Out of Control and Close to Home

MERCURY POLLUTION FROM POWER PLANTS

ENVIRONMENTAL DEFENSE
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MERCURY POLLUTION FROM POWER PLANTS

AUTHOR
Michael Shore

Mercury pollution from power plants is unregulated and generally uncontrolled. Local mercury emissions in the United States are important contributors to local mercury hot spots, leading to contaminated water, fish that is not healthy for consumption and brain damage in infants.

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Environmental Defense would like to acknowledge Paulette Middleton for her invaluable research and white paper on mercury pollution. Her report, "Mercury—A Local Concern, an International Issue," is available online at www.environmentaldefense.org/go/mercurylocalconcern.

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On the cover
Mercury spewed into the air from coal-burning power plants settles on bodies of water, accumulates in fish and poses a serious health hazard to young children. Smokestacks photo by Photodisk. Fish on plate photo by Tim Connor. Woman and child photo by Getty Images.

Our mission
Environmental Defense is dedicated to protecting the environmental rights of all people, including the right to clean air, clean water, healthy food and flourishing ecosystems. Guided by science, we work to create practical solutions that win lasting political, economic and social support because they are nonpartisan, cost-effective and fair.

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The complete report is available online at www.environmentaldefense.org/go/mercurypowerplants. Questions and comments can be directed to Michael Shore at mshore@environmentaldefense.org.

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Executive summary

Mercury is a highly toxic heavy metal that poses a major public health threat. Because mercury can interfere with development, fetuses and children are most at risk. The Centers for Disease Control and Prevention estimate that 8% of women of childbearing age in the United States have mercury levels in their blood above what the Environmental Protection Agency (EPA) considers safe. In other words, millions of American women who could be pregnant are exposed to dangerous levels of mercury each year, putting more than 300,000 newborns at risk of brain damage and learning disabilities.

Mercury is released into the air from power plant smokestacks and other sources. It can fall to the ground with rain (or without) and enter water bodies in a process known as deposition. People are most often exposed to mercury by eating contaminated fish. The problem of mercury-contaminated fish is widespread, with 43 states issuing advisories to limit consumption of mercury-laden fish. Coal-fired power plants account for about 40% of the mercury emissions in the United States—by far the largest single source. Despite this, no limits exist on mercury pollution from power plants.

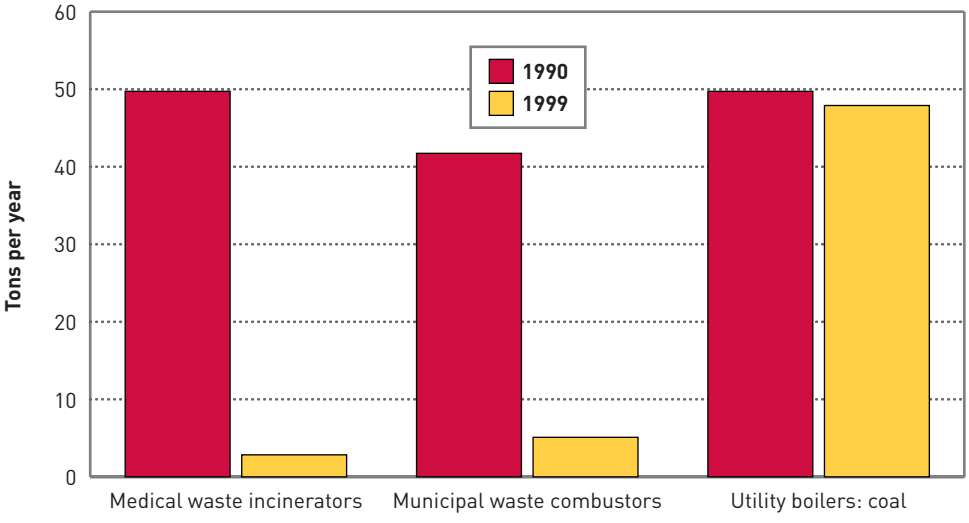
Findings

Analysis of emission trends and recent modeling of how mercury is transported and deposited into soil and water leads to three important findings that should influence how policy makers address mercury pollution:

FIGURE A

Mercury releases from major sectors in the United States

Emissions of mercury from electric utilities have remained static while other major sources of mercury have declined. Since 1990, national regulations have compelled municipal and medical waste incinerators to reduce emissions by over 90%.



Source: United States Environmental Protection Agency, Technology Transfer Network (TTN), Clearinghouse for Inventories and Emissions Factors. www.epa.gov/ttn/chief/.

OUT OF CONTROL

1. Mercury pollution from electric utilities remains completely unregulated. While other industries have achieved considerable reductions in mercury emissions, mercury pollution from electric utilities is predicted to increase with increased electrical demand. National policies have been successful at reducing mercury emissions from medical waste incinerators and municipal waste incinerators by over 90% since 1990 (See Figure A). These sectors provide a model for reductions that could be made in the power plant sector.

CLOSE TO HOME

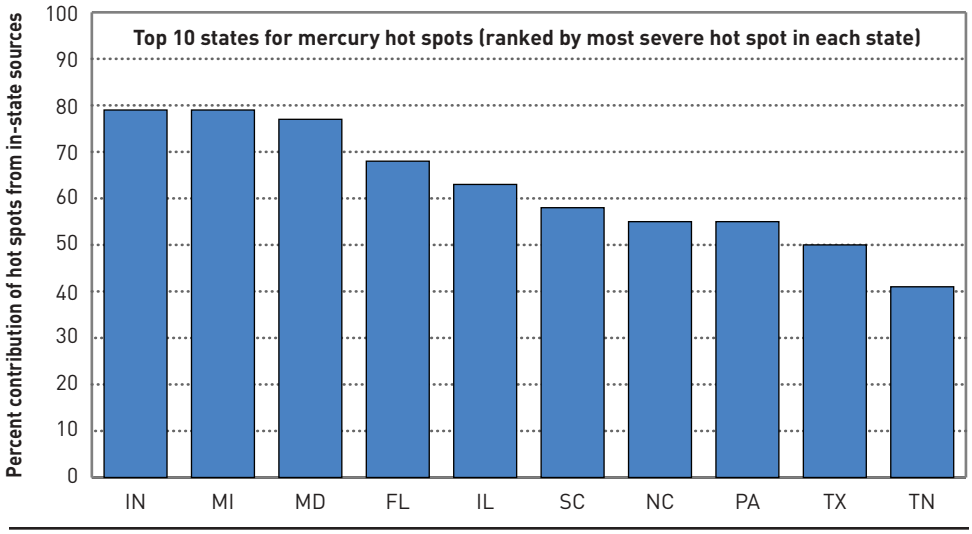
2. Mercury pollution within the United States puts fetuses and children at risk. Since mercury does not break down, it can travel a long way before it is deposited in the environment. However, modeling shows that significant amounts of mercury in waters across the nation come from pollution sources within the United States. Sources in the United States contribute to local mercury "hot spots" and add to global mercury pollution levels, leading to contaminated water, fish that is not healthy for consumption, and brain damage in infants.

3. Local sources can lead to local mercury "hot spots." Local emissions of mercury are largely responsible for mercury deposition hot spots (locations where mercury deposition is high), providing an excellent opportunity for effective reductions. Recent modeling suggests that at mercury hot spots pollution sources within the state can account for large portions of the deposition (Figure B). At hot spots across the United States, local sources often account for 50% to 80% of the mercury deposition. As shown in Figure B, for example, local pollution sources account for over 70% of the deposition in hot spots in Indiana, Michigan, and

FIGURE B

Local pollution sources predominate at mercury hot spots

EPA modeling shows that at mercury hot spots (locations where mercury deposition is highest), local emission sources within a state can be the dominant source of deposition. In-state sources contribute more than 50% of the pollution to sites in 9 of the 10 worst hot spot states.



Source: Draft Mercury Deposition Modeling Results, EPA Office of Water, 2003.

Maryland. In another recent analysis in south Florida, dramatic reductions in mercury pollution from local incinerators was accompanied by a lowering of mercury concentrations in large mouth bass by 60–75%, indicating the importance of controlling local sources to reduce local contamination.

Recommendations

Reducing power plant pollution is critical to lowering local mercury deposition and avoiding the dangerous contamination of fish, wildlife and people. EPA is required by the federal Clean Air Act to lower mercury air pollution from power plants. To protect public health and the environment from harmful mercury emissions, state and federal policy-makers should take the following steps:

- EPA should issue strong mercury standards for power plants to reduce mercury pollution from 48 tons today to about 5 tons, or a 90% reduction. These reductions are consistent with national standards for other source sectors and achievable through available pollution-control technology.

- States with mercury deposition hot spots should pursue their own mercury pollution standards to protect local water bodies and public health, and all states should press for rigorous national standards.

Out of control and close to home

Introduction

Mercury is a highly toxic heavy metal that poses a major public health threat. It is released into the air from power plant smokestacks and other sources. It can fall to the ground with rain and enter water bodies in a process known as deposition. Mercury makes more surface waters in the United States unsafe for fishing than any other toxic contaminant, and people are most often exposed to mercury by eating contaminated fish (see Figure 1).

The form of mercury found in fish, methylmercury, is a neurotoxin that causes brain and nervous system damage. Even with fish-consumption advisories, exposure to mercury-contaminated fish is high.

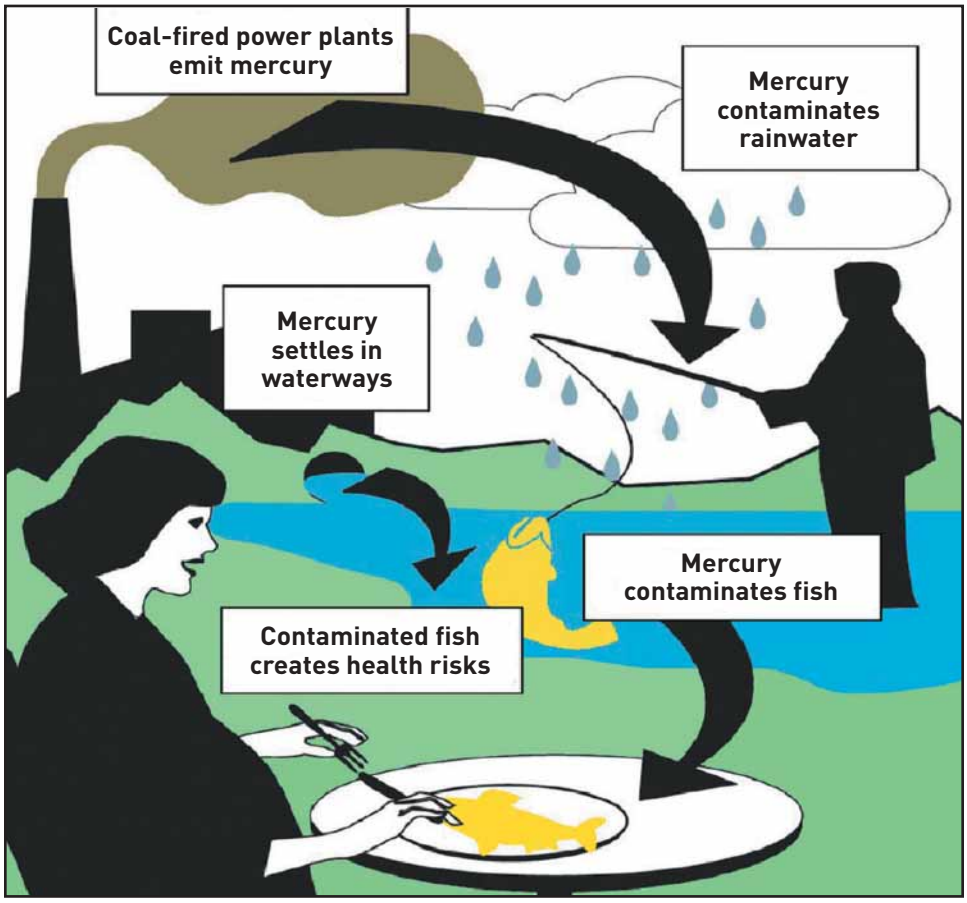
Although coal-fired power plants account for about 40% of mercury emissions in the United States—by far the largest source—mercury pollution from this sector remains completely uncontrolled.

The EPA is obligated to propose rules in December 2003, to be finalized one year later, to reduce mercury and other air toxics from power plants. Although

FIGURE 1

The toxic mercury cycle

Those most at risk from methylmercury are pregnant woman, their fetuses and young children. Even with fish-consumption advisories, exposure to mercury-contaminated fish is high.



DESIGN FOR SOCIAL IMPACT

other sectors, such as waste incinerators, have already reduced mercury pollution by 90%, power companies have called for much weaker standards. Some power companies argue that mercury pollution is a global problem and national standards would not significantly reduce deposition within the United States. Such an argument is based on averaging deposition across the entire nation, which can be misleading.

Along with reviewing health issues and emission trends, this report examines the available scientific evidence on the local deposition of mercury pollution. Cutting-edge scientific research shows that a significant portion of mercury pollution is deposited locally and regionally, which underscores the importance of strong national mercury standards for power plants.

Public health threats of mercury

Mercury is one of the most poisonous forms of air pollution. First emitted into the air as a metal, mercury settles in the beds of rivers, lakes and streams, where bacteria convert it to methylmercury, a highly toxic compound. Methylmercury builds up or bioaccumulates in the bodies of animals, so fish at the top of the aquatic food chain, such as pike, bass, shark and swordfish, may contain mercury concentrations 1 to 10 million times greater than the surrounding water.[1] People are exposed to unsafe levels of methylmercury by eating contaminated fish.

FIGURE 2

Fish consumption advisories for mercury

Currently, 43 states (those shaded on the map) warn against consuming several species of fish, such as pike, bass, shark, swordfish and mackerel.

Source: U.S. EPA, State Fish Advisories web site: www.epa.gov/ost/fish.

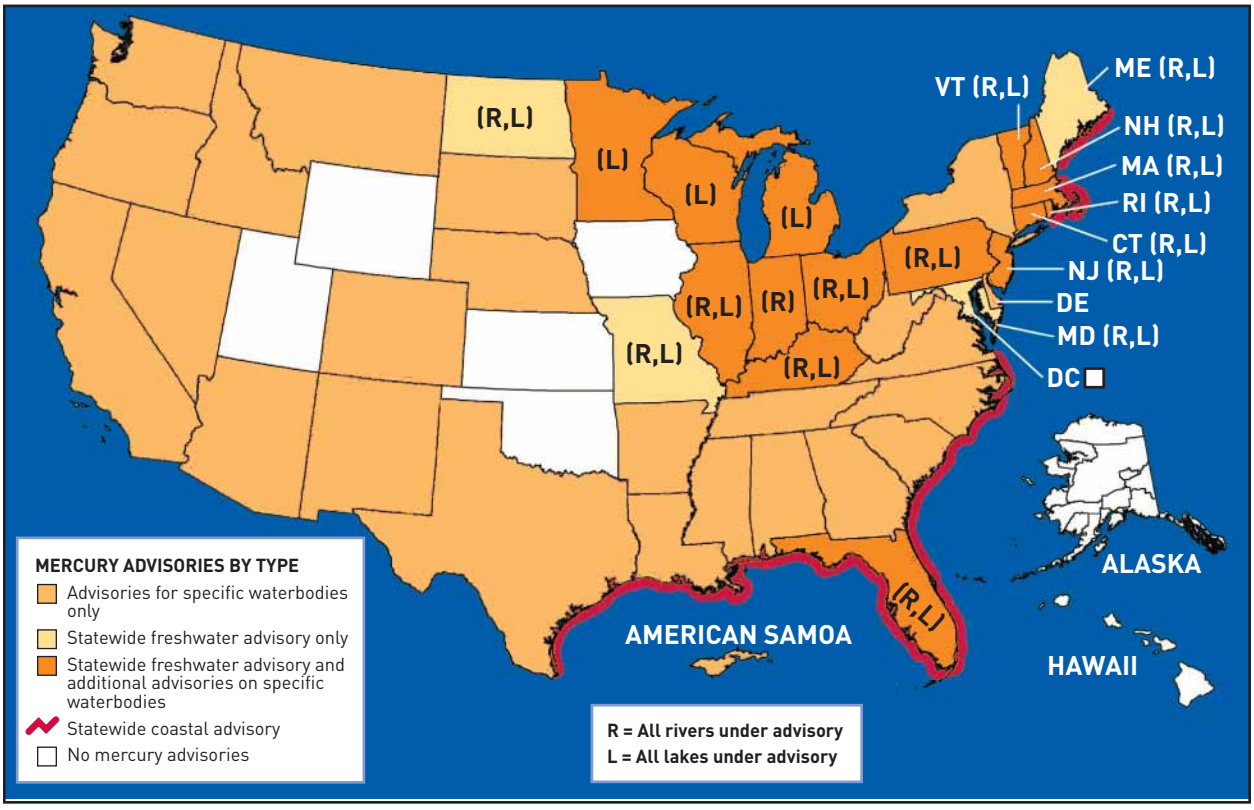
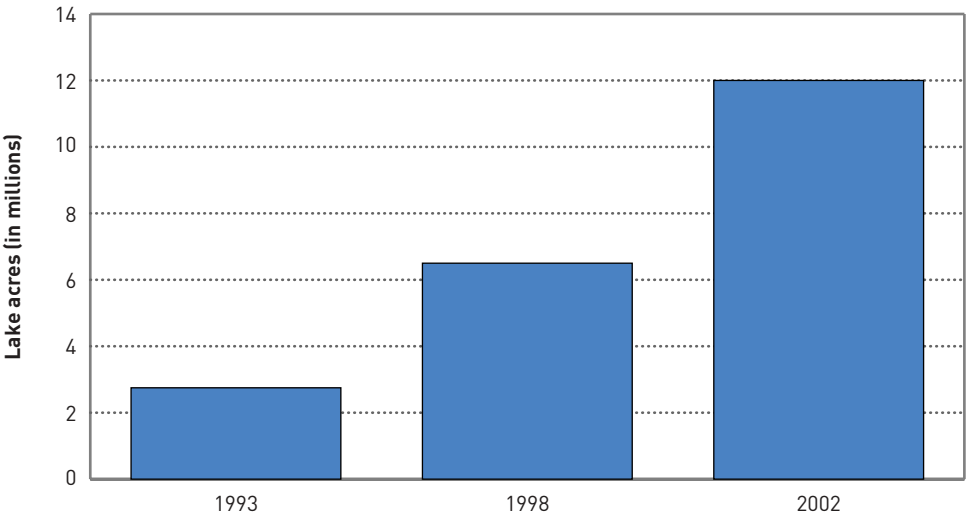


FIGURE 3

Trends in numbers of lakes under advisory for mercury

The increase in fish advisories is not necessarily an indication that the problem of mercury-contaminated fish is worsening, but the increase does reflect that scientists and public health officials have gained an increased understanding of the severity of the mercury-deposition problem.



Source: U.S. EPA, State Fish Advisories web site: www.epa.gov/ost/fish.

Pregnant women, women of childbearing age, children, subsistence fishers, recreational anglers and Native Americans who consume large amounts of fish are most at risk for health problems caused by mercury exposure. Pregnant and nursing women who eat mercury-contaminated fish place their fetuses at risk for brain damage or other birth defects. The Centers for Disease Control estimate that 8% of women of childbearing age nationally have mercury in their blood streams beyond the levels that the EPA considers safe.[2] Thus, millions of American women of childbearing age are overexposed to mercury through consumption of contaminated fish, putting over 300,000 newborns at risk of brain damage and learning disabilities each year.[3]

Recognizing the increasing health threats from mercury pollution, the United States Food and Drug Administration and 43 states warn against eating several species of fish such as pike, bass, shark, swordfish and mackerel. Figure 2 maps the locations of current fish-consumption advisories.[4] The geographic extent of areas under mercury advisories increased by almost 138% from 1993 to 2002, with the most dramatic increases having occurred in the last several years (see Figure 3).

The increase in fish advisories is not necessarily an indication that the problem of mercury-contaminated fish is worsening, but the increase does reflect that scientists and public health officials have gained an increased understanding of the severity of the mercury-deposition problem. Increased testing of fish for mercury contamination has revealed more species and more water bodies with high mercury concentrations.

OUT OF CONTROL

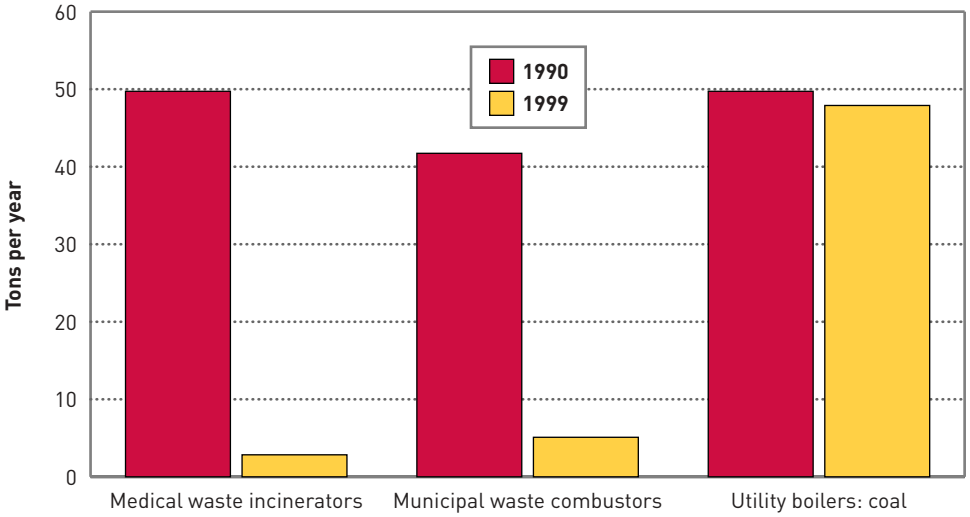
Coal-fired power plants remain unregulated for mercury

In 1999, mercury emissions from coal-fired power plants accounted for about 48 tons, or 41%, of new mercury emissions to the atmosphere from the major sources. While

FIGURE 4

Mercury released from major sectors

Electric utility emissions have remained static while the other two largest sources of mercury have declined. Since 1990, national regulations have compelled municipal and medical waste incinerators to reduce emissions by 90%.



Source: United States Environmental Protection Agency, Technology Transfer Network (TTN), Clearinghouse for Inventories and Emissions Factors. 1999 data: National Emissions Inventories for Hazardous Air Pollutants, Version 3, July 2003. 1990 data: National Toxics Inventory, Version 0302, October, 2003. www.epa.gov/ttn/chief/.

the other two largest sources of mercury pollution have declined, mercury pollution from power plants has remained static. In 1990, municipal waste incinerators, medical waste incinerators and power plants were the three largest sources of mercury pollution. Since then, federal regulations have required the clean-up of both medical and municipal waste incinerators, resulting in a 90% reduction in pollution levels. This leaves power plants as the predominant source of mercury pollution and, of the three largest sources, the only one that is not regulated (Figure 4). The more than 90% reduction from medical and municipal waste incinerators provides a benchmark

States are taking the lead in controlling mercury pollution

In 2003, Connecticut became the first state in the country to regulate mercury emissions from coal-burning power plants.[8] The Connecticut law requires coal-fired power plants to achieve either an emissions standard of 0.6 pounds of mercury per trillion Btu, or a 90% efficiency in technology installed to control mercury emissions. According to the company affected by the legislation, PSEG Power, applying the Connecticut standard nationally could cut mercury emissions from power plants up to 86%.[9]

Other states are also considering mercury standards. Massachusetts has proposed a standard to capture 95% of mercury contained in the combusted coal, while Wisconsin's final proposed rule would require an 80% capture efficiency, based on the mercury content of the coal.[10] New Hampshire intends to propose mercury emissions caps on the power sector in 2004. Illinois is evaluating the need for state standards, and North Carolina is reviewing options for reducing mercury pollution.

for policies to reduce pollution from power plants. Without strong standards, mercury pollution from power plants will increase as demand for electricity rises.

TIGHT CONTROLS ON POWER PLANT MERCURY POLLUTION ARE NECESSARY AND FEASIBLE

EPA is well aware of the public health threats of mercury pollution. In 1997, the agency presented a comprehensive report to Congress on mercury pollution.[5] In December of 2000, EPA made the determination that it would develop mercury standards for power plants, identifying mercury "as the hazardous air pollutant of greatest concern to public health from the [electric utility] industry."[6] Proposed standards are due December 2003 with final standards required one year later. Cost-effective technologies exist to reduce mercury emissions by more than 90%,[7] providing EPA the opportunity to develop strong standards.

CLOSE TO HOME
The significance of local mercury deposition

Mercury does not break down, and it can travel long distances before it is deposited. Some power companies use this as an excuse to oppose strong national mercury limits, claiming most mercury pollution comes from outside U.S. borders. However, modeling data show that significant portions of mercury deposited in waters across the nation come from within North America, and often deposition is local.

Atmospheric mercury pollution that has reacted and combined with other pollutants tends to deposit locally or regionally, while unreacted mercury (elemental) tends to enter the global atmospheric pool, enabling it to be deposited virtually anywhere in the world. Even where the global sources are major contributors, it is important to recognize that the large global pool of mercury is not naturally occurring. The global pool is fed by the emissions that result from the combustion of coal in the United States and around the world.

The EPA Mercury Study Report to Congress in 1997 estimates that 66% of all of the mercury deposited in the U.S. comes from national sources, and that 34% comes from sources outside of the U.S.[11] On the other hand, recent modeling supported by the Electric Power Resource Institute (EPRI), the research arm of some of the nation's largest power companies, estimates that on average 70% of mercury deposition comes from global sources.[12] However, the average deposition figure is highly misleading. Averaging modeling results drowns out the high local deposition rates in specific locations across the country. For example, a family eating fish from a water body that is downwind from a nearby power plant might not take any comfort in the fact that average deposition from North American sources may only be 30%. For the family, the local power plant may account for the vast majority of the deposition.

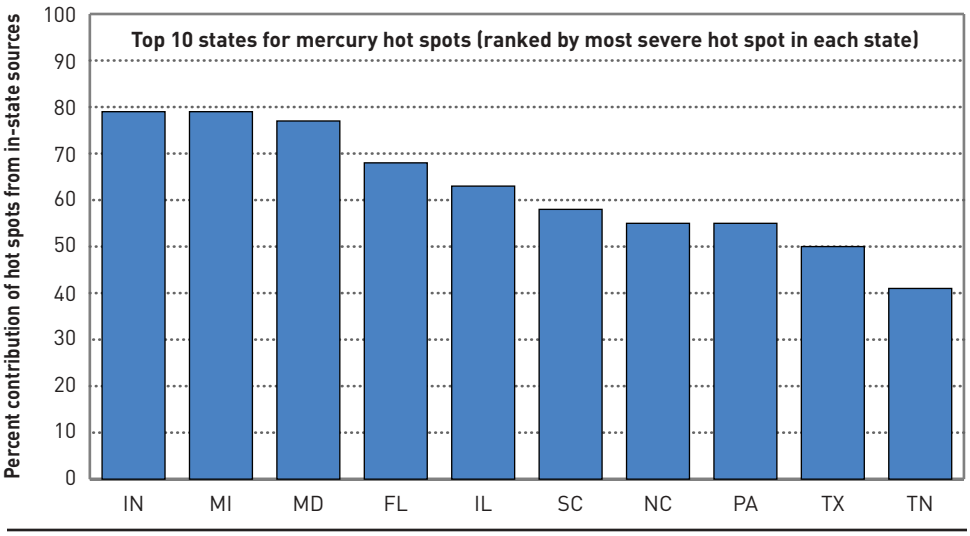
This same EPRI analysis also shows that U.S. sources are responsible for more than 60% of the mercury deposition in the Boston–Washington, DC, corridor, an indication of the importance of local and regional sources. At one of the models' selected receptor areas, Pines Lake, New Jersey, 80% of the deposition comes from sources within the United States, showing that regional deposition can be quite high.

The influence of local emission sources is reinforced by state-of-the-art mercury deposition modeling assessments conducted by EPA.[13] This EPA modeling

FIGURE 5

Local pollution sources predominate at mercury hot spots

EPA modeling shows that at mercury hot spots (locations where mercury deposition is highest), local emission sources within a state can be the dominant source of deposition. In-state sources contribute more than 50% of the pollution to sites in 9 of the 10 worst hot spot states.



Source: Draft Mercury Deposition Modeling Results, EPA Office of Water, 2003.

shows that at mercury hot spots (locations where mercury deposition is highest within a state), local emission sources within a state can be the dominant source of deposition. At hot spots, local sources within a state commonly account for 50% to 80% of the mercury deposition (Figure 5). In-state sources contribute more than 50% of the pollution to sites in 9 of the 10 worst hot spot states. Local deposition hot spots are located across the country, and local deposition estimates would likely be even higher if they accounted for pollution sources in nearby states, not just those in-state.

An ambitious analysis of mercury pollution, deposition and fish contamination in Florida provides on-the-ground evidence that corroborates the importance of local sources.[14] Because of tighter standards on medical and municipal waste incinerators that took effect in mid-1992, South Florida's[15] total estimated local emissions of mercury declined by about 93% between 1991 and 2000. During this same period, mercury deposited via rain and other precipitation declined in South Florida by about 25%. Concentrations of mercury in large mouth bass have also decreased significantly, 60–75% since the early 1990s. These data strongly suggest that reducing local mercury pollution will lower concentrations in local water bodies, and in turn reduce contamination in fish and the risk of human exposure.

Recommendations

Reducing power plant pollution is critical to reducing local mercury deposition and avoiding the dangerous contamination of fish, wildlife and people. EPA is required by the federal Clean Air Act to lower mercury pollution from power plants. To protect public health and the environment from harmful mercury emissions, federal and state policy-makers should take the following steps:

International action

The nations of the world recognize the public health threat posed by mercury pollution. The United Nations Environment Program (UNEP) Governing Council urges all countries to identify populations at risk and reduce human-generated mercury releases, and many nations have initiated measures to reduce mercury pollution.[16]

In North America, the U.S. and Canada Great Lakes Water Quality Agreement calls for the elimination of mercury from the Great Lakes.[17] The New England governors and Eastern Canadian premiers adopted a Mercury Action Plan to reduce mercury pollution in that region.[18] The United States and Canada also joined Europe in signing a 1998 Protocol to the Convention on Long-Range Transboundary Air Pollution to reduce mercury emissions below 1990 levels.[19]

- EPA should issue strong mercury standards for power plants that reduce mercury pollution from 48 tons today to about 5 tons, or a 90% reduction. These pollution reductions are consistent with national standards for other source sectors and achievable through available pollution-control technology.

- States with mercury deposition hot spots should pursue their own mercury pollution standards to protect local water bodies and public health, and all states should press for rigorous national standards.

Conclusion

Sources in the United States contribute to local mercury "hot spots" and add to global mercury pollution levels, leading to contaminated water bodies, fish that is not healthy for consumption and brain damage and learning disabilities in infants. The experience of Florida shows that substantially reducing mercury emissions can dramatically lower mercury contamination in fish and reduce human exposure. To reduce deposition and environmental contamination, the United States needs to clean up its own sources of mercury pollution.

National policies have successfully reduced mercury emissions by 90% in both medical and municipal waste incinerators, and the technology exists for power companies to make similar reductions. Despite being the largest single source, mercury pollution from power plants has never been regulated. It is past time for government to set protective but predictable standards for power plant mercury pollution to protect the nation's children from its damaging effects. Leadership by the United States will not only lower mercury deposition and improve public health within the nation's borders, it will also provide a model to other nations for reducing mercury emissions globally.

Notes

[1] United States Environmental Protection Agency, Office of Water. *Mercury Update: Impact on Fish Advisories (Factsheet)*, June 2001. www.epa.gov/waterscience/fishadvice/mercupd.pdf.

[2] U.S. Centers for Disease Control and Prevention, "Blood and hair mercury level in young children and women of childbearing age—United States, 1999." *Morbidity and Mortality Weekly*, March 2, 2001.

[3] Hahaffey, Kathryn R., Robert Clickner, and Catherine B. Joseph, Blood Organic Mercury and Dietary Mercury Intake: National Health and Nutrition Examination Survey, 1999 and 2000, doi:10.1289/ehp.6587 (available at http://dx.doi.org/), Online 19 November 2003.

[4] State Mercury Advisories can be found on the Internet under "National Listing of Advisories" at http://map1.epa.gov/.

[5] Environmental Protection Agency, "Mercury Study Report to Congress", 1997, www.epa.gov/oar/mercury.html.

[6] Environmental Protection Agency mercury regulatory finding announcement, Federal Register Notice, 2000 at www.epa.gov/ttn/atw/combust/utiltox/utoxpg.html#REG.

[7] For a summary of mercury-capture technologies, see Northeast States for Coordinated Air Use Management (NESCAUM), "Mercury Emissions From Coal-Fired Power Plants, The Case for Regulatory Action," October 2003. This report states: "The evidence suggests with respect to all coal types that existing control devices designed to control pollutants other than mercury can deliver substantial mercury reductions, and that mercury-specific control technologies [e.g. carbon injection] are well on their way to commercial availability. Further, extremely successful field experience with the control of mercury emissions from municipal waste combustors gives additional reason for confidence as to the potential for controlling mercury emissions from the electric sector to stringent levels."

[8] State of Connecticut, House bill 6048 can be viewed at www.cga.state.ct.us/2003/act/Pa/2003PA-00072-R00HB-06048-PA.htm with supplementary information about the bill at www.cga.state.ct.us/asp/CGABillStatus/CGAbillstatus.asp?selBillType=Bill&bill_num=HB6048.

[9] Public Service Enterprise Group. "Leading by Example." www.pseg.com/environment/clean/leading_by_example.html. Last visited 11-10-03.

[10] Northeast States for Coordinated Air Use Management (NESCAUM)," Mercury Emissions From Coal-Fired Power Plants, The Case for Regulatory Action," October 2003.

[11] U.S. Environmental Protection Agency. Mercury Study Report to Congress, 1997, Volume III. www.epa.gov/oar/mercury.html

[12] Seigneur, Christian, Krish Vijayaraghavan, Kristen Lohman, Prakash Karamchandani and Courtney Scott , "Global Source Attributions for Mercury Deposition in the United States" in press, *Environmental Science & Technology*, 2003.

[13] EPA Office of Water, *Draft Mercury REMSAD Deposition Modeling Results*, 2003. This analysis was performed as part of the Devil's Lake, Wisconsin mercury study. The emissions inventory for this model was the same as used for the Bush administration's Clear Skies modeling analysis. Results were presented outside EPA to the Maryland Department of Natural Resources, Annapolis, MD (4/17/03), Region 5 states, Madison, WI (8/6/03), and Region 6 states, Dallas, TX (10/9/03). A Powerpoint presentation of data can be requested from Dwight Atkinson at the following email address: Atkinson.Dwight@epa.gov

[14] Florida Department of Environmental Protection, "Integrating Atmospheric Mercury Deposition with Aquatic Cycling in South Florida: An approach for conducting a Total Maximum Daily Load analysis for an atmospherically derived pollutant," November 2003, pp. 56, 86. www.floridadep.org/labs/mercury/index.htm. Last updated November 2003.

[15] Broward, Dade and Palm Beach Counties.

[16] UNEP Mercury Program Mercury Assessment: www.chem.unep.ch/mercury/.

[17] United States Environmental Protection Agency, "U.S., Canada Move to Eliminate Toxics in Great Lakes," EPA Press Release. April 7, 1997. www.epa.gov/history/topics/canada/04.htm.

[18] New England Governors and Eastern Canadian Premiers Committee on the Environment, "Mercury Action Plan" August 27, 2001, Westbrook Connecticut. www.scics.gc.ca/pdf/850084012_e.pdf.

[19] United Nations Economic Commission for Europe, "Convention on Long-Range Transboundary Air Pollution; the 1998 Aarhus protocol on heavy metals." Last updated November 20, 2003. www.unece.org/env/lrtap/hm_h1.htm.

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National Headquarters
257 Park Avenue South
New York, NY 10010
212-505-2100

1875 Connecticut Avenue, NW
Washington, DC 20009
202-387-3500

5655 College Avenue
Oakland, CA 94618
510-658-8008

2334 North Broadway
Boulder, CO 80304
303-440-4901

2500 Blue Ridge Road
Raleigh, NC 27607
919-881-2601

44 East Avenue
Austin, TX 78701
512-478-5161

18 Tremont Street
Suite 850
Boston, MA 02108
617-723-5111

Project Office
3250 Wilshire Boulevard
Suite 1400
Los Angeles, CA 90010
213-386-5501