

Mercury “Hot Spots” — Emissions and Deposition Patterns

Issue Brief

Concerns have been raised about potential mercury “hot spots” in the United States, particularly those that might be associated with power plant emissions. A specific concern is that “hot spots,” if they occur, might not decline—but might actually become more numerous or severe—following full implementation of EPA’s trading approach for mercury emissions control. EPRI has examined this issue using computer models and data analyses and has concluded that power plant mercury emissions do not and will not create or intensify any “hot spots” under the regulations issued by EPA. In fact, power plants contribute little to the areas of highest deposition in the United States, either currently or in future regulatory scenarios.

Why Are There Concerns About Mercury Hot Spots?

In May 2006 the U.S. Environmental Protection Agency (EPA) issued its final Clean Air Mercury Rule (CAMR) regulating mercury emissions from coal-fired power plants. Prior to issuing CAMR and the parallel Clean Air Interstate Rule (CAIR) regulating other air pollutants, EPA defined a mercury “hot spot” as a location where deposition contributed by U.S. power plants alone is enough to raise mercury in fish tissue above the level EPA deems safe to consume. This is also the highest permissible level before waterways are classified as mercury impaired. In general, mercury “hot spots” are considered to be areas of excessively high mercury deposition compared to national or regional averages.

Widely scattered U.S. measurements of the amount of mercury depositing in precipitation show no strong deposition increases from the Midwest to the East that might reflect the greater number of mercury sources in the eastern United States. However, there has been speculation that some unmeasured U.S. locations may receive elevated mercury deposition, meeting some

general definitions of “hot spots.” At the same time there are concerns that the cap-and-trade regulatory approach of CAMR will allow some power plants to increase the amount of mercury they emit. Thus, there have been assertions that CAMR has the potential to create or exacerbate mercury “hot spots.”

EPRI has Applied State-of-the-Art Modeling to Evaluate the Potential for “Hot Spots” Under the Utility Mercury Regulation Issued by the U.S. EPA

Because it is impractical to look for “hot spots” by measuring mercury deposition at every location in the country, EPRI has run sophisticated state-of-the-art computer models to simulate the transport and deposition of the mercury released from power plants and other emission sources. These model runs looked at current emissions and deposition, and at scenarios of possible future deposition following implementation of EPA’s mercury emission control regulations for utility boilers. EPRI’s analysis considered the amount and chemical forms of mercury emitted from every coal-fired power plant in the U.S. under three scenarios: a 2004 Base Case for current conditions; EPA’s CAMR regulation; and a theoretical “zeroed-out” scenario under which all U.S. utility mercury emissions are eliminated.

The 2004 Base Case simulates mercury emissions from power plants and all other mercury sources (such as municipal and medical waste incinerators) in the U.S. and around the world. The model simulations of CAMR are for the year 2020, when all emission reduction measures required by CAIR and CAMR together will be fully implemented. Some growth in electricity generating capacity is anticipated as allowed by CAMR rules in which a portion of the allowances provided to each state is set aside for new plants. While some new

mercury emissions will occur from these permitted facilities, the overall trend in utility emissions is downward. The CAMR scenario and the “zeroed-out” scenario reduce power plant emissions according to the regulatory requirements or set them to zero, respectively, but keep emissions from all other sources at their 2004 levels. This approach allows researchers to estimate the impact of EPA’s utility mercury regulation alone.

To perform the simulations, EPRI used a national emissions prediction model to evaluate the amount and chemical forms of mercury emitted from U.S. power plants under each scenario. These emission results were fed into an atmospheric fine-scale model which simulates the chemistry and physics of mercury emitted into the atmosphere. The output of this simulation was then used to calculate amounts and patterns of deposition throughout the U.S. under current conditions, CAMR, and the “zeroed-out” scenario.

The U.S. EPA performed its own modeling using a similar approach, but with two differences. First, EPA employed projections of future U.S. mercury emissions in both the utility sector and in other sectors of the economy, including a slight growth in mercury emissions from other sectors to reflect future changes in population and economic activity. Second, EPA employed a 36 km square grid in its atmospheric deposition model (vs. the 20 km square used in EPRI’s model). This regular rectangular grid was then transformed into an irregular grid that roughly outlined U.S. freshwater drainage basins. Despite these differences, the total deposition and general patterns of deposition seen in the EPRI and EPA results were very similar.

EPA and EPRI Results Show That the Greatest U.S. Mercury Deposition is Produced by Emissions From Sources Other Than U.S. Power Plants

According to both EPA and EPRI computer simulations—both before and after imposition of the utility mercury CAMR regulation—the locations of highest mercury deposition in the U.S. are predominantly impacted by emissions from non-power plant sources. To clarify this, a broad definition was used to define “utility-dominated” locations: all locations where half or more of the

deposited mercury originates from U.S. power plants. Even under this broad definition, less than 1% of the U.S. (0.4% of the land area) falls into this category prior to implementation of CAIR and CAMR. Following CAMR, no location in the U.S. is dominated by utility-originated mercury. That is, after EPA’s cap and trade program, no location in the U.S. would receive more than half of its mercury deposition from U.S. power plants. Not only will utilities at that time be emitting lower levels of mercury to meet the regulatory requirements, but some plants will reduce their emissions beyond their required levels. This will provide those utility companies with emissions “credits” that they can “bank” and use to offset emissions from new, future generation. Because new generation throughout the U.S. must meet the existing national and state mercury caps, there is little or no economic incentive to increase emissions at existing plants. Instead, there is a greater incentive to reduce emissions to allow for future generation needs. The same results were found by both EPA and EPRI (and other independent researchers) in analyzing future regulatory scenarios.

Currently, areas in the U.S. with the highest mercury deposition receive most of their mercury from municipal and medical waste incinerators. These areas of high mercury deposition—located primarily in the mid-Atlantic and southern New England states—will continue to exist even after power plants have fully reduced their emissions. The contributing non-utility incinerators are currently at, or will soon reach, their assigned lower levels of mercury emissions, so those deposition high points will remain in the future. Even if the hypothetical “zeroing-out” of utility mercury were to occur, those highest deposition locations would remain high, since they are not significantly influenced by any utility mercury emissions. So the complete elimination of that utility mercury will not result in significantly lower deposition of mercury at the highest-deposition points in the U.S.

The CAMR rule issued by EPA would play an important role in reducing deposition in locations that do have substantial mercury from utility sources. Power plant-dominated locations would all see reductions in their absolute deposition values. Most of this reduction occurs

under CAIR (aimed at pollutants other than mercury) rather than under CAMR because most electric utility mercury deposition is due to emissions of divalent mercury, the form most readily captured by controls to be implemented under CAIR. The elemental form of mercury emitted in flue gas, which is not readily removed by control equipment required by CAIR, does not impact local deposition; elemental mercury is virtually insoluble in water. Thus, if utility mercury emissions were forced to change from a 70% reduction under CAMR to a complete 100% cessation, there would be very little additional change in mercury deposition.

The EPA Mercury Regulation Would Neither Increase Mercury Deposition in High-Deposition Areas nor Create New High-Deposition Areas

EPA and EPRI modeling results show that every state will experience overall reductions in mercury deposition due to CAMR. The greatest reductions will occur in the mid-Atlantic and southeastern states because CAIR and CAMR incorporate greater incentives for the types of power plants located in these regions to pursue highly effective mercury controls. These power plants tend to burn eastern bituminous coal, which emits a relatively higher proportion of divalent mercury—the chemical form most easily captured by the emission control devices for sulfur and nitrogen oxides required by CAIR. Because of the cost-effectiveness to reduce mercury emissions at these plants, they are more likely to install highly effective mercury capture controls and therefore will have a greater relative impact on reducing mercury emissions and deposition. Again, neither CAIR nor CAMR substantially lowers the areas of highest mercury deposition values, which are dominated by municipal and medical waste incinerators.

New EPA Findings from Steubenville, Ohio Are in Concert with EPRI Research Results

EPA established a mercury measurement site in Steubenville, Ohio in 2002; findings from that experiment were published in September 2006. The Steubenville investigators found that 60-70% of the mercury deposited at their location in rainfall is from

coal-fired sources at “local/regional” scales (up to 600 miles distant). It is important to note that most mercury deposition research defines “local” as being within 50 km (30 miles) of the mercury emission source. In the case of Steubenville, “local/regional” includes most of the eastern and mid-western United States. EPRI modeling shows that 64% of the wet-deposited mercury at Steubenville may be from U.S. coal-fired power plants. This is one indication of the power of atmospheric modeling to replicate (or in this case to forecast) data-based conclusions. Other coal-fired sources are also present in the immediate area of the EPA Steubenville measurement site, including plants manufacturing coke for steelmaking. EPRI modeling shows that 42% of the mercury wet deposition occurring within a 15-mile radius of the Steubenville site is attributable to U.S. power plants. Further, the Steubenville researchers assumed no conversion of oxidized mercury emitted from power plants to elemental mercury, a process which has been measured in several power plant plumes in the U.S. Interestingly, their reported skepticism over this possible important reaction has now led to their beginning their own field measurement program of mercury plume chemistry.

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