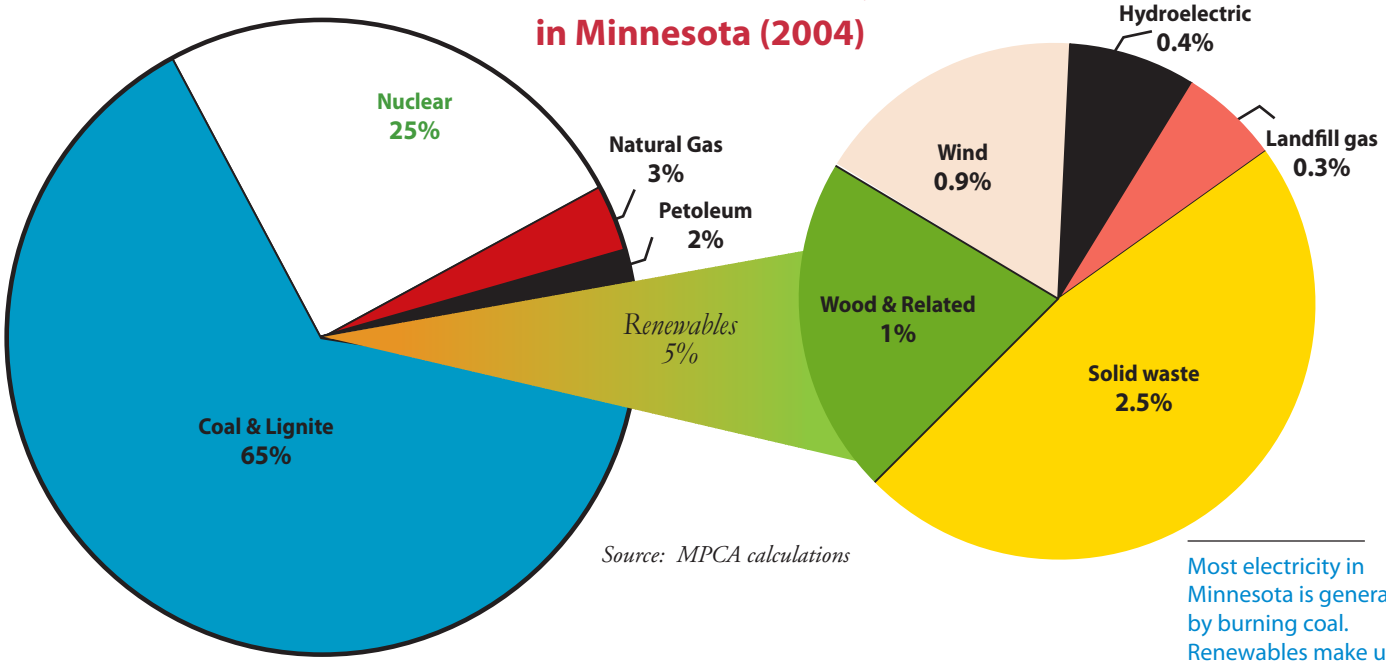
Minnesota State government is also increasing its use of renewable fuels by using E85 in its own flexible fuel vehicles. Executive Order 04-10, issued by the Governor in 2004, sets goals for reducing petroleum use in state vehicles to be reached in part by using E85. In the past year, use of E85 in state vehicles increased 65 percent compared to 2005 levels.

[2] Jason Hill, Erik Nelson, David Tilman, Stephen Polasky, and Douglas Tiffany *Environmental, Economic, and Energetic Costs And Benefits of Biodiesel and Ethanol Biofuels PNAS 2006, 103: 1120611210*

[3] United States Department of Energy, **www.eere.energy.gov/afdc/altfuel/eth_energy_bal.html**

[4] United States Environmental Protection Agency Fact Sheet, *Clean Alternative Fuels; Ethanol, March 2002, EPA400-f-00-035*

Sources of Electricity Generation in Minnesota (2004)



Source: MPCA calculations

Most electricity in Minnesota is generated by burning coal. Renewables make up five percent of electricity generation.

The MPCA refueled its FFVs approximately 50 percent of the time with E85, with greater use in the Twin Cities Metro area due to increased availability of the fuel.

For more information on E85 availability and FFVs, visit **cleanairchoice.org**.

Cellulosic Ethanol

Despite its benefits as a renewable, Minnesota-made fuel, there are several concerns regarding corn-based ethanol production. Ethanol production from corn uses significant amounts of water and agricultural chemicals such as nitrogen and phosphorus (in fertilizers) and pesticides which can cause soil and water pollution. In addition, corn is a food crop and competition between fuel and food supplies is a consideration.

While corn-based ethanol will continue to play an important role as a renewable fuel, it is time to begin moving to the next level of utilizing renewable biomass and transportation fuels.

In the short term, biomass, such as corn stalks, may become a replacement fuel for coal or natural gas which is currently used to power ethanol production facilities. Using biomass can raise the energy ratio for ethanol and help decrease emissions of CO_2.

The Governor's initiative stresses developing cellulosic ethanol which has fewer environmental impacts than ethanol made from corn, and has double the carbon dioxide reductions. Cellulosic ethanol can use non-row crops such as prairie grasses that require fewer or no pesticides or fertilizer and far less

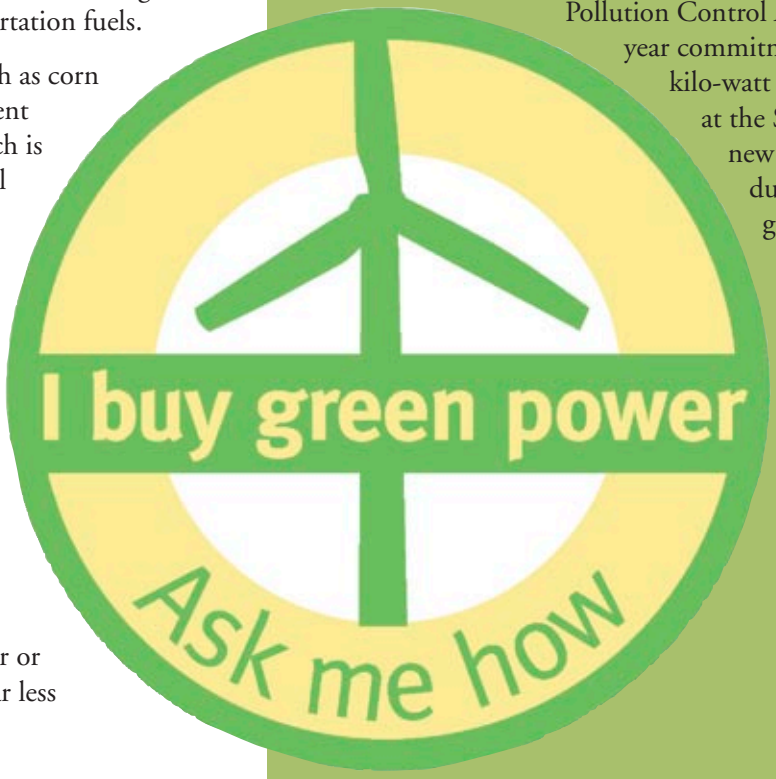
Buy Green Power Campaign

Recognizing that electricity production is a significant contributor to air pollution in Minnesota, the MPCA decided to support implementation of Minn. State law (§ 216B.169) that requires all public electrical utilities to offer their customers the opportunity to purchase renewable energy. During the past two years, the MPCA developed, tested and implemented a "Buy Green Power" campaign encouraging Minnesotans to participate in their utility's green power purchase program.

To date the campaign has resulted in over 3,000 new customers that have signed up or pledged to buy green power. The agency has documented purchases of 1,100 of those customers, which will result in the annual purchase of over four million kilo-watt hours of new green power (enough to build the equivalent of two new, utility-scale wind turbines) and prevent 3,732 tons of carbon dioxide, 22,455 pounds of sulfur dioxide, 16,165 pounds of nitrogen oxides and 81 grams of mercury.

To model environmental stewardship, the Minnesota Pollution Control Agency has made a three-year commitment to purchase 450,000 kilo-watt hours a year of green power at the St. Paul offices to match the new purchases of our employees during a staff challenge to buy green power.

For more information on the green power campaign, check the MPCA website at **www.moea.state.mn.us/energy/greenpower.cfm**.



water than corn. The plants themselves also help store carbon in the soil.

However, unlike the readily available sugars and starches found in corn, the energy in these plants is locked up in cellulose. Research is still underway to find affordable enzymes which will allow these sources to be an economical choice.

In the meantime, the MPCA continues to work to ensure that ethanol facilities in Minnesota provide this important bridge fuel while operating in an environmentally responsible manner. For more information on MPCA's work on ethanol, see our Web site at **www.pca.state.mn.us/programs/ethanol.html**.

Biodiesel

As of September 2005, Minnesota requires nearly all diesel fuel sold in the state to contain at least a two percent biodiesel blend. Biodiesel is a clean-burning alternative fuel produced from domestic, renewable resources. In Minnesota it is made primarily from soybean oil, but it can also be made from other vegetable oils, animal fats and spent cooking oil.

An EPA study[5] found that 20 percent biodiesel blended with 80 percent conventional diesel fuel (called B20) reduced total hydrocarbons by 21 percent, carbon monoxide 11 percent, and total particulate matter up to 10 percent.

Biodiesel yields at least 93 percent more energy than the energy invested in its production[6], the highest energy balance of any fuel. Therefore, biodiesel can also help meet goals for the net reduction of atmospheric carbon

Reduced Carbon Emissions

The main strategies for decreasing CO_2 emissions involve increased efficiency resulting in decreased energy usage and switching away from fossil fuels to renewable fuel choices. Governor Pawlenty is inviting the nationally recognized Center for Climate Strategies (**www.climatestrategies.us/**) to involve stakeholders and develop a plan to reduce greenhouse gases in Minnesota.

Another strategy that could help ameliorate climate change is terrestrial carbon sequestration. This is a process in which CO_2 is removed from the atmosphere through photosynthesis and stored in plant tissue and soils. To support terrestrial carbon sequestration, the MPCA is actively participating in research with the University of Minnesota on sequestration approaches and policies, as well as on the design of a long-term monitoring strategy for climate change in Minnesota.

In addition, the MPCA is participating in a national effort to design a voluntary U.S. greenhouse gas registry which would allow 'carbon credits' associated with terrestrial carbon sequestration to be sold by Minnesota farmers and landowners. Other options include the State of Minnesota joining the Chicago Climate Exchange or other existing greenhouse gas emissions registries.

[5] United States Environmental Protection Agency. 2002. *A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions: Draft Technical Report, EPA420-P-02-001.* **www.epa.gov/otaq/models/analysis/biodsl/p02001.pdf**.

[6] Jason Hill, Erik Nelson, David Tilman, Stephen Polasky, and Douglas Tiffany, *Environmental, Economic, and Energetic Costs and Benefits of Biodiesel and Ethanol Biofuels, PNAS 2006, 103: 11206-11210*

Eco Experience

Many of the air pollution issues in Minnesota are due to our choices in energy use. These choices, including electricity use, home heating, and transportation, are often driven by individuals. Therefore, the MPCA is working to educate and reach out to Minnesota citizens to help change their energy habits. A notable example of MPCA citizen outreach is the Eco Experience at the State Fair.

In 2006, the Minnesota State Fair and the MPCA worked in partnership with dozens of other organizations to present the first-ever Eco Experience building at the 2006 Minnesota State Fair. As the agency's largest single outreach event and a first of its kind in the country, it was a unique opportunity to present environmental messages to a broad cross-section of the state's population.

The Eco Experience was a huge success. The 25,000 square foot building drew 350,000 attendees during its 12-day run, and received tremendous levels of free media coverage much of which provided viewers and readers with specific activities they can do to protect the environment. Many of these actions, either by reducing energy use or directly reducing the burning of fossil fuels will have a positive impact on air quality.

For more information and details on the Eco Experience, visit **www.ecoexperience.org**.

The Minnesota State Fair and the MPCA worked in partnership to present the first-ever Eco Experience building at the 2006 Minnesota State Fair.

2007 Challenges and Opportunities

Through its regulatory functions and pollution reduction programs, the MPCA has successfully helped Minnesota meet federal air standards and decrease levels of toxic air pollutants. However, significant increases in population and subsequent increases in energy use continue to challenge our ability to maintain or decrease levels of regulated pollutants as well as confront the issue of climate change.

Energy production and usage are the primary sources of most air emissions in Minnesota including, carbon dioxide, fine particles and mercury. Therefore, MPCA will need to use tools such as education and partnerships as well as regulatory action to encourage conservation, efficiency and the use of cleaner, renewable energy sources. A switch to a more sustainable and carbon neutral economy and lifestyle will help ensure a healthier and more secure future for all Minnesotans.

Appendix A: Mercury Emissions Associated with Electricity Production and Consumption in Minnesota, 2004-2005

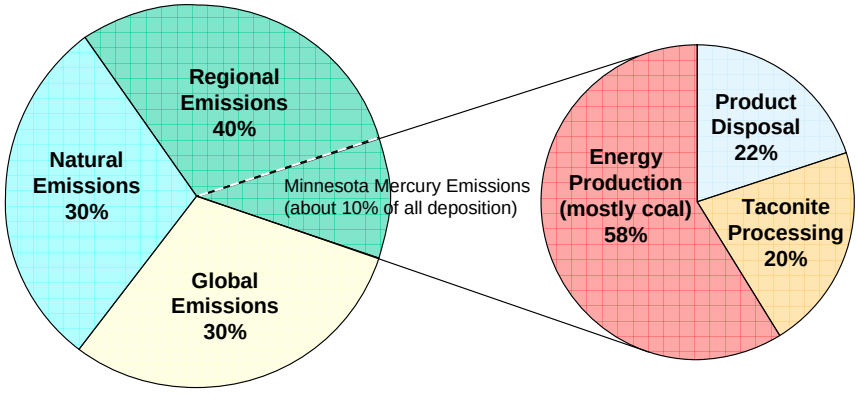
Introduction

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 a variety of other activities in Minnesota which are summarized below. The MPCA has historically considered mercury separately from other air pollutants because it is the subject of a special MPCA initiative with legislatively mandated reports in 2001 and 2005. For more information on mercury emissions, please see the 2005 Mercury Reduction Progress Report to the Legislature at http://www.pca.state.mn.us/air/mercury.html#publications

Background

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 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. These activities include the mining of mercury ores, the use of this mercury in products and manufacturing, and the incidental release of trace concentrations of mercury naturally present in coal, crude oil, and metal ores, such as taconite.

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.



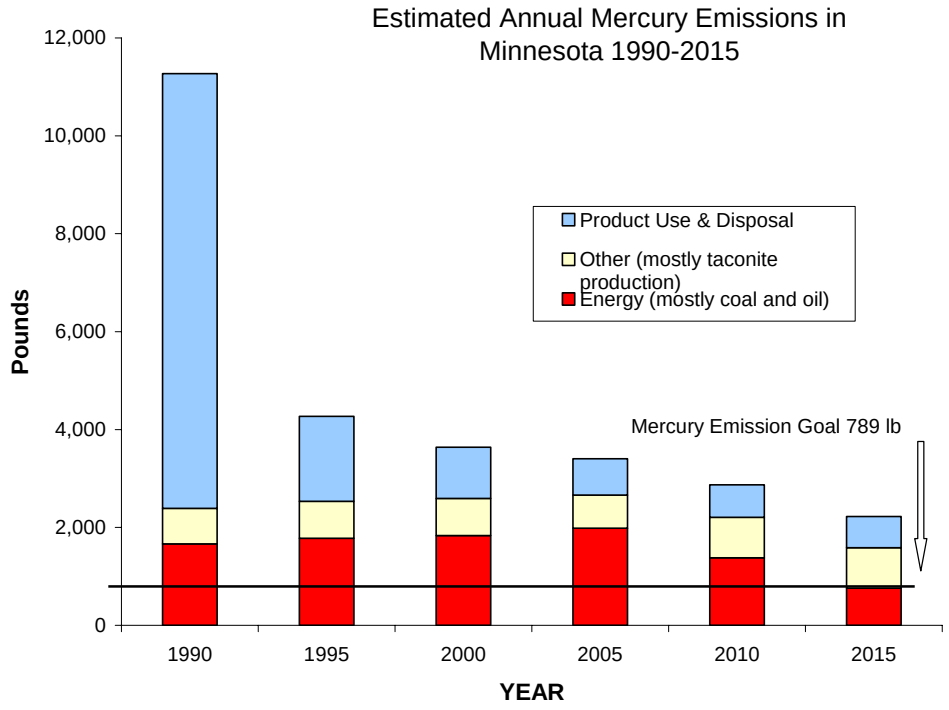
Sources of Atmospheric Deposition to Minnesota, 2005 Minnesota Emissions

Sources and Emissions

Mercury emitted to the atmosphere due to human activities is divided by the MPCA into three categories: (1) emissions incidental to energy production, (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.

Since 1990, the MPCA estimates that mercury emissions in the state have declined by about 70 percent. Most of this decline is due to reductions in releases of mercury in products. In 1990, emissions from products accounted for nearly 79 percent of emissions in the state. By 2005 product-related emissions had been reduced to only 22 percent, largely due to the removal of mercury from latex paint, batteries and pesticides. Emissions from the two other large sectors, taconite processing and coal fired electricity generation have changed little since 1990 and currently account for 20 and 58 percent of annual mercury emissions respectively. For more information on past and current mercury releases, see the MPCA's 2006 Mercury report to the legislature at http://www.pca.state.mn.us/air/mercury.html#reports.

To address the state's largest emissions sources, the Mercury Reduction Act of 2006 requires 3 large electric power plants in the state to reduce emissions by 90 percent by 2014. This will result in a decrease of about 1200 pounds from current levels. This reduction, added to cuts pledged at other coal-fired plants in the state, means that emissions in the state will continue to decline overall despite anticipated increases from new mining and power generation and increases from eclectic generation at remaining coal plants. Planning for these reductions is currently underway and decreases will begin as early as 2010. By 2015, the MPCA predicts that emissions will have declined about 80 percent from 1990 levels.



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 2004 and 2005 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 less than 150 British thermal units (Btu) per hour, 3) generation units with a maximum output of less than or equal to 15 megawatts, and 4) combustion facilities emitting less than three pounds of mercury in a given year. Therefore, generation facilities that do not emit any mercury, such as nuclear, wind, and hydro, are not reported here.

Although not required to annually report to the MPCA, this report does include some combustion facilities that emit less than three pounds because of excellent pollution control or because of the use of 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 the other. 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 about 60 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 for fuel. Some units are fueled by oil or natural gas.

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

Included in Table 2 are about 50 Minnesota distribution cooperatives, which 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 per megawatt-hour from each supplier (milligrams per megawatt-hour, mg/MWh) may vary because of varying amounts of electricity purchased from the grid and from the variable use of hydroelectric power by each distribution cooperative.

For 2004, facilities in Minnesota reported the emission of 1,793 pounds of mercury in the production of 37,495,502 megawatt hours (MWh) of electricity, an average release rate of 22 milligrams per megawatt hour (mg/MWh). For 2005, reported emissions decreased to 1,750 pounds in the production of 37,800,644 MWh, an average emission rate of 21 milligrams per MWh.

Reports of electricity consumed in Minnesota, but produced outside of Minnesota, in 2004 totaled 15,842,978 MWh associated with mercury-emitting facilities. These facilities emitted 1,179 pounds of mercury, for an average emission rate of 34 milligrams per MWh. Reports for 2005 were similar, totaling 16,524,481 MWh and 1,293 pounds of mercury emitted. The average emission rate for 2005 was 36 milligrams per 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 (34 to 36 mg/MWh) compared to Minnesota producers (21 to 22 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 2004, 2,959 pounds of mercury were reported as emitted in the production of 52,979,348 megawatt hours. In 2005, 3,024 pounds of mercury were reported as emitted in the production of 53,875,241 megawatt hours. A significant proportion of mercury emissions associated with Minnesota's electrical production and consumption occurred outside state borders; about 40% in 2004 and 43% in 2005.

Table 1. Reported 2004 and 2005 emissions of mercury from electrical production facilities in Minnesota.

Company	Generating Facility	Major Fuel Type(s)	2004 Electricity Produced (MWh)	2004 Mercury Emissions (lb)	2004 Mercury Emissions per Megawatt-hour (mg/MWh)	2005 Electricity Produced (MWh)	2005 Mercury Emissions (lb)	2005 Mercury Emissions per Megawatt-hour (mg/MWh)
Austin NE Power Plant	Unit 1	coal, gas	158,522	8.56	24	154,313	8.33	24
Covanta Hennepin Energy Resource Co	Unit 1	MSW[a]	130,336	27.02	94	132,091	5.36	18
Covanta Hennepin Energy Resource Co	Unit 2	MSW[a]	129,298	13.61	48	126,430	4.47	16
Great River Energy	Cambridge Station[c,d]	oil	532	0.00	0	341	0.00	0
Great River Energy	Elk River Station[c]	oil, gas, MSW[a]	212,071	2.40	5	215,736	2.15	5
Great River Energy	Lakefield Station [c]	oil, gas	146,362	0.01	0	331,349	0.02	0
Great River Energy	Maple Lake Station[c,d]	oil	401	0.00	3	240	0.00	5
Great River Energy	Pleasant Valley Station[c]	oil, gas	58,222	0.02	0	237,119	0.06	0
Great River Energy	Rock Lake Station[c,d]	oil	479	0.00	3	429	0.00	3
Great River Energy	St. Bonifacius Station[c]	oil	2,297	0.02	4	2,291	0.02	3
Hibbing Public Utilities	Unit 1A[h]	coal,oil	see unit 3A	2.10	exempt[g]	see unit 3A	2.21	exempt[g]
Hibbing Public Utilities	Unit 2A[h]	coal,oil	see unit 3A	0.89	exempt[g]	see unit 3A	1.67	exempt[g]
Hibbing Public Utilities	Unit 3A[h]	coal,oil	57,392	6.46	51	63,986	4.75	34
International Paper Sartell	BBC Turbine/Boiler	coal, oil, wood, sludge	90,526	9.09	46	94,489	5.93	28
Interstate Power and Light Company, Sherburn, MN	Fox lake Power Station #3[f]	oil, gas	48,341	6.70	63	62,554	0.40	exempt[g]
Minnesota Power(Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 1	coal, oil	463,099	27.00	26	558,811	22.00	18
Minnesota Power(Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 2	coal, oil	532,254	27.00	23	477,785	18.00	17
Minnesota Power(Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 3	coal, oil	570,542	22.00	17	460,621	17.00	17
Minnesota Power	Boswell Unit 1	coal	522,680	3.40	3	508,931	3.00	3
Minnesota Power	Boswell Unit 2	coal, oil	523,160	3.40	3	507,721	3.00	3
Minnesota Power	Boswell unit 3	coal, oil	2,818,211	109.00	18	2,486,714	90.00	16
Minnesota Power	Boswell Unit 4[e]	coal, oil	3,029,905	135.00	20	4,365,221	184.00	19
Minnesota Power	Hibbard 3-4	coal, gas	82,567	5.10	28	87,805	6.00	31
Minnesota Power	Laskin Unit 1 & 2	coal, oil	690,878	18.00	12	765,623	21.00	12
Minnesota Power (Rapids Energy Center)	Rapids Energy Center 5-6	coal, wood	NA	1.80	exempt[g]	NA	1.80	exempt[g]
Northshore Mining Company	Silver Bay Power Plant PB 1[c]	coal, oil, gas	309,941	1.40	2	335,695	1.30	2
Northshore Mining Company	Silver Bay Power Plant PB 2[c]	coal, gas	478,107	1.90	2	474,778	1.70	2

Company	Generating Facility	Major Fuel Type(s)	2004 Electricity Produced (MWh)	2004 Mercury Emissions (lb)	2004 Mercury Emissions per Megawatt-hour (mg/MWh)	2005 Electricity Produced (MWh)	2005 Mercury Emissions (lb)	2005 Mercury Emissions per Megawatt-hour (mg/MWh)
NSP dba Xcel Energy	AS King 1	coal, gas, petroleum coke	3,085,970	66.20	10	2,796,588	60.60	10
NSP dba Xcel Energy	Black Dog 3	coal, gas	518,740	23.80	21	520,519	32.20	28
NSP dba Xcel Energy	Black Dog 4	coal, gas	1,034,320	44.60	20	1,165,666	65.10	25
NSP dba Xcel Energy	Black Dog 5[c,d]	gas	368,362	0.00	0	373,347	0.00	0
NSP dba Xcel Energy	Blue Lake 1-4[c]	oil	5,342	0.04	3	17,787	0.16	4
NSP dba Xcel Energy	Blue Lake 7-8[c]	gas	NA	NA	NA	120,173	0.00	0
NSP dba Xcel Energy	Granite City 1-4[c]	oil, gas	14,234	0.01	0	678	0.00	0
NSP dba Xcel Energy	High Bridge 5	coal, gas	588,959	28.20	22	489,977	23.10	21
NSP dba Xcel Energy	High Bridge 6	coal, gas	926,613	39.30	19	875,626	36.60	19
NSP dba Xcel Energy	Inver Hills 1-6[c]	oil, gas	55,156	0.14	1	78,558	0.04	0
NSP dba Xcel Energy	Key City 1-4[c,d]	gas	1,451	0.00	0	5,614	0.00	0
NSP dba Xcel Energy	Minnesota Valley 4[c,d]	coal, oil, gas	0	0.00	0	0	0.00	0
NSP dba Xcel Energy	Red Wing 1 Waste-to-Energy	gas, RDF[b]	54,997	5.20	43	51,155	5.30	47
NSP dba Xcel Energy	Red Wing 2 Waste-to-Energy	gas, RDF[b]	584,282	4.60	4	59,160	5.10	39
NSP dba Xcel Energy	Riverside 6/7	coal, oil, gas	758,828	37.60	22	917,505	45.50	22
NSP dba Xcel Energy	Riverside 8	coal, oil, coke	1,385,651	61.10	20	1,390,983	60.20	20
NSP dba Xcel Energy	Sherburne 1	coal, oil	4,437,353	294.80	30	4,972,513	333.70	30
NSP dba Xcel Energy	Sherburne 2	coal, oil	4,510,132	301.40	30	4,703,775	314.00	30
NSP dba Xcel Energy	Sherburne 3 (Xcel owned portion)	coal, oil	3,609,553	232.30	29	2,778,595	180.90	30
NSP dba Xcel Energy	Wilmarth 1 Waste-to-Energy	RDFb, gas	52,897	3.00	26	51,656	1.80	16
NSP dba Xcel Energy	Wilmarth 2 Waste-to-Energy[c]	RDFb, gas	53,954	1.50	13	53,770	1.80	15
NSP dba Xcel Energy	West Faribault 2-3[c,d]	gas	412	0.00	0	243	0.00	0
Otter Tail Power	Hoot Lake #2 & 3[i]	coal, oil	742,623	26.18	16	931,630	40.13	20
Rochester Public Utilities	Silver Lake 3	coal, gas	78,179	1.85	exempt[g]	71,641	1.39	exempt[g]
Rochester Public Utilities	Silver Lake 4	coal, gas	271,236	2.84	exempt[g]	190,909	1.68	exempt[g]
Rochester Public Utilities	Cascade Creek Station 1	oil, gas	50	0.01	exempt[g]	140	0.01	exempt[g]
Rochester Public Utilities	Cascade Creek Station 2-3	oil, gas	446	0.01	exempt[g]	616	0.01	exempt[g]
Sappi-Cloquet	Power Boiler 7[h]	oil, gas, wood	127,761	0.72	exempt[g]	128,074	0.72	exempt[g]
Sappi-Cloquet	Power Boiler 8[h]	gas	173,702	0.00	exempt[g]	177,173	0.00	exempt[g]
Sappi-Cloquet	Power Boiler 9[h]	oil, gas, wood	124,097	2.04	exempt[g]	101,221	3.05	14

Company	Generating Facility	Major Fuel Type(s)	2004 Electricity Produced (MWh)	2004 Mercury Emissions (lb)	2004 Mercury Emissions per Megawatt-hour (mg/MWh)	2005 Electricity Produced (MWh)	2005 Mercury Emissions (lb)	2005 Mercury Emissions per Megawatt-hour (mg/MWh)
Southern Minnesota Municipal Power Agency	Faribault Energy Park	oil, gas	NA	NA		250,699	0.01	exempt[g]
Southern Minnesota Municipal Power Agency	Sherburne 3 (SMMPA owned portion)	coal, oil	2,819,979	179.50	29	2,019,722	129.40	29
Southern Minnesota Municipal Power Agency	Minnesota River Station Combustion Turbine[d]	oil, gas	5174	0.00	exempt[g]	12,116	0.00	exempt[g]
Willmar Municipal Utilities	Boiler 3	coal, natural gas	48927	3.78	35	41,742	3.67	40
		Summary of Reports	**37,495,502**	**1,793**	**median = 18**	**37,800,644**	**1,750**	**median = 16**
			Total Reported 2004 Electricity Produced (MWh)	Total Reported 2004 Mercury Emissions (lb)	Median Reported 2004 Mercury Emissions per Megawatt-hour (mg/MWh)	Total Reported 2005 Electricity Produced (MWh)	Total Reported 2005 Mercury Emissions (lb)	Median Reported 2005 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 27 pounds of mercury in 2004 and 37 pounds mercury in 2005 associated with electricity sold out of state.
f 5.20% for 2004 and 5.14% for 2005 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
i 12.66 pounds of mercury in 2004 and 19.38 pounds mercury in 2005 associated with electricity sold out of state.

Table 2. Reported 2004 and 2005 emissions of mercury from electrical production facilities outside of Minnesota for which the electricity was likely consumed in Minnesota.

Company	Electrical Supplier*	Generating Facility	Major Fuel Type(s)	2004 Electricity Consumed in Minnesota (MWh)	2004 Mercury Emissions (lb)	2004 Mercury Emissions per Megawatt-hour (mg/MWh)	2005 Electricity Consumed in Minnesota (MWh)	2005 Mercury Emissions (lb)	2005 Mercury Emissions per Megawatt-hour (mg/MWh)
Interstate Power and Light Company, Dubuque, IA (Alliant Energy)		Dubuque 1, Dubuque IA	coal, nat gas	8,802	0.13	7	18	0.11	2690
Interstate Power and Light Company, Dubuque, IA (Alliant Energy)		Dubuque 5, Dubuque IA	coal, nat gas	7,988	0.12	7	8,551	0.20	11
Interstate Power and Light Company, Dubuque, IA (Alliant Energy)		Dubuque 6, Dubuque IA	coal, nat gas	547	0.02	17	9,312	0.01	0
Interstate Power and Light Company, Lansing, IA (Alliant Energy)		Lansing 3, Lansing IA	coal, oil	7,786	0.66	38	5,786	0.39	31
Interstate Power and Light Company, Lansing, IA (Alliant Energy)		Lansing 4, Lansing IA	coal, oil	66,895	5.63	38	67,490	4.62	31
Interstate Power and Light Company, Clinton, IA (Alliant Energy)		ML Kapp 2, Clinton IA	coal, gas	62,519	4.76	35	63,055	3.75	27
Interstate Power and Light Company, Louisa County, IA (Alliant Energy)		Louisa 1/Louisa Co. IA	coal, gas	21,618	1.33	28	9,479	0.54	26
Interstate Power and Light Company, Sioux City, IA (Alliant Energy)		Neal 3, Sioux City IA	coal, gas	45,557	2.85	28	55,988	3.28	27
Interstate Power and Light Company, Sioux City, IA (Alliant Energy)		Neal 4, Sioux City IA	coal, oil	65,224	3.94	27	54,210	2.86	24
Interstate Power and Light Company, Burlington, IA (Alliant Energy)		Burlington Station #1	coal, nat gas	61,339	4.91	36	58,637	5.21	40
Interstate Power and Light Company, Ottumwa, IA (Alliant Energy)		Ottumwa Station #1	coal, oil	105,477	12.79	55	76,735	9.24	55
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Prairie Creek Station #1a-2	coal, gas	69,981	16.00	104	3,347	0.96	130

Company	Electrical Supplier*	Generating Facility	Major Fuel Type(s)	2004 Electricity Consumed in Minnesota (MWh)	2004 Mercury Emissions (lb)	2004 Mercury Emissions per Megawatt-hour (mg/MWh)	2005 Electricity Consumed in Minnesota (MWh)	2005 Mercury Emissions (lb)	2005 Mercury Emissions per Megawatt-hour (mg/MWh)
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Prairie Creek Station #3	coal, oil, gas	4,790	0.80	76	5,084	0.91	81
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Prairie Creek Station #4	coal, gas	40,709	3.02	34	36,317	3.00	37
Interstate Power and Light Company, Marshalltown, IA (Alliant Energy)		Sutherland Station #1	coal, gas	9,704	0.85	40	7,892	0.59	34
Interstate Power and Light Company, Marshalltown, IA (Alliant Energy)		Sutherland Station #2	coal, gas	9,299	0.83	40	7,775	0.61	36
Interstate Power and Light Company, Marshalltown, IA (Alliant Energy)		Sutherland Station #3	coal, gas	26,312	1.73	30	20,900	1.21	26
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #2	coal, oil, gas	833	0.18	98	NA	NA	NA
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #3-4	coal, gas	1,298	0.22	77	555	0.16	130
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #5-6	coal, gas	NA	NA	NA	2,079	0.46	101
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #7-8	coal, gas	7,332	1.07	66	2,887	0.32	50
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #9-10	coal, gas	NA	NA	NA	2,624	0.65	113
Minnesota Power	Minnkota Power Coop.	Milton R. Young #2, Center, ND	lignite coal	2,005,776	322.00	73	2,268,397	318.00	64
Marshall Municipal Utilities	Heartland Power		sub coal	417,925	20.74	23	420,532	20.86	23
Marshall Municipal Utilities	Missouri River Energy		sub coal	37,575	1.86	23	52,637	2.61	23

Company	Electrical Supplier*	Generating Facility	Major Fuel Type(s)	2004 Electricity Consumed in Minnesota (MWh)	2004 Mercury Emissions (lb)	2004 Mercury Emissions per Megawatt-hour (mg/MWh)	2005 Electricity Consumed in Minnesota (MWh)	2005 Mercury Emissions (lb)	2005 Mercury Emissions per Megawatt-hour (mg/MWh)
Northern Municipal Power Agency, Thief River Falls	Minnkota Power Coop.	Milton R. Young #1, Center, ND	lignite coal	152,522	17.40	52	155,377	20.50	60
Northern Municipal Power Agency, Thief River Falls	Minnkota Power Coop.	Milton R. Young #2, Center, ND	lignite coal	66,259	7.50	51	74,523	10.80	66
Northern Municipal Power Agency, Thief River Falls	Minnkota Power Coop.	Coyote Station, Beulah, ND	lignite coal	73,876	6.00	37	76,672	7.50	44
							0	0.00	
People's Coop. Services	Dairyland Power Coop.	Alma 1-5	Bit/Sub Coal	38,578	1.35	16	36,401	1.22	15
People's Coop. Services	Dairyland Power Coop.	JP Madgett	Sub bituminous coal	84,019	3.28	18	96,846	8.31	39
People's Coop. Services	Dairyland Power Coop.	Genoa	Bit/Sub Coal	77,025	2.57	15	93,091	3.83	19
People's Coop. Services	Dairyland Power Coop., Great River Energy/G3	Great River Energy/G3	Bit/Sub Coal	514	0.02	18	221	0.01	21
People's Coop. Services	Dairyland Power Coop.	Seven Mile Creek	Landfill gas	NA	NA	NA	708	0.02	13
Tri-County Electric Coop.	Dairyland Power Coop.	Alma 1-5	Sub Coal	52,634	1.84	16	49,051	1.65	15
Tri-County Electric Coop.	Dairyland Power Coop.	JP Madgett	Bit/Sub coal	114,633	4.48	18	130,502	11.20	39
Tri-County Electric Coop.	Dairyland Power Coop.	Genoa	Bit/Sub Coal	105,090	3.51	15	125,443	5.16	19
Tri-County Electric Coop.	Dairyland Power Coop.	Great River Energy/G3	Bit/Sub Coal	702	0.02	13	297	0.01	15
Tri-County Electric Coop.	Dairyland Power Coop.	Seven Mile Creek	Landfill gas	NA	NA	NA	954	0.03	14
Freeborn-Mower Coop. Services	Dairyland Power Coop.	Alma 1-5	Bit/Sub Coal	29,123	1.02	16	27,986	0.94	15
Freeborn-Mower Coop. Services	Dairyland Power Coop.	JP Madgett	Sub bituminous coal	63,427	2.48	18	74,456	6.39	39
Freeborn-Mower Coop. Services	Dairyland Power Coop.	Genoa 3	Bit/Sub Coal	58,147	1.94	15	71,570	2.94	19
Freeborn-Mower Coop. Services	Dairyland Power Coop.	Great River Energy/G3	Bit/Sub Coal	388	0.01	12	170	0.01	27
Freeborn-Mower Coop. Services	Dairyland Power Coop.	Seven Mile Creek	Landfill gas	NA	NA	NA	544	0.02	17

Company	Electrical Supplier*	Generating Facility	Major Fuel Type(s)	2004 Electricity Consumed in Minnesota (MWh)	2004 Mercury Emissions (lb)	2004 Mercury Emissions per Megawatt-hour (mg/MWh)	2005 Electricity Consumed in Minnesota (MWh)	2005 Mercury Emissions (lb)	2005 Mercury Emissions per Megawatt-hour (mg/MWh)
Agralite Electric Coop.	Great River Energy		lignite coal	174,354	7.63	20	137,831	8.57	28
Arrowhead Electric Coop.	Great River Energy		lignite coal	65,318	3.73	26	64,585	4.01	28
Benco Electric Coop.	Great River Energy		lignite coal	25,624	14.88	263	267,335	16.61	28
Brown County Rural Electrical Ass'n	Great River Energy		lignite coal	117,010	5.07	20	91,348	5.68	28
Connexus Energy	Great River Energy		lignite coal	2,046,465	118.75	26	2,212,059	137.47	28
Coop. Light and Power	Great River Energy		lignite coal	88,577	5.14	26	91,493	5.69	28
Crow Wing Power	Great River Energy		lignite coal	492,777	28.60	26	528,276	32.83	28
Dakota Electric Ass'n	Great River Energy		lignite coal	1,692,159	98.19	26	1,815,739	112.84	28
East Central Energy	Great River Energy		lignite coal	843,567	48.95	26	888,545	55.22	28
Federated Rural Electric	Great River Energy		lignite coal	180,349	7.82	20	144,560	8.98	28
Goodhue County Coop. Electric Ass'n	Great River Energy		lignite coal	84,065	4.88	26	87,964	5.47	28
Itasca-Mantrap Co-op. Electrical Ass'n	Great River Energy		lignite coal	170,102	9.87	26	179,151	11.13	28
Kandiyohi Power Coop.	Great River Energy		lignite coal	141,110	6.35	20	115,245	7.16	28
Lake Country Power	Great River Energy		lignite coal	661,595	38.39	26	674,129	41.89	28
Lake Region Electric Coop.	Great River Energy		lignite coal	351,696	16.02	21	291,925	18.14	28
McLeod Coop. Power Ass'n	Great River Energy		lignite coal	156,058	8.46	25	156,093	9.70	28
Meeker Coop. Light & Power Ass'n	Great River Energy		lignite coal	150,983	7.49	23	135,852	8.44	28
Mille Lacs Electric Coop.	Great River Energy		lignite coal	185,320	10.75	26	193,508	12.03	28
Minnesota Valley Electric Coop.	Great River Energy		lignite coal	528,192	30.65	26	583,169	36.24	28
Nobles Electric Coop.	Great River Energy		lignite coal	147,041	5.54	17	102,269	6.36	28

Company	Electrical Supplier*	Generating Facility	Major Fuel Type(s)	2004 Electricity Consumed in Minnesota (MWh)	2004 Mercury Emissions (lb)	2004 Mercury Emissions per Megawatt-hour (mg/MWh)	2005 Electricity Consumed in Minnesota (MWh)	2005 Mercury Emissions (lb)	2005 Mercury Emissions per Megawatt-hour (mg/MWh)
North Itasca Electric Coop., Inc.	Great River Energy		lignite coal	49,661	2.43	22	51,409	2.72	24
Redwood Electric Coop.	Great River Energy		lignite coal	137,242	5.66	19	32,397	2.01	28
Runestone Electric Ass'n	Great River Energy		lignite coal	201,130	8.97	20	166,770	10.36	28
South Central Electric Ass'n	Great River Energy		lignite coal	137,242	5.66	19	130,230	8.09	28
Stearns Electric Ass'n	Great River Energy		lignite coal	370,868	18.87	23	353,107	21.94	28
Steele-Waseca Coop. Electric	Great River Energy		lignite coal	201,168	11.67	26	207,498	12.89	28
Todd-Wadena Electric Coop.	Great River Energy		lignite coal	153,370	7.14	21	129,556	8.05	28
Wright-Hennepin Coop. Electric Ass'n	Great River Energy		lignite coal	703,745	40.84	26	774,696	48.14	28
Clearwater-Polk Electric Coop.	Minnkota Power Coop.	Milton R. Young #1, Center, ND	lignite coal	27,344	3.10	51	31,193	4.10	60
Clearwater-Polk Electric Coop.	Minnkota Power Coop.	Milton R. Young #2, Center, ND	lignite coal	13,788	1.60	53	14,961	2.20	67
Clearwater-Polk Electric Coop.	Minnkota Power Coop.	Coyote Station, Beulah, ND	lignite coal	14,558	1.20	37	15,392	1.50	44
North Star Electric Coop.	Minnkota Power Coop.	Milton R. Young #1, Center, ND	lignite coal	49,917	5.70	52	49,574	6.50	59
North Star Electric Coop.	Minnkota Power Coop.	Milton R. Young #2, Center, ND	lignite coal	21,685	2.40	50	23,777	3.40	65
North Star Electric Coop.	Minnkota Power Coop.	Coyote Station, Beulah, ND	lignite coal	24,178	2.00	38	24,463	2.40	45
PKM Electric Coop.	Minnkota Power Coop.	Milton R. Young #1, Center, ND	lignite coal	36,290	4.10	51	39,500	5.20	60
PKM Electric Coop.	Minnkota Power Coop.	Milton R. Young #2, Center, ND	lignite coal	18,298	2.10	52	18,945	2.70	65
PKM Electric Coop.	Minnkota Power Coop.	Coyote Station, Beulah, ND	lignite coal	19,321	1.60	38	19,491	1.90	44
Red Lake Electric Coop.	Minnkota Power Coop.	Milton R. Young #1, Center, ND	lignite coal	49,380	5.60	51	50,074	6.60	60
Red Lake Electric Coop.	Minnkota Power Coop.	Milton R. Young #2, Center, ND	lignite coal	21,452	2.40	51	24,017	3.50	66
Red Lake Electric Coop.	Minnkota Power Coop.	Coyote Station, Beulah, ND	lignite coal	23,918	2.00	38	24,709	2.40	44

Company	Electrical Supplier*	Generating Facility	Major Fuel Type(s)	2004 Electricity Consumed in Minnesota (MWh)	2004 Mercury Emissions (lb)	2004 Mercury Emissions per Megawatt-hour (mg/MWh)	2005 Electricity Consumed in Minnesota (MWh)	2005 Mercury Emissions (lb)	2005 Mercury Emissions per Megawatt-hour (mg/MWh)
Red River Valley Coop. Power Ass'n	Minnkota Power Coop.	Milton R. Young #1, Center, ND	lignite coal	50,363	5.80	52	51,745	6.80	60
Red River Valley Coop. Power Ass'n	Minnkota Power Coop.	Milton R. Young #2, Center, ND	lignite coal	21,879	2.50	52	24,818	3.60	66
Red River Valley Coop. Power Ass'n	Minnkota Power Coop.	Coyote Station, Beulah, ND	lignite coal	24,394	2.00	37	25,534	2.50	44
Roseau Electric Coop.	Minnkota Power Coop.	Milton R. Young #1, Center, ND	lignite coal	68,760	7.90	52	68,400	9.00	60
Roseau Electric Coop.	Minnkota Power Coop.	Milton R. Young #2, Center, ND	lignite coal	29,871	3.40	52	32,806	4.80	66
Roseau Electric Coop.	Minnkota Power Coop.	Coyote Station, Beulah, ND	lignite coal	33,305	2.70	37	33,752	3.30	44
Wild Rice Electric Coop.	Minnkota Power Coop.	Milton R. Young #1, Center, ND	lignite coal	95,638	10.90	52	100,177	13.20	60
Wild Rice Electric Coop.	Minnkota Power Coop.	Milton R. Young #2, Center, ND	lignite coal	41,547	4.70	51	48,047	7.00	66
Wild Rice Electric Coop.	Minnkota Power Coop.	Coyote Station, Beulah, ND	lignite coal	46,323	3.80	37	49,433	4.80	44
Beltrami Electric Coop.	Minnkota Power Coop.	Milton R. Young #1, Center, ND	lignite coal	186,236	21.30	52	188,708	24.90	60
Beltrami Electric Coop.	Minnkota Power Coop.	Milton R. Young #2, Center, ND	lignite coal	80,904	9.10	51	90,509	13.10	66
Beltrami Electric Coop.	Minnkota Power Coop.	Coyote Station, Beulah, ND	lignite coal	90,206	7.40	37	93,119	9.10	44
Sioux Valley-Southwestern Electric Coop.[a]	L & O Electric (Puchases from Basin Elec.)		coal	63,791	3.57	25.40	56,701	3.75	30.01
Lyon-Lincoln Electric Coop.	East River Electric Power Coop.		lignite coal	56,372	2.70	22	59,768	2.87	22
Minnesota Valley Coop.. Light & Power Ass'n	Basin Electric		lignite coal	104,684	5.80	25	115,401	6.46	25
Traverse Electric Coop.	Basin Electric		lignite coal	27,444	1.32	22	29,238	1.40	22
Wright-Hennepin Coop. Electric Ass'n	Basin Electric		lignite coal	8,780	0.42	22	8,731	0.59	31
Renville Sibley Coop. Ass'n	East River Electric Power Coop.		lignite coal	101,663	4.88	22	107,987	5.18	22

Company	Electrical Supplier*	Generating Facility	Major Fuel Type(s)	2004 Electricity Consumed in Minnesota (MWh)	2004 Mercury Emissions (lb)	2004 Mercury Emissions per Megawatt-hour (mg/MWh)	2005 Electricity Consumed in Minnesota (MWh)	2005 Mercury Emissions (lb)	2005 Mercury Emissions per Megawatt-hour (mg/MWh)
Minnesota Valley Electric Coop.	Utilities Plus		lignite, sub coal	47,908	2.30	22	43,265	2.94	31
Stearns Electric Association	Utilities Plus		sub coal, lignite	26,280	1.26	22	46,492	1.77	17
Wright-Hennepin Coop. Electric Ass'n	Utilities Plus		lignite, sub coal	57,490	2.76	22	51,918	3.53	31
Willmar Municipal Utilities	Coal Creek, ND		sub coal				197,224	12.26	28
			Summary of Reports:	**15,842,978**	**1,179**	**median = 26**	**16,524,481**	**1,293**	**median = 28**
				Total Reported 2004 Electricity Produced (MWh)	Total Reported 2004 Mercury Emissions (lb)	Median Reported 2004 Mercury Emissions per Megawatt-hour (mg/MWh)	Total Reported 2005 Electricity Produced (MWh)	Total Reported 2005 Mercury Emissions (lb)	Median Reported 2005 Mercury Emissions per Megawatt-hour (mg/MWh)

Notes

NA Data was either not available or not submitted to MPCA

a Used Basin Electric lb Hg/MWh emission factor to calculate estimated emissions

* Electrical Supplier if not generated by the Reporting Company

Appendix B: Air Toxics Emissions Information

Introduction

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

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

Point Sources

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

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

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

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

Area Sources

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

Mobile Sources

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

The twenty eight vehicle types are described below.

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

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

There are also nine types of nonroad equipment, including:

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

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

Emissions

The MPCA staff attempted to estimate emissions for about 500 target compounds, including 188 Hazardous Air Pollutants listed by EPA, pollutants in the Great Lakes regional air toxics emission inventory project, and pollutants monitored in Minnesota's outdoor air. For a complete list of the compounds in the 2002 inventory go to: http://www.pca.state.mn.us/air/toxics/toxicsinventory.html. However, emissions data were only available for 257 of the targeted compounds. The 257 pollutants were categorized to 172 individual and grouped compounds. For example, chromium, strontium chromate, and zinc

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

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

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

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

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

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

Limitations and Uncertainties

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

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

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

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

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

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

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

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

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

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

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

Information

For more information about Minnesota's air toxics inventory and other information related to air toxics in Minnesota, visit this website:
http://www.pca.state.mn.us/air/toxics/toxicsinventory.html

Or contact:

Ms. Chun Yi Wu at 651-282-5855 or chun.yi.wu@pca.state.mn.us

References

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

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

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

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

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

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

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

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

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

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

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

* The following link will bring you to the EPA Documentation for the Final 2002 Point Source National Emissions Inventory.
ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/point/2002nei_final_point_source_documentation0206.pdf
DC = Department of Climatology, University of Minnesota. It provided heating degree days for adjusting the wood consumption.
DNR = Minnesota Department of Natural Resources
MD = Minnesota Department
NESHAP = National Emission Standards for Hazardous Air Pollutants
WWTIR = Wastewater Treatment Facilities Inventory Report

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Principal Category	Category	Emissions (lb)	Percent (%)
Grand Total		**1.62E+08**	**100**

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

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

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

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

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

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

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

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

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

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

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

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

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

Total emissions in 2002: 162 million pounds

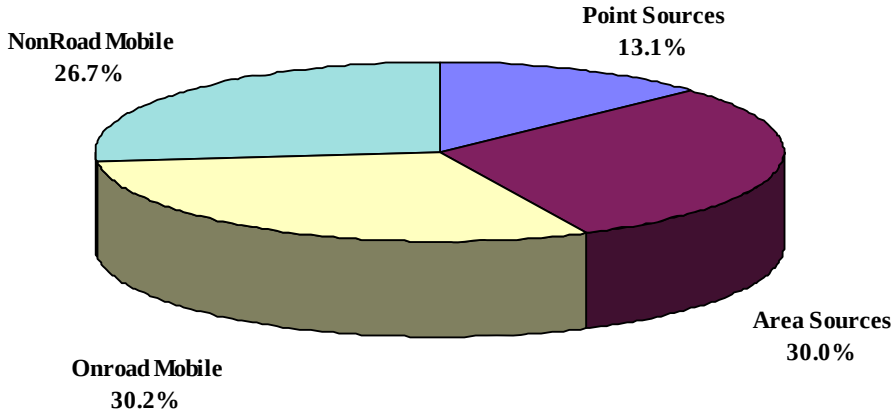


Figure 2. Contribution of top source categories to state total air toxics emissions

Total air toxics emissions: 162 million pounds

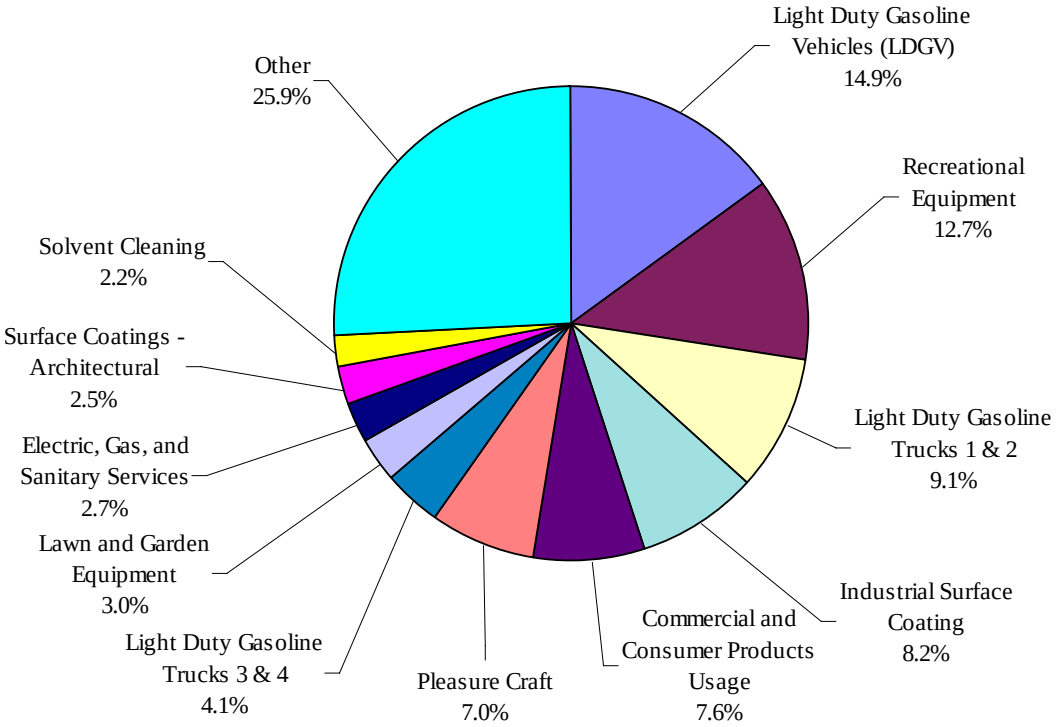


Figure 3. Contribution of top source categories to state total benzene emissions

Total air toxics emissions: 12.4 million pounds

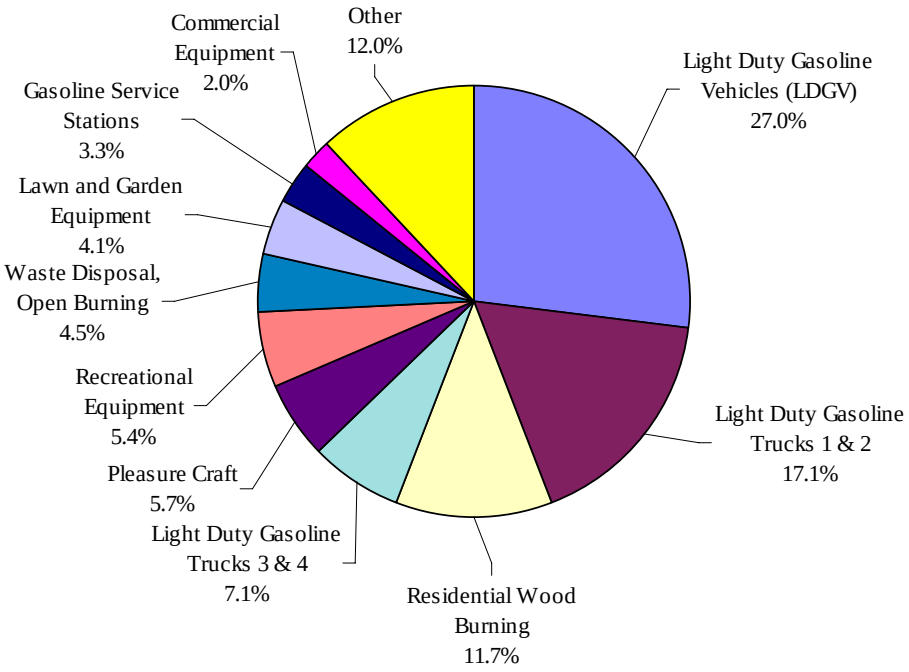


Figure 4. Contribution of top source categories to state total formaldehyde emissions

Total air toxics emissions: 6.49 million pounds

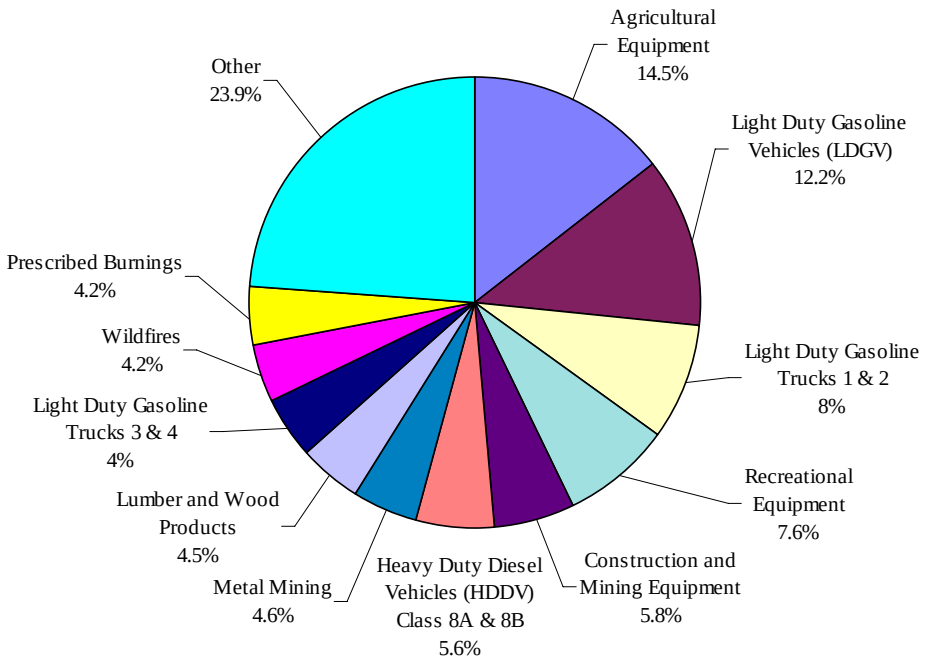


Figure 5. Responding status of large point sources with individual total facility permits.

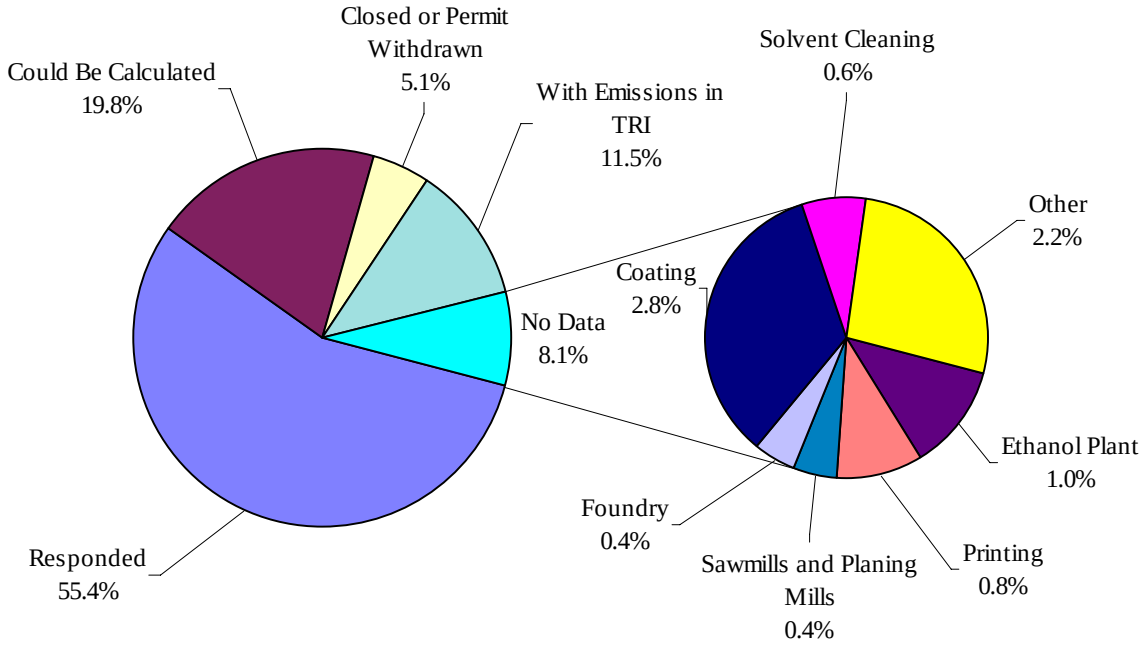


Figure 6. Number of pollutants inventoried with emission estimates.

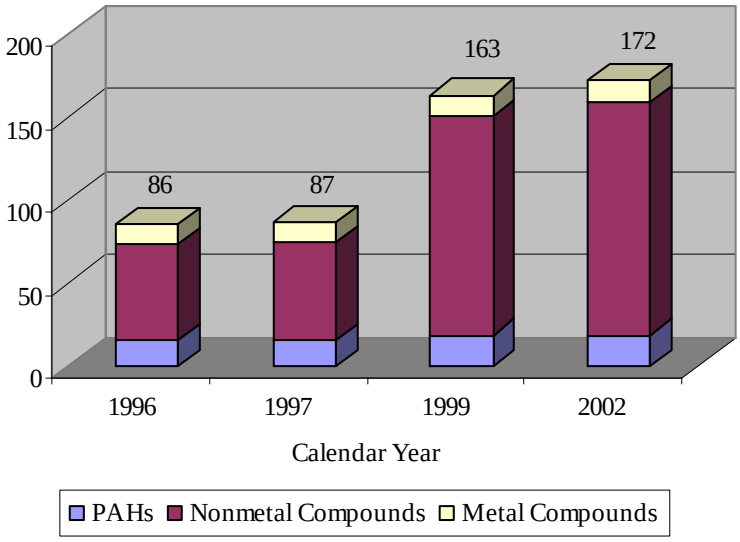

200
150
100
50
0
86
87
163
172
1996
1997
1999
2002
Calendar Year
PAHs
Nonmetal Compounds
Metal Compounds

Figure 7. Number of point sources with emission estimates.

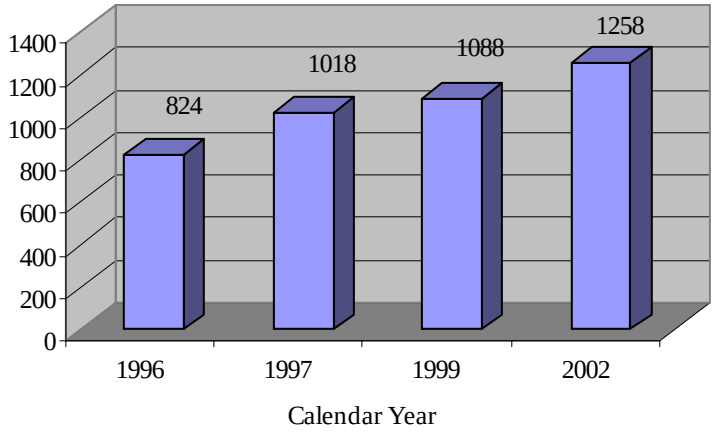


Figure 8. Number of area source categories included in inventories.