EQUITABLE ASSIGNMENT OF STANDING FOR INTERGENERATIONAL AND INTERNATIONAL ENVIRONMENTAL POLICIES

W. Kip Viscusi* & Sydney C. Schoonover**

Recently, the U.S. Environmental Protection Agency ("EPA") issued a final rule updating valuations of the social cost of greenhouse gases ("SC-GHG"), which measure the global economic loss caused by the emission of greenhouse gases. The ability to monetize the costs and benefits of regulation is an exceptionally relevant component of regulatory impact analyses as the finding of a favorable cost-benefit balance is crucial to the enaction of policy. In the environmental context, the SC-GHG is the most important measure for cost-benefit analysis of ameliorative climate change policies. Mortality costs comprise the major component of the SC-GHG and may result from both the direct and the indirect impacts of climate change—which vary greatly depending on the temporal and geographic context under consideration.

The valuation of risks to future lives raises concerns along these two dimensions. Future assessments intrinsically involve the consideration and weighting of intertemporal impacts, which become particularly pronounced when very remote time periods—such as those involved in modeling climatic futures—are involved. Because climate change is a global problem, there is also an international dimension to valuation. Countries may differ on their assessment of the benefits associated with reduction of climate-change-related mortality risks and on the discount rate that reflects their intertemporal preferences. Variation along these dimensions greatly influences the measure of SC-GHG.

*SC-GHG estimates have previously been the subject of litigation, and judicial scrutiny of these measurements will only increase in a post-*Chevron *era. In each instance, the court has upheld the use of the SC-GHG in performing regulatory impact analyses, but recently federal appellate courts have signaled a willingness*

---

* University Distinguished Professor of Law, Economics, and Management, Vanderbilt University, Nashville, TN, United States of America.

** J.D. Candidate & Ph.D. Student, Vanderbilt University Law School, Ph.D. Program in Law & Economics. The authors would like to thank Dr. P. Christen Dockins, National Center for Environmental Economics, U.S. Environmental Protection Agency, for helpful comments.

to strike down regulations justified through controversial SC-GHG estimates. Thus, it is imperative that the measures be based in solid economic and scientific reasoning.

This Article explores the intertemporal and international valuation of mortality risks in the context of climate change, drawing on insights from the structure of pertinent statutes and the manner in which courts and federal agencies have historically addressed the valuation of environmental harms. We develop six interrelated principles for valuing environmental policy impacts internationally and intertemporally: (1) federal agencies should account for future generations in regulatory impact analyses; (2) federal agencies should use country-specific preferences to monetize future mortality risks; (3) assessments of the global costs of greenhouse gases ("GHGs") should use discount rates that reflect the country's intertemporal preferences; (4) estimates of the global costs of GHGs should also report country-specific estimates; (5) more affluent countries should subsidize countries with a low share of domestic benefits; and (6) courts should allow for the representation of future generations in present environmental litigation. The organizing theme of our framework is that there should be full recognition of the impacts of current policies on affected populations across time and, when relevant, across countries. As part of this full recognition, the assessment of the benefits of these policies should be valued based on the preferences of the affected populations. The principles developed in this Article may appear straightforward and clearly desirable, but they would induce a major departure from current practices. Still, recognizing the costs and benefits of environmental policies—accounting for both intergenerational and international differences—will be more legally sound and ensure environmental equity across generations.

TABLE OF CONTENTS

INTRODUCTION

Mortality costs comprise the largest share of regulatory policy benefits;[1] however, policies that reduce mortality risks typically do not do so immediately. For example, regulations that make vehicles safer provide for safety-related benefits over the life of the vehicle.[2] In some instances, benefits may extend beyond the lifetime of the present generation. An extreme case pertains to the hazards posed by the proposed storage of nuclear waste in a deep geological repository, where the D.C. Circuit concluded that the compliance period for the U.S. Environmental Protection Agency's ("EPA") radiation exposure standards was deficient, as the agency had not adequately addressed the risk to the lives of those potentially exposed to the radiation hazards beyond 10,000 years.[3] Distant time horizons are not the norm for regulatory impact analyses, but the concern for long-term future impacts is not restricted to nuclear waste storage. A prominent regulatory context of

---

1. *See* OFF. OF MGMT. & BUDGET, EXEC. OFF. OF THE PRESIDENT, OFF. INFO. & REGUL. AFFAIRS, 2015 REPORT TO CONGRESS ON THE BENEFITS AND COSTS OF FEDERAL REGULATIONS AND AGENCY COMPLIANCE WITH THE UNFUNDED MANDATES REFORM ACT 13 (2015), https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/2015_cb/2015-cost-benefit-report.pdf [https://perma.cc/W6VR-3PRE]. This report concludes, "[t]he largest benefits are associated with regulations that reduce risks to life." *Id.* at 13. Regulations by the Environmental Protection Agency and the U.S. Department of Transportation are most influential. *See id.* at 9–10 tbl.1–1.

2. *See, e.g.*, NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY REGULATORY IMPACT ANALYSIS: CORPORATE AVERAGE FUEL ECONOMY STANDARDS FOR PASSENGER CARS AND LIGHT TRUCKS FOR MODEL YEARS 2027 AND BEYOND AND FUEL EFFICIENCY STANDARDS FOR HEAVY-DUTY PICKUP TRUCKS AND VANS FOR MODEL YEARS 2030 AND BEYOND 37–39 (2023).

3. Nuclear Energy Inst., Inc. v. Env't Prot. Agency, 373 F.3d 1251, 1257 (D.C. Cir. 2004). Specifically, the Court held EPA's 10,000-year compliance timeframe violated the Energy Policy Act, which required the agency to set standards based on the recommendations of the National Academy of the Sciences. *Id.* at 1270. The National Academy of the Sciences recommended a one-million-year compliance timeframe and found no basis for the agency to limit the period of potential radiation exposure to 10,000 years. *Id.* at 1270–71.

temporally remote mortality impacts is that posed by climate change. Analysis of the benefits associated with climate change regulation has a time horizon in the hundreds of years, extending long past the lifespan of the current generation.[4] Indeed, the finite time limit on these analyses is dictated more by our limited understanding of the costs and benefits of environmental regulation very far into the future, not because climate change policies do not have impacts beyond the time horizon for the analysis.

Government agencies routinely monetize contemporary and near-term mortality risks following guidelines established by the U.S. Office of Management and Budget ("OMB").[5] Matters become more complex, however, for more distant time periods. For example, how should regulatory agencies value mortality risks that impact the current generation as well as posterity? Should future generations be considered even though they are not funding the policies and were not able to vote for the legislators who drafted the statutes guiding regulatory policies, or should the current generation receive priority? If impacts on future generations are judged to be consequential and relevant to regulatory assessment, what weight should be placed on the mortality risk reductions for future generations? To what extent is consideration of future policy impacts consistent with agencies' statutory mandates? Further, although regulatory agencies typically consider only domestic costs, the global nature of climate change raises questions as to whether international costs should be incorporated into the measure of mortality risks.

This Article explores the intertemporal and international valuation of mortality risks in the context of climate change, focusing on the valuation of mortality risks within the calculations of the social cost of carbon, or more broadly, the social cost of greenhouse gases ("SC-GHG"). The SC-GHG measures the monetized valuation of the net economic impact of emissions of one metric ton of greenhouse gases ("GHGs").[6] Therefore, it serves as the unit benefits measure for the reduction of greenhouse gases.[7] The SC-GHG is a comprehensive price measure

---

4. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2021: THE PHYSICAL SCIENCE BASIS, CONTRIBUTION OF WORKING GROUP I TO THE SIXTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 642 (2021) ("[The] delay between a peak in emissions and a decrease in concentration is a manifestation of the very long lifetime of CO_2 in the atmosphere; part of the CO_2 emitted by humans remains in the atmosphere for centuries to millennia.").

5. For the prevailing guidance, see OFF. OF MGMT. & BUDGET, EXEC. OFF. OF THE PRESIDENT, CIRCULAR NO. A-4, REGULATORY ANALYSIS (2023) [hereinafter CIRCULAR A-4], https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf [https://perma.cc/NM84-UL43].

6. ENV'T PROT. AGENCY, SUPPLEMENTARY MATERIALS FOR THE REGULATORY IMPACT ANALYSIS FOR THE FINAL RULEMAKING, "STANDARDS OF PERFORMANCE FOR NEW, RECONSTRUCTED, AND MODIFIED SOURCES: OIL AND NATURAL GAS SECTOR CLIMATE REVIEW": EPA REPORT ON THE SOCIAL COST OF GREENHOUSE GASES: ESTIMATES INCORPORATING RECENT SCIENTIFIC ADVANCES 1 (2023) [hereinafter 2023 FINAL RULE]. Greenhouse gases are gases that trap heat in the atmosphere, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. *Greenhouse Gas Emissions*, ENV'T PROT. AGENCY, https://www.epa.gov/ghgemissions/overview-greenhouse-gases#overview [https://perma.cc/449F-LWR9] (last visited July 7, 2023).

7. 2023 FINAL RULE, *supra* note 6, at 1.

encompassing a broad class of impacts of climate change, including impacts on health, agriculture, energy, labor productivity, and coastal areas.[8] Policies that impact climate change have ramifications for mortality; thus, the monetized benefits of reducing these risks are a central component in the SC-GHG. While financial benefits are often straightforward to quantify, mortality costs are more challenging and potentially controversial.

The value of the SC-GHG is consequential because of longstanding procedures for promulgating federal regulations. Executive Order 13,563[9] requires that government agencies provide for all major regulations a regulatory impact analysis using the best available methods to assess the benefits and costs of the regulation. These guidelines have been in place in various iterations for nearly half of a century.[10] OMB is responsible for reviewing the benefits and costs of a proposed regulation before granting approval.[11] The principal test OMB applies is that the benefits must exceed the costs.[12] This requirement, however, is subject to possible limits imposed by the pertinent statutory mandate.[13] The purpose of the SC-GHG, then, is to allow agencies to monetize the benefits and costs of policies to control greenhouse gas emissions in their regulatory impact analyses.

This Article considers the proper treatment of future generations and international populations in the context of environmental policies. How equitable treatment in environmental regulation is achieved entails a plethora of ethical controversies and potential conflicts with agencies' statutory requirements. Equity involves multiple components—both geographic and temporal. The impacts of climate change are global, thus so are the costs and benefits of U.S. climate change policy, which differs from the setting of a typical regulatory impact analysis. Should international ramifications be considered at all, and, if so, how should they be addressed? To what extent should different values be assigned to domestic and international lives in considering regulatory impacts? If there are adjustments between the two, what should be the basis for these differences, and how great

8. ENV'T PROT. AGENCY, SUPPLEMENTARY MATERIALS FOR THE REGULATORY IMPACT ANALYSIS FOR THE SUPPLEMENTAL PROPOSED RULEMAKING, "STANDARDS OF PERFORMANCE FOR NEW, RECONSTRUCTED, AND MODIFIED SOURCES AND EMISSIONS GUIDELINES FOR EXISTING SOURCES: OIL AND NATURAL GAS SECTOR CLIMATE REVIEW": DRAFT REPORT ON THE SOCIAL COST OF GREENHOUSE GASES 69–70 tbl.3.1.4 (2022) [hereinafter 2022 PROPOSED RULE]. Table 3.1.4 presents the sectoral disaggregation of the social cost of carbon. *Id.* The chosen sectors represent those currently for which the Data-driven Spatial Climate Impact Model ("DSCIM") currently estimates climate damages. *Id.* at 39–40.

9. Exec. Order No. 13,563, 76 Fed. Reg. 3821, 3821 (Jan. 18, 2011).

10. First beginning with President Reagan. Exec. Order No. 12,291, 48 Fed. Reg. 13193 (Feb. 19, 1981), *replaced by* Exec. Order No. 12,866, 59 Fed. Reg. 51735 (Oct. 4, 1993) by President Clinton, *amended by* Exec. Order No. 13,258, 67 Fed. Reg. 9385 (Feb. 28, 2002) by President George W. Bush, *replaced by* Exec. Order No. 13,497, 74 Fed. Reg. 6113 (Jan. 30, 2009) by President Obama.

11. *See* Exec. Order No. 12,866, 58 Fed. Reg. 51735, 51735–36 (Sept. 30, 1993); Exec. Order No. 13563, 76 Fed. Reg. 3821, 3821 (Jan. 21, 2011); CIRCULAR A-4, *supra* note 5, at 2.

12. *See generally* CIRCULAR A-4, *supra* note 5.

13. *See id.* at 3.

should the adjustments be? Income levels have been rising over time,[14] so future generations will be more affluent than present generations, but how do rising income levels affect the monetized value of mortality risks? What role should providing for the well-being of the disadvantaged play when dealing with a policy structure in which the impacts may be global and extend for centuries? This entire class of issues does not arise with respect to domestic policies with comparatively short-term impacts that affect only the current generation.

In order to confront these complex questions, this Article proposes six interrelated principles, which provide guidance to agencies in quantifying and reporting the benefits and costs of environmental policies with international and intergenerational impacts.[15]

First, federal agencies should recognize the impact of climate change on future generations by accounting for future generations in regulatory impact analyses. This principle is quite inclusive and is in stark contrast with suggestions that propose narrowing the relevant policy impacts to those pertaining to the current generation or citizens who voted for the statutes that govern policy actions. There should be no temporal bound on recognition of the effects on future populations, though, as a practical matter, the present value of the benefit estimates for policies with impacts very far in the distant future may not play a consequential role.

Second, government agencies should use country-specific preferences to monetize future mortality risks. These preferences may vary for many reasons, but income has been the chief differentiating factor considered to date. The distribution of the populations exposed to the damages of climate change is concentrated among low-income countries, so there will be a consequential impact on benefit assessments once the international differences are recognized. The estimates presented in this Article indicate that abstracting from these differences leads to a distorted international assessment of the benefits of reducing climate change. Recognizing this heterogeneity will boost the assessment of the SC-GHG relative to the estimates based on current practices.

Third, assessments of the global costs of GHG should use discount rates that reflect the country's intertemporal preferences. The other country-specific aspect of preferences that is instrumental is the discount rate that countries apply to valuation of long-term risks. Aligning the intertemporal weighting with the preferences in the affected countries can have a powerful impact on the assessed benefit values. Adoption of the country-specific discount rates will reduce the estimates of how low-income countries benefit from climate policies and will reduce global estimates of SC-GHG.

Fourth, estimates of the global costs of SC-GHG should also report country-specific estimates. Recognition of costs and benefits of non-domestic populations in valuing global risks requires an assessment of the impacts in these

---

14. Juliana Menasce Horowitz, Ruth Igielnik & Rakesh Kochhar, *Most Americans Say There Is Too Much Economic Inequality in the U.S., but Fewer Than Half Call It a Top Priority*, PEW RSCH. CTR. 1, 12 (Jan. 9, 2020), https://www.pewresearch.org/social-trends/2020/01/09/trends-in-income-and-wealth-inequality/ [https://perma.cc/5NJ3-KMAX].

15. *See* discussion *infra* Part IX.

countries. This procedure would provide for reporting of the domestic benefits to the United States as well as country-specific benefit assessments for other countries. Information on a country-specific basis makes clear the global nature of the adverse effects of climate change as well as the differences in the threats posed to different countries. The size of the affected populations and international differences in mortality risks are two international dimensions that will create heterogeneity in the benefit assessments. Provision of country-specific estimates of the SC-GHG will highlight the extent to which low-income countries should be subsidized to engage in cooperative efforts to mitigate climate change.

Fifth, high-income countries should subsidize countries with a low share of domestic benefits. The extent to which countries benefit from global climate change policies increases with the size of the affected population. However, the benefits of GHG reductions are diminished if the country is relatively lower income or places a comparatively lower weight on the value of future impacts. Countries with a lower share of domestic benefits from climate change reductions should be subsidized to properly incentivize necessary climate action.

Sixth, courts should allow for the representation of future generations in present environmental litigation. Courts should expand standing for cases centering on long-term environmental harms to include an appointed representative of future interests. Allowing for the recognition of future interests in present climate change litigation would serve to increase intergenerational equity. The public trust doctrine and the doctrine of waste from property law provide a blueprint for existing legal limitations on property rights that could be invoked and expounded to account for the interests of future generations.

These principles, when implemented in conjunction, ensure efficiency in present policies and promote intergenerational equity by recognizing the impacts of environmental policies across time and geography. The accurate measuring and reporting of the costs and benefits of policies across countries enable estimates of the SC-GHG to be fully comprehensive in reflecting the different dimensions of impacts. Including all adverse impacts of GHG will tend to boost estimates of the SC-GHG and other policies with intertemporal and global impacts. However, it is essential to ground these estimates in the particular values that are pertinent to the affected populations. Recognition of future harm entails incorporating the preferences of populations both with respect to mortality risks and intertemporal valuation of impacts across time.

Full recognition along these lines has competing effects, some of which may lower the SC-GHG and some of which may raise the SC-GHG. Given the distribution of the impacts across different countries, it is likely that recognition of the heterogeneity of valuations and intertemporal preferences will boost the assessed SC-GHG. But the overall global level of these costs is not the only matter of concern. Assessment of the international differences in the costs imposed by GHG will make clear the substantial degree to which countries differ in the damages imposed by climate change. Rather than considering only a single aggregate measure of the global costs, there should be increased attention to the country-specific components of the harms. Understanding the country-specific impacts is essential to creating an effective framework for climate change policy, and failure to address these issues in a meaningful way could lead courts to find that SC-GHG estimates are arbitrary and capricious. Finally, recognizing the costs and benefits of those harmed and benefitted by environmental policies—accounting for both intergenerational and international differences—will ensure environmental equity across generations.

Part I lays the foundation for this analysis, describing the regulatory oversight context and highlighting the importance of quantifying mortality costs in the SC-GHG. Part II analyzes the past instances in which the federally determined SC-GHG has been subject to legal challenges. Part III provides an overview of climate-related mortality by assessing differences in incidence temporally and geographically. Part IV contemplates the proper time horizon for the analysis, which importantly determines whether the benefit and cost values in future periods should be included. Part V presents a discussion of whether and how the SC-GHG should account for impacts on future generations. Part VI assesses the global versus the domestic view of the SC-GHG and provides an empirical analysis of how different valuations of international impacts change the SC-GHG. We consider three different approaches for constructing the international values of statistical life ("VSL"): (1) an equal VSL approach, where the U.S. VSL is imputed to all countries; (2) an equal income elasticity approach in which a given percentage change in income will have the same percentage effect on the VSL for all countries; and (3) a country-specific income elasticity approach based on the relation between the VSL and income for each country. Part VII discusses equity implications following from the analysis. Part VIII explores how the expansion of standing to future generations could serve to promote intergenerational equity. Finally, Part IX proposes six principles for proper recognition of environmental policy impacts throughout the world, both now and in the future, based on the assessments of the preferences of those who are directly affected. A brief conclusion then follows.

I. THE REGULATORY OVERSIGHT CONTEXT

Executive Orders 12,866[16] and 13,563[17] require federal agencies to present a regulatory impact analysis—for all major rules[18]—calculating the projected benefits and costs of proposed regulations.[19] To do so, agencies must use the best available methodologies.[20] Once completed, OMB compares the estimated benefits and costs of the regulation before giving approval.[21] The principal test OMB applies

---

16. *See* Exec. Order No. 12,866, 58 Fed. Reg. 51735, 51735 (Sept. 30, 1993).

17. Exec. Order No. 13,563, 76 Fed. Reg. 3821, 3821 (Jan. 18, 2011).

18. "Major" government regulations are defined as those with annual costs of $100 million or more. Exec. Order No. 12,866, 3 C.F.R. 638 (1994), *reprinted as amended in* 5 U.S.C. § 601 app. at 86–91 (2006 & Supp. V 2011).

19. Specifically, Executive Order 12,866 provides agencies "promulgate only such regulations as are required by law, are necessary to interpret the law, or are made necessary by compelling public need, such as material failures of private markets to protect or improve the health and safety of the public, the environment, or the well-being of the American people." Exec. Order No. 12,866, 58 Fed. Reg. 51735, 51735 (Sept. 30, 1993).

20. Exec. Order. No. 13,563, 76 Fed. Reg. 3821, 3821 (Jan. 21, 2011) ("Our regulatory system . . . must be based on the best available science . . . . It must identify and use the best, most innovative, and least burdensome tools for achieving regulatory ends.").

21. *See* CIRCULAR A-4, *supra* note 5, at 2.

is that the benefits exceed the costs;[22] however, this balancing is subject to possible statutorily mandated limitations.[23] OMB Circular Number A-4 provides guidance to agencies for conducting regulatory impact analyses. Once the agency quantifies the costs and benefits of the proposed action, as well as those of regulatory alternatives, the agency "select[s] those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless statute requires a different regulatory approach."[24]

The SC-GHG represents an important component of regulatory impact analyses for environmental regulations by providing a scientific- and economic-based method to quantify and monetize the climate impact from additional emissions of greenhouse gases. The SC-GHG refers to the monetized impact of emissions from carbon, methane, and nitrous oxide.[25] While the most familiar component of SC-GHG measurements is the social cost of carbon ("SCC"), for simplicity, we refer to the more comprehensive measure of the SC-GHG. When properly formulated, the SC-GHG allows agencies to account for climate impacts in identifying programs and policies that engender net societal benefits. The SC-GHG and its antecedent SCC have been used in federal government valuations of environmental policies since climate damage modules first emerged in the 1990s.[26] In 2008, the Ninth Circuit held the federal government must monetize climate impacts when it conducts a cost-benefit analysis.[27] Subsequently, the Obama Administration created the Interagency Working Group on the Social Cost of Carbon ("Working Group"). Drawing on 12 federal agencies and departments, the Working Group promulgates uniform damage valuations across federal agencies.[28] The Working Group released its first estimate for the SCC in 2010.[29] Since then, it has released updated

---

22. *Id.*
23. *Id.* (quoting Exec. Order No. 12,866, 58 Fed. Reg. 51735, 51735 (Sept. 30, 1993)).
24. *See* Exec. Order No. 12,866, 58 Fed. Reg. 51735, 51735–36 (Sept. 30, 1993).
25. *See generally* 2023 FINAL RULE, *supra* note 6.
26. *See* INTERAGENCY WORKING GRP. ON SOC. COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 5 n.2 (2010) [hereinafter 2010 TSD], https://www.epa.gov/sites/default/files/2016-12/documents/scc_tsd_2010.pdf [https://perma.cc/3WTH-GFDT]; William D. Nordhaus, *An Optimal Transition Path for Controlling Greenhouse Gases*, 258 SCIENCE 1315 (1992), https://stephenschneider.stanford.edu/Publications/PDF_Papers/OptimalScience1192.pdf [https://perma.cc/ML8E-L29F].
27. *See* Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin., 538 F.3d 1172, 1198–1203 (9th Cir. 2008).
28. *See* 2010 TSD, *supra* note 26.
29. *See id.*

measurements in 2013,[30] 2016,[31] and 2023,[32] and has produced social cost measurements for other greenhouse gases.[33]

The SC-GHG measurements are comprised of multiple inputs and require a series of assumptions. Calculation of the SC-GHG requires that policy analysts make several decisions, for example, possible socioeconomic and emissions trajectories, choice of discount rates, and the geographic scope of the analyses. Further, uncertainty pervades the analyses due to lack of knowledge regarding: "(1) future emissions of greenhouse gases, (2) the effects of past and future emissions on the climate system, (3) the impact of changes in climate on the physical and biological environment, and (4) the translation of these environmental impacts into economic damages."[34] Despite this, EPA has concluded that there is consensus that the SC-GHG provides the best-available estimate of the monetized costs of greenhouse gas emissions.[35]

The Working Group has historically relied on three integrated assessment models ("IAMs") to generate social cost estimates: the Climate Framework for Uncertainty, Negotiation and Distribution ("FUND"), the Dynamic Integrated Climate-Economy Model ("DICE"), and the Policy Analysis of the Greenhouse Effect ("PAGE") model.[36] IAMs are "computational models of global climate change that include representation of the global economy and greenhouse gas emissions, the response of the climate system to human intervention, and impacts of climate change on the human system."[37] Developing SC-GHG measurements requires projection of future GHG emissions; estimating resulting changes in the climate system; and translation of environmental, physical, and biological impacts

---

30. 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 (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/Q5YN-HCTY].

31. 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 (2016) [hereinafter 2016 TSD], https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc_tsd_final_clean_8_26_16.pdf [https://perma.cc/X2PR-WEW7].

32. 2023 FINAL RULE, *supra* note 6, at 3.

33. 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 1 (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/CKC9-7BMX].

34. 2010 TSD, *supra* note 26, at 2.

35. 2023 FINAL RULE, *supra* note 6, at 9 ("[T]he SC-GHG estimates . . . reflect the best available science and the recommendations of the National Academies [of Sciences, Engineering, and Medicine].").

36. *Id.* at 6.

37. NATIONAL ACADEMIES OF SCIENCE, ENGINEERING, AND MEDICINE, VALUING CLIMATE DAMAGES: UPDATING ESTIMATIONS OF THE SOCIAL COST OF CARBON DIOXIDE 40 (2017).

into economic damages[38]—this Article is concerned with the third step of the process. In a departure from relying on the three aforementioned IAMs, EPA's most recent rulemaking on SC-GHG estimates relies on a modular approach to estimation. Under this approach, the methodology underlying each of the four components of the estimation process—socioeconomics and emissions, climate, damages, and discounting—is drawn from the latest research relevant to that component.[39] Further, the approach relies on only two IAMs—the Data-driven Spatial Climate Impact Model ("DSCIM") and the Greenhouse Gas Impact Value Estimator ("GIVE") damage model—in addition to a meta-analysis.[40]

The sectoral damage models included in the IAMs disaggregate the impacts of climate change into five sectors: health, energy, agriculture, labor productivity, and coastal regions.[41] The largest component of SC-GHG under each model is damages due to net mortality risk increases.[42]

In completing a regulatory impact assessment, costs and financial benefits are often straightforward to quantify; however, mortality costs are more challenging and potentially controversial. Policies are prospective, so the time frame is the valuation of risks to future lives saved, not compensation for past deaths, as in wrongful death cases. The procedure used by government agencies throughout the world[43] is to monetize the reduced mortality risks through application of the VSL—which is the willingness to pay to prevent the risk of one expected death.[44] The VSL represents individuals' rate of tradeoff between risk and money for small changes in mortality risk, where this amount is either based on market-based data or interview studies that elicit respondents' attitudes toward risk.[45] Government agencies such as the U.S. Department of Transportation, EPA, and the U.S. Department of Health and Human Services all have specific guidance for quantifying and utilizing VSL, and current generation values are between $11 and $12 million—based largely on revealed preference evidence from the labor market with respect to the wage premium that workers receive for occupational mortality risks.[46] In the SC-GHG

---

38. *See* 2023 FINAL RULE, *supra* note 6, at 1–4.

39. *Id.*

40. *Id.* at 2.

41. *Id.* at 80–81 ("The GIVE and DSCIM damage modules are consistent in that net mortality risk increases are the largest share of marginal damages across the categories considered in each damage module.").

42. *Id.* at 80.

43. *See, e.g.*, CIRCULAR A-4, *supra* note 5; HM TREASURY, THE GREEN BOOK: APPRAISAL AND EVALUATION IN CENTRAL GOVERNMENT 62 (2020). *See generally* W. KIP VISCUSI, PRICING LIVES: GUIDEPOSTS FOR A SAFER SOCIETY (2018).

44. CIRCULAR A-4, *supra* note 5, at 49.

45. *See id.* at 30.

46. Current estimates for government agencies include $11.4 million (2020 USD) by the Department of Health and Human Services, $12.5 million (2022 USD) by the Department of Transportation, and $7.4 million (2006 USD) by EPA. *See* DEP'T HEALTH & HUMAN SERVS., GUIDELINES FOR REGULATORY IMPACT ANALYSIS, APPENDIX D: UPDATING VALUE PER STATISTICAL LIFE (VSL) ESTIMATES FOR INFLATION AND CHANGES IN REAL INCOME D-10 tbl.D.1 (2021), https://aspe.hhs.gov/sites/default/files/2021-07/hhs-guidelines-appendix-d-vsl-update.pdf [https://perma.cc/6SDC-VVY6]; *Departmental Guidance on*

context, the projected changes in premature mortality due to increased GHG emissions are monetized and incorporated into the social cost measurements.

II. LEGAL CONTEXT

The government's use of the SC-GHG in regulatory impact analyses has been subject to legal challenges three times over the course of three unique presidential administrations. In each of the three cases, the court has upheld the use of the SC-GHG in performing regulatory impact analyses, and importantly, reviewing courts have declined to prohibit agencies' consideration of global—rather than solely domestic—costs in SC-GHG measures.[47] Agency justifications of regulation through cost-benefit assessments are subject to review under the Administrative Procedure Act,[48] which permits courts to set aside agency actions found to be arbitrary or capricious. Courts apply this standard by asking whether the agency:

> [H]as relied on factors which Congress had not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.[49]

In 2016, in *Zero Zone v. Department of Energy*,[50] small businesses brought procedural and substantive challenges over the Department of Energy's ("DOE") newly promulgated energy efficiency standards for commercial refrigeration equipment, which were developed and justified using the SCC.[51] The Seventh Circuit held that DOE did not act arbitrarily or capriciously by considering the environmental benefits of the standards via the SCC when determining whether the standards were economically justified.[52] Further, the court held that DOE did not act arbitrarily or capriciously by considering global—rather than solely domestic—costs.[53] Finally, although the petitioners claimed that DOE had failed to adequately respond to concerns during the notice and comment period following the proposed

---

Valuation of a Statistical Life in Economic Analysis, DEP'T OF TRANSP. (May 7, 2024), https://www.transportation.gov/office-policy/transportation-policy/revised-departmental-guidance-on-valuation-of-a-statistical-life-in-economic-analysis [https://perma.cc/AYE6-AG5]; *Mortality Risk Valuation*, ENV'T PROT. AGENCY, https://www.epa.gov/environmental-economics/mortality-risk-valuation [https://perma.cc/Q6SY-XEMQ] (Mar. 11, 2024).

47. *See* Zero Zone v. Dep't of Energy, 832 F.3d 654, 679 (7th Cir. 2016); California v. Bernhardt, 472 F. Supp. 3d 573, 609 (N.D. Cal. 2020); Louisiana v. Biden, 64 F.4th 674, 683–84 (5th Cir. 2023).

48. *See* Nat'l Ass'n of Home Builders v. EPA, 682 F.3d 1032, 1040 (D.C. Cir. 2012) ("[W]hen an agency decides to rely on a cost-benefit analysis as part of its rulemaking, a serious flaw undermining that analysis can render the rule unreasonable.").

49. Nat'l Ass'n of Home Builders v. Defs. of Wildlife, 551 U.S. 644, 658 (2007) (internal quotation marks omitted) (quoting Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 43 (1983)).

50. 832 F.3d 654 (7th Cir. 2016).

51. *Id.* at 677.

52. *Id.* at 679.

53. *Id.*

energy efficiency standards, the court held that DOE had provided a meaningful opportunity for notice and comment by providing access to an "engineering spreadsheet," which compiled data that DOE used in its analysis.[54]

California v. Bernhardt[55] involved challenges to the Bureau of Land Management's ("BLM") partial rescission of the 2016 Waste Prevention Rule, which aimed to reduce natural gas flaring and venting.[56] Under the original rule, BLM had used the social cost of methane from the Obama Administration's Working Group, which involved consideration of global costs.[57] In 2017, BLM published a final rule rescinding multiple key provisions of the Waste Prevention Rule, which the agency justified on the basis that compliance costs exceeded benefits.[58] In justifying the rescission, BLM's calculations relied on an interim domestic social cost of methane, developed under the Trump Administration, which excluded global costs.[59] The U.S. District Court for the Northern District of California found that BLM acted arbitrarily and capriciously in its use of the interim domestic social cost of methane because the model for obtaining the measurement was developed in a matter of months without any public comment or peer review, in contrast to the Working Group's social cost of methane, which was developed over several years.[60] Further, the interim domestic social cost of methane underestimated the domestic effects of the rule's rescission.[61]

Most recently, in *Louisiana v. Biden*,[62] various states—including Louisiana, Alabama, Texas, Kentucky, Florida, and Mississippi, among others—brought an action challenging the validity of Executive Order 13,390, which reestablished the Working Group and directed it to publish updated estimates of SC-GHGs.[63] The plaintiffs also challenged the interim estimates for the SC-GHGs released by the Working Group.[64] The U.S. District Court for the Western District of Louisiana enjoined the Biden EPA from developing new estimates of SC-GHGs on multiple grounds, including that the estimates would include non-domestic impacts of climate change.[65] On appeal, the Fifth Circuit held that the petitioners lacked standing to challenge the interim estimates, failing on the injury-in-fact prong necessary for Article III standing.[66] Specifically, the court held that the fiscal, procedural, and sovereignty-related harms that the plaintiffs alleged were not harms that could be caused by the interim estimates, but by regulations that might result

---

54. *Id.* at 670.
55. 472 F. Supp. 3d 573 (N.D. Cal. 2020).
56. Waste Prevention, Production Subject to Royalties, and Resource Conservation, 81 Fed. Reg. 83009 (Nov. 18, 2016).
57. *Id.* at 83014.
58. Waste Prevention, Production Subject to Royalties, and Resource Conservation; Delay and Suspension of Certain Requirements, 82 Fed. Reg. 58050, 58051 (Dec. 8, 2017).
59. *Id.*
60. *Bernhardt*, 472 F. Supp. 3d at 611–12.
61. *Id.* at 612.
62. 64 F.4th 674 (5th Cir. 2023).
63. *See* Exec. Order No. 13,990, 86 Fed. Reg. 7037, 7040 (Jan. 20, 2021).
64. Louisiana v. Biden, 64 F.4th at 677.
65. Louisiana v. Biden, 585 F. Supp. 3d 840, 864 (W.D. La. 2022).
66. Louisiana v. Biden, 64 F.4th at 680–81.

from the interim estimates.[67] As a result, the mere "possibility of regulation" did not satisfy the injury-in-fact prong sufficiently to establish standing, and so the claim was not ripe for judicial review.[68] Nearly identically, in *Missouri v. Biden*,[69] the Eighth Circuit likewise dismissed a challenge to both Executive Order 13,390 and the SC-GHG estimates for lack of standing, again finding the plaintiffs had failed to establish the injury-in-fact prong.[70]

Holistically, judicial challenges concerning the SC-GHG suggest that courts will uphold the SC-GHG if it is adequately justified, based in sound scientific and economic reasoning, responsive to expert feedback, and inclusive of all statutorily mandated considerations. Although the SC-GHG has withstood judicial scrutiny thus far, legal challenges involving SC-GHG are likely far from subsiding. The Fifth Circuit in *Louisiana v. Biden* and the Eighth Circuit in *Missouri v. Biden* both suggested in dicta that prospective plaintiffs may be successful in actions challenging agencies' *use* of the SC-GHG in rulemaking, as opposed to challenging the estimates themselves.[71] The potential for courts to strike down regulations justified or premised on an SC-GHG estimate raises concerns over the politicization of the methodology used in arriving at specific social cost measures, engendering a more definite need for accurate, well-justified estimates.[72]

---

67. *Id.*
68. *Id.*
69. 52 F.4th 362 (8th Cir. 2022).
70. *Id.*
71. Concluding its dismissal, the Fifth Circuit wrote:

> E.O. 13990 does not itself mandate any particular regulatory action by a federal agency. In Plaintiffs' own words, these estimates would be used to merely "justif[y]" harmful regulations. Such harms are traceable to possible agency actions, not to E.O. 13990 or the Interim Estimates. We conclude that Plaintiffs have not established standing . . . . Plaintiffs contemplate harms that are several steps removed from—and are not guaranteed by—the challenged Executive Order or the Interim Estimates. The states cannot do away with their alleged parade of horribles in a single swipe at the duly elected executive. Although the case-by-case approach that this requires is understandably frustrating [to plaintiffs], this remains the "the traditional, and remains the normal, mode of operation of the courts."

Louisiana v. Biden, 64 F.4th at 684 (internal quotation marks omitted). Similarly, the Eighth Circuit noted, "if the States believe that specific agency actions justified by the interim SC-GHG estimates inflict concrete and particularized injury, they may challenge the actions, and the interim SC-GHG estimates themselves, in federal court." Missouri v. Biden, 52 F.4th at 371.

72. Notably, there is presently ongoing litigation in the D.C. Circuit surrounding the legitimacy of EPA's use of the social cost of methane in the regulatory impact analysis supporting new methane standards, although EPA did not rely on the social cost of methane in setting the standards themselves. *See* Indus. Ass'n. Petitioners' Motion to Stay, Mich. Oil & Gas Ass'n v. U.S. Env't Prot. Agency (2024) (No. 24-1054). Petitioners point to the dissonance between the Clean Air Act's stated purpose of improving the air quality of the "Nation" and the social cost of methane's inclusion of global benefits. *Id.* at 12. The D.C. Circuit denied the consolidated petitioners' Motion to Stay on July 9, 2024.

III. THE NATURE OF CLIMATE MORTALITY

Climate change affects human health in multiple ways. Mortality caused by climatic factors is difficult to estimate due to complicated—and often indirect—causal pathways; however, mortality costs account for the largest share of damages incorporated into the SC-GHG,[73] and there is expert consensus that global climate-related mortality will increase with the unfettered progression of climate change.[74] Further, variability in vulnerability, exposure, and adaptability means that there is a disparity in the distribution of climate-related mortality effects, with low-income countries and small-island developing states experiencing the largest share of impacts.[75]

A. Direct Impacts

Temperature-related mortality is perhaps the most direct consequence of climate change. Country-level percentage of mortality attributable to non-optimum temperature—either heat or cold—is estimated in the range of 3.4% to 11%.[76] Rising global temperatures engender increased instances of heat stroke and heat exhaustion, and this risk is exacerbated by urbanization, increased exposure, increased instances of extreme heat events, and demographic changes in countries with aging populations.[77] Rapid changes and variability in temperature further serve to increase heat-related mortality risk. As climatic conditions change, extreme weather events increase in frequency and impose a substantial mortality burden that varies by location and hazard.

B. Indirect Impacts

Indirect impacts of climate change are numerous and diverse. The greatest health risk from indirect impacts is increased prevalence of both communicable and non-communicable diseases.[78] Disease prevalence will escalate through both increased temperatures—which allows zoonotic diseases, for example, to have a wider geographic range than previously possible—and through increased human movement due to migration.[79] Additionally, non-communicable diseases including heart disease, cancer, diabetes, and chronic lung disease, which are collectively the cause of 74% of all deaths worldwide, are climate-sensitive based on their exposure

---

73. 2023 FINAL RULE, *supra* note 6, at 164 ("[N]et costs of expected premature mortality associated with climate change driven changes in hot and cold weather comprise the largest share of the DSCIM and GIVE based SC-GHG estimates presented in this report.").

74. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2022: IMPACTS, ADAPTATION AND VULNERABILITY 50 (Hans-Otto Pörtner et al. eds., 2022) [hereinafter AR 6].

75. *See id.* at 78.

76. *Id.* at 1073.

77. *See Climate Change Indicators: Heat-Related Deaths*, ENV'T PROT. AGENCY, https://www.epa.gov/climate-indicators/climate-change-indicators-heat-related-deaths [https://perma.cc/W8PK-NUXT] (July 23, 2024); AR 6, *supra* note 74, at 1072.

78. AR 6, *supra* note 74, at 50, 63.

79. *Id.* at 51–52.

pathways—for example, temperature, particulate matter, ozone, smoke, and allergens.[80]

Increased food insecurity and decreased access to suitable water sources are additional outcomes of climate change due to increased frequency and intensity of temperature extremes. Crop diversity will decrease as temperature-sensitive crops become infeasible to grow in extreme temperatures.[81] Food production and access are also restricted through ocean acidification and sea level rise, especially in coastal areas.[82] Food insecurity, which decreases diet diversity, will generate increased malnutrition in many communities.[83] Roughly half of the population currently experiences "severe" water scarcity for at least half of the year, and this proportion will only increase with higher frequency of droughts.[84]

Finally, climate change will increase migration—both in terms of displacement and involuntary relocation—as large swaths of land become uninhabitable due to high exposure and limited adaptability.[85] Increased human movement will, in turn, lead to multiple indirect health impacts, including mortality and morbidity from violent conflict.[86] Additionally, mental health is worsened as an indirect consequence of increased displacement, relocation, and exposure to violent conflict.[87]

C. Geographic Distribution

Low-income countries and small-island developing states are exposed to the highest health impacts due to vulnerability.[88] These locations primarily include most of Africa and Southern Asia. Adaptability and vulnerability are directly tied to wealth, meaning low-income countries will experience a disproportionate amount of health impacts. Geographically, areas closest to the equator will suffer the most direct impacts of temperature extremes, while coastal areas will be affected by sea level rise and extreme weather events.[89] Additionally, the populations at greatest risk from climate change are the elderly, pregnant people, and children, who are among the most vulnerable groups of the global population for many health risks.[90]

D. Incidence Across Time

Climate mortality will increase in the future, with over nine million climate-related deaths per year projected by the end of the century.[91] Both the direct and indirect consequences explored above will continue to increase in frequency as

---

80. *Id.* at 52; *Noncommunicable Diseases*, WORLD HEALTH ORG., https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases [https://perma.cc/JRT7-2YC] (Sept. 16, 2023).
81. AR 6, *supra* note 74, at 14.
82. *Id.* at 9.
83. *Id.*
84. *Id.* at 21.
85. *Id.* at 11.
86. *Id.* at 15, 64.
87. *Id.* at 63.
88. *See id.* at 9–11.
89. *Id.* at 12, 1701.
90. *Id.* at 9.
91. *Id.* at 63.

climate change progresses. Heat vulnerability is especially consequential in areas of high urbanization, a trend that continues to increase.[92] Temperature and precipitation changes, which are also trending in an upward trajectory,[93] enhance the spread of vector-borne illnesses.[94]

Despite being the largest component of damages in EPA's SC-GHG, climate-related mortality measures are severely limited in EPA's damage modules.[95] The two IAMs relied on by EPA in the latest estimates (DSCIM and GIVE) only account for heat- and cold-related mortality;[96] however, climate-related mortality is caused by a multitude of other direct and indirect impacts of climate change,[97] which EPA notes in its description of the methods current estimation limitations:

> There are still many categories of climate impacts and associated damages that are only partially—or not at all—reflected in these estimates . . . . [T]he modeling in this report omits most of the consequences of changes in precipitation, damages from extreme weather events, the potential for nongradual damages from passing critical thresholds . . . in natural or socioeconomic systems, and non-climate mediated effects of GHG emissions[.][98]

Beyond direct and indirect mortality effects, the modules also do not contemplate climate "tipping points," which are large-scale Earth system feedback effects caused by climate change, with irreversible and dire consequences.[99] Although uncertainty and data constraints may prevent inclusion of the totality of climate-related mortality impacts in current modeling, these omissions likely lead to an underestimation of the true SC-GHG.

IV. TIME PERIODS OF BENEFITS AND COSTS WHEN THERE ARE INTERGENERATIONAL IMPACTS

The time horizon used for a regulatory impact analysis determines whether the benefit and cost values in future periods should be included. If the assessment of benefits and costs stops at a certain point, then all long-term impacts beyond that time period will be excluded from consideration. As was indicated in the aforementioned decision by the D.C. Circuit regarding the risks posed by storage of nuclear waste, the court found that agencies were remiss in failing to ensure that

---

92. *Id.* at 80.
93. *Id.* at 8–9.
94. *Id.* at 11.
95. 2023 FINAL RULE, *supra* note 6, at 3, 56, 81.
96. Even in the mortality related to temperature extremes:

> The damage modules have not yet explicitly incorporated damages associated with other changes in the temperature distribution such as variability and changes in the probability of extreme temperatures throughout the year. There is only a limited consideration of climate-driven physical changes other than temperature . . . within the existing damage modules.

Id. at 81.

97. *See* discussion *supra* Sections III.A–B.
98. 2023 FINAL RULE, *supra* note 6, at 3.
99. *Id.* at 82.

radiation risks to those living over 10,000 years in the future would not be at a sufficiently low level so as to not pose a threat.[100]

Nuclear waste storage is not the only policy initiative that has long-term impacts. Long-term assessments of future impacts may be hindered by the tremendous uncertainty regarding the magnitude of the benefits and costs in remote time periods, perhaps leading analysts to be reluctant to speculate too far into the future. Changes in technology, populations, and the global economy are probabilistic and, in many cases, unforeseen events. Was the development of artificial intelligence ("AI") anticipated 50 years ago? Now that AI has emerged, how accurately can we forecast its likely impact on different sectors of economies throughout the world? More generally, have all the important innovations been discovered, or are there many more fundamental innovations to come?[101] Because of the hazardous nature of predicting outcomes in remote time periods, regulatory analyses undertaken by government agencies impose limits on the time periods that are considered and do not extend to infinity.[102] The neglect of impacts far into the future is not always consequential as future effects are discounted to convert them to present values. Because future effects are discounted, or weighted, in such a way, limitations in the time period for the analysis may not be of practical consequence in affecting the overall assessed policy merits.

The pertinent time horizon considered by agencies may be fairly modest even for policies with impacts that extend far into the future. The most recent EPA Report on the Social Cost of Greenhouse Gases, which is the principal benefit category in climate change studies, extends estimates for SC-GHGs to 2080, even though there is no reason to believe that greenhouse gas emission will not affect global warming beyond that time.[103] Similarly, EPA's regulatory impact analysis of fuel economy standards limited the time frame to 2017–2025, even though these standards that influence vehicle design and production will affect a longer-term stock of vehicles and their environmental consequences.[104] Judicious selection of the time horizon for the analysis undertaken by EPA may be dictated by practical concerns, such as the feasibility of predicting long-term impacts.[105]

Setting aside the analysis feasibility issues, should there be a time limit on the impacts that are considered? What is the statutory guidance on these matters?

---

100. Nuclear Energy Inst. v. Env't Prot. Agency, 373 F.3d 1251, 1257 (D.C. Cir. 2004).

101. *Compare* ROBERT J. GORDON, THE RISE AND FALL OF AMERICAN GROWTH: THE U.S. STANDARD OF LIVING SINCE THE CIVIL WAR 567 (2017) (arguing the massive scale of innovation in the century following 1870 cannot be repeated), *with* Joel Mokyr, *The Past and Future of Innovation: Some Lessons From Economic History*, 69 EXPLS. IN ECON. HIST. 1, 32–33 (2018) (arguing there is no evidence that the rate of technological progress will slow down).

102. *See* discussion *infra* notes 103, 104, and accompanying text.

103. 2023 FINAL RULE, *supra* note 6, at 4.

104. ENV'T PROT. AGENCY, REGULATORY IMPACT ANALYSIS: FINAL RULEMAKING FOR 2017-2025 LIGHT-DUTY VEHICLE GREENHOUSE GAS EMISSION STANDARDS AND CORPORATE AVERAGE FUEL ECONOMY STANDARDS 3-103 to 06 (2012).

105. *See* 2022 PROPOSED RULE, *supra* note 8, at 19 (justifying that extending models beyond 2300 is inhibited by increasing uncertainty).

The Clean Air Act specifies that the benefits of consequence are those to "the Nation."[106] However, the Clean Air Act guidance and similar provisions do not indicate the time period of valuations of the individuals within the nation that are consequential.[107]

Eric Posner has maintained that the only pertinent benefits are those that reflect the benefits and costs to the current citizenry, and that policy concerns should not extend more than 30 or 50 years into the future.[108] Based on his reasoning, citizens have elected these representatives to reflect their preferences, and the laws that have been enacted are a reflection of these preferences.[109] In Posner's view, the public did not elect these representatives to focus on temporally remote effects.[110] The current citizenry may have an altruistic concern with the well-being of those living in the future, and if that is the case, this concern is something that is valued by the current citizenry and should be taken into account when tallying the role of future benefits and costs. However, there is no requirement that people have such future-oriented concerns, that these concerns hold indefinitely, or that the weight given to these impacts be the same as the weight placed on the impacts derived from those who currently live and vote.

In the economics and philosophy literature, the general framing of this issue is: How do we characterize the social welfare function that society is seeking to advance?[111] In effect, claiming that the current citizenry has a short-term focus is positing a particular social welfare function. Ultimately, what matters is the preferences of those whose welfare is being promoted and how these impacts should be valued. Various authors have offered hypotheses about what form this social welfare function should take, and there are many feasible options.[112] John Rawls, for example, has suggested that the task is to promote the well-being of the least advantaged, and that we should choose our policies as if we are under a "veil of ignorance."[113] If we do not know in advance what our place in society will be or, in the intertemporal context, when we will be alive, what social welfare function would we want to guide policy decisions? Rawlsian principles embody normative assumptions that some may or may not share. Other conceptions of the social welfare function are also possible. At one extreme, the current generation may have no concern with the future. Only immediate policy impacts may be of concern. At

---

106. *See* Clean Air Act, 42 U.S.C. § 7401(b)(1) ("The purposes of this subchapter are—(1) to protect and enhance the quality of the *Nation's* air resources so as to promote the public health and welfare and the productive capacity of its population." (emphasis added)).

107. *See generally id.* § 7041.

108. Eric Posner, *Agencies Should Ignore Distant-Future Generations*, 74 U. CHI. L. REV. 139, 143 (2007) ("Beyond thirty or fifty years, the discount rate should be infinity. A simple way of putting this point is that agencies should ignore the effects, both positive and negative, of their regulations beyond fifty or one hundred years.").

109. *Id.*

110. *Id.*

111. *See, e.g.*, MATTHEW D. ADLER, MEASURING SOCIAL WELFARE: AN INTRODUCTION 19 (2019).

112. *See, e.g.*, *id.*; Matthew D. Adler, *Benefit-Cost Analysis and Distributional Weights: An Overview*, 10 REV. ENV'T ECON. & POL'Y 264, 265–69 (2016); JOHN RAWLS, A THEORY OF JUSTICE 284–93 (1971).

113. RAWLS, *supra* note 112, at 284–93.

the other extreme, future generations could receive a weight that is the same or greater than that for the present generation. As a practical matter, this concern must necessarily be bounded because promoting the well-being of an infinite number of future generations would divert all available resources from the current generation and would not be supported by them. There is also a broad range of intermediate, feasible approaches in which there may be varying degrees of emphasis on the value of future impacts.[114]

The approach we are taking is to treat all future generations equally and to count them the same as the current generation. In effect, agencies should carry out a conventional cost-benefit analysis, taking the valuations into the future. Doing so does not necessarily imply that future effects will outweigh present concerns. Future benefits and costs are discounted, as is also done for other future impacts, to convert them into their present value.

The focus of this Article is U.S. policies and the allocation of U.S. resources to promote policy objectives. Given the social welfare function that defines the weights placed on policy outcomes, the task for policy design is to determine how to best allocate resources now and in the future to best promote social welfare. The difficulty lies in speculation regarding future conditions and preferences, though current preferences may be certain. Future generations cannot communicate their preferences in the present or vote on policies that might affect their well-being.[115] Although it is not feasible for future generations to communicate their policy preferences to the current generation, we propose that analyses consider the best assessment of their likely impacts in the same manner as they would for impacts on the current generation.

This formulation is not innocuous and may not reflect the preferences of the current citizenry, who may have a more near-term focus limited perhaps to the next few decades. Even future-oriented people may value impacts on the next generation but not all subsequent future generations, much less those exposed to environmental hazards 10,000 years from now. Consequently, from the standpoint of the subsequent discussion, it should be emphasized that any analysis that incorporates recognition of all such future impacts and treats them in the same manner as effects 10 or 20 years away is already tilted more in favor of advancing the welfare of future generations than many might support.

V. VALUING U.S. LIVES IN THE FUTURE

Policies such as climate change efforts have future ramifications for mortality risks in many countries. An instructive starting point to exploring how to monetize the benefits of reducing these risks is to determine how mortality risks for

---

114. *See, e.g.*, Posner, *supra* note 108, at 143 ("Beyond thirty or fifty years, the discount rate should be infinity."); Nuclear Energy Inst., Inc. v. Env't Prot. Agency, 373 F.3d 1251, 1257 (D.C. Cir. 2004) (finding EPA's use of a 10,000-year time horizon to calculate risk insufficient).

115. Richard A. Epstein, *Justice Across the Generations*, 67 TEX. L. REV. 1465, 1467 (1989) ("The problem of equity between the generations presupposes that we can identify a conflict of interest between what people want today and what unborn people will want on some distant tomorrow.").

the United States should be valued, and then turn to how the procedure might differ for other countries. The procedure used by U.S. government agencies to value mortality risks is to use the VSL.[116] The VSL represents individuals' rate of tradeoff between risk and money for small changes in mortality risk, where the amount is based on either market data or interview studies that elicit attitudes toward risk.[117] Suppose that a worker receives $900 in compensation to face an occupational mortality risk of 1/10,000. Then, a group of 10,000 similarly situated workers would require $900 x 10,000, or $9 million for that group to incur the risk of one expected death. This figure is the VSL. Current estimates of the VSL based on labor market risks are in the vicinity of $12 million.[118] Government agencies such as the U.S. Department of Transportation, EPA, and the U.S. Department of Health and Human Services all have specific guidance for the VSL procedures used in these agencies.[119]

While it is possible to assign the same monetized value to present and future lives, doing so would not recognize the greater ability of the more affluent future populations to pay for risk reduction. The increased income in turn will affect the future VSL. A well-established result is that the VSL rises with income levels, which is reasonable as the VSL is based on the public's willingness to pay for small reductions in risk.[120] Real U.S. per capita income levels are currently increasing at a rate of about 2% annually.[121] How this percentage increase affects the VSL depends on the income elasticity of the VSL, or the percentage change in the VSL in response to a 1% increase in income.[122] There have been many estimates of the impact of this value on the VSL for the United States, ranging from 0.6 to 1.4 or higher, with the midpoint of this range being near 1.0.[123] Thus, a 2% increase in real income each year will translate into a 2% increase in the VSL. The assumption in the SC-GHG analysis that the U.S. income elasticity is 1.0 and should generate an increase in the future VSL based on increases in per capita income is consistent with benefit assessment practices throughout the federal government, such as those at the U.S. Department of Transportation.[124]

---

116. *See* CIRCULAR A-4, *supra* note 5, at 49–50.

117. *Id.* at 49.

118. *Id.* at 50.

119. *See supra* note 46 and accompanying text.

120. *See* discussion *infra* note 123 and accompanying text.

121. More recently, 2.7%. IMF, *World Economic Outlook (2023)*, https://www.imf.org/external/datamapper/profile/USA [https://perma.cc/X8RD-3975] (last visited Jan. 24, 2024).

122. *See* W. Kip Viscusi & Clayton J. Masterman, *Income Elasticities and Global Values of a Statistical Life*, 8 J. BENEFIT-COST ANALYSIS 226, 228 (2017).

123. *See id.* (finding an income elasticity of the value of a statistical life of 1.0); W. Kip Viscusi & Joseph E. Aldy, *The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World*, 27 J. RISK & UNCERTAINTY 5, 40 (2003) (finding an income elasticity of the value of a statistical life between 0.5 and 0.6); Thomas J. Kniesner, W. Kip Viscusi & James P. Ziliak, *Policy Relevant Heterogeneity in the Value of Statistical Life: New Evidence from Panel Data Quantile Regressions*, 40 J. RISK & UNCERTAINTY 15, 30 (2010) (finding an income elasticity of the value of a statistical life of 1.4).

124. *See* DEP'T OF HEALTH & HUM. SERVS., GUIDELINES FOR REGULATORY IMPACT ANALYSIS, APPENDIX D: UPDATING VALUE PER STATISTICAL LIFE (VSL) ESTIMATES FOR

Making an adjustment for future changes in income is a feasible way to recognize changes in the VSL in the future based on present evidence about factors that affect the VSL over time. Unfortunately, we do not know the preferences of future generations and how much they are willing to pay for small reductions in risk. However, we do know that the procedure for addressing VSL changes for future generations is consistent with how government agencies routinely update the VSL over time.[125] We propose that agencies carry the same procedure forward for future generations.

The standard practice for regulatory analyses is to discount the value of future benefits and costs in recognition that immediate economic payoffs are more highly valued than future effects.[126] Suppose that someone could invest current funds and earn some interest rate r. Then, \$1 invested this year has a value of $1 + r$ after one year. Put somewhat differently, \$1 received a year from now is equivalent to having a present value in the base period of $1/(1+r)$. Using analogous calculations, agencies determine the present value of impacts for the entire stream of benefits and costs.[127]

While this procedure is straightforward for monetary payoffs, does it make sense to discount mortality risks in the future? Does this procedure discount lives rather than money and implicitly assume that future lives are not as worthwhile? What is in fact being discounted is not future lives but rather the VSL associated with these mortality risk reductions. Whether discounting of nonmonetary impacts is meaningful and appropriate has been the subject of legal challenges. For example, in *Corrosion Proof Fittings v. EPA*,[128] the Fifth Circuit upheld EPA's use of a nonzero (3%) discount rate on the value of mortality reductions associated with the agency's ban on asbestos.[129]

Even if discounting the monetized value of future mortality risk reductions is permissible, would a better approach be to treat all lives equally irrespective of the time period involved? Unfortunately, such symmetry would not be feasible, particularly for policies that have impacts that extend indefinitely. Protecting all future generations would bankrupt the current generation and would also involve a tremendous subsidy to more affluent future generations, which would not serve to promote intertemporal equity.

Discounting is essential, but at what rate? Particularly for long time horizons, the choice of the discount rate plays a pivotal role in determining the feasibility of a policy. In the case of climate change policies, the benefits derived may be far into the future. Until 2023, OMB discounting guidance for regulatory

---

INFLATION AND CHANGES IN REAL INCOME D-10 tbl.D.1 (2021); DEP'T OF TRANSP., DEPARTMENTAL GUIDANCE ON VALUATION OF A STATISTICAL LIFE IN ECONOMIC ANALYSIS (2023).

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

126. *See* CIRCULAR A-4, *supra* note 5, at 75.

127. *Id.* at 75–76.

128. 947 F.2d 1201 (5th Cir. 1991).

129. *Id.* at 1218 n.19. *But see* Richard L. Revesz, *Environmental Regulation, Cost-Benefit Analysis, and the Discounting of Human Lives*, 99 COLUM. L. REV. 941 (1999) (opposing the discounting of lives in regulatory policy analysis).

impact analyses is to use discount rates of 3% and 7%, but agencies had the option of using a lower discount rate for distant future impacts.[130] The 2023 OMB guidance for regulatory analysis adopted a discount rate of 2%, which is the same value that EPA adopted in its analysis of the SC-GHG.[131] These seemingly small differences in percentages can have a major effect on impacts far into the future. A benefit value of $1 in 100 years has a present value of $0.14 using a discount rate of 2%, $0.05 using a discount rate of 3%, and $0.009 using a discount rate of 7%.

Adopting the reference social rate of discount established for U.S. policy analyses does not necessarily diminish the value of future lives to a great extent. One reason that interest rates have a positive value is that there are increases in societal productivity over time.[132] Part of this productivity is reflected in the rate of income growth noted above. Suppose that the discount rate is 2% and that the rate of income growth is 1%. Then, assuming that the income elasticity of the VSL is 1.0, the VSL will also rise by 1%. The net discount rate is the difference between the discount rate and the growth rate in the VSL, or 2% minus 1%.[133]

While there have been some suggestions that the discount rate should have a declining value for future periods, we support a constant discount rate to avoid potential intertemporal inconsistencies.[134] Suppose that every generation has a within-generation discount rate of 2%. Then, if generation "A" adopts a discount rate of 1% for the within-generation impacts in generation "B," this lower discount rate may result in a distortion of the within-generation preferences for benefits across that generation in different years. It should also be noted that the net discount rate approach leads to a lower rate of discounting in the future when there are factors—such as the growth in income levels—that reduce the discount rate.[135]

How would a concern with intertemporal equity affect the desirability of sacrificing financially now to protect the well-being of future generations? In thinking about this issue, it is helpful to ask whether previous generations should have sacrificed more for the present generation. Should those alive in 1824 or 1924 have foregone more of their expenditures then and instead sacrificed those funds to make the present generation better off? Life expectancy—and almost all aspects of living conditions—were far worse in the past.[136] Thus, sacrifices by earlier

---

130. *See* CIRCULAR A-4, *supra* note 5, at 76.

131. *See* 2022 PROPOSED RULE, *supra* note 8, at 2 (opting for three discount rates, 1.5, 2.0. and 2.5%, with its "central value" being 2.0%); CIRCULAR A-4, *supra* note 5, at 76.

132. *See Why do Interest Rates Matter?*, FED. RESERVE, https://www.federalreserve.gov/faqs/why-do-interest-rates-matter.htm [https://perma.cc/UHL7-447H] (Sept. 9, 2016).

133. Consequently, a VSL in 10 years will not have a present value of $\frac{VSL}{1.02^{10}} = x\,VSL$, but rather a more substantial $\frac{VSL}{1.01^{10}} = x\,VSL$.

134. *See* W. Kip Viscusi, *Rational Discounting for Regulatory Analysis*, 74 U. CHI. L. REV. 209, 212 (2007).

135. *See* Viscusi & Masterman, *supra* note 122, at 227.

136. *See* Lawrence Kosick, *4 Reasons Life Expectancy Has Increased In The Past 200 Years*, FORBES (Sept. 15, 2022), https://www.forbes.com/sites/quora/2022/09/15/4-reasons-life-expectancy-has-increased-in-the-past-200-years/ [https://perma.cc/4XCL-NVB8].

generations to enhance the well-being of those in the present would increase intertemporal inequities.[137] Fairness arguments are consequently not compelling. Under our proposal, government agencies would value the future as if the current generation would be part of it, even though it will not.

VI. ACCOUNTING FOR THE GLOBAL DIMENSIONS OF CLIMATE CHANGE

Climate change affects all other countries, not just the United States alone. This is because of the global nature of GHG emissions: a ton of carbon emitted from a point source in one location enters the atmosphere and has global implications that extend well beyond the location of emission.[138] Thus, another important aspect of the SC-GHG is whether it accounts for only domestic benefits, or whether it is a global measure. If the measure is global, one question that arises is whether countries other than the United States count the same as the United States. This would be impractical from the standpoint of structuring U.S. policy decisions, as the United States does not let foreign countries design our domestic policies. However, from the standpoint of efficient global control of climate change, benefits to other countries should be fully counted and compared with the costs to establish globally efficient policies.[139]

However, assessments of whether these benefits are counted and to what extent vary. Gayer and Viscusi[140] claim that U.S. statutes and current regulatory practices focus on benefits to the United States—for example, the Clean Air Act,[141] the Clean Water Act,[142] and the Toxic Substances Control Act.[143] These benefits can include U.S. altruism to other countries as well as benefits to the United States

---

137. *See id.*

138. *See* DANIEL A. FARBER & CINNAMON P. CARLARNE, CLIMATE CHANGE LAW 46 (Saul Levmore et al. eds., 2d ed. 2023) (discussing collective climate action).

139. *See* Richard L. Revesz, et al., *Letter to the Editor: The Social Cost of Carbon: A Global Imperative*, 11 REV. ENV'T ECON. & POL'Y 172, 172–173 (2017) (arguing that "[t]o solve the unprecedented global commons problem posed by climate change, all nations must internalize the global externalities of their emissions; otherwise, collective abatement efforts will never achieve an efficient, stable climate outcome" (citation omitted)); *see also* Peter Howard & Jason Schwartz, *Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon*, 42 COLUM. J. ENV'T L. 203, 222 (2017).

140. Ted Gayer & W. Kip. Viscusi, *Determining the Proper Scope of Climate Change Policy Benefits in U.S. Regulatory Analysis: Domestic Versus Global Approaches*, 10 REV. ENV'T ECON. & POL'Y 245, 249–52 (2016).

141. *See, e.g.*, 42 U.S.C. § 7401(b)(1) ("The purposes of this subchapter are—(1) to protect and enhance the quality of the *Nation's* air resources so as to promote the public health and welfare and the productive capacity of its population." (emphasis added)).

142. *See, e.g.*, 33 U.S.C § 1321(c)(1)(A)(iv) (federal removal authority to mitigate hazardous spills into navigable waters and adjoining shores and hazardous spills "that may affect natural resources belonging to, appertaining to, or under the exclusive management authority *of the United States*." (emphasis added)).

143. *See, e.g.*, Corrosion Proof Fitting v. Env't Prot. Agency, 947 F.2d 1201, 1209 (5th Cir. 1991) ("EPA was not required to consider the effects on people or entities outside the United States. TSCA provides a laundry list of factors to consider . . . including 'the effect [of the rule] on the *national* economy.'" (emphasis added)).

resulting from international reciprocity in GHG reductions.[144] Thus, U.S. benefits are of direct importance, and international impacts are consequential as well. These arguments are fairly similar to those regarding the international distribution of the COVID-19 vaccines: in the early stages of the pandemic, U.S. residents were given priority.[145] Although there was sharing internationally, it was less than efficient if the objective was to reduce total risks to life irrespective of country.[146] Others take a broader view of the importance of recognizing benefits to all countries, giving great weight to the necessity of addressing the intrinsically global problem in a global manner.[147] For example, the Obama and Biden EPA adopted a global approach to the SC-GHG,[148] while the Trump EPA adopted a U.S.-centric approach. With emerging legal challenges to the global SC-GHG, an intermediate solution for regulatory analyses is to report the benefits and costs both to the nation and to the world. Reporting benefits and costs to the nation is relevant from the standpoint of complying with agencies' statutory mandates and with President Biden's Executive Order to document the distributional effects of policies on the U.S. citizenry.[149] Also, reporting benefits to the world provides information on the pricing of GHGs, which is pertinent for efficient global control of GHG emissions.[150] The procedures we advocate can be utilized irrespective of how different administrations choose to treat international impacts. Given that the U.S. cannot unilaterally stop GHG emissions, there will necessarily be an international dimension to all future climate change amelioration policies.

The separation of the U.S. domestic share of benefits from that of other countries is essential for undertaking the types of international refinements discussed below in Parts VII[151] and VIII.[152] Previous estimates of the SC-GHG were performed in a manner that made it feasible to distinguish the U.S. share of benefits.[153] Based on the implications of the IAMs used to project future impacts, the U.S. share of climate change benefits in estimates of the SC-GHG during the

---

144. *See* Gayer & Viscusi, *supra* note 140, at 258–65.

145. Jeff Mason & Carl O'Donnell, *Under Pressure, U.S. Donates Half Billion More COVID-19 Vaccine Doses to the World*, REUTERS (Sept. 22, 2021), https://www.reuters.com/world/us/biden-pledges-new-vaccine-donations-bid-rally-global-pandemic-fight-2021-09-22/ [https://perma.cc/X4ZH-36XB].

146. *See id.*

147. *See* Revesz et al., *supra* note 139, at 172.

148. INTERAGENCY WORKING GRP. ON SOC. COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 17 (2016); INTERAGENCY WORKING GRP. ON SOC. COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON, METHANE, AND NITROUS OXIDE INTERIM ESTIMATES UNDER EXECUTIVE ORDER 13990 15 (2021).

149. Exec. Order No. 13,990, 86 Fed. Reg. 7037 (Jan. 20, 2021).

150. A higher SC-GHG establishes a higher price on GHG emissions. Increasing the benefit value for control of GHG increases the desirability of emissions reductions. *See* W. KIP VISCUSI, JOSEPH E. HARRINGTON, JR. & DAVID E. M. SAPPINGTON, ECONOMICS OF REGULATION AND ANTITRUST 800–03 (5th ed. 2018).

151. *See* discussion *infra* Part VII.

152. *See* discussion *infra* Part VIII.

153. *See, e.g.*, Michael Greenstone, Elizabeth Kopits & Ann Wolverton, *Developing a Social Cost of Carbon for US Regulatory Analysis: A Methodology and Interpretation*, 7 REV. ENV'T ECON. & POL'Y 23 (2013).

Obama Administration is 7–10%, and if it is assumed that these benefits are proportional to GDP, the U.S. share of benefits is 23%.[154] The 2023 EPA analysis does not provide information on the U.S. domestic share of benefits, which makes it infeasible to identify the domestic equity impacts of the policies.[155]

More importantly, it is not possible to reassess how the global estimates would differ if the preferences of the affected countries were incorporated in a different manner. In particular, the monetized value of the reduced mortality rates and the rate at which future effects are discounted will vary across countries. These differences, in turn, affect the total SC-GHG as well as each country's share of the benefits of GHG risk reductions.

A. Three Empirical Formulations for International Impacts

For policies with a domestic focus, the issue of how to account for costs and benefits outside the United States does not arise. However, for policies with global implications, being able to monetize fatality risks in other countries is an essential concern. Assessments of the global health losses, such as the mortality costs of the COVID-19 pandemic, are not directly relevant for regulatory impact analyses of U.S. policies but could potentially provide guidance for philanthropic organizations and international healthcare agencies. The role of international impacts is greater for climate change policies.[156] Effective and widely adopted COVID-19 vaccination policies can potentially have a major impact on reducing COVID-19-related deaths within the United States.[157] In contrast, control of GHGs by the United States has a more dispersed impact on global warming throughout the world.[158] It could be that any given amount of emission controls by the United States, China, or India may not have a demonstrable influence on climate change in the United States, but collectively, the impact of comparable emission reductions by all countries would be influential.[159]

While experts may differ on the relative weight that analyses should place on global and domestic impacts, monetization of these international impacts will be a component of any assessment of climate change policies with an international focus. The basic principle for assessing the benefit value from GHG reductions is the same for all countries. In particular, the key measure is determining the magnitude of the country's willingness to pay to reduce climate change.

For simplicity, consider a one-period snapshot of these benefits for countries other than the United States. Assessing the trajectory of these mortality costs over time follows the same procedure used for U.S. benefits and is a straightforward exercise. The mortality cost calculation for any country can be obtained by multiplying three components: the country's VSL, the population size, and the reduction in the climate-related mortality rate from GHG policies.

---

154. *See id.* at 34 n.22.
155. *See generally* 2023 FINAL RULE, *supra* note 6.
156. *See* FARBER & CARLARNE, *supra* note 138, at 46.
157. *See* Mason & O'Donnell, *supra* note 145.
158. *See* FARBER & CARLARNE, *supra* note 138, at 46.
159. *See id.*

The first of these components involves generalizing the U.S. VSL so that it will be accurately translated to other countries. Countries differ in income levels, healthcare systems, culture, and ethical norms. These and other factors may give rise to international heterogeneity of the VSL. The difference in income level across countries is the main distinguishing characteristic used in these projections.

The second component of the benefit calculation is the size of each country's population. The magnitude of the expected number of lives saved—and, consequently, the magnitude of the assessed benefits—increases linearly with the number of people whose lives are improved by reduced GHG emissions. Very populous countries such as India and China will be prominent contributors to the assessed benefit.

The third component of the calculation is the reduction in the mortality rate from the GHG policy. This value will not be uniform across countries, as the ability of nations to cope with climate change will be greater when adaptation mechanisms for reducing the mortality risks of climate change are readily available.[160] Countries with a lower ability to undertake precautionary measures will tend to be particularly hard hit by climate change and, consequently, will experience a greater mortality rate reduction from effective climate change policies. It is well established that the countries most vulnerable to the risks posed by climate change tend to be lower-income countries.[161] Therefore, estimates that do not take such differences into account will understate the burden of climate change on lower-income countries. The calculations presented below are not able to draw on country-specific estimates of the incremental impact of GHG policies on mortality risks in different countries, though these can be embedded in more complex climate change models. Our focus is on the role of international differences in the VSL in conjunction with the population estimates in order to outline and illustrate the principles for evaluating international impacts.

The applicable VSL across countries may differ for a variety of reasons, but differences in per capita income levels are the main contributor to economic analyses of the international VSL. Income-related differences in the VSL are the focal component of changes over time in the VSL as assessed by government agencies, such as the Department of Transportation, and in assessments of the SC-GHG by EPA.[162] We will consider the global impacts of climate change, distinguishing three different approaches to constructing the VSL for different countries. We then illustrate the implications of these approaches using country-specific data on population sizes.

There are three different approaches that we consider for constructing the international VSL below: (1) an equal VSL approach, where the U.S. VSL is imputed to all countries; (2) an equal income elasticity approach; and (3) a country-specific income elasticity approach.

---

160. *See supra* Part III.
161. *See supra* Part III.
162. *See supra* note 46 and accompanying text.

1. Method 1: U.S. VSL Approach

The first method for constructing international VSL is using the U.S. VSL number for all countries ("U.S. VSL Approach"). Thus, analysts might value every climate-change-caused death throughout the world using the same VSL figure as is used in the United States. In effect, this approach treats all people as if reductions in the risk to their lives have the same value irrespective of their country and its associated income level. Some observers have advocated for this approach as the ethically defensible method in that it values reduction in risk to all lives equally.[163] However, the principle underlying the benefit assessment does not pertain to saving identified lives but to a willingness to pay to reduce small changes in mortality risks. The U.S. VSL reflects how much people in the United States are willing to pay to reduce their risks of death, but it does not correspond to how much people in other countries would be willing to spend to reduce their risks. If residents of these countries were asked what it would be worth to them to reduce mortality risks from climate change, they would base this answer on their own economic resources, not those of the U.S. population. If instead the question was what residents in the United States would be willing to pay to reduce mortality risks in other countries, the answer to that question would be based on the extent of their altruism toward residents in these countries, rather than their personal VSL, which is their willingness to pay to reduce risks to their own lives. Neither EPA nor any other international government agency has adopted the valuation approach of using the U.S. VSL to value mortality risk reductions throughout the world.[164] As the calculations below will indicate, adopting the U.S. VSL as the measure of mortality risks generates a much higher estimate of the SC-GHG mortality costs than income-adjusted approaches such as that used in EPA's SC-GHG analysis.[165]

2. Method 2: Equal Income Elasticity Approach

While the first valuation approach equates all countries' VSLs to the U.S. VSL, the second valuation approach is the Equal Income Elasticity Approach, whereby the manner in which income differences affect the VSL is the same for all countries. This VSL adjustment method uses the average international income elasticity of the VSL to make international VSL adjustments. Empirical estimates of the average international income elasticity of the VSL are 1.0, based both on labor market studies of wage–mortality risk tradeoffs,[166] as well as the average income elasticity for stated preference surveys of the VSL.[167] The 2023 EPA analysis of the

163. This position was held by a previous environmental minister of India. *See* Fred Pearce, *Price of Life Sends Temperatures Soaring*, NEW SCIENTIST (Apr. 1, 1995), https://www.newscientist.com/article/mg14619710-400-price-of-life-sends-temperatures-soaring/ [https://perma.cc/UP68-87RP].

164. *See supra* note 46 and accompanying text.

165. *See* discussion *infra* Section VI.B.

166. *See* Viscusi & Masterman, *supra* note 122, at 226.

167. *See* Clayton J. Masterman & W. Kip Viscusi, *The Income Elasticity of Global Values of a Statistical Life: Stated Preference Evidence*, 9 J. BENEFIT COST ANALYSIS 407, 407–08 (2018).

SC-GHG adopted this international income elasticity and used the Equal Income Elasticity Approach.[168]

3. Method 3: Country-Specific Income Elasticity Approach

A third valuation approach is the Country-Specific Income Elasticity Approach. This approach is a refinement of the equal income elasticity method in that it uses the responsiveness of the VSL to income based on the income elasticity estimates for each country. This refinement in estimating the VSL is potentially consequential if mortality risks and the sizes of populations differ by the country's average per capita income, in which case it would be important to use country-specific weights. Countries such as the United States have an income elasticity below 1.0, whereas very low-income countries have an income elasticity above 1.0. Some economic observers suggest that failing to account for the greater income elasticity in lower-income countries leads to an implausibly large budgetary commitment to risk reduction policies in those countries.[169] The discussion below will not rely on those subjective assessments but will draw on empirical evidence across countries.

B. How Each Formulation Impacts Mortality Cost Assessments

For purposes of illustrating the impact of these different approaches, we divide the population into per capita income quartiles. The reason for this division is that the income elasticity is approximately 1.5 for the bottom quartile, 1.2 for the next quartile, and 0.5 throughout the top half of the per capita income distribution.[170] Government agencies should, of course, refine these values based on additional research, but figures of this general order of magnitude are consistent with available estimates.[171] Let the U.S. VSL be indicated by v and the climate change policy mortality rate reduction be indicated by m. Note that the current value of v used by U.S. government agencies is now in the range of $10–$12 million, and we use a value of $12 million for the following analysis.

Figure 1 below presents the total benefit value for each method as a percent of the U.S. VSL Approach, which is simply the U.S. VSL multiplied by the climate change policy mortality rate reduction multiplied by the total population in each group. Given the differences in population sizes, the benefits are greatest for higher-

168. 2023 FINAL RULE, *supra* note 6, at 165. While EPA cited several references regarding the validity of making adjustments for differences in income, Viscusi and Masterman (2017) and Masterman and Viscusi (2018) are the only two references that provided an estimate of the average international income elasticity figure of 1.0 that was adopted by EPA. *Id.*

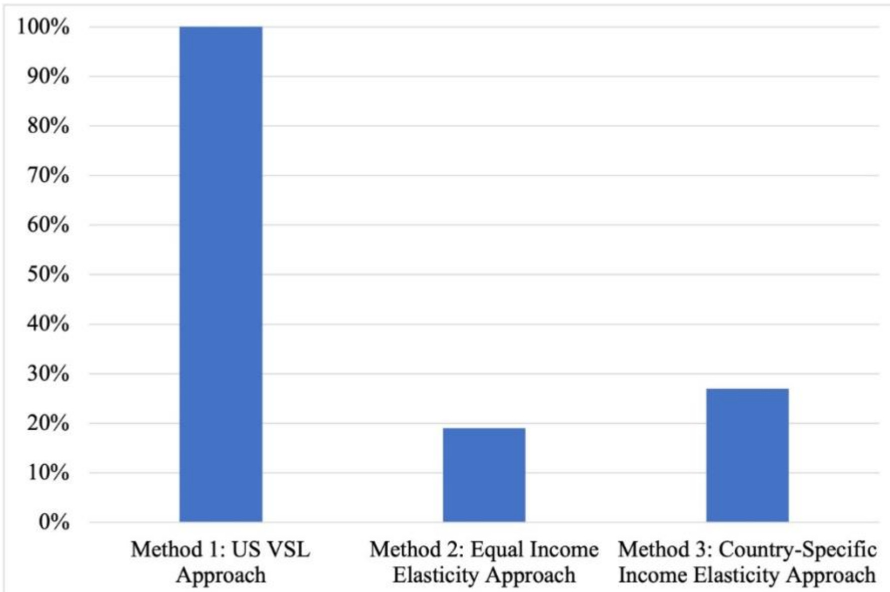
169. *See, e.g.*, James K. Hammitt & Lisa A. Robinson, *The Income Elasticity of the Value per Statistical Life: Transferring Estimates Between High and Low Income Populations*, 2 J. BENEFIT-COST ANALYSIS 1, 13 (2011) ("[U]sing these elasticities to extrapolate to countries with very low incomes leads to VSL estimates that appear implausibly large."). *But see* Lisa A. Robinson, James K. Hammitt & Lucy O'Keeffe, *Valuing Mortality Risk Reductions in Global Benefit-Cost Analysis*, 10 J. BENEFIT-COST ANALYSIS 15, 23–24 (2019) (arguing that income elasticity adjustments should seek validating support from relevant studies produced by the regulated population).

170. *See* Viscusi & Masterman, *supra* note 122, at 240 tbl.4.

171. *See supra* note 46 and accompanying text.

income countries if the same VSL is applied to all countries. As a means of comparison, the average VSL is $12 million under the U.S. VSL Approach, $3.17 million under the Equal Income Elasticity Approach, and $3.98 million under the Country-Specific Income Elasticity Approach.

FIGURE 1: TOTAL BENEFIT OF GREENHOUSE GAS REDUCTIONS AS PERCENT OF THE U.S. VSL APPROACH BENEFIT



The implications of using any income elasticity of the VSL to extrapolate the U.S. VSL to other countries are quite dramatic. Adoption of the equal income elasticity of 1.0 reduces mortality risk reduction benefits by 81%, as compared to the value using the U.S. VSL Approach. Adoption of country-specific income elasticities also reduces the assessed total mortality costs, but not to the same extent, as there is a 73% decrease from the U.S. VSL Approach. Monetizing mortality risks for countries other than the United States using either of these country-specific estimates in Method 2 or Method 3 greatly reduces the estimated mortality costs, which in turn translates to a reduction in the SC-GHG.

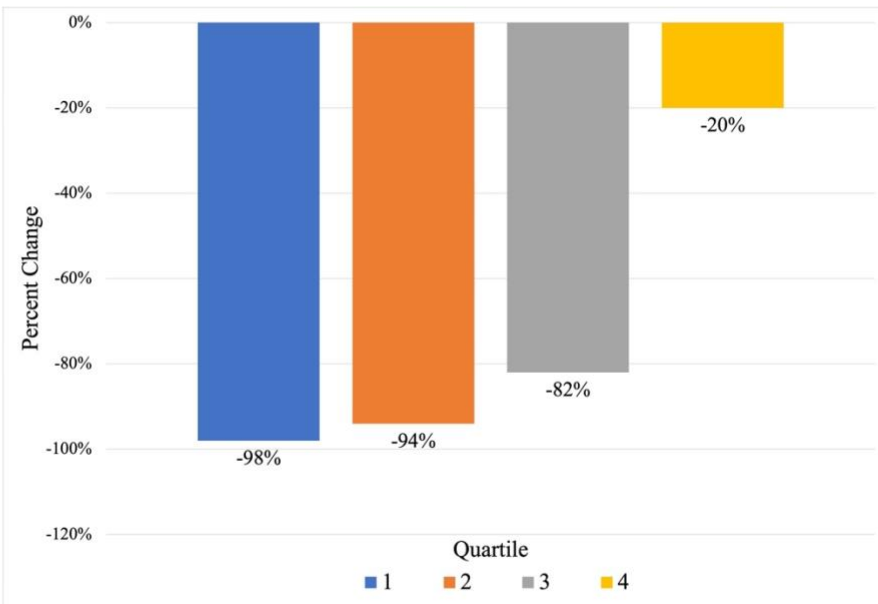
The effect of the different elasticity assumptions varies across the income levels of impacted countries. Moving from using the U.S. VSL Approach to the Equal Income Elasticity Approach, which was adopted by EPA,[172] reduces the estimated mortality costs of GHG across all quartiles, but the extent of the reduction varies. The estimates for the equal income elasticity of the 1.0 approach are presented in Figure 2 below, where quartile 1 represents the lowest-income countries, and quartile 4 represents the highest-income countries.

In this case, the population figures for each country income group and the mortality rate *m* are the same as in the U.S. VSL Approach; however, it is no longer

172. *See generally* 2023 FINAL RULE, *supra* note 6.

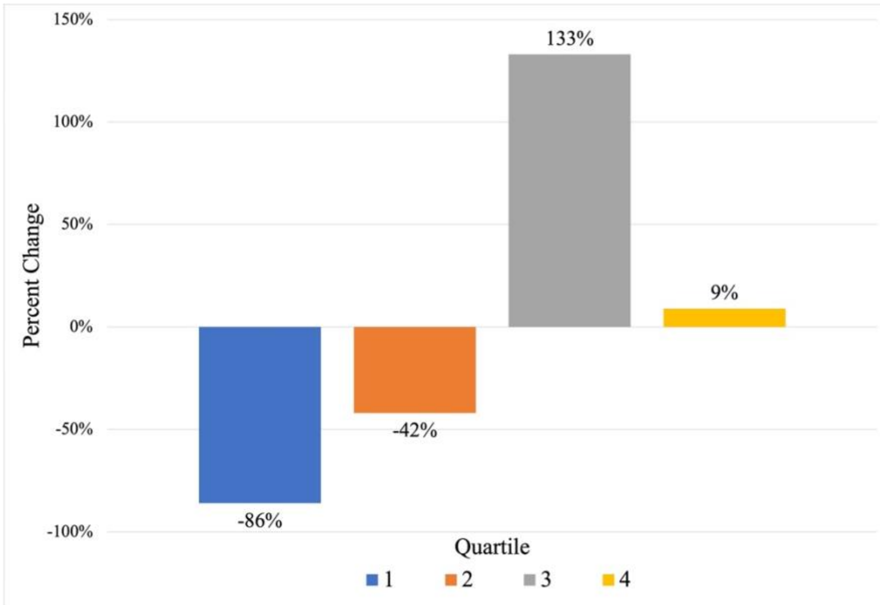
appropriate to multiply these values by the U.S. VSL. Countries with a higher per capita income than the United States will receive a higher VSL than the United States, and countries with a lower per capita income will receive a lower VSL. The top income quartile based on per capita income experiences a drop in mortality costs of 20% due to the 1.0 income elasticity. The second highest income quartile experiences a drop of 82%. The bottom income quartiles are more greatly affected as they incur a drop of 94% and 98% of mortality costs, respectively. The greatest drop in the VSL is for the lowest-income quartile of countries as the number is magnified by the fact that the lowest-income quartile countries are also highly populated. Importantly, viewed from the perspective of the lower-income countries, shifting from the U.S. VSL method to the equal income elasticity method makes this group's mortality costs negligible in terms of the benefits of climate policies, with a near 100% reduction.

FIGURE 2: PERCENT CHANGE IN BENEFIT OF GREENHOUSE GAS REDUCTIONS BY QUARTILE BETWEEN U.S. VSL APPROACH AND EQUAL INCOME ELASTICITY APPROACH



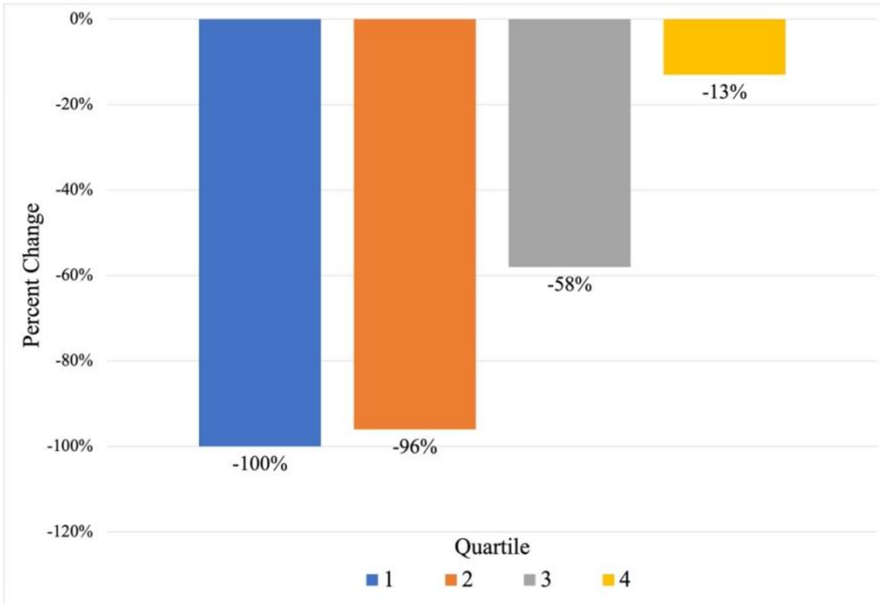
If country-specific income elasticity figures are used as in Method 3, the percentage change in the benefits from adopting the income adjustment to the VSL results in a drop in the mortality cost estimates for the bottom two quartiles and a gain in the top two quartiles, as compared to the Equal Income Elasticity Approach. This comparison is presented in Figure 3 below. As the graph shows, the top income quartile experiences a slight positive change, while the second highest income quartile experiences the most significant change—increasing by 133%, as compared to the Equal Income Elasticity Approach. The bottom two quartiles experience yet another negative change, with the second lowest-income quartile experiencing a drop of 42% and the lowest-income quartile experiencing a drop of 86%.

FIGURE 3: PERCENT CHANGE IN BENEFIT OF GREENHOUSE GAS REDUCTIONS BY QUARTILE BETWEEN EQUAL INCOME ELASTICITY APPROACH AND COUNTRY-SPECIFIC APPROACH



Finally, moving from the U.S. VSL numbers under Method 1 to the country-specific income elasticity numbers in Method 3 decreases expected mortality costs across all quartiles. This comparison is displayed in Figure 4 below. The top two income quartiles experience a smaller drop in mortality costs than do the lower-income quartiles, with the top income quartile decreasing by 13% and the second highest-income quartile decreasing by 58%. Once again, the bottom two income quartiles of countries experience a drop that drives their mortality costs near zero in terms of the mortality risk reductions provided by climate policies, with the second lowest-income quartile experiencing a 96% drop and the lowest-income quartile experiencing a complete reduction of 100%. Thus, in changing from the U.S. VSL method to the country-specific method, the mortality costs of the lower-income countries are negligible in terms of the assessed mortality reduction benefits of climate policies. Any departure from the U.S. VSL Approach reduces the mortality cost-benefit estimates and all but eliminates the benefits associated with half of the world's population.

FIGURE 4: PERCENT CHANGE IN BENEFIT OF GREENHOUSE GAS REDUCTIONS BY QUARTILE BETWEEN U.S. VSL APPROACH AND COUNTRY-SPECIFIC APPROACH



Setting aside international differences in mortality rates from climate change, what is the most valid approach to global benefit assessments? Given we have recognized—for the purposes of the SC-GHG assessment—that impacts on global populations now and in the future should be recognized, it is essential to incorporate their mortality risk valuations in the assessment process. The most precise approach to doing so is Method 3, which reflects differences both in income levels as well as in how income affects the VSL across countries. Using the average responsiveness in Method 2, rather than in Method 3, generates an underestimate of the mortality costs associated with climate change and, as a result, an underestimate of the SC-GHG. The net effect of these impacts is that the country-specific estimates based on Method 3 yield a higher value of global mortality costs than in Method 2's 1.0 income elasticity case. When assessing the SC-GHG for countries throughout the world, it is appropriate to use the values that most closely reflect the benefit levels based on the preferences of people in the affected countries. Using average income elasticity values rather than country-specific values is a less precise method for incorporating international differences and understates the extent of the disparities. Adopting our country-specific values of the income elasticity of the VSL would boost the mortality benefits of SC-GHG regulations.[173]

Next, we consider how the addition of climate mortality impacts the total benefit of GHG reductions. As highlighted in Part III, the consequences of climate change will vary geographically. Low-income countries and small-island developing states—which primarily include most of Africa and Southern Asia—are

173. The calculations presented above assume a constant mortality rate across countries from climate change.

exposed to the greatest health impacts due to vulnerability.[174] Further, adaptability, resilience, and vulnerability are direct functions of wealth, meaning low-income countries will benefit more from greater GHG reductions. Even though these countries are the largest in terms of climate mortality, the country-specific VSL adjustment will offset the difference in mortality.

FIGURE 5: CLIMATE MORTALITY BY QUARTILE

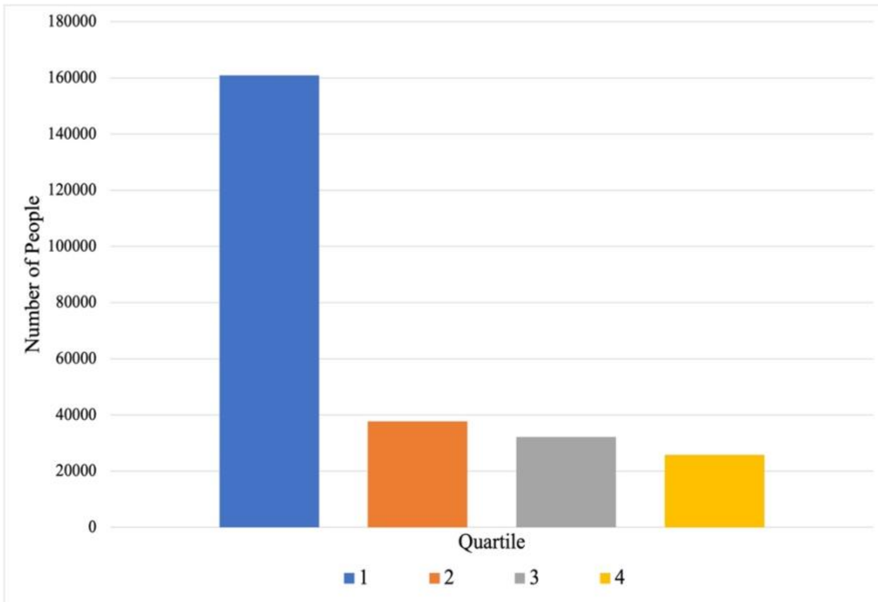


Figure 5 above demonstrates the comparison of climate mortality between income quartiles. The mortality estimates are a summation of mortality due to undernutrition, malaria, dengue, diarrheal disease, and heat.[175] The lowest-income quartile has the highest rate of additional deaths attributable to climate change through 2050 under A1b[176] emissions scenario and base case socioeconomic scenario, at over 160,000 deaths. This quartile includes countries primarily located

---

174. *See supra* Part III.

175. Emission scenarios describe the projection of emissions under certain assumptions; for example, "A1b" denotes the scenario where future climate change involves medium-high emissions. WORLD HEALTH ORG., QUANTITATIVE RISK ASSESSMENT OF THE EFFECTS OF CLIMATE CHANGE ON SELECTED CAUSES OF DEATH, 2030S AND 2050S 1 (2014). "Base case socioeconomic scenario" describes a possible global socioeconomic future which is between a "high growth" and a "no growth" future. *Id.*

176. Although these climate mortality categories are not comprehensive, they are more complete (in terms of coverage of climate mortality sources) than the estimates used in EPA's SC-GHG. *See* 2023 FINAL RULE, *supra* note 6, at 81 (noting the DSCIM and GIVE models only estimate temperature-related mortality); WORLD HEALTH ORG., QUANTITATIVE RISK ASSESSMENT OF THE EFFECTS OF CLIMATE CHANGE ON SELECTED CAUSES OF DEATH, 2030S AND 2050S 12 (2014). Notably, these mortality estimates are used in the Intergovernmental Panel on Climate Change's 2022 edition of AR 6. AR 6, *supra* note 74, at 50.

in South Asia and Sub-Saharan Africa. The second lowest-income quartile, which includes countries in Central and Eastern Europe, Latin America, North Africa, and the Middle East, is predicted to experience about 40,000 additional deaths attributable to climate change through 2050. The third income quartile, which is comprised of countries located in Central Europe, the Middle East, and Southeast Asia, is predicted to experience over 30,000 additional deaths attributable to climate change through 2050. Lastly, the highest-income quartile, which includes countries located primarily in Western Europe and North America, is predicted to experience approximately 25,000 additional deaths attributable to climate change through 2050.

C. Discounting

The evaluation of the mortality risk reduction benefits by country has focused on a snapshot of the VSL at the current time. However, future benefits will be affected in two principal ways by looking beyond the current time period: the impact of income growth on the VSL and the influence of discounting on what the future benefits will be after being converted to their present value.[177] The role of income growth parallels the influences reflected in the discussion thus far. The calculations of the VSL by country shown above were based on the per capita income levels in the country. As these income levels rise over time, the VSL will increase as well. The rate of increase can be calculated using the country-specific income elasticities. Thus, low-income countries with a higher income elasticity will have a VSL level that is more responsive to increases in per capita income than countries with lower income elasticities, potentially narrowing the VSL disparity across countries over time. This process will serve to boost the VSL in low-income countries more than in high-income countries for any given percentage change in per capita income. In conjunction with information on a country's expected growth in income levels over time, it will be feasible for government analysts to project the pertinent VSL at a future date.

The role that any future projections will play depends on the degree to which future impacts are discounted in calculating the present value of benefits and costs. Long-standing U.S. government guidance in OMB Budget Circular A-4 indicated that analyses should be undertaken using real (i.e., net of inflation) discount rates of 3% and 7%, though agencies were permitted to consider unspecified lower discount rates for policies with very long-term impacts.[178] However, the 2023 Circular A-4 indicates that the new discount rate should be 2%.[179] The discount rate that EPA used in calculating the SC-GHG in 2023 was 2%, which is equivalent to the most recently announced rate.[180]

The choice of the discount rate used for U.S. policy has a critical impact on the present value of benefits and costs in the distant future. For example, using the 2% discount rate rather than the 3% rate has a consequential impact on the assessment of the SC-GHG, which involves discounting climate change impacts

---

177. W. Kip Viscusi, *Rational Discounting for Regulatory Analysis*, 74 U. CHI. L. REV. 209, 229–30 (2007). The future VSL is determined by the net discount rate, or the difference between the rate of time preference and the rate of income growth. *Id.*

178. *See* CIRCULAR A-4, *supra* note 5, at 76.

179. *See id.*

180. *See* 2023 FINAL RULE, *supra* note 6.

over a 30-year period. Although there remains a debate over whether 2%, 3%, or some other number is most appropriate for the United States's preferred discount rate, the OMB has provided a justification for current use of the 2% rate.[181] For purposes of this discussion, we assume that EPA's use of a 2% rate is a reasonable value for benefits and costs affecting the United States.

However, the SC-GHG is not restricted to domestic benefits, but instead involves a calculation of global benefits. Just as the role of including global benefits makes it appropriate to recognize the country-specific preferences regarding the VSL, it is also appropriate to incorporate the country-specific intertemporal preferences. The pertinent discount rate that should be used for each country's component of these global benefits should therefore reflect country-specific intertemporal preferences rather than the U.S. discount rate. The 2% discount rate used in EPA's analysis substantially understates the degree to which many other countries will discount future effects. A review of discount rates used in policy analysis throughout the world finds that the discount rate was 2% in the United States;[182] 3.5% in the United Kingdom;[183] 7% in Australia and Canada;[184] 5% in New Zealand;[185] 12% in India, Pakistan, and in many South American countries including Columbia, Bolivia, Argentina, and Uruguay; and 15% in the Philippines.[186] The disparity in the discount rates used by the United States and lower-income countries is reflected in the recommended real discount rate of 12% used by the Inter-American Development Bank.[187]

There is an enormous disparity in the present value assessments based on a discount rate of 12% rather than EPA's value of 2%.[188] Distant future impacts on countries with relatively high discount rates effectively drop out of any calculation. Failing to use a discount rate that reflects the preferences of these countries leads to an overstatement of the benefits derived by these countries as they value them, an

181. *See* CIRCULAR A-4, *supra* note 5, at 76. The newly published A-4 guidance document discusses how it developed the 2% rate. *Id.* at 76 n.152. EPA analysis of SCC used a 2% rate. *See* 2023 FINAL RULE, *supra* note 6.

182. *See* CIRCULAR A-4, *supra* note 5, at 76.

183. HM TREASURY, THE GREEN BOOK: APPRAISAL AND EVALUATION IN CENTRAL GOVERNMENT 116 (2022).

184. DEP'T OF THE PRIME MINISTER & CABINET, GUIDANCE NOTE, COST-BENEFIT ANALYSIS 7 (2020); GOV. OF CANADA, CANADA'S COST-BENEFIT ANALYSIS GUIDE FOR REGULATORY PROPOSALS (May 5, 2023).

185. NEW ZEALAND GOVERNMENT, CBAX TOOL USER GUIDANCE: GUIDE FOR DEPARTMENTS AND AGENCIES USING TREASURY'S CBAX TOOL FOR COST BENEFIT ANALYSIS 2 (2022).

186. Javier Campos et al., *Time Goes By: Recent Developments on the Theory and Practice of the Discount Rate*, INTER-AM. DEV. BANK 31–32 (2015).

187. *Cost Benefits and Cost Effectiveness Overview, Assumptions and Methodologies*, INTER-AM. DEV. BANK, https://www.iadb.org/en/who-we-are/measuring-results/project-evaluation/cost-benefit-and-cost-effectiveness [https://perma.cc/V9Q9-284K] (last visited Aug. 1, 2024) ("Projects require that future benefit and costs flows be discounted to account for the opportunity cost of capital. It is recommended that a 12% real discount rate be used in all Bank projects.").

188. *See* 2023 FINAL RULE, *supra* note 6.

overstatement of the total SC-GHG, and a distortion in the relative degrees to which climate change policies benefit different countries.

Using country-specific discount rates will tend to reduce the estimates of the SC-GHG. The effect of using discount rates that are pertinent to specific countries will be especially great for the low-income countries that have a higher discount rate. Will such a change in the discounting approach lead to a decrease in the SC-GHG? Inspection of Figure 4 suggests that it will not. After the income elasticity adjustments to the VSL under Method 3—which is more favorable to low-income countries than the current SC-GHG approach—the magnitude of the mortality reduction benefits is all but eliminated. Most consequential in this analysis is recognizing countries' heterogeneity, as Method 3 does, which boosts the mortality cost estimates for higher-income countries. This effect is likely to be the most dominant impact.

VII. THE DIMENSIONS OF EQUITY

Climate change policies have fundamental equity impacts: the most severe impacts of climate change will fall on lower-income countries and countries with the largest populations.[189] Viewed from a U.S.-centric perspective, there will be an intertemporal inequity as lower-income present generations sacrifice expenditures to protect relatively higher-income future generations. Viewed from a global perspective, the conclusion will be different. If lower-income countries experience greater population growth and are more impacted by climate change, then the main beneficiaries of GHG-reducing policies will be those who incur relatively greater harms, thus promoting intergenerational global equity. The monetization of these outcomes implicates the calculation of SC-GHG and the overall weight placed on the climate change impacts to these countries in the creation of U.S. policy. The international heterogeneity of the VSL has fundamental implications for who benefits from GHG-reducing policies, and it will also influence countries' incentives to control GHG emissions. Country-specific valuations of the benefits generated by climate policies may be more instrumental in guiding countries' climate change initiatives than the global SC-GHG because the country-specific values reflect the country's stake in climate change policies, whereas the SC-GHG includes effects on all countries. This heterogeneity is not a technical nuance but a fundamental deterrent that must be overcome for successful climate change policy.

It is feasible to calculate the total benefits to the world of reductions in GHG emissions using the SC-GHG. For simplicity, we focus only on the mortality reduction benefits, which are the most prominent benefit component of the SC-GHG. The global benefit is the sum of all individual countries' benefits. As shown in Part V, the benefits will be related linearly to the population size of the country and the country-specific VSL.[190] Lower-income countries often have very large populations, which increases their benefits share, but the income-adjusted VSL diminishes the mortality cost value for those countries.[191]

189. *See supra* Part III.
190. *See supra* Part V.
191. *See supra* Part VI.

What share of the climate change amelioration benefits are reaped by each country? Using the estimates from Part VI, it is easy to provide such estimates and examine how this share depends on the method for valuing mortality costs.[192] Consider the share of the U.S. benefits from a reduction in carbon emissions. If all countries are assigned a VSL equal to the U.S. VSL, then the U.S. share of the SC-GHG reduction benefits would be 4.31%. Each country's GHG reduction benefit is then proportional to that country's share of the world population, subject to potential modifications if the climate mortality risk differs by country. If the income elasticity of the VSL is 1.0—as in Method 2 and in the current EPA analysis—almost all countries other than the United States would incur a reduction in their relative share of the SC-GHG reduction benefits because of the income adjustment, boosting the U.S. share of benefits to 24%. Finally, adopting Method 3's more refined VSL adjustment—which reflects each country's income level—not only reduces the estimates of the global SC-GHG, but also impacts the U.S. share. Based on these values, the U.S. share would decrease from Method 2's estimate—but increase from Method 1's estimate—to 16%.

The valuation of mortality cost reduction affects both the overall estimate of the SC-GHG in the benefit calculations and the country-specific estimates. It also influences each country's relative share of the benefits because which countries benefit and to what extent is tied to the income level in a given country. If controls are implemented to reduce GHG, the SC-GHG provides the measure of benefit to the world for each unit of GHG reduction. The SC-GHG then might be viewed as reflecting the financial payoff to the world of GHG policies. However, not all countries benefit equally. Countries for which the share of mortality cost reductions is very low benefit much less as compared to countries for which the share of mortality cost reductions is high. The degree to which a country obtains benefits from the policies is likely to influence the extent to which the country views the allocation of GHG control costs throughout the world to be an equitable matter for international cooperation.

The heterogeneity of the VSL also has implications in terms of the costs that countries are willing to incur for GHG controls. While the global SC-GHG sets the reference point for what countries collectively should do to reduce GHG emissions, that number does not affect what the country will derive from its own pollution-reduction policies. Rather, the domestic impacts are governed by country-specific losses. Whether the country embarks on control efforts based on the global impacts of its efforts or on the domestic impacts depends on how a country's VSL compares to the average VSL used in calculating the SC-GHG. A country with a VSL that is below that of the average value used in calculating the SC-GHG will have a reduced domestic incentive to embark on a vigorous set of controls than it would undertake if guided by the global SC-GHG. Low-income countries experience greater climate mortality, but a lower VSL diminishes the monetized value of these impacts. Other factors that may reduce the country-specific estimate of harms, such as a higher country-specific discount rate, can also create a disparity between the country-specific values and the global SC-GHG.

---

192. *See supra* Part VI.

The calculation of the global SC-GHG highlights the tremendous challenge in implementing international controls of GHG. The SC-GHG monetizes GHG reductions in terms of the global value of these reductions. Countries should incorporate this number into policies to control GHG emissions. Consider a situation in which the incremental costs of GHG reductions steadily increase with the degree of controls that are implemented, and the unit benefit of reducing GHG emissions is some constant value of SC-GHG. The globally efficient GHG level will result if every country continues to institute controls up to the point at which the incremental costs of GHG emission reductions just equal the global SC-GHG. This procedure will lead to globally efficient GHG controls, but it will not be consistent with the stake that different countries have in the benefits of GHG reductions. As the calculations above indicate, there is a tremendous disparity in how climate change policies enhance the well-being of countries and in what different countries will perceive as the benefit to them.

Binding international agreements and policy subsidies are two mechanisms that should be employed to reduce GHG emissions globally. However, recognition of the disparities between the global SC-GHG and country-specific estimates is an especially important consideration in setting environmental policies—such as trade policies—that impact other countries. For example, multiple countries are considering implementing carbon border adjustment mechanisms to reduce carbon leakage between countries with disparate levels of carbon control policies, incentivize collective climate action, and protect domestic industries from cheaper, emission-heavy imports.[193] Carbon border adjustments function by assessing the inherent carbon emissions of a good and imposing a tariff on imports from countries with less restrictive carbon mitigation policies.[194] There is also an exemption component to the mechanism: countries that have undertaken carbon pricing—either through a domestic carbon tax or emissions trading scheme—are exempt from the tariff.[195] Border adjustment mechanisms have complicated equity implications. On one hand, the mechanism attempts to dislodge climate free riders by inducing laggard countries to reduce their own emissions. On the other, the mechanism does not distinguish between high-polluting, industrialized countries and least-developed countries, nor does it account for country-specific estimates of mortality cost. Although the exemption component of the mechanism may incentivize countries to implement domestic carbon pricing to be exempt from the tariff, this policy undertaking may be infeasible for lower-income countries due to financial, political, and administrative constraints.[196]

---

193. Goran Dominioni & Daniel C. Esty, *Designing Effective Border Carbon Adjustment Mechanisms: Aligning the Global Trade and Climate Change Regimes*, 65 ARIZ. L. REV. 1, 4 (2022).

194. *Id.*; *see* Micheal A. Mehling et al., *Designing Border Carbon Adjustments for Enhanced Climate Action*, 113 AM. J. INT'L 433, 442 (2019).

195. *See* Dominioni & Esty, *supra* note 193, at 7, 9–10.

196. *See id.* at 15–19.

For example, the European Union's ("EU") carbon border adjustment mechanism,[197] which entered into force in 2023, will have the largest impact on least-developed countries whose economies are dependent on iron and steel, chemicals and petrochemicals, nonferrous metals, and cement—the sectors covered by the mechanism.[198] In response to the EU mechanism, least-developed countries have pointed out the policy's discriminatory impact, especially in light of the difficulty of implementing domestic carbon pricing policies in order to be exempt from the mechanism.[199]

VIII. STANDING FOR FUTURE GENERATIONS

Standing in the context of cost-benefit analysis—including the type implicated in the SC-GHG—and legal standing are two distinct but related concepts. Standing in the context of cost-benefit analysis refers to questions surrounding whose benefits and whose costs should be counted in the analysis. In the legal context, standing is a constitutionally mandated procedural requirement for lawsuits in federal court—it necessitates that only cases alleging that the defendant's conduct caused the plaintiff to suffer an injury in fact, which is redressable by a court, may proceed.[200] Standing is especially difficult to establish in cases alleging harm in the context of the environment because of the latent nature of environmental harms and, thus, the challenge of linking a defendant's conduct to a plaintiff's particularized injury.[201] Most state courts also have standing requirements, often based in state constitutions.[202] Expanding standing to allow for representation of future generations in present environmental litigation helps to ensure intergenerational equity—or the fairness among generations in the use and conservation of the environment and its natural resources.[203]

The legal standing requirement originates from Article III of the U.S. Constitution, which necessitates that federal courts may only hear "cases and controversies," meaning that lack of standing results in immediate dismissal of lawsuits from federal court.[204] Thus, an initial threshold question in environmental law is *who* may sue for the harm in question. The Administrative Procedure Act[205]

---

197. *See Proposal for a Regulation of the European Parliament and of the Council Establishing a Carbon Border Adjustment Mechanism*, COM (2021) 564 final (July 14, 2021).

198. Emily Benson et al., *Analyzing the European Union's Carbon Border Adjustment Mechanism*, CTR. FOR STRATEGIC & INT'L STUD. (Feb. 17, 2023), https://www.csis.org/analysis/analyzing-european-unions-carbon-border-adjustment-mechanism [https://perma.cc/SD9A-993Q]. It is important to note that a larger proportion of global emissions are generated from sectors such as transport, agriculture, and building heating and cooling. *Id.*

199. *Id.*

200. *See* Lujan v. Defs. of Wildlife, 504 U.S. 555, 560 (1992).

201. *See generally* Jan G. Laitos, *Standing and Environmental Harm: The Double Paradox*, 31 VA. ENV'T. L. REV. 55 (2013).

202. *See* Peter N. Salib & David K. Suska, *The Federal-State Standing Gap: How to Enforce Federal Law in Federal Court Without Article III Standing*, 26 WM. & MARY BILL RIGHTS J. 1155, 1169 (2018).

203. EDITH BROWN WEISS, IN FAIRNESS TO FUTURE GENERATIONS 107 (1989).

204. U.S. CONST. art. III, § 2, cl. 1.

205. 5 U.S.C. §§ 551–59.

creates a potential cause of action through its judicial review provision, which allows persons who are "adversely affected or aggrieved" by federal agency action to sue the relevant agency.[206] Additionally, beginning with the Clean Air Act, Congress has incorporated individual citizen-suit provisions into most environmental laws, which allow private citizens to file federal lawsuits against the agencies and private entities that violate the statute's requirements.[207] Thus, the Administrative Procedure Act, in combination with the federal environmental citizen-suit provisions, allow for third-party challenges to environmental or natural resource regulations. This means citizens and public interest groups can challenge environmental regulation, regardless of whether they are subject to either the regulations or impacted by an entity's compliance with the regulations.

In *Lujan v. Defenders of Wildlife*,[208] the Supreme Court created a three-prong test for whether a plaintiff has standing to bring a case in federal court.[209] First, the plaintiff must have suffered an injury in fact, defined as the invasion of a legally protected interest.[210] The injury must be concrete and particularized, and must be actual or imminent, as opposed to conjectural or hypothetical.[211] Second, there must be a causal connection between the injury suffered by the plaintiff and the defendant's conduct.[212] Finally, the injury must be redressable by a favorable decision from the court.[213] Whether the third prong is met hinges primarily on the type of relief requested by the plaintiff.[214] Courts have held that in cases where the plaintiff requests an overhaul of federal policy, the third prong remains unsatisfied—even if the other two prongs are met.[215]

Standing is especially difficult to establish in cases alleging harm in the context of the environment because of the latent nature of environmental harms and, thus, the challenge of linking a defendant's conduct to a plaintiff's particularized injury. On its face, the first prong is least likely to be met in the situation of environmental harm caused by present generations and inflicted upon future generations. This is mostly because of the discrepancy in time between the defendant's conduct and the plaintiff's resulting injury—many environmental harms are latent in nature, meaning the harm caused is not realized until a long time after the underlying conduct. To remedy the discrepancy in the timing of conduct and harm, we propose expanding standing to allow for representation of future generations in present environmental litigation. Expanding standing helps to ensure intergenerational equity, which is the concept of fairness among generations of use and conservation of the environment and its natural resources.[216]

---

206. § 581(a).
207. *See generally* 42 U.S.C. § 7604.
208. 504 U.S. 555 (1992).
209. *Id.* at 560–61.
210. *Id.* at 560.
211. *Id.*
212. *Id.*
213. *Id.* at 561.
214. Massachusetts v. Env't Prot. Agency, 549 U.S. 497, 526 (2007) (explaining the injury must be likely to be redressed "to some extent").
215. *See* Juliana v. United States, 947 F.3d 1159, 1171 (9th Cir. 2020).
216. WEISS, *supra* note 103, at 107.

The concept of allowing a contemporary representative to defend the interests of future generations is not novel. For example, property law allows the appointment of a guardian to represent future individuals. Certain states have provisions in their civil procedure codes that allow for the appointment of a lawyer in such instances where there is a conflict of interest between current beneficiaries and future ones.[217] This concept is easily expandable to account for the impacts of climate change: given that the impacts of climate change will certainly alter and may even destroy the interests of future generations in a multitude of ways, statutes similar to those contained within state civil procedure codes could be leveraged to appoint a contemporary representative in present environmental litigation. Additionally, the definition of public trust could be interpreted as sufficiently similar to a conventional trust, which would further support the application of this technique in the environmental context. This proposal is relevant and applicable independent of our proposals to refine the SC-GHG: regardless of the number SC-GHG takes on, the interests of future generations will be adequately represented in relevant litigation through the appointment of a representative.

IX. SIX PRINCIPLES FOR PROPER RECOGNITION OF INTERGENERATIONAL AND INTERNATIONAL IMPACTS IN ENVIRONMENTAL POLICIES

Our approach to recognition of policy impacts across geographic and temporal dimensions consists of six interrelated principles that create a new framework for approaching such decisions. These principles will ensure proper recognition of the impacts throughout the world both now and in the future based on the assessments of the preferences of those who are directly affected. Adoption of these principles will lead to a restructuring of how analysts should approach policies affecting future lives. These principles will also bring to the forefront the importance of giving proper treatment to concerns regarding equitable treatment of global populations now and in the future, which current policies do not do.

A. Account for Future Populations in Regulatory Impact Analyses

Impacts of GHG reducing policies on future populations should be accorded the same attention in the assessment of policy interventions as are impacts on current populations due to the expansive temporal impact of climate change and because many climatic impacts are cumulative and cascading. Federal agencies' analyses should fully incorporate these impacts to reflect the valuations of those who are affected by policies. The assessed willingness to pay of future populations for mortality risk reductions should remain the guiding benefit assessment principle. This approach differs from that of those who propose to consider only effects on the current generation or the preferences of the citizenry who voted for the laws that govern current policies.

---

217. *See e.g.*, CAL. CIV. PROC. CODE § 373.5 ("If . . . a person or persons of a designated class who are not ascertained or who are not in being, or a person or persons who are unknown, may be or may become legally or equitably interested in any property, real or personal, the court in which any action . . . affecting the property is pending, may . . . appoint a suitable person to appear and act therein as guardian ad litem of the person or persons not ascertained, not in being, or who are unknown.").

B. Use Benefit Values that Reflect the Country's Preferences

The monetization of reductions in mortality should be based on the preferences of those impacted. There should be recognition of both the difference in per capita income across countries as well as difference in the relationship of income levels to the VSL. The recent effort by EPA to incorporate the level of income in the SC-GHG is sound; however, the use of an average international relationship between income and the VSL does not fully capture the extent to which there is international heterogeneity in the income elasticity of the VSL, which will affect the country-specific VSL levels. Adjusting for income levels reduces the VSL for other countries, but the current procedures may overstate the extent of the income adjustment. The consequences can be quite large, particularly when the countries with overstated VSL estimates also have very large populations. Adjusting for differences in income levels, but not the impact that income has on the VSL, leads to an understatement of the global SC-GHG.

C. Use Discount Rates that Reflect the Country's Intertemporal Preferences

Whether the focus is on global impacts or country-specific impacts, the discount rate applied to these benefits and costs should reflect the intertemporal preferences of those countries. These countries are the beneficiaries of the various positive implications of climate change policies. The intertemporal weighting applied to these benefits should be aligned with the preferences of residents in those countries. The current practice of using a discount rate that is specific to the United States is inconsistent with any effort to construct a meaningful global SC-GHG. If the United States was the only country affected and if the focus was on strictly domestic impacts, using the U.S. discount rate would be appropriate. However, using the U.S. rate-of-time preference within the context of an analysis that purports to be an evaluation of the global SC-GHG is incongruous and tends to produce an overstatement of global benefits.

D. Report Country-Specific Estimates

Analyses of the SC-GHG and other future-oriented policies with global impacts should report the effects for each country rather than a single global number. This proposal goes beyond suggestions that the domestic U.S. benefit share of the global benefits should be reported.[218] Our concern is broader for several reasons. Given the information that is currently available, it is not feasible to undertake damages calculations that reflect the preferences of each country because we lack the requisite information on each country. When countries are similarly situated, it may be feasible to undertake such analyses by group, as we did in Part VI. Going forward, government agencies should refine the type of analysis that we presented here. Country-specific estimates also are pertinent from the standpoint of determining the international equity of climate change policies; the incentives of each country to control GHG emissions; the political support for climate change policies; and the degree to which there may be a conflict between environmental statutes in a given country and the relative emphasis that should be placed on global and domestic impacts.

---

218. *See* Gayer & Viscusi, *supra* note 140, at 261.

E. Subsidize Countries that Have a Low Share of Domestic Benefits

A properly calculated global SC-GHG provides the yardstick for determining the degree to which policies in every country should control GHG emissions in order to yield the efficient level of GHG policies for the world. Even countries with very limited economic resources could use the global SC-GHG as a guide for setting policy stringency, as doing so will be in line with the controls needed for global control of GHG emissions. However, the global number is not reflective of how much each country benefits from the climate change policies that it implements, even assuming that the country's control measures induce some type of reciprocity from other countries. By definition, no country receives the entire benefit from the global benefit calculation, as that figure includes the benefits to all countries. However, by adopting our six principles, it will be possible to assess which countries derive a disproportionately small share of the benefits. The incentives in these countries to undertake climate change policies for which there is little domestic benefit is likely very modest. In situations where there is a pronounced gap in the degree to which countries reap the benefits of climate change policies, subsidies should be provided to better enable the undertaking of GHG reduction policies that will provide domestic and global benefits.

F. Allow for Representation of Future Generations in Present Environmental Litigation

Courts should expand standing to include an appointed representative of future interests for cases centered on long-term environmental harms. Allowing for the recognition of future interests in present climate change litigation would serve to increase intergenerational equity. The public trust doctrine and the doctrine of waste from property law provide a blueprint for existing legal limitations on property rights that could be invoked and expounded upon to account for the interests of future generations.

Applying these six principles will ensure that the well-being of future generations is fully recognized in policy design. Implementing these principles will lead to an overhaul of the current regulatory analysis approach. Current procedures understate the mortality costs included in the global SC-GHG, fail to indicate the degree to which the United States benefits from these policies, and embody too much of a U.S.-centric approach to the weighting of future impacts, rather than fully recognizing the intertemporal preferences of those throughout the world.

Although the provision of country-specific information, as well as global assessments of the overall SC-GHG, might be viewed as diminishing the impetus for aggressive climate change policies, the provision of country-specific information on benefits will serve to highlight the international inequities in the degrees to which different countries benefit from GHG reductions. This information, in turn, can provide the basis for establishing a framework for subsidizing low-income countries—that would not otherwise have the resources or the incentive to undertake such efforts—to undertake GHG controls.

CONCLUSION

The ability to accurately monetize the costs and benefits of regulations is a critical component of analyses for major regulations promulgated by federal agencies. In the context of ameliorative environmental policies, the SC-GHG—of which mortality costs comprise the primary component—sets the monetary price for the global value of GHG emissions. As a result, the SC-GHG may vary greatly depending on the temporal and geographic context under consideration in the valuation of climatic risks to future lives. The intertemporal aspect becomes particularly pronounced when considering very remote time periods—such as those involved in the modeling of climate futures. Additionally, although analysis of costs is usually limited to domestic costs, the global nature of climate change necessitates consideration of the international dimension of impacts.

We propose six interrelated principles to ensure proper recognition of the impacts of environmental policies throughout the world both now and in the future based on the assessments of the preferences of those who are directly affected. First, environmental regulatory impact analyses should account for future populations. Further, these analyses should rely on benefit values and discount rates that reflect country-specific preferences. Analyses relying on the SC-GHG should report country-specific estimates in addition to an aggregate, global number, and, relying on country-specific estimates, countries with a low share of domestic benefits of GHG reductions should be subsidized to better enable them to undertake ameliorative climate policies. Finally, courts should expand standing in cases involving environmental harms to allow for a representative of future generations, which will serve to promote intergenerational environmental equity. As the above empirical analysis demonstrates, applying these six principles will better promote intergenerational and international equity in combatting climate change, as compared to current regulatory policy.

***