



# **2005 Mercury Reduction Progress Report to the Minnesota Legislature**



**Minnesota Pollution Control Agency**

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## Executive Summary

Mercury is an environmental problem because it accumulates in fish and can adversely affect the health of the people and wildlife that eat the fish.

Even the trace amounts present after global dilution can cause significant fish contamination. Mercury is released to the environment around the world and transported by the atmosphere to lakes and rivers where a portion accumulates in fish. The primary route of mercury exposure for most Minnesotans is eating contaminated fish — a problem that has been addressed through fish consumption advisories and actions to reduce mercury pollution.

More than 99 percent of the mercury in Minnesota's environment comes from the atmosphere, deposited by rain, snow and attached to dry particles. About 10 percent of mercury deposited in Minnesota comes from air emission sources within the state, with the remainder made up of equal shares from regional, global and natural sources.

In 1999, the Minnesota Legislature called for reductions in mercury emissions, established goals, directed the Minnesota Pollution Control Agency (MPCA) to implement reduction strategies and

mandated reports in 2001 and 2005. This is the 2005 report to the legislature.

The 1999 mercury reduction law (Minn. Stat. 116.915 subd. 1) called for a 70 percent reduction in mercury emissions from Minnesota sources by 2005 compared to 1990 levels. The MPCA estimates that from 1990 to 2005, Minnesota sources reduced emissions by 70 percent. However, changes made to the 1990 baseline inventory since the goal was established allowed Minnesota sources to reach the goal with fewer reductions than initially envisioned. The MPCA made this change to reflect new information prior to finalizing the inventory, as called for in the mercury reduction law.

The MPCA estimates that a 93 percent reduction in world-wide emissions contributing to deposition in the state is needed (from 1990 baseline) for its fish to be safe to eat by most Minnesotans. The MPCA is moving toward adoption of this goal — meeting it will require significant reductions from all sources. To achieve the goal, the MPCA will develop a detailed implementation plan in consultation with stakeholders.

## Section 1. Introduction and Background

Exposure to elevated levels of mercury can damage the central nervous system of humans and wildlife. Mercury acts as a neurotoxin, a substance which, at high enough concentrations, can damage or destroy nerve tissue or hamper the development of the nervous systems of fetuses and children.

Mercury is a global pollutant; it is released to the environment around the world, transported in the atmosphere, chemically transformed in water and bioaccumulated in fish. The primary route of exposure for most Minnesotans is eating mercury-contaminated fish — a well-documented problem. The Minnesota Department of Health advises people to restrict their consumption of sport fish due to mercury for virtually every lake that has been tested.

Minnesota has been a national leader in addressing mercury releases to the environment since the early 1990s. The legislature, government agencies and businesses in the state have taken steps to significantly reduce emissions. Among other actions in the 1990s, the legislature passed Minn. Stat. 116.915 in 1999, which established state mercury-reduction goals, required the Minnesota Pollution Control Agency (MPCA) to solicit voluntary reduction agreements, and required reports in 2001 and 2005. Specifically the law requires that the reports address the state's success in meeting the mercury release reduction goals, whether different strategies are needed and whether the reduction goals are still appropriate.

This report describes the state's success in meeting mercury-reduction goals and summarizes reductions achieved to date. The report also presents a mercury

emissions inventory that includes an update to projected 2005 emissions.

The federal Clean Water Act requires the MPCA to assess lakes, rivers and streams in the state for mercury and other pollutants. Waters with elevated pollution levels are placed on a state list of Impaired Waters. Two-thirds, or 1,239 of the 1,890 waters on Minnesota's 2004 Impaired Waters List, are polluted with elevated mercury levels, mostly in fish tissue. For these waters, the MPCA is required to complete a Total Maximum Daily Load (TMDL) study determining the source of the contamination and the reductions required to resolve the problem.

The MPCA has completed a draft TMDL Study for Mercury and is now getting public comments before submitting it to the U.S. Environmental Protection Agency (EPA) for approval. The draft TMDL document contains more detailed information than is presented in this report on mercury contamination of fish in Minnesota, sources of mercury pollution and pollutant reductions needed to return fish to safe levels. As discussed in Section 6, the draft TMDL also proposes a new state mercury-reduction goal. The draft TMDL study is available on the agency's Web site at [www.pca.state.mn.us/publications/wq-iw4-01b.pdf](http://www.pca.state.mn.us/publications/wq-iw4-01b.pdf).

Nearly all — more than 99 percent — of the mercury deposited in Minnesota's environment comes from atmospheric deposition; rain and snow transport mercury to the land, lakes and rivers and mercury can also fall as dry deposition. About 30 percent of the mercury deposited from the atmosphere comes from natural sources of mercury.

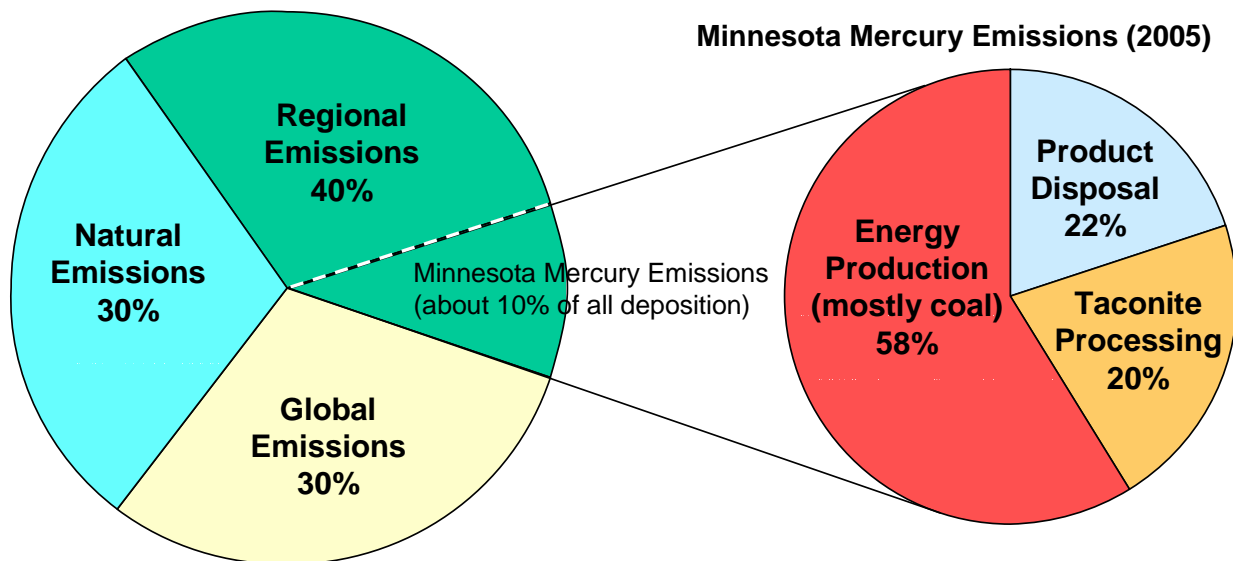
But 70 percent of the deposited mercury is a result of human activities that have increased the release of mercury from the geological materials in which it had been locked up. These activities include the mining of mercury ores, the use of this mercury in products and manufacturing, and the release of trace concentrations of mercury naturally present in coal, crude oil and metal ores.

Because mercury vapor can be transported long distances in the atmosphere, most of Minnesota's emissions are deposited in other states and countries, and Minnesota receives some of their emissions. In Minnesota, about 10 percent of mercury deposition is the result of emissions within the state. The remaining 90 percent is made up of equal shares of regional (North America), global and natural sources as illustrated in Figure 1.

Some of the mercury deposited in Minnesota is chemically transformed in the water and accumulates in the tissue of fish. The MPCA, in partnership with the Minnesota Departments of Health and Natural Resources, tests fish from lakes and rivers for mercury contamination. Testing of fish in Minnesota dates back to 1967, with about half of the fish samples taken since 1990.

About 1,000 of the estimated 5,500 fishing lakes in Minnesota have been tested, and for 184 of those lakes the MPCA has at least two years of data to compare past and present mercury levels. Overall, mercury concentration in fish decreased by about 10 percent from 1990 to 2000. That same small, but significant, decrease appears to be continuing.

**Figure 1. Sources of Atmospheric Mercury Deposition to Minnesota**



## **Section 2. Current Mercury Emissions in Minnesota**

MPCA staff projects that annual human-caused emissions from Minnesota sources will total 3,341 pounds (lb.) for 2005. The MPCA divides mercury that is emitted to the atmosphere due to human activities into three categories: (1) emissions resulting from energy production, mostly from burning coal; (2) emissions due to material processing, mostly taconite; and (3) emissions due to the purposeful use of mercury, mostly related to the disposal of products.

As of 2005, 58 percent of Minnesota's emissions are from energy sources, 20 percent are from taconite processing, and 22

percent are from purposeful uses. Mercury is used in a variety of products, such as electrical switches, thermometers and dental amalgams. Major emission sources related to mercury in products include solid waste handling and combustion, recycling cars with mercury switches, and preparation and cremation of dental amalgams.

A summary of emissions sources within these categories is included in Table 1 on the next page of this report. Appendix A includes the MPCA's full inventory of estimated emissions for 1990, 1995, 2000 and 2005.

**Table 1. Minnesota Mercury Emissions 1990–2005 (in pounds)**

Mercury Emission Inventory for Minnesota Date of Estimates: October 12, 2005	confidence	1990	1995	2000	2005 (projected)
<b>Incidental to Energy Production</b>					
Coal combustion (total) (1)	high	1,518.6	1,612.1	1,648.7	1,738.1
electric utility coal	high	1,418.3	1,512.8	1,544.8	1,650.0
commercial/industrial coal	medium	60.8	68.5	73.4	51.3
public utility / university & college heating	medium	39.0	30.5	30.2	36.4
residential coal	medium	0.4	0.4	0.4	0.4
Petroleum Product Refining and Consumption (2)	low	136.0	156.0	175.0	175.0
Wood combustion(3)	high	12.5	10.5	10.0	10.0
Natural gas combustion(4)	low	0.2	0.3	0.3	0.3
Subtotal incidental with energy production		1,667	1,779	1,834	1,923
% of total state emissions		15%	42%	50%	58%
<b>Largely Resulting from the Purposeful Use of Mercury</b>					
Latex paint volatilization (5)	medium	2,850.0	2.8	0.0	0.0
Class IV incinerators (6)	low	55.2	28.0	0.0	0.0
Golf course fungicide volatilization (7)	low	1,487.0	1.0	1.0	0.0
Volatilization: land application of compost (8)	low	2.2	1.3	0.3	0.2
Medical waste incineration (9)	high	516.0	36.0	6.1	0.4
Volatilization: land application of sludge (10)	low	3.6	1.8	1.4	0.7
Volatilization from dissipative use (11)	low	0.8	0.8	0.8	0.8
Landfill volatilization (12)	low	5.9	2.2	2.4	1.2
Hazardous waste incineration (13)	medium	5.0	5.0	5.0	5.0
General laboratory use (14)	low	44.0	44.0	22.0	10.0
Sewage sludge incineration (15)	medium	247.0	160.0	112.0	11.0
Fluorescent lamp breakage (16)	low	272.3	59.4	32.2	15.0
Volatilization from spills and land dumping (17)	low	54.7	48.0	48.0	24.0
On-site household waste incineration (18)	low	402.0	93.0	60.0	40.0
Recycling mercury from products within MN (19)	medium	3.5	35.0	50.0	65.0
Crematories (20)	low	30.8	49.5	68.2	80.0
Dental preparations (21)	low	103.0	99.0	95.0	84.0
Municipal solid waste combustion (22)	high	1,806.4	633.9	168.6	93.5
Smelters that recycle cars and appliances (23)	medium	186.0	186.0	176.0	125.0
Volatilization during solid waste collection & processing (24)	low	805.5	251.5	195.9	183.0
Subtotal associated with purposeful use of mercury		8,881	1,738	1,045	739
% of total state emissions		79%	41%	29%	22%
<b>Emissions Incidental to Material Processing</b>					
Taconite processing (25)	high	710.5	742.3	745.4	665.7
Pulp and paper manufacturing (26)	low	0.0	0.0	0.0	0.0
Soil roasting (27)	low	13.3	13.3	13.3	13.3
Subtotal emissions incidental to material processing		724	756	759	679
% of total state emissions		6%	18%	21%	20%
GRAND TOTAL =		11,272	4,273	3,637	3,341
Percent Reduction since 1990=			62%	68%	70%

### **Section 3. Progress Toward Meeting State Mercury-reduction Goals**

The statewide mercury-reduction goal set in Minn. Stat. 116.915 is to reduce annual mercury releases 60 percent by 2000 and 70 percent by 2005, compared to 1990 levels. As reported in the MPCA's January 2002 mercury-reduction progress report to the legislature, the MPCA estimates that the 2000 goal of a 60 percent reduction from 1990 levels was easily met, with an estimated reduction in emissions of 68 percent. Similarly, the MPCA believes that Minnesota will just achieve the 70 percent reduction goal for 2005.

The MPCA estimates that since 1990, emissions of mercury to the air in Minnesota have declined from 11,272 lb. to 3,341 lb. by 2005 — a 70 percent reduction. A combination of federal and state initiatives, local programs and voluntary actions led to these reductions. Emissions related to the use of mercury in products constitute the vast majority of these reductions. Actions that led to significant reductions during this period and anticipated future reductions and increases are discussed in detail in Section 4.

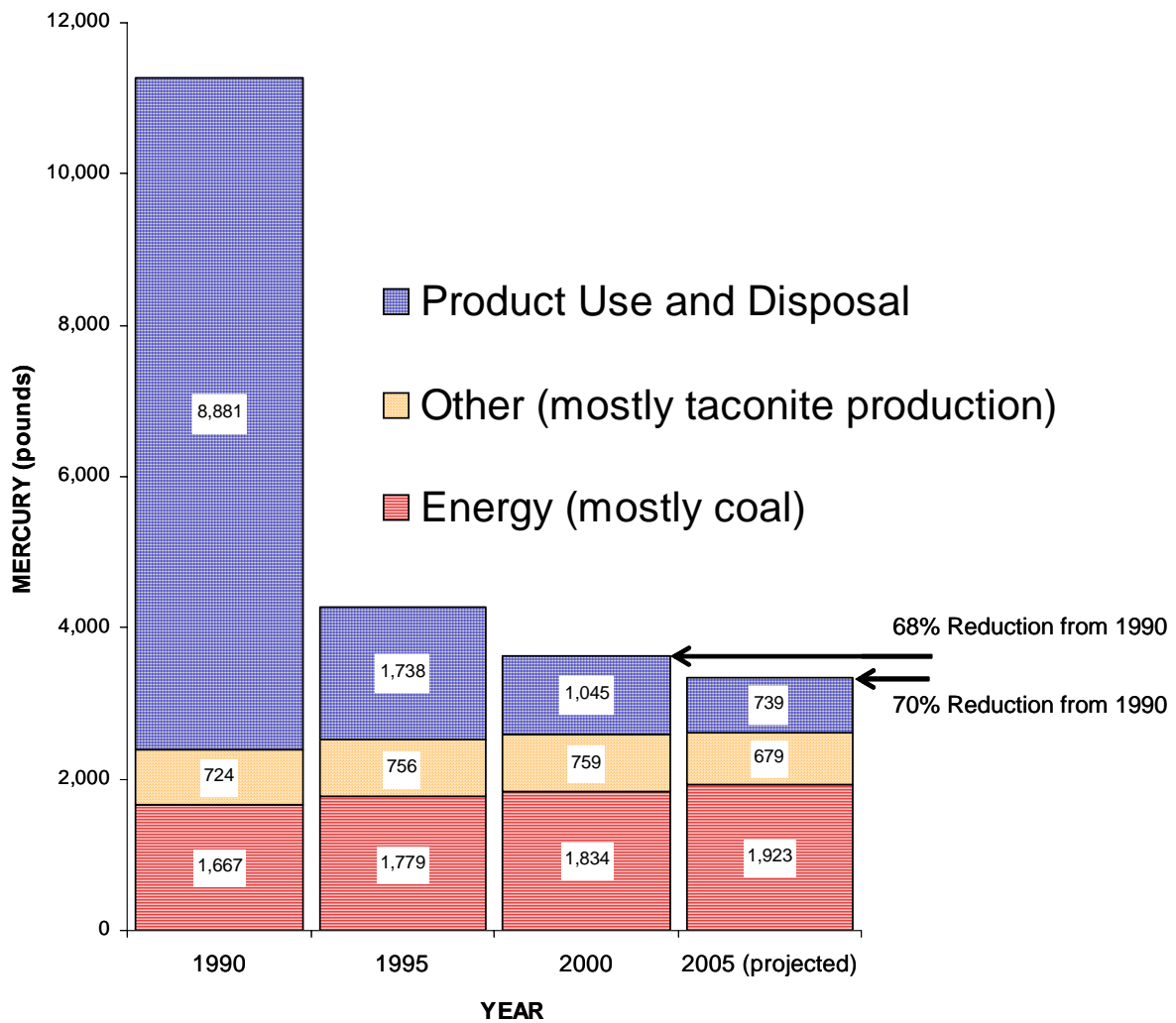
It should be noted that since establishing the 70 percent reduction goal in 1999, the MPCA, in consultation with stakeholders, significantly increased its estimate of the product-related emissions in the baseline year of 1990. This change was made to incorporate the latest scientific understanding of mercury emissions in Minnesota to prepare the inventory for publication in the *State Register*, as required by the mercury reduction law (Minn. Stat. 116.915 subd. 1). The total baseline emissions estimate rose from about 8,450 lb. to 11,272 lb. due primarily to an increase in the estimated amount of mercury released from latex paint.

While the MPCA's mercury emissions inventory is dynamic and changes to reflect new scientific information and new knowledge, a change of this magnitude was not anticipated. As a result, the percent decline in mercury emissions between 1990 and 2000 was much greater than was known when the legislature established the goals. This essentially means that we had met our 2000 reduction goal and came within 2 percent of the 2005 goal before the legislation even took effect.

Had the 1990 baseline emissions estimates not been revised upward, Minnesota emissions sources would not have met the 70 percent reduction goal. Compared to the baseline as presented in 1999 when the goals were established, 2005 estimated emissions of 3,341 lb. represent a 60 percent reduction from 1990 levels. A 70 percent reduction from the original baseline would have required formidable reductions from all sectors. Reductions since 1990 are attributed primarily to product-related sources. Voluntary reductions from the energy and taconite sectors since 1999 account for about a 3.3 percent reduction. These reductions are described in Section 5 of this report.

The stakeholders involved in recommending the goal in 1999 envisioned a reduction of about 1,000 lb. from that time in order to meet the 2005 goal. The MPCA estimates total reductions between 2000 and 2005 to be 296 lb. While the understanding of 1990 emissions was thought to be accurate at the time and the goal was established in good faith, it is likely that the MPCA and stakeholders involved in developing the goal would have recommended a more ambitious goal given what is known now.

**Figure 2. Mercury Air Emissions by Sector, 1990-2005**



## **Section 4. Mercury Air Emissions by Sector — Past and Future**

This section summarizes past reductions and future trends from the three emissions sector categories — product-related, energy production and taconite processing. Future trends for total emissions are discussed, also.

### **Product Sector**

Mercury and mercury compounds have been used in a variety of products and processes for centuries. In the United States, mercury use peaked in the 1960s at more than 2,000 metric tons per year, most of this being added to products such as batteries, switches and paint. Many of these uses have been discontinued and are no longer a concern. Some have been discontinued and the product remains in use or in storage, while other uses continue. In most cases, mercury used in products has the potential to contribute to air emissions through the use of the product, spills or disposal.

Since 1990, emissions of mercury in Minnesota from the use of mercury in products have declined by 92 percent, from 8,881 lb. to 739 lb. by 2005. This impressive reduction occurred largely as a result of discontinued use of mercury in a few key products, controls on waste combustors, and product and waste-stream reduction efforts. The MPCA believes that product-related reductions will continue into the future, albeit at a slower rate, as mercury uses decrease, product-management efforts continue and combustion source controls improve.

### **Waste Combustor Reductions**

In 1990, municipal and medical waste incineration accounted for 1,806 and 516 lb. of mercury emissions, respectively. Due to MPCA-initiated control requirements and reduced mercury content of the waste stream

because of source separation and product reductions, these amounts fell to 93.5 lb. from municipal incinerators and 0.4 lb. from medical incinerators by 2005, for a combined reduction of about 2,230 lb. since 1990. In Minnesota, these regulations and resulting emissions reductions preceded federal regulations for these sources.

The largest decrease in mercury emissions from municipal waste incineration came as a result of MPCA permit requirements on the Hennepin Energy Resource Company (HERC), the state's largest unit. In 1993, the HERC installed an activated carbon-injection control system, which reduced annual mercury emissions from 496 lb. in 1990 to 45 lb. in 1995.

After 1995, Minnesota's waste combustor standards banned on-site burners (such as those at businesses, grocery stores and apartment buildings) and required most of the state's remaining municipal incinerators to lower their emissions, resulting in an additional reduction from 1995 to 2005 of about 570 lb. A significant share of this reduction came from Xcel Energy's Red Wing refuse-derived fuel electricity boiler. Pollution-control equipment upgrades completed in 2000 reduced annual emissions by 313 lb., or 91 percent for that one facility.

Since 2000, Olmsted County's waste-to-energy facility upgraded its emissions-control equipment (beginning in 2004) and reduced its emissions from about 48 lb. per year to 3 to 5 lb. per year. Olmsted County is pursuing an expansion of this facility. Still in the early stages of environmental review, this proposed expansion would increase annual emissions by an additional 3 to 5 lb.

In 1990, emissions of 516 lb. came from about 80 medical waste incinerators at hospitals and one commercial facility. The largest facility, Mayo Foundation incinerator, emitted 115 lb. After 1990, the Mayo Foundation constructed a new incinerator with an activated carbon control system to meet MPCA permit limits. Emissions from the new plant were reduced to 1 lb. per year by 1995. After 1995, Minnesota's waste combustor standards and federal regulations required medical waste incinerators to reduce mercury emissions or cease operation. By the end of 2000, all medical waste incineration facilities except Mayo had closed.

### **Sewage Sludge**

Mercury enters the liquid waste stream through discharges from product-related uses, such as dental amalgams and laboratory reagents. In the sewage-treatment process, more than 90 percent of the mercury ends up in sludge. When the sludge is land applied or incinerated, this mercury can be released to the air.

Typically the largest contributor of mercury to a sewage-treatment plant is wastewater from dental practices. Two large wastewater-treatment plants in Minnesota have been national leaders in efforts to work with dentists to reduce the amount of mercury from dental amalgam entering the liquid waste system. The Western Lake Superior Sanitary District in Duluth and Metropolitan Council Environmental Services (MCES) in the Twin Cities have worked extensively with dentists in their service areas and statewide to adopt best management practices for dental amalgam.

Incineration of wastewater-treatment plant sludge releases the mercury into the air, unless it is captured by pollution-control equipment. The MCES operates two sewage sludge incinerators. Mercury

emissions from these plants dropped from 247 lb. in 1990 to 112 lb. by 2000, largely due to reducing mercury inputs to the wastewater.

The MCES began operating a new sewage sludge incinerator at its metro plant in January 2005 and has been testing the operation of the new pollution-control equipment that uses activated-carbon removal of mercury. If performance observed in this initial testing stage continues, MCES expects mercury emissions to be reduced by approximately 98 percent or more, from about 95 lb. in 2000 to less than 2 lb. per year.

### **Product and Waste Stream Mercury-reduction Efforts**

Beginning in the early 1990s, the Minnesota Legislature passed laws banning the use of mercury in certain products (most notably batteries), prohibiting the disposal of mercury in solid waste, and requiring the management and recycling of mercury-containing lamps and other items. During this period and continuing to the present, local and state governments, manufacturers, waste haulers, and companies established programs to ensure the proper handling of mercury-containing items.

These initiatives led to direct reductions in mercury releases to the environment and to reductions from municipal and medical waste management. For example, mercury in municipal solid waste declined from about four parts per million (ppm) in 1990 to about 1.5 ppm in 1995. While it is difficult to estimate the air emissions reductions associated with reduced spills and improved management, the MPCA believes that these actions, coupled with the trend of reduced use of mercury in products, significantly contributed to a decline of up to 2,000 lb. per year since the 1990s.

Notable examples of product- and waste-reduction efforts include the establishment of a thermostat take-back program, fluorescent lamp collection and recycling, the removal of mercury manometers used on dairy farms, the auto manufacturer outreach and mercury switch collection program, dental amalgam separation initiatives, and the Mercury-Free Zone Program, which removes mercury from schools.

### **Fungicide Registration Cancellations**

In the early 1990s, the EPA cancelled registrations for two mercury-containing

fungicides (discontinuing their sale and subsequent use), resulting in substantial reductions in mercury emissions.

Registration for a mercury compound as a preservative in paint was cancelled and withdrawn in the United States, resulting in a 2,847-lb. reduction in annual emissions in Minnesota by 1995 (compared to 1990 levels). Withdrawal of a mercury fungicide for snow mold control resulted in a reduction of 1,486 lb. during the same period. Together, these two actions account for a 38 percent reduction in total mercury emissions from 1990 levels.

**Table 2. Summary of Actions Resulting in Significant Mercury Emission Reductions**

<b>Date</b>	<b>Action</b>	<b>Reduction in annual emissions, if known</b>	<b>Percent reduction for source</b>	<b>Reduction from total 1990 levels</b>
1991-2000	Toxicity reduction/management programs and Minnesota Statutes (disposal restrictions, product bans, labeling and management)	Contributed to reductions from waste management, product breakage of up to 2,000 lb.	64% (approx.)	18% (approx.)
1991	Registration for mercury as a preservative in paint cancelled and withdrawn in the U.S.	2,847-lb. reduction (1990-1995)	100%	25.0%
1993	Registration for mercury fungicide for snow mold control withdrawn in the U.S.	1,486-lb. reduction (1990-1995)	100%	13.0%
1993	HERC installs activated-carbon-injection control systems.	Combined with toxicity reduction actions, led to 451-lb. reduction	91%	4.0%
1994	Mayo constructs new facility and installs activated carbon controls.	Reduced from 115 lb. to 11b.	99%	1.0%
1995	Waste combustor standards for municipal and medical waste incinerators (not incl. HERC and Mayo)	851 lb. (456 lb. municipal, 395 lb. medical) by 2000	86%	7.6%
2000	Minnesota Power switch to lower-mercury coal	70 lb.	20% (company-wide)	0.6%
2000	Red Wing RDF-fired electric boiler upgrades pollution-control equipment	313 lb.	95%	2.8%
2003	Xcel Energy replaces 2 coal-burning units with natural gas at Black Dog plant	35 lb.	47%	0.3%
2004	Olmsted County waste-to-energy-plant control upgrade	44 lb.	92%	0.4%
2005	Metropolitan Council Environmental Services sludge incinerator upgrade	94 lb.	99%	0.8%
2009	Xcel Energy MERP repowers Highbridge and Riverside plants to natural gas and upgrades emissions control at King plant	170 lb. (expected by 2009)	15% company-wide (100% from two gas facilities, 20% from King plant)	1.5%

## Energy Sector

Mercury is a trace contaminant in coal and other solid fuels. When these fuels are burned to generate heat for industrial and utility boilers and other purposes, the mercury is released. The vast majority of emissions from this sector result from burning coal to generate power to meet the increasing demand for electricity in the state. Emissions from all energy sector sources increased by about 16 percent between 1990 and 2005.

### Electric Power Generation

Since 1990, mercury emissions from coal-fired electric-generation boilers have increased about 16 percent, from 1,418 lb. to 1,650 lb. in 2005. This increase in emissions is the result of burning more coal to produce more electricity at power plants in Minnesota.

In addition to mercury emissions from power plants within the state, Minnesota's consumption of electricity that is generated outside of the state also creates mercury pollution. Power plants located in North Dakota, South Dakota and Wisconsin supply electricity to Minnesota.

Minnesota law requires producers and retailers of electricity, including sources located outside the state, to report the amount of mercury emitted through the generation of electricity. In 2003, facilities located outside the state generating electricity consumed in Minnesota reported mercury emissions of 1,272 lb. attributable to Minnesota's share of the electricity. These out-of-state generation sources also emit on average about 50 percent more mercury per unit of electricity produced than do Minnesota electric generators. This information is summarized in Appendix A of the MPCA's 2005 air quality report to the legislature. This report can be found at

[www.pca.state.mn.us/publications/reports/lr-airqualityreport-2005.html](http://www.pca.state.mn.us/publications/reports/lr-airqualityreport-2005.html).

In 2000, as part of a commitment to reduce emissions under the state's voluntary mercury-reduction agreements, Minnesota Power substituted lower-mercury coal to achieve a 70 lb. annual reduction in mercury emissions from its operations. While this is not a permanent reduction in mercury emissions, Minnesota Power intends to continue to burn this lower-mercury coal to keep its mercury emissions at the present level.

In 2003, Xcel Energy completed the replacement of two coal-burning units at its Black Dog generating plant with a natural-gas-fired turbine generator. This new unit eliminates up to 35 lb. of mercury annually compared to the old boilers and produces an additional 100 megawatts of electricity.

In December 2003, the Public Utilities Commission approved Xcel Energy's Metropolitan Emissions Reduction Program (MERP), which will re-fire two coal plants with natural gas and upgrade the pollution-control equipment at a third Twin Cities area plant. When fully implemented in 2009, the MERP will result in an estimated annual mercury emissions reduction of 170 lb., assuming that electrical output at the two re-powered plants is similar to the existing units.

Taken together, Minnesota Power's lower-mercury coal, Xcel's Black Dog re-powering, and Xcel's MERP will result in a reduction of up to 275 lb., an 18 percent reduction in utility-sector emissions and a 7.6 percent reduction in total emissions compared to 2000 levels. These reductions will account for a 2.4 percent reduction in total emissions (based on 1990 levels) when fully implemented.

Based on the utilities' estimates of coal use, the MPCA projects that mercury emissions will decline slightly from 2005 to 2010 due to Xcel's MERP. After 2010, the MPCA estimates that increased coal consumption will cause the sector's emissions to begin to increase again, unless other voluntary, state or federal regulatory measures are taken.

In June 2005, the EPA issued the Clean Air Mercury Rule (CAMR) to reduce mercury emissions from coal-fired utility boilers. This rule establishes a national "cap" or nationwide limit on mercury emissions from coal-fired units greater than 25 megawatts of 15 tons by 2018. This cap represents a 70 percent reduction from 2002 levels from existing plants of this size. It also allows for "trading" or buying and selling of mercury reductions between generating units in order to meet the national cap.

The cap-and-trade program of the CAMR has been challenged legally and its implementation may be delayed. It is even possible that the EPA could be in the position of having to restart the rule-development process.

Cap-and-trade programs are favored by some because total emissions are limited — no further increases can occur from the electric generating sector, even as more coal-fired power plants are constructed. A trading program means that facilities that can remove mercury very cheaply will do so, and sell their mercury allowances to plants that cannot. This means that some plants will reduce emissions more than 70 percent and other plants will reduce less.

Plants where the reductions are the most expensive will purchase credits from plants

that are able to achieve greater reductions at lower costs. However, trading for mercury has drawn criticism because it does not guarantee that all states or regions of the country will experience emission reductions nor does it prevent the possibility of regional increases in emissions.

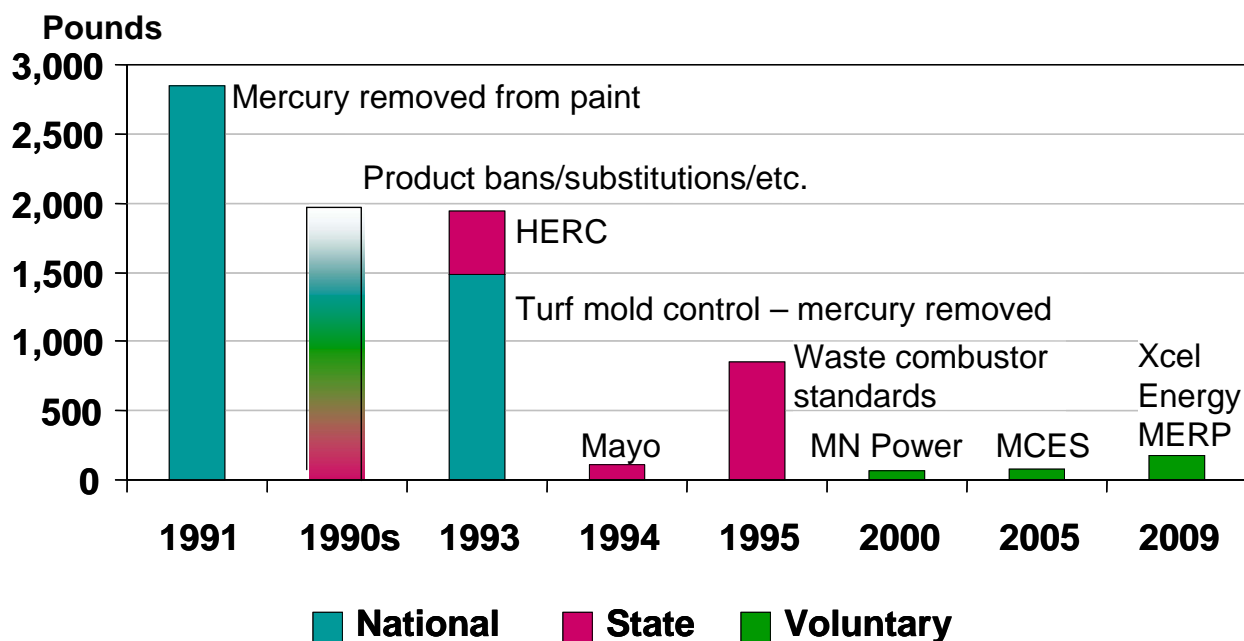
During the public comment period for the CAMR, the MPCA commented that while it is in favor of cap-and-trade programs, the cap must be lower than 15 tons, and should become effective sooner than the rule proposes. The MPCA's comments can be found at: [www.pca.state.mn.us/hot/mercury-reductions.html](http://www.pca.state.mn.us/hot/mercury-reductions.html).

The CAMR's impacts on Minnesota emissions are expected to be small because emissions reductions at Minnesota plants are projected to be more expensive than in other states. The EPA's modeling of how trading between electric-generation units would meet the cap predicts that Minnesota utilities, for cost reasons, would purchase allowances rather than make reductions.

### **Industrial/Commercial Boilers**

In 2004, the EPA adopted an industrial boiler and process heater standard, which imposes mercury-emission limits on new and existing solid-fuel boilers and major sources of hazardous air pollutants. This will reduce mercury emissions from sources such as coal-fired industrial boilers by an unknown amount. Current annual emissions from this sector in Minnesota are estimated to be 51 lb. A new coal-burning ethanol production facility in Minnesota will voluntarily meet the requirements of this standard and emit about 4 lb. per year starting in 2007.

**Figure 3. Annual Reductions in Air Emissions from Selected Activities**



### Taconite Sector

Mercury is a trace contaminant in iron ore and is released when the ore is heated in the process of forming more concentrated taconite pellets. Mercury emissions from the processing of iron ore are directly related to the output from taconite-processing facilities.

Between 1990 and 2000, annual sector emissions increased 35 lb. due to increased production of taconite pellets. Since 2000, annual emissions have declined by about 80 lb. due to the closing of one large mine and processing plant.

Current taconite-processing facilities are operating at or near capacity due to a strong international demand for iron. If this strong demand continues, production capacity at

Minnesota facilities may expand, resulting in a proportional increase in mercury emissions.

In the fall of 2004, in its settlement agreement with the National Wildlife Federation, the EPA agreed to set maximum achievable control technology (MACT) limits for mercury. This may reduce mercury emissions from taconite processing in the future. Before the EPA can undertake this effort, it is seeking more data, and is likely to rely on research being conducted by Minnesota Department of Natural Resources staff and others on taconite mercury and potential controls. The MPCA does not expect the EPA to propose standards for several years due to constraints on the EPA’s resources and data.

## **Future Emissions from All Sources**

The MPCA estimates that emissions from all human-caused sources in Minnesota will continue to decline slightly or level off between 2005 and 2010. While product-related sources will continue to decline and reductions from voluntary measures at existing coal-fired power plants will fully take effect by 2010, these declines are likely

to be mostly offset by new known sources, increased taconite production, and increased electrical production. The MPCA estimates that after 2010, without significant voluntary reductions or federal or state regulatory intervention, the recent trend of decreasing emissions will reverse and emissions from Minnesota sources will begin to increase.

## Section 5. Voluntary Reduction Agreements

The 1999 mercury law (Minn. Stat. 116.915) directed the MPCA to establish a voluntary mercury-reduction agreement program encouraging the largest emitters in the state to enter into agreements with the state to reduce their mercury air emissions.

Participants in the program were expected to implement cost-effective, technologically feasible reduction measures and conduct research into future reductions. The MPCA agreed not to pursue additional state regulations, at least until 2005, as long as adequate progress is made in reducing emissions.

Thirteen companies and two regional waste management jurisdictions participated in the

voluntary agreement program and have taken actions or made pledges to reduce mercury emissions in some way (Table 3). These include actions taken to reduce emissions, pledged reductions, reduction research, collected and inventoried mercury products and supported other mercury-reduction efforts.

Actions to date are summarized below. Progress reports submitted by voluntary agreement participants since the 2002 report to the legislature are attached as Appendix B. The 2002 legislative report with progress reports from 2000 and 2001 is available at [www.pca.state.mn.us/air/mercury-mn.html](http://www.pca.state.mn.us/air/mercury-mn.html).

**Table 3. Voluntary Agreement Participants**

Company/Entity	Highlights of Voluntary Reductions/Actions/Commitments
Alliant Energy	Plant product inventory and removal. Emits approx. 7 lb. per year.
Flint Hills Resources	Conduct refinery mercury mass balance
Great River Energy	No in-state emissions sources. Participates in research.
Metro Council Environmental Services (MCES)	Upgrade on sludge incinerator, dental clinic amalgam program with Minnesota Dental Assoc.
Minnesota Power	Fuel switching, research, product removal, community involvement
North Star Steel	Automotive switch removal
Otter Tail Power	Supports research, plant and community product removal/management.
Western Lake Superior Sanitary District (WLSSD)	Dental community outreach, community and small business product collection, community involvement
Xcel Energy	Research, product collection, emissions reduction pledge, support mercury-detecting dog
Taconite Industry: (North Shore Mining, Hibbing Taconite, Ispat-Inland Mining, Cliffs Erie, United Taconite, US Steel-Keewatin Taconite)	Research, plant and community product removal

## Voluntary air emissions reductions

Of the air emission reductions noted in Section 4, four resulted from voluntary actions initiated or fully implemented since the establishment of the voluntary program in 1999. As summarized in Table 4, these actions include fuel switching and increased controls by electric utilities and added

controls on sewage-sludge incineration. To date, these voluntary commitments have resulted in approximately 199 lb. of annual emissions avoided. When fully implemented, voluntary reduction agreement actions initiated to date will result in additional reductions in annual emissions of an estimated 369 lb. by 2009, or about 3 percent of 1990 emissions.

**Table 4. Recent Voluntary Reductions**

Voluntary Agreement Participant	Action	Effective Date	Pounds Reduced
Minnesota Power	Switch to low-mercury coal	2000	70
Xcel Energy	Repowering 2 coal-fired units at Black Dog plant	2003	35
Metropolitan Council Environmental Services	Upgrade sewage sludge incinerator at Metro plant	2005	94
Xcel Energy Metropolitan Emissions Reduction Project	Re-powering two coal fired utility boilers to natural gas, installing upgraded control equipment on a third metro area plant.	2009	170
<b>Total Annual Emissions Reductions from Voluntary Agreement Participants</b>			<b>369</b>

## Emissions Reduction Research

Taconite and electric power generation sector participants have supported research into reducing mercury at their facilities. A summary of this research is included in the voluntary agreement progress reports in Appendix B.

## Mercury Product Inventorying and Removal

Most Voluntary Agreement participants have identified, removed and properly managed mercury-containing equipment from their facilities and plants. While this mercury was probably not contributing to air emissions during use, its removal greatly

reduces the possibility that the mercury will enter the environment through spills or improper disposal. Voluntary agreement participants have reported thousands of pounds of mercury removed from service and recycled.

## Other Actions

Several voluntary agreement participants have collected mercury-containing products from employees or supported community collection programs. Others have participated in community-awareness activities and release-reduction initiatives outside their facilities. For example, Xcel Energy helped fund Clancy, the MPCA's mercury-detecting dog (Appendix C).

## **Section 6. Adequacy of State's Emission-reduction Goal and Strategies**

The 1999 mercury law directed the MPCA to discuss, in this report, whether the reduction goals and strategies called for in the law are appropriate given the most recent information and whether other voluntary or mandatory reduction strategies are needed.

Since the legislature established reduction goals in 1999 (60 and 70 percent decreases in emissions from 1990 levels by 2000 and 2005 respectively) the MPCA has improved its inventory of estimated mercury emissions in the state. As discussed in Section 3, this change helped Minnesota to reach the reduction goals with less reduction than originally expected.

More importantly, in the past five years, the MPCA has improved its scientific understanding of how mercury contaminates fish in Minnesota and has new information on safe fish mercury levels. Minnesota's draft Total Maximum Daily Load (TMDL) Study for Mercury, required by the Clean Water Act to address lakes and rivers polluted with mercury, summarizes the latest scientific information. With this information the MPCA has set a mercury reduction target that is intended to be protective of human health when it is reached.

In the draft TMDL study the MPCA demonstrates that in order for fish from Minnesota waters to be safe to eat for all but the highest consumers, a 93 percent reduction in human-caused emissions (from 1990 levels) is needed from all sources worldwide that contribute to air-deposited mercury in Minnesota. The draft TMDL establishes 789 lb. in annual mercury emissions, a 93 percent reduction from 1990 levels, as a new goal for air emissions from Minnesota sources. To meet this goal, a reduction of about 2,552 lb. from current

levels is needed. This represents a decrease of 76 percent from 2005 estimated emissions.

Since the early 1990s, the MPCA has used an array of regulatory, voluntary and educational approaches to reduce mercury emissions in Minnesota. In concert with similar initiatives on the federal level, efforts by governmental agencies, businesses, the legislature and others in Minnesota, these activities have contributed to a 70 percent decline in mercury emissions during the last 15 years. Appendix C describes these strategies in more detail including the strategies required by the legislature.

Reductions since 1990 occurred mostly by 2000 and were largely due to reductions in product-related emissions. Since 2000, the pace of reductions slowed dramatically compared to the previous 10 years. For 2005, the MPCA estimates that annual air emissions are only 296 lb. less than in 2000.

Since 2000, the MPCA has relied largely on voluntary efforts for reductions from the state's largest emitters through its voluntary agreement program. During this time, mercury emissions reductions of about 199 lb. per year were achieved by voluntary means. Additional annual voluntary reductions of about 170 lb. are expected by 2009 as well as reductions from the implementation of new federal standards for industrial boilers.

Reaching the 93 percent reduction goal established in the draft TMDL study will require significant reductions from all sectors — product-related releases, emissions from taconite processing and the energy-producing sector. While current strategies have been successful in reducing emissions, especially product-related

releases, achieving the reductions needed from all sectors will require additional voluntary and regulatory strategies.

The intended purpose of the TMDL study is to determine the sources of mercury contributing to pollution in Minnesota and how much these sources need to reduce in order for fish from Minnesota waters to be safe to eat. To allow the reader of the TMDL study to understand how the reductions could occur, the draft study includes a brief outline of possible short and long-term actions and strategies to meet the

proposed goal, as well as highlights the need for national and international reductions of mercury emissions.

Strategies to reduce emissions will be developed during the TMDL implementation planning phase in collaboration with interested stakeholders. Implementation planning will begin once the draft TMDL study is finalized and will last about a year. The MPCA is in the process of seeking public comments on the draft TMDL study and will finalize the document and forward to the EPA for approval.

## Section 7. Conclusions and Recommendations

Minnesota sources have reduced mercury air emissions by 70 percent since 1990, just meeting the reduction goals established by the legislature in 1999. These reductions are the result of voluntary and regulatory actions on the state and national level. The pace of reductions has slowed in the last five years and the MPCA predicts that emissions will begin to rise after 2010 unless additional voluntary or regulatory measures result in new reductions.

Minnesota's 2005 draft Total Maximum Daily Load Study for Mercury summarizes the latest scientific information on mercury in Minnesota fish, the sources of that mercury and the reductions needed for fish from Minnesota waters to be safe to eat. The draft TMDL demonstrates that a 93 percent reduction in worldwide human-caused emissions contributing to deposition in Minnesota (from 1990 levels) is needed.

The MPCA recommends that the state adopt this goal for in-state sources while also continuing to encourage further national and international reductions. National and international reductions are important because 90 percent of the mercury that is deposited from the air on Minnesota comes from sources outside the state. Conversely, most of Minnesota's mercury emissions are deposited in other states and countries.

The TMDL study proposes a tiered approach to reduce mercury emissions in Minnesota that continues existing voluntary and regulatory approaches, enhances aspects of the current MPCA program, and proposes additional state-level regulatory tools. The MPCA intends for the goal in the draft TMDL study and subsequent implementation plan to replace the goals and strategies established in the 1999 mercury law.

Meeting this goal will require significant reductions in emissions from all sources in the state, especially the utility and taconite sectors. A comparison of voluntary reductions from these sectors to date with the statewide reduction goal contained in the draft TMDL study (a 2,552-lb. reduction in annual emissions from today's levels) infers the need for more substantial reductions from these sectors. Additional state or federal regulation will be required to meet the 93 percent reduction goal.

To achieve this reduction goal, the MPCA will work with interested stakeholders to identify reduction strategies and to develop a detailed implementation plan. The draft TMDL study briefly outlines possible implementation strategies; however, the implementation plan is the second phase of the process and is not part of the TMDL study. The draft TMDL must be finalized and submitted to the EPA before development of the implementation plan can begin.

Implementation planning will address the timelines and specific strategies that will be used to achieve the 93 percent reduction called for in the draft TMDL study. The MPCA intends for the development of the implementation plan to be an open process that will last about a year.

The MPCA is in the process of seeking public comments on the draft TMDL study. Based on comments received, the agency may make changes to the draft document, including the reduction goal, before submitting it to the EPA for approval. The strategies to reach the goal will subsequently be developed with extensive stakeholder involvement.

## Summary of Conclusions and Recommendations

### Conclusions:

- Mercury emissions have decreased by about 70 percent since 1990, meeting the goal established by the legislature in 1999.
- A change in the 1990 baseline inventory incorporating new scientific information allowed Minnesota to reach the goal with fewer reductions than expected by the stakeholders involved in establishing the goal.
- Since 1990 emissions in Minnesota from product-related sources have been reduced by 92 percent, taconite sector emissions have declined by 6 percent and emissions from the energy production sector have increased by 15 percent.
- Actions by voluntary agreement participants have resulted in annual reductions of about 199 lb. with an additional 170 lb. expected by 2009 from reductions in progress at power plants.
- Ninety percent of the mercury deposited in Minnesota comes from air emissions sources outside of the state.
- Mercury in fish from Minnesota lakes decreased 10 percent between 1990 and 2000 and appears to be continuing to decline.
- Scientific work in the last five years allowed MPCA to establish a reduction goal of 93 percent (from 1990 levels) that is protective of human health.

### Recommendations:

- Adopt the proposed 93 percent reduction goal (from 1990 levels) contained in the draft TMDL study for Minnesota emissions sources.
- Develop strategies to reach the goal using an open process that involves interested stakeholders in the implementation planning process.
- Pursue additional short-term actions outlined in the draft TMDL study. These include:
  - develop a strategy to limit future emissions from new and expanding facilities;
  - develop monitoring and reporting protocol;
  - continue current reduction strategies including regulatory, voluntary, education and collection efforts;
  - encourage the development of federal regulations and international efforts to reduce emissions; and
  - investigate cooperation among other states in the region.