Air Quality in Minnesota

2011 Report to the Legislature

January 2011

Minnesota Pollution Control Agency

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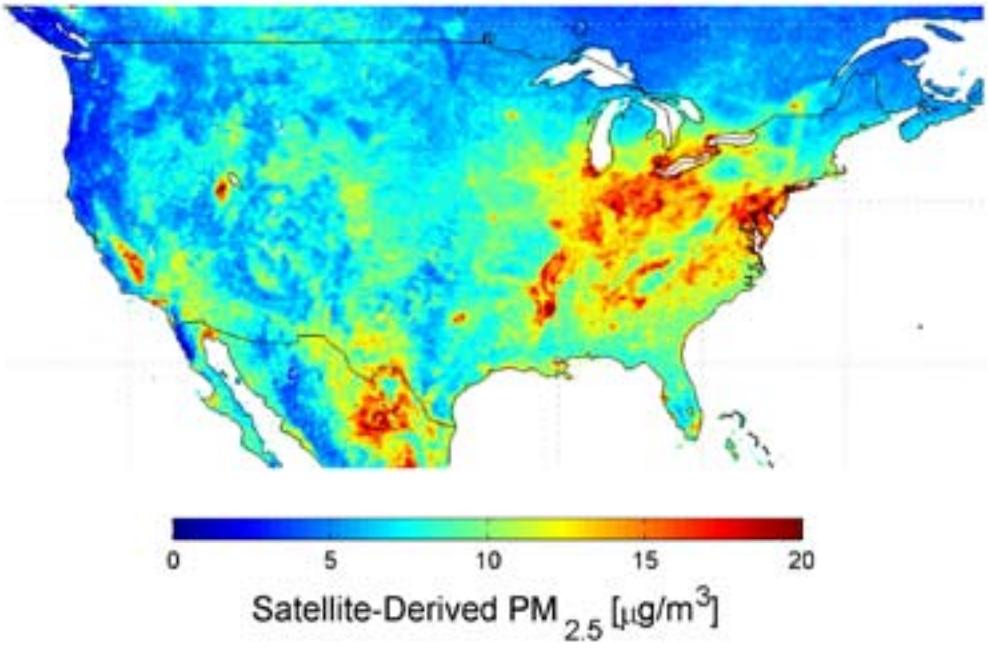
Foreword

Minnesotans have good reason to be proud of the state's air quality. For example, recently released maps developed using satellite-derived remote sensing show Minnesota to have some of the lowest concentrations of fine particle pollution in the United States.

Concentrations of fine particles in the United States



Source: van Donkelaar et al , "Global Estimates of Ambient Fine Particulate Matter Concentrations from Satellite-Based Aerosol Optical Depth: Development and Application", Environmental Health Perspectives, 118(6), 2010 Reproduced with permission from Environmental Health Perspectives

Still, levels of fine particles and other pollutants are elevated in the Twin Cities metropolitan area and other Minnesota cities. Researchers continue to find serious health effects at ever lower levels of air pollution. In response to this increased concern, the U.S. Environmental Protection Agency (EPA) plans to strengthen health-based standards for all six pollutants with national ambient air quality standards (NAAQS) by the end of 2011. In addition, in 2009 and 2010, EPA implemented the first-ever national reporting rules and permitting thresholds for greenhouse gases.

Although EPA sets national standards, the Minnesota Pollution Control Agency (MPCA) is responsible for their implementation and enforcement in Minnesota. The updated standards will necessitate new monitoring and modeling requirements for MPCA and permitted facilities. Minnesota may be out of attainment for standards such as lead and fine particles, creating a need to develop plans for reducing pollutant concentrations. MPCA has begun work to meet these new and complex requirements.

The majority of priority pollutant emissions come from energy-related sources through the combustion of fuels in transportation and off-road equipment, electricity generation, industrial processes, and residential burning. With the air pollutants of greatest concern coming from fuel combustion, MPCA sees opportunities for multi-pollutant reductions, as well as opportunities for voluntary and partnership-based emission reduction efforts. As Minnesota moves into an era of tighter standards, potential non-attainment and limited budgets, MPCA will need creative new ways to keep Minnesota's air clean and safe.

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

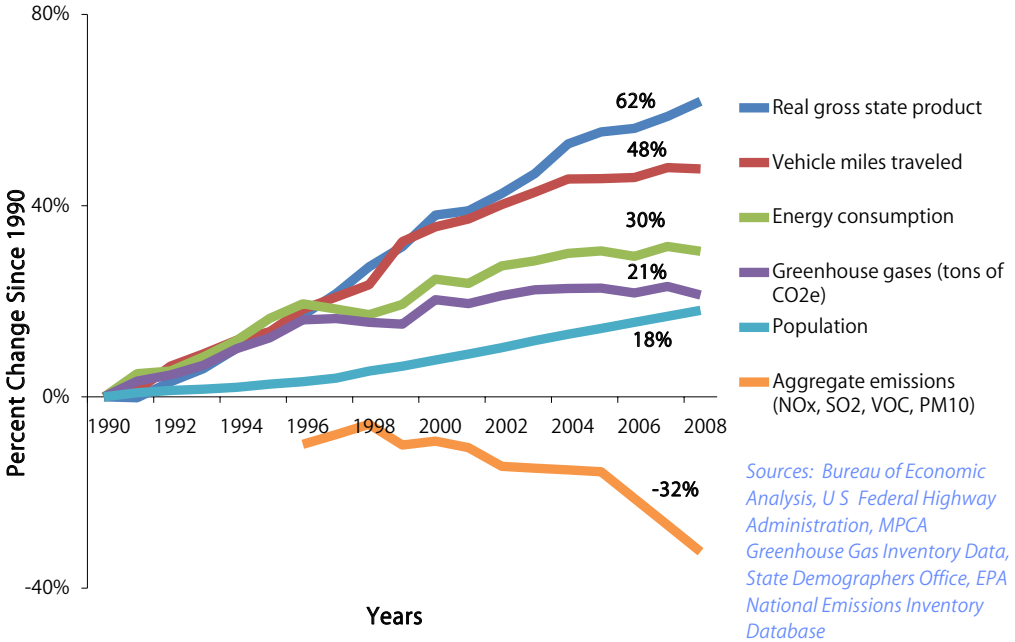
Air quality in Minnesota

Keeping Minnesota's air healthy and clean has been a primary goal of the Minnesota Pollution Control Agency (MPCA) since its inception in 1967. Thanks to enforcement of the Clean Air Act by the state and federal governments as well as the actions of an increasingly engaged and informed citizenry, Minnesota's air quality has consistently improved. In fact, despite sizeable increases in population, energy use, vehicle miles traveled and gross state product in Minnesota, emissions of most regulated pollutants have declined since 1990. A notable exception is greenhouse gases; emissions closely track levels of energy consumption and after years of growth have decreased only recently, due mainly to the recession and decreased energy use.

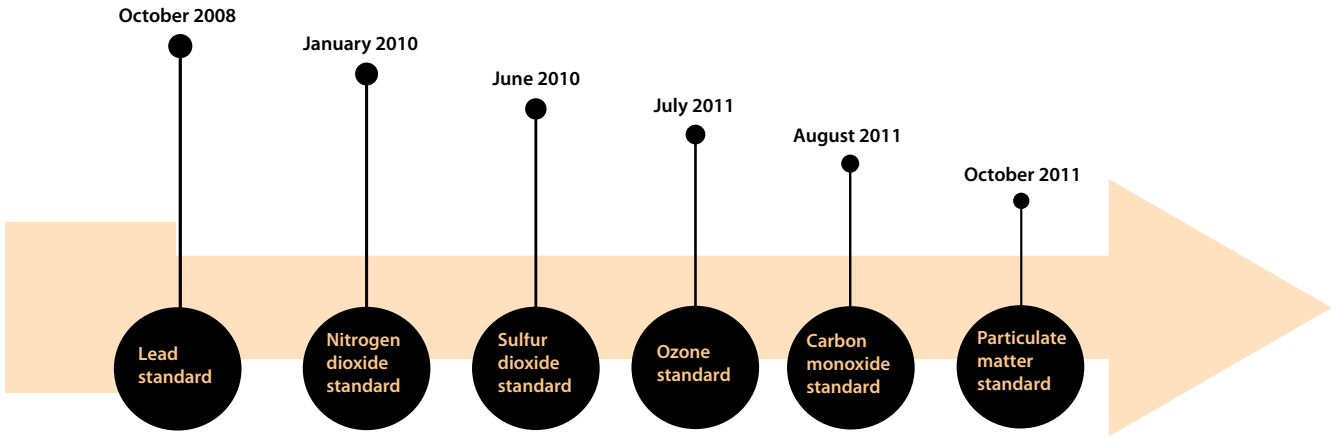
However, even as air quality programs and regulations have contributed to the decrease in emissions and concentrations of many air pollutants, an increased understanding of their serious health effects has resulted in on-going reevaluation of standards by the U. S. Environmental Protection Agency (EPA). Between 2008 and 2011, EPA plans to finalize new, more stringent standards for all six pollutants with National Ambient Air Quality Standards (NAAQS). These standards are being reviewed to better protect the health of those exposed to elevated levels of air pollutants.

These updated standards include new monitoring and modeling requirements to be completed by MPCA and permitted facilities to demonstrate compliance. In addition, Minnesota may exceed some of the NAAQS for the first time since 2002. For example, EPA announced in November 2010 that a portion of Eagan, Minnesota will be designated as "non-attainment" for the federal standard

Comparison of growth areas and emissions in Minnesota



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



EPA plans to finalize new health standards for all six pollutants with NAAQS by the end of 2011. Due to increased knowledge of potential health impacts from exposure to air pollution, most of these new standards are expected to be more stringent and focus on high-concentration days or hours. These changes pose monitoring, modeling and permitting challenges.

for airborne lead due to emissions from a lead recycling facility. Being out of attainment with federal standards can result in significant new requirements on MPCA, Minnesota businesses, transportation projects, and other projects to ensure that air pollutant emissions are reduced and concentrations decrease.

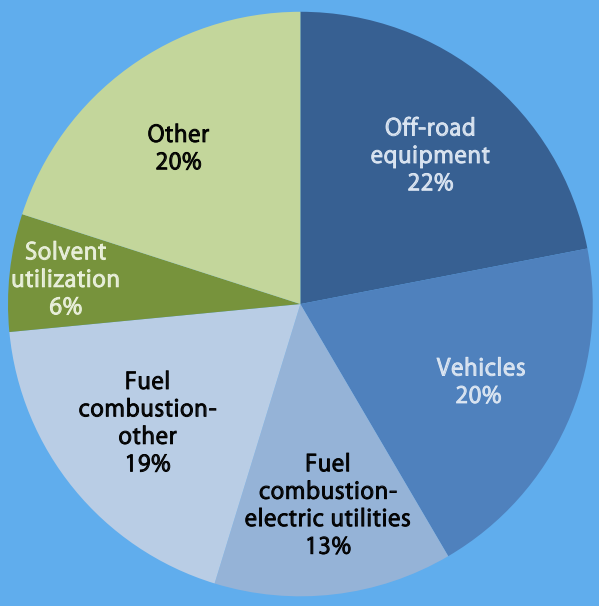
Even though overall air quality in Minnesota has been improving, on a given day, air pollution can reach levels of health and environmental concern for complex reasons. Pollutants can be produced locally, or can be emitted in other states or countries and travel hundreds of miles to affect air quality in Minnesota. Some components of measured pollutants such as fine particles, ozone and some toxic air pollutants are not emitted directly from sources, but form in the air from other pollutants. Wind direction and speed, temperature, and the ratio of pollutants in the air can all affect the final measured concentration of these pollutants.

The majority of Minnesota's current air pollutant emissions come from burning fossil fuels. Historically, MPCA has had limited authority over transportation and residential combustion sources. Therefore, MPCA is exploring innovative programs and partnerships to meet these new challenges.

Air emissions from burning fuel

Most of our current air quality challenges result from the combustion of fuels to produce electricity, generate heat, and move people or things on our highways and streets. Nearly 75 percent of key air pollutants including nitrogen oxides (NO_x), fine particles ($PM_{2.5}$), sulfur dioxide (SO_2), and volatile organic compounds (VOCs) come from burning fuel in vehicles, off-road equipment, electric utilities, and other industrial and residential sources. Increasing the energy efficiency of fuel combustion will be important to achieve future emission reductions due to the extensive reliance of our society and economy on the combustion of fuels, especially fossil fuels, for energy purposes.

Emission sources of key air pollutants



Source: 2008 emission estimates of NO_x, $PM_{2.5}$, SO_2 and VOCs from EPA's National Emissions Inventory Database

Pollutants with federal standards

EPA sets health-based NAAQS for six especially widespread air pollutants: particulate matter, ozone, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and lead. All of these standards have been made or are expected to be made more stringent by the end of 2011.

In Minnesota, fine particles and ozone concentrations will likely be very near or even above the new standards. The other pollutants are likely to remain below standards statewide; however, the new rules contain additional monitoring and modeling requirements and will impact permitting for both the state and facilities.

Particulate matter

Particulate matter has been regulated since 1971. The NAAQS for particles includes a standard for larger particles with an aerodynamic diameter less than 10 microns, known as PM_{10}. But through the years, researchers also recognized the health risk of smaller particles. As a result, starting in 1997, standards have been set for fine particles with an aerodynamic diameter less than 2.5 microns, known as $PM_{2.5}$.

Fine particles can be inhaled deeply into the lungs. These particles then accumulate in the respiratory system, where they can cause serious health effects. Specifically, elevated levels of fine particles cause a rise in heart attacks, acute and chronic bronchitis, asthma episodes, and reduced lung function and increased respiratory illness in young children. Some evidence suggests that exposure to fine particles may cause lung cancer.

EPA is reevaluating the particulate standards in response to scientists' better understanding of the serious risks associated with breathing even low levels of fine particles. In light of these potential health effects, EPA's new standards, expected in 2011, will likely be more stringent.

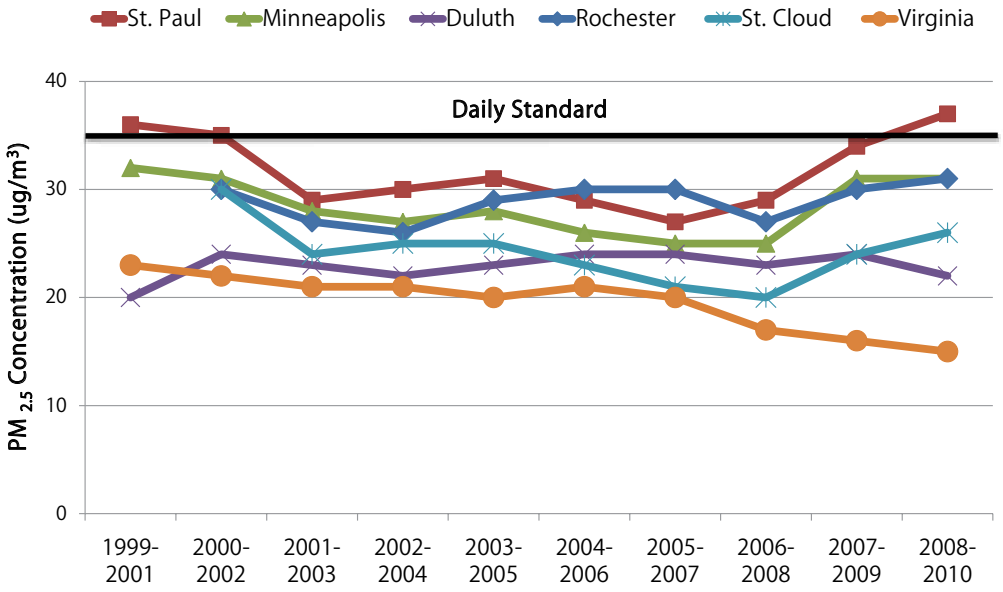
The concentration of particles in the air is the result of direct Minnesota emissions, transport of particles and precursor gases from outside the state, formation of particles in the air, and weather conditions. Weather affects the concentration of particles in the air by creating conditions that promote the formation of particles and by causing static air that holds pollution near the ground.

Currently there are daily and annual standards for $PM_{2.5}$. The daily standard protects against short-term high exposures to fine particles, while the annual standard protects against long-term average exposure. Historically, Minnesota has met both of these standards. However, while annual average concentrations have remained relatively stable, there were several short episodes of elevated particles in both 2009 and 2010. These episodes resulted in pollution levels in St. Paul over the current daily standard.

If EPA lowers the daily standard, then other locations in the Twin Cities may also have levels over the new standard. Because $PM_{2.5}$ is considered a regional pollutant, it is likely that the entire Twin Cities area would be considered out of attainment with the $PM_{2.5}$ NAAQS, even if only a few monitors show levels above the standard.

Non-attainment will have important consequences for Minnesota businesses, government and citizens. Air permits will have to ensure that emissions will not significantly increase levels of $PM_{2.5}$. MPCA will have to formulate and implement a federally approved plan to reduce concentrations of $PM_{2.5}$ and demonstrate through monitoring and modeling that the plan will be effective. While this reduction work will be resource-intensive, the long-term benefit will be cleaner air, fewer health problems, and avoided health costs for Minnesota citizens.

Minnesota daily $PM_{2.5}$ trends (1999-2010)

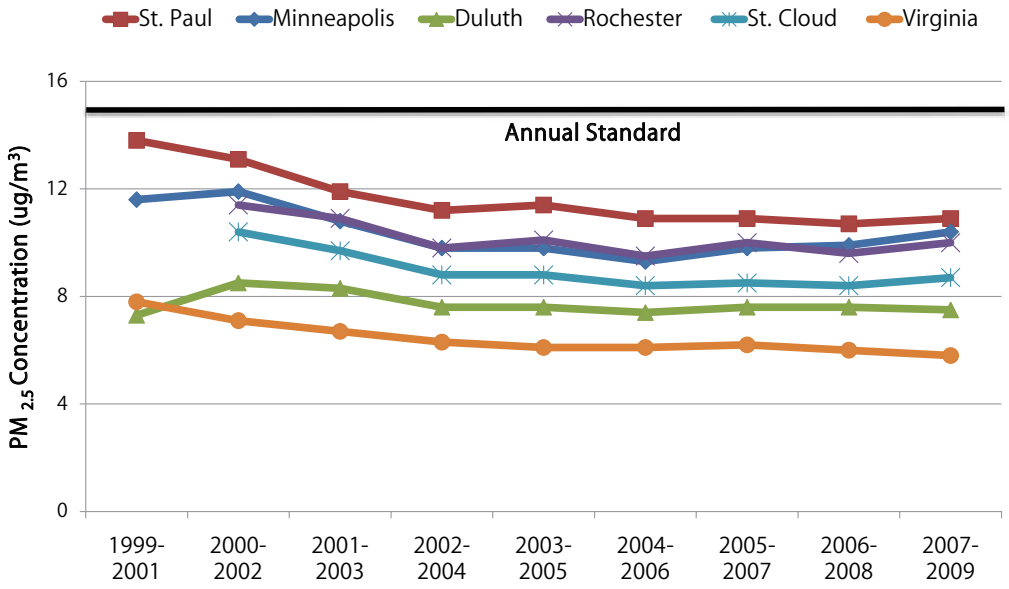


Source: MPCA air monitoring data

** 2010 data is incomplete*

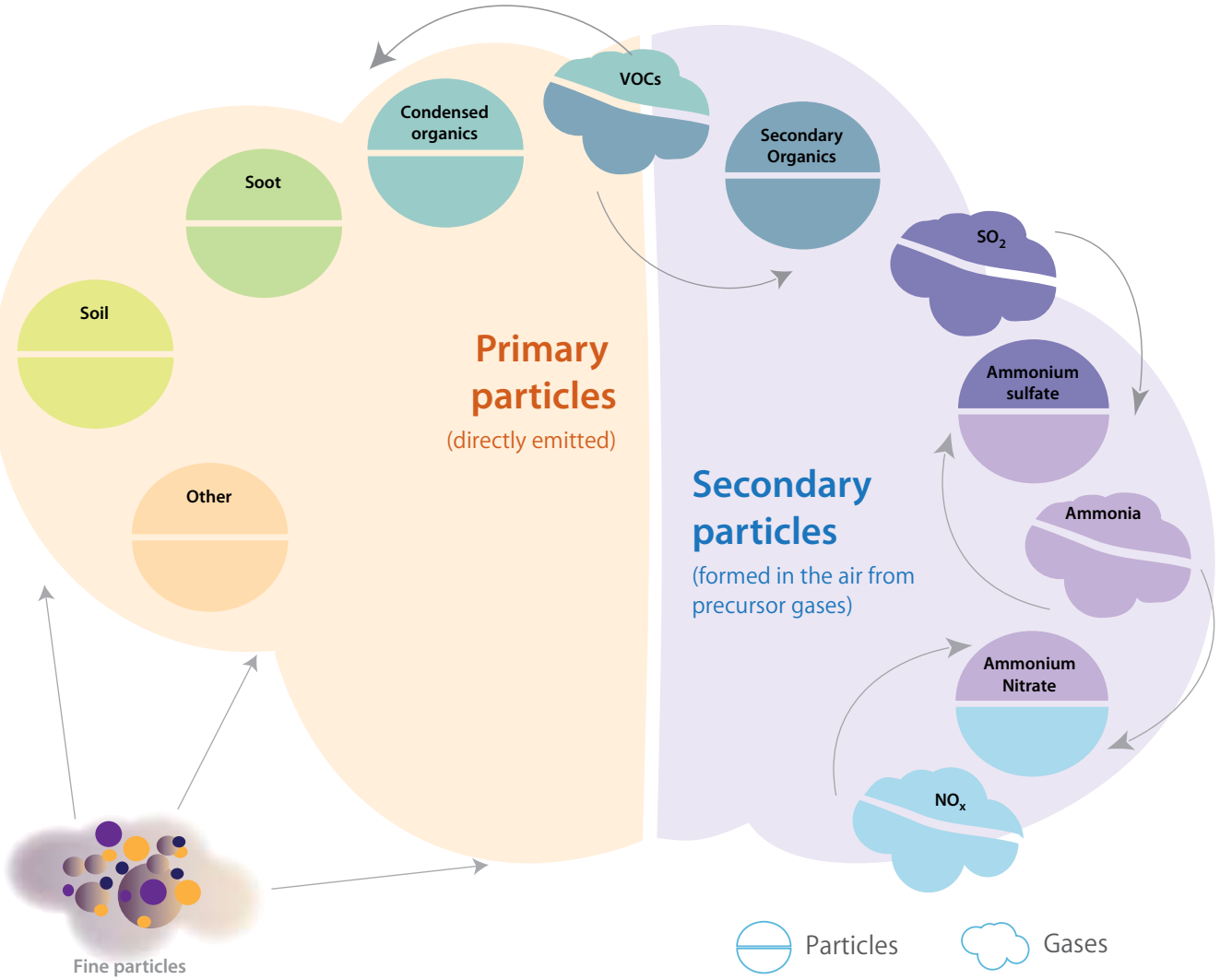
To meet the current daily $PM_{2.5}$ standard, the 98th percentile of the 24-hour $PM_{2.5}$ concentrations at a monitoring site in a year, averaged over three years, must be less than or equal to 35µg/m³. Since the daily standard is based on a few of the highest monitored days of the year, it is very sensitive to weather conditions. Until 2008, daily levels were well below the standard; however, several short periods of poor air quality in 2009 and 2010 resulted in estimated 2008-2010 $PM_{2.5}$ concentrations in St. Paul exceeding the current standard.

Minnesota annual $PM_{2.5}$ trends (1999-2009)



Source: MPCA air monitoring data

To meet the current annual $PM_{2.5}$ standard, the average annual concentration over three years must be less than or equal to 15µg/m³. The 2009 and 2010 average $PM_{2.5}$ concentrations have not shown the same increase as the daily values. Overall, concentrations in Minnesota have stayed relatively stable. Still, health effects associated with long-term $PM_{2.5}$ exposure, even below the standard, as well as potentially stricter 2011 annual standards, remain a concern. Minnesota may need to lower annual average $PM_{2.5}$ concentrations as well as high daily concentration days.



Fine particle formation

Fine particles are a chemically and physically diverse mixture of very small particles and liquid droplets, most of which are smaller than 2.5 microns in diameter. These particles vary in size, composition and origin. Some are directly emitted into the air, while others are formed in the air from "precursor gases."

Soot is directly emitted from combustion sources such as diesel engines or burning biomass. Soil material results from road, construction or agricultural dust. However, other particles such as ammonium sulfate and ammonium nitrate form when SO_2 and nitrogen oxides (NO_x) react with ammonia in the air.

Some particles can be both directly emitted and formed in the air. For example, organic particles are directly emitted when fuels are combusted and are also formed when gaseous organic compounds are released and react in the air.

Additionally, some sources release both direct particles and pollutants that form fine particles in the air. For example, diesel engines emit diesel particulate and soot directly as well as releasing NO_x, which may later react with ammonia to form ammonium nitrate particles.

Ozone

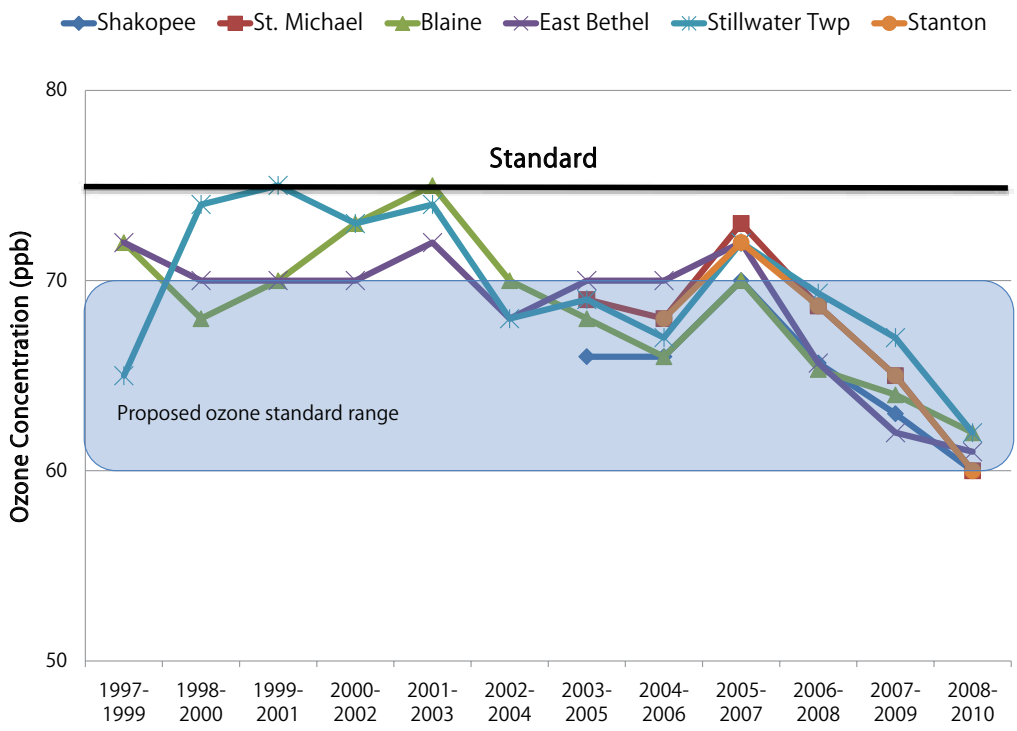
The current ozone standard of 75 ppb was set in 2008. EPA decided to reconsider this standard due to concerns that it may not be fully protective of public health. In early 2010, EPA proposed a more stringent standard of between 60 and 70 ppb. The final standard is expected by mid 2011.

Breathing air containing elevated ozone concentrations can reduce lung function, thereby aggravating asthma or other existing respiratory conditions. The impact of exposure to ozone includes increased medicine use, doctor and emergency room visits, and hospital admissions. Ozone may also contribute to premature death in people with heart and lung disease. In addition, repeated exposure to low levels of ozone damages vegetation, trees and crops.

All Minnesota monitoring sites meet the current ozone standard. However, concentrations in the Twin Cities as well as some locations in greater Minnesota such as Brainerd, Marshall and Rochester are within the proposed range of the new standard. Minnesota's future attainment of the ozone NAAQS will depend on the final level of the standard as well as which years EPA chooses to use for final attainment designation, due to the strong impact of varying summer weather conditions on ozone levels. With ozone levels in Minnesota so close to concentrations that have the potential to cause health concerns, MPCA will need to focus on reductions regardless of the final attainment designations.

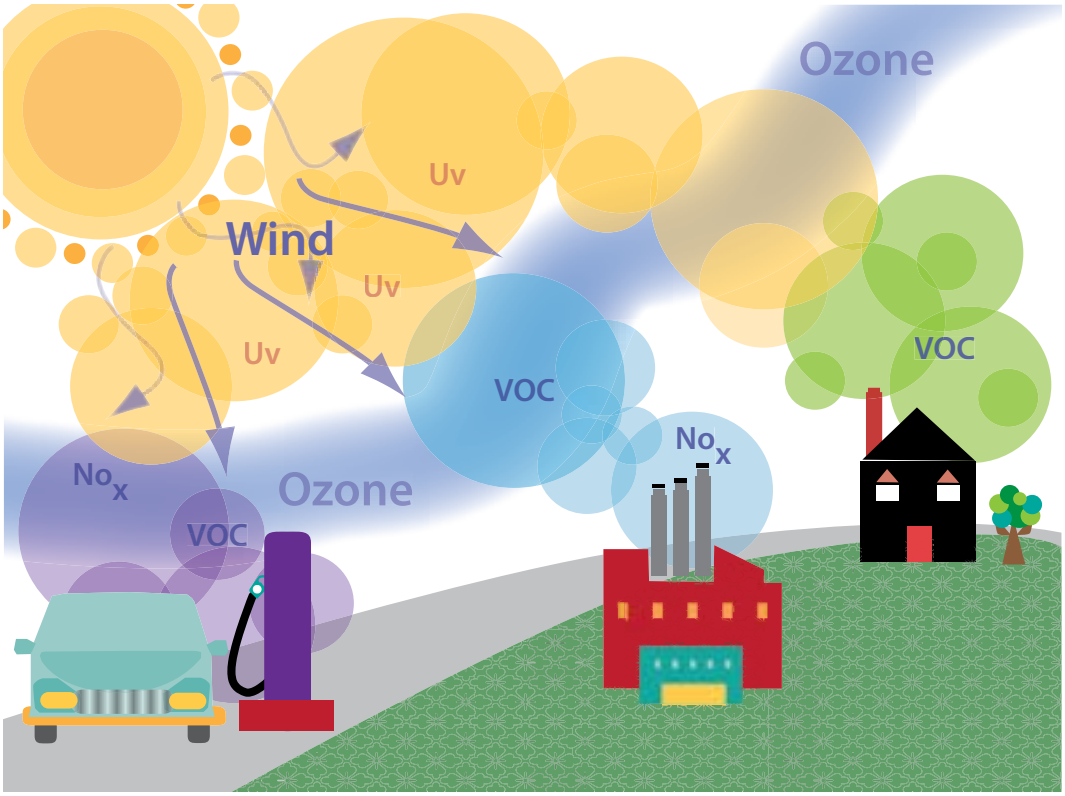
Ozone concentrations tend to be highest just outside urban areas, since other pollutants emitted in urban centers actually destroy ground level ozone. As a result, MPCA does not monitor ozone in urban centers such as Minneapolis and St. Paul, but does in surrounding suburban areas.

Twin Cities ozone trends (1997-2010)



Source: MPCA air monitoring data

To meet the current ozone NAAQS, the three-year average of the fourth-highest daily maximum eight-hour concentration must be less than or equal to 75 ppb. All of the monitoring sites in Minnesota continue to meet this standard; however, concentrations fall within the range of the proposed new NAAQS of 60-70 ppb. The new final standard is expected in 2011.



Ozone formation

Ozone is a colorless gas composed of three atoms of oxygen. In the upper atmosphere it helps protect the earth from the sun's ultraviolet radiation, but at ground level it can be a harmful pollutant.

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

NO_x is a group of highly reactive gases that includes nitrogen dioxide (NO_2), and nitric oxide. NO_2 is the component of greatest interest and is used as an indicator for the larger group of NO_x.

Levels of ozone are dependent on the amount and ratios of these VOCs and NO_x in the air as well as weather conditions including sunlight, temperature, and wind speed and direction.

Sulfur dioxide and nitrogen dioxide

EPA finalized new standards for both nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) in 2010. With these new standards, EPA has shown an increased focus on protecting against short-term exposures to these pollutants. For NO_2, EPA set a new hourly standard of 100 ppb in addition to the existing annual standard of 53 ppb. EPA eliminated the daily and annual standard for SO_2, replacing it with an hourly standard of 75 ppb.

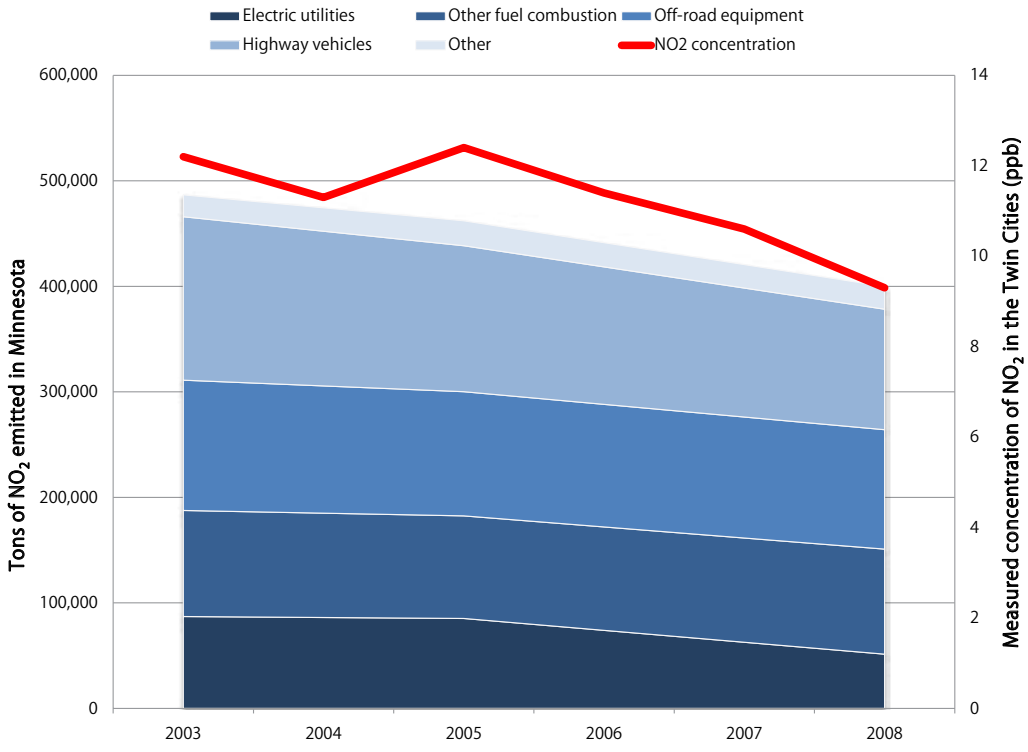
Short-term standards are needed to prevent aggravation of asthma and chronic bronchitis and reduce unnecessary emergency room and hospital visits. However, short-term standards are more difficult to monitor, model and regulate.

The new hourly standard for NO_2 is designed to protect public health by limiting people's exposures to short-term peak concentrations of NO_2, which primarily occur near major roads. EPA estimates that concentrations of NO_2 within about 50 meters of heavy traffic or freeways can be 30 to 100 percent higher than concentrations away from major roads. In order to show compliance with this new standard, EPA will require MPCA to add two new monitors near major roadways in the Twin Cities by 2013. In addition, facilities that emit NO_2 may need to use computer models to demonstrate that they will not go over the standard.

The new SO_2 standard also poses unique challenges. While additional monitoring will likely not be required in Minnesota, EPA plans to use a new approach for reviewing air quality conditions by combining air quality monitoring and modeling to determine compliance with the hourly standard. Medium and large facilities will be expected to model the impact of their SO_2 emissions on surrounding communities while smaller sources will rely on MPCA monitoring data to demonstrate that they meet the standard.

Current monitoring data show that Minnesota air concentrations are below the new standards. However, EPA will likely consider Minnesota's air as "unclassifiable" for NO_2 and SO_2, meaning that no further action will be taken until MPCA has sufficient near-road monitoring and facility-specific modeling data to determine attainment status.

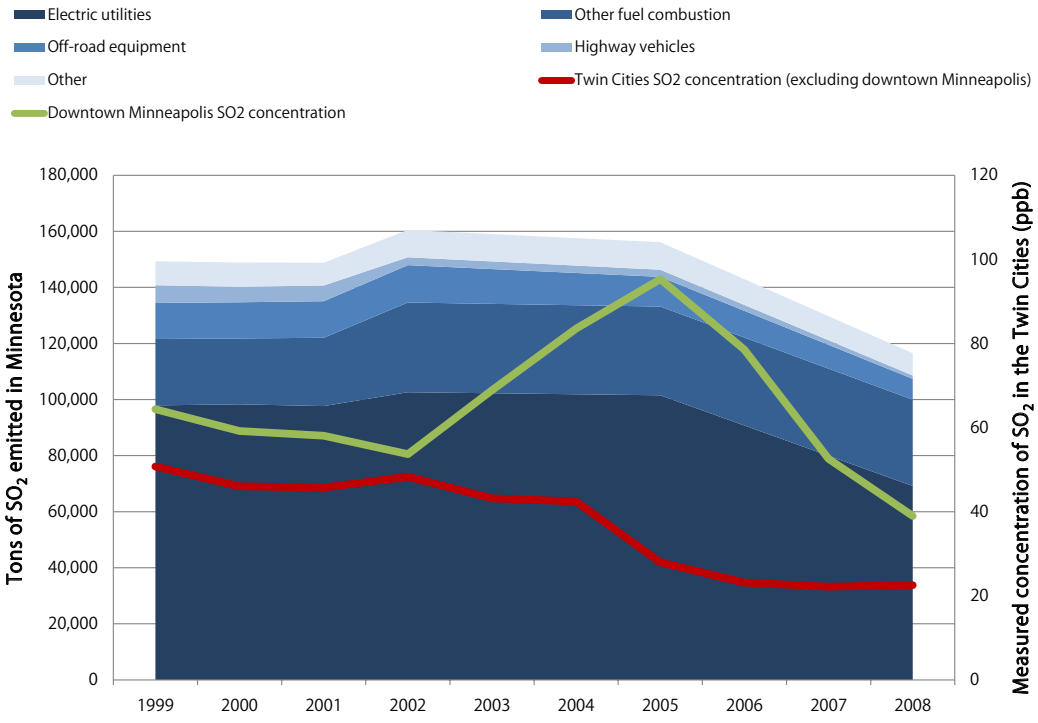
Trends in NO_2 annual emissions and concentrations (2003-2008)



Sources: NO_2 emissions from the EPA National Emissions Inventory Database NO_2 concentrations from the MPCA air monitoring network

Annual average concentrations of NO_2 (red line) have been decreasing since 2003, mainly due to decreases in emissions from electric utilities and highway vehicles. Measured concentrations of annual NO_2 are well below the annual standard of 53 ppb. Near-roadway measurements will be available in 2013 to compare to the new hourly standard.

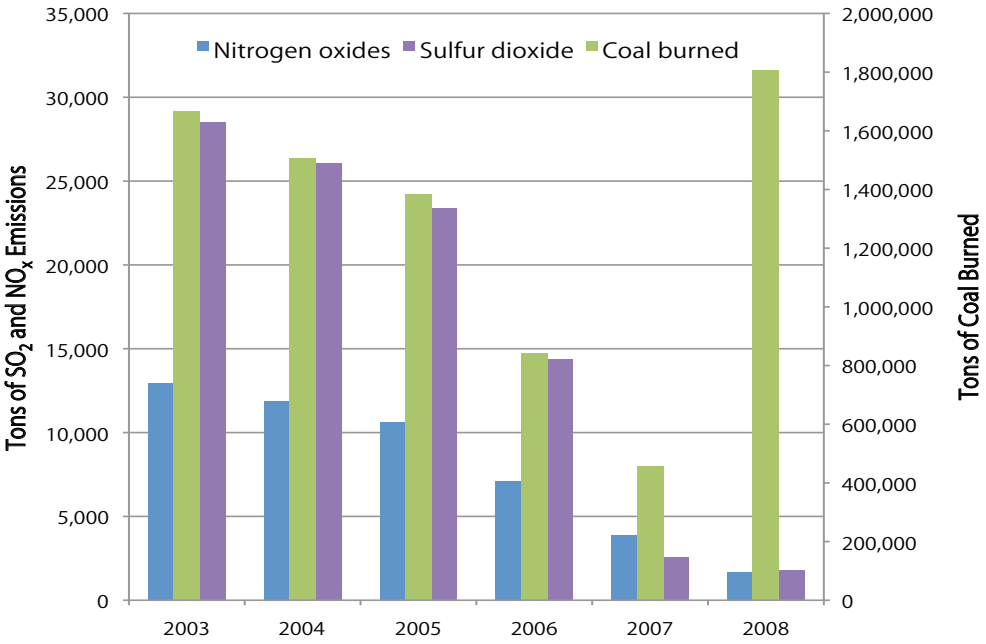
Trends in SO_2 annual emissions and hourly concentrations (1999-2008)



Sources: SO_2 emissions from the EPA National Emissions Inventory Database
SO_2 concentrations from the MPCA air monitoring network

Hourly concentrations of SO_2 have decreased as emissions from coal-fired power plants and off-road equipment have decreased. Measured levels are well below the new hourly standard of 75 ppb. The downtown Minneapolis site is near the Hennepin Energy Recovery Center, a source of SO_2. Hourly standards are sensitive to high, short-term peaks in concentration from local sources. As a result, while hourly concentrations at other Twin Cities monitoring sites (red line) decreased as emissions decreased, higher short-term concentrations were measured at the downtown Minneapolis site (green line). Recent concentrations measured in downtown Minneapolis meet the new standard.

Emission reductions resulting from the MERP at the Allen S. King power plant



Source: Minnesota Criteria Pollutant Emissions Inventory

Power plant emission reduction projects

In 2004, the Minnesota Public Utilities Commission (PUC) approved Xcel Energy's Metropolitan Emissions Reduction Project (MERP) which planned to retrofit several coal-fired power plants to increase capacity while reducing emissions of mercury, NO_x, SO_2 and particulates. The St. Paul High Bridge power plant was converted from coal to natural gas in 2008, while the Riverside facility in Minneapolis was converted in 2009. After the conversion, SO_2 emissions from the High Bridge facility dropped from nearly 4,000 tons to just under one ton, while NO_x emissions decreased from 6,000 tons to 30 tons.

In addition, Xcel Energy renovated the Allen S. King coal-fired power plant in Oak Park Heights with state-of-the-art pollution controls. As a result of these changes, in 2008 the Allen S. King plant burned more coal than it did in 2004, but decreased emissions of SO_2 by over 26,000 tons and emissions of NO_x by over 11,000 tons. Emissions of SO_2 decreased seven percent statewide while nitrogen oxides decreased four percent, mainly due to MERP renovations.

In 2007, the PUC approved Minnesota Power's Boswell 3 Environmental Improvement Plan. As a result, Minnesota Power installed modern air pollution controls on Unit 3 of the Boswell coal-fired power plant in Cohasset . The pollution controls were operational in April 2009, resulting in over 90 percent reduction of NO_x, SO_2 and mercury.

Minnesota Power has also undertaken NO_x reduction projects on all of its coal-fired boilers at the Boswell power plant, the Laskin power plant in Hoyt Lakes, and the Taconite Harbor power plant in Schroeder. In an effort to achieve additional SO_2 and mercury reductions, Minnesota Power has also installed novel air pollution control systems at Taconite Harbor. Within the next five years, all three Taconite Harbor units will be operating NO_x, SO_2 and mercury controls.

Impact of proposed transport rule in Minnesota

The Clean Air Act contains a requirement, known as the "good neighbor" provision, meant to prevent emissions within a state from contributing significantly to non-attainment of the NAAQS in other states. In March 2005, EPA promulgated the Clean Air Interstate Rule (CAIR) to address this interstate transport of air pollutants. CAIR capped emissions of SO_2 and NO_x from power plants in 28 eastern states, including Minnesota, and set up a cap-and-trade system. In 2008, the District of Columbia Circuit Court of Appeals remanded the rule to EPA for reconsideration. In response, EPA proposed the Transport Rule in 2010.

The Transport Rule covers power plants in 31 states. The states included in the Transport Rule were determined by EPA to make a "significant contribution" to non-attainment or interference with maintenance of existing standards for ozone and $PM_{2.5}$ in other states. The framework of the rule is designed so that it can be easily adapted as EPA lowers the standards for these pollutants. Minnesota is included due to its impact on non-attainment of the $PM_{2.5}$ NAAQS in the Chicago and Milwaukee areas, and interference with maintenance of the $PM_{2.5}$ NAAQS in Wisconsin and Iowa.

The CAIR states must reduce their emissions to levels specified in budgets set forth by EPA. EPA establishes a budget for SO_2 and NO_x emissions for each covered source; these budgets are aggregated to create a state-level budget. The budgets are based on emission reductions that can be made at a price of $500 per ton for NO_x reductions and $2,000 per ton for SO_2.

The program allows unlimited trading within a state, along with limited trading between states. There are two SO_2 trading markets: one for Group 1 states and one for Group 2 states. Group 1 states have more stringent pollution budgets in 2014. Minnesota is a Group 2 state because EPA determined that the Phase 1 emission reductions should be enough to mitigate Minnesota's significant impact on other states.

States can trade SO_2 allowances only with other states in the same group. Annual NO_x allowances can be traded with any other state covered by the Transport Rule. In 2014 and later, the overall emissions in a state cannot exceed the state's budget plus a variability limit of about 10 percent. This is designed to account for the inherent variability in emissions and to prevent a shift in emissions toward any state through the utilities in that state simply buying allowances to comply. The final version of the Transport Rule is expected in late spring 2011. After that, additional rulemaking is needed to account for the reconsidered ozone and upcoming $PM_{2.5}$ standards.

Taconite Harbor Power Plant, Schroeder, Minnesota

Lead

In 2008, EPA finalized a NAAQS for lead that was 10 times stricter than the previous standard. Scientific evidence about the health effects of lead has expanded significantly in recent years. Exposure to low levels of lead early in life has been linked to effects on IQ, learning, memory and behavior.

Minnesota air meets this new, more stringent lead standard at nearly all locations. However, lead concentrations measured near Gopher Resources, a lead recycling facility in Eagan in Dakota County, exceed the current standard. EPA has designated 4.5 square miles around the facility as being in non-attainment with the new standard. Gopher Resources has already installed additional pollution control equipment to lower its lead emissions. MPCA will submit a state implementation plan in 2012 detailing how Gopher Resources and the state plan to meet the lead standard by 2015.

The new standard also required lead monitoring near two additional facilities in Minnesota with the potential to emit at least one ton of lead per year. Monitoring began in 2010. So far, no concentrations above the standard have been measured at these facilities. For more information on lead monitoring see **www.pca.state.mn.us/index.php/view-document.html?gid=394**.

Carbon monoxide

A new carbon monoxide (CO) standard is expected in 2011. CO is a colorless and odorless toxic gas that is formed during incomplete combustion of fuels. Outdoors, CO is mainly a concern near major roadways and intersections. Currently, concentrations of CO in Minnesota are nearly five times lower than the current NAAQS and are expected to be below the levels proposed for the new NAAQS.

Air monitoring equipment near Gopher Resources, a lead recycling facility in Dakota County

Air toxics

While only six air pollutants have NAAQS, there are hundreds of other chemicals in Minnesota air that can cause serious health problems. Referred to as air toxics, these chemicals interact in the air in complex ways. For example, many air toxics such as formaldehyde and acrolein are also VOCs that contribute to the formation of ozone. Other air toxics are metals or organics that can also exist in the form of fine particles.

In recognition of the importance of air toxics, in 2010 MPCA began developing strategies to reduce the levels of these pollutants by identifying those of greatest concern. The air toxics identified include diesel particulate, formaldehyde, acrolein, polycyclic aromatic hydrocarbons (PAHs), and dioxins and furans. These air toxics are somewhat different than those highlighted in the past since MPCA used not only monitoring data, but a powerful new risk screening tool called MNRiskS (see sidebar on page 18) to identify them. MNRiskS is a computer program that models mutipathway, multipollutant human health risks from air toxics statewide.

Combustion of fossil fuels, biomass, and garbage is the most important emission source for all the identified air toxics. Now that MPCA has identified priority air toxics, the agency will engage partners to develop strategies to reduce emissions and concentrations of these pollutants. Since air pollution is interconnected, it is likely that multiple pollutants can be reduced by controlling targeted sources. A broad PM and VOC emission reduction strategy could help reduce public health impacts of several pollutants of concern and assist with non-attainment efforts. MPCA will continue its regulatory efforts and also is likely to focus on community engagement, partnerships, and voluntary programs to help lower the risk Minnesotans face from air toxics.

Diesel particulate

MNRiskS modeling identified diesel particulate as a priority air toxics risk in Minnesota due to its widespread emissions and potential to aggravate allergies and asthma and even cause lung cancer. Diesel particulates are formed by the incomplete combustion of diesel fuels. Currently, diesel particulate concentrations cannot be directly measured. While there is no federal or state standard for diesel particulate, it is a component of directly emitted $PM_{2.5}$. Reducing diesel particulate should directly improve the health of exposed individuals as well as help Minnesota meet federal $PM_{2.5}$ standards.

MNRiskS modeling

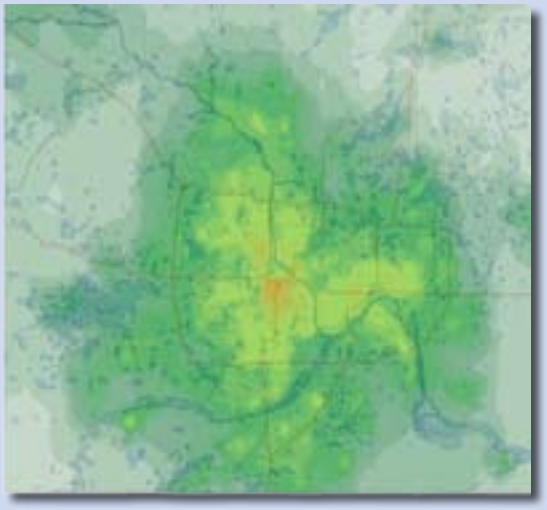
MNRiskS is a risk screening tool developed by MPCA that models multipathway, multipollutant human health risks from air toxics statewide. MNRiskS includes estimated 2002 emissions from large facilities, smaller stationary sources, and mobile sources. An updated version using 2005 data is expected to be complete in 2011. (Minnesota only estimates air toxics emission every three years, and 2008 data are not yet available.) MPCA is using results from MNRiskS to help identify priority air pollutants and their primary sources to target for risk reductions.

MNRiskS can model the risks of pollutants from different emissions sectors. The majority of diesel particulate emissions in Minnesota come from commercial and industrial diesel generators and from off-road diesel equipment such as agricultural, construction and mining equipment, and locomotives. Heavy-duty diesel trucks and buses also contribute significantly to emissions. Large facilities are not a significant source of diesel emissions overall. The graphics on this page show the estimated concentration of diesel particulate emissions due to different types of emission sources in the Twin Cities, based on 2002 emissions.

Large facilities

Smaller stationary sources

Off-road equipment



Highway vehicles

Increasing diesel particulate concentration

Cleaner transportation

Transportation remains a major source of air pollution. Burning fuels in vehicles creates a quarter of all VOC emissions and a third of all NO_x emissions. Transportation is a major contributor to direct fine particle emissions including diesel particulates and air toxics. This sector contributes over a quarter of CO_2 emissions from fossil fuel combustion in Minnesota. While MPCA has limited authority over transportation, programs are in place to reduce emissions from diesel vehicles and encourage new technologies such as electric vehicles.

Clean diesel

MPCA has focused on the reduction of heavy duty diesel vehicle emissions, including particulate matter, NO_x and CO_2. Using partnerships and state and federal funding, MPCA has facilitated the purchase of pollution reducing technology and idle reduction devices as well as replacement of engines and exhaust systems. MPCA has partnered with and provided state and federal grants to Clean Air Minnesota (CAM), a nonprofit organization that has focused on retrofitting school buses with emission reduction equipment. Through CAM's Project Green Fleet program, over 1,800 school buses have been retrofitted across Minnesota.

MPCA has also used a federal Recovery Act grant to reduce heavy-duty diesel emissions from nearly 275 vehicles. Included are 75 cleaner trailer refrigeration generator engines, 47 diesel oxidation catalysts, six new engines for marine and construction vehicles, and 145 idle reduction devices placed on long haul trucks. MPCA also has offered loans using state small-business and federal grant funding for idle reduction devices on 111 long haul trucks. Another federal grant focuses on reducing emissions from public, heavy-duty vehicles in the Twin Cities, including snowplows, dump trucks and fire trucks. By the end of 2010, 360 trucks will have been retrofitted.

These diesel emission reduction programs are expected to result in emission decreases of CO_2 by nearly three tons, NO_x by 70 tons, and $PM_{2.5}$ by over four tons per year.

Electric vehicles

MPCA is interested in promoting the use of electric vehicles because they emit no toxic air pollutant emissions at the tailpipe and, when charged with electricity generated from renewable sources, emit no toxic or greenhouse gas air emissions during electricity generation.

The Minnesota Electric Vehicle Coalition, led by MPCA, includes representatives from metro-area cities, counties, state agencies, interested non-profits, and a major utility. This coalition is working toward the installation of publicly available plug-in charging stations and early procurement of electric vehicles by local government fleets.

The result is the planned installation of electric-vehicle supply equipment to create approximately 30 on-street, parking-ramp, and flat-lot charging stations during 2011. In addition, four solar powered stations are planned for inclusion in the Energy Innovation Corridor adjacent to the light rail corridor between St. Paul and Minneapolis. A coalition goal is to power public plug-in charging sites with renewable wind-source or solar equivalent electricity.

Formaldehyde and acrolein

Formaldehyde and acrolein have been identified as priority air toxics by EPA's National Air Toxics Assessment, MNRiskS, and MPCA monitoring. Both pollutants cause eye and respiratory irritation at low levels, and formaldehyde is also a carcinogen. They have diverse sources, including direct emissions from combustion sources and emissions from natural sources such as vegetation. More complex pollutants can also break down in the air, creating formaldehyde and acrolein. In the summer, over half of the concentrations of these pollutants result from airborne reactions rather than direct emissions.

Due to the variety of sources and formation in the air, concentrations can be elevated across the state. Because of their complex sources, the best strategy for reducing formaldehyde and acrolein may be a broad reduction of VOCs.

PAHs, dioxins and furans

Some air pollutants cause harm not just by breathing them directly, but also by settling onto the ground and becoming part of the food chain. Both polycyclic aromatic hydrocarbons (PAHs), and dioxins and furans are persistent, toxic, and bioaccumulate in meat, fish and dairy products. Dioxins and furans as well as some PAHs are also potent human carcinogens that are especially harmful for pregnant women, children, and the elderly. A special concern for dioxins and furans includes high levels in human breast milk.

Residential garbage burning is the largest source of dioxins and furans, while residential wood burning is one of the largest sources of PAH emissions. These pollutants are also emitted from other combustion sources. MNRiskS modeling shows elevated cancer risks in population centers, including the Twin Cities, for PAHs, dioxins and furans. MPCA does not routinely monitor for these pollutants.

Residential combustion

Minnesotans burn at home for many reasons including heating, cooking, recreation, and garbage disposal. In many parts of the state, particularly rural areas, wood stoves and furnaces are used for supplemental or primary home heating. As other traditional heating methods such as electricity, natural gas and fuel oil have increased in price, more Minnesotans have turned to wood stoves and outdoor wood boilers.

These stoves and boilers emit more air pollutants because they burn with lower efficiency than furnaces burning natural gas or fuel oil. Additionally, these devices often have short stacks that don't allow smoke to adequately disperse.

According to the 2005 Minnesota Emissions Inventory, residential wood burning including fireplaces, woodstoves, outdoor boilers, and recreational fires contributed 28 percent of direct emissions of $PM_{2.5}$, 54 percent of benzo(a)pyrene (a major component of PAHs), and 11 percent of VOCs statewide.

Besides burning wood for heat and recreation, many Minnesotans burn garbage in burn barrels, backyard fire pits, and wood stoves. According to Minnesota's 2005 emissions inventory, garbage burning creates the majority of airborne dioxins and furans in Minnesota (67 percent) and almost a quarter of benzo(a) pyrene. Garbage burning also contributes to direct emissions of $PM_{2.5}$ (13 percent) and formaldehyde (five percent).

In Minnesota, open garbage burning has been illegal for nearly all residents since 2006. MPCA has actively engaged local units of government and other partners to reduce backyard burning through a combination of policy and statutory discussions, education, enforcement, incentives, and development of garbage collection infrastructure.

MPCA conducted a statewide study in the spring of 2010 on residential garbage burning to explore what had changed since a 2005 baseline study. Residents from rural and semi-rural areas within 80 of Minnesota's 87 counties were interviewed. According to these most recent results, the use of open burning as a means to dispose of garbage has fallen 12 percent (30,657 households) since the 2005 baseline study was completed.

According to preliminary analysis, in order for MPCA to reach the goal of reducing household burning garbage by 75 percent by January 2013, about 169,000 more households need to quit burning trash in the next two years.

These results and others will be further analyzed by MPCA and its partners to determine the best course of action to reduce on-site burning of household waste in the future. A copy of the 2010 study can be viewed or downloaded at **www.pca.state.mn.us/index.php/view-document.html?gid=14316**.

Mercury

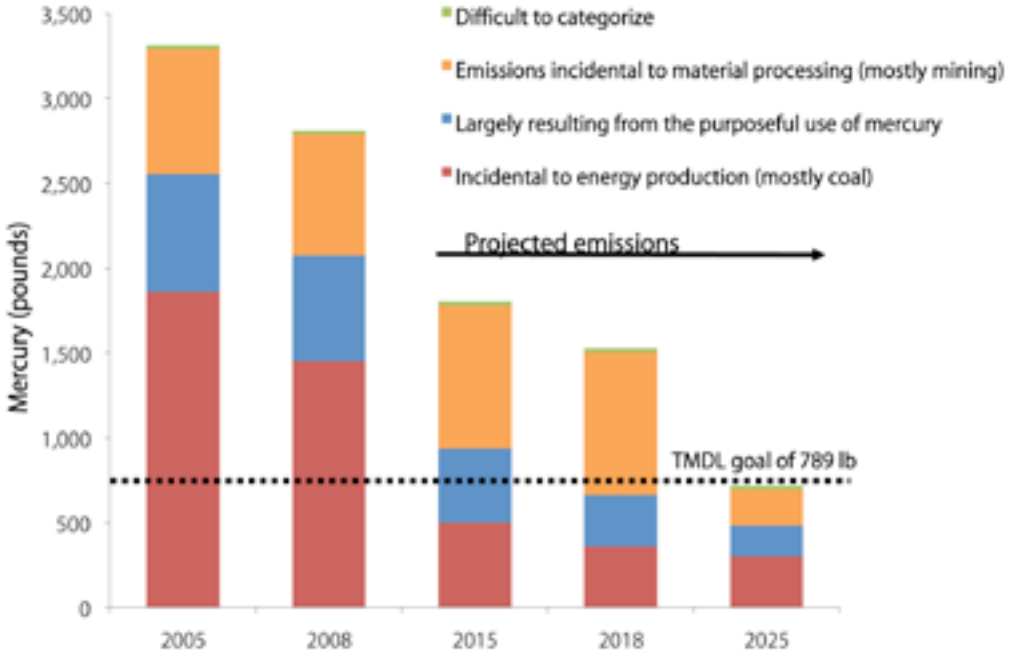
Many Minnesota lakes have high enough concentrations of mercury in fish to potentially affect the health of people and fish-eating wildlife such as loons, mink, and eagles. In about two-thirds of the lakes, rivers, and streams that MPCA tests, fish such as walleye and northern pike are contaminated with too much mercury. Because of health concerns, the Minnesota Department of Heath recommends that people restrict their consumption of these fish.

The vast majority of mercury in Minnesota's environment comes from the air, falling out of the sky with rain and snow. Only about 10 percent of mercury falling from the air in Minnesota comes from sources in the state. The remainder is emitted by sources in the rest of the world, including some from other states. Similarly, most of the mercury emitted in Minnesota falls outside of the state.

In 2007, under the federally mandated Total Maximum Daily Load (TMDL) provisions of the Clean Water Act, the MPCA established a goal of reducing air emissions of mercury by about 75 percent from 2005 emissions of 3,314 pounds. The TMDL goal is to emit no more than 789 pounds per year by the year 2025. Subsequently, stakeholders and the MPCA developed a TMDL implementation plan to achieve these reductions by 2025. The largest emission sources in the state are the burning of coal and the processing of taconite iron ore. In addition, the use and disposal of a variety of mercury-added products contributes significantly to emissions. The MPCA estimates that in 2008, emissions of mercury from all sources in the state totaled 2,763 pounds, a level that is compatible with reaching the reduction goal by 2025.

Producers and retailers of electricity are required by Minnesota's Mercury Emissions Consumer Information Act of 1997 to report the amount of mercury emitted through the generation of electricity. This law also requires the MPCA to summarize this information in its biennial air toxics report to the Legislature. In 2008 and 2009, facilities in Minnesota reported the emission of 1,251

Actual and projected mercury emissions in Minnesota, 2005-2025



Source: Minnesota Criteria Pollutant Emissions Inventory Reduction targets established by the Mercury Strategy Workgroup

and 1,090 pounds of mercury, respectively, in the production of electricity within the state. Electricity consumed in Minnesota, but produced outside the state, resulted in an additional 1,892 and 1,926 pounds of mercury emissions in those two years.

Reductions called for in the Minnesota Legislature's Mercury Emission Reduction Act of 2006 will contribute significantly to achieving the state's reduction goal. This law calls for reductions at the state's three largest coal-burning power plants by the end of 2014. The first phase of this reduction was completed in 2010 at Minnesota Power's Boswell Plant in Cohasset and Xcel Energy's Sherco Plant in Becker. Minnesota Power has completed an air pollution control retrofit of Boswell Unit 3, and is expecting to achieve 90 percent control of mercury from this coal-fired generating unit. Xcel Energy has installed mercury control equipment on Sherco Unit 3, and is expecting similar results. Data demonstrating mercury capture will be finalized in early 2011.

Minnesota's taconite-processing industry, soon to be the largest mercury emission source in the state due to decreases in the coal-fired energy sector, is working to identify and prove pollution control technologies suited to their unique industry. Promising initial research findings will be expanded with the aid of a federal grant awarded to the Minnesota Department of Natural Resources in 2010.

Greenhouse gases

Climate change results from the buildup of a group of compounds, collectively called greenhouse gases, in the atmosphere. Scientists agree that the most important greenhouse gas is carbon dioxide (CO_2), which comes mainly from the combustion of fossil fuels such as coal, oil, and gas. Methane makes up about 10 percent of Minnesota's greenhouse gas emissions in terms of carbon dioxide equivalents, while about 84 percent of Minnesota's greenhouse gas emissions consist of CO_2. Methane emissions are 25 times more potent than CO_2 per unit released.

Climate change will affect Minnesota's natural ecosystems, agriculture, forestry, outdoor recreation, infrastructure such as wastewater treatment and flood control, and human comfort. There is strong evidence[1] that current Minnesota ecosystems will be affected by a changing climate and may not be able to persist in their current condition in a warmer climate. For example, some species, such as those in the boreal forest that are currently at the southern edge of their range, may move northward as suitable habitat is lost. These changes will alter the face of Minnesota's physical and cultural landscapes.

The mean annual temperature in Minnesota has increased about 1° F in the southern area of the state and about 2° F in the northern area of the state in the last 100 years. Most of the rise in temperature occurred in the last decades. Besides changes in temperature, precipitation is expected, and has been observed, to occur in more frequent and intense storms, with fewer light and moderate precipitation events.[1]

The federal government has been active in addressing greenhouse gases over the last few years. In 2009, EPA implemented greenhouse gas reporting requirements for six gases: CO_2, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. These emissions are reported in terms of carbon dioxide equivalents (CO_2e) which compares warming potential to the impact of CO_2. The initial reports are due to EPA in 2011 for emissions from 2010.

Suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of greenhouse gases are required to submit annual reports to EPA. Currently, MPCA estimates greenhouse gas emissions from sources holding air quality permits in Minnesota based upon their annual emissions reporting data.

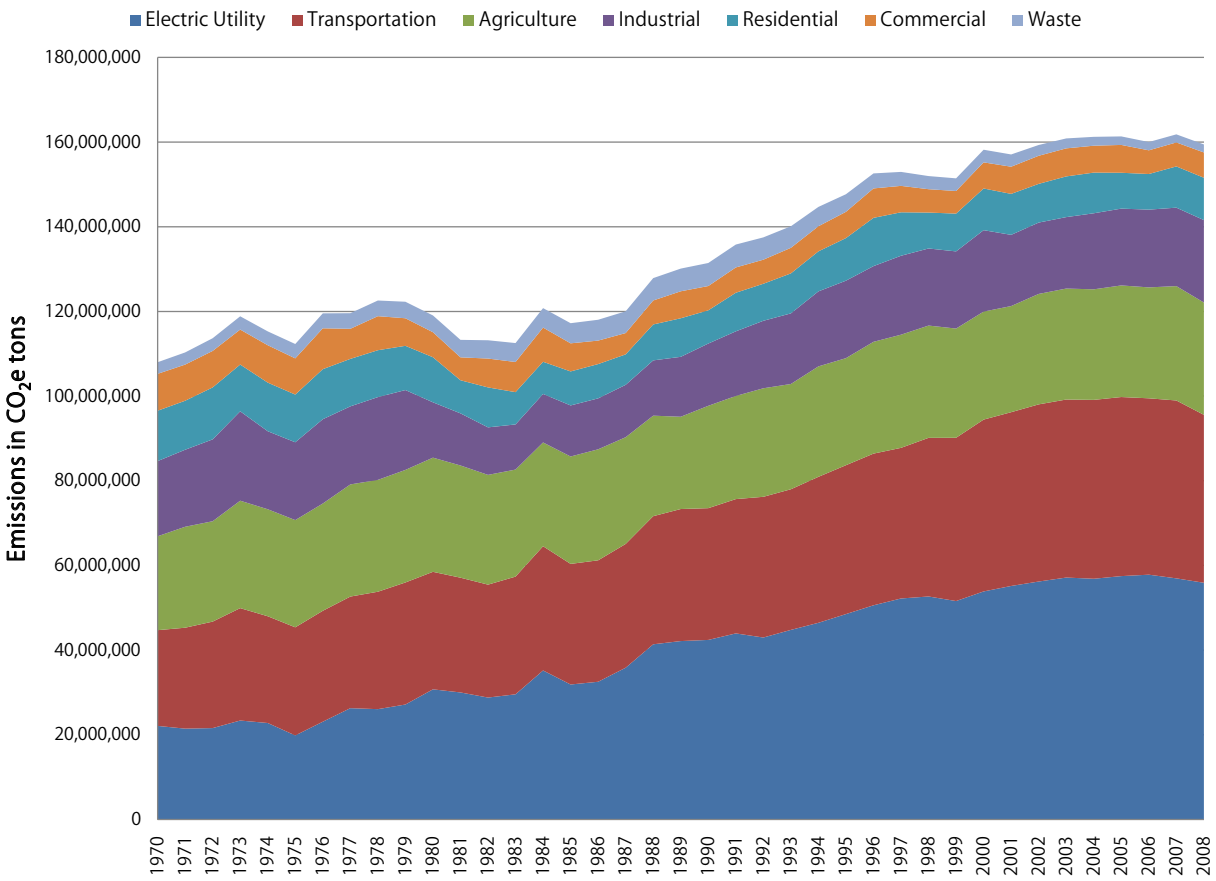
A detailed inventory of emissions through 2008, and current progress towards reaching these reduction goals, will be completed in January 2011. This information will be available at **www.pca.state.mn.us/index.php/topics/climate-change/climate-change-in-minnesota/greenhouse-gas-emissions-in-minnesota.html**.

In May 2010, EPA issued a final rule to establish permit thresholds for greenhouse gas emissions. MPCA will modify its air permit rules to incorporate these new federal permit requirements.

This rule will affect both construction and operating permits. A facility needs a major-source permit if it has a potential to emit at least 100,000 tons per year of CO_2e. Starting on January 2, 2011, EPA's new greenhouse gas permit requirements will apply to new or modified sources under certain conditions. All facilities with emissions above the thresholds are affected starting July 1, 2011.

[1] http://climate.umn.edu/climateChange/climateChangeObservedNu.htm

Greenhouse gas emissions from Minnesota by economic sector



Source: MPCA greenhouse gas inventory

Emissions of major greenhouse gases including CO_2, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride have been estimated annually in Minnesota since 1970. They are reported in terms of carbon dioxide equivalents (CO_2e). Roughly 85 percent of all greenhouse gas emissions are associated with energy consumption or the production and transportation of fuels.

Between 1970 and 2008, the majority of the growth in estimated statewide greenhouse gas emissions occurred in just two sectors: electric utilities and transportation. Emissions from transportation and electric power generation comprised roughly 40 percent of all Minnesota greenhouse gas emissions in 1970; however, by 2008 they accounted for 60 percent of emissions.

Conclusions

Although Minnesota's air quality has continued to improve through implementation of the Clean Air Act, research shows serious public health effects at lower levels of pollution. In response, EPA is finalizing strict new standards for six key air pollutants. The good news is that, in the long run, more stringent standards will result in cleaner air and better health for Minnesotans. Unfortunately, implementation of these new standards will also create challenges in the near term for the state and Minnesota business.

These new standards, along with new reporting and permitting regulations for greenhouse gases and the need to reduce the risks posed by air toxics, will present a unique challenge for MPCA in coming years. The challenge before MPCA is to work with partners to find ways to reduce air emissions from sources not traditionally regulated by MPCA in order to reduce health risks and meet federal standards.

MPCA plans to use its resources strategically to target combustion sources that will reduce multiple pollutants simultaneously. This will be achieved by leveraging community outreach, voluntary programs and partnerships, as well as through traditional regulatory methods.

This report deals with the most pressing issues of air quality in Minnesota However, MPCA provides other annual and biannual reports dealing with air pollution The reports noted below include detailed pollutant specific air emission and monitoring data

Annual Pollution Report: *Annual legislative report that estimates total amounts and trends of Minnesota air and water emissions* **www.pca.state.mn.us/index.php/about-mpca/legislative issues/legislative-reports/legislative-reports.html**

Annual Air Monitoring Network Plan: *Annual report to the EPA detailing MPCA's air monitoring network* **www.pca.state.mn.us/index.php/air/air-monitoring-and-reporting/air-emissions-and-monitoring/air-monitoring-network-plan.html**

Greenhouse Gas Emissions Report: *Biannual legislative report on statewide progress toward the greenhouse gas reduction goals enumerated in the Next Generation Energy Act* **www.pca.state.mn.us/index.php/topics/climate change/regulatory initiatives-programs-and-policies/climate change publications-reports-and-fact-sheets.html**