



Report 1 of the Council on Science and Public Health (I-06) Full Text

Mercury Pollution

NOTE: This report, written in response to [Resolution 411 \(A-05\)](#), represents information on this subject as of November 2006.

Full Text

Methods. English-language reports were selected from a MEDLINE search of the literature from 1995 to 2006 using the search terms *mercury/*analysis*, in combination with *air pollutants*, *environment* or *environmental monitoring*, and the text terms *regulation* or *emission*. In addition, the Web sites of the U.S. Environmental Protection Agency (EPA), Government Accounting Office, National Resources Defense Council, and the Mercury Policy Project were searched for relevant information.

Background

The Council previously discussed the human health effects of mercury (Hg) in [Council on Scientific Affairs \(CSA\) Report 13 \(A-04\)](#). The critical target organ for Hg toxicity is the brain.¹ The developing nervous system is more susceptible than the adult nervous system. Fetal exposure to large amounts of methylmercury (MeHg) from maternal consumption of fish results in a pattern of severe neurodevelopmental defects and fatalities.² Chronic low-dose prenatal MeHg exposure from maternal consumption of fish has been associated with more subtle decrements in several measures of neurological development, which may resemble a number of learning disabilities present in the overall population of children.³ As noted in [CSA Report 13 \(A-04\), Mercury and Fish Consumption: Medical and Public Health Issues](#), contemporary data on mercury exposure in U.S. women and children are available from the National Health and Nutrition Examination Survey (NHANES). This cross-sectional national survey conducted by the Centers for Disease Control and Prevention (CDC) is designed to assess the health and nutritional status of adults and children in the United States. A mercury component was added in 1999, which assessed children 1 to 5 years of age, and women aged 16 to 49 years. Extrapolating the NHANES data to the overall U.S. population suggests that each year in the United States more than 300,000 newborns will have blood mercury concentrations exceeding the EPA's exposure reference dose (ie, the estimated daily intake that is likely to be without appreciable risk of harmful effects). The body burden of

Hg also may be a risk factor for cardiovascular disease in adults.⁴⁻⁶ Thus, reducing the environmental burden of this toxic metal is an important public health issue.

Because [CSA Report 13 \(A-04\)](#) addressed the human health effects of mercury and the genesis of regulatory exposure limits, these issues are not revisited in this report, which focuses on Hg emission and manufacturing sources, and on recent actions intended to reduce the environmental burden of Hg. This report briefly reviews the major anthropogenic (human-caused emissions) sources of mercury in the United States, the mobility of environmental mercury, and actions taken by the EPA and the U.S. government to address these issues.

Relevant American Medical Association Policy

The most relevant AMA policy on this issue supports the “maximum feasible reduction of all forms of air pollution, including particulate, gases, toxicants (such as Hg), irritants, smog formers, and other biologically and chemically active pollutants” and that “governmental control programs should be implemented primarily at those local, regional, or state levels which have jurisdiction over the respective sources of air pollution and the population and areas immediately affected” (Policy H-135.998, [AMA Policy Database](#)).

Mercury Emissions

Mercury is a global pollutant that cycles in the environment, exchanging among air, soil, and water, and back again because of both natural phenomena and human activities. Volcanoes and deep sea vents are large natural contributors. Environmental mercury also is derived from the weathering or mining of rock containing Hg ore (ie, HgS or cinnabar) and from the incineration and burning of fossil fuels. Major man-made sources (or uses) of elemental Hg include coal-burning electric power plants; municipal, medical, and hazardous waste incinerators; commercial/industrial boilers; chlor-alkali plants; gold mining; cement production; and mercury-containing products (eg, thermometers, blood pressure monitors, lamps, batteries, electronic switches and devices). Although volcanoes and other natural sources release substantial amounts of elemental Hg into the environment, anthropogenic emission from coal-fired electric power-generating facilities, chlor-alkali production, waste incineration, and other industrial activities now account for approximately 70% of the 5,500 metric tons of Hg that are released into the earth’s atmosphere annually.⁷⁻⁹ Anthropogenic releases of Hg have substantially increased the entry of Hg into the environment; by some estimates by a factor of 3 to 5 times since pre-industrial times, and by another analysis, a 10-fold increase.¹⁰

In some parts of the world, man-made Hg emissions are increasing, but in this country emissions declined from about 220 tons in 1990 to 115 tons in 1999 because of new requirements on incinerators.¹¹ Among U.S. industrial sources, coal-fired utility plants account for approximately 40% of this burden. These, and other plants that combust other fossil fuels (ie, petroleum, natural gas), account for about two-thirds of U.S. electricity generation, but are also a major source of air pollutants including Hg, as well

as fine particulate matter, sulfur dioxide, and nitrogen oxides, which are regulated under the Clean Air Act. Two other potentially large sources of Hg are not well quantified; namely, mobile sources and chlor-alkali plants.¹² The EPA has now promulgated regulations for all major sources of Hg emissions, although not to the same extent.

Environmental Mobility

Once in the environment, the different forms of Hg interconvert, with sequences of emission, deposition via particles or precipitation, and revolatization. The nature of Hg emissions from coal-fired electric power plants varies depending on the technology and the type of coal used, but roughly 50% is elemental Hg.¹³ Atmospheric mercury is mostly elemental Hg; this global pool may remain airborne for extended periods and distances. Particulate and reactive mercury (both organic and inorganic) deposit more quickly and travel much shorter distances from the point of emission; thus, their relative atmospheric concentrations are much smaller. Atmospheric deposition tends to be greater in areas closer to emission sources and in locations with more rainfall, setting up a scenario where local and regional sources can create “hot spots” of relatively high Hg deposition. According to the EPA, the highest deposition rates occur in the southern Great Lakes, the Ohio Valley, the Northeast, and scattered areas in the Southeast. The link between industrial emission and Hg concentration in the oceans is less well understood.^{14,15}

After deposition, conversion of inorganic to organic mercury is accomplished by microorganisms or abiotic processes, particularly in aquatic sediment. Once in its predominant organic form (MeHg), bioaccumulation occurs. Some ecosystems (ie, low-alkaline lakes and streams with dissolved, decomposed plant or bacterial matter) are more active in accelerating this conversion. Thus, Hg, particularly MeHg, is an established, worldwide environmental pollutant and is concentrated in the food chain in aquatic systems, especially in larger predatory fish. The amount of MeHg in any given seafood or freshwater fish depends on the species, its age/size, and the waters from which it came. An in-depth analysis of the fate and transport of Hg can be found in the EPA’s 1997 Mercury Study Report to Congress.¹⁶ For further discussion of issues related to mercury and fish consumption see CSA Report 13 (A-04). An analysis for clinicians of the relative toxicity of various types of fish, with a summary sheet for patients to use in selecting fish for consumption can be found at http://www.mercuryaction.org/uploads/providers_guide.pdf (PDF, 261KB, requires Adobe® Reader®).

Clean Air Mercury Rule

The path to the Clean Air Mercury Rule was somewhat “hazardous” in its own right. It was triggered by the 1990 Amendments to the Clean Air Act, under which the EPA was to submit to Congress a study on the risks of hazardous air pollutants from power plants. The Agency was sued in 1992 by the Natural Resources Defense Council for not including electric power plants on the initial list of emitting sources to be regulated under Section 112 of the Clean Air Act, and by the Sierra Club in 1994 for missing the deadline

for submitting the Utility Air Toxics study to Congress. Under a settlement (consent agreement) reached in 1994, the EPA agreed to complete its Utility Air Toxics Study by November 1995 and determine whether it was “appropriate and necessary” to regulate power plants under Section 112. Subsequently, this deadline was extended until February 1998. In the meantime, the EPA submitted a Mercury Study Report to Congress in 1997. This report analyzed mercury emissions, their potential health and environmental impacts, and the availability of control technologies.¹⁶

Ultimately, the Utility Air Toxics Study was completed in February 1998.¹⁷ In this report, the EPA provided: (1) a description of the electric utility steam-generating industry; (2) an analysis of emissions data; (3) an assessment of hazards and risks due to inhalation exposures to 67 hazardous air pollutants (HAPs), including mercury; (4) assessments of risks due to multipathway (inhalation plus non-inhalation) exposures to four HAPs (radionuclides, mercury, arsenic, and dioxins); and (5) a discussion of alternative control strategies.

In December 2000, the EPA issued a finding that the regulation of mercury emissions from power plants (using the maximum achievable control technology [MACT] approach) was appropriate and necessary under Section 112 of the Clean Air Act.¹⁸ This finding triggered other provisions of the consent agreement, including a requirement for the Agency to propose MACT standards for electric power plants by December 2003, and finalize them by March 15, 2005. Based on Section 112, for new facilities, the MACT standard must be at least as stringent as the degree of emissions control achieved at the best-controlled similar source (ie, the best-demonstrated technology). For existing facilities, Section 112 allows a somewhat less stringent standard, in which limits equal to the average performance of the best 12% of comparable sources generally must be achieved. However, at present, no U.S. coal-fired electric power plants have installed equipment specifically designed to control mercury emissions. Thus, data collection has been on existing technologies, and has required extensive analysis to establish potential control levels. However, four full-scale field tests of a technology called “activated carbon injection” (ACI) have been conducted by the Department of Energy, with emission reductions of 60% to 90%, depending on the type of coal and type of auxiliary control equipment utilized. ACI has also proved capable of reducing Hg emissions by more than 90% on incinerators and other facilities.

Finally, on January 30, 2004, the EPA issued a proposed rule to substantially cut mercury emissions from coal-fired power plants.¹⁹ This proposal purported to cap emissions from coal-fired electric power plants and provided companies with flexibility to achieve early reductions of mercury, but offered two alternatives for controlling mercury emissions. One approach would require power plants to install MACT controls under Section 112 of the Clean Air Act. This proposal met the Agency’s requirement under the consent agreement by proposing MACT standards that would apply on a facility-by-facility basis, reducing nationwide mercury emissions by 14 tons (or about 30% from the 1999 level) by early 2008. The EPA’s analysis and MACT determination were widely criticized.²⁰

The second approach used Section 111(d) of the Clean Air Act, with the EPA proposing to unilaterally amend its December 2000 regulatory finding, arguing that while MACT standards were “appropriate,” they were not “necessary” since emissions could be controlled under Section 111(d). This approach freed the EPA from the requirement to regulate toxic air emissions under the more health-protective, technology-based MACT standards. The proposal relying on Section 111(d) created a market-based “cap and trade” program that, if implemented, would reduce nationwide utility emissions of mercury in two phases.^{19,21} The EPA claimed that when fully implemented, mercury emissions would be reduced by 33 tons (nearly 70%).

Despite substantial opposition among medical and public health organizations, including more than 600,000 comments submitted to the Docket, the Clean Air Mercury Rule (CAMR) was promulgated on March 15, 2005.²² In it, the EPA concluded that the MACT regulations were neither appropriate nor necessary, and in so doing reversed its previous (December 2003) finding. CAMR does establish the United States as the first country in the world to regulate mercury emissions from coal-fired electric power plants; however, this was accomplished by implementing the cap-and-trade system for power plant emissions of mercury. On March 10, 2005, in a separate but related action, the EPA issued the Clean Air Interstate Rule (CAIR), intended to reduce air pollution that moves across states boundaries.²³ This rule is intended to cap emissions on sulfur dioxide and nitrogen oxides from power plants in 28 eastern states and the District of Columbia.

CAMR establishes national and state rather than facility-specific caps on emissions of Hg. In the rule, the EPA assigned each state and two Native American tribes a total emissions allowance. Each must submit a plan revealing how it will meet the standards. Half of all Hg pollution comes from power plants in eight states (Pennsylvania, Texas, Ohio, Illinois, Indiana, Alabama, West Virginia, and Kentucky).²⁴ States are free to establish more stringent standards for new or existing units. An intermediate nationwide cap of 38 tons per year becomes effective in 2010, with a final cap of 15 tons per year nationwide in 2018. The intermediate cap reflects the level of emissions resulting from the “co-benefits” of controlling sulfur dioxide (SO₂) and nitrous oxide (NO_x) under CAIR (see below). Facilities must demonstrate compliance with the standard by holding one “allowance” for each ounce of Hg emitted in any given year. Allowances are transferable among all regulated facilities. Utilities can either control Hg emissions directly by installing pollution controls or purchase excess allowances from other plants that have decreased their emissions below the cap. These “early reductions” can also be banked for later use, which raises the specter that plants could delay compliance with the final cap by using up previously earned (and banked) allowances. The EPA asserts that such a cap-and-trade approach to limiting Hg emissions is the most cost-effective way to achieve the reductions in Hg emissions from the power sector.

Overall, this approach relies on coupling CAMR with CAIR.²³ Reductions in Hg emissions depend (initially) to a large extent on the SO₂ and NO_x emission caps established under CAIR. This rule establishes a broadly applicable cap-and-trade program that significantly limits SO₂ and NO_x emissions from the power sector. Through the expanded use of technologies commonly used to reduce SO₂ and NO_x (eg,

scrubbers; silicon-controlled rectifiers [SCRs]) to comply with CAIR, secondary benefits will accrue on Hg emissions. Therefore, the EPA believes that significant reduction in Hg emissions, especially oxidized Hg, can and will be achieved by the air pollution controls installed to reduce SO₂ and NO_x, thereby reducing Hg emissions in a cost-effective manner. In taking this approach, the Agency relied on so-called “co-reduction” to achieve its Hg reduction targets, and anticipated little or no specific installed Hg control technology for coal-fired utility boilers, despite the large contribution to air pollution from this industry. The cap-and-trade approach is similar to the proposed “Clear Skies” legislation. Clear Skies would create a mandatory market-based program that would significantly reduce power plant emission of SO₂, NO_x, and mercury by setting a national cap on each pollutant and permitting trading of allowances. This bill, however, was blocked from advancing to the Senate floor in March 2005, and will not be further considered in this report.

One main criticism of the EPA’s approach is that it will not eliminate “hot spots” caused by local or regional polluters who purchase allowances rather than meet cap standards. Accordingly, local populations will still be at increased risk for adverse effects from mercury exposure. The concern over hot spots is exemplified by a study of mercury contamination in the Everglades, which showed a 75% decrease in mercury contamination of fish and wildlife after controls were placed on local incinerators and other sources of Hg.²⁵

Additionally, many believe that the caps are too high, that the pace to achieve them is too slow, and that total emissions could be more significantly reduced by forcing individual plant compliance with a MACT-type approach. Field tests have proven the effectiveness of ACI for reducing mercury emission, and according to a report from the U.S. Department of Energy, this technology is suited for use on existing coal-fired boilers. These mercury-specific controls are already used on municipal waste combustors and medical waste incinerator facilities in the United States and Europe. Furthermore, the EPA’s own Office of Research and Development estimated that the best level of emissions control at existing plants (which would have implications for a MACT-based strategy) could be achieved fairly simply via expanded use of fabric filters.²⁶ Combining the two processes has the potential to achieve a 90% reduction in Hg emissions.

Reconsideration of the Clean Air Mercury Rule. In response to petitions filed by states, tribes, industry, and environmental groups, the EPA reopened certain aspects of the final rule for public comment (by December 19, 2005) and reconsideration.^{27,28} These included the method used to apportion the national caps to individual states, the definition of “designated pollutant,” issues related to New Source Performance Standards, and the definition of covered units as including municipal waste incinerators and some industrial boilers. The EPA took final action on these petitions on May 31, 2006, by: (1) reaffirming its decision regarding interpretation of the Section 112 Rule; (2) amending regulatory language to clarify that CAMR does not apply to municipal waste incinerators (which are controlled under a separate rule); and (3) revising the performance standards for new subbituminous coal-fired units.

In June 2005, the American Academy of Pediatrics, the American Public Health Association, the American Nurses Association, and the Physicians for Social Responsibility jointly moved to intervene in the Hg litigation in federal district court, alleging that CAMR would not protect public health and that the Agency had ignored or failed to ascertain critical evidence about the health effects of its rule on vulnerable populations, especially children. Additionally, 11 states filed suit in opposition to the Mercury Rule alleging it will delay meaningful emission reductions for many years and perpetuate hot spots of local mercury deposition, thus posing a “grave threat” to the health of children (www.state.nj.us/oag/newsreleases05/pr20050518b.html).

Several legislative proposals also have aimed to reduce levels of mercury in the environment in consumer products, solid waste, utility and other emission sources, and in surface water. The legislative and administrative proposals differ on how much and how soon emission reductions would be required.

Manufacturing Sources

As noted above, major man-made sources (or uses) of elemental Hg include coal-burning electricity-generating plants, hazardous medical waste incinerators, institutional boilers, chlor-alkali plants, gold mining, cement production, and certain mercury-containing products (eg, thermometers, blood pressure monitors, lamps, batteries, electronic switches and devices). Considerable progress has been made in eliminating the use of mercury in lamps and thermometers, and in phasing out mercury-containing batteries.²⁹

One remaining major concern in the manufacturing sector is the use of Hg in chlor-alkali plants. Some U.S. plants continue to manufacture chlorine by using vats of elemental Hg (“mercury-cells”). Individual cells typically are about 60 feet long and 9 feet wide, and are connected in series with 30 or more cells, each containing an electrolytic cell to generate the chlorine gas, and a separate decomposer, which produces hydrogen gas and caustic solution. A stream of liquid Hg flows in a continuous loop between these two elements. Saturated NaCl or KCl solutions are fed in, and an electric current is applied to the anode of the electrolytic cell, as well as the Hg stream, which functions as the cathode. Chlorine gas, caustic solution, and NaHg (or KHg) amalgam are formed. The chlorine is captured and produced for use in water purification, bleach, and a myriad of plastic, polyvinyl chloride, etc., type compounds.

Nine such plants are currently operating in eight states (Alabama, Delaware, Georgia, Louisiana, Ohio, Tennessee, West Virginia, and Wisconsin). One has committed to converting to mercury-free technology, and another has announced plans for closure. The other 53 U.S. chlorine-generating facilities have converted to mercury-free processes for chlorine generation and production. Companies using mercury-free processes rely on the use of membrane electrolysis technology. The electrolysis cells used in modern chlor-alkali plants employ large ion-exchange membranes and inert diametrically stable electrodes in place of the liquid-film mercury cathodes.

In Hg cell plants, Hg is emitted from the end cell ventilation system, and from the by-product hydrogen system. These plants are required to report their mercury emissions and off-site disposals each year. These self-reported emission figures amounted collectively to about 8 tons in 2003, and another 6 tons are attributable to “fugitive emission.”³⁰ However, there is a huge discrepancy between what the industry reports having consumed and what it reports having released. For example, in 2000, the nine mercury-based chlorine plants in the United States used 79 tons of mercury during the manufacturing process, but only 14 tons were reported as released, leaving 65 tons unaccounted for. In 2003, the EPA issued a final rule intended to reduce mercury emissions from mercury cell chlor-alkali plants.¹² In its analysis, the EPA declared that “the fate of all the mercury consumed at mercury cell chlor-alkali plants remains somewhat of an enigma.”¹⁰ The industry claims the remainder is contained on site within the manufacturing infrastructure and processing equipment.¹²

Global Context

Worldwide, 5000 to 6000 tons of mercury are emitted from all sources annually. On a continental basis, Asia generates more than half of the emissions, followed by Africa and Europe. Although U.S. anthropogenic emissions account for approximately 3% of the world total, significant problems remain with local emissions and deposition.³¹

International Actions for Reducing Mercury Emissions. In June 1998, the Executive Body of the United Nations Economic Commission for Europe Conventions on Long-Range Transboundary Air Pollution adopted the Protocol on Heavy Metals. The United States is a party to this legally binding agreement, which went into effect in December 2003.³² The protocol targets three heavy metals: cadmium, lead, and mercury emissions from industrial sources (iron and steel industry, non-ferrous metal industry), combustion processes (power generation, road transport), and waste incineration. It largely commits the United States to stabilize emissions, but not reduce them, inasmuch as the reference year for the protocol is 1990, and Hg emissions have declined substantially in this country since that benchmark year.

At the twenty-third session of the United Nations Environment Program (UNEP) Governing Council in February 2005, attempts were made to move toward a legally binding global treaty to reduce mercury pollution. This approach was opposed by the United States, which instead advocated that governments agree to develop and implement partnerships as the preferred approach to reducing the risks to human health and the environment from the release of mercury and its compounds.³³ This approach was eventually agreed upon. Subsequently, the United States has been involved with four global partnerships, three of which have begun joint activities, including: (1) mercury reductions in the chlor-alkali sector; (2) mercury reductions in products; and (3) mercury management in artisanal and small-scale gold mining. A fourth initiative is intended to generate research to achieve a better understanding of the global cycling of mercury. The estimated amount of mercury coming into, and being transported from, individual countries is uncertain. This factor, together with a limited number of country-specific release inventories, and lack of standard measurement methods, limits the accuracy of

modeling predictions and, therefore, the ability to quantify the effects of emission and use reductions.

Summary and Conclusion

Mercury is a global pollutant, a major contaminant in the marine food supply, a serious neurotoxin, particularly in the developing fetus, and possibly a promoter of cardiovascular disease. Man-made emissions and manufacturing processes account for more than half of the annual global mercury burden, with significant variation among countries and continents of the world. The United States is the first country to regulate the major remaining source of uncontrolled mercury emissions; namely, coal-fired electricity-generating plants, although some states have gone substantially further in moving to reduce Hg emissions.

While the market-driven approach taken by the EPA will significantly reduce mercury emission over the next three decades, there is general agreement that more could be done sooner by using existing control technology, and without the potential for local and regional citizenry to continue to bear a disproportionate exposure burden (ie, generation of hot spots) that may continue to occur under a national cap-and-trade approach. The United States opposed a binding international treaty on mercury, but is cooperating in a voluntary manner with other countries to address several aspects of the mercury burden. It is also a member of one binding agreement intended to reduce mercury emissions on an international basis, although this agreement will not affect U.S. emissions.

Further progress is needed in reducing the use of mercury in manufacturing and other devices, using the alternatives that are already available. Furthermore, the development of economically feasible mercury control technologies should help accelerate regulatory and voluntary reductions in sources of Hg emissions.

RECOMMENDATIONS (Adopted AMA Policy and Directives)

The following statements, recommended by the Council on Science and Public Health, were adopted by the AMA House of Delegates as AMA policy and directives at the 2006 AMA Interim Meeting:

1. The AMA recognizes that the trading of air pollutants is potentially harmful for vulnerable populations, and that the Clean Air Mercury Rule is inconsistent with the AMA's health-protective approach to air pollution. **(Policy)**
2. The AMA encourages state governments to be proactive in protecting citizens from harmful mercury emissions. **(Directive)**
3. The AMA encourages reduction in mercury use in manufacturing wherever possible, and recognizes that more must be done using available and emerging technology to reduce mercury emissions. **(Directive)**
4. The AMA recommends increased vigilance, monitoring, and tracking of mercury use and emissions in chlor-alkali facilities that use mercury in manufacturing processes. **(Directive)**

5. The AMA encourages the U.S. government to assume a leadership role in reducing the global mercury burden and work toward promoting binding, health-protective international standards. (**Directive**)

[CSAPH home page](#)

[Reports by topic](#)

References (PDFs require [Adobe® Reader®](#))

1. National Research Council. *Toxicological Effects of Methylmercury*. Washington, DC: National Academy Press; 2000.
2. Wendroff AP. The toxicology of mercury. *N Engl J Med*. 2004;350:946.
3. Mahaffey KR. Recent advances in recognition of low-level methylmercury poisoning. *Curr Opin Neurol*. 2000;13:699-707.
4. Guallar E, Sanz-Gallardo MI, van't Veer P, et al. Mercury, fish oils, and the risk of myocardial infarction. *N Engl J Med*. 2002;347:1747-1754.
5. Yoshizawa K, Rimm EB, Morris JS, et al. Mercury and the risk of coronary heart disease in men. *N Engl J Med*. 2002;347:1755-1760.
6. Virtanen JK, Voutilainen S, Rissanen TH, et al. Mercury, fish oils, and risk of acute coronary events and cardiovascular disease, coronary heart disease, and all-cause mortality in men in eastern Finland. *Arterioscler Thromb Vasc Biol*. 2005;25:228-233.
7. United Nations Environmental Program. Global Mercury Assessment Report. New York: United Nations Environmental Programme. Available at: www.chem.unep.ch/mercury/Report/GMA-report-TOC.htm. Accessed July 28, 2006.
8. Bindler R. Estimating the natural background atmospheric deposition rate of mercury utilizing ombrotrophic bogs in southern Sweden. *Environ Sci Tech*. 2003;37:40-46.
9. Pacyna EG, Pacyna JM. Global emission of mercury from anthropogenic sources in 1995. *Water Air Soil Pollution*. 2000;137:149-165.
10. Pacyna JM, Pacyna EG, Steenhuisen F, et al. Mapping 1995 global anthropogenic emissions of mercury. *Atmosph Environ*. 2003;37(Suppl 1):S109-S117.
11. U.S. Environmental Protection Agency. Controlling power plant emission: emission progress. Available at: www.epa.gov/mercury/control_emissions/emission/htm. Accessed February 18, 2006.
12. U.S. Environmental Protection Agency. National Emission Standards for Hazardous Air Pollutants: Mercury Emissions From Mercury Cell Chlor-Alkali Plants-Final Rule. *Fed Reg*. 2003;68:70903-70955.
13. U.S. Environmental Protection Agency. 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. *Fed Reg*. 2004;69: 4651-4700.
14. Landis MS, Keeler GJ. Atmospheric mercury deposition to Lake Michigan during the Lake Michigan mass balance study. *Environ Sci Technol*. 2002;36:4518-4524.
15. Weiss-Penzias P, Jaffe DA, McClintick A, Prestbo EM, Landis MS. Gaseous elemental mercury in the marine boundary layer: evidence for rapid removal in anthropogenic pollution. *Environ Sci Technol*. 2003;37:3755-3763.
16. U.S. Environmental Protection Agency. Mercury Study Report to Congress, Volume

1. Summary. Washington, DC. 1997. Publication Number 452/R-97-001.
17. U.S. Environmental Protection Agency. Utility Air Toxics Study. Available at: <http://www.epa.gov/ttn/atw/combust/utitox/utilexec.pdf>. Accessed February 18, 2006.
18. U.S. Environmental Protection Agency. Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units. *Fed Reg.* 2000;65:79825-79832.
19. U.S. Environmental Protection Agency. 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. *Fed Reg.* 2004; 69:4652-4752.
20. Shea DA, Parker L, McCarthy JE, Chapman T. Mercury emissions from electric generating units: a review of EPA analysis and MACT determination. Congressional Research Service. January 21, 2005.
21. U.S. Environmental Protection Agency. Supplemental notice for the 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. *Fed Reg.* 2004;69:12398-12472.
22. U.S. Environmental Protection Agency. Standards of Performance for New and Existing Stationary Sources: Electric Steam Generating Units (the Clean Air Mercury Rule or CAMR). *Fed Reg.* 2005;70:28605-28700.
23. U.S. Environmental Protection Agency. Ambient air quality standards, national. Fine particulate matter and ozone; interstate transport control measures (Clean Air Interstate Rule). *Fed Reg.* 2005;70:25162–25405.
24. Environment Working Group— Natural Resources Defense Council. Mercury Falling. An analysis of mercury pollution from coal-burning power plants. Washington, DC; 1999. Available at: <http://www.ewg.org/reports/mercuryfalling/mercurypr.html>. Accessed July 28, 2006.
25. Florida Department of Environmental Protection. Integrating Atmospheric Mercury Deposition with aquatic cycling in south Florida. Available at: <ftp://ftp.dep.state.fl.us/pub/labs/assessment/mercury/tmdlreport03.pdf>.
26. U.S. Environmental Protection Agency. Office of Research and Development. Control of Mercury Emissions from Coal-fired Electric Utility Boilers. Available at: www.epa.gov/ttn/atw/utility/hgwhitepaperfinal.pdf.
27. U.S. Environmental Protection Agency. Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units: Reconsideration, October 21, 2005. Available at: <http://www.epa.gov/air/interstateairquality/rule.html>. Accessed February 18, 2006.
28. Environmental Protection Agency. 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: Reconsideration October 21, 2005. Available at: <http://www.epa.gov/air/interstateairquality/rule.html>. Accessed February 18, 2006.
29. Mercury-Containing and Rechargeable Battery Management Act of 1996 (P.L. 104-142).
30. U.S. Environmental Protection Agency. Toxic Releases Inventory 2003. Available at: www.epa.gov/triexplorer.

31. U.S. Environmental Protection Agency. Mercury emissions: the global context. Available at www.epa.gov/mercury/control_emissions/global.htm. Accessed February 18, 2006.
32. United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution Protocol on Heavy Metals . Available at: http://www.unece.org/env/lrtap/hm_h1.htm Accessed February 18, 2006.
33. United Nations Environment Program (UNEP) Governing Council Decision. Available at: <http://www.chem.unep.ch/mercury/partnerships/>. Accessed February 18, 2006.

[CSAPH home page](#)

[Reports by topic](#)

Resolution 411 (A-05)

Resolution 411 (A-05), introduced by the Illinois Delegation at the 2005 Annual Meeting and referred to the Board of Trustees, asked:

That the American Medical Association (AMA) endorse the reduction of mercury usage in manufacturing whenever possible, especially in chlorine manufacturing; and
That the AMA urge the U.S. to lead the development of a binding protocol to reduce mercury pollution worldwide.

<http://www.ama-assn.org/ama/pub/category/17010.html>

<http://www.ama-assn.org/ama/pub/category/17010.html>

