Mercury Pollution and Regulation

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Health issues related to methylmercury in fish—which are discussed in the "Chemical Risk" section of *The Environmental Source*—are only half of the mercury policy debate. Of equal concern to many is the source of that mercury. Some see the alleged consumer health risk from mercury exposure as a justification for restricting mercury emissions from coal- and oil-fueled electric utility power plants. Because methylmercury in fish is unhealthy for consumers, critics argue, mercury power plant emissions must be significantly reduced in order to improve public health.

However, even if the amount of mercury in the American diet did pose some genuine health risk, it still is not clear that even sizable reductions in mercury emissions from U.S. power plants would have an appreciable effect on exposure to methylmercury. In contrast, the cost of complying with new power plant emissions regulations is estimated to have a large human impact.

Origins of Mercury in the Environment

Mercury is a naturally occurring element that appears in the environment in elemental form, as well as in organic and inorganic compounds. In its various forms, mercury cycles through the environment—in air, land, and water—and is circulated and modified by both natural and human (anthropogenic) activities.[1]

1. United Nations Environment Programme, *Global Mercury Assessment* (Geneva: United Nations Environment Programme Chemicals, 2002). See also Mark

Most of the mercury in power plant emissions is in either elemental or inorganic form. It is the organic compound methylmercury, however, that accumulates in fish and other animals. Methylmercury is created in two primary ways. First, elemental mercury can bind with dissolved organic carbon in oceans and other waterways. Second, certain microorganisms in soil and water can ingest inorganic mercury and add carbon atoms to the molecules in a process called *methylation*. The elemental and inorganic mercury in power plant emissions *can* be converted into methylmercury in each of these ways. However, extensive study of the mercury cycle shows that only a small portion of the mercury from anthropogenic sources is converted to methylmercury.[2]

Organic compounds such as methylmercury readily bind to proteins, and methylmercury binds easily with fats in the tissues of living organisms. Once it begins to accumulate in aquatic organisms such as algae and plankton, methylmercury becomes more concentrated as it bioaccumulates up the food chain. Small fish eat the algae and plankton, amassing greater methylmercury levels, and larger fish accumulate still higher levels by eating small fish.

Historical records show that fish have always had trace amounts of methylmercury, however, and that the amounts have remained relatively stable throughout the years, despite large increases in mercury emissions in the latter half of the 20th century.[3] French scientists, for example, recently found that methylmercury levels measured in Yellowfin tuna were the same in 1998 as they were in 1971, despite a prediction of a 9 to 26 percent increase that would have corresponded with increases in global mercury emissions.[4] Fish caught during the late 19th and early 20th centuries—and preserved at the Smithsonian Institution—have average methylmercury levels more than three times higher than a similar sample of fish today.[5] Similarly, the amount of methylmercury in human bodies today is within the same range as

Wheeler, "Measuring Mercury," Environmental Health Perspectives 104, no. 8 (1996): 826–31.

2. Leonard Levin, "Mercury Sources, Transport, and Fate in the Atmosphere," in U.S. Department of Energy, National Technology Laboratory, *Proceedings of the Mercury Control Technology R&D Program Review Meeting* (Washington, DC: U.S. Department of Energy), and Leonard Levin, "Prepared Statement of Leonard Levin, Ph.D., Technical Leader, EPRI, Palo Alto, California," Senate Committee on Environment and Public Works, Senate Hearing 108-359, *Climate History and the Science Underlying Fate, Transport, and Health Effects of Mercury Emissions*, 108th Congress (July 29, 2003), 211–15.

3. Matthew Barber, "Survey of Metals and Other Elements," Food Service Information Sheet 48/04, U.K. Food Standards Agency, London, March 2004, http://www.foodstandards.gov.uk/science/surveillance/fsis-2004branch/fsis4804metals. See also U.S. Department of Human Health Services and U.S. Environmental Protection Agency, "Mercury Levels in Commercial Fish and Shellfish," U.S. Department of Human Health Services and U.S. Environmental Protection Agency, Washington, DC, February 2006, http://vm.cfsan.fda.gov/~frf/sea-mehg.html.

4. Anne M. Kraepiel, Klaus Keller, Henry B. Chin, Elizabeth G. Malcolm, and François M. Morel, "Sources and Variations of Mercury in Tuna," *Environmental Science and Technology* 37, no. 24 (2003): 5551–58.

5. G.E. Miller, P.M. Grant, R. Kishore, F. J. Steinkruger, F. S. Rowland, and V. P. Guinn, "Mercury Concentrations in Museum Specimens of Tuna and Swordfish," *Science* 175, no. 4026 (1972): 1121–22. See also C. D. Carrington, G. M. Cramer, and P. M. Bolger, "A Risk Assessment for Methylmercury in Tuna," *Water, Air and Soil Pollution* 97, nos. 3–4 (1997): 273–83; National Fisheries Institute, "NFI Position Statement on Joint FDA/EPA Mercury Advisory," National Fisheries Institute, McLean, VA, March 2004, http://www.nfi.org/?a=news&b=eMedia+Kit&c=&x=3050; and U.S Department of Human Health Services and U.S. Environmental Protec-

that in preserved human corpses from several centuries ago.[6] Thus, ample evidence shows that the range of methylmercury to which humans are exposed has remained essentially constant or falling over the past century, despite steadily rising levels of anthropogenic mercury emissions during that time.

Mercury Power Plant Emissions

A large proportion of mercury added to the environment each year comes from natural earth processes, not human processes.[7] And anthropogenic sources in the United States represent less than one percent of the total annual mercury deposition. The U.S. Environmental Protection Agency (EPA) estimates that 4,400 to 7,500 tons of mercury are emitted into the atmosphere each year from both natural and human-generated sources.[8]

Natural sources of mercury emissions include volatilization from the Earth's crust and the oceans, volcanic action, and erosion. Anthropogenic sources are estimated to make up 50 to 75 percent of the total atmospheric deposition, but that includes a variety of sources, such as the mining of elemental mercury for use in such things as thermometers and sphygmomanometers, not just power plant emissions.[9] Furthermore, most of the mercury from power plant emissions is generated not in industrial countries such as the United States, but in poorer countries with few pollution controls.[10]

The EPA indicates that U.S. power plant emissions account for approximately 48 tons per year of mercury deposition, a level that has been falling over time.[11] And only an estimated 1 percent or less of mercury that ends up in a body of water is converted into methylmercury.[12] Consequently, even a total elimination of mercury emissions from U.S. power plants would be expected to have much less than a 1 percent effect on human dietary exposure to methylmercury.

Despite this sobering information, the environmental activist community continues to scare consumers and the media into believing that more stringent emissions regulations are necessary to address the alleged problem of methylmercury in fish.[13] In 2003, when the EPA proposed a simplification of Clean Air Act (CAA) regulations that would relax emissions standards for a group of Midwestern power plants while simultaneously requiring a two-thirds reduction

tion Agency, "Mercury Levels in Commercial Fish and Shellfish."

6. Food and Drug Administration, "Methylmercury," Transcript of the Center for Food Safety and Nutrition, Food Advisory Committee Methylmercury Meetings, Beltsville, MD, July 23–24, 2002, http://www.fda.gov/OHRMS/DOCKETS/ac/02/transcripts/3872t2.htm.

7. U.S. Environmental Protection Agency, "Clean Air Mercury Rule: Basic Information," March 2, 2006, U.S. Environmental Protection Agency, Washington, DC, http://www.epa.gov/air/mercuryrule/basic.htm.

8. Ibid.

9. United Nations Environment Programme, *Global Mercury Assessment*.

10. Richard Carlton, Paul Chu, Leonard Levin, et. al., "[Electric Power Research Institute] Comments on EPA-Proposed Emission Standards/Proposed Standards of Performance, Electric Utility Steam Generating Units: Mercury Emissions," Electric Power Research Institute, Palo Alto, CA, June 16, 2004.

11. EPA, "Clean Air Mercury Rule."

12. Harold M. Koenig, *Mercury in the Environment: The Problems, the Risks, and the Consequences* (Annapolis, MD: Annapolis Center for Science-Based Public Policy, 2003).

13. Natural Resources Defense Council, "Mercury Contamination in Fish: A Guide to Staying Health and Fighting Back," Natural Resources Defense Council, New York, http://www.nrdc.org/health/effects/mercury/index.asp.

in overall mercury emission levels, environmental organizations and their allies misrepresented the proposal as one that would poison the food supply.[14] But the facts suggest otherwise.

Emissions Regulation and Politics

One provision of the 1990 CAA amendments required the EPA to study the effects of mercury and other substances in electric power plant emissions in order to determine whether any of those emissions should be subject to more stringent regulation.[15] The Clinton administration committed the EPA to setting such rules by December 2004 (later extended to March 2005). In doing so, the administration recommended a conventional policy that would set an upper-bound limit on the amount of mercury any facility could emit and would require every power plant in the country to adopt the maximum available control technology (MACT)—that is, install new equipment that would achieve the greatest possible reduction in mercury emissions.[16] Proponents of that option claimed that a MACT requirement could be stringent enough to reduce mercury emissions by as much as 90 percent by 2008.[17] The U.S. Department of Energy disputed that claim, however, indicating that no proven technologies were capable of achieving such reductions, and it suggested that actually attaining a 90 percent reduction might require technologies that had not yet been developed.[18]

After George W. Bush became president in 2001, the EPA reconsidered the Clinton administration's recommendation and proposed two possible approaches for regulating mercury emissions.[19] The first option was a MACT approach similar to the Clinton administration's plan. It would have achieved an estimated 30 percent reduction in mercury emissions by 2008 by setting uniform emissions limits for existing facilities and more restrictive limits for new ones.

The second option paired mandatory emissions reductions with an emissions credit trading program—a combination known as "cap and trade." It would achieve an estimated 20 percent reduction in mercury emissions by 2010 by piggybacking on reductions that would coincide with on-going declines in other emissions, such as sulfur. The cap and trade approach would then mandate a 70 percent reduction by 2018—setting combined emissions limits for all the facilities in a given state—paired with the emissions credit trading system. Facilities that achieved greater reductions than those mandated by the upper-bound limit could sell the

14. Mercury Policy Project, "Hold the Tuna Charlie: Pres. Bush's Mercury Moves Gift Industry," E-Wire press release, Washington, DC, November 15, 2003, http://www.ewire.com/display.cfm/Wire_ID/1919.

15. 40 CFR Part 63, codifying Clean Air Act Amendments of 1990, §112(n)(1)(A).

16. EPA, "Revision of December 2000 Regulatory Finding on the Emissions of Hazardous Air Pollutants from Electric Utility Steam Generating Units and the Removal of Coal- and Oil-Fired Electric Utility Steam Generating Units from the Section 112(c) List," *Federal Register* 70, no. 59 (2005): 15995.

17. Natural Resources Defense Council, "New EPA 'Do-Nothing' Mercury Pollution Rules Dangerous to Public Health," *NRDC Press Backgrounder*, March 24, 2005.

18. U.S. Department of Energy, Energy Information Administration, *Analysis of Alternative Mercury Control Strategies* (Washington, DC: U.S. Department of Energy, 2005).

19. EPA, "Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units—Proposed Rule," *Federal Register* 69, no. 20 (2004): 4652–752.

"right" to emit the difference to another facility in the same state.

The Bush administration clearly preferred the cap and trade alternative. However, because an emissions credit trading system would allow some facilities to make little or no emissions reductions, and because it provided for a slower phase-in of reduction mandates, opponents claimed that it would slash environmental and public health protections.[20] Rep. Richard Gephardt (D-MO) characterized the cap and trade proposal as "the most alarming rollbacks in environmental efforts that we have ever seen."[21] In that environment, the concern about methylmercury in fish began to emerge as a serious political issue. The subtext of most reporting on the fish safety issue was, invariably, that very stringent mercury emissions restrictions were needed to promote consumer safety.

Alleged Health Gains from Regulation

On the basis of its very conservative assumptions—derived primarily from the Faroe Islands methylmercury study (see the policy brief titled "Methylmercury Science)—the EPA insisted that significant reductions in U.S. emissions would result in improved human health, a reduction in early mortality, a very small increase in children's intelligence (an average of less than 0.025 IQ points per affected child), and positive effects on wildlife.[22] The monetized benefit from the slightly higher projected IQ levels was estimated to be less than $5 million a year, and the total benefit for all mercury reductions (from the power plant emissions rule and other EPA regulations) was estimated to be approximately $50 million a year.

However, because the harmful effects of current mercury exposure levels are subject to serious doubt, and because the elimination of most (or even all) U.S. mercury emissions from power plants would have almost no impact on those levels, many critics argued that neither proposal would produce measurable benefits. Nevertheless, even assuming that the EPA's benefit estimates were correct, the agency's own analysis indicated that annual costs for implementing the cap and trade rule would be about $750 million a year, or $3.9 billion from 2007 to 2025.[23]

The EPA adopted the cap and trade approach and published its final Clean Air Mercury Rule in March 2005.[24] Although the costs of implementing either proposal were expected to vastly outweigh any benefits derived, the cap and trade option was estimated to achieve roughly the same emissions reduction at approximately $15 billion less than the MACT option.[25]

Although the monetized cost of the EPA's Clean Air Mercury Rule is substantial, what is missing from that calculation is the total human cost of the requirements; the rule shifts resources away from expenditures that produc-

20. Gregg Easterbrook, "Everything You Know about the Bush Environmental Record Is Wrong," Working Paper 02-6, AEI–Brookings Joint Center for Regulatory Studies, Washington, DC, April 2002.

21. Ibid.

22. EPA, Office of Air Quality Planning and Standards, Air Quality Strategies and Standards Division, *Regulatory Impact Analysis of the Clean Air Mercury Rule: Final Report*, EPA-452/R-05-003 (Research Triangle Park, NC: EPA, 2005).

23. Ibid.

24. EPA, "Revision of December 2000 Regulatory Finding."

25. Ted Gayer and Robert Hahn, "The Political Economy of Mercury Regulation," *Regulation* 28, no. 2 (2005): 26–33.

ers and consumers prefer in order to address a small and possibly nonexistent risk. The new mercury emissions limits will make it more expensive to produce electric power from coal and oil. And because some amount of power generation will shift from coal and oil to other fuels, the indirect effects will ripple throughout the economy.

A U.S. Department of Energy study estimated that the emissions restrictions would result in an average of 32 percent higher electric power rates and 17 percent higher natural gas rates.[26] In addition, higher prices for all fuels and for electricity will directly affect the costs borne by other producers, which, in turn, will affect the costs of consumer and industrial products. These higher costs will fall most heavily on lower-income earners, who, in turn, will have less disposable income for purchasing other essential goods and services such as nutritious foods and health care.

Conclusion

From the start, the Clean Air Mercury Rule has been a solution in search of a problem. A substantial body of evidence indicates that the amount of mercury in the American diet is so low that it has little or no health effect on even at-risk populations, such as pregnant women and children. Even if the EPA's overly pessimistic risk assessment is accurate, however, other research indicates that no American women of childbearing age have dietary mercury exposure anywhere near the level at which there is any evidence of harm.

Furthermore, the substantial reduction in mercury emissions will have almost no real effect on human dietary exposure, because U.S. power plant emissions of mercury represent considerably less than 1 percent of total global mercury deposition. The Clean Air Mercury Rule will, however, come at a substantial cost, which can be measured not only in dollars, but also in decreased health and welfare for millions of Americans.

Key Experts

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Recommended Readings

Koenig, Harold M. 2003. *Mercury in the Environment: The Problems, the Risks, and the Consequences*. Annapolis, MD: Annapolis Center for Science-Based Public Policy.

Szwarc, Sandy. 2004. *Fishy Advice: The Politics of Methylmercury in Fish and Mercury Emissions*. Washington, DC: Competitive Enterprise Institute.

U.S. Congress. 2003. Senate Committee on Environment and Public Works, Senate Hearing 108-359. *Climate History and the Science Underlying Fate, Transport, and Health Effects of Mercury Emissions*. 108th Congress, July 29.

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26. U.S. Department of Energy, Energy Information Administration, *Analysis of Strategies for Reducing Multiple Emissions from Electric Power Plants with Advanced Technology Scenarios*, SR/OIAF/2001-05 (Washington, DC: U.S. Department of Energy, 2001).