

Air Quality in Minnesota

2015 Report to the Legislature



Minnesota Pollution Control Agency

January 2015

Legislative charge

The Minnesota Pollution Control Agency has a statutory requirement (Minn. Stat. §115D.15 and §116.925) to report to the Minnesota Legislature biennially on the status of toxic air contaminants and the MPCA's strategies to reduce the emissions of air pollutants. The MPCA uses this report as an occasion to discuss the most pressing outdoor air quality issues facing Minnesota and to explore the opportunities available for emission reductions.

Authors

Cassie McMahon
Amanda Jarrett Smith

Contributors/acknowledgements

David Bael	Melissa Kuskie
Ned Brooks	Cassie McMahon
Peter Ciborowski	Catherine Neuschler
Anne Claflin	Tanya Maurice
Fran Crotty	Margaret McCourtney
Barbara Conti	Mike Nelson
Eric David	Rick Patraw
Mary Dymond	Kari Palmer
Kristie Ellickson	Rebecca Place
Mary Jean Fenske	Amanda Jarrett Smith
Jeffrey Hedman	Chuck Strobel (MDH)
Anna Henderson	Kelsey Suddard
Jim Kelly (MDH)	Mark Sulzbach
Frank Kohlasch	Brian Timerson
Azra Kovacevic	Linden Weiswerda (MDH)
Dorian Kvale	Mary Williams

Editing and graphic design

Scott Andre
Theresa Gaffey
Tanja Michels
Ralph Pribble
Cover photo courtesy *The Greenway Guy*

Estimated cost of preparing this report (as required by Minn. Stat. § 3.197)

Total staff time: 451 hrs.	\$21,000
Production/duplication	\$91
Total	\$21,091

The MPCA is reducing printing and mailing costs by using the Internet to distribute reports and information to a wider audience. Visit our website for more information.

MPCA reports are printed on 100% post-consumer recycled content paper manufactured without chlorine or chlorine derivatives.

Minnesota Pollution Control Agency

520 Lafayette Road North | Saint Paul, MN 55155-4194 | www.pca.state.mn.us | 651-296-6300

Toll free 800-657-3864 | TTY 651-282-5332

This report is available in alternative formats upon request, and online at www.pca.state.mn.us.

Document number: Iraq-1sy15

Contents

Air Quality in Minnesota: 2015	1
Why we care about air pollution	3
Clean air means healthier people	3
Clean air means healthier ecosystems	3
Clean air means a stronger economy	3
Understanding air pollution and health	5
Air pollution, human exposure, and health	5
Sources of air pollution in Minnesota	7
Air pollution and environmental justice	10
Costs of air pollution-related health effects	13
Progress toward meeting clean air goals	14
Goal: Minnesota’s outdoor air is healthy for all to breathe	14
Goal: Minnesota reduces its contribution to regional, national, and global air pollution	18
Actions to meet clean air goals	24
Traditional stationary sources	24
Nonpoint sources	26
Mobile sources	28
Wood smoke	30
New and continuing challenges	31
Changing federal standards	31
Silica sand	32
Ultrafine particles	34
Conclusion	34
Appendix A: Mercury emissions associated with electricity production and consumption in Minnesota, 2007-2011	35
End notes	40

Summary

Report to the Legislature

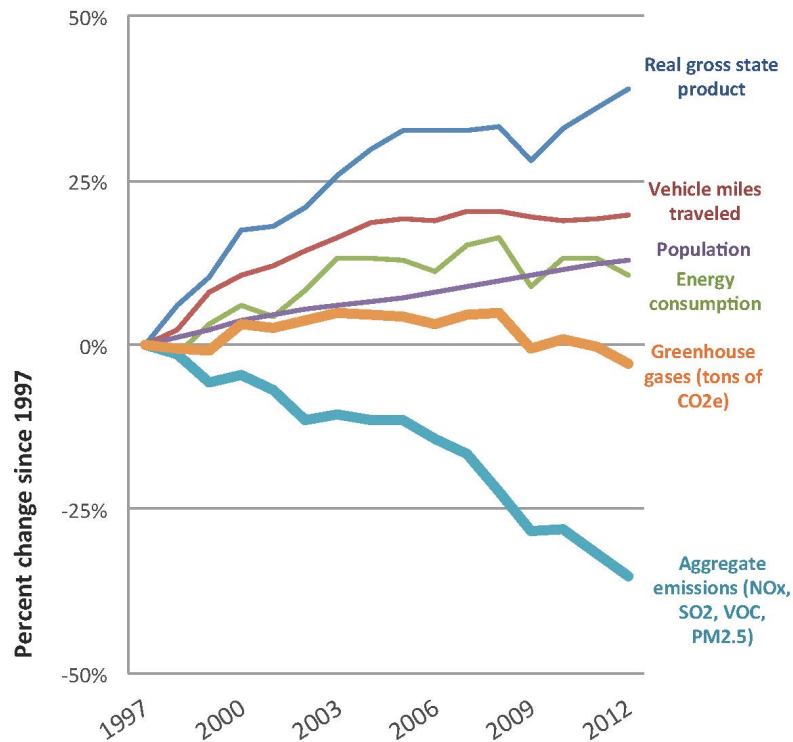
Air Quality in Minnesota: 2015

What is the issue?

Overall air quality in Minnesota has improved over the past 20 years, but current levels of air pollution still contribute to health impacts.

The economic cost of health effects associated with exposure to current levels of air pollution in Minnesota may exceed \$30 billion every year.
Report page 13.

Comparison of growth areas and emissions in Minnesota



Minnesota's air quality is improving despite increases in population and economic activity.

Sources: Bureau of Economic Analysis, U.S. Federal Highway Administration, MPCA Greenhouse Gas Inventory, State Demographers Office, MPCA Emissions Inventory

How are we doing?



Clean air supports healthier people, healthier ecosystems, and a stronger economy. Minnesota is ranked among areas with the best air quality across the country and the world, and the state's families, businesses, and visitors expect the air to be clean and clear.

Over the last two decades, Minnesota has successfully reduced the level of unhealthy air pollutants across the state. Report pages 14-23.

These air quality improvements have been driven by strong regulatory compliance, innovations in pollution control technology, voluntary emissions reductions programs, and actions citizens have taken to reduce our individual contributions to air pollution where we live, work, and play. Report pages 24-30.

Where are improvements needed?

We must continue to reduce air pollution in Minnesota.

- Advancing science shows that current levels of air pollution are impacting the health of Minnesotans. Report pages 5-9.
- Evidence suggests that, compared to higher-income and white Minnesotans, people of color and lower-income Minnesotans may be exposed to higher levels of air pollution and are likely more vulnerable to health impacts related to air pollution. Report pages 10-12.
- As federal standards are strengthened, Minnesota becomes less likely to meet the revised standards. Report page 31.

We must do more to reduce emissions from non-permitted sources.

- Point sources that are traditionally regulated, such as factories and power plants, are becoming a smaller part of Minnesota's air concerns. These sources now contribute to just over 25% of all air pollution emissions in the state. Report page 7.
- The majority of the air pollutants of most concern today come from smaller, widespread sources that are not regulated in the way power plants and factories are. These nonpoint sources include cars, trucks, construction equipment, residential wood burning, and residential garbage burning. These sources contribute to nearly 75% of air pollution emissions in the state. Report page 7.
- Traditional regulatory tools, like air quality permits, are effective at reducing air pollution from factories and power plants, but are less effective at reducing pollution from nonpoint sources. Future air pollution reductions will require new innovations, partnerships, and strategies. Report pages 24-30.

Full report

Air Quality in Minnesota: 2015 Report to the Legislature is available at www.pca.state.mn.us/yhizb6a

Contact

David Thornton, Assistant Commissioner
j.david.thornton@state.mn.us
651-757-2018

Why we care about air pollution

Clean air means healthier people

Air pollution affects all Minnesotans. Scientists are finding that lower and lower concentrations of air pollutants can still harm people and the environment, and that for some pollutants there may not be a safe threshold.

Breathing in air pollution can cause a range of problems, from itchy throats and burning eyes, to triggering asthma and bronchitis attacks. It contributes to cancer, heart attacks, other serious illnesses, and premature death. Young children may be more susceptible to health problems from air pollution because of their small size and rapid breathing. The elderly and people with heart and lung conditions are also at increased risk of harm from air pollution. Even healthy, athletic adults can be harmed by breathing air pollutants, especially when exercising outdoors on days with high pollution levels.

And breathing in air pollution is not the only way Minnesotans are affected. Mercury, for example, settles out of the air into Minnesota's lakes and streams, where it can accumulate in fish. Elevated mercury levels in the environment contribute to elevated blood mercury levels in pregnant women, which put newborns at risk of experiencing deficits to learning later in life.

Clean air means healthier ecosystems

Air pollution affects the ecosystems that Minnesotans value. Pollutants in Minnesota's air reduce visibility, creating a haze that can affect scenic views in pristine places such as the Boundary Waters Canoe Area and Voyageurs National Park, as well as in the state's urban areas.

Minnesota's lakes and streams can be harmed by air pollution that causes acid rain, and fish can be affected by mercury that settles out of the air and into the water. In addition, emissions of greenhouse gases, such as carbon dioxide and methane, contribute to climate change, which will cause significant changes to Minnesota's ecosystems in the years to come.

Clean air means a stronger economy

Cleaner air and a growing economy can go hand in hand. Since the Clean Air Act was passed in 1970, emissions of common air pollutants in the U.S. have dropped 68 percent while the U.S. gross domestic product has grown 212 percent and total private sector jobs have increased by 68 percent.ⁱ

Improving air quality is not without costs. As air quality standards are lowered, Minnesota is increasingly at risk for not meeting the strengthened standards. Not meeting the standards will introduce more stringent pollution control requirements, which will increase costs for businesses in the state. These costs vary widely depending on the pollutant, the type of control equipment needed, and how much pollution reduction is necessary. In 2012, Environmental Initiative updated a 1999 study commissioned by the Minnesota Chamber of Commerce to estimate the economic impact of violating the ozone standard in the Twin Cities. Using information from similar efforts in Milwaukee, the study estimated the annual costs of the necessary emission reductions to be between \$189 and \$266 million.ⁱⁱ

However, as standards are lowered, regulators, regulated parties, and other stakeholders pay considerable attention to the costs and benefits of meeting the standards. In most instances, the benefits of meeting air quality standards outweigh the increased control costs. The money spent on reducing pollution in Minnesota often stays in Minnesota. Companies that design, build, install,

maintain, and operate pollution-reducing processes and equipment create thousands of high-paying green jobs in engineering, manufacturing, construction, materials, operation, and maintenance. In the 2014 Green Jobs Report, the Minnesota Department of Employment and Economic Development found that clean energy employment in Minnesota surged 78 percent between January 2000 and the first quarter of 2014, growing steadily through the recession.ⁱⁱⁱ Cleaner air also improves the health of Minnesotans, resulting in fewer missed work and school days and less spending on air pollution-related illness. The MPCA estimates that the overall economic cost of health effects associated with exposure to current levels of air pollution in Minnesota may exceed \$30 billion per year.

Understanding air pollution and health

Exposure to air pollution can cause many different health impacts, ranging from relatively minor annoyances such as coughing or itching eyes, to far more severe impacts such as emergency-room visits and hospital admissions, cancer, or even premature death. The direct impact of air pollution on health varies from person to person. Those with pre-existing heart or lung conditions, children, and the elderly are the most at risk from air pollution. Even healthy adults can be harmed by breathing in air pollution. The MPCA strives to ensure that the air is healthy to breathe for all Minnesotans.

Air pollution, human exposure, and health

With each breath, we take in a mixture of air pollutants coming from a variety of sources both near and far. On any given day, the types and amount of pollution we breathe vary by our location, the time of day, and even the weather. For most of us, our highest exposure to air pollution occurs near roadways, when we breathe emissions from cars and trucks. But we can also be exposed to higher levels of air pollution when we are near industrial facilities, gas stations, or even a neighbor's backyard fire.

For some air pollutants, health effects may only occur if you are exposed to a very high amount of a pollutant for a short period of time. For others, health effects may occur after being exposed to relatively small amounts of air pollution over a very long period of time. The MPCA works to ensure that air pollution levels in Minnesota are low enough to protect against health risks associated with both short- and long-term exposure to air pollution.

When might I be exposed to higher levels of air pollution?

Near sources



Air pollution levels are highest the closer you are to an emissions source. For most of us, our highest exposure to air pollution occurs near busy roadways.

Time of day



Fine particle levels are often highest in the morning, but can be elevated at any time of day.

Ozone is a summertime pollutant. Ozone levels are highest in the afternoon and evening.

Temperature



Fine particle levels often increase on unseasonably warm winter days.

Most unhealthy ozone days occur when day-time high temperatures exceed 90° F.

Stagnant weather



Minnesota's weather patterns usually help keep air pollution below unhealthy levels, but on days with fog, light winds, or temperature inversions, weather conditions can allow pollution to build to unhealthy levels.




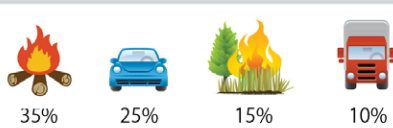


The Air Quality Index can help you reduce your exposure to unhealthy air











The Air Quality Index (AQI) provides real-time air quality information for areas across Minnesota and daily forecasts for the Twin Cities and Rochester. Similar to a weather report, Minnesotans can use the AQI to plan their activities to reduce their exposure to air pollution. With a new mobile app, twitter feed, and updated website, using Minnesota's AQI is now easier than ever. More at www.pca.state.mn.us/aqi.



Pollutants of concern and their sources

Air pollution is a complex mixture of many different gases and particles. Each individual air pollutant can affect health differently. Some pollutants affect our lungs or hearts, while others can contribute to developmental problems or increase our risk for developing cancer. The pollutants listed below contribute to the majority of air pollution-related health risks in Minnesota.¹

Pollutants	Sources ²	Potential health effects
Fine particles directly emitted from combustion sources ³	 35% 20% 15% 10%	Associated with serious health effects like heart attacks, acute and chronic bronchitis, asthma episodes, reduced lung function, and increased respiratory illness in young children. ⁴
Fine particles diesel exhaust	 40% 30% 10%	Aggravates allergies and asthma and can cause lung cancer with prolonged exposure
Nitrogen oxides (ozone ⁵ and fine particle precursor)	 30% 25% 10% 15%	Can worsen bronchitis, emphysema and asthma and increase risk of premature death from heart or lung disease
Polycyclic aromatic hydrocarbons	 35% 25% 15% 10%	Breathing air containing some PAHs can contribute to lung cancer or respiratory irritation. We can also be exposed to PAHs when air emissions of PAHs settle on the land or in the water and accumulate in the food chain.
Volatile organic compounds (ozone ⁵ precursor)	 25% 20% 20%	Short term exposure to high levels can result in eye, nose and throat irritation, headaches, nausea/vomiting, dizziness, and worsening of asthma symptoms. Long term exposure can contribute to cancer and can cause damage to the liver, kidney, or central nervous system.
Dioxins and furans	 60% ⁶ 25%	Potent carcinogens, cause the most harm by accumulating in meat, fish and dairy products. Especially harmful for pregnant women, nursing infants, children and the elderly.

 Construction and mining equipment	 Diesel on-road heavy-duty trucks, delivery trucks, buses	 Gasoline light-duty vehicles & trucks	 Recreational equipment and pleasure craft	 Agricultural equipment
 Point sources (emissions from facilities)	 Residential woodburning (wood stoves, boilers, campfires)	 Residential garbage burning (e.g. burn barrels)	 Prescribed fire and wildfire	 Solvent use (e.g. gas stations, autobody shops)

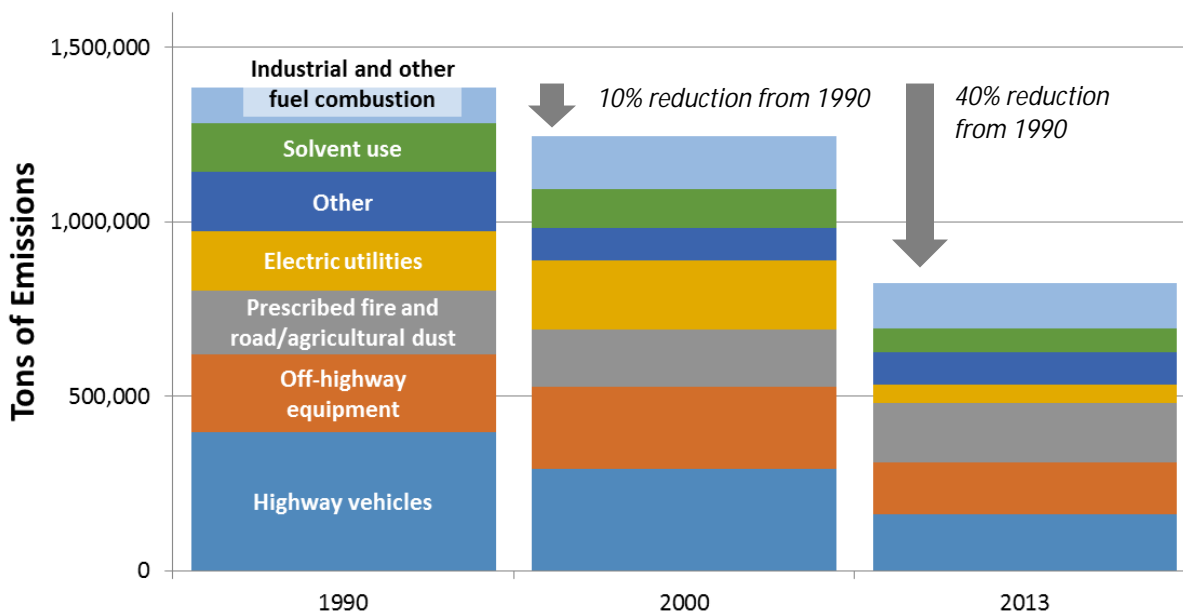
- Screening level modeling suggests that adverse effects from exposure to the included pollutants can be significant for more Minnesotans than other inventoried pollutants. This list does not include all pollutants that contribute to health risks. For example, exposure to pollutants such as lead and mercury can also result in significant health effects, especially to developing fetuses, infants, and children.
- From Minnesota's 2008 emissions inventory. Percentages indicate the approximate amount of total emissions of pollutants of concern emitted by primary source categories in Minnesota. For simplicity, sources contributing less than 10% are not listed. Results are rounded to the nearest 5%. Except for PAHs, emissions from wildfires, agricultural, and prescribed burning are not included.
- Sources shown here emit fine particles directly; a large amount of fine particles in Minnesota's air are formed indirectly in the atmosphere from reaction of gases.
- Fine particles are also of concern because levels in Minnesota are near federal air quality standards and particles can impact visibility in pristine areas.
- Ozone levels in Minnesota are near levels proposed for future federal air quality standards.
- Point-source dioxin/furan emissions are primarily from aluminum smelting and copper foundry furnaces.

Sources of air pollution in Minnesota

Typically when we think of sources of air pollution, we think about buildings with big smoke stacks like power plants and factories. Yet these sources make up a relatively small proportion of air pollution emissions in Minnesota. Today, the majority of air pollution comes from driving our cars, heating our homes and buildings, and using motorized equipment on our farms, construction sites, and backyards.

Over the last 20 years, as a result of controls put in place under the Clean Air Act, annual air pollution emissions in Minnesota have decreased by nearly 40 percent. Among all sources, the greatest emission reductions have been achieved by power plants, with emissions falling by nearly 70 percent between 1990 and 2013.

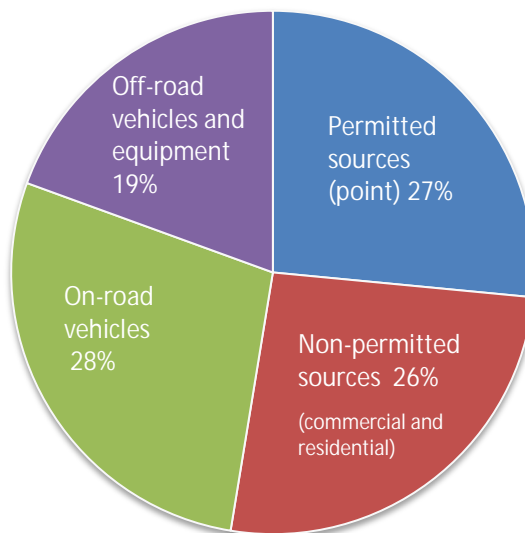
Trends in air pollution emissions by source category, 1990-2013^{iv}



Includes emissions of VOCs, SO₂, NO_x, and directly emitted fine particles (PM_{2.5})

Non-permitted sources are the largest emitters of air pollution in Minnesota

Minnesota's air emissions inventory shows that traditional permitted sources of air pollution only contribute about a quarter of the overall emissions of several of the regulated air pollutants of major concern in the state. The majority of air pollutants of most concern today come from smaller, more widespread sources that are not regulated in the way power plants and factories are.



Point sources are becoming a smaller part of the air quality problems in Minnesota.

MN 2008 Emissions Inventory: NO_x, SO_x, PM_{2.5}, VOCs

Non-permitted sources of air pollution include:



Onroad vehicles

On-road vehicles include passenger cars and trucks, semi-trucks, and buses. These sources contribute nearly 30 percent of statewide air pollution emissions. Within the Twin Cities metropolitan area, these sources contribute to an even larger fraction of overall air pollution emissions.

Off-road vehicles

Off-road vehicles include those vehicles used in construction and agriculture, yard and garden equipment, recreational vehicles, trains, planes, and boats. These sources make up about 20 percent of statewide air pollution emissions.



Residential and commercial

Residential sources of air pollution include home heating, garbage burning, and wood burning for heat or recreation.

Commercial sources of air pollution include gas stations, char-broilers, dry cleaners, and autobody shops.

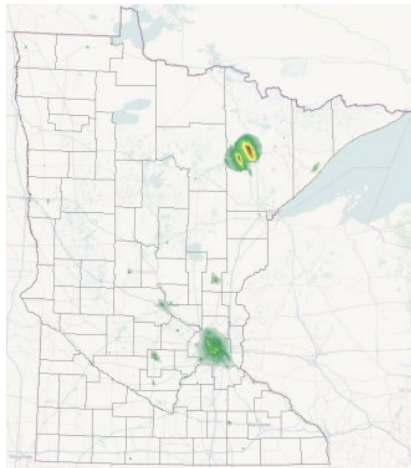
Combined, these sources contribute about 25 percent of statewide air pollution emissions.

Non-permitted sources contribute to the majority of air pollution exposures

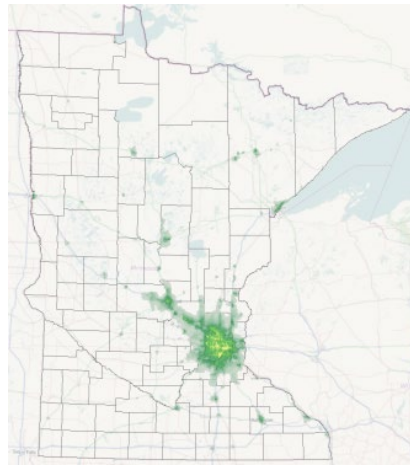
Results from the MPCA's MnRiskS model¹ suggest that the majority of risks from outdoor air pollution in Minnesota are due to air emissions from non-permitted sources. Higher levels of exposure to air pollutants can increase an individual's risk of developing an air pollution-related disease or health effect. In the Twin Cities metro area, the majority of health risks are driven by emissions from on- and off-road vehicles. In greater Minnesota, the majority of risks are due to emissions from residential, agricultural, or commercial sources. Reducing emissions from these sources will not only reduce air pollution, but will also improve the health of all Minnesotans.

Estimated exposure to air pollutants, by emissions source

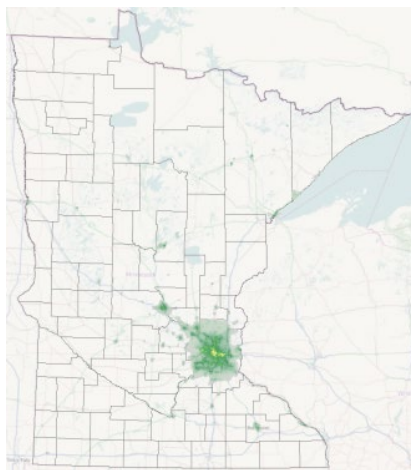
Facilities with permits



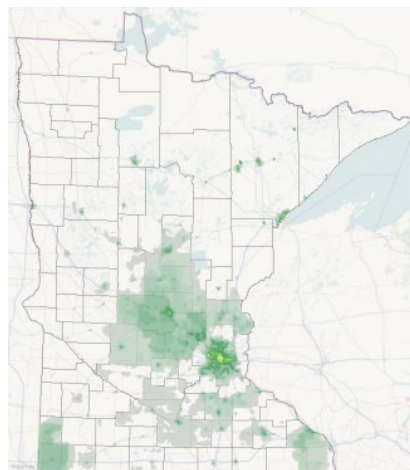
On-road vehicles



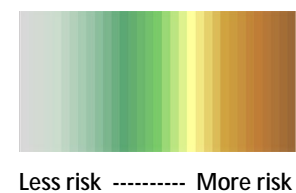
Off-road vehicles



Residential, commercial, and agricultural



These maps describe estimated non-cancer health risks from air pollutants released by permitted and non-permitted sources in Minnesota. Breathing air in areas of higher exposure over a lifetime may increase the risk of developing conditions that impact the heart, lungs, and nervous or reproductive systems. Exposure to air pollution is one of many factors including genetics, tobacco use, diet, occupation, and other environmental exposures that contribute to the risk of developing a disease or illness.



¹ The MnRiskS model is a comprehensive risk screening tool developed by the MPCA to estimate, analyze, and display human health risks from air pollution. MPCA and EPA inventories that quantify air pollution emissions from large industrial facilities, smaller stationary sources, on-road vehicles, and non-road sources such as recreational and construction equipment are used to model air concentrations, deposition, and resulting health risks.

Air pollution and environmental justice

The MPCA strives to ensure that pollution does not have a disproportionate impact on any group of people. This principle, often referred to as “environmental justice,” also compels the agency to actively seek the involvement of lower-income residents and communities of color in its decisions and actions that affect their communities.

Environmental justice concerns are multiple and complex. The MPCA is working to better understand how air pollution interacts with other factors to result in different health outcomes between white and higher-income Minnesotans and communities of color and residents of lower-income areas of the state. One of the challenges of this work is to understand the impacts of air pollution exposure in the context of different vulnerabilities among populations and individuals.

Many studies show that lower socio-economic status and minority populations are disproportionately exposed to air pollution and are more vulnerable to adverse health impacts. One recent study by University of Minnesota researchers reported that across the United States and in Minnesota, low-income and non-white populations are exposed to higher nitrogen dioxide levels than higher-income and white populations.^v

There is much still to learn about the interaction between air pollution and health inequities, but Minnesotans are experiencing these disparities every day. The MPCA is therefore increasing its efforts to better understand these complex issues and to actively promote environmental justice in Minnesota.

Actions to improve environmental equity

To address disparities in exposures to air pollution and related health effects, the MPCA is working with a variety of stakeholders and state, local, and national government partners to strive toward justice in services and outcomes. Areas that have larger proportions of lower-income residents or communities of color are considered potential areas of concern for environmental justice and are the focus of this work. The following sections highlight the MPCA’s efforts to better understand and ensure environmental justice.

Outreach and prevention work in environmental justice areas

In communities of potential concern for environmental justice, the MPCA is increasing outreach and assistance to reduce air pollution that could impact already overburdened areas. For example, the MPCA’s grant program to help small businesses reduce VOC emissions has been advertising its services through partnerships with ethnic newspapers and foreign-language media. The MPCA also participates in events and forums in communities presenting information about its work.

Minneapolis comprehensive air permitting pilot project

The MPCA has started a pilot project to experiment with a more comprehensive and proactive approach to issuing air quality permits in the downtown Minneapolis area.

Air quality permits address emissions from facilities individually. In recognition of the potentially cumulative impact of neighboring sources of air pollution, the MPCA is working with 10 to 15 facilities in or near downtown Minneapolis to better understand their impact on air quality in the urban core. Through this process, the MPCA will engage industry and the community to identify options for reducing air pollution.

Urban Air Quality and Respiratory Health Joint Initiative

The 2013 Minnesota Legislature provided funding for an Urban Air Quality and Respiratory Health Initiative. Through this initiative, the MPCA and the Minnesota Department of Health (MDH) are collaborating to provide communities with data-driven information about the impact of air pollution on their health. During the first half of 2015, the MPCA and MDH will release the following resources:

Twin Cities Air Pollution and Health Report

This report evaluates potential respiratory and cardiovascular health effects of baseline (2008) air pollution levels in the Twin Cities seven-county metro area. The report also estimates the potential health benefits associated with reducing air pollution.

The report includes:

- Estimated fine particle and ozone pollution levels for each ZIP code in the study area.
- Estimated health impacts resulting from baseline air pollution levels for each ZIP code.
- Predicted health improvements resulting from a 10 percent reduction in air pollution levels for each ZIP code.
- Estimated disparities in air pollution-related health impacts for Twin Cities demographic groups.

Community toolkit

The community toolkit will be primarily web-based and will help inform individuals and communities about how air quality in their neighborhoods may be affecting their respiratory and cardiovascular health. It will also provide resources and actions people can take to reduce negative health outcomes associated with air quality in their communities.

Health Impact Assessment

Health Impact Assessment (HIA) is a tool that can help residents and decision makers understand issues regarding air quality and health outcomes in their communities. Through a community-led process, this tool will help identify areas of concern to communities disproportionately burdened by poor air quality and health conditions. The HIA will help residents assess the current factors affecting local health outcomes, and outline possible strategies for improving the health and environment of their communities.

Community Air Monitoring Project

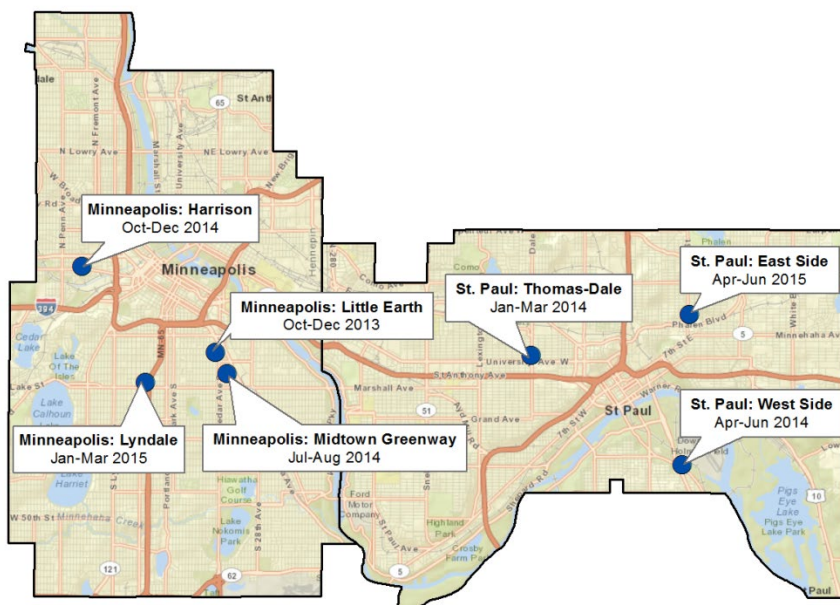
With funding from the 2013 Minnesota Legislature, the MPCA is conducting a two-year air quality monitoring project to measure whether low-income communities or communities of color are disproportionately impacted by air pollution emissions from highways, air traffic, or industrial sources.

Project goals

- Monitor levels of fine particles and air toxics^{vi} in seven communities selected based on criteria identified in the legislation.
- Compare the results to air pollution levels measured at existing air monitoring sites.
- Share the results with legislators, neighborhood groups, and the general public.



Community Air Monitoring Project monitoring sites



- Communities were chosen based on criteria identified in the funding legislation.
- The monitor location within each community was selected based on community input and the ability to meet monitor siting requirements.
- Each participating community is monitored for about three months, after which the equipment moves to the next community site.

Initial findings

In the communities where the MPCA has monitored and analyzed results, the majority of air pollution levels are similar to existing MPCA air monitoring sites in the Twin Cities metropolitan area. Fine particle ($PM_{2.5}$) levels are slightly higher at community monitoring sites compared to existing sites, but do not exceed health-based air quality standards. The MPCA is evaluating why $PM_{2.5}$ levels are higher at these sites. The location of the monitors at ground level, compared to traditional sites which are located on rooftops, may be contributing to the higher values. More detailed results from the project are available on the Community Air Monitoring Project website, www.pca.state.mn.us/9xc4ahc.

Costs of air pollution-related health effects

The MPCA estimates that the overall economic cost of health effects associated with exposure to current levels of air pollution in Minnesota may exceed \$30 billion per year. These estimates include direct health-care costs to deal with respiratory and cardiovascular health impacts of air pollution; lost productivity and earnings from missed work days; and estimated values of what people are willing to pay to reduce the risk of various health impacts related to air pollution, including premature death. These findings are consistent with nationwide studies by the EPA that have estimated that the economic value of the health impacts of air pollution across the nation exceeds \$1 trillion every year.^{vii}

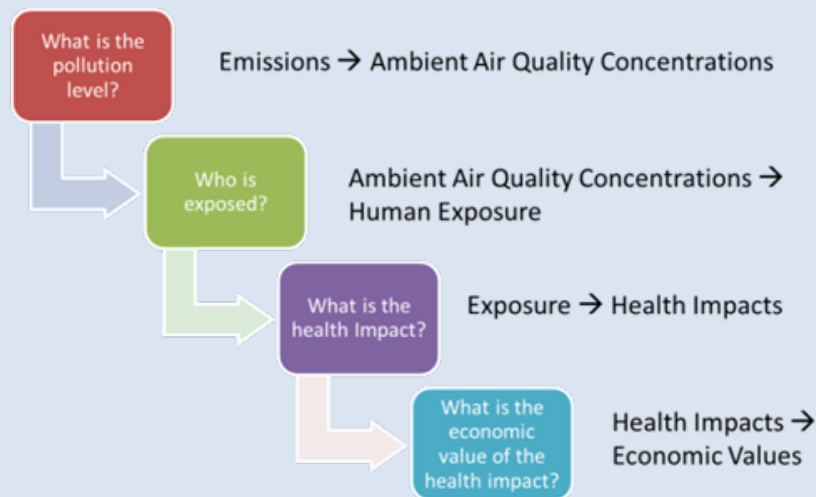
Estimated annual incidence and costs of air pollution related health effects in Minnesota

Category	Incidence	Value ¹
respiratory or cardiovascular symptoms	1,900,000	\$290,000,000
lost school or work days	333,000	\$46,000,000
premature death	3,800	\$34,000,000,000
non-fatal emergency room hospital visits	2,000	\$33,000,000

¹ Value estimates are based on health impact values established by the EPA.

How does the MPCA estimate the cost of air pollution-related health effects?

Air pollution, like other significant risk factors for poor health such as smoking and obesity, is rarely indicated in official records as the cause of an individual emergency room visit, hospital admission, or death. To estimate the cost of air pollution related health effects, the MPCA uses statistical models to apply research findings about the relationship between air pollution exposures and the risk of illnesses and death to actual rates of deaths and illnesses in Minnesota.



This process includes:

- Estimating current levels of air pollution for all areas of the state.
- Estimating air pollution exposure for all Minnesotans.
- Estimating the health impacts related to these exposures.
- Translating these health impacts into economic values.

Progress toward meeting clean air goals

The work of the MPCA's air programs is driven by the vision to ensure that Minnesota's clean and clear air supports healthy communities and a strong economy. To achieve that vision, the Agency has adopted clean air goals and objectives to focus its work and measure its progress.

Goal: Minnesota's outdoor air is healthy for all to breathe

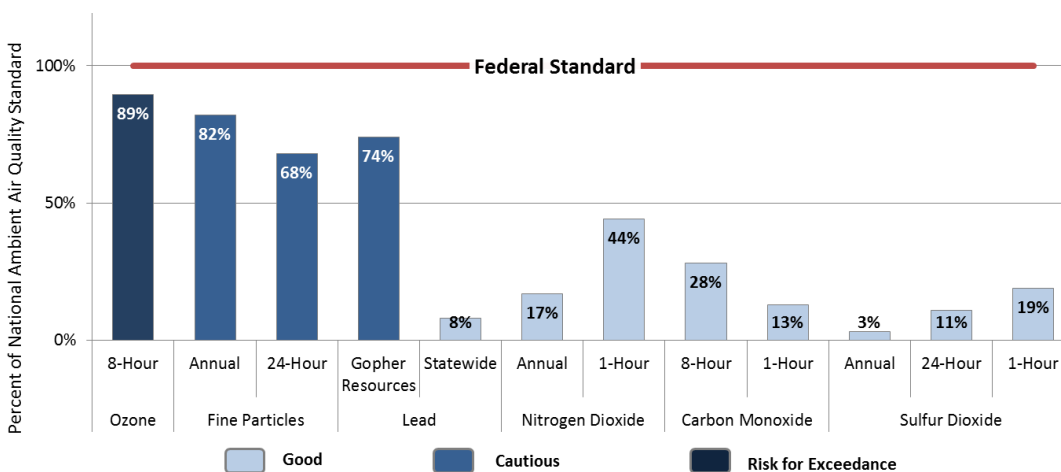
Access to clean and clear air is important for the health of all Minnesotans. The MPCA strives to ensure that outdoor air is healthy for all to breathe.

Objective: Minnesota's air is better than air quality standards

The federal Clean Air Act requires the EPA to set National Ambient Air Quality Standards for pollutants that are considered harmful to public health, and the environment. The EPA set standards for six common air pollutants — ozone, fine particles, lead, nitrogen dioxide, carbon monoxide, and sulfur dioxide. Every five years, the EPA is required to review the science related to the environmental and health impacts associated with these pollutants. If the body of scientific research indicates an existing standard is not protective, the EPA is required to strengthen the standard.

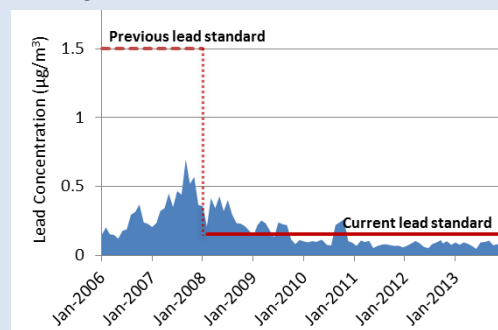
One of the MPCA's clean air goals is that Minnesota's air is better than air quality standards. To assess its progress toward meeting this goal, the MPCA monitors air pollution across the state and compares the results to these standards. In 2013, monitoring results in all areas of the state were better than air quality standards.

Minnesota's air quality compared to National Ambient Air Quality Standards (2013)



Gopher Resources reduces lead emissions in response to strengthened federal standard

In 2008, the EPA finalized a new lead standard that was 10 times stronger than the previous standard. Levels of lead in the air near Gopher Resources, a lead battery recycler in Eagan, were found to violate the strengthened standard. In response, Gopher Resources invested in new pollution control equipment to reduce lead emissions from the facility. As a result of these new controls, the lead level near Gopher Resources is now below the federal lead standard.



Targeting further reductions in ozone and fine particle pollution in Minnesota

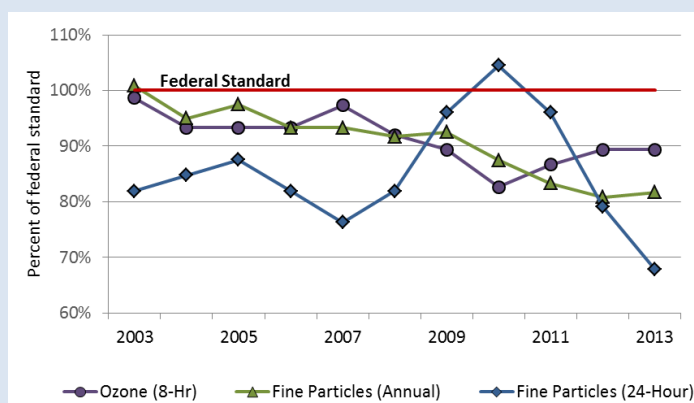
While all areas of the state currently meet federal air quality standards, the MPCA continues to focus on identifying new strategies to reduce ozone and fine particle pollution in Minnesota. In November 2014, the EPA proposed to lower the existing ozone standard. Depending on the final number selected in October 2015, Minnesota may violate the ozone standard for the first time. In addition, as was described in previous chapters, current levels of ozone and fine particle pollution result in a large number of health impacts across Minnesota. Continuing to reduce the level of these pollutants will not only improve public health, but will also help our economy by avoiding air pollution-related health costs like medical expenses and productivity losses due to missed school or work days.

Progress toward reducing ozone and fine particle pollution

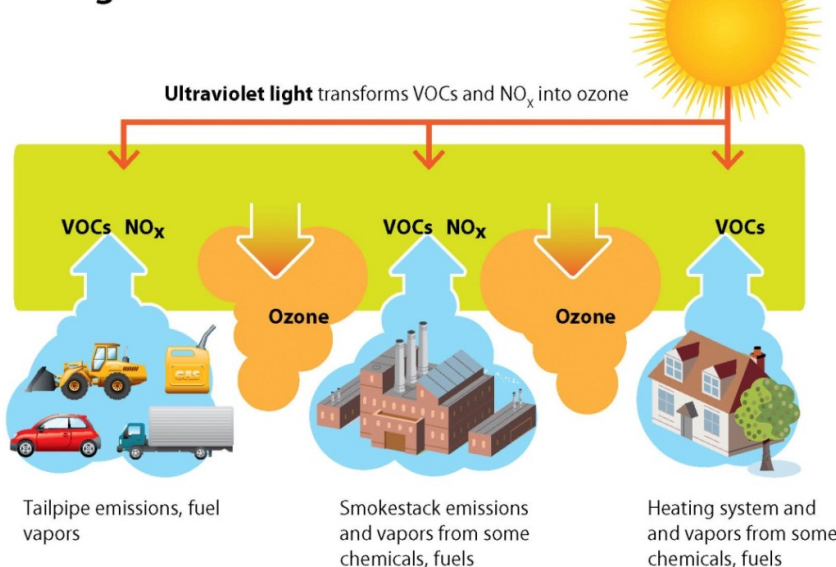
Ozone and fine particle pollution levels in Minnesota have been steadily improving since 2003. However, progress in reducing both pollutants has been affected by year-to-year variability in the weather.

- Between 2009 and 2011, daily fine particle levels increased due to more frequent stagnant weather conditions caused by a southerly shift of the jet stream. In recent years, with a more northerly jet stream, daily fine particle levels have fallen dramatically.
- Since 2011, there has been little improvement in ozone pollution. This may be due to more frequent days with temperatures greater than 90°F. Hot temperatures and sunshine are key ingredients in the formation of ozone.

Trends in ozone and fine particle pollution levels (2003-2013)



How ground-level ozone forms



Pollutants called VOCs and NO_x mix in the air and then are transformed by UV light into ground-level ozone. High levels of ozone are harmful to humans, especially those with respiratory health issues. Temperature, wind and amount of sunshine are important variables: hot, sunny days often produce higher levels of ground-level ozone.

Where fine particles come from

PM_{2.5} can be emitted directly or formed in the air from gases. On a typical day, roughly half of the PM_{2.5} in urban air is directly emitted from combustion sources as soot and the other half is formed from chemical reactions in the air. Particle pollution varies by time of year and location, and is affected by changes in weather such as temperature, humidity, and wind, which can transport PM_{2.5} thousands of miles from where it was formed. Episodes of PM_{2.5} pollution can result from high-pressure weather systems that are often combined with temperature inversion conditions and low wind speeds.

Indirect particle sources



Indirect particle formation
(chemical and condensation process)

Fine particle pollution

Direct particle sources

Particles from diesel, gasoline, and wood burning emissions

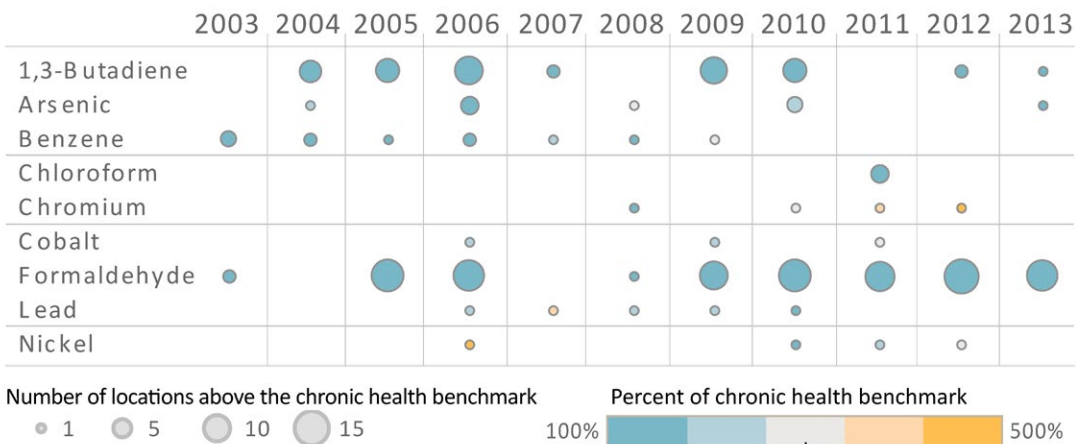


Objective: Minnesota's air is better than air toxics health benchmarks

The term, "air toxics" refers to a group of over 100 air pollutants that cause or may cause cancer or other serious health effects. Nationally, there are no enforceable regulatory standards for air toxics in the environment. Minnesota relies on guidelines called health benchmarks to assess health risks associated with toxic pollutants in the air.

The MPCA works to ensure that concentrations of all air toxic pollutants in Minnesota are below health benchmarks. The MPCA monitors air toxics at nearly 20 locations in the state, with the majority of monitors located in the Twin Cities metro area. Each of these monitors measure over 70 air toxic pollutants. Over the last decade, nine air toxic pollutants have been measured at levels above a health benchmark (see graphic on next page). Most elevated air toxics concentrations are located near a specific source, such as a permitted facility. However, formaldehyde has and continues to be measured at levels above the health benchmark in areas across the Twin Cities metropolitan area.

Measured air toxics above chronic health benchmarks, 2003-2013



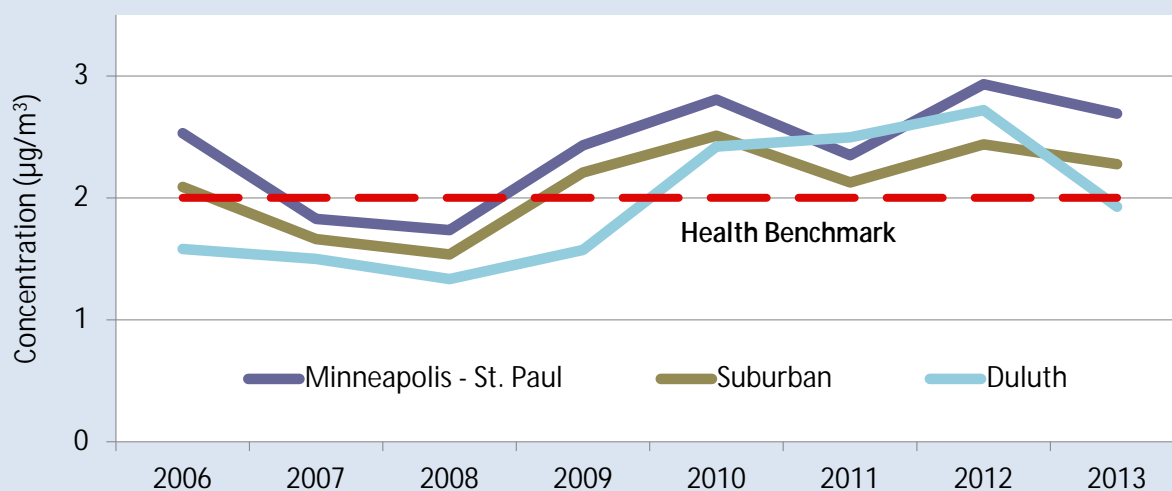
This chart describes air toxic pollutants that have been measured above a chronic health benchmark. The size of the circle represents the number of monitoring sites where the pollutant was measured above the benchmark. The color of the circle describes the measured air concentration as a percentage of the health benchmark.

Measured levels of formaldehyde are above the health benchmark

Formaldehyde is a common pollutant found in indoor and outdoor air. Formaldehyde is used in the production of particleboard and as an intermediary in the production of other chemicals. Formaldehyde is also produced in the environment when other pollutants react in the air. Exposure to high levels of formaldehyde can result in respiratory symptoms and eye, nose, and throat irritation.

Beginning in 2009, formaldehyde levels in Minnesota began to rise, and are currently above the chronic inhalation health benchmark. Similar to ozone pollution, formaldehyde levels rise on hot and sunny days. A recent study completed by students at Carleton College suggests that our recent string of warm summers may be contributing to the increase in formaldehyde pollution in the state. The MPCA is working to better understand what is causing the increase so that it can develop strategies to reduce formaldehyde pollution to levels below the health benchmark.

Annual average formaldehyde trends in Minnesota, 2006-2013

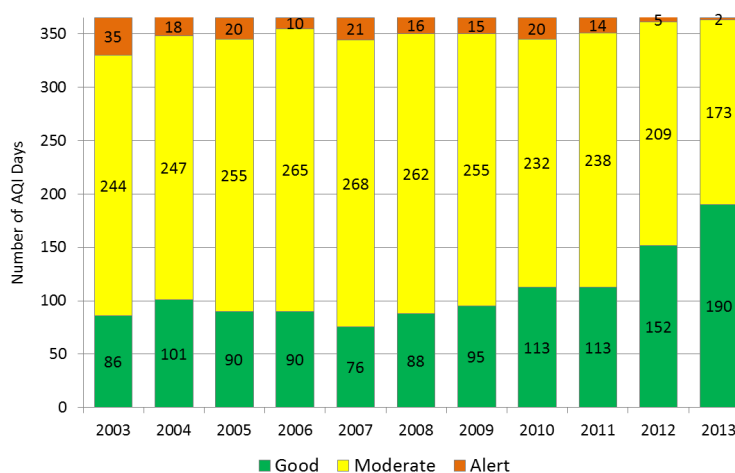


Objective: Minnesota reduces the number of days with poor air quality

On most days, air quality across Minnesota is healthy to breathe, but on several days each year pollutants such as ozone and fine particles can reach unhealthy levels. The MPCA uses the Air Quality Index to rank daily air quality. Air quality can be ranked as *good*, *moderate*, *unhealthy for sensitive groups*, or *unhealthy for everyone*. The MPCA issues an air pollution health alert when daily air quality reaches the *unhealthy for sensitive groups* ranking.

The statewide trend in Air Quality Index days shows improvements in air quality over time. Since 2003, the number of days with good air quality has nearly doubled. In 2003, air quality was considered good in all areas of the state on less than 25 percent of all days that year. In 2013, air quality was good in all areas of the state on more than 50 percent of all days.

Statewide trend in Air Quality Index days, 2003-2013



Goal: Minnesota reduces its contribution to regional, national, and global air pollution

The MPCA's Strategic Plan states that Minnesota will reduce its contribution to regional, national, and global air pollution. Since the passage of the Clean Air Act, state and federal regulatory programs have achieved significant reductions in air pollution emissions. Despite Minnesota's success, further reductions are needed to improve health and the environment. Today, the MPCA is focused on reducing emissions of mercury, greenhouse gases, and pollutants that contribute to regional haze. To achieve these goals, emissions reductions will be needed from both traditional permitted sources and smaller, more widespread sources such as vehicles, small businesses, and housing.

Objective: Minnesota reduces emissions from point sources

Today, much of the air pollution in Minnesota comes from cars, trucks, construction vehicles, and fuel combustion for things like home heating — sources over which the MPCA has little regulatory control. In contrast, the amount of air pollution coming from factories and electric utilities — sources with MPCA permits — has decreased significantly over the last 20 years. These reductions are largely due to government and industry efforts to reduce smokestack emissions.

Point source emissions 2002–2012



Objective: Minnesota reduces mercury emissions

In response to widespread mercury contamination of sport fish, the MPCA developed a statewide Total Maximum Daily Load (TMDL) for mercury. The TMDL establishes an estimate of the maximum amount of mercury that Minnesota's water bodies can receive and still meet water-quality standards. The goal of the mercury TMDL is to reduce Minnesota mercury emissions to 789 pounds annually by 2025.

Virtually all of the mercury in Minnesota's surface water is deposited from mercury pollution in the air. In Minnesota, the largest mercury emission sources are coal-fired power plants, taconite processing, and the use and disposal of mercury-containing products. To meet the statewide mercury TMDL, mercury emissions from man-made sources in Minnesota must be reduced by 93 percent compared to the 1990 baseline. National and international reductions will also be needed to meet the TMDL.

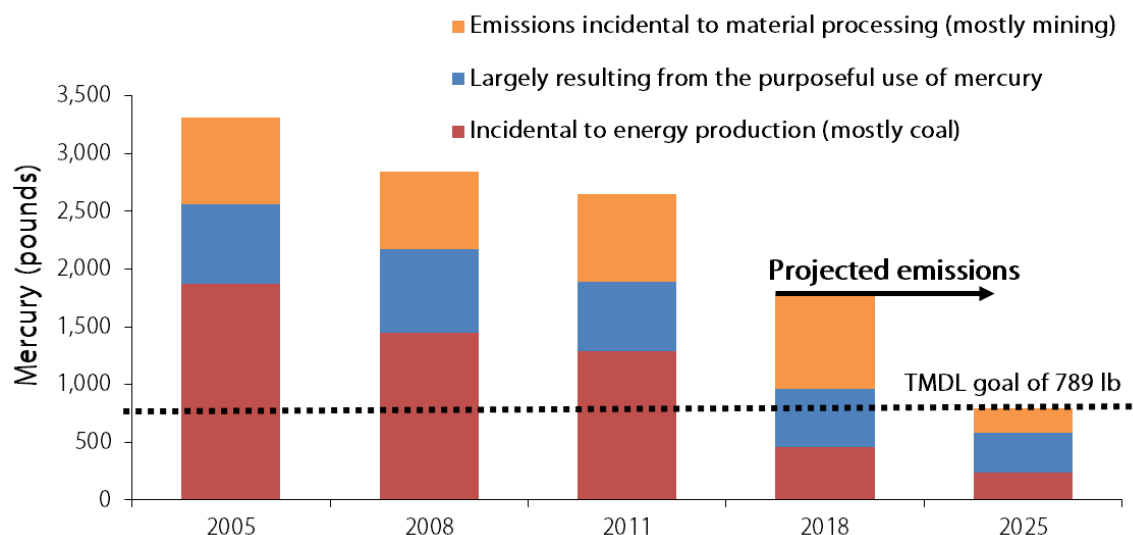
Coal-fired power plants

The mercury reductions called for in the Minnesota Mercury Emission Reduction Act of 2006 are contributing significantly to achieving the TMDL reduction goals for the electric utility sector. This law requires reductions from the state's three largest coal-burning power plants by the end of 2014. Recently adopted national emissions standards for mercury and air toxics from coal-fired utility boilers are also reducing mercury emissions. These two regulations have put Minnesota's utilities on track to achieve greater reductions than the goals set in the mercury TMDL implementation plan, and four or five years earlier than planned. The most recent complete emissions inventory year (2011), shows that mercury emissions from electric utilities have decreased to 660 pounds, down from 1,716 pounds in 2005.

Ferrous mining

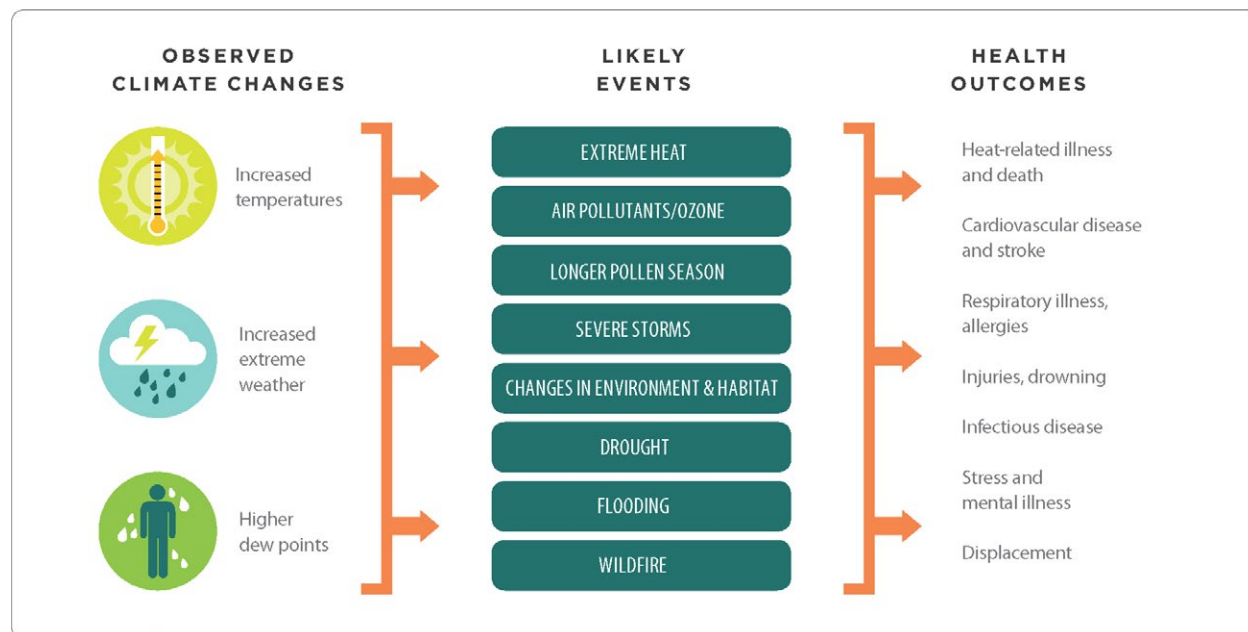
Mercury emissions from the ferrous mining sector have increased due to Mesabi Nugget running at commercial capacity. To meet the 2025 TMDL goal, Minnesota's taconite-processing industry is working to identify and test pollution-control technologies suited to its unique needs. Initial testing at operating taconite facilities in 2011 and 2012 identified methods that have the potential to control mercury to levels that will allow the industry to achieve its 72 percent reduction goal. Additional research is now underway on these and other mercury controls to evaluate their technical feasibility and any potential environmental, energy, and economic impacts.

Progress toward meeting the 2025 mercury TMDL goal



Objective: Minnesota reduces greenhouse gas emissions

Greenhouse gases (GHGs), such as carbon dioxide and methane contribute to climate change and may make the effects of other pollutants, such as ground-level ozone, worse. Scientists warn that changes are happening now. Climate trends include rising temperatures, extreme storms, and higher dew points—driving the frequency and intensity of extreme weather in Minnesota.



Source: *Minnesota and Climate Change Our Tomorrow Starts Today (2014)*

In 2007, the Minnesota Legislature enacted the Next Generation Energy Act. The act set statewide greenhouse gas (GHG) reduction goals of 15 percent below 2005 emissions by 2015, 30 percent below by 2025, and 80 percent below by 2050. Minnesota has also adopted one of the strongest renewable energy standards in the nation, which requires 25 percent of power consumed in Minnesota to come from renewable energy sources by 2025.

Next Generation Energy Act GHG emission reduction goals



Since the act was passed in 2007, Minnesota has made progress in establishing policies and programs to achieve the GHG reduction goals over the long term. Between 2005 and 2012, Minnesota GHG emissions declined by 7 percent. Without additional effort, Minnesota will not achieve the first Next Generation Energy Act milestone — a 15 percent reduction in GHG emissions by 2015.

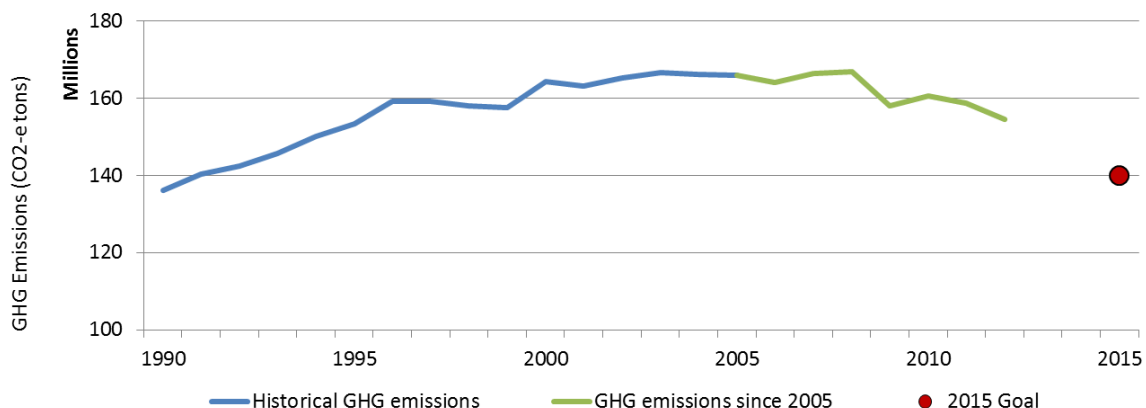
There is evidence of progress. Since 2005, GHG emissions from the electric utility sector have decreased by 17 percent due to reduced coal use². Coal is being replaced by increased use of renewable wind and solar and by switching to cleaner fuels such as natural gas. In less than one decade, the state's use of coal has dropped by 33 percent. Yet today, Minnesota still receives more than 55 percent of its

² The 17 percent reduction in electric utility sector emissions may be inflated due to Sherco being offline in 2012.

electricity from coal-fired power plants. The electric power sector remains the biggest emitter of GHG in the state.

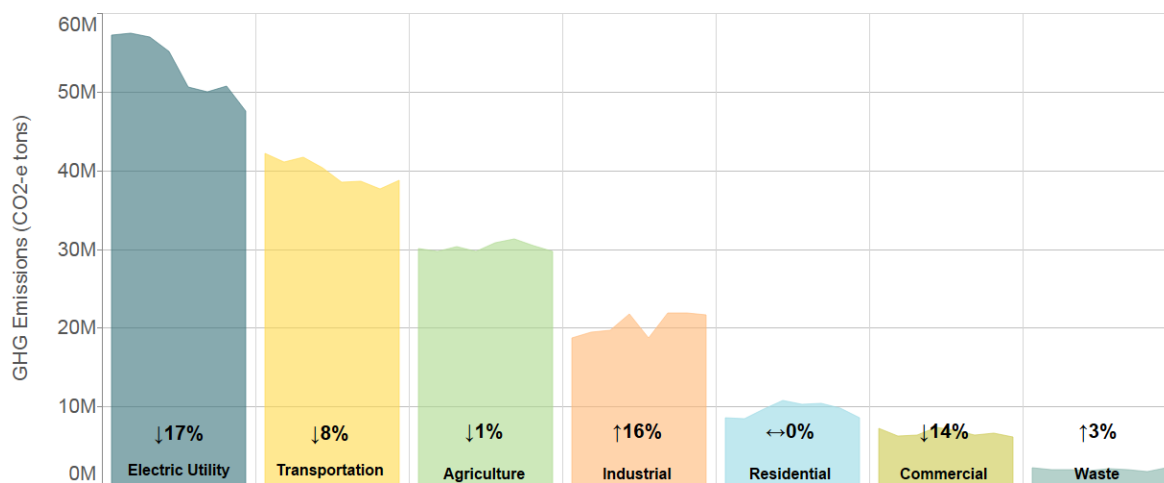
These results demonstrate that Minnesota’s progressive energy laws and programs are working, but more must be done to reduce GHG emissions across all sources in the state. Minnesota needs to remain a leader in greenhouse gas emission reductions, particularly in the next 15 years, to meet the reduction goals in the Next Generation Energy Act and to forestall the worst effects of global climate change.

Tracking progress on reducing Minnesota greenhouse gas emissions



The chart above shows the trend in GHG emissions in Minnesota since 1990. The dark blue line shows annual GHG emissions prior to 2005. The green line shows GHG emissions after 2005. The red circle describes the first Next Generation Energy Act milestone of a 15% reduction (from 2005) in GHG emissions by 2015. Minnesota is not expected to meet the 2015 milestone.

Changes in greenhouse gas emissions by economic sector: 2005-2012



The chart above describes the trend in GHG emissions in Minnesota by economic sector since 2005. The electric utility sector has achieved the greatest GHG reductions, yet remains the largest contributor to GHG emissions in the state. The commercial, transportation, and agricultural sectors have also experienced reductions in GHG, while the industrial and waste sectors have experienced increases in GHG emissions since 2005.

For more information on greenhouse gas emission trends in Minnesota, visit <http://www.pca.state.mn.us/uypuqu3>.

Updating strategies to reduce greenhouse gas emissions

Following passage of the Next Generation Energy Act, Minnesota stakeholders and state agencies worked with the Center for Climate Strategies (CCS) and the Minnesota Climate Change Advisory Group to design and evaluate recommended policy options to reduce greenhouse gas emissions. Since their report was completed in 2008, the price of renewable energies has declined rapidly, new natural gas extraction technologies have created a revolution in domestic production, and in other areas new technologies have been developed which offer new possibilities for change.

In light of these changes, the Environmental Quality Board (EQB) with assistance from CCS is facilitating a process to reevaluate and update the GHG reduction strategies analyzed in 2008. The Climate Solutions and Economic Opportunities (CSEO) initiative aims to develop an updated set of Minnesota-specific reduction strategies. These strategies cut across economic sectors, including electric supply, commercial, residential, and industrial demand-side energy management, transportation and land use, agriculture, forestry, and water and waste management.

The analysis will look at each strategy's:

- Potential to reduce GHGs.
- Projected societal costs and savings.
- Projected indirect effects on the economy.

The CSEO process relies heavily on interagency collaboration and public input. Prior to finalizing the CSEO recommendations, the EQB is holding nine stakeholder meetings between November 2014 and February 2015 to:

- Inform interested parties about the results of the analysis of emissions reduction strategies and the process to engage stakeholders in discussions around opportunities for action.
- Gather input into how potential policies and programs intended to reduce GHGs and grow a low-carbon economy might be designed to maximize effective implementation.
- Identify potential partners in the implementation of priority strategies.

For more information on the CSEO initiative, visit

<http://www.environmental-initiative.org/projects/cseo-stakeholder-engagement>



For more information about climate change in Minnesota, check out the EQB's 2014 report,

Minnesota and Climate Change Our Tomorrow Starts Today
<https://www.eqb.state.mn.us/content/climate-change>

Objective: Minnesota improves visibility at our most pristine places

Fine particle pollution in the atmosphere can reduce visibility over wide areas, called regional haze. Haze occurs when sunlight encounters fine particles in the air, which absorb and scatter light. Haze-causing pollutants come from a variety of sources, both natural and man-made, including motor vehicles, electric utilities, taconite processing facilities, agriculture, and wildfires.

Pristine conditions



Visible haze

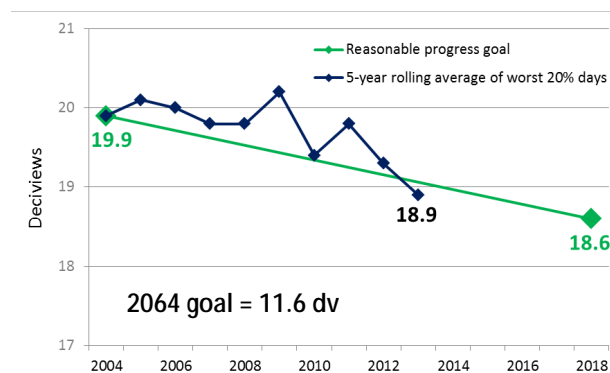


In 1999, EPA established a regulatory program to reduce haze caused by man-made air pollution at national parks and wilderness (Class I) areas. The goal of the regional haze rule is to achieve natural visibility conditions in Class I areas by 2064, with interim progress goals every 10 years. The first interim progress goal is set for 2018.

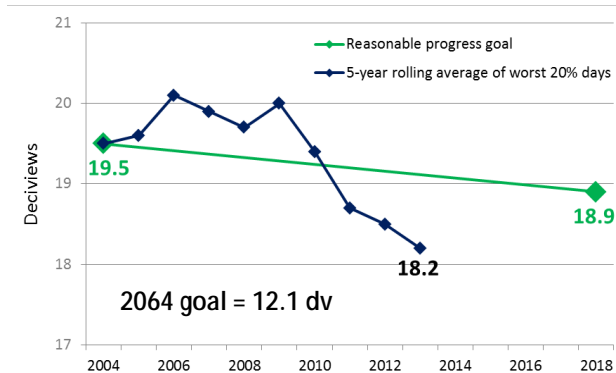
Progress toward meeting the 2018 interim regional haze goals

Both the Boundary Waters Canoe Area Wilderness and Voyageurs National Park are expected to meet the 2018 interim progress goal toward natural visibility conditions. Visibility improvements at the Boundary Waters were impacted in 2011 by the Pagami Creek wildfire, which burned 145 square miles of forest that year.

Boundary Waters Canoe Area Wilderness



Voyageurs National Park



Actions to meet clean air goals

Air pollution in Minnesota comes from a wide variety of sources. Different sources of pollution require different strategies to best reduce emissions. For decades, the MPCA has worked with large stationary facilities using traditional methods of permitting, compliance, and enforcement to reduce pollution from these sources. As noted in previous sections, pollution from stationary sources has been greatly reduced by these efforts.

However, smaller, more diffuse sources of pollution such as small businesses, vehicles, lawn equipment, and recreational fires pose a growing challenge for the MPCA because the state has little regulatory authority to control them. Traditional tools to reduce emissions such as permitting, compliance, and enforcement are not a good fit for reducing pollution from these sources. The MPCA needs to explore new initiatives and creative solutions to reduce air pollution emissions from these sources as it strives to protect and improve Minnesota's air quality.

Traditional stationary sources

The MPCA continues its long-standing work to reduce air pollution from stationary sources (aka point sources). Traditional regulatory methods such as permitting, compliance, and enforcement actions are well-suited to reduce emissions from large stationary facilities such as mining operations and power plants. The MPCA and, at the federal level, the EPA, work to review and update rules that govern these facilities as both the science to understand pollutants and the technology to control them advance. Some of these new rules, efforts, and points of emphasis are highlighted here.

Mercury Air Emission and Reduction Requirements Rule

Most of the mercury in our lakes and streams comes from the air. The MPCA has been working on a new set of rules to reduce air emissions to keep mercury out of waterways and ensure fish are safe to eat. In 2014, the MPCA adopted new rules that require certain sources of mercury air emissions, such as metal smelting and iron mining, to demonstrate how they will reduce emissions and help the state achieve its reduction goals. The rule requires certain facilities to develop a mercury reduction plan and adopt mercury performance standards. The largest emitters are also required to complete and submit an annual mercury emissions inventory.

For more information, visit <http://www.pca.state.mn.us/iryp4a1>.

Mercury and Air Toxics Standard (MATS)

In 2012, EPA adopted standards limiting mercury, acid gases, and other toxic pollution from coal and oil-fired power plants. The standards for new power plants were updated in March 2013. Power plants are the largest source of U.S. mercury air emissions, and the new standards are expected to yield substantial reductions by 2016. These standards will not only reduce emissions of toxic pollutants, but will also reduce emissions of fine particles, sulfur dioxide, and nitrogen oxides. The MATS rule is expected to achieve significant health benefits. Estimated reductions of 28,000 tons of sulfur dioxide, 800 pounds of mercury, and 1,040 tons of fine particles would result in 4,200 to 11,000 fewer particle-related premature deaths nationwide. This could save Minnesota an estimated \$880 million to \$1.6 billion annually in avoided health costs.

Reducing mercury emissions in products

In addition to reducing mercury emissions from regulated sources such as power plants and taconite processing facilities, the MPCA is working to address mercury emissions from smaller, more diffuse sources. One source of particular interest is the continued presence of mercury in dental amalgam (dental fillings). The MPCA has partnered with the University of Minnesota, local funeral directors, and the Department of Health to work toward the goal of reducing mercury emissions from dental amalgam at crematoria. A two-year study to quantify mercury emissions from cremation of dental amalgam in Minnesota is underway and is expected to be completed by July 2015.

The MPCA is also increasing its outreach to appliance recyclers and scrap processors to reduce mercury emissions. The MPCA is hosting workshops with state and local compliance and enforcement staff and industry professionals to increase awareness of proper handling of mercury waste and the environmental problems associated with improperly handling that waste.

Addressing carbon pollution from power plants

The EPA has proposed regulations under Section 111 of the Clean Air Act to address carbon pollution from power plants. The proposals include a federal program that will establish standards for new, modified, and reconstructed sources (New Source Performance Standards) published in January 2014 and proposed regulations defining a state-based program (the Clean Power Plan) for existing sources published in June 2014.

The federal standards for new plants, when finalized, would be the first national limits on the amount of carbon pollution that future plants will be allowed to emit. The state-based approach for addressing carbon pollution at existing sources would require states to develop plans to reduce carbon emissions from existing plants. The proposed reductions are in line with investments in clean energy technologies already occurring in Minnesota's power sector. As proposed, the rule establishes state-specific greenhouse gas emission reduction targets with a requirement that states meet its target by 2030. The rule is also expected to reduce particle pollution, nitrogen oxides, and sulfur dioxide by more than 25 percent. In developing its proposal, Minnesota was one of a handful of states EPA looked to as a model for determining best systems of emission reduction. The MPCA is working closely with stakeholders to determine the most effective strategies for ensuring compliance with the rule, expected to be finalized in the summer of 2015. Minnesota is expected to continue to be a national leader in clean, cost-effective energy.

Air quality "omnibus" rulemaking

The MPCA strives to continuously improve its existing rules as well as writing new rules. The Omnibus Air Rule is part of that effort. The overall purpose of the rulemaking is to keep air quality rules current, ensure consistency with applicable federal and state regulations, remove redundant language, clarify confusing language, and correct gaps or errors that may have been identified since a rule was written. The Omnibus Air Rule is expected to be complete by late 2015.

For more information, visit <http://www.pca.state.mn.us/enzq146d>.

Fugitive emissions

Fugitive emissions are releases of air pollution that do not pass through a chimney, stack, or vent. The term is most commonly used for fugitive dust — particles that come from roads or piles of materials. A facility's total "potential to emit" — the amount of pollution that could be emitted if the facility

operated at capacity, all day, every day — is one of the tools used to determine if the facility needs a permit to operate and, if so, what kind of permit. In the past, fugitive emissions have been included in the calculation of potential to emit. In 2013, the Minnesota Legislature directed the MPCA to amend the definition of “potential to emit” to exclude fugitive emissions from this emission calculation, unless a federal law requires fugitive emissions to be included. In 2014, the MPCA completed a “good cause exempt” rulemaking to implement the legislative direction. The revised definition became effective on September 22, 2014.

How do MPCA air permits improve air quality?

Air quality permits are an important tool to control pollution from traditional air pollution sources like factories and electric utilities. The goal of an air quality permit is protect human health and the environment by ensuring large sources of air pollution properly install, operate, and maintain pollution-control equipment.

Individual operating permits compile the requirements related to control equipment into one document to ensure compliance with air pollution law, reduce violations, and improve enforcement. Depending on the type of air pollution controls used, control equipment can reduce pollution from a source by over 99 percent.

For example, permits require that facilities:

- Always operate pollution-control equipment when the process it is controlling is operating.
- Conduct daily monitoring of control equipment to make sure it is working properly.
- Conduct periodic inspections of the integrity of the control-equipment components.
- Operate and maintain control equipment according to the manufacturer’s specifications.
- Test the efficiency of control equipment to ensure it is achieving the control needed.

Nonpoint sources

Today, most of the air pollution in Minnesota originates from smaller, more diffuse sources such as passenger cars and trucks, tractor trailers, small businesses, and recreational fires. Individually, each of these sources may not produce much pollution, but when added together they become a major concern for Minnesota’s air quality. The MPCA has been working on new strategies for tackling emissions from these sources.

Voluntary emission reduction programs and outreach campaigns are important tools to achieve emissions reductions from sources that are difficult to address with traditional regulatory programs. Voluntary programs allow for increased flexibility in reducing emissions, often resulting in less burdensome control costs. Voluntary programs also allow small businesses to reinvest in their operations, adopt more sustainable practices, and be better neighbors. The MPCA works with a variety of partners including industry, community, and non-governmental organizations to achieve voluntary emissions reductions from nonpoint sources.

Clean Air Minnesota

As part of the MPCA’s long standing focus to develop new means of tackling these complex pollution concerns, in 2003 the MPCA formed a public-private partnership to work toward reducing air pollution to protect public health and meet federal air quality standards. This partnership, called Clean Air Minnesota (CAM), was founded through the joint effort of the Minnesota Pollution Control Agency, the Minnesota Center for Environmental Advocacy, and the Minnesota Chamber of Commerce to address these shared goals. This partnership helps gather stakeholder input, prioritize strategies, connect

projects with funding, increase cross-sector communication about initiatives, and track emissions reductions.

Since refocusing efforts in November 2013, the MPCA and other CAM members have been working to identify and implement air pollution reduction strategies and education opportunities to reduce health risks related to air pollution and improve environmental justice in Minnesota.

To date, projects include:

- Reducing VOC emissions at small businesses
- Conducting research on the air quality benefits of increased urban forestry
- Reducing air pollution emissions from older diesel engines
- Increasing outreach for the Air Quality Index and air pollution health alerts
- Increasing outreach on wood smoke and developing a wood heater change-out program
- Promoting the use of electric vehicles through Drive Electric Minnesota
- Supporting 10 Green Corps members to work on air quality issues in cities across Minnesota.

For more information, visit <http://www.environmental-initiative.org/projects/clean-air-minnesota>

Particulate Matter and Ozone Advance

The EPA's Advance Program is a voluntary program to help state and local governments reduce air pollution emissions in areas that currently meet federal standards for ozone and fine particles. As science better understands the health impacts of air pollutants, EPA reviews and strengthens national air quality standards to ensure the standards protect public health. Without continued improvements in air quality, Minnesota is at risk for violating strengthened air quality standards.

The Advance Program provides support to state and local governments that wish to work ahead of the standards to avoid possible violations in the future. The MPCA enrolled in the Advance Program for both particulate matter and ozone in 2012. The Advance Program serves as an umbrella for all of the voluntary initiatives that the MPCA and its partners have undertaken to reduce fine particle and ozone emissions ahead of the release of new, likely more stringent air quality standards for these pollutants.

For more information on EPA's Advance Program, visit <http://www.epa.gov/ozoneadvance/>

Reducing small business emissions of VOCs

VOCs are emitted from many industrial and commercial processes used in businesses all around us. You may recognize them as the solvent-like fumes coming from coatings, inks, solvents, adhesives, gasoline, or other chemicals used in everyday commerce. They are released when fuels are burned in cars, trucks, generators, lawn mowers, machinery, and recreational equipment. VOCs can also be released from the storage and transportation of chemicals and fuels. When these VOCs are released into the air, they can be chemically transformed into ground-level ozone, which is a component of smog and is a harmful air pollutant. Some common business sectors emitting VOCs are trucking companies, dry cleaners, auto body shops, print shops, and gas stations. Reducing VOC emissions is an important part of protecting human health in Minnesota and reducing air pollution that contributes to ozone.



Environmental assistance grants

In 2014, MPCA for the first time provided more than \$370,000 in grants for small businesses to reduce VOC emissions. The grants were promoted statewide in five different languages, and resulted in requests for more than \$1 million in funding. Projects completed in 2015 are estimated to reduce VOC emissions by almost six tons per year.

Mobile sources

Across Minnesota, emissions from mobile sources like cars, trucks, tractor trailers, and buses contribute nearly 30 percent of all air pollution emissions in the state. Within the Twin Cities metropolitan area, the fraction of air pollution emissions due to mobile sources is even higher. While federal standards have significantly reduced vehicle-related emissions over time, more must be done to reduce the health risks associated with current mobile-source emissions in Minnesota. Because areas near busy roadways are often inhabited by higher concentrations of people of color and lower-income Minnesotans than other parts of the Twin Cities, continuing to reduce vehicle-related air pollution emissions is especially important to help address disparities in air pollution exposure and health risks for those communities.

Electric vehicles

The MPCA helped found Drive Electric Minnesota, a partnership of businesses, nonprofits, state agencies, local governments, and utilities working to promote use of electric vehicles (EVs) and development of charging infrastructure. Because EVs have zero tailpipe emissions, increasing the number of EVs on Minnesota roads will result in direct improvements in air quality. The Zero Emission Charging Challenge will further reduce air pollution associated with charging EVs by replacing fossil fuel-based electricity generation with onsite renewable solar- or-wind generated electricity at public charging stations.

Electric vehicles and infrastructure in Minnesota



As of October 2014, Minnesota had:

- 2,949 personal EVs on the road
- 187 public and private charging stations

In 2014, electric vehicles on Minnesota roads resulted in:

- 63,000 fewer pounds of nitrogen dioxide
- 69,000 fewer pounds of VOCs
- 7,000 fewer pounds of particulate matter
- 10,000 fewer tons of greenhouse gases

For more information on Drive Electric Minnesota, visit <http://tinyurl.com/nraq8o4>

Heavy-duty diesel engines

Since 2008, the MPCA has focused on reducing emissions from heavy-duty diesel engines in fleets and construction equipment. Modern diesel engines and retrofit equipment can drastically reduce emissions of fine particles as well as vibration and noise. Retrofits, upgrades, and replacements protect the health of operators as well as public health and the environment.

In the fall of 2014, the MPCA awarded nearly \$200,000 for five grants to reduce emissions from 11 heavy-duty diesel engines. This year's grant projects alone reduced fine particles emissions by 2.3 tons. Since 2006, diesel-emissions reduction grants have improved or replaced over 4,000 diesel engines in Minnesota. These grants are supported with state and federal funds and require a match from the grantee. Updating or replacing older diesel engines with cleaner-burning models has reduced fine particle emissions in the state by 42 tons each year. This equates to taking nearly 750,000 cars off the road.



For more information on the MPCA's clean diesel program, visit <http://www.pca.state.mn.us/wfhy4c4>.

New federal vehicle and fuel standards

Certain types of emission sources and pollutants are better regulated at the national level than at the state level in order to provide businesses with regulatory certainty and consistency across states. For this reason, EPA has taken the lead on developing fuel and vehicle standards that apply across the nation.

In March 2014, EPA finalized its new Tier 3 Tailpipe and Evaporative Emission and Vehicle Fuel Standards. These new standards require both the production and use of cleaner fuels and the sale of more efficient vehicles with improved emissions-control technologies. These new standards will help achieve large reductions in emissions of vehicle-related pollutants starting in 2017. By 2030, the new standards are projected to reduce annual vehicle emissions of nitrogen oxides by 25 percent, VOCs by 16 percent, carbon monoxide by 24 percent, and sulfur dioxide by 56 percent. These reductions will go a long way to help improve air quality and maintain federal air quality standards. The Tier 3 standards are also highly cost-effective. They are projected to cost less than a penny per gallon of gas and add only \$72 to the cost of a new car.

Wood smoke

Smoke from burning wood contains particles and toxic chemicals that can be hazardous to human health. Emissions from wood burning continue to increase in Minnesota as more people have backyard fire pits or use wood for home heating^{viii}. Sources of wood smoke include outdoor wood boilers, wood stoves, backyard recreational fires, wildfires, and prescribed burning. The MPCA is working to better understand data about wood-burning habits and related emissions in the state.

The MPCA is collaborating with a variety of partners to reduce potential public health concerns related to wood burning. For example the MPCA is working with local governments on efforts to reduce the impact of wood smoke, including drafting a model ordinance to help local governments address concerns stemming from the use of outdoor wood boilers. The MPCA is also participating in an EPA effort to develop new standards for new residential wood heaters. The MPCA is advocating for tighter emissions limits on these units to reduce pollution from these devices, while also recognizing the potential impacts to Minnesota manufacturers.



New and continuing challenges

Changing federal standards

Science is constantly improving our understanding of air pollutants and their impacts on human health and the environment. The Clean Air Act requires the EPA to review its air quality standards every five years and consider the latest science in the review to protect human health and the environment. Over the last 10 years, the EPA has reviewed the National Ambient Air Quality Standards for all six criteria air pollutants. For all pollutants except carbon monoxide, these reviews have resulted in stronger, more health-protective standards.

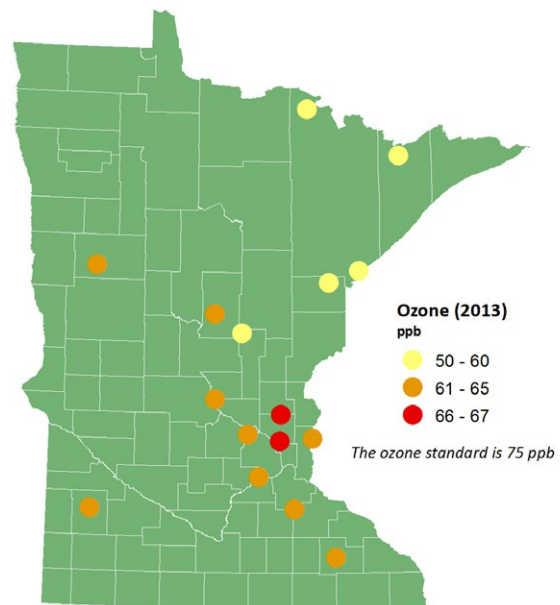
Summary of recent revisions to the National Ambient Air Quality Standards

	Last review	Summary of major changes
Ozone	March 2008	Existing 8-hour standard strengthened from 80 ppb to 75 ppb.
	November 2014	EPA has proposed to strengthen the 8-hour standard from 75 ppb to a value between 70 ppb and 65 ppb. More information on next page.
Particle pollution including PM _{2.5} and PM ₁₀	December 2012	Existing annual standard strengthened from 15 µg/m ³ to 12 µg/m ³ . Existing daily standard retained.
Lead	November 2008	Existing standard made 10 times stronger.
Sulfur dioxide	June 2010	New 1-hour standard. Existing annual and daily standards were revoked.
Nitrogen dioxide	February 2010	New 1-hour standard. Existing annual standard retained.
Carbon monoxide	August 2011	No changes, existing 1-hr and 8-hr standards retained.

Proposed changes to the National Ambient Air Quality Standard for ozone

On November 24, 2014, the EPA announced proposed changes to the National Ambient Air Quality Standard for ozone. The proposal seeks to strengthen the ozone standard by lowering the standard from 75 ppb to a value between 65 ppb and 70 ppb. The proposal is based on scientific evidence that strongly indicates ozone impacts human health at levels below the existing standard of 75 ppb.

Based on 2013 ozone monitoring results, all areas of Minnesota will meet the revised ozone standard if it is set at 70 ppb. If the ozone standard is set at 66 ppb or lower, the Twin Cities metropolitan area will not meet the standard. The EPA is expected to finalize the revised ozone standard in October 2015. EPA plans to use monitoring data from 2014-2016 to determine compliance. The MPCA will closely monitor ozone levels over the summer of 2015 and 2016 to assess the likelihood of violating the revised ozone standard.



Silica sand

Mining, processing, and transportation of silica sand is an expanding industry in Minnesota. The high-quality sand is used in oil and gas extraction processes. While silica is a very common material found throughout the world, high-quality silica sand deposits are concentrated in southeastern Minnesota and the Minnesota River Valley. Communities are concerned about the growth of this industry in their counties, towns, and townships. The state has developed a multi-agency website devoted to statewide work in this area: <http://silicasand.mn.gov/>.



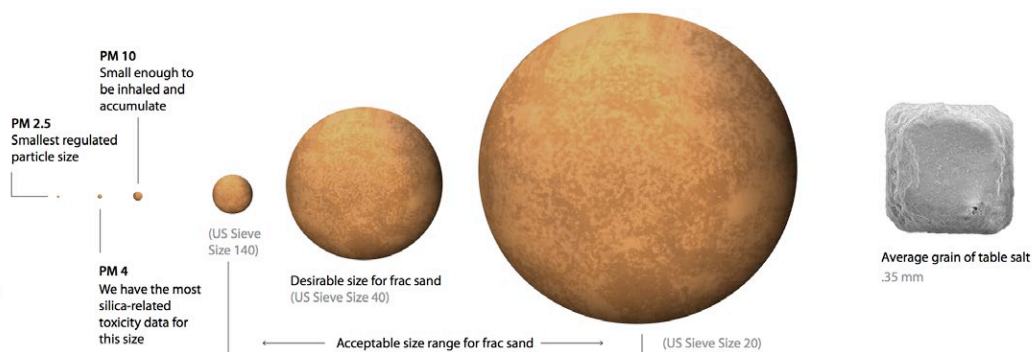
Rulemaking to address silica sand

At the direction of the Legislature, the MPCA is undertaking rulemaking for the control of particulate emissions from silica sand mining projects. This is one of three silica sand rulemakings required by the Legislature. In January 2014, the MPCA, the Minnesota Department of Natural Resources, and the Minnesota Environmental Quality Board convened an advisory panel to provide input to the agencies on all three silica sand rules. The panel members represent citizen, local government, and industry perspectives. The MPCA anticipates that a rule will be proposed in the first half of 2015.

More information on the rulemaking process is available at <http://www.pca.state.mn.us/6xqx9wh>.

Silica sand size

PM: Particulate matter found in air, such as dust, soot, or smoke. Measured in microns (one-millionth of a meter)



Understanding the health impacts of silica sand

In occupational settings, exposure to elevated levels of silica has been linked to the development of the lung disease silicosis. Silicosis can increase the risk of developing lung cancer. Very few research studies have looked at the relationship between exposure to silica sand in outdoor air and health.

In July 2012, the MPCA requested the Minnesota Department of Health to consider developing a health based value (HBV) for short- and long-term exposures to respirable crystalline silica. In response, MDH reviewed all available research studies and developed an HBV to protect against silicosis that would result from long-term exposure to crystalline silica. HBVs are used as a comparison value for measured or modeled air concentrations. MDH determined that existing air quality standards provide sufficient protection against health risks associated with short-term exposures to crystalline silica, and therefore chose not to develop a short-term HBV from the limited study information available.

Silica sand air monitoring

The Minnesota Environmental Quality Board recommends that when permitting a silica sand mine or related facility, responsible governmental units require fence line air monitoring.^{ix} The pollutants of concern for silica sand operations are related to dust and diesel emissions. Facilities are encouraged to measure total suspended particulate (TSP), particulate matter less than 10 microns (PM₁₀), fine particles (PM_{2.5}), and respirable crystalline silica (PM₄).



Two silica sand facilities in Minnesota are operating air monitors, including the Shakopee Sands facility in Scott County and the Tiller facility in Chisago County. While the facilities are responsible for conducting this monitoring, the MPCA provides technical assistance including guidance on monitor placement and operations, quality assurance, and data analysis.

The MPCA is also interested in the community-level air quality impacts of increased silica sand operations in Minnesota. In 2014, the Agency deployed a community air monitor in downtown Winona to measure the level of fine particles and respirable crystalline silica in the air.

Initial air monitoring results from both the facility- and community-oriented monitoring sites do not indicate any violations of air quality standards or health based values resulting from silica sand related activities. The MPCA will continue to investigate and respond to issues surrounding this growing industry.

For more information, visit <http://www.pca.state.mn.us/6f6dhkf>.

Ultrafine particles

As researchers continue to focus on smaller particles, there is increased evidence that ultrafine particles are contributing to health risks related to air pollution. Ultrafine particles have a diameter of less than 0.1 microns, and are most prevalent near combustion sources such as traffic and wood burning. When ultrafines are released into the air, they quickly combine into larger particles, such as fine particles (PM_{2.5}). Due to their very small size, some ultrafines are able to pass effectively into the bloodstream and may be transported throughout the body, potentially having effects beyond the heart and lungs. Further research is needed on the health effects and potential concerns of ultrafine particles.

In 2013, the MPCA began monitoring ultrafine particles along the I-94 and I-35W freeway commons in downtown Minneapolis. The results of this monitoring will contribute to ongoing research on ultra-fine particles in the environment.

Conclusion

Over the last two decades, Minnesota has successfully reduced the level of unhealthy air pollutants in the air across the state. These air quality improvements have been driven by strong regulatory compliance, innovations in pollution control technology, voluntary emissions reductions programs, and citizen actions to reduce individual contributions to air pollution where Minnesotans live, work, and play.

Despite the MPCA's past success, more can and must be done to reduce air pollution levels in the state. Research has shown that current levels of air pollution in Minnesota continue to cause negative health effects. There is evidence that communities of color and lower-income Minnesotans are more vulnerable to air pollution in the state. As the MPCA works to make further reductions in air pollution, the agency is striving toward improving environmental equity for all Minnesotans.

Today, much of the air pollution in Minnesota originates from smaller, more diffuse sources such as cars, trucks, tractor trailers, small businesses, and recreational fires. Individually, each of these sources may not produce much pollution, but when added together they become a major concern for Minnesota's air quality. Addressing these sources will require increased reliance on new, innovative strategies that move beyond traditional regulatory programs. Through increased community outreach, voluntary programs, and partnerships, the MPCA is well positioned to achieve future emissions reductions from these sources.

Air pollution impacts all Minnesotans in all areas of the state. Continuing to improve air quality in Minnesota is critical to the MPCA's mission to protect and improve the environment and enhance human health.

Appendix A: Mercury emissions associated with electricity production and consumption in Minnesota, 2007-2011

Introduction

In accordance with Minnesota Statute §116.925, this appendix reports mercury emissions associated with electricity production. Although not required by the statute, electricity consumption in Minnesota is also reported. In 2007, the Minnesota Pollution Control Agency (MPCA) established an emissions reduction goal and is now implementing stakeholder recommendations to meet the goal. The electric utility sector has made changes to reduce mercury and is on track to meet the interim mercury emission reduction goals in 2018. More information about Minnesota's mercury emissions and reduction strategies can be found at www.pca.state.mn.us/air/mercury.html.

Mercury emissions from electricity generation

Minnesota Statute §116.925 requires producers and retailers of electricity to report the amount of mercury emitted through the generation of electricity. This law also requires MPCA to summarize this information in its biennial air toxics report to the Legislature. Emissions from 2007, 2008, 2009, 2010, and 2011 are summarized in the following pages.

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

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

The submissions are from coal-fired generators, gas and biomass fuel burning, and municipal waste incinerators.

In 2007, facilities in Minnesota reported the emission of 1,302 pounds of mercury. For 2008, facilities in Minnesota reported the emission of 1,256 pounds of mercury. For 2009, reported emissions decreased to 1,102 pounds of mercury. In 2010, mercury emissions decreased again to 963 pounds of mercury. In 2011, reported emissions increased to 1,055 pounds of mercury due to an increase in power production.

Company	Generating Facility	Major Fuel Type(s)	2011 Mercury Emissions (lb)	2010 Mercury Emissions (lb)	2009 Mercury Emissions (lb)	2008 Mercury Emissions (lb)	2007 Mercury Emissions (lb)
Austin NE Power Plant	Unit 1	coal, gas	0.83	0.18	0.08	2.25	4.51
Covanta Hennepin Energy Resource Co	Unit 1 ^c	MSW ^a	3.73	4.32	6.21	4.20	2.44
Covanta Hennepin Energy Resource Co	Unit 2 ^c	MSW ^a	2.08	7.09	3.47	2.95	3.45
Faribault Energy Park	FEP 13100071	oil, gas	0.00	0.00	0.04	0.03	
Faribault Energy Park	MRS-01900059	oil, gas		0.00	0.00	0.00	
Great River Energy	Arrowhead Station	oil		0.00	0.00	0.00	
Great River Energy	Cambridge Station ^{c,d}	oil		0.00	0.00	0.00	0.00
Great River Energy	Elk River Station ^c	oil, gas, MSW ^a	1.31	13.50	6.70	7.50	2.01
Great River Energy	Lakefield Station ^{c,d}	oil, gas		0.00	0.00	0.00	0.00
Great River Energy	Maple Lake Station ^{c,d}	oil		0.00	0.00	0.00	0.00
Great River Energy	Pleasant Valley Station ^{c,d}	oil, gas			0.00	0.00	0.00
Great River Energy	Rock Lake Station ^{c,d}	oil		0.00	0.00	0.00	0.00
Great River Energy	St. Bonifacius Station ^c	oil		0.00	0.00	0.00	NA
Hibbing Public Utilities	Unit 1A ^{h,c}	coal,oil	0.83	totalled in sum	3.75	2.55	3.07
Hibbing Public Utilities	Unit 2A ^{h,c}	coal,oil	1.01	totalled in sum	3.92	2.56	3.07
Hibbing Public Utilities	Unit 7A ^{h,c}	wood	N/A	N/A	0.00		1.67
Hibbing Public Utilities	Unit 4A	wood, oil		totalled in sum	3.28	2.40	
Hibbing Public Utilities	Unit 3A ^h	coal,oil	10.92	totalled in sum	3.95	3.61	6.99
Hibbing Public Utilities	Total for all units	wood, coal, oil	13.04	13.90			
Interstate Power and Light Company, Sherburn, MN	Fox lake Power Station #3 ^f	oil, gas	0.00	0.00	0.00	0.00	0.30
Marshall Municipal Utilities	GE Turbine	oil	0.00	0.00	0.00	1.48	
Minnesota Power (Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 1	coal, oil	26.14	30.65	16.26	19.28	20.00
Minnesota Power (Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 2	coal, oil	10.71	14.98	6.30	1.69	18.00
Minnesota Power (Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 3	coal, oil	22.80	18.18	14.57	21.23	21.00

Company	Generating Facility	Major Fuel Type(s)	2011 Mercury Emissions (lb)	2010 Mercury Emissions (lb)	2009 Mercury Emissions (lb)	2008 Mercury Emissions (lb)	2007 Mercury Emissions (lb)
Minnesota Power	Boswell Unit 1	coal, oil	3.90	4.71	3.81	5.30	15.00
Minnesota Power	Boswell Unit 2	coal, oil	4.75	4.38	4.38	4.82	8.00
Minnesota Power	Boswell unit 3	coal, oil	4.05	7.62	62.94	121.41	80.00
Minnesota Power	Boswell Unit 4 ^a	coal, oil	227.87	149.37	155.10	151.02	164.00
Minnesota Power	Hibbard 3-4	coal, gas	12.91	15.93	1.13	4.84	4.00
Minnesota Power	Laskin Unit 1 & 2	coal, oil	27.19	16.53	16.71	20.40	11.00
Minnesota Power (Rapids Energy Center)	Rapids Energy Center 5-6 ^c	coal, wood	6.78	1.70	0.81	2.66	2.00
Northshore Mining Company	Silver Bay Power Plant PB 1 ^c	coal, oil, gas	22.70	22.92		16.57	1.30
Northshore Mining Company	Silver Bay Power Plant PB 2 ^c	coal, gas	14.70	16.89		16.75	1.80
Xcel Energy	AS King 1	coal, gas, petroleum coke	30.10	50.50	50.00	45.20	5.40
Xcel Energy	Black Dog 3	coal, gas	26.72	23.00	33.00	27.70	28.80
Xcel Energy	Black Dog 4	coal, gas	46.28	50.70	45.80	61.80	56.80
Xcel Energy	Black Dog 5 ^{c,d}	gas	N/A	N/A	0.00	0.00	0.00
Xcel Energy	Blue Lake 1-3 ^c	oil, gas	0.01	0.00	0.00	0.00	0.10
Xcel Energy	Blue Lake 4	oil	0.00	0.00	0.00		
Xcel Energy	Blue Lake 7-8 ^{c,d}	gas	0.00	0.00	0.00	0.00	0.00
Xcel Energy	Granite City 1-4 ^{c,d}	oil, gas	0.00	0.00	0.00	0.00	0.00
Xcel Energy	High Bridge 5	coal, gas	N/A	N/A		0.00	11.40
Xcel Energy	High Bridge 6	coal, gas	N/A	N/A		0.00	23.20
Xcel Energy	High Bridge 7-8		0.00	N/A		0.00	
Xcel Energy	High Bridge 13-16	natural gas	0.00	0.00	0.00		
Xcel Energy	Inver Hills 1-6 ^c	oil, gas	0.00	0.00	0.00	0.00	0.20
Xcel Energy	Key City 4-7	gas	0.00			0.00	0.00
Xcel Energy	Minnesota Valley 4 ^{c,d}	coal, oil, gas	0.00	0.00	0.00	0.00	0.00
Xcel Energy	Red Wing 1 Waste-to-Energy	gas, RDF ^b	2.28	1.50	1.30	2.20	3.60
Xcel Energy	Red Wing 2 Waste-to-Energy	gas, RDF ^b	3.18	2.80	1.80	3.40	3.80
Xcel Energy	Riverside 6/7	coal, oil, gas	N/A	N/A		23.30	20.70
Xcel Energy	Riverside 3	coal, oil, coke	N/A	N/A	0.20		
Xcel Energy	Riverside 15-16	natural gas	0.00	0.00	0.00		

Company	Generating Facility	Major Fuel Type(s)	2011 Mercury Emissions (lb)	2010 Mercury Emissions (lb)	2009 Mercury Emissions (lb)	2008 Mercury Emissions (lb)	2007 Mercury Emissions (lb)
Xcel Energy	Riverside 8	coal, oil, coke	N/A	N/A		48.90	58.50
Xcel Energy	Sherburne 1	coal, oil	208.40	199.00	221.90	221.70	183.90
Xcel Energy	Sherburne 2	coal, oil	208.40	166.40	219.30	213.40	239.70
Xcel Energy	Sherburne 3 (Xcel owned portion)	coal, oil	23.10	90.60	182.90	155.80	148.40
Xcel Energy	Wilmarth 1 Waste-to-Energy ^c	RDFb, gas	2.20	2.10	2.00	3.20	2.90
Xcel Energy	Wilmarth 2 Waste-to-Energy ^c	RDFb, gas	1.89	1.20	1.40	1.20	2.40
Otter Tail Power	Hoot Lake #2 & 3	coal, oil	38.17	16.98	18.99	15.74	17.56
Rochester Public Utilities	Silver Lake 1	coal, gas	0.15	0.01	0.01	0.08	
Rochester Public Utilities	Silver Lake 2	coal, gas	0.18	0.40	0.59	0.40	
Rochester Public Utilities	Silver Lake 3	coal, gas	0.56	0.70	0.12	1.88	2.96
Rochester Public Utilities	Silver Lake 4	coal, gas	0.00	0.00	0.05	1.58	2.64
Rochester Public Utilities	Cascade Creek Station 1	oil, gas	0.00	0.00	0.00	0.00	0.01
Rochester Public Utilities	Cascade Creek Station 2-3	oil, gas	0.00	0.00	0.00	0.00	0.01
Sappi-Cloquet	Power Boiler 7 ^h	oil, gas, wood	1.33	0.67	0.90	0.98	0.76
Sappi-Cloquet	Power Boiler 8 ^h	gas	0.00	0.00	0.00	0.00	0.00
Sappi-Cloquet	Power Boiler 9 ^h	oil, gas, wood	2.63	1.67	2.65	2.91	2.98
Sappi-Cloquet	Power Boiler 10 ^h	gas	2.11	2.05	0.97	0.99	1.06
Sappi-Cloquet	Lime Kiln	natural gas	0.23	0.23	0.00	0.00	
Southern Minnesota Municipal Power Agency	Faribault Energy Park	oil, gas	0.00				0.02
Southern Minnesota Municipal Power Agency	Sherburne 3 (SMMPA owned portion)	coal, oil	23.10				101.30
Southern Minnesota Municipal Power Agency	Minnesota River Station Combustion Turbine ^d	oil, gas	0.00				0.01
Verso Paper- Sartell	BBC Turbine/Boiler	coal, oil, wood, sludge	0.44	0.06	0.16	5.44	5.75

Company	Generating Facility	Major Fuel Type(s)	2011 Mercury Emissions (lb)	2010 Mercury Emissions (lb)	2009 Mercury Emissions (lb)	2008 Mercury Emissions (lb)	2007 Mercury Emissions (lb)
Virginia Public Utilities Commission	Virginia Public Utilities	coal, gas, wood	13.07	10.41			
Willmar Municipal Utilities	Boiler 3	coal, natural gas	2.84	2.34	2.63	3.00	3.53
Willmar Municipal Utilities	Boiler 2	natural gas	0.00	0.00	0.00	0.00	
			Total Reported 2011 Mercury Emissions (lb)	Total Reported 2010 Mercury Emissions (lb)	Total Reported 2009 Mercury Emissions (lb)	Total Reported 2008 Mercury Emissions (lb)	Total Reported 2007 Mercury Emissions (lb)
Summary of Reports			1055.66	966.18	1100.08	1256.31	1302.00

Notes

^aMSW is municipal solid waste.

^bRDF is refuse-derived fuel, which is sorted and processed municipal solid waste.

^cFacility has agreed to include for reporting mercury emissions of less than 3 pounds.

^dMercury emissions round to less than 0.00 pounds mercury for one or both years.

^e34 pounds of mercury in 2006 and 33 pounds mercury in 2007 associated with electricity sold out of state.

^f5.21% for 2006 and 5.23% for 2007 of total energy production for all facilities is sold to Minnesota customers.

^gExempt from reporting. (Facilities emitting under 3 pounds of mercury or less than 240 hours of operation per year.)

^hDue to common steam headers, calculation of mercury per electrical generation is not possible, electrical generation is from each individual turbine not from each boiler.

End notes

ⁱ See <http://www.epa.gov/airtrends/aqtrends.html#comparison>, and <http://www.epa.gov/airtrends/images/comparison70.jpg>.

ⁱⁱ In 1999 dollars (www.environmental-initiative.org/images/files/MNChamber-ozone.pdf)

ⁱⁱⁱ See Minnesota Department of Employment and Economic Development (2014), *Minnesota Clean Energy Economy Profile*. <http://mn.gov/deed/data/research/clean-energy.jsp>

^{iv} See EPA National Emissions Inventory (2014). <http://www.epa.gov/ttnchie1/trends/>

^v See Clark LP, Millet DB, Marshall JD (2014) National Patterns in Environmental Injustice and Inequality: Outdoor NO₂ Air Pollution in the United States. *PLoS ONE* 9(4): e94431. doi:10.1371/journal.pone.0094431

^{vi} The term “air toxics” refers to a group of over 100 air pollutants that cause or may cause cancer or other serious health effects. The MPCA monitors for nearly 80 different air toxic pollutants including metals, VOCs, and carbonyls.

^{vii} See Fann N, Lamson A, Wesson K, Risley D, Anenberg SC, Hubbell BJ. Estimating the National Public Health Burden Associated with Exposure to Ambient PM_{2.5} and Ozone. *Risk Analysis*; 2011. <http://onlinelibrary.wiley.com/doi/10.1111/j.1539-6924.2011.01630.x/full>

^{viii} See Minnesota Pollution Control Agency (2013). Residential Wood Combustion Survey Report. <http://www.pca.state.mn.us/index.php/view-document.html?gid=19775>

^{ix} See Minnesota Environmental Quality Board (2014). Tools to Assist Local Governments in Planning for and Regulating Silica Sand Projects. https://www.eqb.state.mn.us/sites/default/files/documents/Tools%20for%20Local%20Govt%20approved%20March%2019_with_Errata.pdf