February 13, 2023

To: Environmental Protection Agency

Submitted By: Center for Climate and Energy Solutions, Clean Air Task Force, Earthjustice, Environmental Defense Fund, Institute for Policy Integrity at New York University School of Law, Montana Environmental Information Center, Natural Resources Defense Council, Sierra Club, Union of Concerned Scientists, Western Environmental Law Center

Subject: Comments on the EPA External Review Draft of Report on the Social Cost of Greenhouse Gases (Docket No. EPA-HQ-OAR-2021-0317)

The undersigned organizations[1] respectfully submit the following comments in response to the Environmental Protection Agency's (EPA) draft report on the social cost of greenhouse gases (Draft Report).[2]

The Draft Report faithfully implements the roadmap laid out in 2017 by the National Academies of Sciences for updating the social cost of greenhouse gases[3] and applies recent advances in science and economics on the costs of climate change. EPA's methodology and valuations are consistent with those applied by a range of expert independent researchers. And it is hardly surprising that the Draft Report proposes to increase the government's existing climate-damage valuations—after all, the government has repeatedly acknowledged that those valuations are underestimates, and extensive evidence confirms that the true social cost of greenhouse gases is considerably higher than previously estimated.

Despite the extraordinary advances reflected in the Draft Report, EPA acknowledges that **the valuations presented in that report continue to represent underestimates for numerous reasons**. EPA should commit to incorporating omitted impacts into its damage estimates as the methodologies for valuing those impacts advance. And because the range of discount rates applied in the Draft Report continues to reflect conservative assumptions, **EPA should consider using lower discount rates and including a central near-term rate of 1.5%**.

Along those lines, these comments make the following points:

- The Draft Report faithfully incorporates the National Academies' recommendations, reflects the latest research and expert consensus, and is

[1] Our organizations may separately and independently submit other comments to this docket. This document does not purport to represent the views, if any, of New York University School of Law.
[2] EPA External Review Draft of Report on the Social Cost of Greenhouse Gases (2022) [hereinafter Draft Report].
[3] Nat'l Acad. Sci., Engineering & Med., Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide (2017) [hereinafter NAS 2017 Report].

consistent with the federal government's **repeated recognition that the Working Group's valuations substantially underestimate climate costs**.

- The Draft Report properly focuses on global damage estimates in recognition of the benefits of reciprocal foreign emissions reductions and the spillover effects to U.S. economic health, and security interests from climate impacts that originate beyond the nation's borders. **To further bolster its legal support for this geographic perspective, EPA can provide additional precedent** for its consideration of climate damages on a global scale. Namely, EPA can highlight the fact that **agencies often consider the extraterritorial effects of their actions when exercising their statutory authority, and courts have endorsed this practice**.

- The Draft Report focuses on an appropriate range of discount rates. To further bolster its legal support for its discounting approach, EPA can provide additional precedent for its use of discount rates—namely the fact that **EPA has previously endorsed lower discount rates for long-term impacts**. Moreover, existing evidence indicates that **the Draft Report's range of discount rates is likely conservative**. Accordingly, EPA should prioritize climate-damage valuations using lower discount rates and **consider using 1.5% as the central near-term, risk-free rate**.

- **EPA should further emphasize that the valuations in the Draft Report underestimate the true costs of climate change**, and commit to incorporating omitted damages into its estimates as those valuations advance.

This document is organized into two parts. Part I explains that the Draft Update faithfully incorporates the recommendations of the National Academies of Sciences and applies appropriate methodologies on key inputs. This Part provides **additional precedent that EPA can provide for its choice of discount rates and geographic scope**, and for the fact that its climate-damage valuations represent a large increase over the damages estimates that the federal government previously developed.

Part II of this document emphasizes that the valuations reflected in the Draft Report, while economically rigorous and legally appropriate, continue to underestimate the full social costs of greenhouse gas emissions. This Part suggests that **EPA applies a lower range of discount rates in light of considerable evidence that the 2% central estimate that it applies in the Draft Report reflects conservative assumptions**. This Part also recommends that EPA commit to incorporating omitted damages into its estimates as valuations advance.

I. EPA's Climate-Damage Valuations Are Consistent With Both the Latest Available Science and Past Agency Practice, and EPA Can Provide Additional Regulatory Precedent To Support Its Methodological Choices

EPA's valuations of the social cost of greenhouse gases, though they continue to understate the true costs of climate change, faithfully incorporate the recommendations of the National Academies of Sciences and are consistent with the latest available science. As it finalizes the Draft Report, EPA should consider providing additional legal justification grounded in regulatory precedent for its methodological choices and final valuations. In particular, EPA can further highlight that the federal government has always considered its climate-damage valuations to be underestimated, and that EPA's updated valuations represent an increase over those prior values for the reasons previously anticipated. Additionally, EPA can provide examples of past agency practices (both from EPA and other agencies) for its consideration of global damages and its selection of discount rates.

A. The Draft Report Follows the Latest Available Science, and Its Valuations Reflect the Federal Government's Repeated Recognition that the Working Group Undervalued the Social Cost of Greenhouse Gases

The Draft Report reflects the first comprehensive update to the social cost of greenhouse gases in a decade. During that period, the science and economics around climate change have advanced, dozens of relevant new peer-reviewed studies have been published, and the scientific community has developed a more complete understanding of the economic cost of greenhouse gas emissions. The Draft Report comprehensively incorporates this new research and updates the social cost of greenhouse gases consistent with the best available science and economics.

The Draft Report closely applies the 2017 recommendations of the National Academies of Sciences, Engineering, and Medicine.[4] In that report, the National Academies called for estimating the social cost of greenhouse gases using a model constructed of four interconnected modules—"socioeconomic, climate, damages, and discounting—that reflects the state of scientific knowledge in the current, peer-reviewed literature."[5] The National Academies recommended that the socioeconomic module rely on "expert judgment for projecting distributions of economic activity, population growth, and emissions into the future."[6] It suggested that the climate module "reflect current scientific understanding of the relationships between greenhouse gas emissions, concentrations, radiative forcing, and global mean surface temperature change,"[7] and specifically endorsed the FAIR model that EPA adopted as satisfying those criteria.[8] It explained that the damages modules should "draw on recent scientific literature" and "extend far enough in the future" to capture all key climate impacts.[9] And it

[4] *See id.*
[5] *Id.* at 2–3.
[6] *Id.* at 3.
[7] *Id.* at 13.
[8] *Id.* at 14–15, 105–09.
[9] *Id.* at 3, 10.

suggested the use of discount rates based on consumption rates of interest[10] that decline over time.[11] The Draft Report reflects each of these recommendations from the National Academies, along with many others.

Given that EPA followed the latest available science and the National Academies' recommendations, it is hardly surprising that its marginal climate-damage valuations represent a large increase from the Working Group's years-old estimates. Independent valuations of the social cost of greenhouse gases closely resemble those in the Draft Update. For instance, a recent analysis from Resources for the Future published in *Nature*, which EPA incorporated into its Draft Update, found that the proper present-day social cost of carbon is $185.[12] Numerous foreign countries including Germany,[13] France,[14] and the United Kingdom[15] also apply similar or higher valuations for the social cost of greenhouse gases. And experts widely agree that the Working Group's climate-damage estimates are far too low.[16]

EPA's updated valuations are also consistent with the federal government's repeated recognition that its earlier values were conservative underestimates. When EPA first estimated the social cost of greenhouse gases under the George W. Bush administration, it recognized that those valuations were "very likely to underestimate the benefits of [greenhouse gas] reductions"[17] due to various considerations including the use of potentially high discount rates,[18] the lack of accounting for uncertainty and risk aversion,[19] and the likelihood that climate models

[10] *Id.* at 19.
[11] *Id.* at 171–79.
[12] Kevin Rennert et al., *Comprehensive Evidence Implies a Higher Social Cost of CO2*, NATURE (2022). This is nearly identical to the Draft Update's central valuation of $190 for year 2020 emissions. Draft Report, *supra* note 2, at 3 tbl.ES.1.
[13] Germany applies values of €205 (at a 1% discount rate) and €670 (at a 0% discount rate) per ton of carbon dioxide-equivalent, for year 2030 emissions, in 2016€. Umweltbundesamt, Methodological Convention 3.0 for the Assessment of Environmental Costs at 8 (2019), https://perma.cc/CQ8M-ZD47. As of this writing, the euro-to-U.S. dollar conversion is roughly (though not exactly) one-to-one.
[14] France applies values of $295 per ton of carbon dioxide for year 2030 emissions, and $916 for year 2050 emissions. These values are based on an abatement-cost rather than a damage-cost approach. *See* Nicki Hutley et al., *A Social Cost of Carbon for the ACT* 16 tbl.3 (2021), https://perma.cc/65WE-AXPA.
[15] The United Kingdom applies values of $108 per ton of carbon dioxide for year 2030 emissions, and $309 for year 2050 emissions. These values are also based on an abatement-cost approach. *See id.*
[16] *E.g.* Martin C. Hansel et al., *Climate Economics Support for the UN Climate Targets*, 10 NATURE CLIMATE CHANGE 781 (2020); Robert S. Pindyck, *The Social Cost of Carbon Revisited,* 94 J. ENV'T ECON. & MGMT. 140 (2019); Peter Howard & Derek Sylvan, Inst. for Pol'y Integrity, *Gauging Economic Consensus on Climate Change* (2021).
[17] EPA, Regulating Greenhouse Gas Emissions Under the Clean Air Act, 73 Fed. Reg. 44,354, 44,446 (July 30, 2008).
[18] *Id.* at 44,414–15 (recognizing support for intergenerational discount rates as low as 0.5% and noting the importance of "evaluating uncertainty in the discount rate," which would drive down the long-term discount rate).
[19] *Id.* at 44,415 ("[S]ome have expressed concern in the economics literature that standard deterministic approaches . . . do not appropriately characterize the uncertainty and risk related to climate change and may lead to a substantial underestimation of the benefits from taking action").

were not fully reflecting the severity of climate impacts.[20] Notably, these factors reflect the very reasons that EPA's updated valuations represent an increase from prior government estimates.

The Working Group has also consistently recognized that its climate-damage valuations were conservative underestimates. In its initial technical support document in 2010, for instance, the Working Group highlighted economic evidence supporting the use of "a graduated scale of lower discount rates further out in time" to account for long-term uncertainty.[21] The Working Group's 2013 and 2016 updates similarly highlighted the lack of formal modeling for risk aversion or a declining discount rate as reasons why the Working Group's climate-damage estimates likely understated the true costs of climate change.[22] In its 2016 update, the Working Group highlighted that the IPCC has "concluded that [social cost of carbon] estimates 'very likely . . . underestimate the damage costs'" from greenhouse gas emissions and that "the peer-reviewed literature has continued to support this conclusion."[23]

The Working Group's 2021 update to the social cost of greenhouse gases builds off of its prior updates and provides the most extensive discussion of the Working Group's conclusion that its values reflect underestimates. In that update, the Working Group detailed "how the understanding of discounting approaches suggests discount rates appropriate for intergenerational analysis in the context of climate change [should be] lower than 3 percent."[24] In that update, the Working Group surveyed the economics literature and concluded that discount rates of "2 percent and lower[] are warranted when discounting intergenerational impacts."[25] Based on this analysis, as well as the continued omission of key climate impacts in the damage models, the Working Group concluded that the range of climate-damage valuations presented in that document "likely underestimate societal damages from [greenhouse gas] emissions."[26]

EPA and the Working Group have also recognized that prior valuations of the social cost of greenhouse gases were underestimates due to omitted damages.[27] Because the Draft Report

---

[20] *Id.* at 44,416 ("Underestimation is even more likely when one considers that the current trajectory for GHG emissions is higher than typically modeled"); *id.* at 44,428 (discussing "the potential for associated and difficult-to-predict-and-quantify extreme events is not adequately incorporated into impact assessments").

[21] Interagency Working Group, *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis* 22–23 (2010) ["2010 TSD"].

[22] Interagency Working Group, *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis* 15 (2013); Interagency Working Group, *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis* 20–21 (2016) ["2016 TSD"].

[23] 2016 TSD, *supra* note 22, at 21 (citing Gerald Meehl et al., *Global Climate Projections*, in: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge Univ. Press, 2007)); *see also* Interagency Working Group, *Response to Comments* 27–28 (2015) ("[T]he IPCC Fifth Assessment report observed that SCC estimates continue to omit various impacts that would likely increase damages.").

[24] Interagency Working Group, *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990* at 4 (2021) ["2021 TSD"]; *see also id.* at 18–22 (offering extensive evidence for the use of lower discount rates, including a declining rate for long time horizons).

[25] *Id.* at 21.

[26] *Id.* at 4.

[27] *See, e.g.*, 73 Fed. Reg. at 44,416 ("Current estimates do not capture many of the main reasons for concern about climate change, including non-market damages (e.g., species existence value and the value of having the option for

continues to omit many important damage categories, EPA once again recognizes that its valuations are likely underestimates.[28]

As EPA finalizes the Draft Report, it should consider emphasizing that the federal government has repeatedly recognized its existing climate-damage valuations as underestimated, and that the valuations in the Draft Report increase for the very reasons that the government has previously provided for why those prior valuations were conservative.

B. EPA Appropriately Focuses on Global Damage Estimates and Can Provide Additional Regulatory Precedent to Support That Focus

EPA appropriately accounts for global climate damages in the Draft Update,[29] following the approach consistently applied by the Working Group that EPA first adopted under the George W. Bush administration.[30] Including climate impacts that originate abroad but affect domestic welfare is consistent with Circular A-4's guidance that agency analysis incorporate effects "that accrue to citizens and residents of the United States" and to also report "effects beyond the borders of the United States."[31]

EPA correctly identifies numerous pathways through which the use of global climate-damage valuations captures critical climate-change impacts that affect the United States and its citizens but do not originate within the country's borders. For one, as EPA explains, U.S. economic, national security, public health, and humanitarian concerns are "inextricably linked to the rest of the world" such that climate-change impacts that originate in foreign countries will inevitably spill over into the United States, affecting global supply chains, migration patterns, and security risks.[32] EPA also recognizes that "climate change will directly impact U.S. interests that are located abroad," highlighting the millions of U.S. citizens living abroad, the more than $6 trillion in U.S. assets located abroad, the more than 500 U.S. military bases located abroad, and U.S. resources in the global commons such as fisheries.[33]

In addition to noting the direct impacts of transboundary climate pollution on U.S. welfare, EPA also recognizes that applying a global focus will benefit U.S. welfare by spurring foreign nations to reduce their own greenhouse gas emissions. EPA explains that considering

---

future use), the effects of climate variability, risks of potential extreme weather (e.g., droughts, heavy rains and wind), socially contingent effects (such as violent conflict or humanitarian crisis), and potential long-term catastrophic events."); *see also id.* (discussing climate tipping points); 2010 TSD, *supra* note 21, at 31 (noting that key omitted damages that "lead to underestimates of the [social cost of carbon]"); 2016 TSD, *supra* note 23, at 19, 21; 2021 TSD, *supra* note 24, at 27, 30–31.

[28] *See* Draft Report, *supra* note 2, at 73 tbl.3.2.1 (cataloging omitted damages).

[29] *Id.*. at 10–15.

[30] Regulating Greenhouse Gas Emissions Under the Clean Air Act, 73 Fed. Reg. 44,354, 44,446 (July 30, 2008).

[31] Zero Zone, Inc. v. Dep't of Energy, 832 F.3d 654 (7th Cir. 2016); California v. Bernhardt*,* 472 F. Supp. 3d 573, 611–14 (N.D. Cal. 2020).

[32] Draft Report, *supra* note 2, at 11–13.

[33] *Id.* at 11.

climate damages on a global scale prevents a tragedy of the commons.[34] Accordingly, EPA recognizes that "the only way to achieve an efficient allocation of resources for emissions reduction on a global basis—and so benefit the U.S. and its citizens and residents —is for all countries to consider estimates of global marginal damages."[35] EPA properly recognizes that the adoption of global climate-damage valuations has facilitated reciprocal emissions reductions by other nations, highlighting the fact that many countries have either directly adopted U.S. climate-damage valuations or use other valuations that similarly adopt a global focus.[36]

While EPA offers extensive justification for its focus on global damage estimates, it can provide additional regulatory precedent supporting that approach. Agencies often consider the extraterritorial effects of their actions—including effects on international reciprocity, international cooperation, and transboundary spillovers—when administering their statutory authority. And on numerous occasions, courts have endorsed this practice. To bolster its justification for its global perspective, EPA should highlight these regulatory precedents.

For one, while EPA recognizes in a footnote in the Draft Report that the National Environmental Policy Act (NEPA) requires agencies to administer and interpret the nation's law to "recognize the worldwide and long-range character of environmental problems" and to "lend appropriate support" to help "maximize international cooperation,"[37] it can draw further support from NEPA. Notably, for instance, EPA can highlight that several courts—including the U.S. Court of Appeals for the D.C. Circuit—have held that reasonably foreseeable transboundary effects must appear in NEPA analyses.[38] And agencies have assessed transboundary impacts under NEPA for over forty years under Executive Order 12,114, which instructs agencies to "take into consideration in making decisions" effects of their actions on the "environment of foreign nations" and "global commons."[39]

EPA can also highlight the fact that, outside the climate context, agencies have considered effects on international reciprocity in their regulatory cost-benefit analyses and decisionmaking. Perhaps the best antecedent on this front is EPA's 1988 regulations to protect stratospheric ozone—another global pollutant that, like greenhouse gases, requires international cooperation to effectively mitigate. In issuing those regulations, EPA recognized that it could "consider other countries' willingness to take regulatory action" in "deciding whether and how to regulate."[40] EPA also took "[c]onsideration of the international ramifications of United States

[34] *Id.* ("Unlike many environmental problems where the causes and impacts are distributed more locally, GHG emissions are a global externality making climate change a true global challenge. GHG emissions contribute to damages around the world regardless of where they are emitted.").
[35] *Id.* at 13.
[36] *Id.* at 13–15.
[37] 42 U.S.C. § 4332(2)(F) (*cited at* Draft Report, *supra* note 2, at 15 n.37).
[38] *E.g.* Env't Def. Fund, Inc. v. Massey, 986 F.2d 528 (D.C. Cir. 1993); Gov't of Man. v. Salazar, 691 F. Supp. 2d 37, 51 (D.D.C. 2010).
[39] See Exec. Order No. 12,114 § 2–3, 44 Fed. Reg. 1957 (Jan. 4, 1979).
[40] Protection of Stratospheric Ozone, 53 Fed. Reg. 30,566, 30,569 (Aug. 12, 1988).

action" into account when "analyzing the cost and feasibility of controls."[41] And in its regulatory impact analysis, EPA modeled alternative regulatory stringency levels based on potential international participation rates and the influence that EPA regulation would have on reciprocal international actions.[42] By adopting a global approach to the social cost of greenhouse gases, EPA therefore draws upon the approach that it took for stratospheric ozone under the Reagan administration.

On several prior occasions—again outside the context of climate change—courts have upheld EPA's authority to consider effects on international reciprocity and cooperation due to domestic pollution standards. In one case, for instance, the D.C. Circuit upheld EPA's decision to set an interim tolerance of 30 ppb for the chemical ethylene dibromide under the Food, Drug, and Cosmetic Act (FDCA)—rather than ban the chemical altogether—after EPA concluded that a ban "could damage cooperative [food-safety] efforts," reasoning that "[s]ince effective enforcement of food safety laws depends upon such cooperation, a ban might increase the risk that fruit and vegetables would enter the U.S. treated with unsafe levels of pesticides or infested with pests or diseases."[43] The D.C. Circuit similarly upheld EPA's consideration of international harmonization in setting NO_x emissions standards for commercial aircraft gas turbine engines, after EPA issued a standard under the Clean Air Act to align U.S. standards with the International Civil Aviation Organization's standards.[44]

In addition to EPA's consideration of international reciprocity and cooperation in prior rulemakings, agencies have also considered transboundary spillover effects in making key decisions. As one example, when considering the "public interest" in the certification of natural gas exports under the Natural Gas Act,[45] the Department of Energy routinely "consider[s] international trade policy, foreign policy, and national security interests."[46] As another example, the Food and Drug Administration also frequently considers international effects as part of its regulatory decisionmaking, and has recognized that such costs are particularly relevant because "a portion of foreign costs could be passed on to domestic consumers."[47]

Courts have confirmed that agencies may—and, in some cases, must—take into account international spillover effects. In 2020, the U.S. Court of Appeals for the Ninth Circuit rejected a Bureau of Ocean Energy Management approval of an offshore oil drilling and production facility after the agency concluded that domestic extraction would not affect international fossil-fuel

[41] *Id.*. ("Certainly other nations' ozone-depleting emissions or control of emissions affect the cost of United States' controls, and the need for other nations to limit their emissions may make appropriate United States action that encourages, or does not discourage, other nations to agree to such limits.").
[42] Env't Prot. Agency, *Regulatory Impact Analysis for the Protection of Stratospheric Ozone* (1988).
[43] National Coalition Against the Misuse of Pesticides v. Thomas, 815 F.2d 1579, 1582 (D.C. Cir. 1987).
[44] National Ass'n of Clean Air Agencies v. EPA, 489 F.3d 1221 (D.C. Cir. 2007).
[45] 15 U.S.C. § 717b(a).
[46] New Policy Guidelines and Delegation Orders from Secretary of Energy to Economic Regulatory Administration and Federal Energy Regulatory Commission Relating to the Regulation of Imported Natural Gas, 49 Fed. Reg. 6,684 6,688 (Feb. 22, 1984).
[47] Requirements for Additional Traceability Records for Certain Foods, 87 Fed. Reg. 70,910, 71,071 tbl.2 (Nov. 21, 2022).

supply and consumption.[48] As the court explained, because domestic production causes "foreign consumers [to] buy and consume more oil"—and because that consumption "can be translated into estimates of greenhouse gas emissions" that harms the United States—the agency had an obligation to consider those increased foreign emissions resulting from domestic action.[49] Two subsequent district court opinions similarly faulted Department of Interior analyses for omitting the effects of domestic production on foreign demand and consumption.[50] The fact that courts have required agencies to consider the spillover impacts from foreign greenhouse gas emissions provides strong support for EPA's consideration of spillovers from domestic emissions.

As all of these examples illustrate, EPA's consideration of climate damages on a global scale is consistent with how EPA and other agencies have exercised regulatory authority in numerous contexts. EPA should highlight these antecedents as further support for its global approach.

C. EPA Applies a Reasonable Range of Discount Rates, and Can Further Highlight Regulatory Precedent Supporting the Use of Lower Discount Rates Over Long Time Horizons, Including Declining Discount Rates

In the Draft Update, EPA applies a reasonable (albeit conservative) range of discount rates that more appropriately captures harm to future generations. The discount rates used in the Draft Update—which begin at 2.5%, 2%, and 1.5% and decline over time—are generally consistent with economic evidence,[51] theory,[52] and consensus.[53] As detailed in Part II, *infra*, the discount rates in the Draft Update continue to reflect conservative assumptions, and EPA should apply lower discount rates including a central rate of 1.5%.[54]

EPA appropriately notes that its approach to discounting is consistent with the recommendations in Circular A-4[55] and from the National Academies of Sciences.[56]

---

[48] Ctr. for Biological Diversity v. Bernhardt, 982 F.3d 723, 738 (9th Cir. 2020).
[49] *Id.*
[50] Sovereign Iñupiat for a Living Arctic v. Bureau of Land Mgmt., 555 F. Supp. 3d 739, 764–67 (D. Alaska 2021); citing Friends of the Earth v. Haaland, No. CV 21-2317 (RC), 2022 WL 254526, at *14–15 (D.D.C. Jan. 27, 2022).
[51] As EPA explains, real interest rates in recent decades are generally consistent with the short-term discount rates applied in this update. Draft Report, *supra* note 2, at 56–58. For this reason, the Council of Economic Advisors recommends that the short-term consumption rate of interest be "at most 2 percent." COUNCIL OF ECON. ADVISERS, DISCOUNTING FOR PUBLIC POLICY: THEORY AND RECENT EVIDENCE ON THE MERITS OF UPDATING THE DISCOUNT RATE 1 (2017).
[52] Circular A-4 provides multiple justifications for applying lower discount rates over longer time horizons, including uncertainty and intergenerational equity. OFF. OF MGMT. & BUDGET, CIRCULAR A-4: REGULATORY ANALYSIS 35–36 (2003).
[53] *See, e.g.*, Moritz A. Drupp et al., *Discounting Disentangled*, 10 AM. ECON. J. 109 (2018) (finding "consensus among experts" at a 2% discount rate); 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, 223 tbl.1 (2020) (conducting expert elicitation and finding mean discount rate of 2.3%); *see also* Draft Report, *supra* note 2, at 61 (summarizing expert literature).
[54] *See infra* Part II.A.
[55] *E.g.*, Draft Report, *supra* note 2, at 7 n.13, 54 n.98, 58 & n.107, 112–13.
[56] *E.g. id.* at 54, 56, 59, 61. The National Academies' recommendations are in line with the standard practice of using the Ramsey discount rate in climate-economics, as exemplified by the as the DICE, FUND, and PAGE models used by the Interagency Working Group. In fact, it was the Interagency Working Group that deviated from the

Additionally, as noted above, EPA's approach to discounting reflects the Working Group's prior recognition that discount rates of "2 percent and lower[] are warranted when discounting intergenerational impacts"[57] and that there is strong support in the economics literature for the use of a declining discount rate.[58] EPA's approach to discounting, while conservative, is strongly grounded in the economics literature as reflected in the relevant guidance, external reviews, and prior recognitions from both EPA and the Working Group.

While EPA offers strong support for its approach to discounting, it should consider adding additional justifications in regulatory practice and precedent. In particular, EPA can further highlight that Circular A-4 explicitly endorses the use of lower discount rates for long-term effects such as climate change.[59] Pointing to intergenerational equity and long-term uncertainty, Circular A-4 recognizes the importance of discounting for "future generations at a lower rate" and suggests an annual discount rate as low as 1% based on the evidence that was then available.[60] Circular A-4's approach to intergenerational discounting offers strong support for EPA's declining-rate approach.

EPA can also point to regulatory practice to support its approach to discounting, as agencies have applied lower discount rates for long-term impacts on numerous occasions going back decades. For instance, as discussed above, under the Reagan administration in 1988, EPA developed regulations to protect the ozone layer from chlorofluorocarbons. Although OMB guidance at the time endorsed a 10% discount rate, EPA used a central rate of 2%.[61] EPA similarly applied a discount rate of 2% for regulations affecting ozone-depleting substances (and thus imparting significant long-term benefits) in both 1993[62] and 2004.[63] Notably, the latter regulation, promulgated under the George W. Bush administration, was completed after the publication of Circular A-4 in 2003. The Department of Housing and Urban Development has also applied lower discount rates in regulatory impact analysis based on the long-term nature of the regulatory effects analyzed.[64] And in 2005, EPA applied a 1% discount rate to its analysis of

---

standard assumptions in the literature replacing the Ramsey discount rate equation with constant discount rates. 2010 TSD, *supra* note 21, at 21–23, 27.

[57] *See supra* note 25 and accompanying text.

[58] *See supra* notes 21–22 and accompanying text.

[59] CIRCULAR A-4, *supra* note 52, at 35–36.

[60] *Id.* at 36.

[61] Protection of Stratospheric Ozone, 53 Fed. Reg. 30,566, 30,595 tbl.4 (Aug. 12, 1988). EPA explained that the rule's long time horizon called for a "more refined selection" of discount rates. Env't Prot. Agency, *Regulatory Impact Analysis for the Protection of Stratospheric Ozone* app. at H-20 (1988).

[62] Protection of Stratospheric Ozone; Labeling, 58 Fed. Reg. 8136, 8162–63 (Feb. 11, 1993).

[63] Protection of Stratospheric Ozone; Refrigerant Recycling; Substitute Refrigerants, 69 Fed. Reg. 11946, 11975 (Mar. 12, 2004).

[64] Requirements for Notification, Evaluation and Reduction of Lead- Based Paint Hazards in Federally Owned Residential Property and Housing Receiving Federal Assistance, 64 Fed. Reg. 50,140, 50,186–87 (Sept. 15, 1999). While OMB at that time recommended using only a 7% discount rate, HUD discounted the lifetime earnings benefits for young children who avoid lead exposure at both 3% and 7%. As HUD explained, a special "intergenerational discount rate" was applied because "lifetime earnings benefits will be realized by the children and grandchildren of the[] adult taxpayers" bearing the rule's costs.

the Clean Air Mercury Rule "due to the potential for intergenerational effects" from mercury pollution.[65]

Perhaps most significantly, EPA should highlight the fact that it has previously recommended the use of lower discount rates for the social cost of greenhouse gases. Under the George W. Bush administration in 2008, EPA estimated climate damages using discount rates of 2% and 3%.[66] The explanations that EPA provided for discounting long-term climate impacts at a low rate—such as long-term uncertainty and the appropriateness of consumption-based discount rates[67]—are consistent with the justifications EPA provides now for its range of discount rates.

II. EPA's Climate-Damage Valuations Continue to Reflect Conservative Underestimates, and EPA Should Take Further Steps to Better Ensure That It Does Not Underestimate the Costs of Climate Change

Although EPA's updated social-cost valuations reflect a reasoned approach to valuing climate impacts, they continue to reflect conservative underestimates. To the extent practical, EPA should consider incorporating additional scientific advances—either now or in the future—to ensure that its climate-damage estimates most accurately reflect the true costs of climate change. EPA can do this in two principal ways.

First, as discussed below and detailed in a separate comment letter filed by the Institute for Policy Integrity, the short-term discount rates that EPA applies in the Draft Report remain conservative. The lines of evidence that EPA cites in the Draft Report in fact support a lower range of short-range discount rates from 0.5% to 2.5%, with a central estimate of about 1.5%. Based on this evidence, EPA should adjust its selection of discount rates downward.

Second, as EPA notes throughout the Draft Report, its updated estimates continue to omit many key climate damages. EPA should continue to follow the science and commit to incorporating reliable quantifications of omitted impacts as they become available.

A. In Light of Extensive Evidence, EPA Should Apply a Lower Range of Discount Rates, Including a Central Near-Term Rate of 1.5%

The Draft Report applies near-term discount rates of 1.5–2.5%, with a central rate of 2% "based on multiple lines of evidence on observed market interest rates."[68] These mark a substantial improvement over the discount rates applied in the Working Group's climate-damage valuations (which range from 2.5–5%) and reflect the extensive evidence that the discount rates applied in regulatory analysis systemically undervalue impacts that accrue to future

[65] Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units, 70 Fed. Reg. 28,606, 28,642 (May 18, 2005). This rule was later vacated by the D.C. Circuit on grounds unrelated to the discount rate. New Jersey v. EPA, 517 F.3d 574 (D.C. Cir. 2008).
[66] EPA, Regulating Greenhouse Gas Emissions Under the Clean Air Act, 73 Fed. Reg. 44,354, 44,416, 44,446 (July 30, 2008); EPA, Technical Support Document on Benefits of Reducing GHG Emissions (2008).
[67] *See* 73 Fed. Reg. at 44,414–15.
[68] Draft Report, *supra* note 2, at 2.

generations.[69] As discussed above, EPA's decision to revisit the discount rates applied by the Working Group and apply a lower range of rates is consistent with the National Academies' recommendations and reflects the economic consensus that the Working Group's discount-rate range is too high.

However, the Draft Update continues to reflect conservative discounting choices and overlooks extensive evidence supporting a further downward adjustment to the discount rates. As discussed below—and detailed further in a separate comment letter filed to this docket by the undersigned Institute for Policy Integrity—multiple lines of evidence collectively support a discount rate range from 0.5% to 2.5%, with a central estimate of 1.5%.

First, real rates of return on the ten-year Treasury bill—the primary evidence that EPA cites for its near-term discount selections—support a central rate of 1.5–2%, if not lower. While EPA calculates the average real rate of return to the ten-year Treasury bill over two time periods (1991–2020 and 1973–2020), it acknowledges that the 30-year timeframe merits "greater focus" due to "structural shifts in the interest process beginning in the 1990s" found in the economics literature.[70] Notably, as EPA recognizes, use of a 30-year time horizon implies a central rate of approximately 1.5% to 2.0%.[71] Real returns on the ten-year Treasury bill have continued to drop in recent decades, with real interest rates in the 2010s falling under 1%.[72]

Second, while EPA extensively cites the work of Bauer and Rudebusch,[73] it overlooks critical components of their analysis supporting lower discount rates. For one, while EPA focuses on Bauer and Rudebusch's estimates using ten-year Treasury notes,[74] the authors themselves express a preference for using one-year Treasury notes[75] and, using those one-year notes, identify a discount-rate range of 0.5% to 1.3% with a central estimate of 0.7%.[76] Moreover, even their discount-rate estimates corresponding to the 10-year rates suggest a lower

---

[69] *See* Peter Howard & Jason A. Schwartz, *Valuing the Future: Legal and Economic Considerations for Updating Discount Rates*, 39 YALE. J. ON REG. 595 (2022) ("In the economics literature, multiple lines of evidence point to a central consumption rate below 2% as appropriate in government decisionmaking—and capital-based rates as largely inappropriate for many policy contexts—particularly in rulemakings with inter-generational implications, like climate change.").

[70] Draft Report, *supra* note 2, at 59.

[71] *Id.* at 59 tbl.2.4.1.

[72] Howard & Schwartz, *supra* note 69, at 618. As discussed further below, long-term forecasts point to a wider range of interest rates in the future.

[73] Michael D. Bauer & Glenn D. Rudebusch, *The Rising Cost of Climate Change: Evidence from the Bond Market*, REV. ECON. & STAT. (2021).

[74] Draft Report, *supra* note 2, at 58 (citing a range of 1.3% to 2.4% with a central estimate of 1.9% using data of the nominal return to the ten-year Treasury note from 1969 to 2019 adjusted for inflation using the perceived adjustment target rate).

[75] Michael D. Bauer & Glenn D. Rudebusch, *The Rising Cost of Climate Change: Evidence from the Bond Market,* at 6 (Working Paper, Jan. 17, 2021) (discussing "ample evidence that long-term bond yields for maturities of, say, five or ten years include a term premium and thus differ from the expected return of rolling over short-term bonds"); Bauer & Rudebusch*,* supra note 73, at 13 & 17 (explaining that the "canonical approach" of using the dynamics of short-term Treasury rates to estimate long-term social discount rates "is the appropriate method to obtain risk-free social discount rates, which include neither a term premium nor a climate risk premium, and it has been used by many previous empirical studies in this literature").

[76] Bauer & Rudebusch*,* supra note 75, at 12 tbl.1.

discount rate: Using their preferred model,[77] Bauer and Rudebusch find a preferred estimate of 1.3% using ten-year Treasury notes.[78]

Third, while EPA cites long-term forecasts from the Congressional Budget Office and Social Security Administration,[79] a more complete analysis of government forecasts indicates a lower range of discount rates than EPA applies. Notably, the Congressional Budget Office forecasts rates of 1.6% to 1.7% in the medium-run (in 10 to 20 years),[80] and in its 2021 and 2022 forecasts, the Congressional Budget Office also calculates average forecasts of 1.3% to 1.5% over the next 30 years.[81] And the Council of Economic Advisors, in a 2017 forecast, cites future forecasts from Blue Chips of between 1.2% to 1.5%.[82] While forecasts admittedly point to different estimates over different time-periods, EPA's exclusive focus on long-range forecasts may not be appropriate as uncertainty increases farther into the future. Emphasizing the full range of government forecasts thus suggests a central rate near 1.5%.

Fourth and finally, while EPA cites expert elicitations identifying a median discount rate of 2%,[83] experts find a lower discount rate when they explicitly consider relative prices.[84] In particular, the experts surveyed in Drupp et al. (2018) that explicitly accounted for relative prices supported a lower discount-rate range of 0% to 2% with a central estimate of 1%.[85] This is important, as damage functions have historically failed to account for the increased value of non-market goods and services due to their growing relative scarcity from climate and non-climate factors.[86] Relative prices can be implicitly captured by adjusting the social discount rate downward to account for the slower growth rate in per-capita consumption of non-market goods and services relative to market goods and the limited substitutability of market goods for these

---

[77] Bauer and Rudebusch's preferred model is the unobserved-components (UC) model, not the "simple autoregressive (AR) model of Newell and Pizer (2003)" that the authors include to check for robustness. *Id.* at 11–12. As the authors explain, their preferred model is consistent with the inclusion of "structural economic changes" found in the literature. *Id.* at 9.

[78] *Id.* at 12 tbl.1.

[79] Draft Report, *supra* note 2, at 58 (citing CONG. BUDGET OFFICE, THE 2021 LONG TERM BUDGET OUTLOOK (2021), https://www.cbo.gov/publication/56977 [hereinafter CBO 2021]; SOCIAL SECURITY ADMIN., THE 2021 ANNUAL REPORT OF THE BOARD OF TRUSTEES OF THE FEDERAL OLD-AGE AND SURVIVORS INSURANCE AND FEDERAL DISABILITY INSURANCE TRUST FUND (2021), https://www.ssa.gov/OACT/TR/2021/).

[80] CBO 2021, *supra* note 79, at 34 tbl.A-2; *see also* CONG. BUDGET OFFICE, THE 2022 LONG TERM BUDGET OUTLOOK (2022) [hereinafter CBO 2022].

[81] CBO 2021, *supra* note 79; at 43 tbl.A-2; CBO 2022, *supra* note 80, at tbl.B-1.

[82] Council of Econ. Advisers, *Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate* (2017), https://perma.cc/K28D-XXPQ.

[83] Moritz Drupp et al., *Discounting Disentangled*, 10 AM. ECON. J.: ECON. POL'Y 109, 118 (2018); Robert S. Pindyck, *The Social Cost of Carbon Revisited,* 94 J. ENV'T ECON. & MGMT. 140 (2019); Peter H. Howard & Derek Sylvan, *Wisdom of the Experts: Using Survey Responses to Address Positive and Normative Uncertainties in Climate-Economic Models*, 162 CLIMATIC CHANGE 213, 221–23 (2020).

[84] *Drupp* et al.*, supra* note 83, at 123.

[85] *Id*.

[86] Howard & Schwartz, *supra* note 69, at 632–33; Peter H. Howard, INST. FOR POL'Y INTEGRITY, *Omitted Damages: What's Missing from the Social Cost of Carbon*, at 31–33 (2014), https://policyintegrity.org/files/publications/Omitted_Damages_Whats_Missing_From_the_Social_Cost_of_Carbon.pdf.

non-market goods.[87] In the case of the Howard and Sterner (2017) damage function—one of the three damage functions that EPA incorporates in the Draft Update—this downward adjustment applies as relative prices were not factored into the damage function.[88]

Looking at all four lines of evidence, it appears that EPA applies overly conservative central and lower-bound discount rates. These lines of evidence generally support a range of social discount rates between 0.5%–2.5% with a central estimate of 1.5%.[89]

B. EPA Should Further Emphasize that the Climate-Damage Valuations in the Draft Report Are Underestimates Due to Omitted Damages and Conservative Modeling Choices, and Commit to Future Updates as Omitted Damages Are Quantified

EPA appropriately emphasizes in the Draft Update that its draft valuations "likely underestimate the marginal damages from [greenhouse gas] pollution" as a result of both "conservative methodological choices" and "numerous categories of damages that are not currently quantified."[90] In fact, practically all of the impacts that were omitted from the Working Group's climate-damage estimates—and even some that were included in those estimates—are unquantified here.

In the Draft Report, EPA continually stresses that its valuations likely underestimate the true costs of climate change.[91] In fact, EPA appropriately dedicates an entire section of the report to highlighting omitted damages and other modeling limitations that, "taken together . . . make it likely that the SC-GHG estimates presented in [the Draft Report] underestimate the damages from [greenhouse gas] emissions."[92] While EPA appropriately notes that both its conservative modeling choices and the continued omission of key climate damages likely undervalue the true social cost of greenhouse gases, it does not recognize that its selection of discount rates is conservative and thereby contributes to this undervaluation.[93] If EPA does not decrease its range of discount rates, as recommended above,[94] it should at least incorporate the arguments from that

---

[87] *See* Christian Gollier, *Ecological Discounting*, 145 J. ECON. THEORY 812–14 (2010). Christian P. Traeger, *Sustainability, Limited Substitutability, and Non-Constant Social Discount Rates*, 62 J. ENV'T ECON. & MGMT. 215 (2011).

[88] The downward adjustment for relative prices does not fully apply to the other two damage functions as EPA accounts for future increases in the value of statistical life (such that the health impacts vary with the GDP per capita income path).

[89] For further explanation, see the comment letter from the Institute for Policy Integrity at New York University School of Law separately filed to this docket.

[90] Draft Report, *supra* note 2, at 2.

[91] *E.g., id*. at 4 ("[B]ecause of data and modeling limitations . . . estimates of the SC-GHG are a partial accounting of climate change impacts and, as such, lead to underestimates of the marginal benefits of abatement."); *id.* at 72 ("Although not all omitted climate change impacts work in the same direction in terms of their influence on the SC-GHG estimates, taken together, the numerous omitted damage categories, modeling assumptions that go in the direction of being conservative, and other limitations discussed above and throughout Section 2, make it likely that the SC-GHG estimates presented in this report underestimate the damages from GHG emissions."); *id.* at 73 tbl.3.2.1 (cataloguing omitted damages).

[92] *Id.* at 72.

[93] *See supra* Part II.A.

[94] *Id.*

section into its dedicated discussion of reasons that the Draft Update's climate-damage valuations are likely underestimates.

As EPA recognizes in the Draft Report, the climate-damage valuations developed therein do not incorporate many expected climate impacts including infectious diseases, ecosystem services, water impacts, and national security effects.[95] For the sector-specific damage functions, these omission includes several impacts captured previously by the Interagency Working Group, including storms, freshwater resources, ecosystem services / biodiversity, and climate tipping points, as well as almost all impacts previously omitted (the exceptions being labor productivity in the DSCIM damage function and a risk premium via the calculation of the certainty-equivalent social cost of greenhouse gases).[96] The Draft Report also does not incorporate important ecological effects of climate change such as impacts on precipitation, extreme weather events, non-climate mediated effects such as ocean acidification, feedback loops, and climate tipping points.[97]

Currently, independent experts are working on quantifying some of the key impact categories that are omitted from EPA's estimates. For instance, the Climate Impact Lab—the team behind EPA's Data-driven Spatial Climate Impact Model (DSCIM) damage function—currently lists conflict and migration as an additional research area.[98] Similarly, Resources for the Future—the team behind the Greenhouse Gas Impact Value Estimator (GIVE) damage function—indicates that future damage sectors will include "biodiversity, labour productivity, conflicts, and migration."[99] EPA should commit to incorporating reliable quantifications of omitted impacts as they become available in the future. However, social cost of greenhouse gases estimates will likely always be underestimates to a certain extent, as economics will likely undervalue or omit certain hard-to-measure climate impacts.[100]

In the meantime, EPA should recognize that omitted impacts imply an overestimate in the discount rate, as well. The simple Ramsey framework implies a correlation between the discount rate and the growth rate of per-capita consumption. Because larger climate impacts negatively impact the growth rate of consumption per capita—particularly as the damage functions become steeper as temperature increases—they result in a discount-rate decrease.[101] Thus, omitted impacts not only bias the social cost of greenhouse gases downwards by directly lowering damages, but also by increasing the discount rate via a higher economic growth rate.

---

[95] Draft Report, *supra* note 2, at 73 tbl.3.2.1; *see also id.* at 70–77.
[96] See Peter H. Howard, *Omitted Damages: What's Missing from the Social Cost of Carbon* (2014), https://policyintegrity.org/files/publications/Omitted_Damages_Whats_Missing_From_the_Social_Cost_of_Carbon.pdf.
[97] *See id.*
[98] Climate Impact Lab, https://impactlab.org/.
[99] Rennert et al., *supra* note 12, at 4.
[100] *Id.*
[101] Draft Report, *supra* note 2, at 51, 54–55 ("When using the Ramsey formula to estimate the SC-GHG, the per capita consumption growth rate . . . is calculated net of baseline climate change damages as estimated by the damage modules described in Section 2.3.")

Furthermore, omitted impacts also inflate the certainty-equivalent social cost of carbon by decreasing the variability in the growth rate of per-capita consumption and producing an overly strong correlation between global GDP and the amount of climate damages (i.e., increasing the "climate beta"). In particular, the omission of explicitly represented environmental and social tipping points strongly increases variance and decreases the climate beta by introducing strong non-linearities into the climate-economic system.[102] One potential solution is to use a lower discount rate range, as discussed earlier in Section II.A.

Conclusion

EPA's update to the social cost of greenhouse gases faithfully implements the roadmap laid out by the National Academies of Sciences and applies recent advances in science and economics on the costs of climate change. EPA properly considers climate damages on a global basis and lowers the range of discount rates. Consistent with independent estimates and the federal government's repeated acknowledgements, its valuations represents a large increase over the Working Group's estimates. This letter provides additional precedent and support for these methodological choices and result, which EPA should integrate into its analysis as it finalizes the Draft Report.

The valuations presented in the Draft Report nonetheless remain underestimates for several reasons. Because the range of discount rates applied in the Draft Report continues to reflect conservative assumptions, EPA should consider using lower discount rates and applying a central near-term rate of 1.5%. EPA should also commit to incorporating omitted impacts into its damage estimates as the methodologies for valuing those impacts advance.

(Signatures on next page)

[102] Howard & Schwartz, *supra* note 69, at 626–31; Derek Lemoine, *The Climate Risk Premium: How Uncertainty Affects the Social Cost of Carbon*, 8 J. ASSOC. ENV'T & RES. ECON. 27 (2021)

Sincerely,

Natasha Brunstein, Legal Fellow, Institute for Policy Integrity at NYU School of Law
Mohit Chhabra, Senior Scientist, Natural Resources Defense Council
Rachel Cleetus, Ph.D., Policy Director, Union of Concerned Scientists
Stephanie Gagnon, Associate Policy Fellow, Center for Climate and Energy Solutions
Anne Hedges, Director of Policy and Leg. Affairs, Montana Environmental Information Center
Melissa Hornbein, Senior Attorney, Western Environmental Law Center
Peter Howard, Ph.D., Economics Director, Institute for Policy Integrity at NYU School of Law
Nat Keohane, Ph.D., President, Center for Climate and Energy Solutions
Andres Restrepo, Senior Attorney, Sierra Club
Max Sarinsky, Senior Attorney, Institute for Policy Integrity at NYU School of Law
Grace Smith, Attorney, Environmental Defense Fund
Hana Vizcarra, Senior Attorney, Earthjustice
Ann Brewster Weeks, Senior Counsel and Legal Director, Clean Air Task Force
Rosalie Winn, Director & Senior Attorney, Environmental Defense Fund

For any questions regarding these comments, please contact:

Max Sarinsky, Senior Attorney | max.sarinsky@nyu.edu
Institute for Policy Integrity at NYU School of Law
139 MacDougal Street, Third Floor, New York, NY 10012