REDUCING MERCURY IN THE NORTHEAST UNITED STATES

by Susannah King, Paul Miller, Terri Goldberg, John Graham, Stephen Hochbrunn, Adam Wienert, and Meg Wilcox

Over the past 10 years, the states in the Northeast United States—for purposes of this article, the Northeast States are Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont—have put tremendous effort into regional approaches to reduce mercury in the environment. In 1998, the New England Governors (NEG) and Eastern Canadian Premiers (ECP) Committee on the Environment formed a regional mercury task force with a goal of virtually eliminating all in-region human-related sources of mercury emissions and discharges. This initiative was instrumental in jump-starting mercury reduction programs across the region.

The states added momentum in 2007 when the six New England states and New York developed a regional proposal to establish a Northeast Mercury Total Maximum Daily Load (TMDL) under the U.S. Clean Water Act. The U.S. Environmental Protection Agency (EPA) approved the regional Northeast Mercury TMDL request in December 2007.

The Northeast States, through their state mercury reduction programs, are achieving significant and rapid reductions in mercury releases from in-region pollution sources, and are beginning to see indications that these reductions are resulting in lower accumulated mercury levels in the environment.

The primary concern associated with mercury is human exposure through the consumption of fish contaminated with this toxic metal. The mercury that accumulates in fish primarily originates from air emissions; sources include the burning of coal at power plants, burning of mercury-containing products at municipal waste combustors and medical waste incinerators, burning of sewage sludge that contains mercury from dental and other uses, and releases attributable to broken mercury-containing products (e.g., thermometers). Mercury that is released to the air returns

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to the land through atmospheric deposition and makes its way into waterbodies. Through processes in the environment, the emitted mercury can be converted to an oxidized form (methylmercury) that can accumulate in fish and other aquatic organisms. If methylmercury accumulation reaches levels that pose risks to human health, states must issue fish consumption advisories to provide information to their residents on the amount and types of fish that are safe to eat. All of the Northeast States have statewide or regional fish consumption advisories, indicating that mercury pollution is significant in this part of the country.

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Reductions in mercury levels in fish can be accomplished through installing systems to reduce the mercury emitted to the atmosphere by power plants and other facilities, or by reducing the amount of mercury that reaches incinerators, which can be achieved through programs to collect, recycle, and reduce use of mercury-containing products. This article briefly describes some of the results of mercury reduction programs in the Northeast that have targeted air emissions, mercury-added products, and wastewater discharges.

Actions to Reduce Mercury

Mercury in Air Releases

Reductions in mercury emitted to the air in the Northeast have been dramatic since the 1990s, when states began adopting aggressive mercury emission limits for municipal and medical waste incinerators. Across the Northeast, states with large municipal waste incinerators adopted a mercury emission limit of 28 micrograms per dry standard cubic meter (µg/dscm)[1]—almost three times more stringent than the federal New Source Performance Standard of 80 µg/dscm.[2] As a result, mercury emissions from municipal waste incinerators in the eight Northeast States decreased by 85% from the late 1990s, from more than 14,000 lb of mercury emitted to approximately 2000 lb. Furthermore, mercury emissions from medical waste incinerators have decreased by more than 95% in the region, falling from almost 1600 lb in 1998 to 58 lb in 2002 (see Figure 1).[3]

Similar reductions have been achieved across the border in Canada, as a result of cooperative efforts between the NEG/ECP mercury task force. For example, of the three medical waste incinerators in New Brunswick existing in 2000, two have since closed and the third has mercury controls achieving mercury reductions well below a December 2003 NEG/ECP limit of 55 µg/dscm.[4]

A recent study conducted in Massachusetts has shown significant declines in fish mercury concentrations coinciding with decreases in mercury emissions from incinerators.[5]

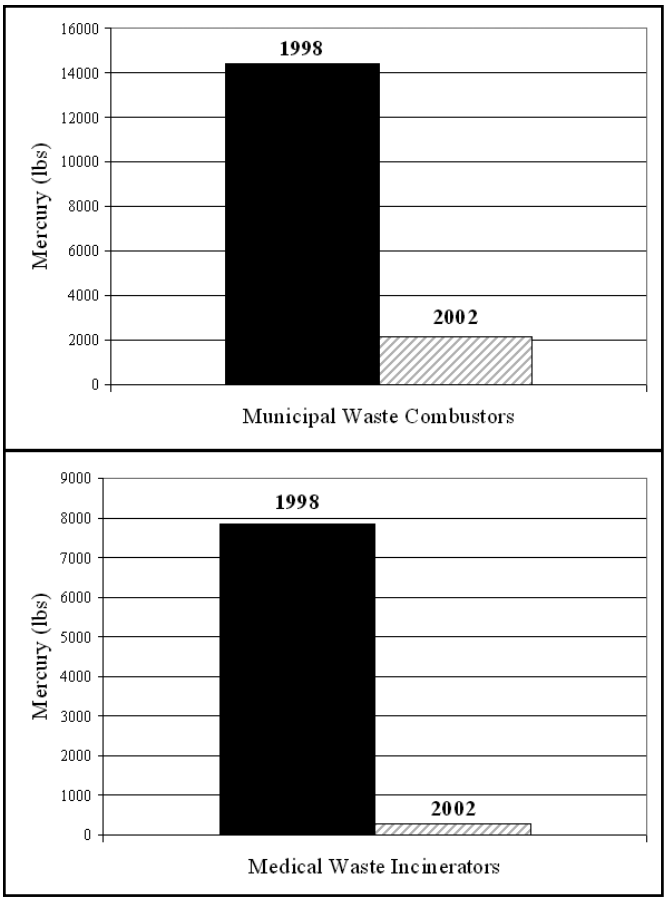

Figure 1. Bar charts showing the decrease in mercury air releases from municipal waste combustors (upper bar chart) and medical waste incinerators (lower bar chart) between 1998 and 2002 from sources in the eight Northeast States (based on data collected by Northeast States for Coordinated Air Use Management [NESCAUM]).

In one targeted location in northeastern Massachusetts, mercury emissions fell by approximately 87% due to new pollution controls and closures of local municipal and medical waste incinerators. Fish tissue concentrations in lakes near these sources, which were monitored before and after the emissions reductions, decreased significantly within 36–48 months of adoption and implementation of the controls and closures. The results of the Massachusetts study, along with studies looking at recently deposited mercury versus old mercury in lake systems[6,7] and a study finding higher amounts of mercury in large mouth bass in states with higher wet atmospheric deposition,[8] lend support for concluding that aquatic systems can respond rapidly to recent changes in mercury deposition even though old reservoir sources of mercury (e.g., lake sediments) may exist. The Massachusetts study also indicates that local air emission sources of mercury can have a strong influence on fish tissue mercury levels in nearby waterbodies. This is consistent with studies in Florida of local mercury emissions, deposition, and presence in the environment.[9-12]

Building upon their success with incinerator controls, the Northeast States are now targeting mercury air pollution from coal-fired power plants through measures that are more aggressive than what would have been federally required under the vacated Clean Air Mercury Rule

State	Rules/Legislation—Proposed or Adopted	Was State in National Trading Program Under Vacated CAMR?[13]
Connecticut	State statute requires 90% reduction or compliance with a mercury emissions limit of 0.6 lb/10^{12} Btu by July 1, 2008, with provision for an alternative if controls fail to achieve limitation. More stringent limits possible after July 1, 2012.[b]	No
Maine	All facilities (including electric generating units) have a mercury emission limit of 50 lb/yr which drops to 35 lb/yr in 2007 and to 25 lb/yr in 2010. A mercury reduction plan is required for facilities emitting more than 10 lb/yr.	Only one electric generating unit might have been subject to CAMR and it emits less than 4 lb/yr.
Massachusetts	Adopted rule requires 85% capture or 0.0075 lb/GWh by January 1, 2008, and 95% capture or 0.0025 lb/GWh by October 1, 2012. Averaging between units at the same facility allowed.	No
New Hampshire	Legislation passed House and Senate, and signed by Governor, calls for 80% reduction of mercury emissions from coal-burning power plants through installation of scrubber technology no later than July 1, 2013. Emission credits for sulfur dioxide for early mercury reductions.	No
New Jersey	Adopted rule requires control efficiency of 90% or 3 mg/MWh [0.0066 lb/GWh] by December 15, 2007, for coal-fired boilers of any size. A multipollutant approach can reduce the initial reduction required and extend compliance to December 15, 2012.	No
New York	Adopted rule for coal-fired electric utility steam generating units implements a Phase I emission cap for the years 2010–2014, and beginning in 2015 establishes a facility-wide emission limit for each applicable facility. Phase I imposes annual facility-wide mercury emission limitations, based upon the state mercury budget EPA distributed to New York. Facilities will not be permitted to generate and trade mercury reductions with other facilities or states. The annual facility-wide emission limitations will be in effect from 2010 to 2014. Starting in 2015, Phase II, in conjunction with other electric sector regulations, such as the Regional Greenhouse Gas Initiative (RGGI) and the second phase of the Clean Air Interstate Rule (CAIR), will establish a facility-wide emission limit of 0.6 lb/10^{12} Btu for each applicable facility.[b]	No
Rhode Island	Zero state budget for mercury under EPA's CAMR.	Yes, for new sources
Vermont	Zero state budget for mercury under EPA's CAMR.	No

Table 1. State mercury control programs for coal-fired power plants.[a]

Notes: [a]Information taken from *State Mercury Programs for Utilities* (National Association of Clean Air Agencies [NACAA]; November 20, 2007; www.4cleanair.org/Documents/StateTable.pdf [accessed November 26, 2007]). [b]For comparative purposes with other states, an input-based mercury standard of 0.6 lb/10^{12} Btu is comparable to an output-based standard of 0.006 lb/GWh, assuming a power plant efficiency of 35%.

(CAMR).[13] Table 1 lists the state requirements in adopted or proposed regulations.

Mercury in Products

Since 2000, the Northeast States have enacted major legislation to address mercury use in products and ultimately in solid and hazardous waste. This legislation includes bans and phase-outs on the sale of certain products, requirements for product labeling, and requirements for manufacturers to disclose their use of mercury in products that are sold in the region. The states have coordinated implementation of their laws through the Interstate Mercury Education and Reduction Clearinghouse (IMERC). Analysis prepared by IMERC found that from 2000 to 2006, restrictions on product sales in the region have eliminated approximately 14 tons of mercury.

The states have pursued mandatory and voluntary programs for collecting certain mercury-containing products once they reach end-of-life status. States have also focused on eliminating or reducing the use of mercury and mercury-added products at various types of facilities, such as schools and hospitals. Mercury collection and recycling efforts by the Northeast States led to an additional 7.5 tons of mercury recovered from homes, schools, hospitals, and other locations throughout the region. Some of the actions that have contributed to these reductions include the recycling of 41,764 mercury-containing thermostats, the collection of 120,973 mercury automobile switches and 213,322 mercury thermometers, and the removal of 4696 lb of mercury from 456 schools. Table 2 provides a more complete list of the collection and recycling efforts for the 2000–2006 period.

Mercury in Wastewater

At the end of 2005, more than half of the dental offices in the New England states and eastern Canadian provinces had installed dental amalgam separators to reduce the amount of mercury going to wastewater treatment facilities. All of the Northeast States now have legislation or regulations that require installation of amalgam separators, whereas previously many of the states had voluntary programs. In some cases, states have taken steps to reward early compliance. For example, Massachusetts began a voluntary program in 2004 that allowed dentists who installed separators prior to regulations becoming effective in 2006 to be exempt

Activity	Mercury Collected and Recycled (lb)	Comments
Mercury removal from schools	4696[b]	456 schools
Auto switches collected and recycled	267.5	120,973 switches[c]
Bulk mercury collected and recycled from dental offices	2151	In the past, dentists mixed amalgam on-site; therefore, many older dental clinics had leftover containers of bulk mercury. Most of the states in the Northeast now also require dental clinics to install amalgam separators to separate the mercury from their wastewater discharges.[d]
Thermostats recycled	458	41,764 thermostats[e]
Hospitals reducing mercury	761	10 hospitals received Hospitals for a Healthy Environment mercury reduction awards for reducing an estimated 530 lb of mercury,[f] 825 sphygmomanometers collected from Massachusetts and Vermont hospitals, and 61 lb of bulk mercury collected from Massachusetts hospitals.
Dairy manometers collected	140	140 dairy manometers
Household hazardous waste collection	6092	
Plumbing gauges	74	
Maple sugar thermometers	0.7	
Fever thermometers collected	352	213,322 thermometers
Total Collected = 14,992 lb or 7.5 tons		

Table 2. Mercury collection and recycling for Northeast States, 2000–2006.[a]

Notes: [a]Information sources for table entries are given in *Northeast States Succeed in Reducing Mercury and Continue to Address Ongoing Challenges* (Northeast Waste Management Officials' Association [NEWMOA], 2007; www.newmoa.org). [b]Does not include all mercury equipment collected; some states reported pounds of liquid mercury only, while others estimated amount of mercury collected from equipment in addition to liquid mercury. [c]Assumes 1 g of mercury per switch. [d]It is not possible to estimate the amount of mercury that has been eliminated from wastewater by the installation of amalgam separators in the region, but studies have shown substantial declines in mercury in wastewater treatment sludge at facilities following the installation of amalgam separators. [e]Assumes 5 g of mercury per thermostat based on data from the Thermostat Recycling Corporation. [f]*Source:* Hospitals for a Healthy Environment's (H2E) "Making Medicine Mercury Free Award." More than 10 hospitals have eliminated mercury in New England; however, only 10 applied for the H2E Award. The 530 lb is based on an estimate derived by H2E of 95.2 g of mercury/acute care bed removed.

from future Massachusetts Department of Environmental Protection amalgam separator installation, operation, maintenance, and upgrade regulations and related fees until either 2007 or 2010, depending on the date of installation. This program resulted in approximately 75% of dentists installing separators. The environmental benefits of the increased separator use can be seen in the decline in mercury concentrations in sewage sludge at the Massachusetts Water Resources Authority (MWRA) Deer Island treatment plant, which receives sewage from homes, businesses, and industries in 43 greater Boston communities. The mercury concentration in the plant's sludge pellets in September 2004 was 3.8 mg/kg; by August 2006, it had decreased to 1.2 mg/kg (see Figure 2). It was during this time that dental offices installed the majority of amalgam separators now in operation.

Summary

All of the activities described above have played a significant role in regional mercury reductions in the Northeast. Emission controls on municipal waste combustors and medical waste incinerators and reductions in products that contain mercury have led to significant mercury reductions from these sources and created momentum for requiring greater mercury reductions from coal-fired power plants. Improved management and reduced use of mercury-containing products have translated into further reductions. The decrease in mercury released from dental offices has resulted in lower mercury levels in both sewage sludge and wastewater released to regional waterbodies. Reduced sludge concentrations have led to lower emissions from sewage sludge incinerators. All of these declines contribute to lower mercury levels in fish tissue, and hence, lower human exposure through fish

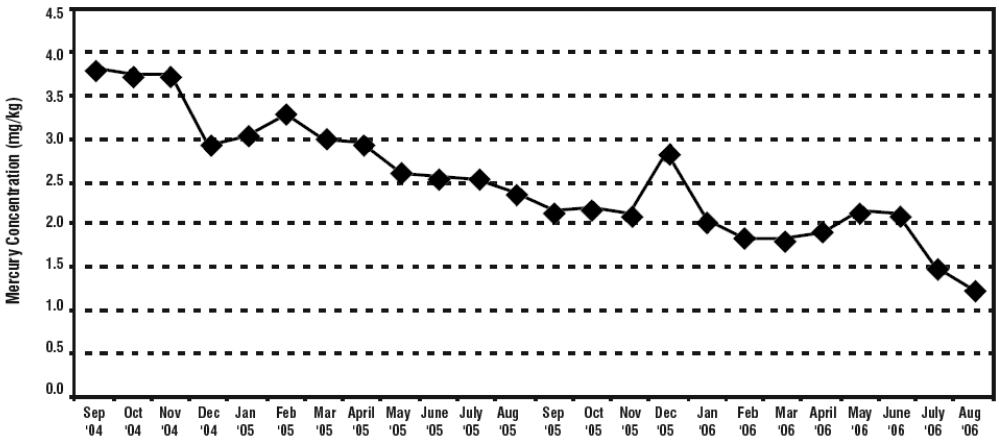

Figure 2. Trend line showing decreasing mercury concentrations in sewage sludge pellets at the Deer Island treatment plant in Massachusetts, between September 2004 and August 2006. This period coincides with the installation of amalgam separators at dentists' offices in the Boston, MA, metropolitan area (based on 2006 data provided by MWRA).

consumption—the ultimate goal of the regional mercury reduction efforts. While these results show great progress, further reductions are needed from in-region and out-of-region mercury sources to ensure that fish are safe to eat. The Northeast States continue to be committed to reducing mercury and will remain dedicated to this effort until fish consumption advisories are no longer necessary.

Further Reading

More detailed information on the topics covered in this article can be found in three supplementary reports: *Tracking Progress in Reducing Mercury Air Emissions* (Northeast States for Coordinated Air Use Management [NESCAUM]; www.nescaum.org); *Northeast States Succeed in Reducing Mercury and Continue to Address Ongoing Challenges* (Northeast Waste Management Officials' Association [NEWMOA]; www.newmoa.org); and *Reducing Mercury in Wastewater and Spreading the Word about Mercury in the Environment* (New England Interstate Water Pollution Control Commission [NEIWPCC]; www.neiwpcc.org). **em**

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13. The Clean Air Mercury Rule (CAMR) was a federal rule intended to permanently reduce mercury emissions from U.S. coal-fired power plants through a cap-and-trade program. The Northeast States objected to the concept of mercury trading between power plants in lieu of source-specific controls, as well as to the relatively modest reductions required and the long times allowed for power plants to reduce their mercury emissions. Led by New Jersey, the Northeast States and other states challenged the rule in court. On February 8, 2008, the U.S. Court of Appeals for the District of Columbia Circuit ruled in favor of the states, and vacated CAMR in its entirety.