



# Benefits of Regulating Hazardous Air Pollutants from Coal and Oil-Fired Utilities in the United States

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1 **Benefits of Regulating Hazardous Air Pollutants from Coal and Oil-Fired Utilities in the**  
2 **United States**

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23 On June 29, 2015, the U.S. Supreme Court ruled that the Environmental Protection Agency  
24 (EPA) acted unreasonably when it determined that cost was irrelevant to deciding whether it was  
25 “appropriate” to regulate emissions of Hazardous Air Pollutants (HAPs) from coal and oil-fired  
26 utilities (EGUs) (U.S. Supreme Court, *Michigan v. EPA*, 2015). According to the 1990 Clean Air  
27 Act Amendments, EPA must make a preliminary determination, known as the “appropriate and  
28 necessary” finding, before regulating EGUs. The Court ruled that EPA made a mistake at this  
29 preliminary stage and sent the regulation, known as the Mercury and Air Toxics Standards  
30 (MATS), back to the agency and ordered EPA to consider costs. The public comment period for  
31 this proposal closed on January 15, 2016 and EPA aims to issue a final cost consideration and  
32 renewed “appropriate and necessary” finding by April 15, 2016.

33

34 In its 2011 regulatory assessment<sup>1</sup>, EPA concluded that the monetized benefits for all air  
35 pollutants (both direct benefits and co-benefits) associated with MATS range between \$37 and  
36 \$90 billion and far exceed the costs of regulation. However, most of these quantified benefits  
37 come from reductions in particulate emissions. Monetized benefits associated with reducing  
38 HAP emissions in EPA’s regulatory assessment ranged between \$4-\$6 million, leading some  
39 critics to argue that the rule was unreasonable. However, both the scientific community and EPA  
40 have repeatedly emphasized the many additional, significant, unquantified benefits of this  
41 regulation that further outweigh the costs. Even preliminary efforts to monetize these benefits  
42 suggest they are substantially greater than the costs of the proposed regulation.

43

44 Although EGUs release a variety of HAPs, we will focus specifically on the benefits associated  
45 with reducing emissions of mercury and exposures to its organic form, methylmercury, which is

46 formed in aquatic ecosystems and bioaccumulates in food webs. Based on recent peer-reviewed  
47 scientific literature, we find the monetized benefits for EGU mercury emissions reductions  
48 identified by EPA in the regulatory impact analysis supporting MATS vastly understate the  
49 benefits associated with reductions of those emissions.

50 Specifically we elaborate upon three key points below:

- 51 1. Recent research demonstrates that quantified societal benefits associated with declines in  
52 mercury deposition attributable to implementation of MATS are much larger than the  
53 amount estimated by EPA in 2011.
- 54 2. As-yet-unquantified benefits to human health and wildlife from reductions in EGU  
55 mercury emissions are substantial.
- 56 3. Contributions of EGUs to locally deposited mercury have been underestimated by EPA's  
57 regulatory assessments.

58 **1. Quantified societal benefits associated with declines in mercury deposition attributable**  
59 **to implementation of MATS are much larger than the amount estimated by the EPA in**  
60 **2011.<sup>1</sup>**

61 Due to data limitations and gaps in the available research, EPA's regulatory assessment only  
62 considered a small subset of the public health and environmental risks associated with mercury  
63 emissions from EGUs. Specifically, EPA monetized the value of IQ losses for children born to a  
64 limited population of recreational fishers who consume freshwater fish during pregnancy from  
65 watersheds where EPA had fish tissue data. The monetized value of benefits for this small  
66 subpopulation was estimated between \$4 and \$6 million annually.<sup>1</sup>

67 If one considers instead all of the benefits of reducing EGU mercury emissions, recent research  
68 confirms that the benefits are orders of magnitude greater than those quantified by EPA in 2011.  
69 One study found that the cumulative U.S. economy-wide benefits associated with  
70 implementation of MATS exceeded \$43 billion.<sup>2</sup> This value is far greater than EPA's estimate of  
71 the costs associated with the regulation. Other work has estimated an annual benefit of \$860  
72 million associated with a 10% reduction in methylmercury exposure in the U.S. population.<sup>3</sup>

73 **2. As-yet unquantified benefits to human health and wildlife are substantial.**

74 In part these estimates are so much greater than the quantified benefits identified in EPA's  
75 regulatory assessment because they consider additional types of benefits from reducing EGU  
76 mercury emissions. For example, many of these benefits are associated with adverse impacts of  
77 methylmercury on cardiovascular health. EPA did not quantify cardiovascular effects in the  
78 regulatory assessment. At that time, there was a split in the scientific evidence regarding the  
79 significance of those impacts. On one side, an independent expert panel in 2011 asserted there is  
80 sufficient scientific evidence to incorporate these outcomes in regulatory assessments.<sup>4</sup> On the  
81 other, a high-profile study of risks of cardiovascular disease associated with methylmercury  
82 exposures in two U.S. cohorts found no evidence of adverse effects.<sup>5</sup>

83 There are several reasons, however, to conclude that the cardiovascular impacts are substantial  
84 despite the latter study. First, the study included only low-to-moderate fish consumers and  
85 therefore lacked the statistical power to detect effects seen in studies that included a greater  
86 range in exposures (e.g., <sup>6</sup>). Second, it is challenging to isolate the neurodevelopmental and  
87 cardiovascular impacts of methylmercury exposure from seafood consumption because seafood  
88 also contains long-chained fatty acids (eicosapentaenoic acid and docosahexaenoic acid) that

89 serve to mask those deleterious impacts.<sup>7, 8</sup> These confounding effects make it difficult for some  
90 epidemiological studies to identify the negative health outcomes associated with methylmercury  
91 exposures against the background of beneficial effects of consuming long-chained fatty acids in  
92 seafood. However, this does not imply that exposures to methylmercury on its own are not  
93 harmful, or that it does not reduce the benefits of an otherwise healthy food source.<sup>9, 10</sup> In  
94 addition, imprecision in exposure biomarkers biases many epidemiological studies toward a null  
95 finding rather than detection of adverse effects.<sup>11</sup> We note that failure to find a statistically  
96 significant effect is not evidence that no such effect exists, though it may provide evidence that  
97 constrains the magnitude of the effect.

98 Although EPA's regulatory assessment did quantify one type of neurological effect (IQ loss)  
99 among one group of fish consumers, its consideration of neurodevelopmental benefits from the  
100 proposed rule is incomplete. For example, the assessment did not consider benefits associated  
101 with reductions in methylmercury in coastal U.S. fisheries. It therefore significantly  
102 underestimates the neurodevelopmental benefits of the rule, because marine fish account for  
103 >90% of methylmercury intake by the U.S. population.<sup>12</sup> These benefits are difficult to quantify  
104 because they require attributing changes in methylmercury exposure from domestic,  
105 international, and natural sources of mercury. Nevertheless, many species of marine fish eaten by  
106 Americans spend a large portion of their lifecycle foraging in coastal U.S. domestic waters (Gulf  
107 of Mexico, Atlantic and Pacific coastal waters). Recent research suggests the regulation of  
108 domestic U.S. mercury emissions will have a substantial effect on mercury inputs to coastal  
109 waters (see point 3 below). For example, a recent study reported marked decreases in mercury in  
110 Atlantic coastal fisheries in response to decreases in mercury emissions.<sup>13</sup>

111 Furthermore, recent epidemiological data have revealed a suite of more sensitive  
112 neurodevelopmental effects than full-IQ, the impact valued in EPA's 2011 regulatory  
113 assessment. Even the original National Academy of Sciences Panel on the *Toxicological Effects*  
114 *of Methylmercury* conceded that full-IQ was not the most sensitive indicator of  
115 neurodevelopment.<sup>14</sup> In addition, neurodevelopmental impacts of methylmercury have more  
116 recently been documented at exposure levels below the reference dose established by the NRC  
117 Panel in 2000.<sup>15</sup> Similar to lead exposure, there is no evidence from epidemiological studies for a  
118 health effects threshold, below which neurodevelopmental effects do not occur.<sup>16, 17</sup> As a result,  
119 compared with EPA's regulatory assessment, a full quantification of the neurodevelopmental  
120 impacts of EGU mercury emissions would need to take into account both other kinds of fish  
121 consumption and effects other than reductions in IQ.

122 Many other benefits of regulating mercury emissions from EGUs have not been monetized on a  
123 national scale due to the heterogeneity in effects across ecosystems, lack of data, and challenges  
124 associated with monetization. These additional benefits include:

- 125 • Reductions in the deleterious impacts of methylmercury exposure on endocrine  
126 function,<sup>18</sup> risk of diabetes,<sup>19</sup> and compromised immune health.<sup>20</sup>
- 127 • Benefits to fish and wildlife, including sensitive bird species (songbirds, loons), marine  
128 mammals, fish, and amphibian populations threatened by high levels of mercury  
129 contamination in many U.S. ecosystems. Emerging research on the ecological impacts of  
130 methylmercury exposures indicates that adverse effects on the reproductive and  
131 behavioral health of wildlife populations occur at low levels of environmental  
132 exposure.<sup>21, 22</sup>



133 **3. Contributions of EGUs to locally deposited mercury have been underestimated by EPA's**  
134 **regulatory assessments.**

135 The regulatory assessment supporting MATS<sup>1</sup> also underestimates the benefits of reducing EGU  
136 mercury emissions because it underestimated the portion of those emissions that are deposited to  
137 the land and waters of U.S. ecosystems. Human and ecological health risks associated with  
138 utility-derived mercury emissions are greatest in regions that are most affected by locally  
139 deposited mercury. Some of the mercury emissions from EGUs are highly water-soluble and  
140 locally deposited while the rest are emitted to the atmosphere as a stable, long-lived species that  
141 is transported and distributed globally.

142 Benefits of MATS associated with declines in mercury deposition to U.S. ecosystems in the  
143 regulatory assessment were based on atmospheric modeling that suggested global (non-U.S.)  
144 anthropogenic sources would be most important for regional declines in deposition. However, for  
145 the past two decades, mercury researchers have noted slow and steady declines in atmospheric  
146 mercury concentrations in North America, Europe, and over the open oceans. Initial attempts to  
147 rationalize these observations from a scientific perspective were confounded by a commonly  
148 held (but incorrect) assumption among researchers that global mercury emission trends from  
149 anthropogenic sources were steady or increasing over this same time period. Zhang et al.<sup>23</sup>  
150 recently corrected an error in previous emissions inventories on the form of mercury released by  
151 EGUs over time. This correction helps enable global models to reproduce the observed declining  
152 atmospheric mercury trends and shows that local and regional mercury deposition to U.S.  
153 ecosystems is much more influenced by domestic actions than previously assumed.

154 Other new studies also support the premise that declining mercury emissions in the United States  
155 will substantially reduce mercury deposition and biological exposures in U.S. ecosystems and  
156 hence to U.S. populations. For example, several U.S. studies have measured substantial declines  
157 in domestic atmospheric and ecologic mercury concentrations attributable to reductions in  
158 mercury emissions from EGUs. Castro and Sherwell<sup>24</sup> observed declines in atmospheric mercury  
159 concentrations at a pristine site in Maryland downwind of power plants in Ohio, Pennsylvania,  
160 and West Virginia. Drevnick et al.<sup>25</sup> observed a mean ~20% decline in mercury accumulation in  
161 104 sediment cores from the Great Lakes regions attributable to domestic emissions reductions.  
162 Evers et al.<sup>26</sup> identified biological mercury hotspots in the northeastern United States driven  
163 mainly by U.S. domestic emissions. Similarly, Hutcheson et al.<sup>27</sup> noted declines in  
164 methylmercury concentrations in freshwater fish in the United States concurrent with domestic  
165 mercury emissions reduction. Cross et al.<sup>13</sup> report marked decreases in mercury in Atlantic  
166 coastal fisheries in response to decreases in mercury emissions.

167 Together, these new studies demonstrate that declines in mercury deposition to U.S. ecosystems  
168 and resulting human and ecological exposures have been underestimated by the 2011 regulatory  
169 impact assessment performed by EPA.

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