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An Evaluation of the Benefit-Cost Analysis in the 2020 Steam Electric Reconsideration Rule, 85 Fed. Reg. 64,650 (Oct. 13, 2020)

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I. Introduction

Under the Clean Water Act, the United States Environmental Protection Agency (EPA) is required to issue technology-based standards regulating discharges of pollutants from power plants such as toxic metals. EPA sets the standards by issuing "effluent limitation guidelines" that are based on the "best available technology economically achievable" (BAT) by the class of dischargers.[1] Since 1982, EPA has provided effluent standards for power plant discharges of total suspended solids, copper, oil and grease, and iron.[2] The standards set in 1982 were not updated until EPA revisited them over 30 years later.[3] In 2013, EPA found that steam electric power plants were discharging significant levels of other toxic metals in their waste streams, including arsenic, mercury, and selenium, largely due to increased use of air pollution control systems designed to control sulfur dioxide air emissions.[4] The toxic metals discharged in plants' wastewater had many harmful effects, such as lowering IQ in children, increasing cancer and

[1] 33 U.S.C. § 1311(b); *see also id.* § 1314(b)(2)(B).
[2] *See* Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category, 80 Fed. Reg. 67,838, 67,840-41 (Nov. 3, 2015) (to be codified at 40 C.F.R. pt. 423) (hereinafter "2015 Rule"); *see also* 40 C.F.R. § 423.12(b)(3)-(4).
[3] By 2013, the 1982 effluent standards were "out of date" as they did "not adequately control the pollutants (toxic metals and other) discharged by this industry" and did not reflect the "relevant process and technology advances that have occurred in the last 30-plus years." 2015 Rule, 80 Fed. Reg. at 67,840-41.
[4] *See* Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category, Proposed Rule, 78 Fed. Reg. 34,432, 34,439 (June 7, 2013).

cardiovascular risks, and poisoning wildlife such as fish and other aquatic organisms.[5] In 2015, EPA issued a final rule establishing technology-based limits on discharges of arsenic, mercury, selenium, and nitrogen (2015 Rule).[6]

Two waste limits are at issue in this rule: the effluent limitation guidelines for 1) flue gas desulfurization (FGD) wastewater and 2) bottom ash transport water. The first process occurs because some power plants use water to flush out sulfur-dioxide-laden waste products, rather than releasing the toxic gas into the air.[7] The second provides a means to dispose of heavy ash particles that fall to the bottom of a furnace: Most power plants quench the ash in water and subsequently flush the water out in what becomes bottom ash transport water.[8] The 2015 Rule regulated pollutants from both waste streams. For FGD wastewater, EPA established BAT effluent limits for mercury, arsenic, selenium, and nitrate, based on treatment of that wastestream with systems that combine chemical precipitation and biological treatment.[9] For bottom ash transport water, EPA established a zero-discharge BAT effluent limit based on conversion of that wastestream to a closed-loop or dry handling system.[10]

In 2017, EPA announced that it would reconsider the 2015 Rule and postpone the rule's compliance deadlines.[11] In 2019, EPA proposed a new rule that would relax several of the 2015 Rule's standards (2019 Proposed Rule).[12] In 2020, EPA finalized this weakened set of standards (2020 Rule) so that more pollutants would be discharged through both streams.[13]

Along with the 2020 Rule, EPA prepared a Benefit-Cost Analysis (BCA) to estimate the total monetary value of annualized costs and benefits when compared to a baseline that includes the 2015 Rule's promised improvements. In the BCA, the agency estimated that the benefits (minus the forgone benefits) would range from −$1.7 million to $43.3 million using a 3 percent discount rate and from $6.5 million to $45.9 million using a 7 percent discount rate.[14]

However, these estimates leave out a significant number of harms, including: 1) harms from additional bromide discharges, 2) harms to threatened and endangered species, 3) negative health effects associated with increases in adult exposure to lead or mercury, 4) negative effects associated with children's exposure to lead beyond compensatory education and earnings impact, (5) harms related to reuse of dry coal ash and decreased risks of impoundment release, and (6) harms of forgone climate benefits related to use of the Trump administration's interim social cost of carbon (SCC) value. Moreover, the agency repeatedly characterizes categories of harms as too

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[5] *See* 2015 Rule, 80 Fed. Reg. at 67,838.
[6] *See id.* at 67,840–41.
[7] *See id.* at 67,846.
[8] *See id.*
[9] *See id.* at 67,841, 67,850.
[10] *See id.* at 67,841, 67,849.
[11] *See* Letter from S. Pruitt to H. Johnson and M. Clark (Apr. 12, 2017), ROA Doc. No. 12849.
[12] *See* Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category, 84 Fed. Reg. 64,620 (Nov. 22, 2019) (to be codified at 40 C.F.R. pt. 423) (hereinafter "2019 Proposed Rule").
[13] *See* Steam Electric Reconsideration Rule, 85 Fed. Reg. 64,650 (Oct. 13, 2020) (to be codified at 40 C.F.R. pt. 423) (hereinafter "2020 Rule").
[14] *See id.* at 64,652.

"small" to merit quantification,[15] but it never performs an aggregate or holistic assessment of those harms across categories to determine if, in the aggregate, they could be substantial.

Longstanding White House guidance explains that agencies should assess "quantitative information" about a rule's impacts whenever possible[16]—and should provide "estimates of the probabilities of environmental damage to soil or water, the possible loss of habitat, or risks to endangered species as well as probabilities of harm to human health and safety."[17] If an agency cannot "express in monetary units all of the important benefits and costs," then it should carefully assess how "important the non-quantified benefits or costs may be in the context of the overall analysis," performing a detailed qualitative analysis where "the non-quantified benefits and costs are likely to be important" and affect the outcome of the agencies' decision.[18] As the guidance makes clear, where the unquantified costs or benefits are significant, the alternative that maximizes the quantified net benefits may not be the most socially desirable one.[19]

In this case, EPA failed to adequately provide quantitative estimates for numerous harms from these wastewater streams and drew conclusions about the rule's impacts that are undermined by a fair assessment of unquantified impacts. Given the significant number of forgone benefits that the agency left unquantified, it is likely that the agency undervalued the harms of the rule by a large amount. Thus, the unquantified forgone benefits would likely undermine the agency's decision to finalize the 2020 Rule. In such a case, it is imperative that the agency rethink its approach.

II. The 2020 Rule Is Based on Faulty and Incomplete Benefits Estimates That EPA Could Easily Amend by Applying Information That Is Already in the Rulemaking Record

A. EPA Arbitrarily Failed to Monetize or Quantify Several Benefit Categories

There are several categories of forgone benefits that the 2020 Rule irrationally ignored or failed to monetize, including benefits that the agency had previously monetized for the 2019 Proposed Rule.

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[15] ENVTL. PROT. AGENCY, BENEFIT AND COST ANALYSIS FOR REVISIONS TO THE EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE STEAM ELECTRIC POWER GENERATING POINT SOURCE CATEGORY 2-12 (2020) (hereinafter "2020 BCA"), *available at* https://www.epa.gov/sites/production/files/2020-08/documents/steam_electric_elg_2020_final_reconsideration_rule_benefit_and_cost_analysis.pdf ("Given . . . the small changes in the quantity of bottom ash handled wet . . . EPA did not quantify this benefit category."); *Id.* at 2-13 (justifying the lack of quantification of the impacts on irrigation in part due to the "small estimated changes in water quality"); *Id.* at 2-14 (justifying the failure to monetize impacts by citing the "small changes in fish landings" among other things); *Id.* at 2-15 (asserting that the impact on tourism of increasing pollutants will be "small").
[16] OFFICE OF MGMT. & BUDGET, CIRCULAR A-4: REGULATORY ANALYSIS 27 (2003) (hereinafter CIRCULAR A-4)
[17] *Id.* at 40.
[18] *Id.* at 2.
[19] *See id.*

1. Human Health Impacts: Drinking Water -- Bromides and Incidence of Bladder Cancer

Power plants discharge bromides (a type of halogen) into surrounding waters through both waste streams at issue here: bottom ash transport water and FGD wastewater.[20] Bromide reacts with chemicals used in drinking water treatment, producing several disinfectant byproducts with carcinogenic potential. These include brominated trihalomethanes and haloacetic acids.[21] Drinking water containing these harmful pollutants can lead to serious adverse human health effects, including bladder cancer.[22] As a result, decreasing bromide discharges can lower the production of disinfectant byproducts and reduce incidences of bladder cancer. While the 2015 rulemaking did not control bromide directly,[23] EPA acknowledged at the time that increasing concentrations of the chemical were negatively affecting downstream drinking water supplies and suggested additional controls might be warranted.[24]

In the 2019 proposal to reconsider the 2015 rulemaking, EPA examined how changes in bromide levels could reduce the incidence of bladder cancer and monetized the benefits using cost-of-illness and value of a statistical life methods.[25] The agency also stated that it intended to submit its analysis of the relationship between bromides and bladder cancer to peer review "[s]hould this analysis be used to justify an economically significant rulemaking."[26] EPA indicated that it might seek a review from the agency's Science Advisory Board if the analysis was designated a "highly influential scientific assessment" or HISA.[27]

Following the proposal, in the 2020 rule, EPA abandoned that monetization and instead provided only a qualitative discussion of changes in human health effects associated with exposure to halogenated disinfection byproducts via drinking water.[28] As a result of not monetizing this category, millions of dollars of forgone benefits were left out of the cost-benefit analysis.[29]

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[20] *See* ENVTL. PROT. AGENCY, BENEFIT AND COST ANALYSIS FOR PROPOSED REVISIONS TO THE EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE STEAM ELECTRIC POWER GENERATING POINT SOURCE CATEGORY at 4-1 (2019) (hereinafter "2019 BCA"), *available at* https://www.epa.gov/sites/production/files/2019-11/documents/steam-electric-proposed-benefit-cost-analysis_nov-2019.pdf
; *see also* ENVTL. PROT. AGENCY, SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT FOR REVISIONS TO THE EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE STEAM ELECTRIC POWER GENERATING POINT SOURCE CATEGORY 2-5 (2020) (hereinafter "Supplemental EA"), *available at* https://www.regulations.gov/document/EPA-HQ-OW-2009-0819-9012 (note that Bromides are a component of the "total dissolved solids" produced from flue gas desulfurization).
[21] *See* Stig Regli et al., *Estimating Potential Increased Bladder Cancer Risk Due to Increased Bromide Concentrations in Sources of Disinfected Drinking Waters*, 49 ENVTL. SCI. TECH. 13,094, 13,094 (2015).
[22] *See* 2019 BCA at 2-5; *see also* Supplemental EA at 2-5-2-6.
[23] *See* 2015 Rule, 80 Fed. Reg. at 67,886.
[24] *See id.*
[25] *See* 2019 BCA at 2-5.
[26] *Id.* at 4-3.
[27] *Id*.
[28] *See* ENVTL. PROT. AGENCY, BENEFIT AND COST ANALYSIS FOR REVISIONS TO THE EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE STEAM ELECTRIC POWER GENERATING POINT SOURCE CATEGORY 4-1 (2020) (hereinafter "2020 BCA"), *available at* https://www.epa.gov/sites/production/files/2020-08/documents/steam_electric_elg_2020_final_reconsideration_rule_benefit_and_cost_analysis.pdf.
[29] *See* 2019 BCA at 4-18.

EPA's rationale for abandoning the monetization performed in 2019 was that the agency "received public comments that further evaluation of certain [disinfection byproducts] should be completed and that the analysis at proposal should be subject to peer review;" the agency concluded that an additional peer review, "should be conducted."[30] At present, it does not appear that EPA has begun this process, since the bromide analysis is not listed on the agency's peer review agenda.[31]

As a preliminary matter, there is work that the agency should do to bolster its assessment of the impact of bromides emissions in the 2019 Proposed Rule. For example, EPA neglected to consider benefits from fewer violations of drinking water standards for trihalomethanes and the costs downstream water utilities would incur from increased bromide loads.[32] It also failed to quantify a number of known health effects from pollutants in these wastewater discharges, such as lead pollution's effects on children's birth weight, growth, and development.[33] In fact, the agency did not include the carcinogenic risks of any pollutants other than bromide and arsenic, even though many of the pollutants subject to the regulation are known carcinogens.[34]

In any event, the fact that further analysis would be useful does not bar the agency from including monetized estimates of bromide's health effects in the 2020 Rule. Nor is the agency obligated to conduct an additional peer review of its bromide modeling. Under an Office of Management Budget (OMB) Bulletin from 2005, agencies are required to conduct a formal peer review for HISAs only, though they are advised to engage in some type of review for other important scientific analyses.[35] An assessment may qualify as a HISA if 1) it could have a potential impact of more than $500 million in any year, or 2) is novel, controversial, or precedent-setting or has significant interagency interest.[36] Exceptions to these requirements exist for scientific information that involves time-sensitive health and safety determinations [37]

Aside from these guidelines, agencies have broad discretion to use various peer review methods depending on the type of scientific analysis at issue and its importance to a rulemaking. In deciding what type of peer review is necessary, agencies may give "due consideration to the novelty and complexity of the science to be reviewed, the relevance of the information to decision making, the extent of prior peer reviews, and the expected benefits and costs of additional review."[38] As the OMB bulletin notes, the data and models typically used in scientific

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[30] 2020 BCA at 2-5.
[31] *See Peer Review Agenda*, ENVTL. PROT. AGENCY, https://cfpub.epa.gov/si/si_public_pr_agenda.cfm (last visited Mar. 7, 2021).
[32] *See* American Water Works Association, Comment Letter on Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category5-6 (Jan. 21, 2020).
[33] *See* Earthjustice, Environmental Integrity Project, Sierra Club, Clean Water Action, Natural Resources Defense Council, Waterkeeper Alliance, Southern Environmental Law Center, and Center for Biological Diversity, Comment Letter on Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category 113 (Jan. 21, 2020).
[34] *See id.* at 114.
[35] *See* OFFICE OF MGMT. & BUDGET, FINAL INFORMATION QUALITY BULLETIN FOR PEER REVIEW 2 (2005), *available at* https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2005/m05-03.pdf.
[36] *See id*. at 39.
[37] *See id.* at 2.
[38] *Id.* at 12.

assessments have already undergone some type of peer review.[39] The agency may therefore take these earlier reviews into account when considering whether further checks are necessary.

During the notice and comment period for the 2019 Proposed Rule, EPA received comments from the American Water Works Association claiming that the bromide analysis qualified as a HISA and was thus required to undergo a separate peer review.[40] But EPA's bromide modeling does not trigger the requirement for peer review. The bromide analysis, taken alone, does not have an impact of over $500 million per year, nor is it novel, controversial, precedent-setting, or the subject of significant agency interest.

While the overall costs of the regulatory options analyzed in the 2020 Rule exceed the $500 million threshold in some years,[41] bromide controls are not the sole basis for these expenses. Bromide is just one of 31 pollutants present in the wastewater discharges at issue in this rule.[42] Others include metals like arsenic, mercury, and selenium, non-metal compounds like chloride, fluoride, and sulfates, and conventional pollutants like oil and grease.[43] As explained in the technical documents supporting the 2020 Rule, the same treatment technique that removes bromides is also used to remove these other pollutants.[44] Should a facility install membrane filtration to meet EPA's BAT for FGD wastewater, the controls will remove arsenic, mercury, total dissolved solids, nitrates, and selenium in addition to bromides.[45] EPA's analysis of bromide's health effects is not responsible for imposing more than $500 million in costs. Bromide reductions would be simply one of a series of effects that form the basis for the regulation. There are also reasons to suspect that EPA's calculations overestimated the compliance costs for utilities, which exceed the $500 million threshold for only one year under each regulatory option.[46]

Nor is EPA's bromide analysis clearly novel, controversial, precedent-setting or subject to significant interagency interest. Researchers have investigated the connection between disinfectant byproducts and bladder cancer for decades.[47] Using these studies, EPA was able to

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[39] *See id.* at 11.
[40] *See* American Water Works Association, Comment Letter on Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category7 (Jan. 21, 2020).
[41] *See* 2020 BCA at 12-3.
[42] *See* ENVTL. PROT. AGENCY, SUPPLEMENTAL TECHNICAL DEVELOPMENT DOCUMENT FOR REVISIONS TO THE EFFLUENT GUIDELINES AND STANDARDS FOR THE STEAM ELECTRIC POWER GENERATING POINT SOURCE CATEGORY 6-7 (2020), *available at* https://www.epa.gov/sites/production/files/2020-08/documents/steam_electric_elg_2020_final_reconsideration_rule_supplemental_technical_development_document_0.pdf
[43] *See* ENVTL. PROT. AGENCY, REGULATORY IMPACT ANALYSIS FOR THE PROPOSED REVISIONS TO THE EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE STEAM ELECTRIC POWER GENERATING POINT SOURCE CATEGORY (RIA) B-2 (2020), *available at* https://www.epa.gov/sites/production/files/2020-08/documents/steam_electric_elg_2020_final_reconsideration_rule_regulatory_impact_analysis.pdf.
[44] *See id.* at 8-1 (techniques for removal include membrane, electrochemical and adsorptive techniques).
[45] *See id.* at 8-9.
[46] *See id.* at 23 (presenting several ways EPA inflated its cost estimates of membrane technology).
[47] *See generally* WATER RESEARCH FOUNDATION & AMERICAN WATER WORKS ASSOCIATION, EVIDENCE FOR ASSOCIATION OF HUMAN BLADDER CANCER WITH CHLORINATION DISINFECTION BY-PRODUCTS (2015) (discussing the extensive research on the role of brominated compounds in production of carcinogenic disinfectant byproducts). *See also* Steve E. Hrudey et al., *Evaluating Evidence for Association of Human Bladder Cancer with Drinking-Water Chlorination Disinfection By-Products*, 18 J. TOXICOLOGY ENVTL. HEALTH 213, 216 (2015).

quantify the benefits from reducing bladder cancers caused by disinfectant byproducts to support drinking water regulations for these chemicals in 2005.[48] In its 2019 cost-benefit analysis quantifying the value of reducing bromide discharges, EPA stated that its method directly "builds on the approach the Agency previously used to analyze the effects of the Stage 2 Disinfectants and Disinfection Byproduct Rule" from 2005.[49] It uses additional data from a peer-reviewed 2015 study that broadened the 2005 rule's analysis "to derive a slope factor to relate changes in lifetime bladder cancer risk to changes in TTHM [total trihalomethane] exposure."[50] EPA noted that the 2015 paper employed "many of the methodological components" from the studies used for the 2005 rulemaking.[51] In addition, EPA obtained more recent data from the National Cancer Institute to model instances of bladder cancer based on risk factors like age, an approach "widely used" in "public health, insurance, [and] medical research," and in many EPA and OSHA rulemakings.[52]

In that 2019 analysis, EPA then applied its model to the four regulatory options under consideration.[53] It found that Option 4 (labeled Option C in the 2020 Rule)—the option that would have required membrane filtration, a technology necessary for controlling bromide emissions[54]—produced the most net benefits, at over $84 million per year using a 3% discount rate. According to EPA's estimates, Options 2 (labeled Option A in the 2020 Rule) and Option 3 (labeled Option B in the 2020 Rule) would produce about $38 million and $43 million in benefits at a 3% discount rate, respectively.[55]

As Table 1 demonstrates, if EPA had included those 2019 quantified health benefits from bromide reductions in its final analysis for the 2020 Rule, Option C (labeled Option 4 in the 2019 BCA) would have had nearly the same total benefits or even greater total benefits than the option EPA selected, Option A. EPA should include these estimated benefits in any further rulemaking concerning these effluent guidelines.

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[48] *See* National Primary Drinking Water Regulations: Stage 2 Disinfectants and Disinfection Byproducts Rule, 71 Fed. Reg. 387, 444-45 (to be codified at 40 C.F.R. pts. 6, 141, 142) (Jan. 6, 2006).
[49] *See* 2019 BCA at 4-2.
[50] *Id.*
[51] *Id.*
[52] *Id.*
[53] *See id.* at 4-17.
[54] *See* Earthjustice, Environmental Integrity Project, Sierra Club, Clean Water Action, Natural Resources Defense Council, Waterkeeper Alliance, Southern Environmental Law Center, and The Center for Biological Diversity, Comment Letter on Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category 27 (Jan. 21, 2020).
[55] *See* 2019 BCA at 4-18.

Table 1: Bromides Benefits Estimates

	Option A (chosen in 2020)/ Option 2 (proposed 2019)	Option B (2020)/ Option 3 (2019)	Option C (2020)/ Option 4 (2019)
2020 BCA Total Benefits[56]	-1.7 to 43.3	.3 to 35.7	-12.4 to -13.4
2019 BCA Bromide Benefits[57]	37.61	42.57	84.32
2020 Total Benefits including quantified bromide benefits	35.91 to 80.9	42.87 to 78.27	70.92 to 71.92

All numbers are in 2018 millions and using a 3% discount rate.

Finally, there is no evidence to suggest that other government agencies are concerned about modeling bromides' contribution to disinfectant byproducts in wastewater. For these reasons, EPA's bromide analysis does not fall under OMB's second category for a HISA. It is therefore subject only to OMB's standards for general scientific assessments, which affords the agency broad discretion in choosing which studies to rely on for its regulations.

As discussed above, EPA's 2019 analysis of bromide's impact on bladder cancer is based on well-established scientific methods and peer-reviewed publications, many of which were used in the 2005 drinking water regulation for disinfectant byproducts. OMB's 2005 bulletin specifies that "agencies need not have further peer review conducted on information that has already been subjected to adequate peer review."[58] Prior peer reviews through traditional scientific journal publication can meet this standard, and the agency may opt not to pursue additional feedback given the time and resources involved.[59] It was thus well within the agency's discretion to use these studies and its modeling of bromide's impact on bladder cancer in the cost-benefit analysis of the 2020 final rule without going through a supplemental layer of peer review.

Furthermore, EPA's own Guidelines for Preparing Economic Analyses make clear that peer review is not necessarily a prerequisite to using a study to assess the costs and benefits of a rulemaking.[60] Indeed, meta-analysis guidance provides a process for using studies that are both peer reviewed and not peer reviewed.[61]

In any further rulemaking concerning these effluent guidelines, EPA should follow the same steps it followed in the 2019 analysis to monetize the benefits of bromide reductions on bladder cancer in revisiting controls on bottom ash transport and FGD wastewater. It should 1)

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[56] *See* 2020 BCA at 4.
[57] *See* 2019 BCA at 4-18.
[58] OFFICE OF MGMT. & BUDGET, FINAL INFORMATION QUALITY BULLETIN FOR PEER REVIEW 37 (2005), *available at* https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2005/m05-03.pdf.
[59] *See id.*
[60] *See* ENVTL. PROT. AGENCY, GUIDELINES FOR PREPARING ECONOMIC ANALYSES 7-45 – 7-46 (2010), *available at* https://www.epa.gov/sites/production/files/2017-08/documents/ee-0568-50.pdf.
[61] *See generally* MICHAEL BORENSTEIN, LARRY V. HEDGES, JULIAN P. T. HIGGINS & HANNAH R. ROTHSTEIN, INTRODUCTION TO META-ANALYSIS (2011).

examine bromide concentrations in effluents; 2) determine how many disinfectant byproducts are likely to be produced from reactions between bromides and water treatment chemicals; 3) assess the population likely to be exposed to the resulting disinfectant byproducts; 4) calculate the change in bladder cancer incidence; and 5) determine the value of the health benefits from bromide regulations using cost-of-illness and value of statistical life methods.[62]

2. Human Health Impacts: Fish Consumption -- Incidence of Cardiovascular Disease

The power plants at issue in the 2020 Rule discharge lead into surrounding waters. That lead can be consumed by fish and then consumed by human adults. Exposure to lead in adults can cause an increase in instances of cardiovascular disease and other adverse health effects.[63] Despite this known pathway, EPA decided not to quantify or monetize the forgone benefits of the increased lead discharges in the 2020 Rule, claiming that the "relationship between lead exposure to cardiovascular mortality is evolving and scientific questions remain."[64] The agency did not otherwise go into detail with the specific inadequacies of the research in this area.

This decision arbitrarily ignored the underlying data in the record. EPA was previously able to monetize the benefits of reducing the lead discharges in this rule. In the 2015 Rule, the agency used the value of a statistical life method to monetize this benefit. EPA then aggregated the resulting gains in life expectancy to represent the total magnitude of the expected human health benefits for each regulatory option. EPA relied on a population life model that estimates the gains in life years due to decreased risk of cardiovascular disease mortality from reductions of lead through fish consumption[65] and monetized benefits by applying a constant value per statistical life to the estimated number of premature deaths avoided in each analysis year.[66] EPA estimated the annualized benefits from the regulatory option it selected to be $12.8 million at a 3% discount rate.[67] Regardless of any scientific questions that remain, the value of preventing the harms from lead exposure through this pathway is "certainly not zero" as the EPA assumes in the 2020 Rule.[68]

3. Ecological and Recreational Impacts: Changes in Threatened and Endangered Species Habitat and Potential Effects on Threatened and Endangered Species Populations

Power plants discharge harmful chemicals such as selenium, arsenic, and mercury that affect the reproductive rates and mortality of threatened and endangered species. Consequently,

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[62] *See* 2019 BCA at 4-4.
[63] *See* 2020 BCA at 5-16; Supplemental EA at A-4.
[64] 2020 BCA at 2-6.
[65] ENVTL. PROT. AGENCY, BENEFIT AND COST ANALYSIS FOR THE EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE STEAM ELECTRIC POWER GENERATING POINT SOURCE CATEGORY 3-10 (2015) ("2015 BCA"), *available at* https://www.epa.gov/sites/production/files/2015-10/documents/steam-electric_benefit-cost-analysis_09-29-2015.pdf.
[66] *See id.*
[67] *See id.* at 3-14.
[68] *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin*, 538 F.3d 1172, 1200 (9th Cir. 2008) (holding that the record did not support the agency's "conclusion that the appropriate course was not to monetize or quantify the value of carbon emissions reduction at all").

pollutant discharges from power plants can either lengthen population recovery time or hasten the demise of these species. While the 2015 Rule monetized the benefit of avoiding these harms using a benefit transfer approach, the 2020 Rule declined to do a similar analysis to assess the forgone benefits, essentially valuing the increased harms at zero.

The decision to value those harms at zero is arbitrary. The agency claims that it could not monetize the effects "due to challenges in quantifying the response of threatened and endangered populations to changes in water quality conditions."[69] But in 2015, EPA was able to estimate the probability that individual threatened and endangered species could benefit from the final regulations. In the 2015 Rule, EPA compiled data on locations of steam electric power plants and receiving waterbodies.[70] For each species, EPA "estimated the magnitude of potential benefits by identifying inhabited waterbodies likely to meet AWQC [ambient water quality criteria] for aquatic life" based on the final effluent standards and then compared these areas to the overall habitat occupied by threatened and endangered species.[71] In the 2015 Rule, EPA had a way of handling data limits. In that rule, the agency stated that it could not "identify data sufficient to explicitly model population growth rates as a function of water quality for any of these species."[72] But rather than abandoning any attempt to quantify the impacts, EPA identified a "fraction of the inhabited waterbodies that meet wildlife [ambient water quality criteria] as a consequence" of the 2015 Rule.[73] EPA then monetized the benefits by 1) quantifying the impacts of pollutant discharges from steam electric power plants on threatened and endangered species and estimating the change in these impacts as a consequence of reducing steam electric discharges, and 2) estimating an economic value of improving these species' habitats and populations as a consequence of regulation.[74] To estimate the potential value of increasing their populations, EPA then used a benefit transfer approach based on a meta-analysis of 31 stated preference studies eliciting willingness-to-pay for changes in threatened and endangered species.[75]

In the 2020 Rule, EPA admits that it knows of many studies that calculate values that people place on avoiding species loss.[76] But it then summarily refuses to use many of its own prior estimates about the response of threatened and endangered species populations to changes in water quality conditions.[77] EPA makes no attempt to reconcile its new inability to estimate impacts on the relevant species with its prior ability to do so.

Moreover, EPA's analysis leaves out two other important impacts, which should be considered in any future rulemaking. First, the 2020 analysis includes only species that have been listed as threatened or endangered.[78] But there are currently more than 550 species awaiting

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[69] 2020 BCA at 2-10, 7-6.
[70] *See* 2015 BCA at 5-9 – 5-10.
[71] *Id.* at 5-4.
[72] *Id.*
[73] *Id.*
[74] *See id.* at 5-5.
[75] *See id.*
[76] *See* 2020 BCA at 2-10, 7-6.
[77] *See id.* at 2-10.
[78] *See id.* at 7-3.

consideration for listing under the Endangered Species Act.[79] Those species are divided up into categories, indicating the amount of information that is currently available and the critical status of the species. The top two categories are: "Highest Priority: Critically Imperiled" and "Strong Data Available on Species' Status." Both categories include species that are either critically imperiled or species where the data is available to list the species. EPA could certainly conduct an analysis similar to the one it completed in 2015 in order to model the impact of the discharges at issue on species in those two categories.

Second, the agency's analysis assumes that a threatened and endangered species will be harmed only if the 2020 Rule causes a particular water body to exceed the National Recommended Water Quality Criteria.[80] But the agency acknowledges that there could be adverse health consequences below that threshold.[81] EPA thus failed to take into account the fact that critically imperiled species could be harmed by pollution that does not exceed a particular National Recommended Water Quality Criteria.

4. Market and Productivity Effects: Marketability of Coal Ash for Beneficial Use

In the 2015 Rule, EPA found that the rule would encourage "plants to convert from wet handling of fly ash, bottom ash, and/or FGD waste to dry handling."[82] Compared to wet ash, dry ash's chemical and physical properties make it more suitable for re-use, such as being used as a substitute for sand and gravel in structural fill and concrete.[83] There are economic productivity benefits from plants avoiding costs associated with disposing of the ash as waste and avoiding the cost and life-cycle effects associated with displaced material.[84]

The 2015 Rule quantified and monetized benefits for the marketability of coal ash for beneficial use.[85] The 2015 Rule used avoided disposal costs, avoided raw material costs, and life-cycle production impacts (e.g.: environment impacts) to quantify and monetize this benefit category.[86] EPA in particular analyzed "the tonnage of fly and bottom ash handled dry instead of wet, with benefits derived from plants avoiding certain costs associated with disposing of the ashes as waste and society or users of the ash avoiding the cost and lifecycle effects associated with the displaced virgin material."[87] EPA performed a thorough analysis of this benefit category in the 2015 Rule[88] and promised $30 million in net benefits for the selected alternative (Option D).[89]

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[79] *See Listing and Critical Habitat: Listing Workplan Prioritization*, FISH & WILDLIFE SERVICE, https://www.fws.gov/endangered/what-we-do/listing-workplan-prioritization.html (last visited Mar. 20, 2021).
[80] *See* 2020 BCA at 2-10 (assuming that the "NRWQC are set at levels to protect aquatic organisms"); 7-4 (looking at which water bodies exceeded the NRWQC).
[81] *See* 2020 BCA at 7-7.
[82] 2015 BCA at 10-1.
[83] *See id*.; 2020 BCA at 2-11.
[84] *See id.*
[85] *See* 2015 BCA at 2-9.
[86] *See id.* at 2-2, 2-15.
[87] *Id*. at 2-9.
[88] *See id*. at 10-1 – 10-10.
[89] *See id.* at 10-10.

In the 2020 Rule, EPA acknowledges that its chosen option will increase the amount of ash that would be handled wet rather than dry, but it does not quantify the forgone benefits on this front. To justify that decision, the agency points to the small increase in how much bottom ash would be handled wet and the uncertainty surrounding the relevant numbers.[90]

But given the thorough analysis in the 2015 Rule, the uncertainty that the 2020 Rule cites is overstated. Indeed, the 2015 Rule specifically noted uncertainties and limitations associated with the quantification and monetization analysis.[91] Even with those limitations, EPA was able to make reasonable assumptions in order to quantify and monetize this benefit.

In the 2020 Rule, EPA does quantify some key values, such as the increase in how much bottom ash would be handled wet (246,871 tons per year at five plants[92]). Like it did in the 2015 Rule, EPA could monetize and quantify the forgone benefits in this category and supplement it with a description of remaining uncertainties and limitations, rather than assigning it effectively zero value in its numerical analysis.[93] And even if EPA is correct that the change is "small," small estimations could potentially build up across the benefit categories. The exclusion of a monetization and quantification analysis here thus contributes to an inaccurate conclusion that the rule is cost-benefit justified.

5. Market and Productivity Effects: Impoundment Release

For plants that use wet handling of fly and bottom ash, waste is often flushed to surface impoundments (such as settling ponds), where solids settle out of the water.[94] Impoundments typically contain water with high concentrations of pollutants, including dissolved metals.[95] Benefits arising from the reduced risk of impoundment releases include avoided cleanup costs, environmental damage, and transaction costs.[96]

The 2015 Rule featured a section on the benefits from lowering the risk of impoundment releases, and the rule promoted decreased reliance on impoundments to handle coal combustion residuals (CCR). EPA quantified and monetized these benefits in the 2015 Rule based on expected future impoundment release rates, the volumes of CCR that would be released in an incident, the costs of cleanup, natural resource damages, and transaction costs.[97] It ultimately found that total benefits of Option D (the chosen option) range from $95.6–102.9 million using the 3% discount rate.[98]

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[90] *See* 2020 BCA at 2-12; 2019 BCA at 2-10.
[91] *See* 2020 BCA at 10-10 – 10-11.
[92] This is a slight decrease from their estimation in the 2019 Proposed Rule of 310,671 tons per year at 20 plants. *See* 2019 BCA at 2-10.
[93] *See CBD v. NHTSA*, 538 F.3d 1172, 1200 (9th Cir. 2008) ("NHTSA insisted at argument that it placed no value on carbon emissions reduction rather than zero value. We fail to see the difference.").
[94] *See* 2015 BCA at 2-9.
[95] *See id.*
[96] *See id.*
[97] *See id.* For the details of this analysis, *see id.* at 6-1 – 6-13.
[98] *See id.* at 6-13 (table 6-10).

This benefit category does not appear in the 2020 Rule or 2019 Proposal at all. EPA appears to assume that as a result of the Coal Combustion Residuals Rule, there are no open impoundments left to consider.[99] But the conclusion that the Coal Combustion Residuals Rule completely addresses the risk on this front is left unsupported. Without an analysis and confirmation about the impact of the Coal Combustion Residuals Rule, the assumptions on this issue are unreasonable.

B. EPA Arbitrarily Changed Its Methodology When Calculating the Impact of Rising Carbon Dioxide Emissions in the 2020 Rule

EPA's calculations of the benefits from reducing carbon dioxide (CO_2) emissions shifted across the 2015 Rule, 2019 Proposed Rule, and 2020 Rule, because of changes in either the methodological technique or underlying numerical assumptions. Many of these adjustments had the effect of decreasing the apparent benefits associated with the 2015 Rule, causing the laxer standards of the 2020 Rule to artificially appear cost-benefit justified.

CO_2 is a greenhouse gas that endangers public health and welfare through its contribution to climate change.[100] Climate change is expected to affect agricultural productivity and human health, create property damage from increased flood risk, and affect energy costs (such as increased costs for air conditioning).[101] In the 2015 Rule, EPA used the SCC developed by the Interagency Working Group on Greenhouse Gases[102] to calculate the benefits of reducing CO_2. But in the 2020 Rule the agency used a new "interim" figure it claimed reflected the domestic-only impacts of carbon emissions.[103] That interim figure decreases the social cost of carbon by more than 85%[104] and has since been abandoned by the Biden administration.[105] Without that severe reduction, the analysis would likely have shown clear net harms, as indicated by EPA's own analysis provided in an Appendix.[106]

EPA inappropriately relied on the Trump-era "interim" number to calculate the forgone climate harms of the rule. As a federal court recently found, that number was "riddled with flaws" and ignored "impacts on 8 million United States citizens living abroad, including thousands of United States military personnel; billions of dollars of physical assets owned by United States companies abroad; United States companies impacted by their trading partners and suppliers abroad; and global migration and geopolitical security."[107] The number relied on

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[99] *See* 2020 BCA at 1-2, n. 2.
[100] *See* 2020 BCA at 2-16.
[101] *See id.*
[102] *See* 2015 BCA at 7-7.
[103] *See* 2020 BCA at 8-6.
[104] *Compare* 2020 BCA at 8-7 ($8 social cost of carbon in 2030, in 2018$ and discounted at 3 percent) *with* 2015 BCA at 7-9 ($55 social cost of carbon in 2030, in 2013$ and discounted at 3 percent).
[105] Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990 (Feb. 2021), https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf.
[106] *Compare* 2015 BCA Appendix I at 5-6 (reporting forgone climate benefits based on the IWG's number of $110 million in 2025 and $190 million in 2045 at a 3% discount rate) *with* 2020 BCA ES-4-ES-5 (reporting total annualized net benefits for the entire rule using the Trump-era "interim" estimate of -1.7 to $43.3 million).
[107] *See California v. Bernhardt*, 472 F. Supp. 3d 573, 614 (N.D. Cal. 2020), appeal filed (9th Cir. No. 20-16793).

models never built for the purpose of calculating regional damages[108] and failed to reflect international spillovers to the United States,[109] U.S. benefits from foreign reciprocal actions,[110] or the extraterritorial interests of U.S. citizens, including financial interests[111] and altruism.[112]

The Trump-era "interim" number led to severe undercounting. As Table 2 below shows, using the Interagency Working Group's numbers, Option C would have had substantially more total benefits from carbon reductions than Option A.

Table 2: Impact of Differing Social Cost of Carbon Estimates on Total Benefits Estimates

	Option A (chosen)	Option B	Option C
Total Benefits in 2020 Rule[113]	-1.7 to 43.3	.3 to 35.7	-12.4 to -13.4
Total Benefits with IWG's Estimates[114]	-103.9 to -58.9	-80 to -44.6	3.4 to 4.4

All numbers are in 2018 millions and using a 3% discount rate.

The Biden administration has reestablished the Interagency Working Group and announced that the administration will now use the estimates developed prior to 2017, adjusted

[108] An examination of the individual models used by the agency to calculate the domestic social cost of carbon—PAGE 2009, FUND 3.8, and DICE 2010—highlights the current limitations to calculating a domestic value of the social cost of greenhouse gases. The author of DICE 2010 has explicitly warned against using a domestic-only value. *See* William D Nordhaus, *Revisiting the Social Cost of Carbon*, 114 PROC. NAT'L ACAD. SCI. 1518, 1522 (2017).

[109] Economic disruptions in one country can cause financial crises that reverberate globally. *See* Steven L. Schwarcz, *Systemic Risk*, 97 GEO. L.J. 193, 249 (2008). As climate change disrupts the economies of other countries, decreased availability of imported inputs, intermediary goods, and consumption goods may cause supply shocks to the U.S. economy, and the U.S. economy could further experience demand shocks as climate-affected countries decrease their demand for U.S. goods. The human dimension of climate spillovers includes migration and health effects.

[110] Because greenhouse gas pollution does not stay within geographic borders but rather mixes in the atmosphere and affects climate worldwide, each ton emitted by the U.S. not only creates domestic harms, but also imposes large externalities on the rest of the world. Conversely, each ton of greenhouse gases abated in another country benefits the U.S. along with the rest of the world. The U.S. stands to gain hundreds of billions of dollars in direct benefits from efficient foreign action on climate change. *See* INST. FOR POL'Y INTEGRITY, FOREIGN ACTION, DOMESTIC WINDFALL: THE U.S. ECONOMY STANDS TO GAIN TRILLIONS FROM FOREIGN CLIMATE ACTION (2015), *available at* http://policyintegrity.org/files/publications/ForeignActionDomesticWindfall.pdf.

[111] A domestic-only estimate based on some rigid conception of geographic borders or U.S. share of world GDP will fail to capture all the climate-related costs and benefits that matter to U.S. citizens, including significant U.S. ownership interests in foreign businesses, properties, and other assets, the benefits to the 8.7 million Americans living abroad, as well as consumption abroad including tourism. *See* David A. Dana, *Valuing Foreign Lives and Civilizations in Cost-Benefit Analysis: The Case of the United States and Climate Change Policy* (Northwestern Univ. Sch. L., Working Paper No. 196, 2009); *see also* Association of Americans Resident Overseas, *8.7 million Americans (excluding military) live in 160-plus countries*, AMERICANS HELPING AMERICANS ABROAD, https://www.aaro.org/about-aaro/8m-americans-abroad (last visited Mar.. 20, 2021).

[112] Circular A-4 recognizes that U.S. citizens may have "altruism for the health and welfare of others," and instructs agencies that when "there is evidence of selective altruism, it needs to be considered specifically in both benefits and costs." Circular A-4 at 22.

[113] *See* 2020 BCA at 4.

[114] These calculations are based on a 7.3 conversion rate, which was obtained from the RIA by comparing the global figures presented on pages I-5 and I-6 with those presented in Table 8.7, and is a best estimate given available information. *See* 2020 BCA at I-5 and I-6.

for inflation, which are in line with the number that EPA used in the 2015 Rule.[115] The administration also intends to update the estimates "to better reflect the recent science" and will be seeking public comment on that update.[116] In light of these updates, the agency's failure to follow the best available science in estimating the impact of the 2020 Rule is a serious error.

Conclusion

With just two of the changes discussed in this report—on the social cost of carbon and bromides—Option C, a more protective option, promises net benefits. Quantifying these benefits is possible and straightforward, as EPA already did so for the 2015 Rule. By failing to quantify the bromides impacts and undercounting the climate change harms, EPA failed to provide an adequate analysis of the harms (in the form of forgone benefits) of the 2020 Rule. Incorporating these impacts into its analysis would allow the agency to give appropriate weight to the harms of the climate change impacts at issue in the rule, consistent with President Biden's intention to take a "government-wide approach to the climate crisis" as laid out in Executive Order 14008.[117] Additional changes, such as quantifying health and environmental benefits from reductions in pollutants like mercury and lead, would not be difficult to complete and would materially improve the BCA.

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[115] *See* The White House, *A Return to Science: Evidence-Based Estimates of the Benefits of Reducing Climate Pollution* (Feb. 26, 2021), https://perma.cc/5N3N-2949.

[116] INTERAGENCY WORKING GROUP ON SOCIAL COST OF GREENHOUSE GASES, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON, METHANE, AND NITROUS OXIDE INTERIM ESTIMATES UNDER EXECUTIVE ORDER 13990 3 (Feb. 2021), https://perma.cc/GZ45-SKP4.

[117] *See* Executive Order 14,008 of January 27, 2021, Tackling the Climate Crisis at Home and Abroad, 86 Fed. Reg. 7619, 7622 (Feb. 1, 2021).