

**Report to the Advisory Council
of the Minnesota Pollution Control
Agency
Mercury Contamination Reduction
Initiative**

**From the
Source Reduction Feasibility and Reduction Strategies
Committee**

**OPTIONS and STRATEGIES FOR REDUCING
MERCURY RELEASES**

April 2000

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Minnesota Pollution Control Agency

Forward

Staff of the Minnesota Pollution Control Agency (MPCA) prepared this report with assistance from members of the committee. The MPCA wishes to recognize and thank the committee members, whose names are listed in Part 3, for their effort. Wherever possible, the content of this report reflects the consensus of committee members. Committee members and other interested parties authored many of the detailed descriptions of proposed options and strategies. MPCA staff made decisions on final wording of this document, which could not in all cases be based on group consensus.

Readers will note that the final date for this report occurs after the date of the Advisory Council's final report (March of 1999). An October 1998 draft of this report provided information used by the Advisory Council in preparing recommendations to the MPCA. However, comments received last fall had to be included in this report before it could be considered final.

Lists of mercury reduction options and strategies are not arranged in any particular order of preference or priority. The option and strategy descriptions are generally grouped by mercury source categories. Cost and reduction potential estimates derived from secondary sources, not from primary studies. Estimators did not make site-specific studies to support their conclusions. Instead, committee members relied on professional judgment or on others' estimates of costs incurred in cases equivalent to the options and strategies recommended for Advisory Council consideration. To the extent that options or strategies reduce pollutants other than mercury, these benefits are not factored into cost-effectiveness estimates. The actual cost per pound of pollution reduced would be lower than the estimates presented here for options and strategies that simultaneously reduce multiple pollutants. Most estimates were not reviewed with great care. They were accepted as planning guidelines. Both cost and reduction potential estimates merit a second look before specific ideas are put into practice.

Readers should also take into account the scope and durability of cost estimates. USEPA's Mercury Study Report to Congress covers the issues well:

One is that, as presented, all of the cost of control could mistakenly be attributed to mercury removal. As described in this Report, many of these controls achieve reductions of other pollutants as well (e.g., acid gases, dioxin, other metals). In some cases (e.g., the emission guidelines for MWI [medical waste incinerators]), the choice of control technology or control strategy is aimed at reducing pollutants other than mercury. In these cases, there is a co-control benefit of mercury reduction. The benefits of reducing other pollutants should be considered when interpreting the mercury control costs. Second, the technologies available for mercury control represent relatively new applications of these technologies. Thus, in the future, it is likely that as new or emerging technologies develop, the cost-effectiveness of control will improve. Air pollution control and prevention techniques are continuously under development and improvement. There is a fairly rapid pace of innovation in the air pollution control sector. The demand for cleaner products and cleaner processes that lower overall costs, combined with the necessity for improved air and water quality, create strong incentives for technological innovation and a growing market for such innovations. As the demand for more innovative, cost-effective and cost-saving technologies increase, new technologies will move from the research and development or pilot program phase to commercial availability.

(Volume 8: "An Evaluation of Mercury Control Technologies and Costs," p. ES-13.)

Various factors kept the SRFRS Committee from meeting one last time to approve the final draft of its report. As noted above, parts of the report do not reflect the consensus of the full committee. An Appendix ("Remaining Issues") has been added to the end of this report. Readers will find in this appendix the written comments of committee members who disagree with parts of the report.

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1.0 EXECUTIVE SUMMARY

Background

Source Reduction Feasibility and Reduction Strategies (SRFRS) Committee meetings began in October of 1997. After drafting a goal statement and organizing subcommittees, members compiled information that describes mercury reduction options and strategies. Committee members defined “options” as the means used by firms and individuals to reduce mercury releases. Some examples of mercury reduction options are activated carbon injection systems for incinerators, amalgam waste collection traps for dental offices, and switching from coal to natural gas for electricity generators. “Strategies,” in the SRFRS Committee’s terminology, are the actions taken to encourage or compel implementation of mercury reduction options. Some examples of mercury reduction strategies are technology-based regulations, emission cap-and-trade systems, environmental taxes, education, and mercury research programs.

Committee members focused first on mercury reduction options, which were considered as the building blocks for description and evaluation of mercury reduction strategies. Committee members paid particular attention to costs, cost-effectiveness (\$/pound of mercury) and reduction potential (defined as the amount of mercury releases that can be prevented or collected) in their option descriptions. Strategies were identified and defined after options. The committee also worked with MPCA staff to improve the MPCA’s mercury release inventory.

Results

Options have been identified that address most but not all of the known sources of mercury releases in Minnesota. Thirty-two of the most feasible mercury reduction options are described in detail in this report, grouped in terms of the economic sectors likely to put the options into practice. Estimates of potential mercury reductions range from one pound to hundreds of pounds per year. Cost-effectiveness estimates for mercury reduction options ranged from \$10 per pound to \$5,500,000 per pound.

Committee members described approximately 50 strategies that could encourage the use of mercury reduction options. Strategy descriptions identify the affected sources, geographic scope, associated options, cost and cost-effectiveness, potential funding sources, reduction potential, implementation issues, and other “synergistic” strategies. The overall permanence of the mercury release reduction and the technical feasibility of implementing associated options are indicated in the strategy summary table (Table 6-4). Cost-effectiveness and reduction potential estimates for strategies were derived from the associated options in many cases. Other costs, such as administrative costs for government staff to implement a strategy, are typically also included in strategy costs.

Strategies are grouped in Part 9 of this report in terms of their scope (national vs. state) and legal type (voluntary vs. mandatory). Reduction potential estimates for strategies range from nine pounds per year to 3,700 pounds per year. Cost-effectiveness estimates range from \$10 per year to \$922,000 per year. Some strategies (e.g., product bans) would lead directly to reductions in mercury releases, while others (e.g., education) would more indirectly lead to reductions.

The Committee also studied options for managing mercury that are already in the environment to minimize the amount that accumulates in fish. A subcommittee concluded that none of the options that they identified are practical for addressing the general problem of elevated mercury in the environment. However, some options may be of practical use for addressing site-specific mercury contamination problems that have resulted from local pollution.

Recommendations

The SRFRS Committee identified a number of recommendations for the Advisory Council and Screening and Evaluation Committee. A full list of recommendations is shown in Part 7 of this report. A summary of key recommendations is as follows:

- The committee encourages the Advisory Council to recommend in the final report the development of national strategies. This does not mean, however, that Minnesota should wait for national action before taking any action.
- Options or strategies that do not provide 100 % permanent prevention of mercury releases should not be rejected for that reason alone.
- Secondary benefits and impacts are not included in the cost-effectiveness estimates shown in the summary tables. These should be taken into account as part of economic impact evaluation and other evaluations as appropriate.
- It is difficult or, in some cases, not possible to estimate the reduction potential and cost-effectiveness for many of the strategies, particularly the voluntary strategies and information collection/research strategies. These strategies should not be rejected from consideration solely due to lack of cost-effectiveness and reduction potential estimates.

The committee believed that strategy descriptions were sufficient to move forward to strategy evaluation.

2.0 INTRODUCTION

2.1 Background

The Minnesota Pollution Control Agency (MPCA) has undertaken a project called the Mercury Contamination Reduction Initiative aimed at reducing mercury contamination of fish in Minnesota lakes. As part of the initiative, the MPCA formed an Advisory Council to provide the MPCA with recommendations on mercury-reduction strategies for the agency's consideration. The MPCA is also participating in a number of regional, national and international forums intended to establish broader approaches to reducing mercury use and release. Through this initiative the MPCA intends to take further action where state-level action is appropriate while continuing to set an example and provide national and international leadership and assistance.

The Advisory Council process was divided into three phases. The purpose of Phase I was to gather information needed for identifying the actions that have the greatest potential for achieving significant and cost-effective reductions in mercury contamination. During Phase II, strategies for reducing mercury releases and mercury contamination were evaluated using a set of clearly defined criteria. Under Phase III the Advisory Council made recommendations, using the information collected during the first two phases to support their decisions.

In September 1997, the Advisory Council decided to form two committees to conduct the Phase I information gathering and preparation for evaluating strategies under Phase II. Three subjects required definition before evaluations began: sources, strategies and evaluation criteria. Because sources and strategies are closely linked, these were grouped together under one committee, the Source Reduction Feasibility and Reduction Strategies Committee (SRFRS). The SRFRS were tasked with identifying sources of mercury emissions in the state, historical reductions from those sources and ways to further reduce mercury releases. The Criteria Committee was tasked with identifying and defining criteria that mercury reduction strategies ideally should satisfy, along with providing a more detailed proposal for how the strategy evaluations should be conducted. The results of the Criteria Committee were provided to the Advisory Council in May 1998 in a separate report.

This report is a summary of the tasks and findings of the SRFRS committee. The main purpose of the report was to provide information to the Advisory Council and the Screening and Evaluation Committee (SEC). The SEC used SRFRS information to evaluate strategies and to recommend a shorter list of strategies for consideration by the full Advisory Council.

2.2 Regional Context

Mercury is a global pollutant. Most of the air emissions from sources within Minnesota are carried out of the state by atmospheric transport. Most of the mercury deposited in Minnesota comes from sources outside the state.

The focus of the Mercury Contamination Reduction Initiative and the SRFRS committee has mainly centered on mercury sources in Minnesota. These are the sources over which the state has the most control. Moreover, actions taken within the state can establish the viability of and set an example for mercury reduction actions nationwide. The committee also considered mercury reduction strategies applicable at the regional, national, or international level. For political, effectiveness, and cost-effectiveness reasons, it makes sense to implement some mercury reduction strategies on a larger scale. It is also important to keep in mind the potential use outside Minnesota of the information and ideas generated by the SRFRS Committee. Much of the information developed by the SRFRS Committee is transferable to other states.

It should also be noted that because the information contained in this report pertains to Minnesota sources, some estimates (e.g., options, their costs and especially reduction potential) may be quite different for facilities located in other states. The type of mercury sources present will also vary from state to state. The U.S. EPA *Mercury Study Report to Congress* and reports published by other states provide information regarding mercury emissions in other states.

The committee discussed the possibility of working with other states in the region on a regional emission inventory. The four main benefits would be: 1) to make data comparable, 2) to use Michigan's and Wisconsin's detailed knowledge of some sources, and 3) to consider other industries in other states that may be relevant to a regional strategy, e.g., the chlor-alkali plant in Wisconsin, and 4) to enable multi-state control strategies. Although this effort was discussed in regional meetings and by conference calls between states, the regional emissions inventory was not completed.

Finally, one of the criteria to be used to evaluate different strategies is "transferability," which considers applicability of a strategy outside of Minnesota. Consideration of this issue was part of a later phase of the initiative.

2.3 List of Abbreviations

APC	air pollution control
Btu	British thermal unit
CCAP	Center for Clean Air Policy
CEM	continuous emission monitors
CO ₂	carbon dioxide

CP	Cooperative Power
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DPS	Minnesota Department of Public Safety
dscm	dry standard cubic meters
DSM	demand side management
EERC	Energy and Environment Research Center
EPRI	Electric Power Research Institute
GL	Great Lakes
HERC	Hennepin Energy Resource Company
Hg	mercury
HHW	household hazardous waste
IMA	Iron Mining Association
KW	kilowatt, kilowatts
KWh	kilowatt hour, kilowatt hours
lb.	pound, pounds
LCMR	Legislative Commission of Minnesota's Resources
MCES	Metropolitan Council Environmental Services
MDA	Minnesota Dental Association
MDH	Minnesota Department of Health
ME3	Minnesotans for an Energy Efficient Economy
MI	Michigan
MN	Minnesota
MP	Minnesota Power
MPCA	Minnesota Pollution Control Agency
MSDS	material safety data sheets
MSW	municipal solid waste
MW	megawatt, megawatts
MWC	municipal waste combustor
MWI	medical waste incinerator
NSP	Northern States Power
OEA	Office for Environmental Assistance
P2	pollution prevention
PMW	Products, Manufacturing and Wastes (Subcommittee)
ppb	parts per billion
ppm	parts per million
SEC	Screening and Evaluation Committee
SIC	standard industrial classification
SRFRS	Source Reduction Feasibility and Reduction Strategies Committee
TRI	Toxics Release Inventory
U of MN	University of Minnesota
µg/l	micrograms per liter
UMD	University of Minnesota at Duluth
US	United States

UTAC
WLSSD
WWTP

Utilities and Taconite Subcommittee
Western Lake Superior Sanitary District
wastewater treatment plant

3.0 COMMITTEE GOALS AND MEMBERSHIP

3.1 Committee Goals

The SRFRS Committee's responsibilities were described in a memorandum to the Advisory Council, dated October 22, 1997. The responsibility of the SRFRS Committee is to identify sources of mercury, the amount of mercury emitted by those sources, current mercury reduction strategies and the effectiveness of those strategies, historical reductions, and additional steps that could be taken to reduce mercury.

The first mission of this group consists of four tasks:

- I. Compile information by source category pertaining to historical mercury reductions, indicating the method employed and the amount reduced as well as anticipated future reductions based on voluntary efforts already in practice and/or regulatory requirements.
- II. Update Minnesota's emission inventory for all sources that use, emit, recycle, or dispose of mercury or mercury-containing products, and suggest additional information that will be important for evaluating the reduction strategies in Phase II. The purpose of the review is to ensure that the inventory is as current and complete as possible, and all information that is relevant to the list of reduction strategies is included (e.g., information that is not currently included in the inventory may be useful for some reduction strategies, such as how much mercury is recycled, etc.).
- III. Identify and define potential reduction options and strategies.
- IV. Develop a detailed schedule for evaluation in Phase II (this task was completed by the Criteria Committee).

The second mission of this group is to specifically define and evaluate the feasibility of each reduction option. Definitions will include the terms to be used to express the reductions (e.g., % removal efficiency, pounds per year). The group will solicit input from those with the appropriate technical expertise.

3.2 SRFRS Committee and Subcommittee Membership

Members of the SRFRS Committee and its subcommittees are shown below. Members volunteered to serve on the committees or were solicited by MPCA staff or other committee members. Members include Advisory Council members, alternates, and other interested persons. Three subcommittees were initially formed: Inventory, Utilities and Taconite (UTAC), and Products, Manufacturing and Waste (PMW). A fourth subcommittee, the Management of Mercury in the Environment Subcommittee was added in January 1998.

SRFRS Committee and Subcommittee Members (* denotes chair)

MPCA Staff: Carol Andrews, John Gilkeson, Carri Lohse-Hanson, Bob McCarron, Ed Swain

1. Dave Jeronimus*/Tim Hagley Minnesota Power (MP)
2. Bill Grant* Izaak Walton League of America
3. Carl Michaud Hennepin County/Association of Minnesota Counties
4. David Festa/Stacey Davis Center for Clean Air Policy (CCAP)
5. Dave Wright Minnesota DNR, Ecological Services Section
6. J. Drake Hamilton Minnesotans for an Energy-Efficient Economy (ME3)
7. Tim Tuominen Western Lake Superior Sanitary District (WLSSD)
8. Alexis Cain U.S. EPA, Region V
9. Stephani Campbell MnTAC/Iron Mining Association
10. Scott Hautala Hibbing Taconite/Iron Mining Association (IMA)
11. Dick Diercks Minnesota Dental Association (MDA)
12. Patti Leaf Northern States Power (NSP)
13. Leonard Levin/Ramsay Chang Electric Power Research Industry (EPRI)
14. Karen Utt Cooperative Power (CP)
15. Brian Golob Recyclights
16. John Pavlish/Steve Benson Energy and Environment Research Center, UND Grand Forks
17. Larry Schwarzkopf Fond du Lac Reservation
18. Rob Dunnette Olmsted County/ Minn. Resource Recovery Association
19. Betty K. Jensen Public Service Electric and Gas Company (PSE&G)

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Manufacturing, Products and Waste Subcommittee

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6. Rob Dunnette Olmsted County/ Minn. Resource Recovery Association (MRRA)
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8. Rich Korman Minnesota Hospital and Healthcare Partnership (MHHP)

Management of Mercury in the Environment Subcommittee

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4.0 OPTION DEVELOPMENT PROCESS

Before the SRFRS Committee could proceed with their tasks, it became apparent that it was necessary to differentiate between actions taken by sources of mercury to reduce emissions, which have become known as “options,” and actions taken to encourage implementation of mercury emission reduction options, called “strategies.”

The following steps were used to identify options:

1. Create a comprehensive list of mercury reduction options for all significant sources.
2. Prioritize the list of options to narrow it down to those considered most feasible. The definition of “feasible” as applied at this step, based on consultation between SRFRS and the Criteria Committee, is shown in Appendix C (Part 10).
3. Gather estimates of the most feasible options, especially regarding cost-effectiveness, reduction potential, and permanence as defined in Appendix C. Other information was also collected, for example, regarding potential obstacles to implementation of a given option. The outline and questions used to discuss each option are shown in Appendix D (Part 11).
4. Summarize information in a format that is useful for developing strategies.

The subcommittee recognized that the most important criteria to focus on in the options development phase were practicality/feasibility, reduction potential and cost-effectiveness. The committee’s assessment as to how well each option met these criteria is shown in the summary table (Table 6-1) (Readers should note, however, that the cost-effectiveness estimates in the summary table are based solely on the cost to reduce mercury. Other environmental benefits or costs that may occur with the implementation of specific mercury reduction options are identified in the detailed option write-ups under “implementation issues,” and where information was available, under “cost-effectiveness.” It was agreed that co-benefits would be considered in the economic analysis phase of the strategy evaluation process.)

The Advisory Council and SRFRS Committee have also noted and discussed the importance of the link between mercury releases and mercury contamination in fish, given that reducing mercury contamination, not just releases, is the ultimate goal of the initiative. Therefore, the committee has attempted to gather information, where available, regarding the expected environmental fate of mercury releases and the expected permanence of reduction efforts. However, other than noting the type of release (i.e., to air, land or water), and potential for cross-media transfer (e.g., from air to water), limited information is currently available for most sources and options regarding factors, such as mercury speciation, that affect the environmental fate of the mercury released or collected.

During option development, options have been set aside for one or more of the following reasons: 1) lack of available information, 2) lower feasibility or 3) limited application in Minnesota. The fact that these options have been set aside does not indicate, necessarily, that they are not viable options. These options are noted in Part 8.

5.0 STRATEGY DEVELOPMENT PROCESS

After creating a list of options, the committee identified “strategies” that encourage the implementation of options that are most cost-effective and have the highest reduction potential, considering other criteria such as permanence and flexibility. Advisory Council members discussed but did not establish formal cost-effectiveness and reduction potential cut-offs that would eliminate some options from further consideration. It was felt that all options should be available to strategy developers with the understanding that given the same reduction potential, strategies encouraging the most cost-effective options would be preferred.

Although some proposed strategies are tied to a specific option, many strategies leave the decision regarding what option to use to achieve mercury reduction up to the affected sources. In cases where the selection of reduction options is not dictated by the strategy, it was assumed that the most cost-effective options available to the affected sources within the context of the strategy would be implemented.

The list of potential strategies contains input from:

- members of the Advisory Council and its committees;
- staff from the MPCA and the Minnesota Office of Environmental Assistance (OEA); strategies proposed by MPCA include staff’s ideas as well as ideas taken from similar initiatives undertaken by other states and provinces;
- suggestions received in response to a “request for strategies” sent out in early May to the list of interested persons for Minnesota’s Mercury Contamination Reduction Initiative; and
- suggestions received earlier by MPCA, including those from a July 21, 1997, workshop at Como Park.

On May 14, 1998, a combined meeting of the SRFRS Committee and the Criteria Committee was held at the MPCA. The main goal of that meeting was to create a comprehensive list of strategies by adding to and clarifying the list provided by MPCA staff. SRFRS Committee members worked from May to October 1998 to refine this list, add strategies, and develop detailed descriptions of each strategy. The key elements of each strategy were summarized to facilitate evaluation by the Screening and Evaluation Committee.