

Written Testimony
prepared by William Lambert, PhD
for the hearing entitled
“Oversight: Review of the Environmental Protection Agency’s Mercury
and Air Toxics Standards (MATS) for Power Plants”
Subcommittee on Clean Air and Nuclear Safety
Committee on Environment & Public Works
United States Senate
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The coal-fired boilers of utilities are the largest remaining source of airborne mercury emissions in the United States, and they are a major source of hazardous air pollutant emissions for other metals including arsenic, chromium, cadmium, and nickel. In addition these sources emit large amounts of acid gases and fine particulate matter. The primary objective of the Mercury and Air Toxics Standards published in the Federal Register on February 16, 2012 is the reduction of airborne mercury, a known neurotoxin with that impairs the brain development of children, resulting in permanent impairment of cognition and learning ability, with potential repercussions across the lifespan, adversely affecting future earnings and quality of life. The technologies available to remove mercury from smokestack emissions will at the same time remove the other toxic metals, acid gases, and fine particulate matter. These compounds are associated with cancer, asthma, chronic obstructive pulmonary disease, and heart disease. Combined, reduction of these emissions from coal-fired utilities will yield substantial benefits for the protection of public health.

Mercury (Hg) is an environmental pollutant of concern because it is persistent and accumulates in biological systems. Because of its persistent nature, mercury deposited in the environment today can be re-mobilized in the future, and therefore poses a long-lasting risk to public health. The form of mercury emitted

from coal-fired plants determines its behavior in the environment, and the potential hazard to humans. The three forms of mercury are: (1) gaseous elemental mercury, (2) oxidized mercury compounds, and (3) particle-bound mercury. Elemental mercury does not quickly react in the atmosphere, nor does it wash out, resulting in long-range transport and global scale deposition. Oxidized mercury and particle-bound mercury deposit quickly from the atmosphere impacting local and regional areas in proximity to sources. After mercury has fallen out of the air by dry and wet deposition processes, it is present in waterbodies and on the land. Microbes in aquatic sediments and soils convert these forms of mercury into an organic form called methylmercury (MeHg), which is taken up by aquatic organisms and accumulates up the food web. The tissues of predatory fish in the upper part of the aquatic food web may have methylmercury concentrations many times higher than that of the concentrations in the surrounding water and sediments. Methylmercury is much more toxic to humans than mercury in its elemental and oxidized forms, and it is through the ingestion of contaminated fish that human exposure occurs and health is harmed.

Over the past twenty years, multiple scientific panels and the U.S. EPA have reviewed extensive human data and have developed and revised the Reference Dose (RfD) for methylmercury. Epidemiologic data from observation of exposed populations, including the sensitive subpopulation of pregnant women and fetuses, is of sufficient size and quality to negate the need to rely on toxicological models and make extrapolations from animals to humans. These directly collected data from multiple studies of exposed populations in The Seychelles, Faroe Islands, and New Zealand, increase our confidence as to the neurological health effects associated with ingestion of contaminated fish. The available studies, particularly those of the Faroe Islands, suggest there is no evidence of a threshold for methylmercury-related neurotoxicity. The Faroe Island study is the primary basis for the RfD developed by the EPA. Exposures above the RfD can

be interpreted to represent an appreciable potential hazard to public health, although effects are demonstrable at lower levels of exposure. In these studies, children exposed *in utero* and during early life showed reduced performance on several neurobehavioral tests. Following the opinion of an expert panel of the National Academy of Sciences, the EPA used multiple neurobehavioral test measures from these studies as the basis for the RfD. These endpoints are related to the ability of children to learn and to be successful in school. Impairments measured at this age represent long-lasting and permanent impacts that continue into adulthood, affecting learning ability across the lifespan, and in all likelihood adversely affecting future earnings and quality of life.

Of all the hazardous air pollutants emitted by coal-fired plants, mercury presents the greatest hazard to the developing brains of children, and the evidence for adverse effects is well established in science. Children who are prenatally exposed to even low concentrations of methylmercury are at increased risk of reduced performance on neurobehavioral tests of attention, fine motor function, language, visual and spatial abilities, and verbal memory.

The health of populations that consume high amounts of self-caught fish are likely to be exposed to methylmercury levels exceeding the RfD. These subgroups include minority and low-income communities because of their higher levels of subsistence fishing. Among the communities of concern are American Indians and Alaska Natives, African Americans, Hispanics, and Asian Americans and recent immigrants from eastern Europe. In turn, children in these populations are at higher risk for the adverse neurological health effects described above. Children living in Environmental Justice communities are exposed to other stressors in addition to mercury that can result in lower educational performance, creating the potential for combined interaction of environmental toxins with other stressors.

Estimating the extent of neurologic damage in the population from these exposures is a complex process and the EPA followed established and accepted methods developed for another toxic metal, lead. This prior experience also allowed the economic valuation of these health effects using avoided IQ deficits. The use of global IQ to represent the health outcome is a trade-off, because ideally we would choose the more sensitive measures of language, attention, and memory that were directly assessed in these research studies. However, the use of IQ as a proxy allows monetization of benefits that are not possible with these neurobehavioral tests, which makes IQ very useful for the benefits analysis.

In the quantitative risk analysis presented in the Regulatory Impact Analysis of Mercury and Air Toxics Standards (2011), dispersion models identified geographic deposition of airborne mercury with and without controls on coal-fired utilities. Census tract data was used to estimate the number of women and childbearing age and annual pregnancies, and regional data on recreational and subsistence fishing were applied to estimate levels of consumption of locally caught fish. Applying dose-response curves, and accounting for variation, estimates of the shift in IQ points were calculated. Almost a quarter-million children are estimated to be exposed prenatally, with an average IQ loss due to mercury from all sources of 0.11 points in 2005, and 0.10 points in 2016. The average estimated ingestion rate of mercury in pregnant women is estimated to be 6.6% lower in 2016 under the Toxics Rule, relative to 2005. This translates into an estimated 0.00209 IQ points saved per prenatally exposed child compared to the 0.10 points 2016 base estimate.

While the avoided IQ loss may seem small, it must be realized that given the persistence of mercury in the environment, reductions in fish tissue levels will be slow, and moving the average IQ score of 240,000 children will also be accomplished across many years. Unseen in this average is the accompanying movement in the upper tail of the most highly exposed children. As previously

mentioned, using IQ as the outcome is relatively insensitive and probably underestimates the true benefits to reducing prenatal exposures. Impaired cognitive development, problems with language, and abnormal social development likely are related to later success in life and earnings. Other technical uncertainties also limit our confidence in the interpretation of this benefit analysis, and include the inability to focus on susceptible and vulnerable populations. It was not possible to quantify other potential health benefits of reducing mercury; immune and cardiovascular effects, and neurological effects in later life could not be considered because of inadequate scientific evidence. Even recognizing these limitations, this quantitative risk assessment provides valuable insights to gaps in knowledge and areas to improve scientific understanding so that we can better measure the impacts of air pollution control programs.

The health benefits from the reduction of mercury emissions from coal- and oil-fired facilities should not be considered in isolation, but rather in combination with reductions in other metals (arsenic, chromium, cadmium, nickel), organic compounds (benzene, formaldehyde), acid gases (sulfates), and fine particulate matter which also would be scrubbed along with mercury from boiler exhaust flows. The co-occurring pollutants are associated with cancer, asthma, chronic obstructive pulmonary disease, and heart disease. The burden of adverse health effects in the population is largely driven by fine particulate matter (PM_{2.5}) and acid gases, including sulfur dioxide (SO₂).

Using similar methods of quantitative risk assessment as those described above for mercury the EPA estimates substantial co-benefits for adults:

- 6,600 to 17,000 fewer premature deaths
- 4,300 fewer cases of chronic bronchitis
- 10,000 fewer non-fatal heart attacks

- 12,000 fewer hospitalizations (for respiratory and cardiovascular disease combined)
- 4.9 million fewer days of restricted activity due to respiratory illness, and
- 830,000 fewer lost work days.

For children, the avoided health damages include:

- 110,000 fewer childhood asthma attacks
- 6,700 fewer hospital admissions due to asthma
- 10,000 fewer cases of acute bronchitis, and
- 210,000 fewer cases of upper and lower respiratory illness.

The economic valuation of the total avoided health effects ranges from \$37 billion to \$90 billion per year.

EPA's analyses also consider the distribution of benefits of the Toxics Rule by race/ethnicity and income, and they demonstrate broad benefits to all groups in the United States. The Regulatory Impact Analysis estimates that people living in counties with the highest PM_{2.5} mortality risk (top 5 percent) will receive the largest reduction in mortality risk after the Toxics Rule takes effect. Further, the people now living in the poorest 5 percent of the counties are estimated to receive a larger reduction in PM_{2.5} mortality risk than all other counties. When viewed with other clean air policies (the Cross-State Air Pollution Rule), disparities in exposure to PM_{2.5} and its associated health effects will be further reduced for the highest risk counties.

In conclusion, mercury is a potent neurotoxin that threatens the brains and nervous systems of fetuses and young children. Exposure from eating contaminated fish can lead to multiple and life-long neurological problems, including learning and attention disabilities. In 2012, the contamination of our country's lakes and rivers by mercury is widespread. Twenty-six states have issued advisories to limit consumption of mercury-laden fish, and all but Hawaii and the District of Columbia have advisories for specific bodies of water.

Reducing levels of mercury in fish in these waters will reduce exposures to those who eat large amounts of fish for subsistence and recreation. Engineering controls to reduce mercury emissions from coal-fired utilities will also reduce emissions of other toxic metals, acid gases, and fine particulate matter that pose health risks many Americans, and particularly minority and low-income communities. The Mercury and Air Toxics Rule, when implemented and in effect, will immediately reduce these co-occurring hazards, which are extensive and require costly treatment. Over time, I am confident the benefits of reducing mercury will also be manifest in the public's health.

Thank you for the invitation to submit this testimony and to speak at the hearing.

Respectfully submitted,

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