The Social Cost of Greenhouse Gases: Legal, Economic, and Institutional Perspective

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The social cost of greenhouse gases provides the best available method to quantify and monetize the climate damages attributable to the emission of an incremental unit of heat-trapping pollution. Accordingly, the metric can be highly useful for crafting policies that will reduce the nation's greenhouse gas footprint, with potential usages including weighing the impacts of proposed fossil-fuel projects, assessing grant applications and procurement decisions that have climate impacts, and crafting fee schedules for monetary rates that will internalize the cost of climate damages onto polluters. To date, however, the use of the social cost of greenhouse gases for such determinations and processes has been sporadic and fairly limited. It is time for this practice to change, as broad application of the social cost of greenhouse gases will enable agencies and departments to identify programs or policies that cost-effectively reduce greenhouse gas emissions and thus enable a speedy and efficient transition to a greener economy.

Because widespread use of the social cost of greenhouse gases would lend support to many decisions to transition away from fossil fuels, the methodology has become subject to criticism from opponents of climate reforms. While critics attempt to discredit the federal government's social cost of greenhouse gases valuations—arguing that these values overestimate climate costs, disregard best practices, and even usurp the legislative function from Congress—such criticisms lack merit and should not deter agencies from broadly applying the social cost of greenhouse gases. This Article evaluates the various legal, economic, and institutional controversies surrounding the social cost of greenhouse gases and explains why this metric should play a critical role in guiding agency policymaking and decision-making related to climate change.

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Introduction

The social cost of greenhouse gases is one of the most important valuations in administrative law, yet it remains largely unknown to most of the legal and regulatory community.[1] Developed over years by expert scientists and economists—including a working group of experts from across the executive branch (Working Group)[2]—the social cost of greenhouse gases provides the best available method to quantify and monetize the climate damages attributable to the emission of an incremental unit of heat-trapping pollution.[3]

Accordingly, the metric can be highly useful for crafting policies that will reduce the nation's greenhouse gas footprint. Potential uses of the social cost of greenhouse gases include weighing the impacts of proposed fossil-fuel projects, assessing grant applications and procurement decisions that have climate impacts, and crafting fee schedules for monetary rates that will internalize the cost of climate damages onto polluters. To date, however, the use of the social cost of greenhouse gases in such determinations has been sporadic and fairly limited. Instead, its use in federal policy has been mostly confined to assessing the costs and benefits of regulations.[4] For non-regulatory determinations, agencies have mostly overlooked the social cost of greenhouse gases and applied methodologies that fail to meaningfully capture or contextualize climate impacts.

It is time for this practice to change. The Biden Administration has pledged to take a "government-wide approach to the climate crisis" and called on all "agencies to . . . reduce[] climate pollution in every sector of the economy."[5] To help ensure a rational and just transition away from fossil fuels, agencies can and should make use of the social cost of greenhouse gases in a wide range of determinations. Because the social cost metrics enable agencies to put a price on the greenhouse gases emitted or saved from a proposed project, broad use of these metrics will enable agencies to contextualize the climate impacts of their determinations and to rationally weigh those impacts against other project effects

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1. Michael Greenstone, an economics professor at the University of Chicago, former chief economist for the Council of Economic Advisers, and former co-leader of the Interagency Working Group on the Social Cost of Greenhouse Gases, has described the metric as "the most important number you've never heard of." Catherine Early, *"The Most Important Number You've Never Heard Of*," BBC (Nov. 10, 2021), https://www.bbc.com/future/article/20211103-the-most-important-number-youve-never-heard-of [https://perma.cc/6BZK-9D4H].

2. INTERAGENCY WORKING GRP. ON THE SOC. COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS 1 (Feb. 2010) [hereinafter 2010 TSD], https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf [https://perma.cc/AN2S-2X5H].

3. *See id.* at 1 ("The [social cost of carbon] is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services due to climate change.").

4. *See* Peter Howard & Jason Schwartz, *Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon*, 42 COLUM. J. ENV'T L. 203, 219 (2017); *see also* Zoe Palenik, Note, *The Social Cost of Carbon in the Courts: 2013-2019*, 28 N.Y.U. ENV'T L.J. 393, 404 (2020) ("The [social cost of carbon] was explicitly designed for agency use pursuant to E.O. 12,866, which requires that agencies undertake a cost-benefit analysis when a regulatory action will have significant impacts.").

5. Exec. Order No. 14,008, § 201, 86 Fed. Reg. 7619, 7622 (Feb. 1, 2021).

such as monetary cost. Broad application of the social cost of greenhouse gases throughout federal policymaking and processes will therefore enable agencies and departments to identify programs or policies that cost-effectively reduce greenhouse gas emissions, enabling a speedy and efficient transition to a greener economy.

Because widespread use of the social cost of greenhouse gases would lend support to many decisions to transition away from fossil fuels, the methodology has become subject to criticism from opponents of climate reforms. State attorneys general have already pursued two lawsuits seeking to prevent the Biden Administration from applying the social cost of greenhouse gases,[6] with additional lawsuits likely when claims ripen after agencies integrate the social cost methodology into final determinations. The state challengers have repeatedly attempted to discredit the Working Group and cast doubt upon its social cost valuations, arguing that the social cost values overestimate climate costs, disregard best practices, and even usurp the legislative function from Congress. Such criticisms lack merit and should not deter agencies from broadly applying the social cost of greenhouse gases in policymaking. In fact, experts widely agree that the Working Group's social cost values underestimate the full social costs of greenhouse gas emissions, yet are still appropriate to use as conservative estimates.[7]

This Article evaluates the various legal, economic, and institutional controversies surrounding the social cost of greenhouse gases and explains why this metric should play a critical role in guiding agency policymaking and decision-making related to climate change. Part I begins by describing the origins of the federal government's social cost of greenhouse gases estimates, including

6. Complaint, Missouri v. Biden, No. 4:21-cv-00287-AGF, 2021 WL 3885590 (E.D. Mo. Mar. 8, 2021); Complaint, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. Apr. 22, 2021). In August 2021, the U.S. District Court for the Eastern District of Missouri dismissed the *Missouri* lawsuit, finding a lack of standing and ripeness. Missouri v. Biden, No. 4:21-CV-00287-AGF, 2021 WL 3885590 (E.D. Mo. Aug. 31, 2021). That decision is currently on appeal in the U.S. Court of Appeals for the Eighth Circuit. *See* No. 21-3013 (8th Cir. filed Sept. 8, 2021). In February 2022, the U.S. District Court for the Western District of Louisiana issued a preliminary injunction prohibiting defendant agencies from applying the Working Group's social cost of greenhouse gases valuations. Louisiana v. Biden, No. 2:21-CV-01074, 2022 WL 438313 (W.D. La. Feb. 11, 2022). But that decision was widely criticized for violating basis principles of administrative law, with conservative legal scholar Jonathan Adler calling it a "mess." Jonathan H. Adler, *Federal Court Bars Federal Agencies from Considering the Costs of Climate Change in Rulemakings*, REASON: VOLOKH CONSPIRACY (Feb. 21, 2022), https://reason.com/volokh/2022/02/21/federal-court-bars-federal-agencies-from-considering-the-costs-of-climate-change-in-agency-rulemakings/ [https://perma.cc/KP9U-R52W]. And just a few weeks after the injunction was issued, the U.S. Court of Appeals for the Fifth Circuit stayed the injunction on the grounds that plaintiffs could not establish standing. Louisiana v. Biden, No. 22-30087, 2022 WL 866282 (5th Cir. Mar. 16, 2022).

7. INTERAGENCY WORKING GRP. ON THE SOC. COST OF GREENHOUSE GASES, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON, METHANE, AND NITROUS OXIDE – INTERIM ESTIMATES UNDER EXECUTIVE ORDER 13,990, at 4 (Feb. 2021) [hereinafter 2021 TSD], https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf [https://perma.cc/KBZ6-KA4G] (acknowledging that current social cost valuations "likely underestimate societal damages from [greenhouse gas] emissions"); Richard L. Revesz, Peter H. Howard, Kenneth Arrow, Lawrence H. Goulder, Robert E. Kopp, Michael A. Livermore, Michael Oppenheimer & Thomas Sterner, *Global Warming: Improve Economic Models of Climate Change*, 508 NATURE 173 (2014) (explaining that the Working Group's values—though methodically rigorous and highly useful—are very likely underestimates).

key legal developments and methodological choices. It then surveys the usage of those estimates over the past decade, which can be categorized into three stages. Under the Obama Administration from 2010-2016, agencies used the social cost values broadly in regulatory cost-benefit analysis—which was upheld by the U.S. Court of Appeals for the Seventh Circuit[8]—with occasional usage in other contexts. After the Trump Administration took office in 2017, it disbanded the Working Group and sought to replace its damage estimates in regulatory cost-benefit analysis with dramatically lower estimates[9]—a practice that was rebuked by a federal court[10]—while disregarding those valuations outside regulation. In the first year of the Biden Administration, in 2021, the federal government reconstituted the Working Group and signaled an openness to applying its climate-damage valuations well beyond regulatory analysis, including in agency "decision-making, budgeting, and procurement."[11]

Part II encourages government agencies to make broad use of the social cost of greenhouse gases beyond regulatory cost-benefit analysis and provides legal support for using the social cost values in a wide range of agency processes. This Part focuses broadly on two potential uses of the social cost valuations, offering various examples of each. First, use of the social cost of greenhouse gases allows agencies to capture climate effects and seamlessly compare them against other monetized economic effects. This comparison is highly useful in assessments and determinations that involve balancing beneficial and adverse impacts, such as in National Environmental Policy Act (NEPA) assessments, determinations under land-use or energy-management statutes, grantmaking and procurement decisions, and other contexts. Second, when an agency seeks to internalize the costs of climate change, such as through administrative penalties or mineral royalties, the social cost of greenhouse gases provides a monetized estimate of damages that can be directly incorporated into the applicable monetary rate. Using the metric in this context enables an efficient reduction in greenhouse gas emissions.

Part III rebuts prominent objections that have been made against the Working Group's estimates of the social cost of greenhouse gases. Critics have attempted to paint the Working Group's valuations as biased upwards—questioning the choice of damage models, discount rates, treatment of uncertainty, incorporation of climate science, and other methodological

8. Zero Zone v. Dep't of Energy, 832 F.3d 654, 679 (7th Cir. 2016).

9. Exec. Order No. 13,783, § 5(b)-(c), 82 Fed. Reg. 16,093, 16,095-96 (Mar. 31, 2017), *withdrawn by* Exec. Order No. 13,990, § 7, 86 Fed. Reg. 7037, 7041-42 (Jan. 25, 2021). Although the Executive Order does not say so explicitly, agencies interpreted that Order to call for applying a higher range of discount rates and lopping off most of the damage costs in an attempt to segregate costs originating within U.S. borders. The result is that the damage valuations applied under the Trump Administration were dramatically lower than those endorsed by the Working Group. *See, e.g.*, EPA, EPA-452/R-19-003, REGULATORY IMPACT ANALYSIS FOR THE REPEAL OF THE CLEAN POWER PLAN, AND THE EMISSION GUIDELINES FOR GREENHOUSE GAS EMISSIONS FROM EXISTING ELECTRIC UTILITY GENERATING UNITS 7-1 (2019) (outlining methodology).

10. California v. Bernhardt, 472 F. Supp. 3d 573, 623 (N.D. Cal. 2020).

11. Exec. Order No. 13,990, § 5(b), 86 Fed. Reg. 7037, 7040 (Jan. 25, 2021).

choices—and have claimed that the true social cost of greenhouse gases is much smaller or even possibly negative. But these criticisms all miss the mark. In reality, the social cost metrics have been developed through a rigorous methodology that incorporates the best available science and economics and makes rational and balanced choices to fairly, if not conservatively, quantify and monetize climate damages. As many scholars have recognized, these values very likely underestimate, rather than overestimate, the true social cost of greenhouse gas emissions.[12] Criticisms of the metric that posit the contrary are largely predicated on outdated, discredited, or outlier theories of the science and economics of climate change.

Although efforts to combat climate change have been underway for decades, President Biden's all-of-government approach to substantially lower greenhouse gas emissions represents a new and more ambitious frontier in this urgent challenge. The social cost of greenhouse gases offers a very useful tool that agencies can use as they seek methods to efficiently reduce greenhouse gas emissions through their policies and programs. While those valuations should be regularly updated to integrate the latest science and economics, current valuations have been developed through a rigorous and balanced process.

I. Development and Historical Usage of the Social Cost of Greenhouse Gases

Though used by the federal government for only a little more than a decade, the social cost of greenhouse gases already has a complex history marked by uneven and often partisan support. This Part surveys that history, discussing the federal government's development and usage of its social cost of greenhouse gases estimates to date.

A. Development and Methodology

Although the social cost of greenhouse gases is frequently used synonymously with the valuations developed by the federal government, economic research and modeling on the social cost of greenhouse gases predate federal efforts to monetize incremental climate damages. Several of the most renowned economic models of climate damages—such as models by William Nordhaus[13] and Richard Tol[14] that have since been integrated into the federal government's damage valuations—were first released in the 1990s.

12. *See, e.g.*, Tamma Carleton & Michael Greenstone, *Updating the United States Government's Social Cost of Carbon* 9 (Univ. of Chi., Becker Friedman Inst. for Econ., Working Paper No. 2021-04, 2021) (stating that the models currently used by the Working Group "substantially underestimate the *speed* of warming"). The Interagency Working Group on the Social Cost of Greenhouse Gases has acknowledged that its social cost valuations "likely underestimate societal damages from [greenhouse gas] emissions." 2021 TSD, *supra* note 7, at 4.

13. The earliest versions of Nordhaus's DICE model were published starting in 1992. *See* William Nordhaus, *An Optimal Transition Path for Controlling Greenhouse Gas Emissions*, 258 SCIENCE 1315 (1992).

14. The earliest versions of Tol's FUND model were published starting in 1996. *See* Publications, FUND MODEL, http://www.fund-model.org/publications/ [https://perma.cc/9N28-68BY].

Owing to the availability of these economic damage models, the U.S. Court of Appeals for the Ninth Circuit held in 2008 that the federal government must monetize climate impacts when it conducts a cost-benefit analysis. In *Center for Biological Diversity v. National Highway Traffic Safety Administration*, the Ninth Circuit remanded a fuel economy rule to the Department of Transportation (DOT) for failing to monetize the benefits of carbon dioxide reductions in its regulatory impact analysis.[15] The court recognized that there was some uncertainty in the proper valuation of climate damages, but explained that while "there is a range of values, the value of carbon emissions reduction is certainly not zero."[16] By failing to value the benefit of greenhouse gas emission reductions in its analysis despite the availability of economic estimates, the court continued, DOT effectively zeroed out the impact of greenhouse gas emissions and thereby "put a thumb on the scale by undervaluing the benefits and overvaluing the costs of more stringent standards."[17]

Following this decision, federal agencies began applying different valuations of the social cost of greenhouse gases in their regulatory analyses.[18] Though methodologies differed across agencies, the Environmental Protection Agency (EPA) in 2008 used global valuations at discount rates of 2% to 3% (a practice that, as discussed below, is mostly consistent with the Working Group's current approach).[19]

To harmonize damage valuations across agencies, the Obama Administration convened an interagency working group comprised of members of twelve federal agencies and departments, including the Council of Economic Advisors, Office of Management and Budget (OMB), EPA, Department of Energy (DOE), and DOT.[20] The Working Group released its first estimates of the social cost of carbon (i.e., carbon dioxide) in 2010,[21] which it updated in both 2013[22] and 2016[23] to incorporate more recent scientific and economic data. Following the Working Group's 2013 update, OMB also solicited comments on the social cost estimates,[24] resulting in a forty-four-page document with detailed

15. 538 F.3d 1172, 1198-1203 (9th Cir. 2008).

16. *Id.* at 1200.

17. *Id.* at 1198.

18. 2010 TSD, *supra* note 2, at 3-4.

19. *Id.* at 3.

20. *Id.*

21. *Id.*

22. INTERAGENCY WORKING GRP. ON THE SOC. COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: TECHNICAL UPDATE OF THE SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 (May 2013), https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf [https://perma.cc/66B9-H3ST].

23. INTERAGENCY WORKING GRP. ON THE SOC. COST OF GREENHOUSE GASES, TECHNICAL SUPPORT DOCUMENT: TECHNICAL UPDATE OF THE SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 (Aug. 2016) [hereinafter 2016 TSD], https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc_tsd_final_clean_8_26_16.pdf [https://perma.cc/XG5F-BHR5].

24. Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order No. 12866, 78 Fed. Reg. 70,586 (Nov. 26, 2013).

responses to the comments received.[25] In 2016, the Working Group also released damage estimates for two other greenhouse gases, methane and nitrous oxide.[26] The group then changed its name from the Interagency Working Group on the Social Cost of Carbon to the Interagency Working Group on the Social Cost of Greenhouse Gases. (This Article uses "Working Group" to describe all of the body's iterations.[27])

For each greenhouse gas, the Working Group estimated the damages caused by one metric ton of emissions, providing a range of damage estimates along with a central valuation.[28] With each passing year, the damage value estimates increase because each incremental unit of greenhouse gases causes greater incremental damages as the atmospheric concentration of greenhouse gases rises.[29] As its technical support documents explain, the Working Group arrived at these damage valuations through numerous methodologies and analytical tools, which we discuss below.

Damage Models: The Working Group selected three models of climate damages that were among the most widely used and cited models in the economics literature linking physical climate impacts to economic damages[30]: the DICE, FUND, and PAGE models.[31] These models were developed by outside experts, published in peer-reviewed economic literature,[32] and were the product of extensive scholarship and expertise. One of the models, DICE, was developed by William Nordhaus, an economics professor and former provost of Yale University who won a Nobel Memorial Prize in Economic Sciences for developing the model.

The three models reflect a wide diversity of methodological assumptions about a range of key parameters and inputs.[33] The choices embedded in the models reflect, in part, the different judgments of the experts who developed the

25. INTERAGENCY WORKING GRP. ON THE SOC. COST OF CARBON, RESPONSE TO COMMENTS: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 (July 2015) [hereinafter RESPONSE TO COMMENTS], https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc-response-to-comments-final-july-2015.pdf [https://perma.cc/FPS6-92LA].

26. INTERAGENCY WORKING GRP. ON THE SOC. COST OF GREENHOUSE GASES, ADDENDUM TO TECHNICAL SUPPORT DOCUMENT ON SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866: APPLICATION OF THE METHODOLOGY TO ESTIMATE THE SOCIAL COST OF METHANE AND THE SOCIAL COST OF NITROUS OXIDE (Aug. 2016), https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/august_2016_sc_ch4_sc_n2o_addendum_final_8_26_16.pdf [https://perma.cc/TH3B-XZKC].

27. All documents released by the Working Group during the Obama administration are available at https://obamawhitehouse.archives.gov/omb/oira/social-cost-of-carbon [https://perma.cc/3RS9-49JD].

28. 2021 TSD, *supra* note 7, at 5-6.

29. 2010 TSD, *supra* note 2, at 1, 4 (recognizing the "growth in incremental damages over time as the magnitude of climate change increases").

30. RESPONSE TO COMMENTS, *supra* note 25, at 4 (stating that the models "remain the most widely cited"); *id.* at 8 (quoting the National Academies of Sciences for recognizing that the chosen models represent "the most widely used impact assessment models" available).

31. 2010 TSD, *supra* note 2, at 5.

32. RESPONSE TO COMMENTS, *supra* note 25, at 4.

33. *See* 2010 TSD, *supra* note 2, at 6 (discussing how "[t]he parameters and assumptions embedded in the three models vary widely").

models. For instance, Richard Tol, who developed the FUND model, has stated that "[t]he impact of climate change is relatively small" and dismissed much of the research behind climate change as "scaremongering" rather than "sound science."[34] Unsurprisingly, his model produces the lowest damage estimates of the three models employed by the Working Group.[35] William Nordhaus, who developed the DICE model, is widely credited with popularizing the goal that global temperatures should increase no more than 2° Celsius (or 3.6° Fahrenheit) below pre-industrial levels[36]—a goal now considered conservative by the global community.[37] His model produces higher damage estimates that are close to the Working Group's average damage valuations.[38]

When it first developed its social cost estimates in 2010, the Working Group applied the versions of the integrated assessment models (IAMs) that were available at the time. In subsequent updates, the Working Group has applied updated versions of the damage models.[39]

Uncertainty: In addition to the use of three distinct damage models with differing inputs and assumptions, the Working Group integrated various sources of uncertainty into its damage valuations. For instance, the Working Group applied an equilibrium climate sensitivity—that is, an estimate of how much an increase in atmospheric greenhouse gas concentrations affects global temperatures—that reflects a broad distribution of possible outcomes.[40] The Working Group also applied five different socioeconomic and emissions trajectories from the published literature reflecting a range of possible outcomes for future population growth, global gross domestic product, and greenhouse gas emission baselines—all important inputs that affect the long-term climate damage estimates.[41]

The Working Group ran each integrated assessment model 10,000 times per scenario (and per greenhouse gas) for a total of 150,000 draws per greenhouse

34. Richard S.J. Tol, *Why Worry About Climate Change?*, ECON. & SOC. RSCH. INST. 3, 5 (Apr. 21, 2009), http://aei.pitt.edu/98519/1/RB20090101.pdf [https://perma.cc/8SJU-CD6N].

35. *See* 2010 TSD, *supra* note 2, at 50 tbl.A5 (reporting that the FUND model has the lowest mean estimate of the three models at all discount rates, including a negative social cost of carbon estimate at a five percent discount rate).

36. *The 2° C Limit on Global Warming*, ECONOMIST (Dec. 6, 2015), https://www.economist.com/the-economist-explains/2015/12/06/the-2degc-limit-on-global-warming [https://perma.cc/XL27-7D6P].

37. For instance, the Paris Agreement calls for governments to "hold[] the increase in the global average temperature to well below 2°C above pre-industrial levels and pursu[e] efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change." Paris Agreement to the United Nations Framework Convention on Climate Change art. 2(1)(a), Dec. 12, 2015, T.I.A.S. No. 16-1104.

38. *Compare* 2010 TSD, *supra* note 2, at 50 tbl.A5, *with id.* at 1.

39. *See, e.g.*, RESPONSE TO COMMENTS, *supra* note 25, at 2 ("In May of 2013, after all three of the underlying models had been updated and used in the peer-reviewed literature, and agencies had received public comments urging them to update their estimates, the [Working Group] released revised [social cost of carbon] values.").

40. 2010 TSD, *supra* note 2, at 13 tbl.1 (showing the 5th-95th probability range of distributions in the chosen Roe & Baker model from a doubling of atmospheric greenhouse gas concentrations to be 1.72°C to 7.14°C).

41. *Id.* at 15-17.

gas, and then took an unweighted average across those results to develop its recommended estimates.[42] In addition to reporting the average valuations, the Working Group also published the results of each model run under each scenario.[43]

Discount Rates: The Working Group also applied a range of discount rates to account for long-term uncertainty about background economic and social conditions. Because individuals have a positive time preference—meaning they value present welfare more than future welfare—discounting is used to place all impacts along a time continuum into present value; a discount rate represents the annual rate at which future costs and benefits are reduced. (When costs are dispersed over long time horizons, such as with climate impacts, a higher discount rate produces a lower damage valuation.) To assess the magnitude of such time preferences, economists look toward valuations such as rates of return on government debt and private capital.[44] Such valuations are uncertain over climate change's long time horizon, and there is debate among economists and policymakers over the proper discount rates to be applied in intergenerational contexts.[45] Thus, while the Working Group averaged the results from the different integrated assessment models and socioeconomic scenarios, it chose to present those average values at several different discount rates because, it reported, "no consensus exists on the appropriate rate to use in an intergenerational context."[46]

The Working Group chose a central discount rate of 3%, which is both "consistent with estimates provided in the economics literature" and reflects the social rate of time preference recommended in guidance from OMB.[47] In addition to its central rate, the Working Group applied two additional discount rates—2.5% and 5%.[48] The lower annual rate, 2.5%, was "included to incorporate the concern that interest rates are highly uncertain over time," as long-term uncertainty generally counsels for lower annual discount rates.[49] The higher annual rate, 5%, was provided "to represent the possibility that climate damages are positively correlated with market returns."[50]

42. *Id.* at 28; *see also* 2021 TSD, *supra* note 7, at 26-27 (providing additional detail). The Working Group "considered formally assigning probability weights to different" scenarios, but "this proved challenging to do in an analytically rigorous way given the dearth of information on the likelihood of a full range of future socio-economic pathways." 2010 TSD, *supra* note 2, at 16.

43. 2010 TSD, *supra* note 2, at 26 tbl.3.

44. *See generally* OFF. OF MGMT. & BUDGET, EXEC. OFF. OF THE PRESIDENT, CIRCULAR A-4: REGULATORY IMPACT ANALYSIS 32-34 (2003) [hereinafter CIRCULAR A-4].

45. *Id.* at 35-36.

46. 2010 TSD, *supra* note 2, at 25.

47. *Id.* at 23; *see also* CIRCULAR A-4, *supra* note 44, at 33.

48. In addition to presenting social cost values at these three discount rates, the Working Group also presented a fourth value that uses a 3% discount rate but assumes the 95th percentile damage estimate. This was "included to represent the higher-than-expected economic impacts from climate change further out in the tails of the [social cost] distribution." 2010 TSD, *supra* note 2, at 25.

49. *Id.* at 23; *see also id.* at 22-23 (explaining how long-term uncertainty counsels for lower or declining discount rates).

50. *Id.* at 23.

Although regulatory impact analyses typically apply discount rates of 3% and 7%,[51] the Working Group concluded that a 7% discount rate—which reflects the "average before-tax rate of return to private capital in the U.S. economy"[52]—was inappropriate for the social cost of greenhouse gases due to the intergenerational nature of climate damages and the unique ethical considerations that this raises.[53] As the Working Group explained: "Although most people demonstrate time preference in their own consumption behavior, it may not be appropriate for society to demonstrate a similar preference when deciding between the well-being of current and future generations."[54] Accordingly, agencies have applied the Working Group's valuations using the range of discount rates from 2.5% to 5%,[55] often with a focus on the 3% central rate.[56]

Geographic Scope: The Working Group also focused on global damage estimates rather than attempting to analyze only the share of climate damages that originate within U.S. borders. It provided several rationales for this choice.[57] First, the Working Group explained that climate change is a global externality that cannot be adequately addressed if nations "set policies based only on the domestic costs and benefits of carbon emissions," as this "would lead to an economically inefficient level of emissions reductions which could be harmful to all countries, including the United States, because each country would be underestimating the full value of its own reductions."[58] Second, the Working Group noted that "there is no bright line between domestic and global damages," since "[a]dverse impacts on other countries can have spillover effects on the United States, particularly in the areas of national security, international trade, public health and humanitarian concerns" and thus "a purely domestic measure is likely to understate actual impacts to the United States."[59] And third, the Working Group explained that there are "relatively few region- or country-specific estimates of the [social cost of carbon] in the literature," and that the best

51. CIRCULAR A-4, *supra* note 44, at 33.

52. *Id.*

53. 2010 TSD, *supra* note 2, at 17-18.

54. RESPONSE TO COMMENTS, *supra* note 25, at 21 (citing CIRCULAR A-4, *supra* note 44, at 35-36 (examining intergenerational discounting and providing evidence that longer time horizons counsel for lower annual discount rates)).

55. *See, e.g.*, Energy Conservation Program: Energy Conservation Standards for Air Compressors, 85 Fed. Reg. 1504, 1564 (Jan. 10, 2020) (to be codified at 10 C.F.R. pts. 429, 431) (emphasizing the importance of focusing on all three discount rates "for purposes of capturing the uncertainties involved").

56. Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,680 tbl.1 (Oct. 23, 2015) (emphasizing "the importance and value of considering the full range of [social cost] values," but using the Working Group's "central" estimate at 3% discount rate in the main analysis of costs and benefits); *id.* at 64,929 tbl.18 (presenting regulatory climate benefits using the Working Group's full range of estimates).

57. For further justification of the various rationales for focusing on global damages presented in this paragraph, see Howard & Schwartz, *supra* note 4.

58. RESPONSE TO COMMENTS, *supra* note 25, at 31.

59. *Id.* at 31-32.

estimates available are "approximate, provisional, and highly speculative" given the spillover effects of climate change and international reciprocity.[60]

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The Working Group's methodology has been endorsed on numerous occasions by independent reviewers. In 2014, the U.S. Government Accountability Office concluded that the Working Group had followed a "consensus-based" approach, relied on peer-reviewed academic literature, disclosed relevant limitations, and adequately planned to incorporate new information through public comments and updated research.[61] In 2016 and 2017, the National Academies of Sciences, Engineering, and Medicine issued two reports that, while recommending future improvements, supported the continued use of the Working Group's estimates.[62] Leading economists and climate policy experts have also endorsed the Working Group's values as the federal government's best available estimates.[63]

Nonetheless, due to data limitations, the Working Group's estimates do not currently reflect societal costs arising from many significant effects of climate change, including ocean acidification, wildfires, public health effects from methane emissions, abrupt ecosystem disruptions, and many potentially catastrophic outcomes.[64] Because of such omitted damages and other limitations of the current estimates, the Working Group's damage estimates most likely substantially underestimate the full climate effects from greenhouse gas emissions.

B. Use Across Presidential Administrations

1. Agency Usage and Judicial Approval (2010-2016)

After the Working Group released its estimates of the social cost of greenhouse gases, agencies began regularly applying them in their regulatory impact analyses to capture the benefits of reducing, or the costs of increasing, greenhouse gas emissions. Between 2010 and 2016, agencies applied the social cost of greenhouse gases to help justify dozens of rulemakings, with most

60. *Id.* at 32.

61. U.S. GOV'T ACCOUNTABILITY OFF., GAO-14-663, REGULATORY IMPACT ANALYSIS: DEVELOPMENT OF SOCIAL COST OF CARBON ESTIMATES 12-19 (2014).

62. NAT'L ACAD. SCIS., ENG'G & MED., VALUING CLIMATE DAMAGES: UPDATING ESTIMATION OF THE SOCIAL COST OF CARBON DIOXIDE 3 (2017) [hereinafter NAS 2017 REPORT]; NAT'L ACAD. SCIS., ENG'G & MED., ASSESSMENT OF APPROACHES TO UPDATING THE SOCIAL COST OF CARBON: PHASE 1 REPORT ON A NEAR-TERM UPDATE 1-2 (2016) [hereinafter NAS 2016 REPORT].

63. *See, e.g.*, Richard Revesz, Michael Greenstone, Michael Hanemann, Michael Livermore, Thomas Sterner, Denise Grab, Peter Howard & Jason Schwartz, *Best Cost Estimate of Greenhouse Gases*, 357 SCIENCE 655 (2017); Michael Greenstone, Elizabeth Kopits & Ann Wolverton, *Developing a Social Cost of Carbon for U.S. Regulatory Analysis: A Methodology and Interpretation*, 7 REV. ENV'T ECON. & POL'Y 23, 42 (2013); Revesz et al., *supra* note 7 (explaining that the Working Group's values—though methodically rigorous and highly useful—are very likely underestimates).

64. Inst. for Pol'y Integrity, *Climate Impacts Reflected in the SCC Estimates*, COST OF CARBON, https://costofcarbon.org/scc-climate-impacts [https://perma.cc/P42U-B7VU] (listing included and omitted damages in the Working Group's estimates).

applications coming from DOE, DOT, and EPA.[65] For these regulations, the issuing agency calculated the benefits of greenhouse gas emission reductions using the Working Group's social cost estimates and concluded that the rule's monetized benefits—including those climate benefits—justified its compliance costs. Prominent regulations that relied on the Working Group's social cost of greenhouse gases estimates to justify the proposal include EPA's Clean Power Plan,[66] DOT's vehicle fuel-economy standards,[67] EPA's limitations on effluents discharged into surface waters,[68] and DOE's efficiency standards for appliances and equipment.[69]

For one of DOE's efficiency standards, which was aimed at commercial refrigeration equipment, a coalition of regulated entities challenged the agency's consideration of climate benefits as arbitrary and capricious. The U.S. Court of Appeals for the Seventh Circuit rejected that challenge, finding that DOE's reliance on the Working Group's social cost of carbon valuations was rational and reasonable and rejecting petitioners' claims that those valuations are "irredeemably flawed."[70] The Seventh Circuit credited the Working Group with responding to objections to its social cost valuations offered during the comment period, and deferred to the Working Group's judgment that those damage estimates were reliable despite some modeling limitations.[71] The court also rejected petitioners' argument that DOE should have focused narrowly on climate impacts within U.S. borders, deferring to the agency's rationale that because "climate change 'involves a global externality' . . . those global effects are an appropriate consideration when looking at a national policy."[72]

While agencies regularly applied the Working Group's social cost of greenhouse gases valuations in regulatory policymaking during the Obama Administration, their use of these values for other purposes was fairly sporadic and limited. On various occasions, federal agencies such as the Bureau of Land Management, Bureau of Ocean Energy Management (BOEM), Office of Surface Mining Reclamation and Enforcement, and Army Corps of Engineers applied the social cost of greenhouse gases to assess the incremental climate damage or

65. Howard & Schwartz, *supra* note 4, at 270-84 (cataloging agency uses through July 2016).

66. Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,751 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60) (explaining that the rule's cost estimates "are less than the central estimates of the social cost of carbon" from the Working Group).

67. 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 77 Fed. Reg. 62,624, 62,629 (Oct. 15, 2012) (to be codified at 40 C.F.R. pts. 85, 86, 600) (projecting that the standards would produce $49 billion in economic benefits from avoided carbon dioxide emissions).

68. Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category, 80 Fed. Reg. 67,838, 67,880 (Nov. 3, 2015) (to be codified at 40 C.F.R. pt. 423).

69. Howard & Schwartz, *supra* note 4, at 270-84.

70. Zero Zone v. Dep't of Energy, 832 F.3d 654, 677-79 (7th Cir. 2016).

71. *Id.* at 678.

72. *Id.* at 679 (quoting Energy Conservation Program: Energy Conservation Standards for Commercial Refrigeration Equipment, 79 Fed. Reg. 17,726, 17,779 (Mar. 28, 2014) (to be codified at 10 C.F.R. pt. 431)).

benefit in an environmental analysis conducted under NEPA.[73] In a 2016 assessment of an oil and gas lease sale, for instance, BOEM explained that the social cost of greenhouse gases "is a useful measure" that enables the agency "to incorporate the social benefits of reducing carbon dioxide emissions into its decision-making."[74] But no agency developed a policy of applying the social cost of greenhouse gases in non-regulatory decision-making, and agencies were inconsistent in their usage.[75] Some agencies, such as the Federal Energy Regulatory Commission (FERC) and the Nuclear Regulatory Commission, did not use the metric at all.[76]

2. Administrative Attacks and Judicial Pushback (2017-2020)

Two months after taking office, President Trump issued an executive order that disbanded the Working Group and withdrew its technical support documents as no longer representing government policy.[77] The executive order called on agencies to make two key changes "when monetizing the value of changes in greenhouse gas emissions resulting from regulations."[78] First, the executive order indicated that agency analyses should focus primarily on domestic climate costs, while separately reporting climate costs that occur outside U.S. borders.[79] Second, the executive order indicated that agencies should apply annual discount rates of 3% and 7%, rather than the range of discount rates endorsed by the Working Group.[80] The executive order did not otherwise criticize the Working Group's methodology or call upon agencies to reconsider the Working Group's choice of damage models, equilibrium climate sensitivities, baseline socioeconomic and emission trajectories, or other parameters.

Following the issuance of President Trump's executive order, agencies developed social cost of greenhouse gases estimates that used the Working Group's fundamental methodology, but applied a higher range of discount rates

73. *See* Inst. for Pol'y Integrity, *Federal Agencies' Use of the Social Costs of Greenhouse Gases in NEPA Analysis*, COST OF CARBON [hereinafter *Use of the Social Costs of Greenhouse Gases in NEPA Analysis*], https://costofcarbon.org/scc-use-under-nepa [https://perma.cc/52R4-AMYN] (documenting various uses and non-uses of social cost values by federal agencies in NEPA analysis).

74. BUREAU OF OCEAN ENERGY MGMT., U.S. DEP'T OF THE INTERIOR, BOEM 2016-069, COOK INLET PLANNING AREA OIL AND GAS LEASE SALE 244 IN THE COOK INLET, ALASKA FINAL ENVIRONMENTAL IMPACT STATEMENT 4-190 to 4-191 (2016), https://www.boem.gov/sites/default/files/about-boem/BOEM-Regions/Alaska-Region/Environment/Environmental-Analysis/Cook-Inlet-Lease-Sale-244-Final-EIS-Volume-1.pdf [https://perma.cc/7HUA-3PCA].

75. *Use of the Social Costs of Greenhouse Gases in NEPA Analysis*, *supra* note 73 (listing no agencies that regularly use the social cost of greenhouse gases under NEPA and providing examples of non-use by agencies that occasionally use the metric).

76. *Id.*

77. Exec. Order No. 13,783, § 5(b), 82 Fed. Reg. 16,093, 16,095-96 (Mar. 31, 2017), *withdrawn by* Exec. Order No. 13,990, § 7, 86 Fed. Reg. 7037, 7041 (Jan. 25, 2021).

78. *Id.* § 5(c), 82 Fed. Reg. at 16,096.

79. *Id.* (referencing CIRCULAR A-4, *supra* note 44, at 15 ("Your analysis should focus on benefits and costs that accrue to citizens and residents of the United States. Where you choose to evaluate a regulation that is likely to have effects beyond the borders of the United States, these effects should be reported separately.")).

80. *Id.* (referencing CIRCULAR A-4, *supra* note 44, at 33-36)).

and lopped off most of the damage costs in an attempt to segregate costs that would fall within U.S. borders.[81] (While agencies referred to these as "interim" estimates,[82] the Trump Administration did not commence any process to update those valuations.[83]) Although agencies under the Trump Administration occasionally applied the Working Group's damage estimates,[84] they far more frequently applied the "interim" damage valuations developed following the 2017 executive order. Prominent regulatory rollbacks that relied on those valuations included DOT's weakening of vehicle fuel-efficiency standards[85] and EPA's rescission of methane pollution standards for the oil and gas sector.[86]

But use of the "interim" damage valuation was struck down by a federal court as arbitrary and capricious. In a 2020 ruling, the U.S. District Court for the Northern District of California vacated the rescission of an Obama-era Bureau of Land Management rule aimed at preventing methane waste from oil and gas extraction on federal land, after the agency devalued the benefits of that prior rulemaking to justify its rescission by applying the Trump Administration's "interim" social cost valuations.[87] The court explained that "focusing solely on domestic effects has been soundly rejected by economists as improper and unsupported by science"[88] and recognized "the consensus that [the Working Group's] estimates constitute the best available science about monetizing the impacts of greenhouse gas emissions."[89] In addition, the court faulted the Trump Administration for calculating domestic-only climate impacts "without *any* public comment or peer review,"[90] highlighting that its domestic-only damage estimates omitted key spillover effects such as "impacts on 8 million United States citizens living abroad, including thousands of United States military

81. *See, e.g.*, EPA, EPA-452/R-19-003, REGULATORY IMPACT ANALYSIS FOR THE REPEAL OF THE CLEAN POWER PLAN, AND THE EMISSION GUIDELINES FOR GREENHOUSE GAS EMISSIONS FROM EXISTING ELECTRIC UTILITY GENERATING UNITS 7-1 (2019) (describing methodology).

82. *See, e.g.*, *id.* at 4-2 ("The [social cost of carbon] estimates presented in this [analysis] are interim values developed under E.O. 13783 for use in regulatory analyses until an improved estimate of the impacts of climate change to the U.S. can be developed based on the best available science and economics.").

83. *See* U.S. GOV'T ACCOUNTABILITY OFF., GAO-20-254, SOCIAL COST OF CARBON: IDENTIFYING A FEDERAL ENTITY TO ADDRESS THE NATIONAL ACADEMIES' RECOMMENDATIONS COULD STRENGTHEN REGULATORY ANALYSIS 24 (2020) ("The federal government has no plans to address the National Academies' short- and long-term recommendations for updating the methodologies used by federal agencies to develop their estimates of the social cost of carbon.").

84. *See, e.g.*, Energy Conservation Program: Energy Conservation Standards for Uninterruptible Power Supplies, 85 Fed. Reg. 1477, 1477, 1480 (Jan. 10, 2020) (to be codified at 10 C.F.R. pt. 430).

85. The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks, 85 Fed. Reg. 24,174, 24,235 (Apr. 30, 2020) (to be codified at 49 C.F.R. pts. 523, 531, 533, 536, 537).

86. Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Review, 85 Fed. Reg. 57,018, 57,066 (Sept. 14, 2020). The rule was rescinded through a Congressional Review Act resolution. Joint Resolution of June 30, 2021, Pub L. No. 117-23, 135 Stat. 295.

87. California v. Bernhardt, 472 F. Supp. 3d 573, 623 (N.D. Cal. 2020).

88. *Id.* at 613.

89. *Id.* at 611.

90. *Id.*

personnel; billions of dollars of physical assets owned by United States companies abroad; United States companies affected by their trading partners and suppliers abroad; and global migration and geopolitical security."[91]

While agencies under the Trump Administration applied flawed domestic-only estimates of the social cost of greenhouse gases in regulatory impact analysis, they mostly failed to value climate damages in other decision-making contexts such as NEPA analyses for project-level determinations.[92] Instead, agencies assessed the significance of projected greenhouse gas emissions from project-level determinations, if at all, through comparison to larger totals such as global, national, or state emission totals or targets. Agencies typically deemed the project's greenhouse gas emissions to be insignificant because they comprised a small fraction under such a comparison.[93]

3. Resurgence (2021)

When President Biden took office in 2021, he swiftly moved to reconvene the Working Group and restore its damage valuations to prominence in agency analysis. On his first day in office, President Biden signed Executive Order 13,990 titled *Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis*. In addition to setting forth other climate priorities, the executive order explained that "[i]t is essential that agencies capture the full costs of greenhouse gas emissions as accurately as possible, including by taking global damages into account," as "[d]oing so facilitates sound decision-making, recognizes the breadth of climate impacts, and supports the international leadership of the United States on climate issues."[94] The executive order reestablished the Working Group and called for it to publish interim social cost of greenhouse gases estimates within thirty days, publish final estimates by January 2022, and provide additional guidance by September 2021 on how the executive branch could make the best use of the social cost estimates, including in "decision-making, budgeting, and procurement."[95]

The Working Group released its interim social cost of greenhouse gases estimates in February 2021, restoring the values that the Working Group had

91. *Id.* at 613.

92. *See generally Use of the Social Costs of Greenhouse Gases in NEPA Analysis*, *supra* note 73 (listing just a single usage under NEPA between 2017 and 2020).

93. *See, e.g.*, BUREAU OF LAND MGMT., U.S. DEP'T OF THE INTERIOR, DRAFT RESOURCE MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT STATEMENT 4-268 to 4-270 (2018), https://eplanning.blm.gov/public_projects/lup/64444/153042/187358/BLM_CFO_Draft_RMP_-_Volume_I_-_EIS_-_August_2018_(1).pdf [https://perma.cc/7BZQ-KTXL]; OFF. OF SURFACE MINING RECLAMATION & ENF'T, U.S. DEP'T OF THE INTERIOR, BULL MOUNTAINS MINE NO. 1 FEDERAL MINING PLAN MODIFICATION ENVIRONMENTAL ASSESSMENT 57 (2018), https://www.wrcc.osmre.gov/programs/federalLands/NEPA_SignalPeak_EA_080318-051118.pdf [https://perma.cc/Z5VY-37A8] (describing greenhouse gas emissions from the expansion of a coal mine, which would equate to 0.44% of global annual emissions, as "minor").

94. Exec. Order No. 13,990, § 5(a), 86 Fed. Reg. 7037, 7040 (Jan. 20, 2021).

95. *Id.* § 5(b). As of April 2022, the Working Group has not published final estimates or guidance on the use of those valuations.

previously developed (adjusted for inflation).[96] The Working Group concluded that "these interim estimates represent the most appropriate estimate of the [social cost of greenhouse gases] until the revised estimates have been developed," noting that the estimates were "developed using a transparent process, peer-reviewed methodologies, and the science available at the time of that process."[97] The Working Group also dismissed the Trump Administration's domestic-only social cost valuations as failing to reflect the best available science and thus not meriting usage in agency decision-making.[98] Nonetheless, the Working Group recognized that its current estimates "likely underestimate societal damages from [greenhouse gas] emissions" due to omitted damages and other data gaps.[99] Accordingly, the Working Group encouraged agencies to perform additional analysis using higher social cost valuations[100] and pledged to incorporate the latest data on the science and economics of climate change as it updates its social cost valuations.[101]

Significantly, the Working Group recognized that the social cost of greenhouse gases should apply to all "relevant agency actions," and not just regulations.[102] Pursuant to President Biden's aforementioned executive order, the Working Group is expected to provide additional guidance on this issue. Some agencies have already taken action to broaden the usage of the social cost of greenhouse gases. In April 2021, Interior Secretary Deb Haaland issued a secretarial order recognizing that the social cost of greenhouse gases provides a "useful measure to assess the climate impacts of [greenhouse gas] emission changes for Federal proposed actions, in addition to rulemakings," emphasizing the tool as "essential . . . to quantify the costs and benefits associated with a proposed action's [greenhouse gas] emissions and relevant to the choice among different alternatives being considered."[103] As agencies take more concrete actions that limit greenhouse gas emissions, the use of the social cost of greenhouse gases to assess the climate benefits of those actions may become

96. 2021 TSD, *supra* note 7.

97. *Id.* at 3.

98. *Id.* at 15-16.

99. *Id.* at 4; *accord id.* at 31 ("The modeling limitations discussed above do not all work in the same direction in terms of their influence on the [social cost of greenhouse gases] estimates. However, it is the [Working Group's] judgment that, taken together, the limitations suggest that [our] interim [social cost of greenhouse gases] estimates . . . likely underestimate the damages from [greenhouse gas] emissions.").

100. *Id.* at 4 ("[A]gencies may consider conducting additional sensitivity analysis using discount rates below 2.5%.").

101. *Id.* at 32 ("As part of the process for updating the [social cost of greenhouse gases] estimates by January 2022, the [Working Group] will survey the scientific literature, including the economic literature, to identify advances to address the National Academies (2017) recommendations.").

102. *Id.* at 14 (stating that social cost metrics should be used to "monetize[e] the value of changes in greenhouse gas emissions resulting from regulations and other relevant agency actions"); *see also id.* at 12 (recognizing that the social cost of greenhouse gases "has been used previously in non-regulatory Federal analysis, such as in . . . National Environmental Policy Act (NEPA) analysis . . . .").

103. U.S. DEP'T OF THE INTERIOR, SECRETARIAL ORDER 3399, DEPARTMENT-WIDE APPROACH TO THE CLIMATE CRISIS AND RESTORING TRANSPARENCY AND INTEGRITY TO THE DECISION-MAKING PROCESS § 5(b) (2021).

more prominent. How the federal government should make use of these valuations outside of regulatory decision-making is the focus of the next Part.

II. Broadening the Scope of Agency Use

Because the social cost of greenhouse gases provides the best (albeit a conservative) metric to assess the climate damages from a specific amount of emissions—or the climate benefits from emission reductions—it can and should be integrated into all areas of policymaking in which impacts on climate change is a relevant consideration. Broad application of the social cost of greenhouse gases throughout federal policymaking and processes—well beyond regulatory cost-benefit analysis, where its use has thus far been mostly confined—will enable agencies and departments to identify programs or policies that cost-effectively reduce greenhouse gas emissions.[104]

In addition to rulemaking, use of the social cost of greenhouse gases is particularly warranted in two broad categories of agency actions.[105] First, use of the social cost of greenhouse gases allows agencies to account for climate effects and seamlessly compare them in their decision making against other monetized economic effects, such as project revenues or monetary costs. This approach is highly useful in assessments and determinations that involve balancing beneficial and adverse impacts, such as in NEPA assessments, determinations under land-use or energy-management statutes, grantmaking decisions, and procurement. Second, when an agency seeks to internalize the costs of climate change, which can be done through mineral royalties, administrative penalties, or other policies, the social cost of greenhouse gases provides a monetized damage estimate that can be directly incorporated into the applicable monetary rate.

This Part highlights various potential applications of the social cost of greenhouse gases for each of those two purposes, discussing how such uses would promote rational decision-making and enable a balanced consideration of climate impacts.

A. Balancing Climate Impacts

The social cost of greenhouse gases is useful for analyzing and weighing the potential climate benefits or costs of an agency's decisions. In any decision with meaningful greenhouse gas implications—including project assessments,

104. This Part is adapted from the working paper, Max Sarinsky, Brian Canfield, Brandon Ho & Angela Parnay, Broadening the Use of Social Cost of Greenhouse Gases in Federal Policy (June 2021) (working paper), https://policyintegrity.org/files/publications/Broadening_the_Use_of_SCC_vF.pdf [https://perma.cc/CW8L-2VF8]'.

105. Because the social cost of greenhouse gases is already widely applied in regulatory cost-benefit analysis, this Part takes that usage as a given and does not discuss it further. Additionally, while there are many potential areas for Congress to apply the social cost of greenhouse gases to in passing new laws, this Part focuses on avenues for executive agencies and departments to apply the social cost of greenhouse gases under existing law.

grant awards, and procurement choices—agencies should apply the social cost of greenhouse gases and weigh its monetized climate-damage estimates as part of the agency's decision-making.

There are many advantages to using the social cost of greenhouse gases instead of other approaches to determine the significance of greenhouse gas emissions. For example, whereas the significance of volumetric emission estimates standing alone can be difficult to discern because they do not convey any information about the actual climate impacts posed by the emissions (such as human health harms from increasing temperatures, property damage from sea-level rise, etc.), the social cost of greenhouse gases captures those actual impacts and presents them in the single and salient metric of a dollar value. And because dollar-value figures are commensurate with other monetized project impacts such as revenues or cost projections—whereas volumetric emission estimates are not—the social cost of greenhouse gases facilitates an apples-to-apples comparison of climate impacts to other project effects, enabling the agency to rationally situate climate impacts in the decision-making hierarchy and accord them proper weight. As noted above, agencies should consider the existing social cost valuations as conservative underestimates until updated values are available.

A non-exhaustive list of decision-making contexts that would benefit from regular application of the social cost of greenhouse gases includes project-level determinations involving fossil-fuel extraction, transmission, or usage, and grantmaking and procurement decisions with meaningful greenhouse gas implications. This Section surveys these various contexts, explaining how the social cost of greenhouse gases would facilitate lawful and rational consideration of climate impacts in each process. The Section concludes by discussing how NEPA—under which agencies must conduct environmental reviews for significant project-level, grantmaking, and procurement determinations—is particularly well-suited to the use of the social cost of greenhouse gases.

1. Project Determinations

Numerous substantive statutes require agencies to take into account environmental and climate impacts when considering project-level proposals. When those proposals would entail substantial greenhouse gas emissions—such as proposals to extract, transport, or export fossil fuels—the agency's use of the social cost of greenhouse gases would be particularly useful and facilitate an apples-to-apples comparison to other monetized project impacts.

This Section summarizes various key statutes that govern federal decision-making over fossil-fuel extraction and transportation, highlighting provisions that require a balancing of environmental and economic impacts and explaining how use of the social cost of greenhouse gases best facilitates that comparison.[106]

106. While the social cost of greenhouse gases is the best available tool for assessing the climate impacts of a particular amount of greenhouse gas emissions, other tools and methodologies are necessary

The statutes and processes discussed in this Section are not meant as an exhaustive list; for any project-level determination in which the reviewing agency has the legal authority or obligation to consider climate change impacts, the social cost of greenhouse gases provides the best means to meet that obligation.

a. Energy Leasing, Permitting, and Extraction

Through its management of roughly 640 million acres of federal land (about 28% of U.S. land mass)[107] and 2.5 billion acres of the Outer Continental Shelf,[108] the federal government controls vast reserves of fossil fuels. In total, fossil fuels from public lands and waters make up approximately one quarter of all U.S. carbon dioxide emissions.[109]

The Department of the Interior is the agency primarily responsible for managing fossil-fuel leasing and extraction on federal lands and waters, through two main sub-agencies: the Bureau of Land Management (BLM) oversees fossil-fuel leasing on federal lands, while the Bureau of Ocean Energy Management (BOEM) oversees fossil-fuel leasing in federal waters. A third sub-agency, the Office of Surface Mining (OSM), regulates surface coal-mining operations, which includes approving mining plans for federally-leased coal. Other agencies, including the U.S. Forest Service (part of the Department of Agriculture), also have roles in managing leases on federal lands or in approving the roads and infrastructure necessary to develop fossil fuels on federal lands; though the specific statutory provisions applicable to such other agencies may differ, the general principles discussed below still apply.

Under their respective authorities, each relevant sub-agency must manage federal lands for the public interest, balancing environmental and economic values. For instance, the Mineral Leasing Act requires Interior to "[e]nsure the sale of the production of such leased land to the United States and to the public . . . for the protection of the interests of the United States, . . . and for the safeguarding of the public welfare."[110] The Federal Land Policy and Management Act, which governs onshore leasing, sets forth the policy that "the public lands be managed in a manner that will protect the quality of scientific,

to facilitate an accurate estimate of the greenhouse gas emissions from a particular project or approval. In particular, agencies should make use of substitution analysis, which assesses how much of a project's greenhouse gas emissions (or savings) represents excess emissions versus displacement of emissions that would have occurred elsewhere if not for the project.

107. CONG. RSCH. SERV., R42346, FEDERAL LAND OWNERSHIP: OVERVIEW AND DATA 1 (Feb. 21, 2020).

108. *About BOEM: Fact Sheet*, BUREAU OF OCEAN ENERGY MGMT. 1 (Jan. 2021), https://www.boem.gov/sites/default/files/documents/newsroom/fact-sheets/BOEM-FactSheet-About.pdf [https://perma.cc/2PRG-FJU5].

109. *See* MATTHEW D. MERRILL, BENJAMIN M. SLEETER, PHILIP A. FREEMAN, JINXUN LIU, PETER D. WARWICK & BRADLEY C. REED, U.S. GEOLOGICAL SURV., FEDERAL LANDS GREENHOUSE GAS EMISSIONS AND SEQUESTRATION IN THE UNITED STATES: ESTIMATES FOR 2005-14, at 8 (2018), https://pubs.usgs.gov/sir/2018/5131/sir20185131.pdf [https://perma.cc/B68L-DD3Y].

110. 30 U.S.C. § 187.

scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values."[111]

The Outer Continental Shelf Lands Act, which governs offshore leasing, calls for Interior to promote offshore energy development in a manner that "considers economic, social, and environmental values of the renewable and nonrenewable resources"[112] and to "select the timing and location of leasing, to the maximum extent practicable, so as to obtain a proper balance between the potential for environmental damage, the potential for the discovery of oil and gas, and the potential for adverse impact on the coastal zone."[113] The U.S. Forest Service has broad discretion to make lands under its jurisdiction available for mineral leasing,[114] which it should exercise consistent with its mandate to "serve the national interest . . . based on a comprehensive assessment" of land uses including "environmental and economic impacts."[115]

When a land-use determination has meaningful greenhouse gas implications—as decisions involving fossil-fuel extraction inevitably do—the reviewing agency must balance the resulting greenhouse gas impacts as part of that determination.[116] Yet agencies have typically (though not always) eschewed the social cost metrics in previous land-management analyses, causing a minimization of climate impacts and a skewed analysis that prioritizes economic benefits over the environment and public health. In one recent assessment, for instance, OSM declined to apply the social cost of greenhouse gases for a proposed coal mine expansion—and even claimed that the project would "have minor . . . effects on climate"—even though, as the Working Group's central valuation of the social cost of greenhouse gases would have revealed, the project's emissions contribute roughly $9 billion in climate harm.[117] This figure

111. 43 U.S.C. § 1701(a)(8).

112. *Id.* § 1344(a)(1).

113. *Id.* § 1344(a)(3).

114. 16 U.S.C. § 482.

115. *Id.* § 1600(3).

116. Numerous cases have rejected Interior analyses of project-level determinations under NEPA for failing to properly assess greenhouse gas emissions. *See, e.g.*, Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin., 538 F.3d 1172, 1198-1203 (9th Cir. 2008); WildEarth Guardians v. U.S. Bureau of Land Mgmt., 870 F.3d 1222, 1233-38 (10th Cir. 2017). Such cases necessarily imply that Interior has authority to consider greenhouse gas emissions in its land-use determinations, since "when the agency has no *legal* power to prevent a certain environmental effect, there is no decision to inform, and the agency need not analyze the effect in its NEPA review." Sierra Club v. Fed. Energy Regul. Comm'n, 867 F.3d 1357, 1372 (D.C. Cir. 2017). In another case rejecting Interior's analysis of climate impacts, the Ninth Circuit explicitly recognized this authority. *See* Ctr. for Biological Diversity v. Bernhardt, 982 F.3d 723, 740 (9th Cir. 2020) ("BOEM has the statutory authority to act on the emissions resulting from foreign oil consumption. If it later concludes that such emissions will be significant, it may well approve another alternative included in the [environmental impact statement] or deny the lease altogether.").

117. OFF. OF SURFACE MINING RECLAMATION & ENF'T, *supra* note 93, at 57. This project, the Bull Mountains Mine No. 1, was expected to result in the release of approximately 190 million tons of greenhouse gases, *id.* at 56, which equals about 172.36 million metric tons. Using the central social cost of carbon estimate of $51 per metric ton emitted in the year 2020, this amounts to $8.79 billion in climate harm. *See* 2021 TSD, *supra* note 7, at 5 tbl.ES-1.

significantly exceeds the projected economic benefits of the mine expansion that the agency presented, which totaled less than $3 billion.[118]

This example from OSM is not an outlier, as agencies have continually approved leasing and extraction plans that could cause significant climate harm without using the social cost values to contextualize their greenhouse gas emissions. While failing to monetize greenhouse gas emissions, however, those agencies regularly assess monetized economic values such as revenue and payroll totals. Because the government regularly monetizes purported economic benefits, use of the social cost of greenhouse gases would enable an even-handed comparison with climate change impacts and facilitate the careful balancing that is statutorily required. In a recent proposal for fossil-fuel extraction on public lands in northwestern New Mexico, for instance, Interior projected that the additional extraction would yield no more than $720 million in annual oil and gas economic output.[119] Had it monetized climate costs using the social cost of greenhouse gases, however, Interior would have concluded that the proposal would cause about $850 million in annual climate costs.[120]

Although the federal government has rarely applied the social cost of greenhouse gases in land-management decisions, it has done so on a handful of occasions. Though representing the exception rather than the norm, these limited instances illustrate that the social cost of greenhouse gases is a useful and applicable tool for leasing and extraction decisions. In a 2016 assessment of a lease sale, for instance, BOEM explained that the social cost of greenhouse gases provides "a useful measure" that enables the agency "to incorporate the social benefits of reducing carbon dioxide emissions into its decision-making."[121] BLM also applied the social cost of greenhouse gases to assess the climate impacts of several lease sales.[122]

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118. While OSM did not directly report the total value of extracted coal, it did estimate that the mine expansion would result in 86.8 million tons of coal that would sell for $32.50 per ton. OFF. OF SURFACE MINING RECLAMATION & ENF'T, *supra* note 93, at 18, G-6. 86.8 million multiplied by $32.50 equals $2.821 billion—less than one-third of the climate damage cost. In a proper analysis of economic benefits, the agency would forecast long-term coal prices.

119. U.S. DEP'T OF THE INTERIOR, FARMINGTON MANCOS-GALLUP DRAFT RESOURCE MANAGEMENT PLAN AMENDMENT AND ENVIRONMENTAL IMPACT STATEMENT 3-207 tbl.3-50 (2020). In a competitive market, like for coal, oil, or gas, the market price is typically thought to reflect aggregate willingness to pay based on social utility. Therefore, in calculating and reporting total output, BLM presented a monetized estimate of the supposed social benefits of the resource management plan.

120. Interior reported total annual average gross greenhouse gas emissions under the preferred alternative, Alternative C1, as 15.08 million metric tons of carbon dioxide equivalent. *Id.* at 3-35 tbl.3-14. The Working Group's central estimate of the social cost of carbon for year 2025 emissions is $56 (because the emissions from this project would occur through 2037, the year 2025 was chosen to roughly approximate the midpoint of the project). 2021 TSD, *supra* note 7, at 5 tbl.ES-1. 15.08 million multiplied by $56 is $845 million.

121. BUREAU OF OCEAN ENERGY MGMT., *supra* note 74, at 4-190 to 4-191.

122. *See* BUREAU OF LAND MGMT., U.S. DEP'T OF THE INTERIOR, ENVIRONMENTAL ASSESSMENT DOI-BLM-ID-B010-2014-0036-EA, LITTLE WILLOW CREEK PROTECTIVE OIL AND GAS LEASING 81-83 (2015), https://eplanning.blm.gov/public_projects/nepa/39064/55133/59825/DOI-BLM-ID-B010-2014-0036-EA_UPDATED_02272015.pdf [https://perma.cc/7CZ5-3SBA]; BUREAU OF LAND MGMT., U.S. DEP'T OF THE INTERIOR, ENVIRONMENTAL ASSESSMENT DOI-BLM-MT-C020-2014-0091-EA, OIL AND GAS LEASE PARCEL, OCTOBER 21, 2014 SALE 76 (2014), https://www.blm.gov/sites

As mentioned above, Interior Secretary Deb Haaland issued a Secretarial Order in April 2021 recognizing the advantages of the social cost of greenhouse gases and calling for the methodology to be applied more broadly to assess proposed actions "in addition to rulemakings."[123] This order is an important step in the right direction. Because the social cost metrics offer the best methodology for land-management agencies to balance economic development and environmental protection as their governing statutes require, these metrics should be used broadly to assess the merits of project-level land-use decisions.

b. Energy Transmission and Transportation

The federal government also exerts significant control over fossil-fuel transportation and transmission. Here, too, applicable statutes require the responsible agencies to act in the public interest by considering both economic and environmental impacts. Because the social cost of greenhouse gases enables such balancing and offers the best method to contextualize climate effects, it is similarly effective for informing these determinations.

Perhaps the most significant determination for fossil-fuel transportation and transmission is the approval of interstate natural-gas pipelines by the Federal Energy Regulatory Commission. With natural gas distribution, transmission, and storage directly accounting for nearly 200 million metric tons of carbon dioxide equivalent annually[124]—plus the substantial extraction and combustion emissions that pipelines indirectly facilitate[125]—pipelines impose a significant climate cost. FERC is required to consider that climate cost in deciding whether to grant a certificate of public convenience and necessity permitting interstate pipeline construction.[126] This standard encompasses "all factors bearing on the public interest,"[127] with the Supreme Court recognizing that FERC should balance environmental and economic considerations.[128]

/blm.gov/files/MT-DAKs%20MCFO%20EA%20October%202014%20Sale_Post%20for%2030%20day.pdf [https://perma.cc/255R-76PU].

123. *See supra* note 103 and accompanying text.

124. EPA, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS 1990-2019, at ES-20 tbl.ES-4 (2021) (line for "natural gas systems").

125. *See* JAMES BRADBURY, ZACHARY CLEMENT & ADRIAN DOWN, U.S. DEP'T OF ENERGY, GREENHOUSE GAS EMISSIONS AND FUEL USE WITHIN THE NATURAL GAS SUPPLY CHAIN 4 (2015) (attributing roughly 80% of all greenhouse emissions generated by natural-gas supply chain to combustion).

126. *See, e.g.*, Sierra Club v. Fed. Energy Regul. Comm'n, 867 F.3d 1357, 1373 (D.C. Cir. 2017).

127. Alt. Ref. Co. v. Pub. Serv. Comm'n of N.Y., 360 U.S. 378, 391 (1959).

128. NAACP v. Fed. Power Comm'n, 425 U.S. 662, 670 & n.6 (1976) (stating that while the Natural Gas Act was meant "to encourage the orderly development of plentiful supplies of electricity and natural gas at reasonable prices," regulators "ha[ve] authority to consider conservation, environmental, and antitrust questions"); *see also* Romany M. Webb, *Climate Change, FERC, and Natural Gas Pipelines: The Legal Basis for Considering Greenhouse Gas Emissions Under Section 7 of the Natural Gas Act*, 28 N.Y.U. ENV'T L. J. 179 (2020) (detailing FERC's authority to consider climate impacts—including those from upstream and downstream emissions—in pipeline certification).

Like with fossil-fuel extraction, use of the social cost of greenhouse gases would enable FERC to contextualize the real-world climate impacts of proposed pipelines and directly compare those impacts to economic benefits.[129] For this reason, use of the social cost metrics in public convenience and necessity determinations would enable balanced and rational decision-making. To date, however, FERC has consistently resisted the social cost methodology, offering an array of excuses for ignoring the tool.[130] Dissenting FERC commissioners have called on the agency to weigh climate impacts more rationally in pipeline certificate proceedings,[131] and for all the reasons detailed above, the social cost of greenhouse gases offers such a methodology. In fact, the D.C. Circuit recently found that FERC's stated rationales for rejecting the Working Group's valuations were insufficient.[132]

Broad application of the social cost of greenhouse gases in FERC proceedings would add rigor to the Commission's analysis and could have led to different outcomes in key proceedings. For instance, while FERC did not apply the social cost of greenhouse gases before it approved the Atlantic Coast Pipeline in 2017,[133] outside analysis found that the pipeline would cause approximately $1.3 billion in direct and indirect climate damages on an annual basis, based on the Working Group's central estimate of the social cost of greenhouse gases.[134] While the Commission did not provide a full estimate of economic benefits, it projected just $377 million in annual energy cost savings from bringing additional natural gas to market,[135] plus about $70 million in annual direct, indirect, and induced economic output and tax revenue resulting from the pipeline.[136] While the Commission should have conducted a more rigorous analysis of both environmental costs and economic benefits, this available information indicates that the Commission may well have reached a different

129. Avi Zevin, *Regulating the Energy Transition: FERC and Cost-Benefit Analysis*, 45 COLUM. J. ENV'T L. 510-14 (2020) (detailing how FERC could monetize these benefits).

130. *See* Jayni F. Hein, Jason Schwartz & Avi Zevin, *Pipeline Approvals and Greenhouse Gas Emissions*, INST. FOR POL'Y INTEGRITY 39-51 (2019), https://policyintegrity.org/files/publications/Pipeline_Approvals_and_GHG_Emissions.pdf [https://perma.cc/N2TL-D9ED] (documenting and rebutting FERC's myriad justifications).

131. *See, e.g.*, Rio Grande LNG, LLC, 169 FERC ¶ 61,131, at para. 2 (Nov. 22, 2019) (Glick, Comm'r, dissenting) ("[R]efusing to assess the significance of the project's impact on the most important environmental issue of our time is not reasoned decisionmaking."); N. Nat. Gas Co., 175 FERC ¶ 61,146, at para. 4 (May 20, 2021) (Clements & Glick, Comm'rs, concurring in part and dissenting in part) (faulting the Commission for failing to "fully examine the issue and determine whether the Project's adverse effect on climate change is significant").

132. Vecinos para el Bienestar de la Comunidad Costera v. Fed. Energy Regul. Comm'n, 6 F.4th 1321, 1325 (D.C. Cir. 2021).

133. Atl. Coast Pipeline, LLC, 161 FERC ¶ 61,042 (Oct. 13, 2017). Following FERC's approval, the pipeline was delayed by unrelated legal challenges, and developers cancelled the proposed pipeline in 2020.

134. *See* Brief for the Inst. for Pol'y Integrity at N.Y.U. as Amicus Curiae Supporting Petitioners, Atl. Coast Pipeline, LLC v. FERC, No. 18-1224 (D.C. Cir. Apr. 12, 2019), https://policyintegrity.org/documents/Atlantic_Coast_FERC_Brief.pdf [https://perma.cc/N5W2-D8LD].

135. FERC, ATLANTIC COAST PIPELINE AND SUPPLY HEADER PROJECT FINAL ENVIRONMENTAL IMPACT STATEMENT 4-508 (2017), https://www.ferc.gov/sites/default/files/2020-05/volume-I_9.pdf [https://perma.cc/YQ79-CGYC].

136. *Id.* at 4-508 tbl.4.9.8-2.

conclusion based on the wide disparity between the project's estimated climate costs and economic benefits.

Another agency with substantial authority over fossil-fuel transportation is the Surface Transportation Board, which licenses the construction and operation of new railroad lines including lines designed to transport coal. These railroads can produce substantial direct and indirect greenhouse gas emissions, with 70% of coal transported by rail nationwide and coal accounting for almost half of all tonnage sent by rail as of 2015.[137] Just as FERC is required to for natural gas pipelines, the Surface Transportation Board must account for climate impacts in assessing whether proposed rail lines are consistent with the "public convenience and necessity."[138] On several occasions, federal courts have vacated approvals because the Board did not adequately consider the resulting greenhouse gas emissions.[139]

Applying the social cost of greenhouse gases would enable the Board to balance climate and economic impacts, and thus help facilitate a rational assessment of whether a proposed rail line is in the public interest. For a recent decision to construct an 85-mile rail line in the Uinta Basin in Utah and Colorado, for instance, the Board estimated economic benefits such as tax revenue and labor income,[140] yet declined to contextualize the project's potentially more than 100,000 metric tons of greenhouse gas equivalent (from operational emissions alone) using the social cost of greenhouse gases.[141] Applying the social cost of greenhouse gases to assess the impact of those emissions would have facilitated sounder decision-making by enabling the Board to assess whether the project's purported benefits justified its environmental costs.

Finally, the social cost of greenhouse gases could inform determinations about electricity transmission planning. Electricity currently accounts for about one-third of domestic greenhouse gas emissions,[142] and it is widely agreed that "[n]ew high voltage transmission lines can increase the availability of carbon-free energy and facilitate the replacement of energy generated by fossil fuels,"

137. Jayni F. Hein & Peter Howard, *Reconsidering Coal's Fair Market Value*, INST. FOR POL'Y INTEGRITY 10 (2015), https://policyintegrity.org/files/publications/Coal_fair_market_value.pdf [https://perma.cc/3H5G-YUVV].

138. 49 U.S.C. § 10901(c) (providing "public convenience and necessity" standard).

139. *See* N. Plains Res. Council, Inc. v. Surface Transp. Bd., 668 F.3d 1067, 1082 (9th Cir. 2011) (holding that agency violated NEPA by failing to assess potential environmental impacts of approved coal mine); Mid States Coal. for Progress v. Surface Transp. Bd., 345 F.3d 520, 549-50 (8th Cir. 2003) (vacating approval of new rail lines servicing coal mines because agency failed to assess adverse environmental impacts from increased coal combustion).

140. SURFACE TRANSP. BD., STB DOCKET NO. FD 36284, UINTA BASIN RAILWAY ENVIRONMENTAL IMPACT STATEMENT 3.13-28 to 3.13-31 (2020).

141. *Id.* at 3.7-26; SURFACE TRANSP. BD., STB DOCKET NO. FD 36284, DECISION 16 n.13 (2021) (rejecting use of social cost of carbon).

142. *Frequently Asked Questions: How Much of U.S. Carbon Dioxide Emissions Are Associated With Electricity Generation?*, U.S. ENERGY INFO. ADMIN. (Nov. 2, 2021), https://www.eia.gov/tools/faqs/faq.php?id=77&t=e [https://perma.cc/TFB7-NE3U].

thereby reducing greenhouse gas emissions.[143] Various federal agencies, in particular FERC and DOE, have broad jurisdiction over transmission planning, which they could use to help decarbonize the electricity grid.[144] Use of the social cost of greenhouse gases would enable regulators to assess the climate implications of transmission planning decisions, facilitating determinations that promote cost-effective decarbonization.

c. Fossil-Fuel Exports

The federal government also exerts significant authority over the export of fossil fuels. In particular, exporting natural gas requires a determination from DOE that the proposed transport is "consistent with the public interest."[145] This public interest assessment encompasses a broad "range of factors," including "economic impacts, international impacts, security of natural gas supply, and environmental impacts."[146] Thus, assessing whether to permit natural-gas exports requires balancing environmental impacts, including effects on climate change, with economic considerations and other factors bearing on the public interest. Those climate change impacts are substantial: the United States exported roughly 90 billion cubic meters of natural gas in 2017, ranking fourth in the world.[147]

Like with fossil-fuel extraction and transmission, application of the social cost of greenhouse gases would enable DOE to rationally consider climate impacts alongside other costs and benefits in assessing whether a proposed fossil-fuel export project satisfies the public interest. The agency's recent practices, in contrast, have not enabled a meaningful weighting of greenhouse gas impacts. For instance, DOE recently determined that a proposed liquefied natural gas export facility would result in the export of 929 billion cubic feet of natural gas per year[148]—the equivalent of over 50 million metric tons of carbon dioxide annually.[149] DOE could have determined, using the Working Group's current

143. STAFF OF THE FED. ENERGY REGUL. COMM'N, REPORT ON BARRIERS AND OPPORTUNITIES FOR HIGH VOLTAGE TRANSMISSION 12 (2020) [hereinafter FERC CONGRESSIONAL REPORT]; *see also* Avi Zevin, Sam Walsh, Justin Gundlach & Isabel Carey, *Building a New Grid Without New Legislation: A Path to Revitalizing Federal Transmission Authorities*, 48 ECOL. L.Q. 169, 171 (2021) ("There is now broad agreement (if not a consensus) that new, long-distance, high-voltage transmission lines will be indispensable if the United States is to integrate enough renewable generation to decarbonize the electric system . . . .").

144. *See generally* FERC CONGRESSIONAL REPORT, *supra* note 143, at 5-6.

145. 15 U.S.C. § 717b(a).

146. Alaska LNG Project LLC, Final Opinion and Order Granting Long-Term Authorization to Export Liquefied Natural Gas to Non-Free Trade Agreement Nations, DOE/FE Order No. 3643-A, at 10 (Aug. 20, 2020) [hereinafter DOE Final Opinion], https://www.energy.gov/sites/default/files/2020/08/f77/rod-eis-0512-alaska-lng-2020-08-20.pdf [https://perma.cc/YF4H-ZSXN].

147. *The World Factbook: United States*, CIA, https://www.cia.gov/the-world-factbook/countries/united-states/ [https://perma.cc/DB4Q-UXWU].

148. DOE Final Opinion, *supra* note 146, at 1.

149. To convert from cubic feet to metric tons of carbon dioxide, we used the EPA's Greenhouse Gas Equivalencies Calculator, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator [https://perma.cc/E33E-C4NY].

central valuation of the social cost of greenhouse gases, that this equates to about $2.5 billion in climate damages per year[150]—a figure that substantially exceeds the project's payroll totals, for instance.[151] Instead, DOE declined to apply the social cost of greenhouse gases and approved the export project despite finding that it "could not determine whether [the] project's contribution to climate change would be significant."[152] Applying the social cost valuations in future determinations would enable DOE to appropriately weigh the climate impacts of export projects against other factors bearing on the public interest.

2. Grantmaking

Federal agencies can also incorporate the social cost of greenhouse gases into the administration of discretionary grant programs. Pursuant to OMB regulations, agencies have broad authority to award discretionary grants. In particular, agencies are instructed to develop their own "objective process of evaluating Federal award applications" with the aim "of selecting recipients most likely to be successful in delivering results based on the program objectives."[153] Numerical metrics offer an objective basis to assess grant applications under this merit review process, and the social cost of greenhouse gases would fit seamlessly into any quantified assessment and allow an agency to contextualize the project's climate impacts (positive or negative) against its budget and other real-world effects. In fact, several agencies use cost-benefit analysis to assess grant applications, where the social cost of greenhouse gases can be particularly useful.

DOT already uses the social cost of greenhouse gases to assess discretionary grants through cost-benefit analysis. Under the Rebuilding American Infrastructure with Sustainability and Equity (RAISE) program, for instance, DOT provides discretionary grants for investment in road, rail, transit, and port projects, distributing nearly $10 billion in grant funding since 2009.[154] Under the Infrastructure for Rebuilding America program, DOT provides grants for certain regional transportation projects.[155] For both of these programs and others, DOT requests applicants to submit a cost-benefit analysis,[156] and agency

150. This calculation uses the Working Group's central social cost estimation for 2020 carbon dioxide emissions of $51 per metric ton. Multiplied by 50 million metric tons, this equals over $2.5 billion.

151. FERC, FINAL ENVIRONMENTAL IMPACT STATEMENT-ALASKA LNG PROJECT 4-638 tbl.4.11.2-8 (2020).

152. DOE Final Opinion, *supra* note 146, at 26 (internal quotation marks omitted).

153. 2 C.F.R. § 200.205 (2021).

154. *About RAISE Grants*, U.S. DEP'T OF TRANSP., https://www.transportation.gov/RAISEgrants/about [https://perma.cc/SV4E-3YAQ].

155. *Infrastructure for Rebuilding America*, U.S. DEP'T OF TRANSP., https://www.transportation.gov/buildamerica/financing/infra-grants/infrastructure-rebuilding-america [https://perma.cc/S9ZP-C6PS].

156. *See* U.S. DEP'T OF TRANSP., BENEFIT-COST ANALYSIS GUIDANCE FOR DISCRETIONARY GRANT PROGRAMS 5 (2022), https://www.transportation.gov/sites/dot.gov/files/2022-03/Benefit%20Cost%20Analysis%20Guidance%202022%20%28Revised%29.pdf [https://perma.cc/GQB7-P72C] (instructing grant "applicants to provide analyses that are consistent with the methodology outlined in this guidance as part of their application seeking discretionary Federal support, where required").

guidance explicitly endorses the use of the Working Group's social cost valuations in those analyses.[157] By using the social cost of greenhouse gases in evaluating grant applications, DOT is able to contextualize climate costs or benefits with other project effects, incorporate climate impacts seamlessly into the merit review process, and determine if a project's benefits justify its costs.[158]

Other agencies could follow suit. For instance, the Department of Housing and Urban Development (HUD) provides Community Development Block Grant Mitigation funds to communities that are recovering from natural disasters through the Rebuild by Design program. HUD requires applicants to provide a cost-benefit analysis as part of the application, and in fact even recognizes that greenhouse gas impacts are a relevant environmental value in that analysis, yet does not specifically endorse using the social cost of greenhouse gases.[159] Clearer guidance that explicitly endorses the Working Group's damage estimates would ensure consistency and promote energy-efficiency in project design by ensuring that climate impacts are given proper weight alongside other costs and benefits.

Even without requiring formal cost-benefit analyses in grant applications or evaluations, the social cost of greenhouse gases can be highly useful to federal agencies in administering discretionary grant programs. An agency that chooses to evaluate applications in a manner other than calculating net benefits should still be aware of the cost that a project's emissions impose on society (or benefits from an energy-saving project) and factor that into its assessment. As detailed above, the social cost of greenhouse gases allows decisionmakers to view the cost of emissions in a manner that is salient and interoperable.

3. Procurement

Use of the social cost of greenhouse gases can also be highly useful for government procurement. Agencies have broad discretion to consider environmental and climate impacts in their procurement decisions, and use of the social cost of greenhouse gases offers the best method for assessing climate impacts alongside other monetized values such as budgetary cost.

Agency procurement processes are governed by a government-wide regulation known as the Federal Acquisition Regulation (FAR), which is issued by the Federal Acquisition Regulatory Council. Multiple sections of the FAR, as well as federal statutes, permit agencies to use the social cost of greenhouse gases in procurement. For instance, federal law instructs agencies to establish procurement practices to promote proposals "at the lowest cost or best value

157. *Id.* at 38 tbl.A-6.

158. *See id.* at 6 (explaining that cost-benefit analysis "is a systematic process for identifying, quantifying, and comparing expected benefits and costs of a potential infrastructure project").

159. U.S. DEP'T OF HOUS. & URB. DEV., COMMUNITY DEVELOPMENT BLOCK GRANT DISASTER RECOVERY (CDBG-DR)-REBUILD BY DESIGN: GUIDANCE REGARDING CONTENT AND FORMAT OF MATERIALS FOR APPROVAL OF CDBGDR ACTION PLAN AMENDMENTS RELEASING FUNDS FOR CONSTRUCTION OF REBUILD BY DESIGN (RBD) PROJECTS, INCLUDING GUIDANCE FOR BENEFIT-COST ANALYSIS 1-3, 7 (2016), https://www.hud.gov/sites/documents/16-06CPDN.PDF [https://perma.cc/ZR9M-2RX9].

considering the nature of the property or service procured."[160] The FAR explains that "[b]est value must be viewed from a broad perspective and is achieved by balancing the many competing interests in the [procurement] [s]ystem,"[161] and defines the term as "the expected outcome of an acquisition that . . . provides the greatest overall benefit."[162] Because the social cost of greenhouse gases calculates the "overall benefit" or cost from an incremental decrease or increase in greenhouse gas emissions, it can be highly beneficial for assessing the "best value" among competing proposals.

At numerous junctures, in fact, the FAR recognizes that agencies should balance environmental considerations in procurement determinations. One provision, for instance, declares it the policy of the federal government to acquire goods and services in a manner that "safeguards the health of our environment" and "reduces greenhouse gas emissions from direct and indirect Federal activities."[163] Other provisions specifically recognize that agencies may assess "[e]nvironmental and energy efficiency considerations" in evaluating best value.[164] Additionally, agencies are required to "[i]mplement cost-effective contracting preference programs promoting energy-efficiency . . . and the acquisition of environmentally preferable products and services."[165] As detailed throughout this Article, the social cost of greenhouse gases offers the best method for agencies to balance environmental considerations against other monetized values, as it enables an apples-to-apples comparison of different factors.

A service contract awarded by the General Services Administration (GSA) exemplifies how agencies can incorporate the social cost of greenhouse gases into procurement decisions. Specifically, the GSA applied the social cost of carbon to compare different carriers when awarding parcel-shipping contracts.[166] As GSA explained, the agency "asked contractors for initial benchmarks and goals for alternative fuel and vehicle use as part of their proposals," "investigated the anticipated [greenhouse gas] emissions performance of each contractor," and then "used the . . . [social cost of carbon] estimates to monetize and compare the market and non-market economic impacts of these expected contractor emissions."[167] The GSA then "considered these estimates alongside price and other past performance information when assessing the value of proposals" in making its selection.[168]

Many other agency procurement decisions have substantial greenhouse gas implications and could benefit from a similarly robust consideration of climate

160. 41 U.S.C. § 1702(b)(3)(B).
161. 48 C.F.R. § 1.102-1(b) (2021).
162. *Id.* § 2.101.
163. *Id.* § 23.202(a).
164. *Id.* §§ 8.405-1(f)(7), 8.405-3(a)(2)(vii).
165. *Id.* § 23.703(a).
166. *GSA Includes New Environmental Features in Next-Generation Parcel Delivery*, GEN. SERV. ADMIN., https://www.gsa.gov/cdnstatic/DDS3_green_features_fact_sheet.doc [https://perma.cc/9KWL-YRDG].
167. *Id.*
168. *Id.*

impacts using the social cost of greenhouse gases. The federal government consumes over 900 million BTUs of energy annually, about three-quarters of which are attributable to the Department of Defense.[169] Agency purchases of large, energy-intensive equipment—such as aircraft or motor vehicles—could particularly benefit from a rational, monetary assessment of climate effects.[170] The FAR Council recently indicated an interest in potentially applying the social cost of greenhouse gases in federal procurement decisions[171] and should now take further steps to ensure that this occurs.

4. NEPA Assessments

Whether assessing individual project applications, grantmaking proposals, or procurement awards, agencies are typically required to conduct an environmental analysis pursuant to NEPA. NEPA not only permits use of the social cost of greenhouse gases, but in fact the social cost metrics offer the best available methodology to fulfill NEPA's aims and mandates. By contrast, alternative approaches that agencies have adopted in recent years provide limited insight into the scope of climate impacts and do not fulfill NEPA's requirements.

Under NEPA, federal agencies must provide environmental assessments for major actions. They must identify "the environmental impact of the proposed action,"[172] including "any adverse environmental effects which cannot be avoided should the proposal be implemented,"[173] to help ensure that "environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations."[174] As part of the "hard look" that agencies must take at environmental impacts,[175] NEPA and its implementing regulations require them to identify and assess alternatives to the proposed action[176] and consider avenues to mitigate environmental harms.[177] Agencies are expected to "make use of reliable existing data and

169. Fred Mayes, *U.S. Government Energy Consumption Continues to Decline*, U.S. ENERGY INFO. ADMIN. (July 25, 2019), https://www.eia.gov/todayinenergy/detail.php?id=40192 [https:// perma .cc/PU3T-TXSF]. The Department of Defense issues its own supplement to the FAR, known as the Defense Federal Acquisition Regulation, but remains subject to the FAR and its provisions discussed in this section. *See Federal Acquisition Regulation*, U.S. DEP'T OF DEF., https://www.acq.osd.mil/dpap/dars /far.html [https://perma.cc/ZY67-VNNK] (explaining that FAR applies to "all [e]xecutive agencies").

170. In a recent environmental impact statement for the purchase of a new fleet of delivery vehicles, the U.S. Postal Service applied the social cost of greenhouse gases. *See* U.S. POSTAL SERV., FINAL ENVIRONMENTAL IMPACT STATEMENT: NEXT GENERATION DELIVERY VEHICLE ACQUISITIONS 4-16 (2021).

171. Federal Acquisition Regulation: Minimizing the Risk of Climate Change in Federal Acquisition, 86 Fed. Reg. 57,404, 57,405 (Oct. 15, 2021).

172. 42 U.S.C. § 4332(C)(i).

173. *Id.* § 4332(C)(ii).

174. *Id*. § 4332(B).

175. Balt. Gas & Elec. Co. v. Natural Res. Def. Council, 462 U.S. 87, 97 (1983) (internal quotation marks omitted).

176. 42 U.S.C. § 4332(C)(iii); 40 C.F.R. § 1502.14 (2021) (outlining agency's obligations to consider and evaluate alternatives to the proposed action, including the "no action alternative").

177. 40 C.F.R. §§ 1502.14(e), 1502.16(a)(6), (7), (9).

resources" to assess environmental impacts,[178] with a preference for "approaches or research methods generally accepted in the scientific community."[179]

Greenhouse gas emissions are a relevant and necessary consideration under NEPA for projects with climate impacts.[180] As discussed above, agencies under the Trump Administration routinely presented quantitative estimates of the tons of greenhouse gases emitted or reduced under federal proposals in NEPA assessments, which they frequently supplemented with generic qualitative descriptions of the present and future impacts of climate change and comparisons to global, national, or state greenhouse gas emission totals or targets.[181] While quantifying greenhouse gas emissions and understanding the basic effects of climate change are key initial steps to assessing the climate impacts from a single project or proposal, application of the social cost of greenhouse gases would enable a more complete assessment of climate impacts and thereby better fulfill NEPA's requirements and aims.

For one, the social cost valuations best fulfill NEPA's aim of assessing "actual environmental effects."[182] As the U.S. Court of Appeals for the D.C. Circuit has explained, "NEPA requires the health, socioeconomic and cumulative impacts of a proposed action to be disclosed," as such effects inform "decisionmakers of the environmental impact of the action" and their consideration enables "the environmental cost-effectiveness of a proposed action [to] be compared to that of alternative actions."[183] The social cost of greenhouse gases encapsulates these impacts, as it assesses the incremental climate effects of greenhouse gas emissions including property lost or damaged by sea-level rise, coastal storms, flooding, and other extreme weather events, and human health impacts including mortality from heat-related illnesses and changing disease vectors like malaria and dengue fever.[184] Volumetric emission projections, standing alone, do not assess any of those effects.[185]

178. *Id.* § 1502.23.

179. *Id.* § 1502.21(c)(4); *see also* Vecinos para el Bienestar de la Comunidad Costera v. FERC, 6 F.4th 1321, 1329 (D.C. Cir. 2021) (stating that this regulation "appears applicable on its face" to the social cost of greenhouse gases).

180. *See* Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin., 538 F.3d 1172, 1216 (9th Cir. 2008) ("The impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impacts analysis that NEPA requires agencies to conduct."); Sierra Club v. Fed. Energy Reg. Comm'n, 867 F.3d 1357, 1374 (D.C. Cir. 2017) (requiring the FERC to "engage in informed decision making with respect to the greenhouse-gas effects of [natural-gas infrastructure] project" and to consider those effects under NEPA) (internal quotation marks omitted); Border Power Plant Working Grp. v. U.S. Dep't of Energy, 260 F. Supp. 2d 997, 1028-29 (S.D. Cal. 2003) (holding that failure to disclose a project's indirect carbon dioxide emissions violates NEPA).

181. *See supra* note 93 and accompanying text.

182. Balt. Gas & Elec. Co. v. Natural Res. Def. Council, 462 U.S. 87, 96 (1983).

183. Natural Res. Def. Council v. U.S. Nuclear Regul. Comm'n, 685 F.2d 459, 487 (D.C. Cir. 1982), *rev'd on other grounds sub nom.* Balt. Gas & Elec. Co. v. Natural Res. Def. Council, 462 U.S. 87 (1983).

184. 2010 TSD, *supra* note 2, at 6.

185. *See Natural Res. Def. Council*, 685 F.2d at 487 ("[I]t is not releases of [pollution] that Congress wanted disclosed [under NEPA]; it is the effects, or environmental significance, of those releases."); *see also* Klamath-Siskiyou Wildlands Ctr. v. Bureau of Land Mgmt., 387 F.3d 989, 995 (9th

For this reason, numerous federal courts have rejected NEPA analyses that report only volumetric emission projections or that solely compare those emissions to larger volumes such as total global or domestic emissions. The most significant of these cases is the Ninth Circuit's decision in *Center for Biological Diversity*—the opinion discussed above that struck down a regulatory cost-benefit analysis for not including climate costs.[186] In another section of that opinion, the Ninth Circuit also concluded that the agency's NEPA analysis, which projected emissions resulting from the regulation and compared those emissions to national totals, was insufficient because it did not "evaluate the incremental impact that these emissions will have on climate change or on the environment more generally."[187] Since that 2008 opinion, numerous other courts have also rejected NEPA analyses that merely quantified emissions without applying the social cost of greenhouse gases.[188] Though not every reviewing court has come to this conclusion,[189] no court has prohibited use of the social cost of greenhouse gases in assessments under NEPA either. As a result, agencies could limit legal risk by applying the social cost of greenhouse gases in NEPA assessments.

Application of the social cost of greenhouse gases is also useful under NEPA because it allows agencies to seamlessly compare climate impacts to other effects such as the revenue and payroll impacts that agencies typically monetize in their environmental reviews. While NEPA does not require a formal cost-benefit analysis,[190] it does require agencies to balance environmental values with other economic and social considerations.[191] Federal courts have held that NEPA "mandates a rather finely tuned and 'systematic' balancing analysis" of

Cir. 2004) (concluding that quantifying the acres of timber to be harvested or the miles of road to be constructed does not constitute a "description of *actual* environmental effects," even when paired with a qualitative "list of environmental concerns such as air quality, water quality, and endangered species," if the agency fails to assess "the degree that each factor will be impacted").

186. *See supra* notes 15-20 and accompanying text.

187. Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin., 538 F.3d 1172, 1216 (9th Cir. 2008) (internal quotation marks omitted).

188. *See, e.g.*, High Country Conservation Advocates v. U.S. Forest Serv., 52 F. Supp. 3d 1174, 1190 (D. Colo. 2014) ("Beyond quantifying the amount of emissions relative to state and national emissions and giving general discussion to the impacts of global climate change, [the agencies] did not discuss the impacts caused by these emissions."); California v. Bernhardt, 472 F. Supp. 3d 573, 623 (N.D. Cal. 2020) ("[F]raming sources as less than 1% of global emissions is dishonest and a prescription for climate disaster . . . . Mere quantification is insufficient."); Mont. Env't Info. Ctr. v. U.S. Off. of Surface Mining, 274 F. Supp. 3d 1074, 1096-99 (D. Mont. 2017) (rejecting the argument that the agency "reasonably considered the impact of greenhouse gas emissions by quantifying the emissions which would be released if the [coal] mine expansion is approved, and comparing that amount to the net emissions of the United States").

189. Cases that have rejected the need to apply the social cost of greenhouse gases in NEPA analyses include EarthReports, Inc. v. Fed. Energy Regul. Comm'n, 828 F.3d 949, 956 (D.C. Cir. 2016); Citizens for a Healthy Cmty. v. Bureau of Land Mgmt., 377 F. Supp. 3d 1223, 1239-41 (D. Colo. 2019); and WildEarth Guardians v. Zinke, 368 F. Supp. 3d 41, 77-79 (D.D.C. 2019).

190. 40 C.F.R. § 1502.22 (2021).

191. *See* 42 U.S.C. §§ 4331(a), 4332(B).

"environmental costs" against "economic and technical benefits."[192] And regulations broadly sanction the use of cost-benefit analysis under NEPA and indicate that monetized values can be useful.[193] Because agencies frequently provide monetized estimates of the economic benefits of proposed fossil-fuel projects in their environmental impact statements, failing to monetize climate costs jeopardizes the balancing that NEPA requires and could lead to a lopsided analysis. For this reason, federal courts have held on numerous occasions that an agency violated NEPA by monetizing project benefits but not climate costs.[194]

The utility of the social cost of greenhouse gases for assessing climate impacts contrasts sharply with the use of percentage comparisons to jurisdictional totals or targets, which has served as the preferred method for numerous agencies. The latter practice frequently makes massive amounts of emissions from an individual project or action seem relatively small when misleadingly compared to a far larger denominator. As one federal court recently recognized, "[t]he global nature of climate change and greenhouse-gas emissions means that any single . . . project likely will make up a negligible percent of state and nation-wide greenhouse gas emissions."[195] Yet despite its obvious flaws, agencies have persisted in assessing the significance of climate impacts using percentage comparisons.[196] At the same time, agencies have not attempted to minimize other project impacts by comparing them to national or global totals, such as comparing a project's projected revenues to gross domestic product.

The advantages of applying the social cost of greenhouse gases over the percentage-comparison approach are notable. In the NEPA assessment for the recent OSM approval discussed above, for instance, the agency deemed the carbon dioxide emissions from the proposed coal-mine expansion "small" because they comprised 0.44% of the annual global total.[197] While this may seem

192. Calvert Cliffs' Coordinating Comm., Inc. v. U.S. Atomic Energy Comm'n, 449 F.2d 1109, 1113 (D.C. Cir. 1971); *see also*, *e.g.*, Chelsea Neighborhood Ass'ns v. U.S. Postal Serv., 516 F.2d 378, 386 (2d Cir. 1975) ("NEPA, in effect, requires a broadly defined cost-benefit analysis of major federal activities."); Sierra Club v. Sigler, 695 F.2d 957, 978-79 (5th Cir. 1983) (holding that NEPA "mandates at least a broad, informal cost-benefit analysis," and so agencies must "fully and accurately" and "objectively" assess environmental, economic, and technical costs).

193. 40 C.F.R. § 1502.22.

194. *See* High Country Conservation Advocates v. U.S. Forest Serv., 52 F. Supp. 3d 1174, 1190--91 (D. Colo. 2014) (finding that it was "arbitrary and capricious to quantify the *benefits* of the lease modifications and then explain that a similar analysis of the *costs* was impossible when such an analysis was in fact possible"); Mont. Env't Info. Ctr. v. U.S. Office of Surface Mining, 274 F. Supp. 3d 1074, 1094--99 (D. Mont. 2017) (similar)*; see also* Jayni F. Hein & Natalie Jacewicz, *Implementing NEPA in the Age of Climate Change*, 10 MICH. J. ENV'T & ADMIN. L. 1, 41-42 (2021) (explaining that "inconsistent treatment of expected revenue and expected emissions places a thumb on the scale in favor of [fossil-fuel] development").

195. WildEarth Guardians v. Bureau of Land Mgmt., 457 F. Supp. 3d 880, 894 (D. Mont. 2020); *see also* Sw. Elec. Power Co. v. EPA, 920 F.3d 999, 1032 (5th Cir. 2019) (explaining that even a seemingly "very small portion of a gargantuan source of . . . pollution" may "constitute[] a gargantuan source of . . . pollution on its own terms") (internal quotation marks omitted); 350 Montana v. Haaland, 29 F.4th 1158, 1171 (9th Cir. 2022) ("[V]irtually *every* domestic source of GHGs may be deemed to have no significant impact as long as it is measured against total global emissions.")

196. *See* Hein & Jacewicz, *supra* note 194, at 20 (discussing this "'frivolous fraction' fallacy" and providing examples of agency usage).

197. OFF. OF SURFACE MINING RECLAMATION AND ENF'T, *supra* note 93, at D-2.

like a negligible contribution at a quick glance, contextualizing the project's greenhouse gas emissions as contributing roughly $9 billion in climate harm (as the Working Group's current central valuation of the social cost of greenhouse gases would have revealed)[198] demonstrates the fallacy of this logic.[199] Presenting climate impacts as a monetized damage estimate, rather than as a small percentage of the global total, likely would have triggered closer scrutiny from the agency and allowed for a more careful comparison to the project's economic benefits.

B. Internalizing Climate Costs

The social cost of greenhouse gases can also be highly advantageous when administrative agencies seek to internalize the costs of climate change onto the energy producers who are responsible for creating those costs.

In economics, the costs of climate change are known as a *negative externality*, which is a market failure that results when a cost caused by a producer is not financially borne by that producer. Negative externalities are market failures because producers, lacking financial incentive to do so, do not consider the costs that they impose on third parties. Thus, the amount of production and combustion that maximizes producer profit exceeds the amount that is optimal from the perspective of society as a whole. Businesses are insufficiently disincentivized from engaging in fossil-fuel extraction and combustion because they do not bear the costs of climate change, resulting in an overreliance on fossil fuels.

The market failure of negative externalities can be corrected by "internalizing" those externalities—that is, by shifting the external cost from third parties onto the producer. This realigns the producer's incentives with the public interest since there are no longer external costs, and therefore the profit-maximizing approach also maximizes net social benefit. Thus, while producers are currently incentivized to over-invest in fossil-fuel extraction because they bear few of the environmental and climate costs that their production imposes, this market failure can be corrected by internalizing those external costs.

Of course, internalizing a cost onto the responsible party requires quantifying that cost. And since the social cost of greenhouse gases is an estimate of economic damages due to a particular amount of emissions, it provides that quantification.[200] While federal agencies currently do not use the social cost of greenhouse gases to shift the cost of climate change onto responsible parties,

198. *See supra* note 117 and accompanying text.

199. In April 2022, the Ninth Circuit rejected OSM's analysis, concluding that the analysis was "deeply troubling and insufficient to meet Interior's burden" under NEPA to take a hard look at climate effects. *350 Montana*, 29 F.4th at 1170.

200. As discussed above, the current social cost values from the Working Group should be considered conservative underestimates. Even applying those conservative values in the contexts discussed below would shift much of the cost of climate change onto the responsible parties. As the Working Group updates its values to monetize key omitted damages, agencies should apply those updated values to determine the applicable rate for any process meant to internalize climate costs.

there are numerous avenues available to do so. This Section highlights a few of those avenues, namely, mineral royalties, administrative penalties, and wholesale electricity rates.

1. Mineral Royalties

Although fossil-fuel extraction on federal lands accounts for a huge share of domestic greenhouse gas emissions,[201] the federal government currently does not internalize the cost of greenhouse gas pollution onto producers, resulting in an overproduction of fossil fuels. The Department of the Interior can correct this imbalance through royalty rates for mineral extraction. In particular, imposing a "carbon adder" based on the social cost of greenhouse gases as part of the royalty rate would internalize the climate costs of fossil-fuel extraction, better aligning the incentivizes of producers with the public interest while ensuring that taxpayers receive fairer value for the use of public lands and waters.

Internalizing the costs of climate pollution through royalty rates is well within Interior's statutory authority. Resource-management statutes set floors for royalty rates but give the agency wide latitude to set rates above those minimums.[202] By law, moreover, Interior must receive "fair market value" for any onshore or offshore leasing[203]—a broad term that allows for a wide array of considerations. Particularly given the law's concern for the environmental impacts of resource extraction and its charge for Interior to weigh those impacts in setting resource-management policy,[204] it would be both rational and lawful for Interior to account for environmental externalities in assessing the "fair market value" of resource extraction. Several academics have proposed that Interior account for climate externalities in setting royalty rates,[205] and the Bureau of Land Management embraced (though never implemented) the concept as a means of reforming the coal leasing program.[206]

Despite its broad authority, however, Interior's current royalty rates do not account for the costs of greenhouse gas pollution. Analyses based on the social cost of greenhouse gases find that royalty rates would be substantially higher for

201. *See supra* note 109 and accompanying text.

202. *See* 30 U.S.C. § 226(b)(1)(A) (setting a minimum royalty rate of 12.5% of onshore oil and gas revenues); *id.* § 207(a) (setting a minimum royalty rate of 12.5% of surface coal revenues); 43 U.S.C. § 1337(a)(1) (setting a minimum royalty rate of 12.5% of offshore oil and gas revenues).

203. 43 U.S.C. § 1344(a)(4) (offshore); *id.* § 1701(a)(9) (onshore). Federal statutes provide minimum royalty rates for extraction on public lands, but do not impose maximum rates. *See supra* note 202.

204. *See supra* notes 110-115 and accompanying text.

205. *See, e.g.*, Michael Burger, *A Carbon Fee as Mitigation for Fossil Fuel Extraction on Federal Lands*, 42 COLUM. J. ENV'T L. 295 (2017); Jayni F. Hein, *Federal Lands and Fossil Fuels: Maximizing Social Welfare in Federal Energy Leasing*, 42 HARV. ENV'T L. REV. 1, 51-55 (2018).

206. BUREAU OF LAND MGMT., U.S. DEP'T OF THE INTERIOR, FEDERAL COAL PROGRAM: PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT – SCOPING REPORT ES-5 (2017) (expressing interest in "[a]ccount[ing] for carbon-based externalities through royalty rate increase or royalty adder"); *id.* at 6-13 to 6-16.

coal,[207] oil, and gas[208] if they accounted for climate externalities. This could also raise billions of dollars for federal and state governments. According to one estimate, a royalty surcharge on oil and gas extraction, based on the Working Group's current central social cost of greenhouse gases valuations, would increase royalty revenue by $4.5 billion while also reducing emissions by 18 million metric tons per year.[209] Given Interior's broad mandate to balance environmental protection and economic development, the agency should adjust federal royalty rates to internalize the costs of greenhouse gas pollution. The social cost of greenhouse gases offers that opportunity.

2. Administrative Penalties

The social cost of greenhouse gases can also be incorporated into the assessment of federal administrative penalties to help agencies internalize the cost of greenhouse gas emissions resulting from violations of statutory programs. While each federal statute contains its own noncompliance provisions with differing guidelines and limitations, agencies generally retain broad discretion when assessing penalties. Incorporating the social cost of greenhouse gases into penalty assessments would enable agencies to more accurately calculate penalties based on the harms from violations.

Several statutes in particular present opportunities for internalizing the climate costs of emissions from noncompliance. Title I of the Clean Air Act, which authorizes the regulation of pollution from stationary sources (such as power plants and factories), permits EPA to assess a civil penalty of up to $25,000 per day of violation.[210] EPA guidance provides for a penalty schedule that varies based on the gravity of the violation, including the degree of noncompliance, the provision violated, and other factors.[211] This guidance also provides that EPA may adjust upward from the default penalty if "the environmental damage caused by the violation is so severe that the [default penalty amount] alone is not a sufficient deterrent."[212] When noncompliance results in the release of significant greenhouse gas pollution, EPA could apply the social cost of greenhouse gases to determine the "environmental damage

207. Jayni F. Hein & Peter Howard, *Illuminating the Hidden Cost of Coal*, INST. FOR POL'Y INTEGRITY 3 (2015), https://policyintegrity.org/files/publications/CoalCostsSummary.pdf [https://perma.cc/63YX-HQMA] ("Accounting for both methane and transportation externality costs would justify adding 70.1 percent to the current 12.5 percent surface-mine royalty rate," thereby "justify[ing] a new royalty rate of 82.6 percent for federal surface-mined coal.").

208. Brian C. Prest & James H. Stock, *Climate Royalty Surcharges* 4 (Nat'l Bureau of Econ. Rsch., Working Paper No. 28564, 2021) (finding that climate externalities justify a 19% royalty surcharge for oil and gas extraction using the Working Group's current social cost valuations, or a 44% royalty surcharge using a $125 per metric ton social cost of carbon based on a 2% discount rate).

209. *Id.* at 17 tbl.3 (finding that a 19% royalty surcharge on federal oil and gas extraction, based on the current social cost of greenhouse gas valuations, would produce $14.1 billion in annual royalties, compared to $9.6 billion under current royalty figure).

210. 42 U.S.C. § 7413(d)(1).

211. EPA, CLEAR AIR ACT STATIONARY SOURCE CIVIL PENALTY POLICY 8-19 (1991), https://www.epa.gov/sites/default/files/documents/penpol.pdf [https://perma.cc/444H-ZZFN].

212. *Id.* at 19.

caused" and adjust the penalty upward if the default penalty fails to fully internalize that damage amount.

The National Highway Traffic Safety Administration (NHTSA) also has broad discretion to incorporate the social cost of greenhouse gases into penalty assessments for violations of the Corporate Average Fuel Economy (CAFE) program, under which vehicle fuel-efficiency standards are set. The Energy Policy and Conservation Act (under which the CAFE program is administered) prescribes a floor civil penalty amount, which is a function of each fleet's degree of noncompliance above the mandated efficiency standard.[213] The statute further provides, subject to certain limitations, that NHTSA may increase the penalty if doing so "will result in, or substantially further, substantial energy conservation for automobiles."[214] This broad authority enables NHTSA to reconsider and potentially raise the penalty amount to reflect external damages, including climate harm.[215]

In addition to the penalties for downstream usage, the leasing and transmission statutes discussed above also frequently provide leeway for agencies to account for climate damages in administrative penalties. For instance, BOEM "consider[s] the severity of the violations," among other factors,[216] in administering penalties when a lessee "fails to comply with . . . any term of a lease, license, or permit issued [by BOEM], or any regulation or order issued" by the agency.[217] The "severity of the violations" consideration could include external climate-related damages stemming from noncompliance, thus enabling BOEM to incorporate the social cost of greenhouse gases in penalty assessments. Similarly, FERC has discretion to incorporate the social cost of greenhouse gases when assessing penalties under the Natural Gas Act for noncompliance with the terms and conditions of a pipeline certificate, as FERC is authorized to consider "the nature and seriousness of the violation" when assessing civil penalties.[218]

Because federal agencies often have broad discretion when setting penalties for statutory violations, penalty assessments present an opportunity to internalize the harms that result from noncompliance with emission-related standards. Using the social cost of greenhouse gases to accurately reflect climate harms from noncompliance can increase penalty rates and more effectively deter future violations, thus curtailing emissions.

213. 49 U.S.C. § 32912(b).

214. *Id.* § 32912(c)(1)(A)(i).

215. *See* Zero Zone v. Dep't of Energy, 832 F.3d 654, 677 (7th Cir. 2016) (agreeing with DOE that the Environmental Policy and Conservation Act's energy-conservation goals encompass consideration of environmental and climate impacts).

216. 30 C.F.R. § 550.1470 (2021).

217. 43 U.S.C. § 1350(b).

218. *Id.* § 717t-1(c).

3. Wholesale Electricity Rates

The federal government can also internalize the costs of climate pollution onto energy producers through its authority over wholesale electricity rates. In particular, under the Federal Power Act, FERC must ensure that wholesale electricity rates are "just and reasonable,"[219] a standard that enables the agency to consider and address market imperfections.[220] If it rejects a proposed rate, FERC may set just and reasonable rates for the wholesale market.[221] In that case, the agency must demonstrate "that the new rate is just, reasonable and not unduly discriminatory"[222]—a standard that affords the agency broad discretion.[223]

The impact of greenhouse gas pollution is a substantial externality in the electricity market. According to an estimate from Bethany A. Davis Noll and Burcin Unel, the external damages of carbon dioxide emissions from electricity generation caused roughly $87 billion of climate harm in 2017, highlighting the need to consider climate externalities in setting wholesale electricity rates.[224] Internalizing the costs of greenhouse gas pollution into wholesale energy rates would address this market failure, and, as Davis Noll and Unel argue, falls within FERC's authority to ensure that rates are "just and reasonable" and protect the public interest.[225] As detailed above, the Working Group's social cost of greenhouse gases estimates offer the best available metric for FERC to value the incremental cost of climate pollution, enabling the agency to shift that cost onto producers.[226]

III. Rebutting Common Critiques of the Working Group's Valuations

If agencies are going to make broad use of the social cost of greenhouse gases, they should be prepared to defend against lawsuits challenging the use of those valuations.[227] Already, the Working Group's 2021 social cost of greenhouse gases estimates are the subject of two lawsuits filed by coalitions of states[228]—even though those estimates have not yet been widely applied in final

219. 16 U.S.C. § 824d(a).

220. *See* Ill. Cities of Bethany v. Fed. Energy Reg. Comm'n, 670 F.2d 187, 191 (D.C. Cir. 1981).

221. 16 U.S.C. § 824e(a).

222. *Id*.

223. Morgan Stanley Cap. Grp. Inc. v. Pub. Util. Dist. No. 1 of Snohomish Cty., Wash., 554 U.S. 527, 532 (2008) ("[W]e afford great deference to the Commission in its rate.").

224. Bethany A. Davis Noll & Burcin Unel, *Markets, Externalities, and the Federal Power Act: The Federal Energy Regulatory Commission's Authority to Price Carbon Dioxide Emissions*, 27 N.Y.U. ENV'T L.J. 1, 6-7 (2019).

225. *Id.* at 41-47.

226. *Id.* at 51-52.

227. This Part is adapted from Iliana Paul & Max Sarinsky, Playing With Fire: Responding to Criticism of the Social Cost of Greenhouse Gases (June 2021) (working paper), https://policyintegrity.org/files/publications/Playing_With_Fire.pdf [https://perma.cc/86TL-PW5L].

228. *See* Complaint, Missouri v. Biden, No. 4:21-cv-00287-AGF, 2021 WL 3885590 (E.D. Mo. Mar. 8, 2021); Complaint, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. Apr. 22,

agency actions. Those lawsuits, and other criticisms of the social cost of greenhouse gases from opponents of ambitious climate reforms, reflect misconceptions about the Working Group's process and the role of federal agencies in addressing climate change.

This Part rebuts a number of the main objections against the broad use of the Working Group's social cost of greenhouse gases valuations. It sorts those objections into two categories: conceptual and modeling. The conceptual criticisms argue, in essence, that agency valuation of global climate damages is unlawful or that valuing climate damages is such an indeterminate exercise that it should not be pursued at all. The modeling criticisms take issue with the Working Group's process and methodology, claiming that its valuations are irrational or improperly omit key considerations. While there is not an entirely clear dividing line between conceptual and modeling objections, this Part uses that division simply to provide structure to a long list of common objections.

While this Part does not directly respond to several objections to the social cost of greenhouse gases from proponents of climate action, it is important for regulators to keep those objections in mind when making key decisions.[229] For instance, since the Working Group's estimates are widely acknowledged to undervalue the true social cost of greenhouse gases, decisionmakers should apply those values as conservative underestimates and, as the Working Group itself has recommended, conduct additional analysis using higher valuations.[230] Additionally, because the Working Group's valuations only report the scope of climate damages, and not their distribution, agencies should also be cognizant of distributional impacts and properly incorporate considerations of equity and environmental justice.[231] While the social cost of greenhouse gases only measures climate impacts, regulators should also give due consideration to impacts that affect local populations, such as effects on air and water quality.

2021). See *supra* note 6 for discussion about the history of these lawsuits, which both remain ongoing as of March 2022.

229. Some proponents of climate action have argued that decisionmakers should not value the incremental *damages* from the release of greenhouse gases, but rather the marginal *abatement costs* that would be required to keep greenhouse gas emissions below a certain level. We believe that such an approach may pose legal risk in many circumstances, as the federal government has no binding emission-reduction targets. While a full recitation of this argument is beyond the scope of this Article, our colleagues Justin Gundlach and Michael Livermore nicely describe the legal and conceptual differences between a social cost and marginal abatement cost approach in their article, Justin Gundlach & Michael Livermore, *Costs, Confusion, and Climate Change*, 39 YALE J. ON REGUL. 564 (2022).

230. 2021 TSD, *supra* note 7, at 4.

231. *See* Exec. Order No. 12,898, § 1-101, 59 Fed. Reg. 7629, 7629 (Feb. 11, 1994) ("To the greatest extent practicable and permitted by law, . . . each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations . . . .").

A. Conceptual Objections

1. Agency Consideration of Greenhouse Gases

A common objection to agency use of the Working Group's estimates is that Congress, not the executive branch, should set policy with respect to climate change.[232] While concerns about congressional inaction on climate change are legitimate, this objection to agency usage of the social cost of greenhouse gases is not.

It is widely established that a federal agency may—and often must—consider effects on climate change when those effects flow from its actions. The D.C. Circuit has held that FERC must consider climate impacts in determining whether to approve natural-gas pipeline infrastructure.[233] The Seventh Circuit has likewise held that climate impacts are a relevant consideration when DOE sets energy-efficiency standards.[234] The Ninth Circuit has required NHTSA to consider climate costs when assessing vehicle efficiency standards.[235] And the Ninth and Tenth Circuits have vacated Interior leasing and extraction plans for failing to sufficiently analyze climate impacts, indicating that those impacts are relevant.[236] While opponents of climate reform suggest that agencies should disregard or downplay climate change in setting policy, courts have held that such an approach runs afoul of the Administrative Procedure Act's arbitrary-and-capricious standard.

Since agencies must account for climate impacts, the key question is how to account for those effects. While there are alternatives available to the Working Group's estimates—such as agencies developing their own estimates[237] or assessing climate damages through other numerical approaches[238]—it is rational for agencies to rely on the Working Group's estimates given the expertise and rigor that went into their development. And there is nothing amiss about agencies taking guidance from the White House on technical considerations. For instance, agencies often look to OMB for guidance on conducting regulatory analysis, even though there is no statutory requirement that they do so. OMB has published guidance that agencies routinely follow on conducting regulatory cost-benefit

232. *See, e.g.*, Plaintiffs' Memorandum in Support of Motion for Preliminary Injunction at 13-19, Missouri v. Biden, 4:21-cv-00287-AGF, 2021 WL 3885590 (E.D. Mo. May 3, 2021); Plaintiffs' Memorandum in Support of Motion for Preliminary Injunction at 15-17, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. July 27, 2021).

233. Sierra Club v. Fed. Energy Regul. Comm'n, 867 F.3d 1357, 1374 (D.C. Cir. 2017).

234. Zero Zone v. Dep't of Energy, 832 F.3d 654, 677 (7th Cir. 2016).

235. Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin., 538 F.3d 1172, 1198-1203 (9th Cir. 2008).

236. *See supra* note 116.

237. *See supra* notes 18-20 and accompanying text (explaining how agencies developed their own damage valuations following the *Center for Biological Diversity* opinion, and the Working Group was convened to harmonize those values).

238. *See supra* text accompanying notes 196-198 (discussing limitations of the comparison-based approach).

analysis,[239] discounting future costs and benefits,[240] and accounting for other impacts of federal programs.[241] Choosing to apply the Working Group's climate-damage estimates is consistent with this precedent and is hardly grounds for a legal challenge.

2. Potential for Skewed Analysis

Another common objection to the use of the social cost of greenhouse gases—particularly for non-regulatory actions that do not rely on cost-benefit analysis—is that these valuations account only for the damages from climate change, but do not take account of the economic benefits from fossil-fuel production and usage, such as economic development and employment.[242] This argument has several close cousins. In particular, states challenging the Working Group's estimates have focused on the impacts to revenues in states that stand to lose from potential declines in fossil-fuel production.[243] And under the Trump Administration, agencies that resisted monetizing greenhouse gas emissions claimed that doing so would skew the analysis, barring a full monetization of all of the project's economic benefits.[244]

These arguments are unpersuasive for two key reasons. First, the economic benefits of fossil-fuel extraction are far more limited than its proponents suggest, since the broader benefits that society derives from power and electricity are attributable to energy production in general and are not unique to fossil fuels.[245] Accordingly, controls on fossil fuels will hasten a transition to a greener electrical grid and therefore have limited net economic impacts.[246] Second, while there are of course some economic impacts from reductions in fossil-fuel production and usage, including effects on revenues and jobs, those impacts

239. CIRCULAR A-4, *supra* note 44.

240. OFF. OF MGMT. & BUDGET, EXEC. OFF. OF THE PRESIDENT, CIRCULAR A-94: DISCOUNT RATES TO BE USED IN EVALUATING TIME-DISTRIBUTED COSTS AND BENEFITS (1992).

241. For a full list of OMB circulars, see *Circulars*, OFF. OF MGMT. & BUDGET, https://www.whitehouse.gov/omb/information-for-agencies/circulars [https://perma.cc/Z4DC-QCGA].

242. *E.g.*, Complaint ¶ 103, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. Apr. 22, 2021).

243. *E.g.*, Plaintiffs' Memorandum in Support of Motion for Preliminary Injunction at 30, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. July 27, 2021).

244. *E.g.*, BUREAU OF LAND MGMT., U.S. DEP'T OF THE INTERIOR, COASTAL PLAIN OIL AND GAS LEASING PROGRAM FINAL ENVIRONMENTAL IMPACT STATEMENT F-2 to F-3 (2019).

245. Renewable energy, like fossil fuels, generates revenue, supports jobs, and vitalizes local economies. *See, e.g.*, Katie Siegner, Kevin Brehm & Mark Dyson, *Seeds of Opportunity: How Rural America Is Reaping Economic Development Benefits from the Growth of Renewables*, ROCKY MTN. INST. 6-16 (2021), https://rmi.org/insight/seeds-of-opportunity/ [https://perma.cc/DWH9-D4L7].

246. Environmental regulation typically has limited impacts on total employment or other macroeconomic indicators, but rather shifts production from one sector to another. *See Does Environmental Regulation Kill or Create Jobs*, INST. FOR POL'Y INTEGRITY (2017), https://policyintegrity.org/files/media/Jobs_and_Regulation_Factsheet.pdf [https://perma.cc/EGF6-HRNP]. Meanwhile, the sharp decline in the cost of renewable energy is already expected to crowd out the demand for gas-fuel electricity in the coming years and decades. *See* Charles Teplin, Mark Dyson, Alex Engel & Grant Glazer, *The Growing Market for Clean Energy Portfolios*, ROCKY MTN. INST. 8 fig.ES-2 (2019), https://rmi.org/insight/clean-energy-portfolios-pipelines-and-plants [https://perma.cc/P5YJ-WARJ] (showing a precipitous decline in the cost of clean energy, such that it will be cheaper than fossil fuels).

should not be included in any calculation of climate damages, but rather considered separately by regulators on the costs side of the ledger in individual determinations. While agencies need a clear-eyed picture of policy impacts in order to weigh beneficial and adverse policy effects—which the social cost of greenhouse gases enables for climate impacts—climate effects are only one important consideration that should be weighed against other beneficial and adverse effects when agencies decide how to proceed.

Both under NEPA and in regulatory cost-benefit analysis, agencies typically estimate the industry compliance costs or revenues of the chosen action, which reflect the societal economic impact.[247] Nonetheless, perfect information of all impacts is not required in order to act.[248] While agencies should aim to assess the economic effects of proposed reforms as well as possible—including effects on revenues, employment, and consumer prices—the fact that an agency may not quantify or monetize all effects does not mean that it should neglect monetizing other effects for which methodologies are readily available. NEPA regulations provide that an agency can consider quantified costs and benefits alongside "unquantified . . . impacts, values, and amenities."[249] And agencies have typically included monetized values of economic impacts such as revenues without similar qualms about monetizing every environmental impact.[250]

3. Considering Foreign Interests

Critics of the Working Group's social cost valuations have also objected to the consideration of foreign impacts, arguing that agency policies should be limited to domestic concerns.[251] Owing to this objection, the Trump Administration purported to capture only domestic impacts in its climate-damage valuations.[252]

This dispute has already been litigated in two cases, and as discussed above, the Working Group's global focus has decidedly come out on top. First, in a 2016 opinion, the Seventh Circuit held that it is reasonable for agencies to determine that because greenhouse gas emissions cause "global effects, . . . those global effects are an appropriate consideration when looking at a national policy."[253] Then, in a 2020 opinion, the U.S. District Court for the Northern District of

247. *See* CIRCULAR A-4, *supra* note 44, at 21 ("Economists ordinarily consider market prices as the most accurate measure of the marginal value of goods and services to society.").

248. *See* Mont. Wilderness Ass'n v. McAllister, 666 F.3d 549, 559 (9th Cir. 2011) (recognizing that "[a]gencies are often called upon to confront difficult administrative problems armed with imperfect data," and that "the proper response to that problem is for the [agency] to do the best it can with the data it has").

249. 40 C.F.R. § 1502.22 (2021).

250. *See* CIRCULAR A-4, *supra* note 44, at 27 (discussing the importance of considering impacts that are difficult to quantify or monetize).

251. *E.g.*, Plaintiffs' Memorandum in Support of Motion for Preliminary Injunction at 9, 31-36, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. July 27, 2021).

252. *See supra* note 79 and accompanying text.

253. Zero Zone v. Dep't of Energy, 832 F.3d 654, 679 (7th Cir. 2016); *see also supra* notes 70-72 and accompanying text (discussing *Zero Zone*).

California struck down an Interior rule that relied on the Trump Administration's domestic-only damage valuations, holding that a global focus is critical for an agency to reliably assess climate impacts.[254] These two cases offer strong support for the use of global damage valuations.[255]

Considering global damages, as opposed to disregarding all climate effects outside U.S. borders, is desirable for numerous reasons. As the Working Group has explained, using global damage costs reflects U.S. strategic interests by facilitating international reciprocity, and it is methodologically superior to a domestic-only estimate due to the presence of international spillovers and the limitations of existing models.[256] Our colleagues Peter Howard and Jason A. Schwartz expand upon these justifications in a law review article, particularly focusing on the strategic interests to the United States of adopting global damage costs.[257] In addition, Howard and Schwartz catalogue the legal obligations in various environmental statutes requiring consideration of international welfare.[258] Prominent legal scholars such as Cass Sunstein also agree that global damage costs offer the proper framework to value climate impacts.[259]

4. Long-Term Uncertainty

While critics argue also that there it too much uncertainty to value the social cost of greenhouse gases,[260] this argument is incorrect on multiple levels. As a legal matter, the presence of some uncertainty in the social cost valuations should not preclude agencies from using the best numbers available. And as a factual matter, the Working Group rigorously considered uncertainty and accounted for it in numerous ways. If anything, the presence of continued uncertainty suggests that the social cost valuations should be higher than presently valued—not that climate damages should be ignored.

Federal courts have repeatedly recognized that agency analysis necessitates making predictive judgments under uncertain conditions, explaining that

254. California v. Bernhardt, 472 F. Supp. 3d 573, 613 (N.D. Cal. 2020) ("[F]ocusing solely on domestic effects has been soundly rejected by economists as improper and unsupported by science."); *see also supra* notes 87-91 and accompanying text (discussing *Bernhardt*).

255. The Western District of Louisiana recently concluded that it is inappropriate for agencies to rely on global damage valuations. *See* Louisiana v. Biden, No. 2:21-CV-01074, 2022 WL 438313, at *15-16 (W.D. La. Feb. 11, 2022). But that decision has both been widely criticized, see *supra* note 6, and has been stayed by the Fifth Circuit. *See* Louisiana v. Biden, No. 22-30087, 2022 WL 866282 (5th Cir. Mar. 16, 2022).

256. RESPONSE TO COMMENTS, *supra* note 25, at 31-32; *see also supra* notes 57-60 and accompanying text.

257. Howard & Schwartz, *supra* note 4, at 221-38.

258. *Id.* at 245-59.

259. Cass R. Sunstein, Arbitrariness Review (With Special Reference to the Social Cost of Carbon) 1, 20-23 (June 26, 2021) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3874312 [https://perma.cc/3W4X-ULT8] ("A decision to use the domestic number, as opposed to the global number, would be difficult to defend against an arbitrariness challenge; a decision to use the global number, as opposed to the domestic number, would be straightforward to defend against an arbitrariness challenge.").

260. *See, e.g.*, Complaint ¶ 74, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. Apr. 22, 2021).

"[r]egulators by nature work under conditions of serious uncertainty"[261] and "are often called upon to confront difficult administrative problems armed with imperfect data."[262] As the Ninth Circuit has explained, "the proper response" to the problem of uncertain information is not for the agency to ignore the issue but rather "for the [agency] to do the best it can with the data it has."[263] Courts generally grant broad deference to agencies' analytical methodologies and predictive judgments so long as they are reasonable, and do not require agencies to act with complete certainty.[264]

The Working Group also rigorously considered various sources of long-term uncertainty "through a combination of a multi-model ensemble, probabilistic analysis, and scenario analysis."[265] As the Working Group explained, the three IAMs account for uncertainty themselves by spanning a range of economic and ecological outcomes.[266] Additionally, the use of three separate models—all developed by different experts spanning a range of views—accounts for uncertainty by integrating a diversity of viewpoints and structural and analytical considerations.[267] The Working Group further integrated a range of different uncertain parameters such as baseline emissions, population, and economic growth.[268] Combining these difficult parameters, the Working Group ran the IAMs 150,000 times per greenhouse gas and discount rate to develop a probability distribution for the social cost of greenhouse gases.[269]

Moreover, experts broadly agree that the presence of uncertainty in the social cost valuations counsels for more stringent climate regulation, not less.[270] This is due to various factors including risk aversion, the informational value of delaying climate change impacts, and the possibility of irreversible climate tipping points that cause catastrophic damage.[271] In fact, uncertainty is a factor

261. Pub. Citizen v. Fed. Motor Carrier Safety Admin., 374 F.3d 1209, 1221 (D.C. Cir. 2004).

262. Mont. Wilderness Ass'n v. McAllister, 666 F.3d 549, 559 (9th Cir. 2011).

263. *Id.*

264. *See* Wis. Pub. Power, Inc. v. Fed. Energy Regul. Comm'n, 493 F.3d 239, 260 (D.C. Cir. 2007) ("It is well established that an agency's predictive judgments about areas that are within the agency's field of discretion and expertise are entitled to particularly deferential review, so long as they are reasonable.").

265. 2021 TSD, *supra* note 7, at 26.

266. *See id.*

267. *See id.*

268. *See* 2010 TSD, *supra* note 2, at 15-17.

269. *See supra* notes 43-44 and accompanying text.

270. *See, e.g.*, Alexander Golub, Daiju Narita & Matthias G. W. Schmidt, *Uncertainty in Integrated Assessment Models of Climate Change: Alternative Analytical Approaches*, 19 ENV'T MODELING & ASSESSMENT 99 (2014) ("The most important general policy implication from the literature is that despite a wide variety of analytical approaches addressing different types of climate change uncertainty, none of those studies supports the argument that no action against climate change should be taken until uncertainty is resolved. On the contrary, uncertainty despite its resolution in the future is often found to favor a stricter policy.").

271. Our organization, the Institute for Policy Integrity at New York University School of Law, and other environmental groups have filed comments in numerous regulatory proceedings highlighting the various forms of uncertainty that increase the social cost of greenhouse gases and providing numerous references. *See, e.g.*, Env't Def. Fund, Inst. for Pol'y Integrity, Mont. Env't Info. Ctr., Natural Res. Def.

that justifies a lowering of the discount rate, particularly in intergenerational settings.[272] Additionally, the current omission of key features of the climate problem from the social cost valuations, such as catastrophic damages and certain cross-regional spillover effects, further suggests that the true social cost values are likely higher than the Working Group's best estimates.[273]

B. Modeling Objections

1. Discounting of Future Impacts

Perhaps the most common methodological objection from opponents of climate reform is that the Working Group overvalued future impacts through its choice of discount rate. Due to the long time-horizon of climate impacts, the choice of discount rate has a substantial impact on the ultimate damage valuation. The higher the discount rate, the more future generations are devalued and, thus, the lower the total damage estimate. This can be seen through the substantial variation among the Working Group's three estimates applying annual discount rates of 2.5%, 3%, and 5%.[274]

Critics of the Working Group's estimates argue that the Working Group should have applied annual discount rates as high as 7%—and in fact, under the Trump Administration, federal agencies applied a 7% discount rate (along with a 3% rate) to value long-term climate damages.[275] But that choice was inappropriate, and the Working Group was correct to exclude a 7% discount rate from its range of social cost estimates. As the Working Group has explained, there is broad consensus among economists that use of a consumption-based discount rate of 3% or lower is appropriate for evaluating long-term impacts.[276]

Council, Sierra Club, Union of Concerned Scientists, W. Env't L. Ctr., Comment Letter on Improper Valuation of Climate Effects in the Proposed Revised Cross-State Air Pollution Rule Update for the 2008 Ozone NAAQS (85 Fed. Reg. 68,964) (EPA-HQ-OAR-2020-0272), Technical App'x: Uncertainty (Dec. 14, 2020), https://policyintegrity.org/documents/Joint_SCC_comments_EPA_revised_CSAPR_Ozone_NAAQS_2020.12.14.pdf [https://perma.cc/WYY2-5WNL].

272. *See* Peter Howard & Jason Schwartz, *Valuing the Future: Legal and Economic Considerations for Updating Discount Rates*, 39 YALE J. ON REGUL. 595 (2022).

273. *See* 2016 TSD, *supra* note 23, at 21 (recognizing that "these limitations suggest that the [social cost of carbon] estimates are likely conservative").

274. *See* 2021 TSD, *supra* note 7, at 5 tbl.ES-1.

275. *See supra* note 80 and accompanying text.

276. *See* 2021 TSD, *supra* note 7, at 17 ("[T]he latest data as well as recent discussion in the economics literature indicates that the 3 percent discount rate used by the [Working Group] to develop its range of discount rates is likely an overestimate of the appropriate discount rate."). Of particular note, the Working Group highlights a new framework that demonstrates that the consumption discount rate is the solely appropriate rate in inter-generational contexts. *Id.* at 19 (citing Qingran Li & William A. Pizer, *Use of the Consumption Discount Rate for Public Policy Over the Distant Future*, 107 J. ENV'T ECON. & MGMT. 102, 428 (2021)). Elicitations of experts have also consistently found broad support for lower discount rates when assessing long-term climate damages. *See, e.g.*, Peter Howard & Derek Sylvan, *Expert Consensus on the Economics of Climate Change*, INST. FOR POL'Y INTEGRITY 20 (2015), https://policyintegrity.org/files/publications/ExpertConsensusReport.pdf [https://perma.cc/9B4M-LRJV] (showing overwhelming support for discount rates between zero and three percent); Moritz A. Drupp, Mark C. Freeman, Ben Groom & Frikk Nesje, *Discounting Disentangled*, 10 AM. ECON. J. 109 (2018) (finding "consensus among experts" at a 2% discount rate).

In fact, the Council of Economic Advisers,[277] National Academies of Sciences,[278] and economic literature[279] all conclude that a 7% rate is inappropriate for climate change, and that a discount rate of 3% or lower is warranted.

The Working Group's selection of discount rates is also consistent with federal guidance. Although OMB's Circular A-4 normally calls for agencies to apply discount rates of 3% and 7%, it requires agency analysts to do more than rigidly apply default assumptions.[280] Rather than assume that a 7% discount rate should be applied automatically to every analysis, like critics of the Working Group's methodology do, Circular A-4 requires agencies to justify the choice of discount rates for each analysis.[281] And as Circular A-4 further explains, long-term effects counsel for lower discount rates due to their uncertainty and intergenerational nature,[282] and thus the Working Group correctly concluded that "use of 7 percent is not considered appropriate for intergenerational discounting."[283]

2. Positive Impacts of Warming

Critics further claim that the Working Group's social cost values ignore important positive impacts of a warming climate.[284] Examples that have been offered to support this argument include alleged agricultural benefits from higher

277. COUNCIL OF ECON. ADVISERS, DISCOUNTING FOR PUBLIC POLICY: THEORY AND RECENT EVIDENCE ON THE MERITS OF UPDATING THE DISCOUNT RATE (2017), https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf [https://perma.cc/C57U-XSFJ].

278. NAS 2017 REPORT, *supra* note 62, at 28.

279. *See, e.g.*, Kenneth Arrow, Maureen L. Cropper, George C. Eads, Robert W. Hahn, Lester B. Lave, Roger G. Noll, Paul R. Portney, Milton Russell, Richard Schmalensee, V. Kerry Smith & Robert N. Stavins, *Is There a Role for Benefit-Cost Analysis in Environmental, Health, and Safety Regulation?*, 272 SCIENCE 221 (1996) (explaining that a consumption-based discount rate is appropriate for climate change); Peter Howard & Derek Sylvan, *Wisdom of the Experts: Using Survey Responses to Address Positive and Normative Uncertainties in Climate-Economic Models*, 162 CLIMATE CHANGE 213 (2020); Martin L. Weitzman, *Why the Far-Distant Future Should Be Discounted at Its Lowest Possible Rate*, 36 J. ENV'T ECON. & MGMT. 201 (1998); Richard G. Newell & William A. Pizer, *Discounting the Distant Future: How Much Do Uncertain Rates Increase Valuations?*, 46 J. ENV'T ECON. & MGMT. 52 (2003); Ben Groom, Phoebe Koundouri, Ekaterini Panopoulou & Theologos Pantelidis, *Discounting the Distant Future: How Much Does Model Selection Affect the Certainty Equivalent Rate?*, 22 J. APPLIED ECONOMETRICS 641 (2007).

280. CIRCULAR A-4, *supra* note 44, at 3 ("You cannot conduct a good regulatory analysis according to a formula. Conducting high-quality analysis requires competent professional judgment.").

281. *Id.* at 3 ("[S]tate in your report what assumptions were used, *such as . . . the discount rates* applied to future benefits and costs," and explain "clearly how you arrived at your estimates.") (emphasis added).

282. *Id.* at 35-36.

283. RESPONSE TO COMMENTS, *supra* note 25, at 36.

284. *See, e.g.*, Complaint ¶ 103, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. Apr. 22, 2021) (claiming that the Working Group "refuse[d] to consider the potential benefits of a warming climate").

temperatures[285] and decreased wintertime mortality.[286] But these arguments are legally and factually dubious, and miss the forest for the trees.

Mere omission of some impacts does not counsel for abandoning the social cost estimates, particularly since independent experts widely agree that those estimates likely undervalue true climate damages because they omit far more negative effects than positive ones. For instance, the Working Group has explained that several of the underlying economic models omit certain major damage categories such as catastrophic damages and certain cross-regional spillover effects.[287] These effects can be massive: one paper, for instance, finds that the inclusion of tipping points would significantly increase, potentially doubling, the social cost estimates,[288] and another paper concludes that the effect is even greater and thus the Working Group's existing values "may be significantly underestimating the needs for controlling climate change."[289] The current consensus of experts puts damages for a 3°C increase at roughly 5% to 10% of gross domestic product,[290] which is substantially higher than the damages estimated by the IAMs.[291] And as the Ninth Circuit has explained, the presence of some omitted damages does not provide a legal basis to ignore established methodologies to monetize climate damages, since while "there is a range of [plausible] values, the value of carbon emissions reduction is certainly not zero."[292]

In addition to their legal shortcomings, arguments about the impact of positive externalities are also factually suspect. For instance, while agricultural benefits have become a flashpoint in this debate, the IAMs in fact do account for the potential agricultural benefits of carbon dioxide fertilization from a warming planet.[293] And evidence suggests that, if anything, these models overvalue

285. Plaintiffs' Memorandum in Support of Motion for Preliminary Injunction at 24, Missouri v. Biden, 4:21-cv-00287-AGF, 2021 WL 3885590 (E.D. Mo. May 3, 2021).

286. Complaint ¶ 103, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. Apr. 22, 2021).

287. 2010 TSD, *supra* note 2, at 26, 32.

288. Derek Lemoine & Christian P. Traeger, *Economics of Tipping the Climate Dominoes*, 6 NATURE CLIMATE CHANGE 514 (2016). While this paper calculates the optimal carbon tax rather than the social cost of greenhouse gases, the two figures are closely related.

289. Yongyang Cai, Kenneth L. Judd, Timothy M. Lenton, Thomas S. Lontzek & Daiju Narita, *Environmental Tipping Points Significantly Affect the Cost-Benefit Assessment of Climate Policies*, 112 PROCS. NAT'L ACADS. SCIS. 4606, 4610 (2015).

290. *See, e.g.*, Peter Howard & Derek Sylvan, *Gauging Economic Consensus on Climate Change*, INST. FOR POL'Y INTEGRITY 25 (2021), https://policyintegrity.org/files/publications/Economic_Consensus_on_Climate.pdf [https://perma.cc/Z8XJ-WHHZ] (reporting a mean estimate of 8.5% GDP loss and a median estimate of 5% loss, based on elicitation of over 700 climate-policy experts).

291. 2010 TSD, *supra* note 2, at 9 fig.1A (showing a range of GDP loss below 5% for 3°C temperature increase).

292. Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin., 538 F.3d 1172, 1200 (9th Cir. 2008).

293. *See* Peter Howard, *Omitted Damages: What's Missing from the Social Cost of Carbon*, INST. FOR POL'Y INTEGRITY 6 (2014), https://policyintegrity.org/files/publications/Omitted_Damages_Whats_Missing_From_the_Social_Cost_of_Carbon.pdf [https://perma.cc/SZ7F-9PH4]; *see also A Lower Bound: Why the Social Cost of Carbon Does Not Capture Critical Climate Damages and What*

agricultural benefits from a warming planet—and thus undervalue the social cost of greenhouse gases.[294] One paper, for instance, concludes that estimates of net agricultural impacts produced an undervaluation of the social cost of carbon by more than 50%, explaining that "new damage functions reveal far more adverse agricultural impacts than currently represented" in the IAMs used by the Working Group.[295] And a comprehensive investigation of the impacts of climate change on agriculture has rejected the hypothesis "that agricultural damages over the next century will be minimal and indeed that a few degrees Celsius of global warming would be beneficial for world agriculture," concluding that climate change "would have at least a modest negative impact on global agriculture in the aggregate."[296]

Other arguments focusing on omitted positive impacts are equally misguided. For example, while some critics of the Working Group's methodology misleadingly point out that one of the models, DICE, focuses on increased heat-related mortality and does not account for reductions in wintertime mortality,[297] consideration of the many damages omitted from the IAMs (such as particulate matter from wildfires, deaths from flooding, Lyme and other tick-based diseases, and some other mortality effects) consistently point toward a higher social cost value.[298] Several recent studies, in fact, conclude that the IAMs, on net, undervalue mortality from climate change—perhaps severely so.[299]

That Means for Policymakers, INST. FOR POL'Y INTEGRITY 5 (2019), https://policyintegrity.org/files/publications/Lower_Bound_Issue_Brief.pdf [https://perma.cc/3KWB-5NRH] (showing that the models capture some, but not all, agricultural impacts, and that the estimates represent lower bounds on the whole because they omit many negative impacts of warming).

294. *See, e.g.*, Frances C. Moore, Uris Lantz C. Baldos & Thomas Hertel, *Economic Impacts of Climate Change on Agriculture: A Comparison of Process-Based and Statistical Yield Models*, 12 ENV'T RES. LTRS. 65008, at 1 (2017) ("[W]e find little evidence for differences in the yield response to warming. The magnitude of CO_2 fertilization is instead a much larger source of uncertainty. Based on this set of impact results, we find a very limited potential for on-farm adaptation to reduce yield impacts.").

295. Frances C. Moore, Uris Baldos, Thomas Hertel & Delavane Diaz, *New Science of Climate Change Impacts on Agriculture Implies Higher Social Cost of Carbon*, 8 NATURE COMMC'NS 1607 (2017).

296. WILLIAM R. CLINE, GLOBAL WARMING AND AGRICULTURE: IMPACT ESTIMATES BY COUNTRY 1-2 (2007).

297. Complaint ¶ 103, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. Apr. 22, 2021).

298. *See, e.g.*, Howard, *supra* note 293*; see also* 2016 TSD, *supra* note 23, at 21 ("These individual limitations [with the social cost estimates] do not all work in the same direction in terms of their influence on the [social cost of carbon] estimates; however, it is the [Working Group's] judgment that, taken together, these limitation suggest that the [social cost of carbon] estimates are likely conservative.").

299. *See* Tamma A. Carleton, Amir Jina, Michael T. Delgado, Michael Greenstone, Trevor Houser, Solomon M. Hsiang, Andrew Hultgren, Robert E. Kopp, Kelly E. McCusker, Ishan B. Nath, James Rising, Ashwin Rode, Hee Kwon Seo, Arvid Viaene, Jiacan Yuan & Alice Tianbo Zhang, *Valuing the Global Mortality Consequences of Climate Change Accounting for Adaptation Costs and Benefits* (U. Chi., Becker Friedman Inst. for Econ. Working Paper No. 2018-51, 2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3224365 [https://perma.cc/8S5A-LJAR] (finding that new empirical estimates suggest that the increase in morality risk from climate change is valued at approximately 3.2% of global GDP in 2100); R. Daniel Bressler, *The Mortality Cost of Carbon*, 12 NATURE COMMC'NS 4467 (2021) (projecting that cutting greenhouse gas emissions could save 74 million lives this century, as every 4434 metric tons of carbon dioxide emissions produces an extra statistical death).

3. Equilibrium Climate Sensitivity Distribution

Critics further allege that the chosen Equilibrium Climate Sensitivity (ECS) distribution—that is, the amount of warming that is expected to result from a doubling of the atmospheric carbon dioxide concentration—is "out of date" and fails to account for recent evidence allegedly showing that sensitivity to be lower than previously believed.[300] These arguments rely on cherry-picked data and ignore the scientific consensus.

In 2016, the National Academies of Sciences dedicated an entire report to whether the Working Group should update the social cost metrics to reflect more recent science on the ECS. The National Academies decided that such an update was unnecessary, "recommend[ing] against a near-term change in the distributional form of the ECS" and explaining that any reasonable revisions on this front would "have a minimal impact on estimates of the [social cost of greenhouse gases]."[301]

On top of the National Academies' rejection of this argument, there is little support for the claim that the Working Group overstates the pace of climate change. As support, critics cite a paper by Lewis & Curry which estimates a median ECS of 1.64ºC, with an uncertainty range (5-95%) of 1.05-4.05ºC.[302] But that paper is an outlier. The most recent estimate from the Intergovernmental Panel on Climate Change (IPCC)—which reflects consensus estimates from the worldwide scientific community—projects a likely ECS range from 2.5°C to 4°C, with 3°C as a "best estimate."[303] This is far higher than the range from Lewis & Curry's paper. In evaluating the ECS, the Working Group assessed estimates from a wide range of experts and selected consensus values—not extreme outlier estimates. In fact, as the Working Group acknowledged, some ECS estimate ranges go as high as 10ºC, making its selected ECS distribution substantially lower than these high-end estimates.[304]

Opponents of climate reform further argue that the ECS distribution applied by the Working Group inappropriately skews rightward, meaning that its mean ECS value exceeds the median value of 3ºC that the IPCC has identified.[305] But this criticism is misguided. As the National Academies explained, the IPCC has found that there is a "positively skewed distributional form for [the ECS]

300. *See* Plaintiffs' Memorandum in Support of Motion for Preliminary Injunction at 23-24, Missouri v. Biden, 4:21-cv-00287-AGF, 2021 WL 3885590 (E.D. Mo. May 3, 2021).

301. NAS 2016 REPORT, *supra* note 62, at 34, 46.

302. *See* Plaintiffs' Memorandum in Support of Motion for Preliminary Injunction at 24, Missouri v. Biden, 4:21-cv-00287-AGF, 2021 WL 3885590 (E.D. Mo. May 3, 2021) (citing Nicholas Lewis & Judith A. Curry, *The Implications for Climate Sensitivity of AR5 Forcing and Heat Uptake Estimates*, 45 CLIMATE DYNAMICS 1009 (2015)).

303. Working Group, *Climate Change 2021: The Physical Science Basis*, IPCC 11 (2021), https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf [https://perma.cc/SRB7-JSWR].

304. 2010 TSD, *supra* note 2, at 14 fig.2.

305. Declaration of Anne E. Smith, Ph.D. ¶¶ 35-39, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. July 27, 2021).

parameter" similar to the ECS distribution applied by the Working Group.[306] In other words, the mean ECS value should be higher than the median ECS value, and the Working Group applied an appropriate distribution.

4. Emission Baselines

Critics further argue that the Working Group's valuations are an overestimate because they apply "badly out of date" emissions scenarios that exaggerate the baseline level of greenhouse gas emissions in the atmosphere.[307] Using a higher baseline level of emissions raises the social cost estimates because the harm from an additional unit of emissions increases with the baseline atmospheric emissions level. However, the Working Group used a reasonable emissions baseline that reflects different possible mitigation scenarios.

While the Working Group assumed a baseline emissions range of thirteen to 118 gigatons of carbon dioxide emitted per year by 2100,[308] recent projections from the Climate Action Tracker indicate that baseline emissions will reach between fourteen and 175 gigatons of carbon dioxide by 2100 under a range of scenarios reflecting different levels of mitigation.[309] Thus, the baselines used by the Working Group potentially understate baseline emissions rather than overvalue them as opponents argue. In fact, several of the Working Group's supposedly "business-as-usual" scenarios are actually more consistent with baseline estimates reflecting policy projections.[310] Accordingly, the criticism that the Working Group applied an improper baseline falls flat.

Moreover, the choice of a baseline does not significantly affect the social cost valuations. In comparison to the Working Group's central social cost of carbon estimate in 2020 of $51 per ton, the average social cost of carbon under the Working Group's supposed business-as-usual emissions scenarios is $53 per ton, and it is $41 per ton under the emissions scenario that is consistent with sustained and widespread mitigatory action.[311] While relying less on the Working Group's supposed business-as-usual scenarios would therefore modestly decrease the interim social cost valuations in a vacuum, more holistic updates to the metrics as recommended by the National Academies of Sciences

306. NAS 2016 REPORT, *supra* note 62, at 25; *see also* Working Group, *supra* note 303, at SPM-14 (providing a likely ECS range from 2.5°C to 4°C, strongly suggesting that the mean ECS value exceeds 3°C).

307. *See* Plaintiffs' Memorandum in Support of Motion for Preliminary Injunction at 25, Missouri v. Biden, 4:21-cv-00287-AGF, 2021 WL 3885590 (E.D. Mo. May 3, 2021) (internal quotation marks omitted).

308. *See* 2010 TSD, *supra* note 2, at 16 tbl.2.

309. Climate Action Tracker, *Global Emissions Time Series* (Dec. 1, 2020), https://perma.cc/B4X2-RAWA.

310. *Compare id.* (projecting 35-48 gigatons of emissions in 2100 under "current policy projections" scenarios and 83-175 gigatons under business-as-usual scenario), *with* 2010 TSD, *supra* note 2, at 16 tbl.2 (incorporating supposedly business-as-usual scenarios of 42.7 and 60.1 gigatons in 2100).

311. *See* Peter Howard, Alexander Golub & Oleg Lugovoy, *Option Value and the Social Cost of Carbon: What Are We Waiting For?* 16 tbl.1 (Inst. for Pol'y Integrity, Working Paper No. 2020/1, 2020), https://policyintegrity.org/files/publications/Working_paper_06.22.20.pdf [https://perma.cc/V9QF-DVMW].

would very likely increase the social cost valuations overall due to the omitted damages discussed above and recent evidence regarding long-term discount rates.[312] At most, therefore, this argument makes a mountain out of a molehill.

5. Damage Models

Finally, critics claim that the IAMs—the damage functions for translating climate impacts into economic losses—are flawed and arbitrary. In reality, however, the damage functions are based on reasonable assumptions made by a range of experts.[313] They have also withstood scientific scrutiny, and while opponents of climate reform frequently highlight criticism of the damage functions by a notable economist, they take this criticism out of context.

The Working Group thoughtfully selected the IAMs and has continuously followed the science. To begin, the Working Group selected the three most "widely cited models in the economic literature that link physical impacts to economic damages."[314] As discussed above, these models were developed by outside experts, published in peer-reviewed economic literature, and were the product of extensive scholarship and expertise, with one of the models producing a Nobel Prize for its developer. Additionally, the models reflect a wide range of methodological assumptions about numerous parameters and inputs.[315] Thus, while the Working Group should consider avenues to improve upon the damage functions as it updates the social cost valuations, its use of those functions is far from arbitrary.

Opponents of climate reform frequently point to criticisms from Robert S. Pindyck, a noted climate economist who has been critical of the Working Group's choice of damage functions.[316] While Professor Pindyck has questioned the shape of the models' damage functions, he has also acknowledged that the damage functions reflect "common beliefs" about the effects of two or three degrees of warming.[317] And Pindyck emphatically states that uncertainty about the social cost estimates, including the damage functions, "does *not* imply that

312. *See* 2021 TSD, *supra* note 7, at 4 (acknowledging that the Working Group's current social cost valuations "likely underestimate societal damages from [greenhouse gas] emissions").

313. *See* RESPONSE TO COMMENTS, *supra* note 25, at 8 ("While the development of the DICE, FUND and PAGE models necessarily involved assumptions and judgments on the part of the modelers, the damage functions are not simply arbitrary representations of the modelers' opinions about climate damages.").

314. *Id.* at 7; 2010 TSD, *supra* note 2, at 5 ("These models are frequently cited in the peer-reviewed literature and used in the IPCC assessment. . . . These models are useful because they combine climate processes, economic growth, and feedbacks between the climate and the global economy into a single modeling framework.").

315. *See supra* notes 33-38 and accompanying text.

316. *See, e.g.*, Complaint ¶ 68, Louisiana v. Biden, No. 2:21-cv-01074, 2022 WL 438313 (W.D. La. Apr. 22, 2021.

317. Robert Pindyck, *Climate Change Policy: What Do the Models Tell Us?* 16 (Nat'l Bureau of Econ. Rsch., Working Paper No. 19244, 2013), https://www.nber.org/system/files/working_papers/w19244/w19244.pdf [https://perma.cc/M2TS-LC46].

[their] value should be set to zero until that uncertainty is resolved."[318] In fact, he actually advocates for an even higher social cost value than that produced by the Working Group.[319] In other words, the best critic of the Working Group's methodology that opponents of climate reforms could find considers them to be conservative underestimates of the true cost to society of greenhouse gas emissions.

Conclusion

The Working Group's valuations of the social cost of greenhouse gases reflect the federal government's best estimate of the incremental climate damages from a single unit of greenhouse gas emissions. The Working Group has been guided by science in developing these estimates, and its methodology reflects rational, evidence-based decisions that incorporate the best available evidence. Accordingly, legal and modeling criticisms of the Working Group's methodology fall well short of the arbitrary-and-capricious standard's high bar.

Because the Working Group's valuations offer the best method to measure incremental climate effects from a particular amount of greenhouse gas emissions, federal agencies and departments should apply these valuations widely beyond regulatory cost-benefit analysis. The social cost of greenhouse gases should be applied to any process or decision with meaningful greenhouse gas implications, which will promote rationality in federal climate policy and enable a speedy and well-managed transition to a greener economy.

318. Robert S. Pindyck, Comments on Proposed Rule and Regulatory Impact Analysis on Delay and Suspension of Certain Requirements for Waste Prevention and Resource Conservation 3 (Nov. 6, 2017), https://policyintegrity.org/documents/Letter_from_Robert_S_Pindyck,_Bank_of_Tokyo-Mitsubishi,_dated_November_6,_2017.pdf [https://perma.cc/6QRF-S72U]; *see also* Pindyck, *supra* note 317, at 16 ("My criticism of IAMs should not be taken to imply that because we know so little, nothing should be done about climate change right now, and instead we should wait until we learn more. Quite the contrary.").

319. In 2019, Pindyck's own estimate of the average social cost of carbon dioxide was between $80 and $100, with plausible values going up to $200. Robert S. Pindyck, *The Social Cost of Carbon Revisited*, 94 J. ENV'T ECON. & MGMT. 140, 140, 154-55 (2019). This is far higher than the Working Group's current central estimate of $51.