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Benefits of Alternative Mercury Emission Control Strategies in Pennsylvania

Data from U.S. EPA, Final Regulatory Impact Analysis of the Clean Air Mercury Rule, March 2005

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Mercury Stakeholders Meeting
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Background

U.S. EPA has analyzed the reduction of mercury deposition in the United States resulting from implementation of EPA's March 2005 Clean Air Mercury Rule (CAMR) and the Clean Air Interstate Rule (CAIR). CAIR calls for a 70% reduction of emissions of sulfur and nitrogen oxides from electric generating units (EGUs) in 28 eastern states by 2015. CAMR requires a comparable 70% reduction of national EGU mercury emissions by 2018, from a current level of ~47 tons per year to 15 tons. Both rules provide emission trading options to affected states.

EPA also has estimated the reduction of mercury-related risk to the relevant population of women of child-bearing age by tracing the changes in mercury emissions and deposition through the food chain, from changes in the mercury content of fish tissue to changes in maternal mercury blood concentrations. Reductions in maternal mercury concentrations are related in turn to projected changes in IQ among children born to women in households that engage in freshwater fishing, the population group most likely to benefit from the reduction of domestic mercury deposition. EPA uses a net present value estimate of $8,000 per "avoided IQ decrement."

EPA's methodology includes results for a mercury "zero-out" case, where all mercury emissions from electric generation units are eliminated. This "zero-out" case provides an upper bound for measuring the potential benefits of state or regional mercury control strategies more stringent than the EPA mercury rule.

Overview of EPA Modeling Results

EPA's Final Regulatory Impact Analysis for CAMR provides summary displays of current U.S. mercury deposition, reductions of deposition expected under CAIR and two versions of CAMR[1], and reductions under a zero-out EGU emissions alternative:

> **"8.4 Mercury Deposition Results**
> Maps showing the mercury deposition results are provided below. The annual total modeled mercury deposition for the 2001 base case is shown in Figure 8-2. The reduction in total mercury deposition that would result if all US power plant mercury emissions were zeroed out in 2001 is shown in Figure 8-3. The change in 2001 total mercury deposition in 2020 with

[1] CAMR Option 1 is the rule promulgated in March 2005, with a 38 ton mercury cap in 2010 and a 15 ton cap in 2018. CAMR Option 2 would impose the 15 ton cap in 2015.

CAIR is shown in figure 8-4. The total mercury deposition for 2020 with CAIR is shown in Figure 8-5. The decrease in 2020 with CAIR when all US power plant emissions are zeroed-out is shown in Figure 8-6. The change in 2020 CAIR total mercury depositions with CAMR Option 1 is shown in Figure 8-7. The change in 2020 CAIR total mercury deposition with CAMR Option 2 is shown in Figure 8-8. It can be seen in Figures 8.3 and 8.4 that the implementation of CAIR and other minor non-utility mercury emissions decreases in 2020 result in a similar reduction in total mercury deposition as completely eliminating power plant mercury emissions. The main cause of this result is that CAIR results in a very large decrease in reactive gaseous mercury (RGM) emissions from Power Plants through the implementation of scrubber control technology (see Table 8-2). RGM is the most readily deposited form of mercury. It can be seen in Figures 8-7 and 8-8 that the implementation of CAMR Option 1 and CAMR Option 2 results in some scattered total mercury deposition reductions beyond CAIR in 2020, but for the most part these reductions are not very significant compared to those obtained by CAIR. Most of the mercury emissions reductions from CAMR are in the form of elemental mercury (Hg0). This form of mercury is not readily deposited, but enters the global pool of mercury. Thus, CAMR will result in a reduction of the transport of mercury to other places in the world." EPA, CAMR Final RIA, pp. 8-9 (emphasis added.)

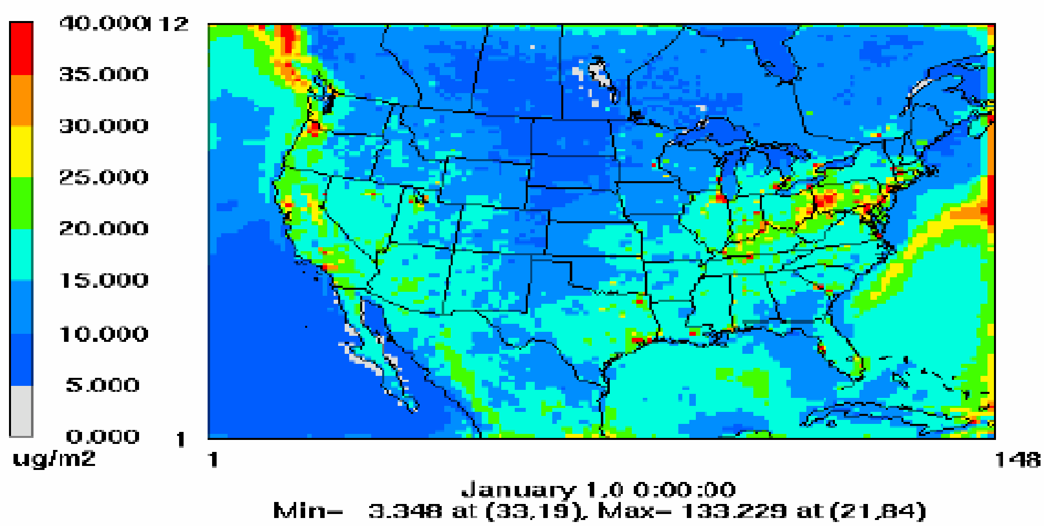


Figure 8-2. Base Case Total Mercury Deposition: 2001

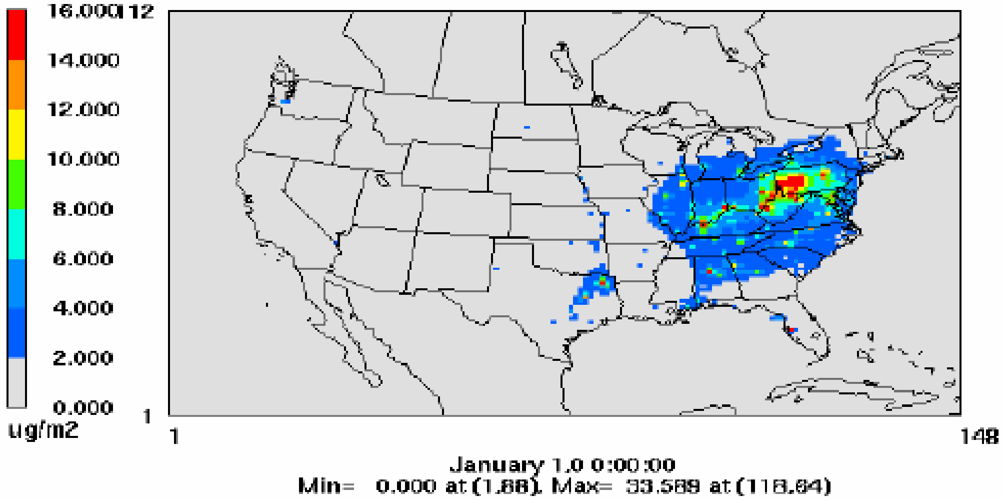


Figure 8-3. Decrease in Total Mercury Deposition with Power Plant Zero-Out Simulation: 2001

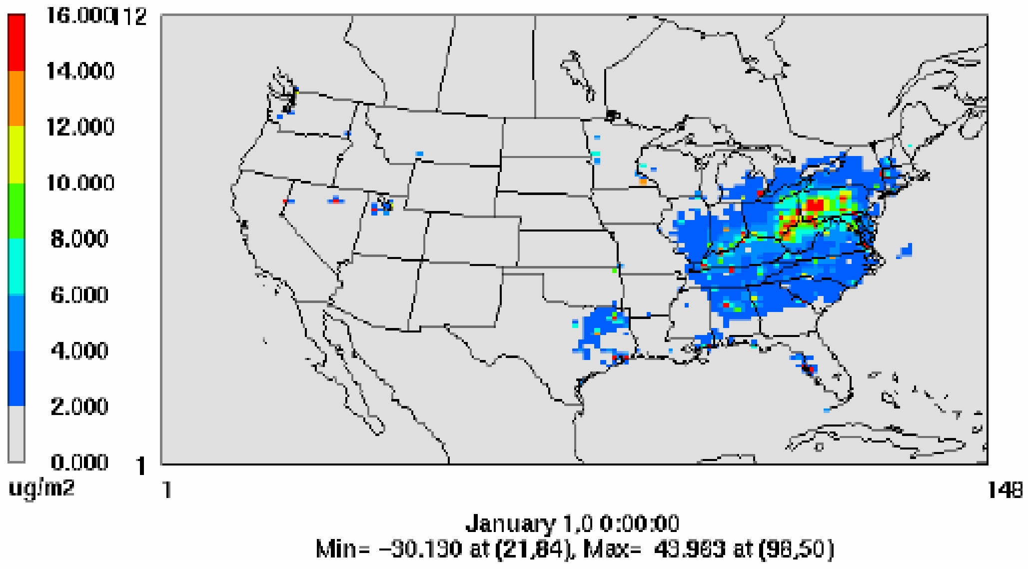


Figure 8-4. Change in Total Mercury Deposition for All Sources: 2020 (with CAIR) Relative to 2001

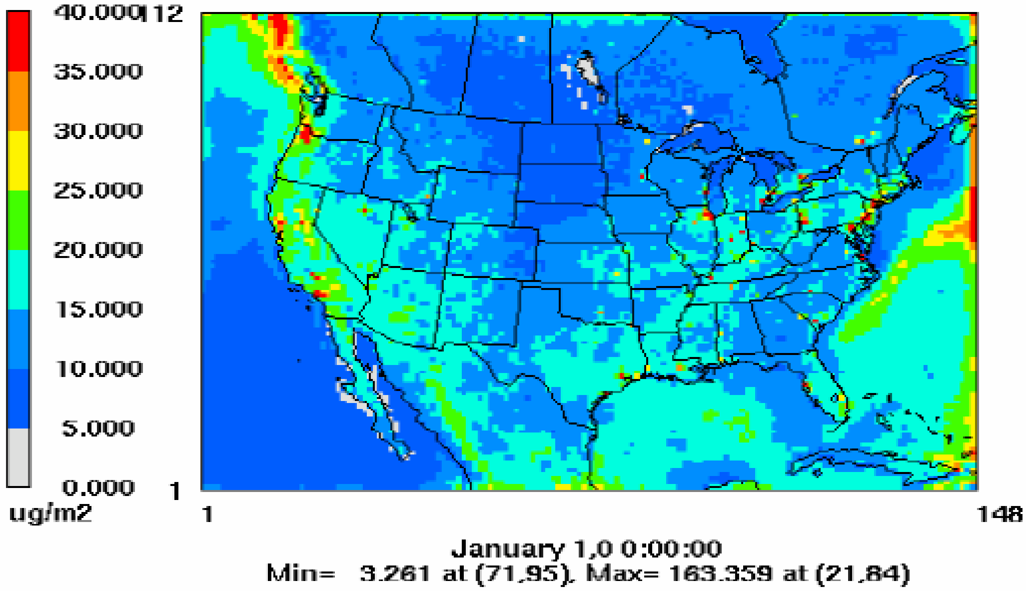


Figure 8-5. Total Mercury Deposition: 2020 (with CAIR)

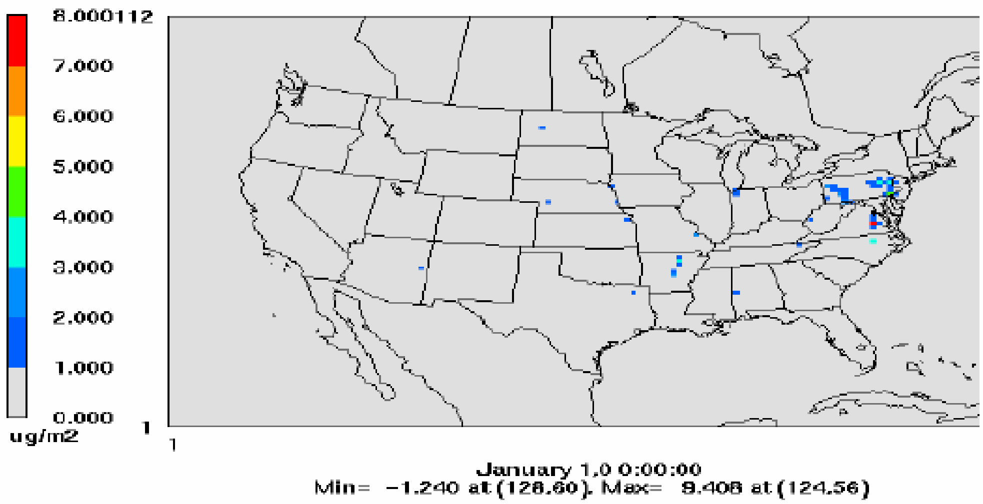


Figure 8-6. Change in Mercury Depositions from Power Plants Due to CAMR Option 1: 2020

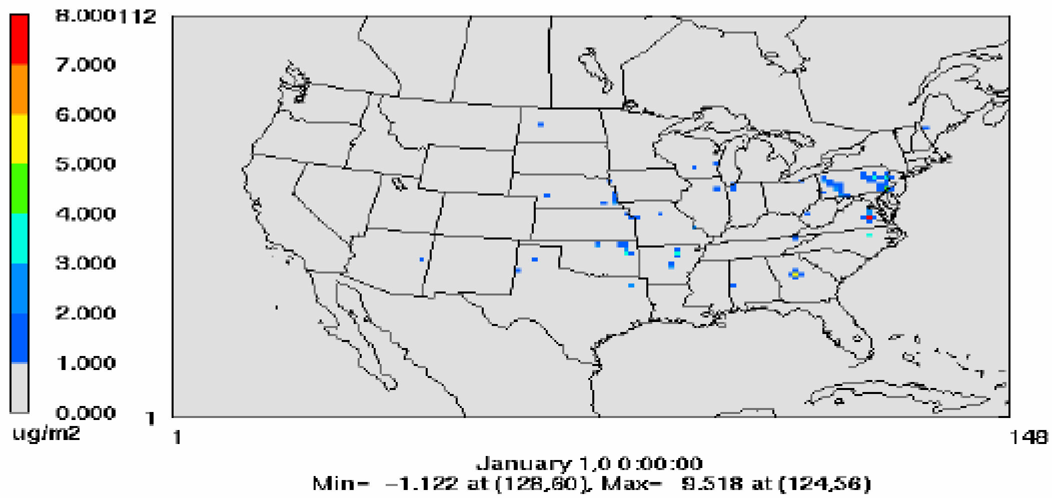


Figure 8-7. Change in Mercury Deposition from Power Plants Due to CAMR Option 2: 2020

IQ Impact Analyses

EPA estimated the differences in mercury deposition for these alternative scenarios and calculated the "avoided IQ decrements" among children of women in households engaged in freshwater fishing. The analysis covered households in states with freshwater fishing, and assessed the changes in maternal mercury consumption among freshwater angling households – that is, households with the most direct exposure to mercury from domestic freshwater fish.

This subpopulation – households engaged in freshwater fishing – represents a small portion of the total population, and of total fish consumption in the United States. However, EPA's analysis indicates that this group is most likely to receive the majority of benefits from the reduction of EGU mercury emissions:

> "Section 8 of this RIA shows that deposition to U.S. waterbodies from coal-fired power plants will predominantly occur in freshwater waterbodies in the Eastern-half of the U.S. Thus, the benefit analysis of freshwater recreational anglers captures the primary segment of the affected population. To the extent that CAMR reductions will impact fish in coastal regions and the ocean, there remains a potential for a small amount of additional IQ benefits related to the general population of fish consumers (including foreign and domestically-caught commercial fish and coastal recreationally-caught fish)." EPA, CAMR Final RIA, p. 4-45.

EPA's reasons for quantifying "IQ decrements" of the affected population center on the availability of reliable data and methods for estimating IQ changes associated with methylmercury consumption, similar to analyses that the agency performed in estimating the benefits of eliminating lead exposures:

> "EPA has chosen to focus on quantification of intelligence quotient (IQ) decrements associated with prenatal mercury exposure as the initial endpoint for quantification and valuation of mercury health benefits. Reasons for this initial focus on IQ include the availability of thoroughly-reviewed, high-quality epidemiological studies assessing IQ or related cognitive outcomes suitable for IQ estimation, and the availability of well-established methods and data for economic valuation of avoided IQ deficits, as applied in EPA's previous benefits analyses for childhood lead exposure." EPA, CAMR Final RIA, p. 9-1.

EPA's summary benefit results for households engaged in freshwater angling in Pennsylvania are shown in the table below. The analysis indicates that:

- In the 2001 base case, 15,146 children in Pennsylvania were exposed to maternal mercury concentrations resulting in an average IQ decrement of .086, with net present value earnings losses of $11.4 million;
- The avoided Pennsylvania earnings losses due to implementation of CAIR relative to the EPA base case range from $1.3 to $1.7 million net present value in 2020, depending upon fish tissue response times;
- Relative to the 2001 base case, a zero-out utility mercury strategy throughout the U.S. would avoid earnings losses in Pennsylvania valued at $1.4 to $2.0 million net present value, depending on fish tissue response lag times;
- Relative to CAIR, implementation of the additional mercury reductions of CAMR would avoid earnings losses in Pennsylvania valued at $166,000 to $213,000 net present value in 2020, depending on fish tissue response lag times;
- The maximum net present value of Pennsylvania benefits for a nationwide "zero-out" utility mercury emission strategy relative to the EPA CAIR program is approximately $132,000-$275,000, depending on fish tissue response lag times, with these values providing an approximate upper-bound on the Pennsylvania benefits to be expected from any control strategy more stringent than CAIR but less stringent than "zero-out" across the United States.

MERCURY REDUCTION HEALTH BENEFITS OF EPA'S CLEAN AIR MERCURY RULE, CLEAN AIR INTERSTATE RULE AND HYPOTHETICAL "ZERO-OUT" U.S. UTILITY MERCURY EMISSIONS STRATEGY IN PENNSYLVANIA, 2020

	PENNSYLVANIA	
EPA 2001 BASE CASE ANNUAL NO. OF CHILDREN EXPOSED	15,146	
2001 AVG DAILY MATERNAL HG INGESTION UG/M3	3.34	
2001 MEAN IQ DECREMENTS IN PRENATALLY EXPOSED CHILDREN	0.086	
2001 PRESENT VALUE OF FOREGONE NET EARNINGS DUE TO IQ DECREMENTS ($1999)	$11,405,684	
2020 CAIR RULE ANNUAL NO. OF EXPOSED CHILDREN	14,621	
2020 CAIR AVG DAILY MATERNAL HG INGESTION UG/M3	2.64	
PCT CHG FROM 2001 BASE CAS	-21.0%	
2020 CAIR MEAN IQ DECREMENTS IN PRENATALLY EXPOSED CHILDREN	0.0675	
MEAN IQ CHG FROM BASE	-0.0185	
2020 CAIR PRESENT VALUE OF FOREGONE NET EARNINGS DUE TO IQ DECREMENTS ($1999)	$8,687,193	
EPA MODELED AVOIDED NET EARNINGS LOSSES DUE TO CAIR VS 2001 BASE CASE IN 2020 (NPV $1999)		
10-YR FISH TISSUE LAG	$1,689,870	
20-YR FISH TISSUE LAG	$1,304,303	
EPA MODELED AVOIDED NET EARNINGS LOSSES WITH ZERO-OUT UTILITY HG EMISSIONS VS 2001 BASE CASE IN 2001 (NPV $1999)		
10-YR FISH TISSUE LAG	$1,965,224	
20-YR FISH TISSUE LAG	$1,435,975	
INCREMENTAL BENEFITS OF 2001 ZERO-OUT RELATIVE TO CAIR, 2020* IN 2020 (NPV $1999)		
10-YR FISH TISSUE LAG	$275,354	SEE NOTE BELOW
20-YR FISH TISSUE LAG	$131,672	SEE NOTE BELOW
EPA MODELED AVOIDED NET EARNINGS LOSSES WITH CAMR 2020 RELATIVE TO CAIR 2020 IN 2020 (NPV $1999)		
10-YR FISH TISSUE LAG	$213,167	
20-YR FISH TISSUE LAG	$166,443	

*Not adjusted for 2001-2020 population change.

SOURCE: U.S. EPA, Regulatory Impact Analysis of the Final Clean Air Mercury Rule (March 2005), Tables 10-14 - 10-19.

Results in Perspective

EPA estimates the net present value of private costs for compliance with CAMR at $3.9 billion for the period 2007-2025, incremental to the $41 billion net present value cost of compliance with CAIR during the same period.[2] The marginal cost of mercury reductions in CAMR is estimated by EPA at $39,000 per pound,[3] or at least $78 million per ton of mercury below the 15 ton annual mercury emissions cap.

The small benefits associated with a national zero-out EGU mercury strategy relative to the EPA base case - estimated at a net present value of $1.4-$2.0 million among Pennsylvania households engaged in freshwater fishing - reflects several factors, including the minor contribution of mercury deposition from domestic EGU sources compared to global deposition sources. The incremental Pennsylvania benefits of a zero-out strategy for the entire U.S. relative to CAIR are much smaller, less than $300,000 net present value.

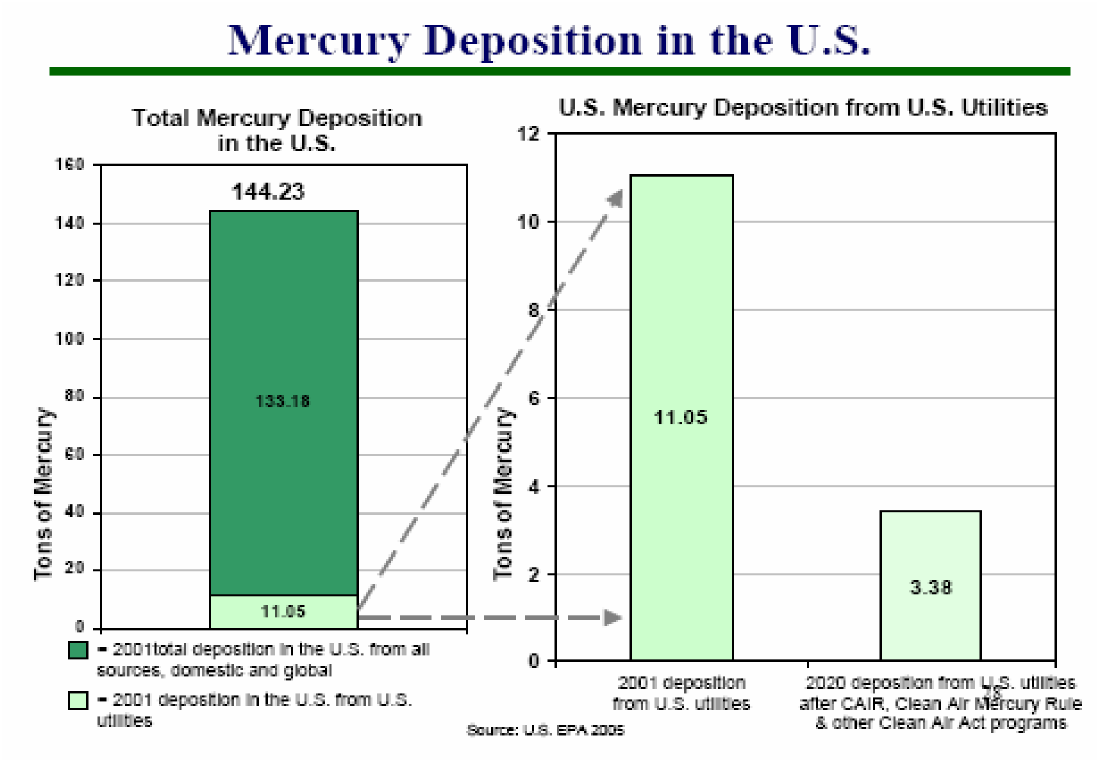
The incremental Pennsylvania benefits of CAMR relative to CAIR in 2020, estimated from EPA modeling results at $166,000 to $213,000 in net present value, is a conservative proxy of the maximum benefits in Pennsylvania of accelerating the emission reductions required by CAMR to an earlier date. Since these values are discounted over 30 years or more, and include reductions in dozens of other states, the maximum annual benefits of an accelerated mercury control regime in Pennsylvania likely would be measured in the tens of thousands of dollars per year.

The chart on the next page illustrates the relationship between domestic EGU-related deposition and deposition from all other sources. In sum:

- In 2001, total mercury deposition in the United States was 144.2 tons;
- EGUs contributed 11.05 tons, or 7.6% of this total deposition;
- By 2020, after implementation of CAIR and CAMR, EGU deposition will be reduced by 70% to 3.38 tons, or just 2.3% of total deposition in 2001;

[2] CAMR Final RIA, Table 7-7.
[3] Id., Table 7-8.

- Global sources of mercury emissions, such as China, India and other Asian nations, are projected to increase their total mercury emissions during the time that U.S. utilities are reducing their emissions.



The minor role of EGU-related mercury deposition in the United States, the small additional benefits estimated for a "zero-out" EGU mercury control strategy, and the $78 million minimum annual cost for reducing one ton of mercury below the 15 ton CAMR final cap, suggest that state or regional efforts to impose mercury limits more restrictive than EPA's CAMR would not generate benefits approaching their potential costs.