



## POLICY FORUM

The John E. Amos coal-fired power plant in West Virginia was retrofitted in response to Mercury and Air Toxics Standards.

### ENVIRONMENTAL ECONOMICS

# Deep flaws in a mercury regulatory analysis

The U.S. EPA ignores scientific evidence, economic best practice, and its own guidance

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**T**he U.S. Environmental Protection Agency (EPA) has proposed to roll back the legal basis of its Mercury and Air Toxics Standards (MATS), in part on the basis of a benefit-cost analysis (BCA) that is seriously flawed in three ways (1, 2). The analysis disregards economically important but indirect public health benefits, or “co-benefits,” in a manner inconsistent with economic fundamentals. It fails to account for recent science that identifies important sources of direct health benefits from the reduction of mercury emissions. And it ignores transformative changes in the structure and operations of the electricity sector over the past decade. These analytical shortcomings run counter to long-standing guidance for economic analysis from the U.S. Office of Management and Budget (OMB) and from the EPA itself. If finalized, the new rule will undermine continued implementation of MATS and set a concerning precedent for use of similarly inappropriate analyses in the evaluation of other regulations.

In 2012, the EPA issued MATS as the first federal regulatory limits on hazardous air pollution from coal-burning power plants. Now, as part of its new proposal, the EPA has produced a flawed analysis to argue that the benefits of reducing power plant emissions of mercury and other hazardous air pollutants (HAPs) do not justify the costs. It concludes that the original MATS rule was not “appropriate and necessary,” a legal requirement under the Clean Air Act. The proposal is not to revoke MATS itself, with which power plants have complied since 2016, but instead to remove the statutory basis of MATS. In effect, the new rule would reverse the EPA’s previously held findings in 2012 and 2016 and, as a consequence, invite legal challenges to MATS (3). The ultimate result is likely to be weaker regulations on mercury and other HAPs.

Beyond the specific implications for MATS, the supporting BCA marks a fundamental shift in how the EPA compares the costs and benefits of its actions. If finalized, it will set a precedent that undermines the EPA’s ability to appropriately compare the full set of costs and benefits of other regulations, both existing and new. The likely result will be weaker and inefficient regulations on many pollutants, not just mercury and other HAPs.

### THE ELIMINATION OF CO-BENEFITS

The EPA’s proposal to reverse its “appropriate and necessary” finding relies on a specious economic analysis that does not count co-benefits. Co-benefits arise when compliance with a regulation leads to reductions in some other pollutant that is not the regulation’s intended target. In the case of MATS, the activities that power plants undertake to reduce mercury and HAPs emissions (for example, switching to cleaner fuels or installing pollution control equipment) also reduce emissions and eventual pollution concentrations of harmful particulate matter. The vast majority of the economic benefits of MATS that the EPA quantified in its 2011 BCA were from reductions in particulate matter due to such expected compliance actions by power plants. Lower fine particulate matter concentrations produce health benefits such as reduced premature mortality and morbidity. The expected benefits ranged from \$33 billion to \$90 billion per year, easily exceeding the expected costs of \$9.6 billion (4).

The EPA’s move to disregard public health co-benefits—and reverse the conclusion of its 2011 BCA—is inconsistent with standard practice for economic analyses. BCAs should seek to account for all economic consequences of a regulation, relative to a baseline without the regulation. These include benefits and costs associated with changes in a directly targeted pollutant, as well as co-benefits or co-costs of changes in other pollutants. It is only through consistent and full recognition of all benefits and costs, including co-benefits and co-costs, that a BCA provides a comprehensive and transparent analysis to inform decision-making.

In cases in which a portion of the direct benefits are not (or cannot be) quantified, showing that even just the quantified co-benefits exceed the costs is sufficient to conclude that the regulation’s overall benefits exceed the costs. That is how the EPA approached its original analysis in 2011, and we find no basis for the agency’s reinterpretation of the same numbers now.

The EPA’s disregard of co-benefits conflicts with long-standing guidance from OMB on the conduct of BCAs and from the EPA’s own guidelines for economic analysis (5, 6). Both agencies have recognized the importance of including co-benefits in economic analyses of regulatory actions. Regarding MATS in particular, the OMB stated as recently as 2017 that particulate matter co-benefits “make up the majority of the monetized benefits, even though the

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regulation is designed to limit emissions of mercury and other hazardous air pollutants. The consideration of co-benefits, including the co-benefits associated with reduction of particulate matter, is consistent with standard accounting practices and has long been required" under OMB guidance (7).

### WHAT ABOUT DIRECT BENEFITS?

In its original, 2011 analysis, the EPA woefully undercounted direct health benefits of reducing mercury emissions, and recent research suggests that even by focusing exclusively on the direct impacts, the benefits of MATS could still exceed the costs. The entirety of the direct health benefits, \$0.5 million to \$6 million per year, were estimated through a single, narrowly defined impact and exposure pathway: changes to the IQs of children born to mothers who, when pregnant, ate freshwater fish caught by recreational fishers. To be fair to the EPA in 2011, the estimated co-benefits easily swamped the \$9.6 billion costs, so the agency might have thought it less critical to further quantify all of the difficult-to-measure direct benefits, and less was known about how to do so at the time.

Today, however, research has revealed more about the wider effects of how power-plant mercury emissions disperse and bioaccumulate in seafood that is consumed by a far greater portion of the population (8). This means that the EPA's most recent comparison of costs and benefits could have readily accounted for the additional and far more substantial exposure through freshwater and coastal commercial fisheries. But the agency chose not to quantify those direct benefits.

The EPA also fails to consider mercury's harmful effects on the human cardiovascular system, such as a greater likelihood of heart attacks. One recent study accounts for these impacts, along with a broader assessment of how consumers are exposed to mercury through food consumption. Although the estimates are not expressed on an annual basis to allow for direct comparison, the authors find that MATS will produce \$150 billion in cumulative health benefits through 2050, more than 90% of which comes from fewer heart attacks (9).

This evidence notwithstanding, the EPA today continues to rely exclusively on the narrow set of direct benefits monetized in 2011. By failing to quantify other direct benefits of mercury reductions, or even discuss research published since 2011, the EPA leaves open the question of whether it draws the right conclusion, even based on its own, inappropriately narrow criterion that excludes co-benefits.

### A LOT HAS CHANGED SINCE 2011

The EPA's continued reliance on outdated estimates made in 2011 about future U.S. electricity generation provides a misleading picture today about MATS costs and benefits. Although forecasting errors were to be expected when the EPA conducted its prospective analysis before MATS implementation, the EPA's new analysis ignores considerable and well-known evidence of major changes in the electricity sector that have occurred since then.

In 2011, the EPA predicted that roughly half of electricity generation in 2015 would come from coal and one-fifth from natural gas (4). The actual shares today are around one-third from coal and one-third from natural gas (3). This means that less of our electricity comes from mercury-emitting sources. Additionally, one-fifth of coal-fired capacity has been retired, and the plants still operating generate 30% less power than the EPA projected, primarily because of inexpensive natural gas and lower-than-expected power demand (10, 11). Fewer plants have incurred the costs to install pollution control equipment than expected, and those that did are incurring lower-than-expected costs for operations and maintenance. Indeed, the pollution control investments that have been made to comply with MATS are about half of what EPA projected in 2011.

The substantial shift away from coal-fired generation in the United States has also changed the baseline against which the benefits of MATS were estimated in 2011. Mercury emissions have fallen more than 80%, and sulfur dioxide emissions, a precursor to ambient particulate matter, have fallen more than 60% (3). The vast majority of these reductions have been due to market factors independent of MATS (10, 11), which means that the baseline scenarios used in 2011 to estimate MATS benefits were off by a wide margin.

Another big change since 2011, ignored in the EPA's most recent analysis, is that power plants began complying with the MATS rule in 2016. This means that the EPA now has access to 3 years of real-world data, rather than forecasts, with which to estimate the rule's costs and benefits. Nevertheless, the EPA has ignored these data, missing an opportunity to conduct a retrospective analysis—or to draw from related peer-reviewed retrospective analyses in the academic literature (10, 11)—that would more accurately inform policy-makers and the public. Instead, the EPA is continuing to rely on outdated forecasts that most likely overestimate both the costs and benefits, with ambiguous implications for the net result.

### EPA CAN AND SHOULD DO BETTER

The EPA's proposed MATS rule reverses its twice-held "appropriate and necessary" finding. Given the agency's U-turn on a finding of such importance, it should have provided supporting evidence that follows best practices and takes advantage of the best available science and most recent data. Yet, the EPA contravenes its own and OMB's guidance and ignores co-benefits, overlooks new research about the health consequences of mercury exposure, and relies on outdated 2011 projections of coal use and compliance costs.

The EPA can and should do better. No BCA is perfect because some impacts are difficult to quantify, and even the best forecasts are generally not completely accurate. But the EPA's original 2011 BCA in support of MATS represented a genuine and credible effort to quantify the expected costs and benefits, according to current data and science at the time. This stands in marked contrast to the EPA approach now. Until the time when a comparable effort is completed and the results can be reviewed, we find no defensible, economic basis for EPA's reversal of the "appropriate and necessary" finding. ■

### REFERENCES AND NOTES

1. EPA, Compliance Cost, HAP Benefits, and Ancillary Co-Pollutant Benefits for "National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units – Reconsideration of Supplemental Finding and Residual Risk and Technology Review" (EPA, 2018); [www.epa.gov/sites/production/files/2018-12/documents/mats-an-cost-benefit\\_memo12-2018.pdf](http://www.epa.gov/sites/production/files/2018-12/documents/mats-an-cost-benefit_memo12-2018.pdf).
2. EPA, *Fed. Regist.* **84**, 24 (2019); [www.govinfo.gov/content/pkg/FR-2019-02-07/pdf/2019-00936.pdf](http://www.govinfo.gov/content/pkg/FR-2019-02-07/pdf/2019-00936.pdf).
3. J. Aldy et al., Report on the Proposed Changes to the Federal Mercury and Air Toxics Standards. Report of the External Environmental Economics Advisory Committee (E-EEAC, 2019); [www.e-eaac.org/mats-report](http://www.e-eaac.org/mats-report).
4. EPA, Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards, EPA-452/R-11-011 (December 2011); [www3.epa.gov/tncas1/regdata/RIAs/matsriafinal.pdf](http://www3.epa.gov/tncas1/regdata/RIAs/matsriafinal.pdf).
5. OMB, Circular A-4: Regulatory Analysis (Executive Office of the President, 17 September 17, 2003); [www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A4/a-4.pdf](http://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A4/a-4.pdf).
6. EPA, *Guidelines for Preparing Economic Analyses, May 2014 Update* (EPA/National Center for Environmental Economics, 2014); [www.epa.gov/sites/production/files/2017-08/documents/ee-0568-50.pdf](http://www.epa.gov/sites/production/files/2017-08/documents/ee-0568-50.pdf).
7. OMB, *2017 Draft Report to Congress on the Benefits and Costs of Federal Regulations and Agency Compliance with the Unfunded Mandates Reform Act* (Executive Office of the President, 2017); [www.whitehouse.gov/wp-content/uploads/2017/12/draft\\_2017\\_cost\\_benefit\\_report.pdf](http://www.whitehouse.gov/wp-content/uploads/2017/12/draft_2017_cost_benefit_report.pdf).
8. E. M. Sunderland, M. Li, K. Bullard, *Environ. Health Perspect.* **126**, 017006 (2018).
9. A. Giang, N. E. Selin, *Proc. Natl. Acad. Sci. U.S.A.* **113**, 286 (2016).
10. J. Coglianese, T. D. Gerarden, J. H. Stock, *Energy J.* **41**, 55 (2019).
11. J. Linn, K. McCormack, *RAND J. Econ.* **50**, 733 (2019).

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