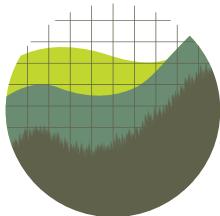


Strategically Estimating Climate Pollution Costs in a Global Environment



Institute for
Policy Integrity

NEW YORK UNIVERSITY SCHOOL OF LAW

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This report does not necessarily reflect the views of NYU School of Law, if any.

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Executive Summary

Federal agencies need to pick estimates of social cost of greenhouse gases that best promote the interests and fulfill the responsibilities of the United States. But debate has reemerged about whether federal agencies' policy analyses should focus on those climate pollution costs that will occur only within U.S. borders, rather than on the full global valuation of climate damages.

The Interagency Working Group on the Social Cost of Greenhouse Gases (Working Group) provides compelling justifications to focus on global estimates. To begin, to avoid the multiple tragedies of the commons created by greenhouse gas emissions—global climate change, but also ocean acidification and globalized health and welfare effects from methane and other pollutants—all countries must adopt policies that internalize the global externalities of their emissions.

Because it will advance U.S. interests for all countries to internalize the global externalities of their emissions, it is strategically the best choice for the United States to apply global estimates of the social cost of greenhouse gases and so encourage reciprocal foreign actions. Practical reasons confirm why it is appropriate to adopt global estimates, including because there is currently no defensible methodology to calculate a domestic-only estimate that fully accounts for important international spillover effects and extra-territorial interests—and it would be arbitrary and illegal to ignore such important factors. The Working Group states these rationales clearly.

Some federal courts have upheld use of the global values as “appropriate” or “the best” estimate, and one federal court struck down a prior attempt to calculate a “domestic-only” value for arbitrarily ignoring spillovers and reciprocal actions that would affect U.S. interests. Adopting a global perspective in analyses also has precedents in prior agency actions.

Nevertheless, at least one federal judge questioned why a domestic-only estimate is not possible, and lawsuits continue to challenge reliance on the global values. **To minimize legal risk, the Working Group should bolster its defense of the global values with additional support.** In particular, the Working Group should explicitly explain why reciprocity can by itself justify the full global values. The Working Group should cite evidence of foreign countries reciprocally adopting global values and climate policies that benefit the United States. Additional strategic considerations, including the potential for informational spillovers to benefit the United States, buttresses this conclusion.

The Working Group should also expand its discussion of spillover effects, to cover transboundary resources and feedback loops, and to explicitly make the case why spillover effects also justify a focus on the full global values, either independently or in combination with strategic and ethical considerations. The Working Group should add to its list of extra-territorial interests the valuable military installations abroad and U.S. citizens' and residents' willingness to pay to protect their foreign relatives as well as cultural, religious, and natural sites abroad. The Working Group should add that it would be arbitrarily inconsistent for agencies to try to separate or ignore non-U.S. climate costs when agencies do not separate

or ignore the portion of compliance costs and other effects that ultimately accrue to foreign entities through investments and ownership in corporations affected by U.S. policies.

The Working Group should also add legal justifications and recommend that agencies incorporate both legal and economic justifications for the global values in their individual proceedings. In particular, statutes that reference “public welfare” or “the needs of the United States” can be read as consistent with the global values, because of the strategic, economic, security, and ethical interests involved. **The National Environmental Policy Act’s requirement to interpret and administer all U.S. laws in light of the “worldwide character of environmental problems” supports this approach.** The Working Group should also explain how the legal standards for arbitrary and capricious review require consideration of various key factors that a non-global estimate would arbitrarily omit from consideration.

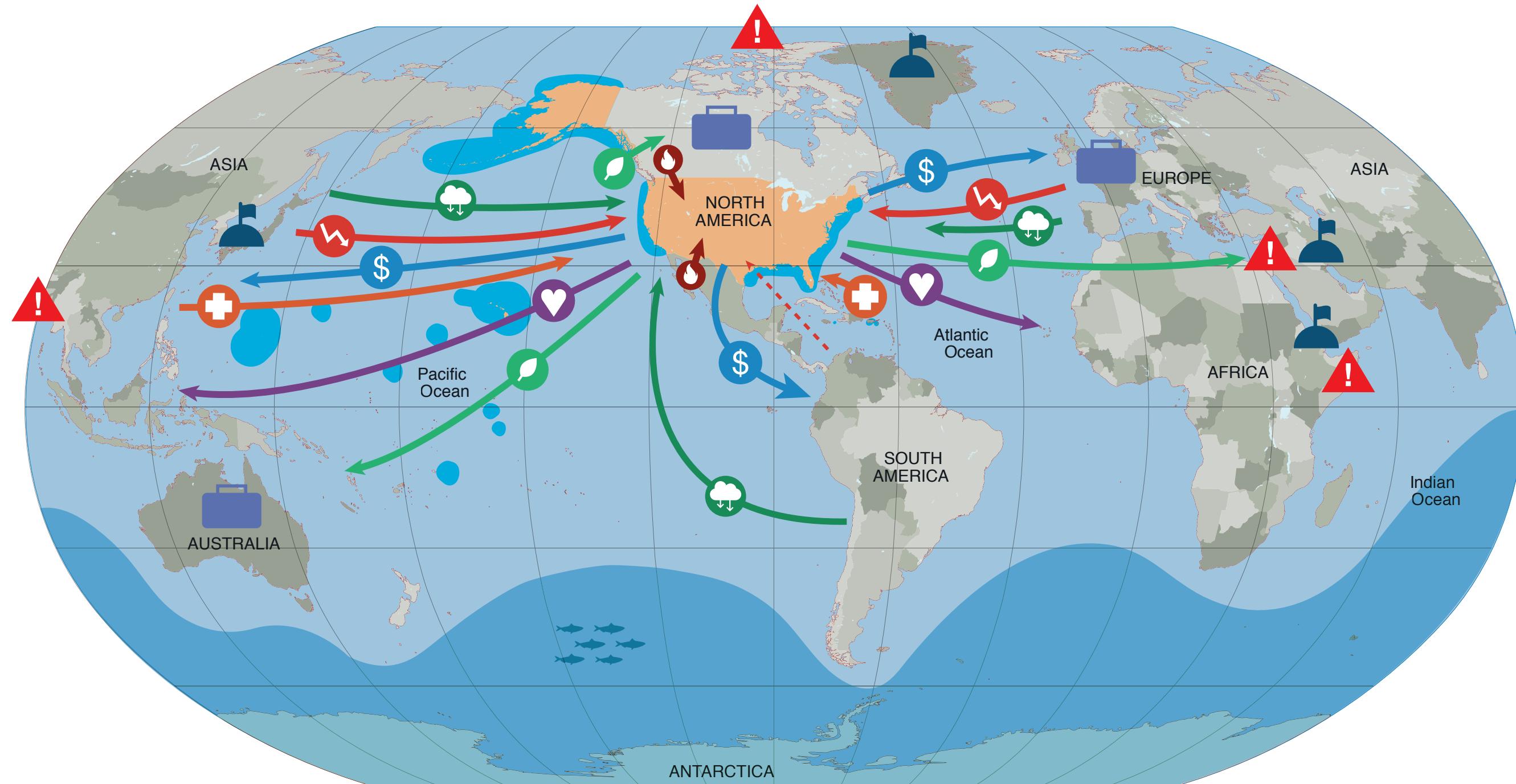
Even as federal agencies stay focused on the global estimates of the social cost of greenhouse gases, the Working Group should consider developing more robust estimates of the reciprocal benefits of foreign actions, international spillovers to the United States, impacts to extra-territorial U.S. interests, and the willingness of U.S. citizens to pay to protect foreign people, locations, and ecosystems. **Estimates of impacts to U.S. interests both can improve the accuracy and completeness of the global estimates, and also can be incorporated when appropriate into agencies’ sensitivity analyses as domestic estimates that may help safeguard against legal or political risks from relying exclusively on the global estimates.**

The Working Group should first disavow as flawed and incomplete any prior suggestions on calculating a domestically-oriented value as 7-23% of the global values. Instead, the Working Group should recommend a new domestic valuation of the social cost of greenhouse gases, as a lower-bound estimate for use in sensitivity analysis. The Working Group should be clear that agencies should focus on the global values in their main analyses to best promote U.S. interests and fulfill U.S. responsibilities. The domestic valuations will reflect the *lower-bound* estimates of the minimum factors that U.S. agencies must evaluate so as not to arbitrarily and illegally omit consideration foreign reciprocity, international spillovers, and extra-territorial interests. The Working Group should make clear that the domestic values are optional and may be used, if appropriate, only in sensitivity analyses.

Based on available evidence—including estimates of the Climate Reciprocity Ratio showing foreign countries pledge to reduce over 6 tons of emissions for every ton pledged by the United States; Matthew Kotchen’s calculation of the U.S. “preferred” social cost of greenhouse gases at nearly three-fourth the global values based just on basic strategic interests (without yet considering spillovers or other important factors); the scale of impacts to hundreds of billions of dollars annually in U.S. exports and imports; the risks to U.S. security interests and military installations abroad with replacement costs in the hundreds of billions of dollars; the U.S. willingness to pay hundreds of billions of dollars annually in remittances, foreign investments, foreign aid, and private philanthropy to benefit foreign countries; evidence from the recent pandemic on the impacts to U.S. interests from a global disruption; and other significant effects to U.S. interests that cannot be quantified or monetized—the Working Group should consider recommending a domestic valuation of at least 75% or more of the global values for optional use as

a lower-bound estimate in sensitivity analysis. Bearing in mind both that the global estimate itself is likely an underestimate (due to omitted damages), and also that the scientific and economic understanding of inter-regional impacts is still developing, the Working Group should clarify that such domestic estimates remain provisional lower-bounds and may underestimate even the minimum strategic value to U.S. interests of addressing global climate change.

Examples of Key Impacts to U.S. Interests from Climate Effects Beyond U.S. Borders



U.S. Interests Beyond the Coastline

- U.S. Exclusive Economic Zones (EEZ)
- Global Commons
- U.S. Military Bases Abroad
- U.S. Citizens Living Abroad
- U.S. Investments & Assets Abroad
- Altruism & Humanitarian Interests
- Migratory Species

Foreign Reciprocity

- Reciprocal Climate Policies
- Influence on Climate Pollution Valuations

Spillover Effects

- Transborder Resource Impacts
- Migration
- Economic Spillovers
- Health Risks
- Security Interests

I. Background

From its first preliminary estimates offered in 2009 until its temporary disbandment beginning in 2017, the Interagency Working Group on the Social Cost of Greenhouse Gases (“Working Group”) consistently advised agencies to focus on a global valuation of the costs of climate pollution.¹ Its reasons were simple and compelling:

- Greenhouse gases cause a global externality, and other countries’ emissions reductions benefit the United States.
- The United States must help spur an international solution to climate change, and using the global values of climate damages will signal a commitment to a cooperative international approach that ultimately benefits the United States.
- Adverse climate impacts abroad will also cause significant spillover damages to the U.S. economy, public health, and national security, but estimates of damages strictly within U.S. borders would exclude these important factors.²

In 2016, a federal court of appeals upheld that focus on global estimates as appropriate.³ In January 2017, the National Academies of Sciences completed its review of the Working Group’s methodology and confirmed the good reasons to focus on a global estimate, including “to leverage reciprocal measures by other countries,” and because existing methodologies are too “limited in practice” to accurately and completely separate out climate damages that occur exclusively to the United States alone.⁴

In March 2017, President Trump disbanded the Working Group and advised agencies to reconsider “domestic versus international impacts” when monetizing the value of changes in greenhouse gas emissions.⁵ Agencies quickly interpreted those instructions as a command to measure only “climate change impacts that occur within U.S. borders.”⁶ Beginning in 2017, federal agencies decimated the estimates of climate pollution costs that they would consider in their main analyses, calculating them at a 3% discount rate to be as low as \$6.61 per ton of carbon dioxide,⁷ \$189.88 per ton of methane,⁸ and \$2312.63 per ton of nitrous oxide⁹ for year 2020 emissions (the numbers here have been adjusted to 2020\$; note that the agencies also presented even lower values calculated at an unreasonably high discount rate of 7%¹⁰). Those values are all less than 13% of the global values calculated by the Working Group. In 2020, a federal district court held that this “domestic-only” approach had irrationally disregarded the best available science and economics, was “riddled with flaws,” and arbitrarily ignored important factors like international spillover effects and U.S. financial assets, military assets, and citizens located abroad.¹¹

Table: “Interim Domestic-Only” Values vs. the Working Group’s 2016 Central, Global Values
 (calculated at the 3% discount rate for year 2020 emissions; adjusted to 2020\$ and rounded)¹²

	Social Cost of Carbon Dioxide	Social Cost of Methane	Social Cost of Nitrous Oxide
“Interim Domestic-Only” Values	\$7/ton	\$190/ton	\$2313/ton
Working Group’s 2016 Central, Global Values	\$51/ton	\$1500/ton	\$18,000/ton

In February 2021, the reconstituted Working Group restored the estimates of the global values and advised federal agencies to once again “center on a global measure” in their analyses.¹³ The Working Group readopted and elaborated on its previous compelling rationales, adding that new evidence and models of international reciprocity support the strategic use of the global values; that impacts to U.S. interests extend beyond the impacts occurring just within U.S. borders, such as the trillions of dollars in U.S. direct investment abroad, trillions more in imports and exports, and millions of U.S. citizens living abroad; and that as an empirical matter, there are very few region-specific estimates in the literature, and all of them ignore international spillovers and reciprocity and so are incomplete.¹⁴

Section II of this report builds on the Working Group’s explanations by providing additional justifications to focus on the full global estimates of climate pollution costs, and offers advice on how to bolster the defense of the global values to protect against legal risks. Section III critiques prior attempts to calculate a domestic-only valuation. Section IV then considers the reasons why—even as agencies remain focused on the global estimates—the Working Group should pursue research to develop robust estimates of the specific benefits to the United States from reciprocal foreign actions, international spillovers to the United States, impacts to extra-territorial U.S. interests, and the willingness of U.S. citizens to pay to protect foreign people and ecosystems. Section IV concludes with recommendations on how a robust estimate of a domestic value of the social cost of greenhouse gases could be used in agencies’ sensitivity analyses.

II. Agencies Should Focus on Global Estimates of Climate Pollution Costs

This section reaffirms the Working Group’s key conclusion: because federal agencies should use estimates of the social cost of greenhouse gases that will promote the interests and fulfill the responsibilities of the United States, agencies should focus on global estimates.¹⁵ To avoid a global tragedy of the commons that could irreparably damage all countries—including the United States—it is necessary for all countries to adopt policies that internalize the global externalities caused by every ton of greenhouse gas emissions.

This section elaborates on several of the rationales already explored by the Working Group and provides additional justifications for focusing on global estimates. To begin, because it will advance U.S. interests for all countries to internalize the global externalities of their emissions, it is strategically the best choice

for the United States to apply global estimates of the social cost of greenhouse gases. This section compiles the available evidence and theoretical bases for why it is strategically rational for the United States to apply the full global estimates of the social cost of greenhouse gases.

This section next explores the practical reasons why it is appropriate to adopt global estimates, including because there is currently no defensible methodology to calculate a domestic-only estimate that accounts for important international spillover effects and extra-territorial interests. Such omissions and other practical considerations provide an independent justification to apply the full global estimates of the social cost of greenhouse gases—and certainly, in combination with strategic interests, such considerations justify the global values.¹⁶ Additional ethical considerations provide supplemental support, and together all these factors create a secure defense for focusing on the global values.

Indeed, application of the global values is at least in some contexts likely legally required, and in all contexts is legally permissible. And because any attempt to calculate a domestic-only estimate that does not account for U.S. strategic interests, international spillovers, and extra-territorial interests would arbitrarily ignore important factors that federal agencies have a responsibility to consider, global values are legally preferred as well. Nevertheless, because the risk of litigation remains, the Working Group and agencies should further bolster their defense of the global values.

II.A. The Global Values Are Necessary to Avoid a Tragedy of the Commons

To avoid a global “tragedy of the commons” that could irreparably damage all countries, including the United States, every nation must adopt policies that internalize the global externalities caused by their greenhouse gas emissions.¹⁷ A stable climate and clean air are global common resources, meaning they are freely available to all countries, but any one country’s use of those resources—i.e., greenhouse gas and black carbon emissions—imposes harms on the polluting country as well as the rest of the world. Because greenhouse gas pollution does not stay within geographic borders but rather mixes in the atmosphere and affects climate worldwide, each ton emitted by the United States not only creates domestic harms, but also imposes large externalities on the rest of the world. Conversely, each ton of greenhouse gases abated in another country benefits the United States along with the rest of the world.

Besides the tragedy of the global *climate commons*, greenhouse gases also cause other globalized damages. In particular, carbon dioxide causes global ocean acidification;¹⁸ methane has direct and globalized health and welfare effects through production of tropospheric ozone, including significant mortality impacts;¹⁹ and nitrous oxide can affect stratospheric ozone and other atmospheric chemistry in ways that threaten human health on a global level.²⁰ These effects are currently omitted from the calculation of the social cost of greenhouse gases due to limitations in the models. But as the peer-reviewed literature develops and monetization of these impacts becomes increasingly possible and accepted,²¹ it will be important for all countries to internalize these quantified global externalities as well, or else countries will continue to inflict an inefficiently high level of ocean acidification and public health damages on each other.

If all countries set policies that addressed only their own contribution to climate damages within their own borders, ignoring the large global externalities, the aggregate result would be substantially sub-optimal protections and significantly increased risks of severe harms to all nations, including the United States. Thus, basic

economic principles demonstrate that the United States stands to benefit greatly if all countries apply global social cost of greenhouse gas values in their regulatory decisions and project reviews.²² Indeed, the United States likely stands to gain trillions of dollars in direct benefits from efficient foreign action on climate change.²³

"To solve the unprecedented global commons problem posed by climate change, all nations must internalize the global externalities of their emissions[.] . . . [O]therwise, collective abatement efforts will never achieve an efficient, stable climate outcome."

*— Nobel Laureate Kenneth Arrow
and co-authors (2017)²⁴*

Some commentators have questioned whether the global commons problems provide sufficient justification for U.S. agencies to “giv[e] full standing to foreigners in domestic environmental benefit-cost analyses” by adopting the global social cost of greenhouse gases.²⁵ As support for their skeptical stance, they first claim that agencies have “not previously” given full consideration to the costs and benefits to citizens of other countries.²⁶ Yet not only have agencies in fact considered international impacts before—from, for example, mercury emissions,²⁷ particulate and ozone emissions,²⁸ transportation safety,²⁹ and space debris³⁰—but the scale and magnitude of the threat of global climate change presents a unique policy context. Past precedents should not prevent federal agencies from making the most appropriate choice now. Moreover, this objection does not consider the strategic interests of the United States in adopting global values to spur beneficial reciprocal actions by foreign countries—as explored next.

II.B. The Strategically Best Choice Is Adopting the Global Values

Because the world’s climate is a single interconnected system, the United States benefits greatly when foreign countries consider the global externalities of their greenhouse gas pollution and cut emissions accordingly. It therefore promotes the strategic interests of the United States to encourage all other countries to think globally in setting their climate policies. The United States can advance this objective by itself adopting the full global social cost of greenhouse gases—as numerous leading climate economists and experts have explained.³¹

The United States is engaged in a repeated strategic dynamic of internationally coordinated efforts to address climate change.³³ Several significant players in these negotiations—including the United Kingdom, Germany, the European Union, Sweden, Norway, and others—have already adopted carbon taxes, climate policies, or cost-benefit metrics that either explicitly or implicitly reflect a global valuation

of climate damages.³⁴ Many of these countries' values are in fact much higher than the Working Group's current global estimates.³⁵ Some countries, like Canada³⁶ and Israel,³⁷ have explicitly adapted the Working Group's methodology and so adopted a global framework; other jurisdictions and players—including Mexico,³⁸ India's National Green Tribunal,³⁹ the Australian Capital Territory,⁴⁰ New Zealand,⁴¹ the International Monetary Fund,⁴² and the Asian Development Bank⁴³—have also taken note of the Working Group's global estimates when developing their own estimates.

Given these current dynamics, the best strategic move for the United States is to adopt the full global social cost of greenhouse gas estimates and apply them broadly across the federal government's full range of decisionmaking and policymaking contexts.⁴⁴ For example, under a variety of conditions for repeat, dynamic negotiations, a tit-for-tat strategy can be very robust.⁴⁵ To implement such a strategy, the United States should continue to match key partners in adopting a global framework for valuing climate damages and should push additional foreign jurisdictions to follow suit. Any prolonged, persistent departure⁴⁶ by the United States from the global framework risks incentivizing all currently cooperating countries to similarly defect toward a self-interested approach and disincentivizing additional countries from strengthening their policies—all of which would cause the United States harm as other countries curtail their mitigation efforts.⁴⁷

"[T]he United States may choose to use a global [social cost of carbon] in order to leverage reciprocal measures by other countries."

— *National Academies of Sciences (2017)*³²

Other economic models counsel for a similar strategy. In a coordination model, unilateral action by one country can increase the incentives for other countries to act, and good faith signals can build credibility and trust that induce cooperation; using the global social cost estimates can provide such a good faith signal.⁴⁸ Similarly, evidence suggests that coalition-building strategies may be more successful if nations' initial commitments are closer to the optimal emissions reduction pathway and not mere half-measures.⁴⁹ The more the United States cares about the future, the more willing the United States should be to take a long-term view of climate negotiations and adopt policies now—like use of the global social cost of greenhouse gases—that will help move the world toward the optimal pathway in the long run.⁵⁰ The prospective introduction by some countries of carbon tariffs,⁵¹ and the attendant potential of a more binding international framework, could further motivate the United States to focus on global social cost estimates.⁵² Finally, international negotiators may balance fairness against pure self-interest, and an offer perceived as unfair may be rejected out of hand; counting the full global social cost of greenhouse gases in agencies' analyses may improve the U.S. reputation for fairness, thus building the trust and credibility essential to secure reciprocal actions from developing countries.⁵³

Another way the United States can benefit from the actions of foreign countries is through informational spillovers. As the largest economy, if the United States sets strong climate policies based on the global values, the result will be a major push for research and technology to lower abatement costs; learning-by-doing will further lower abatement costs. The information generated will then spill over to other countries, both naturally through the marketplace and also as a result of international technology transfer pledges, thereby lowering the abatement costs for other countries. Indeed, because information is a positive externality and private firms cannot entirely capture all the benefits of their research and learning efforts, without a strong government commitment to action the market will tend to underinvest in research and development. By setting strong climate policies based on the global values of the social cost of greenhouse gases, the United States can encourage a more socially optimal level of research into technologies and techniques that can lower abatement costs around the globe.

With lower costs, other countries can pursue even greater emissions reductions, which will benefit the United States. Similarly, the foreign reciprocal actions spurred by U.S. commitments and the U.S. application of the global values will also prompt research, technological development, and learning in other countries. That information can also spill back and help lower abatement costs in the United States. These additional strategic considerations further justify the federal government's focus on the global values.

The Biden Administration has clearly made these precise kinds of strategic choices, to adopt a global valuation of climate damages as part of its diplomatic strategy. Executive Order 13,990 unequivocally states that “[i]t is essential that agencies capture the full costs of greenhouse gas emissions as accurately as possible, including by taking global damages into account . . . [to] support the international leadership of the United States on climate issues.”⁵⁴ The Order later elaborates:

Our domestic efforts must go hand in hand with U.S. diplomatic engagement. Because most greenhouse gas emissions originate beyond our borders, such engagement is more necessary and urgent than ever. The United States must be in a position to exercise vigorous climate leadership in order to achieve a significant increase in global climate action and put the world on a sustainable climate pathway.⁵⁵

The same sentiment has been echoed by the State Department during summits and negotiations with world leaders.⁵⁶ And there is already some recent evidence that the U.S. strategy of combining its domestic efforts—including the global valuation of climate damages—with its diplomatic engagement is spurring additional reciprocity.

During the April 2021 “Leaders Summit on Climate” hosted by the United States, following the announcement of a new U.S. commitment to reduce emissions to 50-52% below 2005 levels by 2030, multiple other countries reciprocally increased the ambition of their own climate targets. Notably, Japan accelerated its reduction goal from 26% to 46-50%; Canada strengthened its target from 30% to 40-45%; the European Union set a target of at least 55%; the United Kingdom set a new target for the year 2035; South Korea strengthened its target to achieve net zero emissions by 2050; China promised to peak coal

use by 2025 and phase down coal consumption after that, and to join the Kigali Amendment to reduce hydrofluorocarbon emissions; Argentina pledged to strengthen its goal by 2.7% and make previously “conditional” targets “unconditional” instead; Brazil committed to a net zero target by 2050 (ten years earlier than its previous 2060 goal) and pledged to end illegal deforestation by 2030; South Africa shifted its emission peak ten years earlier, to 2025; and New Zealand, Bhutan, and Bangladesh all committed to submit more ambitious plans in the near future.⁵⁷

This flurry of activity is just the latest evidence of reciprocity in international climate actions. Some past reciprocity has been explicit. The Kigali Amendment, for example, is the latest internationally negotiated climate treaty, with 120 parties so far committing to common but differentiated responsibilities to phase down hydrofluorocarbons.⁵⁸ Previously, under the Copenhagen Accord and the Paris Agreement, some parties, including the European Union and Mexico, have at times explicitly made conditional pledges, promising to ratchet up their efforts if other countries make comparable reductions.⁵⁹ Other reciprocity has been more implicit.⁶⁰ For example, following the proposal of the Clean Power Plan in 2014, the United States negotiated a bilateral agreement on climate with China,⁶¹ which in turn has been credited with prompting increased commitments from the European Union and Mexico.⁶² By contrast, when the United States “failed to take action to reduce greenhouse gas emissions during the George W. Bush Administration and during . . . the Trump Administration,” as economist Michael Greenstone has testified before the U.S. House of Representatives, “both periods were characterized by little [international] progress, and indeed many instances of backsliding, in reducing emissions globally.”⁶³

In January 2021, Trevor Houser and Kate Larsen published a conservative estimate of the number of tons of greenhouse gases that the rest of the world has committed to reduce for each ton that the United States has pledged to reduce: a figure they call the “Climate Reciprocity Ratio.”⁶⁴ Using only the quantifiable, unconditional pledges that 51 countries have made since 2014 to cut emissions through 2030, Houser and Larsen conservatively estimate that for every ton the United States pledged to reduce, these other countries have pledged 6.1-6.8 tons in return.⁶⁵ While implementation of all these foreign policies is not guaranteed, Houser and Larsen cite evidence that several large emitters are on track to meet their goals, and they also observe that the ratio should grow over time as the U.S. share of global emissions falls.⁶⁶ (Note also that policies adopted by foreign countries before 2014 likely have already delivered hundreds of billions or trillions of dollars in benefits to the United States.⁶⁷) Houser and Larsen therefore recommend that any “domestic-only” calculation of the social cost of greenhouse gases should be multiplied by at least 6.1 times—a multiplication that would justify focus on the full global social cost of greenhouse gases.⁶⁸

Section IV discusses further this work and other efforts to estimate the benefits to the United States of reciprocal foreign actions. But overall, current evidence and economic models strongly support a strategic choice for U.S. agencies to adopt the full global estimates of the social cost of greenhouse gases. The evidence for reciprocity should of course be periodically reviewed.⁶⁹ Yet unless every other nation permanently abandons all efforts to address climate change, it would be arbitrary for U.S. agencies to

wholly ignore the benefits of reciprocal foreign actions when estimating the costs of domestic climate pollution.

II.C. Practical Considerations Make the Global Values the Best Choice—Including as a Proxy for International Spillovers

In addition to strategic reciprocity, several practical considerations necessitate a focus on the global values. First, the United States is inextricably linked internationally through complex patterns of trade, migration, public health, and security threats. Through these links, climate damages occurring in other parts of the world will inevitably spill back and harm U.S. interests. While the current models for estimating the social cost of greenhouse gases do not fully capture these significant inter-regional spillover effects, the global values can serve as a proxy to reflect these and other omitted categories of damage. Similarly, the United States has significant extra-territorial interests extending far beyond its borders, including U.S. citizens, assets, and military installations located abroad. The global values also serve partially as a proxy for these interests, which otherwise would be omitted from the estimates. Third, because agencies' analyses neither separate out nor ignore the share that foreign citizens or foreign entities may bear—due to their ownership and investments in corporations affected by U.S. policies—of total compliance costs, cost-savings, or other effects, it would be inconsistent to attempt to separate out or ignore any climate effects to foreign citizens caused by U.S. policy choices.

II.C.1. The Global Values Serve as a Practical Proxy for International Spillovers

Significant costs to trade, human health, and security will inevitably “spill over” to the United States as other regions of the planet experience climate change damages.⁷⁰ Due to its unique place among countries—both as the largest economy with trade- and investment-dependent links throughout the world, and as a military superpower—the United States is particularly vulnerable to effects that will spill over from other regions of the world.

While the current reduced-form integrated assessment models (“IAMs”) provide reliable (but very conservative) estimates of global damages, they cannot calculate reliable region-specific estimates, in part

because they do not model such spillovers. Yet a multiplicity of substantial spillover effects has already begun and will undeniably continue to occur.⁷¹ In terms of trade-related impacts, as climate change disrupts the economies of other countries, decreased availability of imported inputs, intermediary

“[C]limate change, variability, and extreme events outside the United States are [already] affecting and are virtually certain to increasingly affect U.S. trade and economy.”

— *Fourth National Climate Assessment (2018)*⁷⁴

goods, and consumption goods will cause supply shocks to the U.S. economy. Shocks to the supply of energy, technological, and agricultural goods could be especially damaging. Similarly, the U.S. economy will experience demand shocks as climate-affected countries decrease their demand for U.S. goods. U.S. trade and businesses that rely on foreign-owned infrastructure, services, and resources will suffer.⁷² Financial markets will also suffer as foreign countries become less able to loan money to the United States and as the value of U.S. firms declines with shrinking foreign profits. As seen historically, economic disruptions in one country can cause financial crises that reverberate globally at a breakneck pace.⁷³

The human dimension of climate spillovers includes migration and health effects. Water and food scarcity, flooding or extreme weather events, violent conflicts, economic collapses, and a number of other climate damages could precipitate mass migration to the United States from regions worldwide, especially, perhaps, from Latin America. Infectious disease could also spill across the U.S. borders, exacerbated by ecological collapses, the breakdown of public infrastructure in poorer nations, declining resources available for prevention, shifting habitats for disease vectors, and mass migration.

Climate change is also predicted to exacerbate existing security threats—and possibly catalyze new security threats—to the United States.⁷⁵ Besides threats to U.S. military installations and operations at home and abroad from flooding, storms, extreme heat, and wildfires,⁷⁶ climate change is also a “source[] of conflict around the world”⁷⁷ and a “threat multiplier” that, as recognized by the Department of Defense, will “aggravate stressors abroad such as poverty, environmental degradation, political instability, and social tensions—conditions that can enable terrorist activity and other forms of violence.”⁷⁸ Climate change will create and exacerbate new conflicts and humanitarian crises that will require a U.S. response, even as climate change also greatly complicates the logistics of deploying forces and achieving missions.

Climate change will also very directly cause spillover damages across transboundary resources. The United States has already begun to experience increased smoke from Canadian wildfires and drought conditions that spread along the U.S.-Mexico border.⁷⁹ The United States shares a maritime border with 21 other countries, shares water resources like the Columbia River with our neighbors, and shares ecosystems—including the oceans through which migratory species with high economic and ecosystem-service values, like the Pacific hake, travel and live.⁸⁰

Finally, all of these individual spillover effects can interact and trigger feedback loops that will propagate additional spillover damages.⁸¹ Economic shocks around the world can make it more difficult for other countries to continue investing in mitigation and abatement, thus hastening the pace of climate change.⁸² Conflict and political instability caused by climate change can further reduce the willingness or ability of countries to engage in domestic climate policy or international cooperation.⁸³ Spillover effects can chain together: if climate change accelerates migration, the attendant economic ripple effects and spread of health risks may cause political instability, which in turn can cause more migration and further economic ripple effects, thus starting the feedback loop again.⁸⁴

Some experts on the social cost of greenhouse gases have therefore concluded that, because the integrated assessment models currently do not capture many of these key inter-regional costs, use of the global values can be further justified as a proxy for capturing all spillover effects.⁸⁶ Though not all climate damages will spill back to affect the United States, many will, and together with other justifications, the likelihood of significant spillovers makes a global valuation the better, more transparent accounting of the full range of costs and benefits that matter to U.S. policymakers and the public.

"Significant spill-over effects . . . must be considered . . . [The agency] did not consider these spill-over effects. . . . For all these reasons, the Court finds [the agency's] use of the interim domestic measure to be arbitrary."

— *U.S. District Judge Yvonne Gonzalez Rogers (2020)*⁸⁵

Section IV provides more specific examples of spillover effects and suggests ways that the vulnerability of the United States to foreign climate effects could be more concretely monetized with additional research. Meanwhile, it is arbitrary to ignore spillover effects, and so focus on the global values can be further supported as a proxy for capturing international spillovers that harm U.S. interests.

II.C.2. The Global Values Serve as a Practical Proxy for Extra-Territorial Interests

A domestic-only estimate based on some rigid conception of geographic borders or U.S. share of world GDP will fail to capture all the climate-related costs and benefits that matter to U.S. citizens, including impacts to significant U.S. ownership interests in foreign businesses, properties, and other assets, as well as U.S. consumption abroad including tourism,⁸⁷ and even effects to the 9 million Americans living abroad.⁸⁸ The United States also has military personnel and assets located in almost every nation across the globe, and many if not all installations abroad—including those with high replacement costs or irreplaceable strategic value—face imminent climate risks.⁸⁹ Because no methodology for estimating a “domestic-only” value would capture these impacts to extra-territorial interests, focusing on the global values can be further justified in part as a proxy for these important considerations.

The Office of Management and Budget’s *Circular A-4* guidance on conducting regulatory impact analysis requires agencies to count all significant costs and benefits, including “use” values as well as “non-use” values like bequest and existence values.⁹¹ *Circular A-4* cautions that “ignoring these values” may cause analyses to “significantly underestimate the benefits and/or costs” involved.⁹² Similarly, *Circular A-4* recognizes that U.S. citizens may have “altruism for the health and welfare of others,” and instructs agencies that when “there is evidence of selective altruism, it needs to be considered specifically in both benefits and costs.”⁹³ U.S. citizens will experience costs because of their use values, non-use values, and altruistic values attached to climate effects occurring outside the U.S. borders.

The United States and its citizens have a willingness to pay—as well as a legal obligation—to protect the global commons of the oceans and Antarctica from climate damages. For example, the Madrid Protocol on Environmental Protection to the Antarctic Treaty commits the United States and other parties to the “comprehensive protection of the Antarctic environment,” including “regular and effective monitoring” of “effects of activities carried on both within and outside the Antarctic Treaty area on the Antarctic environment.”⁹⁴ The share of climate damages for which the United States is responsible is not limited to our geographic borders.

U.S. military forces are present in almost every nation across the globe, and operate from nearly 562,000 facilities on 4,800 sites worldwide and covering 24.9 million acres.⁹⁰

A quarter of the U.S. population consists of either foreign-born immigrants or second-generation residents,⁹⁵ and subsequent generations of Americans retain significant familial, cultural, economic, and religious ties to their ancestors’ home nations across the world. Over \$100 billion is sent from the United States to other countries in remittances every year.⁹⁶ U.S. citizens and residents have a significant willingness to pay to protect their relatives, ancestral homes, and cultural and religious sites located abroad.⁹⁷

Similarly, U.S. citizens value natural resources and plant and animal lives abroad, even if they never use those resources or see those plants or animals. Though the methodologies for calculating existence value remain controversial,⁹⁸ U.S. citizens certainly have a non-zero willingness to pay to protect rainforests, charismatic megafauna like pandas, koalas, tigers, lions, ibex, penguins, and other life and environments existing in foreign countries. U.S. citizens also have an altruistic willingness to pay to protect the health and welfare of unrelated foreign citizens⁹⁹ and cultural and world heritage sites threatened by climate change.¹⁰⁰ This altruism is “selective altruism,” consistent with *Circular A-4*, because the United States is directly responsible for a huge amount of the historic emissions contributing to climate change,¹⁰¹ and so U.S. citizens will likely have a greater altruistic concern for those suffering from climate change (relative to any altruistic concern they may have for those who will bear the costs of reducing emissions).¹⁰²

Both strategic considerations and the need to account for spillovers already provide independent justifications for focusing on the full global social cost of greenhouse gas estimates. But the global values can also be at least partly justified as a proxy for these extra-territorial interests that otherwise would be overlooked, including U.S. investments, military assets, and citizens located abroad; consumption and tourism abroad; responsibilities for the global commons; and non-use values in foreign resources, including existence values.

II.C.3. Agencies Cannot Ignore Global Climate Effects If They Count Other Global Effects

In many rulemakings, project approvals, and other decisionmaking processes, agency analyses of compliance costs, cost savings, or other effects to industry implicitly—but routinely and fully—count

effects that ultimately accrue to foreign entities. All industry compliance costs, for example, inevitably fall on some combination of the owners, employees, and customers of the regulated and affected firms. In many agency analyses—perhaps especially in those proceeding where climate effects are at stake and the social cost of greenhouse gas estimates are applied—many of the affected firms will be public companies that have significant foreign ownership of stock and corporate debt.

Foreign investors collectively have a significant stake in U.S. corporations. About 29% of U.S. corporate debt and 14% of equities are foreign-owned,¹⁰³ and adding foreign direct investment to portfolio stock ownership suggests that foreigners own 40% of U.S. corporate equity.¹⁰⁴ Climate-vulnerable sectors in particular show significant foreign direct investment, including U.S. mining and fossil fuel extraction, U.S. utilities, U.S. transportation, and U.S. manufacturing.¹⁰⁵ For example, many utilities that own and operate electric generating units (like Dominion Energy and the Southern Company) and many fossil fuel producers (like Chevron) are large publicly-traded corporations with substantial foreign investors.¹⁰⁶

As a result of foreign ownership, a significant portion of the regulatory or other effects passing through publicly-traded companies would ultimately be experienced by such foreign owners. Affected firms may also pass on some costs to employees (through reduced compensation, or increased hours or responsibilities) or to consumers (through increased prices or changes in the quality of goods). The firms affected by U.S. rulemakings and other agency actions may often have at least some non-U.S. employees and some direct or indirect foreign consumers who will bear some portion of the costs.

In a few recent analyses, agencies have admitted that some portion of the costs or cost savings calculated for publicly-traded corporations will “accru[e] to entities outside U.S. borders” through foreign ownership, employment, or consumption.¹⁰⁷ Yet these analyses do not attempt to separate out such effects to foreign interests, and certainly do not attempt to exclude such effects from consideration altogether. Indeed, splitting corporate effects into subparts based on ultimate ownership could be extremely complicated.¹⁰⁸ Thus, as a practical matter, agencies typically count all costs or benefits to corporations, no matter how those effects may be passed through to foreign owners, foreign employees, or foreign customers.

It would be arbitrary for agencies to “put a thumb on the scale” by selectively treating various categories of costs and benefits differently.¹⁰⁹ Because agencies typically count all costs and benefits to corporate entities, even if such effects would ultimately accrue to foreign interests, to be consistent agencies must also continue to consider all significant effects from U.S. greenhouse gases, even if such effects in part ultimately accrue to foreign interests. In other words, failing to consider the full global social cost of greenhouse gases would be arbitrarily inconsistent with agencies’ general practices for cost-benefit analysis.

II.D. Ethics and Equity Weights

As explored above, individual U.S. citizens have some positive, altruistic willingness to pay to protect foreign countries from climate change. But beyond the altruism of individual U.S. citizens, the United

States government may bear an ethical responsibility to use the global social cost of greenhouse gases.¹¹⁰ Though in recent years the United States has fallen to the second-largest source of annual greenhouse gas emissions, the United States is still responsible for the biggest share of the world's cumulative emissions to date.¹¹¹ And while the United States has not widely incorporated the principle of "polluter pays" into its laws, a more general moral principle could at least partly motivate the use of the full global social cost of greenhouse gases.¹¹² An initial unilateral commitment based on altruism or a preference for equity can also help generate cooperation in international negotiations,¹¹³ as explored above.

The question of how far an ethical principle of responsibility toward the welfare of other countries can go in justifying use of the global estimates of course relates to the question of how completely the current global estimates actually value the welfare of other countries. The Working Group's current methodology for calculating the global social cost of greenhouse gases implicitly discounts foreign welfare to a significant degree, and thus is already biased toward a U.S.-centered perspective. Further moving away from global values and toward a "domestic-only" value would further compound that bias.

The current methodologies value climate damages based on estimates of how much individuals across the globe are willing to pay to avert risks to themselves. However, willingness to pay to avoid risks can depend heavily on ability to pay, in terms of income and wealth. Consequently, the current social cost of greenhouse gas methodology calculates the value of preventing mortality risks based on per capita income of the country or region where the risk would occur. For example, if the social cost of greenhouse gas estimates value eliminating a ten-in-one-million risk of death affecting a million people at \$90 million if those people live in the United States, the same risk reduction may be valued only at \$40 million for people who live in Canada, and at only \$0.9 million if they live in India.¹¹⁴

Yet these valuations mask the actual welfare impacts across different countries. People in India do not value their lives less than the people in the United States value our lives; but they may value a dollar in extra benefits more than the same dollar of benefits would be valued in the United States. A dollar's worth of climate damages will have different, heterogenous welfare effects across different regions of the earth, because those different regions have heterogeneous baseline levels of wealth, and because an additional dollar gained or lost has a marginally decreasing effect on total welfare as baseline wealth increases. This concept—the decreasing marginal utility of consumption—is most easily understood with an example: a few dollars gained or lost each week may go almost unnoticed by a billionaire, but the same amount could make or break the budget of a low-income family.

Some modelers have proposed applying equity weights to re-value the climate damages to different regions, to better reflect the expected welfare impact that the damages will have in that region and so more accurately measure the change in the expected value of social welfare from emissions.¹¹⁵ Nevertheless, the Working Group has so far rejected equity weighting, on the grounds that developing the appropriate equity weights would be "challenging" and practically complicated given a potential need to account for the heterogenous utility impacts resulting from the costs of emissions reductions as well.¹¹⁶ Consequently, the Working Group's current calculations of the social cost of greenhouse gases already place relatively greater weight on domestic climate impacts, because they fail to apply equity weights to impacts

experienced by foreign countries with lower GDP per capita. Any further weighting or emphasis of domestic-only impacts would, therefore, be theoretically and morally questionable.

II.E. The Global Values Are the Legally Appropriate Choice

Application of the global values is at least in some contexts likely legally required, and in all contexts is legally permissible. And because any attempt to calculate a domestic-only estimate that did not account for U.S. strategic interests, international spillovers, and extra-territorial interests would arbitrarily ignore important factors that federal agencies have a responsibility to consider, the global values are legally preferred as well. Any remaining discretion agencies may have to calculate the cost of climate pollution should then be informed by Executive Orders, which further counsel in favor of global values.

II.E.1. The Administrative Procedure Act Does Not Allow Agencies to Ignore Key Factors

The Supreme Court defined the standard of rationality for agency actions under the Administrative Procedure Act as follows:

Normally, an agency rule would be arbitrary and capricious if the agency has relied on factors which Congress has 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 of the product of agency expertise.¹¹⁷

Furthermore, the Court found that the standard requires agencies to “examine the relevant data and articulate . . . a rational connection between the facts found and the choice made.”¹¹⁸

Two federal courts of appeals have applied arbitrary and capricious review to assess when agencies need to account for global climate change in their decisions.¹¹⁹ In *Center for Biological Diversity v. National Highway Traffic Safety Administration*, the U.S. Court of Appeals for the Ninth Circuit ruled that, because the agency had monetized other uncertain costs and benefits of its vehicle fuel efficiency standard, its “decision not to monetize the benefit of carbon emissions reduction was arbitrary and capricious.”¹²⁰ Specifically, it was arbitrary to “assign[] no value to *the most significant benefit* of more stringent [vehicle fuel efficiency] standards: reduction in carbon emissions.”¹²¹ The court also approvingly cited a partial consensus among experts around an estimate of “\$50 per ton of carbon (or \$13.60 per ton CO₂)”,¹²² which, in the year 2006 when the rule was issued, would have been consistent with estimates of a global social cost of carbon.¹²³

In *Zero Zone Inc. v. Department of Energy*, the U.S. Court of Appeals for the Seventh Circuit approved of the Department of Energy’s use of the Working Group’s social cost of carbon estimates, holding that that “the expected reduction in environmental costs *needs* to be taken into account” in order for the Department “[t]o determine whether an energy conservation measure is appropriate under a cost-benefit analysis.”¹²⁴ Furthermore, the court specifically rejected petitioner’s challenge to the Department’s use of

a global (rather than domestic) social cost of carbon, holding that Department had reasonably identified carbon pollution as “a global externality” and appropriately concluded that, because “national energy conservation has global effects, . . . those global effects are an appropriate consideration when looking at a national policy.”¹²⁵

“Focusing solely on domestic effects has been soundly rejected by economists as improper and unsupported by science.”

— *U.S. District Judge
Yvonne Gonzalez Rogers
(2020)*¹²⁶

And finally, a recent ruling from the U.S. District Court for the Northern District of California struck down as arbitrary the Bureau of Land Management’s (“BLM”) rescission of the Waste Prevention Rule in part because the agency had abandoned the peer-reviewed, global estimates of the social cost of greenhouse gases in favor of flawed “interim” estimates that looked only at effects within the U.S. borders.¹²⁷ The court found that the global values reflected “the best available science about monetizing the impacts of greenhouse gas emissions,”¹²⁸ whereas “focusing solely on domestic effects has

been soundly rejected by economists as improper and unsupported by science.”¹²⁹ The court was harshly critical of the agency’s failure to consider “impacts on 8 million United States citizens living abroad, including thousands of United States military personnel; billions of dollars of physical assets owned by United States companies abroad; United States companies impacted by their trading partners and suppliers abroad; and global migration and geopolitical security.”¹³⁰ And the court reminded BLM that executive orders, including Executive Orders 12,866 and 13,783, require consideration of “all” costs and benefits, based on the “best reasonably obtainable scientific, technical, economic, and other information,” and concluded that “none of the regulatory rules or orders require exclusion of global impacts.”¹³¹ In fact, the court observed that even the global estimates are likely underestimated.¹³²

However, at least one federal judge has recently viewed use the global values with greater skepticism. After the Northern District of California vacated the rescission of the Waste Prevention Rule, litigation resumed in the District of Wyoming over implementation of the original Waste Prevention Rule from 2016. Despite the persuasive judicial opinions described above in support of the global values, the District of Wyoming faulted the agency for not “separately analyzing and reporting the United States’ *domestic* share of [climate] benefits.”¹³³ Even after the agency had explained to the court that there was no suitable methodology for estimating domestic damages, the court opined that “there is no reason to think that a domestic analysis cannot also be performed as directed by Circular A-4.”¹³⁴ The court concluded that “there is nothing in any of the statutes empowering the agency to consider or work to address *global* climate change,”¹³⁵ and found that the agency had “failed to adequately explain or support with substantial evidence why it was reasonable to use a global emissions metric to quantify the benefits arising from a rule designed to curb domestic waste under the [statute].”¹³⁶

The District of Wyoming in part took issue with the agency's explanations of why the global values were reasonable and why no suitable methodology existed to estimate a domestic-only value. The case therefore serves as a broad reminder for the Working Group to bolster its defense of the global values and its criticisms of domestic-only values, and for agencies to explicitly incorporate those justifications into their administrative records as appropriate. At a more specific level, though, the District of Wyoming case turned on whether a particular set of statutes authorized the agency to use a global valuation. The Working Group and individual agencies should therefore consider making some statute-specific arguments about application of the global values.

II.E.2. Key U.S. Statutes Require a Global Perspective, and Other Statutes Allow It

At least two key statutes explicitly require consideration of global climate costs.

The National Environmental Policy Act (NEPA) requires that “all agencies of the Federal Government *shall* . . . recognize the worldwide and long-range character of environmental problems.”¹³⁸ This provision is accompanied by a call for agencies to support “the foreign policy of the United States” in order to “maximize international cooperation in anticipating and preventing a decline in the quality of mankind’s world environment.”¹³⁹ There are several notable implications of this statutory language. First, when an administration has adopted a position that a global valuation of the social cost of greenhouse gases is a vital part of its foreign policy strategy—as the Biden Administration has (see *supra* Section II.B)—agencies should “lend appropriate support”¹⁴⁰ by applying the global values. Second, even if that were not the current foreign policy strategy, the first clause of the provision contains an independent¹⁴¹ and binding¹⁴² obligation to broadly consider the worldwide character of environmental problems. Third, the provision is separate from the better-known NEPA requirement to conduct environmental impact statements. While agencies should certainly assess global environmental effects when preparing their environmental impact statements, the requirement to consider worldwide environmental problems applies to agency conduct *outside* the environmental impact statement process as well¹⁴³—including to agencies’ “interpret[ation] and administ[ration]” of public laws.¹⁴⁴ Although NEPA’s requirements are largely procedural in nature and may need to give way if there is an explicit conflict with another statute’s substantive requirements,¹⁴⁵ Congress directed

“Public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this chapter, and all agencies of the Federal Government *shall* . . . recognize the worldwide and long-range character of environmental problems.”

— *National Environmental Policy Act (1970)*¹³⁷

agencies “to the fullest extent possible” that all laws “shall be interpreted and administered in accordance with the policies set forth” in NEPA¹⁴⁶—including the need to “recognize the worldwide and long-range character of environmental problems.”¹⁴⁷ In short, unless an agency is explicitly prohibited from considering the global costs of climate pollution, agencies should interpret their statutes “to the fullest extent possible” with a view toward recognizing the “worldwide and long-range character” of climate change, and so should value the full global social cost of greenhouse gases in their analyses.

The Clean Air Act also requires a global perspective. Most of the provisions authorizing regulatory action on climate change charge EPA with protecting public health and welfare,¹⁴⁸ where “welfare” is defined to include “effects on . . . weather . . . and climate.”¹⁴⁹ Environmental and administrative law scholar Richard Revesz has exhaustively reviewed the legislative history of this definition of “welfare” and has concluded that “when Congress included the ‘effects on . . . climate’ language in the statute, it understood that adverse climate effects could occur on a global scale.”¹⁵⁰ Federal courts have reached the same conclusion. When interpreting the language in Section 202 of the Clean Air Act, the Supreme Court found “there is nothing counterintuitive to the notion that EPA can curtail the emission of substances that are putting the *global* climate out of kilter.”¹⁵¹ And when industry challenged another EPA climate program by arguing that the Clean Air Act “was concerned about local, not global effects,” the U.S. Court of Appeals for the D.C. Circuit had “little trouble disposing of Industry Petitioners’ argument that the [Clean Air Act’s prevention of significant deterioration] program is specifically focused solely on localized air pollution,” finding instead that the statute was “meant to address a much broader range of harms,” including “precisely the types of harms caused by greenhouse gases.”¹⁵²

Under other key statutes, consideration of global climate costs is permissible and reasonable. The Energy Policy and Conservation Act requires the Department of Energy and the Department of Transportation to consider “the need of the United States to conserve energy” when setting energy efficiency standards for appliances, equipment, and vehicles.¹⁵³ Though “need” is not defined, case law and context show it is clearly reasonable for the agencies to weigh the strategic value of reciprocal foreign actions, international climate spillovers, extra-territorial interests, and ethical obligations in assessing the “need of the United States to conserve energy.”¹⁵⁴ Similar references to the “public welfare,” “the interests of the United States,” or the “needs of the American people” in other statutes, like the Mineral Leasing Act¹⁵⁵ and the Federal Land Policy and Management Act,¹⁵⁶ can be interpreted in the same way to allow if not require consideration of the global social cost of greenhouse gases to advance the strategic, economic, security, and ethical interests of the United States.¹⁵⁷ This is especially true in light of NEPA’s broad mandate to interpret all “public laws of the United States” in accordance with the principle to “recognize the worldwide and long-range character of environmental problems.”¹⁵⁸

II.E.3. International Law Commits the United States to Account for Global Effects

International commitments require consideration and mitigation of transboundary environmental harms. Notably, the United Nations Framework Convention on Climate Change—to which the United States is a party¹⁵⁹—declares that countries’ “policies and measures to deal with climate change should be cost-effective so as to *ensure global benefits at the lowest possible cost.*”¹⁶⁰ The Convention further commits

parties to evaluating global climate effects in their policy decisions, by “employ[ing] appropriate methods, for example *impact assessments* . . . with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change.”¹⁶¹ The unmistakable implication of the Convention is that parties—including the United States—must account for global economic, public health, and environmental effects in their impact assessments. In 2008, a group of U.S. senators—including then-Senator John Kerry, who helped ratify the framework convention on climate change—agreed with this interpretation of the treaty language, saying that “[u]pon signing this treaty, the United States committed itself to considering the global impacts of its greenhouse gas emissions.”¹⁶²

The Convention reflects a basic ethical responsibility to prevent transboundary environmental harms that has been enshrined in customary international law.¹⁶⁴ For the United States to knowingly set pollution

“Upon signing this treaty, the United States committed itself to considering the global impacts of its greenhouse gas emissions.”

— Senator John Kerry
& Colleagues (2008)¹⁶³

levels in light of only domestic harms, willfully ignoring that its pollution directly imposes environmental risks—including catastrophic risks—on other countries, would violate norms of comity among countries. Given that the nations most at risk from climate change are often the poorest countries in the world, such a policy would also violate basic and widely shared ethical beliefs about fairness and distributive justice.¹⁶⁵

II.E.4. Executive Orders and Guidance Inform Agency Discretion and Endorse the Global Values

Before it was rescinded, President Trump Executive Order 13,783 advised agencies to reconsider “domestic versus international impacts” in light of “the guidance contained in OMB Circular A-4,”¹⁶⁶ and agencies quickly leapt to the conclusion that *Circular A-4* required them to estimate only “climate change impacts that occur within U.S. borders.”¹⁶⁷ Even before then, opponents of using the global values often seized on *Circular A-4* guidance to “focus” on effects to “citizens and residents of the United States,” while any significant effects occurring “beyond the borders of the United States . . . should be reported separately.”¹⁶⁸ These arguments are mistaken on several grounds.

To begin, if the guidance is read too literally it would actually be internally inconsistent, because impacts to U.S. citizens may include effects occurring “beyond the borders.”¹⁶⁹ As detailed above, to adequately consider all the strategic, internationally linked, extra-territorial, and ethical interests of the United States, it is necessary to look beyond our geographic borders.

Second, *Circular A-4* offers default guidance, not binding requirements. While *Circular A-4* may suggest that most typical decisions should focus on U.S. effects, the Circular cautions agencies that special cases call for different emphases:

[Y]ou cannot conduct a good regulatory analysis according to a formula. Conducting high-quality analysis requires competent professional judgment. *Different regulations may call for different emphases* in the analysis, depending on the nature and complexity of the regulatory issues and the sensitivity of the benefit and cost estimates to the key assumptions.¹⁷⁰

In fact, *Circular A-4* elsewhere assumes that agencies' analyses will not always be conducted from purely the perspective of the United States, as one of its instructions only applies "as long as the analysis is conducted from the United States perspective,"¹⁷¹ suggesting that in some circumstances it is appropriate for the analysis to be global. For example, EPA and the Department of Transportation have adopted a global perspective on the analysis of potential monopsony benefits to U.S. consumers resulting from the reduced price of foreign oil imports following energy efficiency increases.¹⁷² And for the reasons explored above, perhaps more than any other issue, the global tragedy of the commons created by the world's cumulative greenhouse gas emissions requires precisely such a "different emphasis" from the default domestic-only assumption.

Third, while *Circular A-4* undeniably contains much useful guidance for agencies on cost-benefit analysis, formally the document offers guidance specific to implementation of Executive Order 12,866 (as well as on preparing the annual reports to Congress on the costs and benefits of federal regulatory programs, under the Regulatory Right-to-Know Act).¹⁷³ Executive Order 12,866 requires agencies to "assess *all* costs and benefits of available regulatory alternatives . . . unless a statute *requires* another regulatory approach."¹⁷⁴ Moreover, as the U.S. District Court for the Northern District of California observed, Executive Orders do "not alter by fiat what constitutes the best available science . . . about monetizing the impacts of greenhouse gas emissions."¹⁷⁵ The court further found that no Executive Order, nor *Circular A-4*, in any way required exclusion of global impacts, noting that Executive Order 12,866 instead requires consideration of "all costs and benefits" based on "the best reasonably obtainable scientific, technical, economic, and other information."¹⁷⁶ (The Regulatory Right-to-Know Act also does not limit the definitions of "costs" or "benefits."¹⁷⁷) Finally, in considering executive branch guidance, more recent orders must also be taken into account. Executive Order 13,990 instructs agencies to "tak[e] global damages into account," because "[d]oing so facilitates sound decision-making, recognizes the breadth of climate impacts, and supports the international leadership of the United States on climate issues."¹⁷⁸ And while that Executive Order must be "implemented in a manner consistent with applicable law,"¹⁷⁹ as shown above, most if not all statutes allow for consideration of the global values.

"[T]aking global damages into account . . . facilitates sound decision-making, recognizes the breadth of climate impacts, and supports the international leadership of the United States on climate issues."

— *Executive Order 13,990 (2021)*

II.F. The Working Group Should Bolster Its Defense of the Full Global Values

The Interim Technical Support Document already offers a robust defense for focusing on the global values. However, as noted above, while some federal courts have upheld use of the global values as “appropriate” or “the best” estimate, at least one federal judge questioned why a domestic-only estimate is not possible, and lawsuits continue to be brought challenging reliance on the global values.¹⁸⁰

To minimize legal risk, the Working Group should further bolster its defense of the global values with additional justifications and supporting evidence detailed above. In particular, the Working Group should explicitly explain why the theory and evidence for reciprocity can by itself justify a focus on the full global values. Additional strategic considerations, including the potential for informational spillovers to benefit the United States, further supports this conclusion. The Working Group should expand its discussion of spillover effects to cover transboundary resources, and should explicitly make the case why spillover effects can also justify a focus on the full global values, either independently or in combination with strategic and ethical considerations. Similarly, the Working Group should add that extra-territorial interests include significant military installations abroad and U.S. citizens and residents’ willingness to pay to protect their relatives and cultural and religious sites abroad, as well as their existence value and altruism toward the people, animals, and natural habitats across the globe. The Working Group should add that it would be arbitrarily inconsistent for agencies to try to separate or ignore non-U.S. climate costs when those agencies do not separate or ignore the portion of compliance costs and other effects that ultimately accrue to foreign entities.

The Working Group should also add legal justifications and recommend that agencies incorporate both legal and economic justifications for the global values in their individual proceedings. In particular, statutes that reference public welfare or the needs of the United States can be read as consistent with the global values, because of the strategic, economic, security, and ethical interests involved. The National Environmental Policy Act’s requirement to interpret laws in light of the worldwide nature of environmental problems supports this interpretation. The Working Group should also explain how the legal standards for arbitrary and capricious review require consideration of various key factors that a non-global estimate would arbitrarily omit from consideration.

The Technical Support Document (or a separate document responding to public comments) should include sufficient language for agencies to cite to and borrow from to defend their focus on the global values. It may also be useful for the Working Group to detail why past attempts to calculate a domestic-only estimate have failed and are not appropriate for agencies to use. This report turns to that topic next.

III. Past Domestic-Only Valuations Have Failed

Of course, there already are and will continue to be significant localized and quantifiable effects of climate change.¹⁸¹ For example, a peer-reviewed EPA report, *Climate Change in the United States: Benefits of Global Action*, found that by the end of the century, the U.S. economy could face hundreds of billions of dollars in annual damages from lost labor productivity due to extreme temperatures, agricultural damages, water shortages, and U.S. coastal property damage.¹⁸² However, despite the ability to project some discrete localized impacts, attempts to separate out a U.S.-only portion of the global social cost of greenhouse gases remain extremely fraught.

Existing methods for estimating a “domestic-only” value are unreliable and incomplete. Indeed, in 2015, the Working Group concluded that “good methodologies for estimating domestic damages do not currently exist.”¹⁸³ Moreover, current domestic-only estimates misapply models that were not built for the purpose of calculating regional damages, ignore recent literature on significant U.S. climate damages, and fail to reflect international spillovers to the United States, U.S. benefits from foreign reciprocal actions, and the extraterritorial interests of U.S. citizens including financial interests and altruism.

In 2010, the Working Group proposed an “approximate, provisional, and highly speculative” range of 7–23% of the global social cost of carbon as an estimate of the purely direct climate effects to the United States.¹⁸⁴ In 2017, agencies during the Trump Administration developed “interim,” “domestic-only” estimates that were approximately 12-13% of the global values.¹⁸⁵ Both approaches were flawed and should not be used by agencies.

III.A. The 7-23% Range Was Inaccurate and Problematic

In 2010, while affirming the superiority of the global values, the Working Group offered thoughts on domestic estimates. Using the results of one economic model (FUND) as well as the U.S. share of global gross domestic product (“GDP”), the group generated an “approximate, provisional, and highly speculative” range of 7–23% of the global social cost of carbon as an estimate of the purely direct climate effects to the United States.¹⁸⁶ Yet, as the Working Group itself acknowledged, this range was almost certainly an underestimate because it ignored significant, indirect costs to trade, human health, and security that are likely to spill over into the United States as other regions experience climate change damages, among other effects.¹⁸⁷

Neither the existing IAMs nor a share of global GDP is an appropriate basis for calculating a domestic-only estimate. The IAMs were never designed to calculate a domestic value. FUND, like other IAMs, includes some simplifying assumptions: of relevance, FUND and the other IAMs are not able to capture the adverse effects that the impacts of climate change in other countries will have on the United States

through trade linkages, national security, migration, and other forces.¹⁸⁸ This is why the Working Group characterized the domestic-only estimate from FUND as a “highly speculative” underestimate.¹⁸⁹

Similarly, a domestic-only estimate based on some rigid conception of geographic borders or U.S. share of world GDP will fail to capture all the climate-related costs and benefits that matter to U.S. citizens.¹⁹⁰ U.S. citizens have economic and other interests abroad that are not fully reflected in the U.S. share of global GDP. GDP is a “monetary value of final goods and services—that is, those that are bought by the final user—produced in a country in a given period of time.”¹⁹¹ GDP therefore does not reflect valuation of non-market goods, significant U.S. ownership interests in foreign businesses, properties, and other assets, as well as consumption abroad including tourism,¹⁹² or even the 9 million Americans living abroad.

It would also be inappropriate to calculate a domestic-only estimate based on Gross National Income (“GNI”) instead of GDP. GNI defines its scope not by location but by ownership interests.¹⁹³ However, not only has GNI fallen out of favor as a metric used in international economic policy,¹⁹⁴ but using a domestic-only estimate based on GNI would make the social cost of greenhouse gas metrics incommensurable with other costs in regulatory impact analyses, since most regulatory costs are calculated by U.S. agencies regardless of whether they fall to U.S.-owned entities or to foreign-owned entities operating in the United States.¹⁹⁵ Furthermore, both GDP and GNI are dependent on what

“National estimates are so poorly determined.”
— *Nobel Prize Laureate William Nordhaus (2015)*¹⁹⁹

happens in other countries, due to trade and the international flow of capital. International trade grows the global economy and dynamically increases U.S. production and consumption in ways that a fixed estimate of GDP or GNI cannot capture. The artificial constraints of both metrics counsel against a rigid split based on either U.S. GDP or U.S. GNI.

As a result, in 2015, the Working Group concluded that “good methodologies for estimating domestic damages do not currently exist.”¹⁹⁶ Similarly, the National Academies of Sciences concluded that current IAMs cannot accurately estimate the domestic social cost of greenhouse gases, and that estimates based on U.S. share of global GDP would be likewise insufficient.¹⁹⁷ William Nordhaus, the developer of the DICE model, has cautioned that “regional damage estimates are both incomplete and poorly understood,” and “there is little agreement on the distribution of the [social cost of carbon] by region.”¹⁹⁸ In short, the 7-23% range is inaccurate, misleading, and out of step with the best available economic literature.

III.B. The 2017-2021 “Interim” Domestic-Only Estimates Were Arbitrary

As noted above, following Executive Order 13,783, in 2017 agencies began calculating “interim” estimates that attempted to capture only climate effects occurring within U.S. borders. The agencies believed that domestic-only estimates could be “calculated directly” from the models FUND and PAGE; for the model

DICE, the agencies simply assumed that U.S. damages would be 10% of global damages.²⁰⁰ Aggregating the results from these three models produced “domestic-only” estimates that were overall only about 12-13% of the global values. This methodology was deeply flawed, because the agencies were using the models in ways they were never designed for—indeed, in ways their designers specifically cautioned against. And of course, these estimates failed to assess the most up-to-date literature on U.S. damages and failed to take any steps to reflect spillover effects, reciprocal benefits, or U.S. interests beyond our borders.

III.B.1. Limitations of the Models

The IAMs used to calculate the social cost of greenhouse gases were designed to create global estimates and are best suited for that purpose. The models are limited in how accurately and fully they can estimate domestic values of the social cost of greenhouse gases. For example, the models make simplifying assumptions about the extent of heterogeneity in crucial parameters like relative prices and discount rates.²⁰¹ The models also simplify or ignore completely global spillovers from trade, migration, capital flows, and other sources.²⁰² Global estimates will also generally be more accurate than domestic estimates because aggregation of multiple values reduces the error of the overall estimate.²⁰³

An examination of the individual models used to calculate the Trump administration’s “interim” domestic social cost of greenhouse gases—PAGE 2009, FUND 3.8, and DICE 2010²⁰⁴—highlights the current limitations to calculating of a domestic value of the social cost of greenhouse gases. For example, the only way that the PAGE model “calculate[s] directly” regional impacts is through its “regional scaling factors,” which are “based on the length of each region’s coastline relative to the [European Union]. Because of the long coastline in the EU, other regions are, on average, [deemed to be] less vulnerable than the EU for the same sea level and temperature increase.”²⁰⁵ In other words, PAGE calculates climate impacts occurring within U.S. borders by first estimating the climate damages that an additional ton of greenhouse gases will cause in Europe, and then scaling down that value because the United States has a coastline that is three times shorter than Europe’s.²⁰⁶

While relative coastline length may provide a reasonable scaling factor for certain climate damages, such as from coastal flooding, coastal storms, and other sea-level rise issues, it likely understates many other key climate damages—perhaps dramatically so—to the United States, where increases in mortality, agricultural losses, and other important climate effects will also occur in inland, warm areas of the country,²⁰⁷ and will occur regardless of relative coastline length. Accordingly, the methodology for calculating domestic climate damages from the PAGE model—one of just three models that the Trump administration’s “interim” estimate incorporated—completely disregards significant damage categories. Note that applying this coastal-based scaling even more locally would suggest that any landlocked country, like Switzerland—or indeed landlocked states like Nevada, Colorado, and New Mexico—would have a zero valuation of the social cost of greenhouse gases: an absurd results that demonstrates the problems with the methodology.

The other two models on which the Trump administration’s “interim” domestic social cost of greenhouse gases estimate relied similarly overlook substantial damage categories. The FUND model generally

estimates domestic damages from climate change by scaling estimates according to GDP or population. For instance, forestry damages are “mapped to the FUND regions assuming that the impact is uniform [relative] to GDP.”²⁰⁸ Similarly, domestic energy consumption changes are a function of GDP, and the authors note that “heating demand is linear in the number of people” in a FUND region.²⁰⁹ Scaling damages by GDP and population will fail to capture important differences between countries, like pre-existing climate, interconnectedness of trade relationships, climate change preparedness, and preferences.

Finally, the author of DICE 2010 has explicitly warned against using a domestic-only value. In a recent article, William Nordhaus states, “The regional estimates [of the social cost of greenhouse gases] are poorly understood, often varying by a factor of 2 across the three models. Moreover, regional damage estimates are highly correlated with output shares.” He later reiterates that “the regional damage estimates are both incomplete and poorly understood.”²¹⁰

III.B.2. GAO Critique of the Interim Domestic-Only Estimates

In June 2020 the Government Accountability Office (“GAO”) published a report critiquing the federal government’s reliance on the “interim” social cost of carbon under the Trump administration and its failure to implement the National Academies’ recommendations on updating the social cost of carbon estimates.²¹¹ GAO concluded that the integrated assessment models used to derive domestic-only social cost of carbon estimates “were not premised or calibrated to provide estimates of the social cost of carbon based on domestic damages.”²¹² GAO further noted that the National Academies found that country-specific social costs of carbon estimates were “limited by existing methodologies, which focus primarily on global estimates and do not model all relevant interactions among regions.”²¹³ Moreover, it explained, the National Academies concluded that “accurately estimating the damages from carbon dioxide emissions for the United States would involve more than examining the direct impacts of climate change that occur within U.S. physical borders,” as “U.S.-specific damages would need to consider how climate change and emissions reductions in other parts of the world could also affect the United States.”²¹⁴ Although the GAO report referred to the social cost of carbon specifically, its critiques and recommendations were equally applicable to the other social cost values.

III.B.3. Judicial Rebuke of the Interim Domestic-Only Estimates

In July 2020, the U.S. District Court for the Northern District of California ruled that the Bureau of Land Management’s use of the Trump administration’s “interim,” domestic-only estimates for the social cost of greenhouse gases in its justification to rescind the 2016 Waste Prevention Rule was arbitrary and capricious.²¹⁵ The court found that not only did BLM “revers[e] [its] prior position” about the proper social cost value without sufficient justification,²¹⁶ but also that the domestic-only social cost of greenhouse gases is methodologically flawed and inappropriate for use by federal agencies. The court noted that “focusing solely on domestic effects has been soundly rejected by economists as improper and unsupported by science.”²¹⁷ And by omitting global effects, BLM’s

analysis ignores impacts on 8 million United States citizens living abroad, including thousands of United States military personnel [current estimate is 9 million]; billions of dollars of physical assets owned by United States companies abroad; United States companies impacted by their trading partners and suppliers broad; and global migration and geopolitical security.²¹⁸

In other words, even though BLM claimed that its “interim” estimates captured the effects accruing to the United States, the agency in fact overlooked the tremendous damages to U.S. interests resulting from climate impacts occurring from outside the country’s geographical borders. In addition, the Northern District of California explained that by ignoring the National Academies’ findings “that international effects can have significant spill-over effects in the United States, such as on trade and migration, which must be considered in any attempt to estimate domestic impacts,” BLM casted aside the best available science.²¹⁹

IV. Robust Estimates of Strategic, Domestic Values as a Backstop

Even as federal agencies stay focused on the global estimates of the social cost of greenhouse gases, the Working Group should consider working toward more robust estimates of the reciprocal benefits of foreign actions, international spillovers to the United States, impacts to extra-territorial U.S. interests, and the willingness of U.S. citizens to pay to protect foreign people and ecosystems. This section explores the reasons why the Working Group should pursue this line of research, as well as some examples and suggestions of how to begin to make such estimates.

IV.A. Reasons to Develop Robust Estimates of Climates Impacts to U.S. Interests

Research into the reciprocal benefits of foreign actions, international spillovers to the United States, impacts to extra-territorial U.S. interests, and the willingness of U.S. citizens to pay to protect foreign people and ecosystems will improve the global estimates, safeguard against legal risks, and safeguard against political risks.

Improve Global Estimates: While the full global estimates provide an important and defensible proxy for the significant spillover effects and strategic considerations that would otherwise be arbitrarily excluded from domestic valuations based on the share of GDP or physical borders, the global estimates *themselves* do not fully value spillover effects. As the Technical Support Documents have noted, inter-regional interactions are largely not included in the models,²²⁰ even though these inter-regional interactions “are particularly worrisome at higher levels of warming.”²²¹ Better estimates of spillover effects and other regional considerations would therefore help improve the accuracy and completeness of the global valuations.²²²

Minimize Legal Risk: Shortly after the U.S. District Court for the Northern District of California struck down the prior administration’s “domestic-only” calculations as arbitrary, a judge in the U.S. District Court for the District of Wyoming came to a different conclusion about a related rule. After the Northern District of California vacated the rescission of the Waste Prevention Rule, litigation resumed in the District of Wyoming over implementation of the original Waste Prevention Rule from 2016. Despite the Northern District of California’s conclusion that the global values reflected “the best available science about monetizing the impacts of greenhouse gas emissions”²²³—and despite the U.S. Court of Appeals for the Seventh Circuit’s earlier conclusion that a federal agency acted reasonably by considering the global values²²⁴—the District of Wyoming in this case faulted the agency for not “separately analyzing and reporting the United States’ *domestic* share of those benefits.”²²⁵ Even after the agency had explained to the court that there was no suitable methodology for estimating domestic damages, the court opined that “there is no reason to think that a domestic analysis cannot also be performed as directed by Circular A-4.”²²⁶

Thus, previous favorable caselaw notwithstanding, some legal risk remains if agencies rely exclusively on global values without at least conducting a sensitivity analysis using domestically-oriented calculations. Even if rulings like the one from the District of Wyoming are ultimately overturned, they can stymie important agency actions in the meantime. And lawsuits continue to be brought challenging reliance on the global values.²²⁷

Both the Working Group and individual agencies should include in their analyses a strong defense for their focus on global estimates, using the justifications detailed above, to prepare for likely legal challenges. But to further minimize legal risks, the Working Group should consider advising agencies to use appropriately robust, lower-bound estimates of a strategic, domestic value of the social cost of greenhouse gases in a sensitivity analysis.

The Department of Energy, for example, even when giving preference to calculations based on the global social cost of greenhouse gases, has regularly included as a sensitivity analysis a domestic valuation as well.²²⁸ The Department of Energy has previously relied on the Working Group’s “approximate, provisional, and highly speculative” range of calculations,²²⁹ but for the reasons explored above, that approach is flawed and incomplete. The Working Group should disavow its prior suggestions on calculating a domestically-oriented value, work toward instead developing a new estimate that accounts for strategic factors and other considerations, and advise the Department of Energy and other agencies to use, when appropriate, such new domestic estimates in their sensitivity analyses.

Minimize Political Risk: In the future, a new Presidential administration, Congress, state government, or even an individual federal agency may attempt to depart from the current focus on the global estimates of the social cost of greenhouse gases. In that eventuality, a more robust estimate of a domestic value that captures reciprocal benefits, spillover effects, and extra-territorial interests may serve as a useful minimum value.

For example, in 2017, some members of Congress introduced legislation seeking to prohibit use of the social cost of greenhouse gases unless the estimate “considers only the domestic costs and benefits of the activity.”²³⁰ Of course, most recently the prior administration attempted to revert to a “domestic-only” estimate—which ultimately failed for the reasons detailed above. But before a federal court could strike down that arbitrarily incomplete valuation, its calculation still inflicted real-world damage by helping to justify the repeal of a methane-reduction measure,²³¹ as well as the rollbacks of numerous other environmental policies. Had that methane policy taken full effect, for example, it could have reduced harmful emissions. In this way, a more robust and inclusive estimate of the U.S. share of climate damages may provide a useful backstop, setting a minimum value for the future.

IV.B. How to Estimate Impacts to U.S. Interests

The Working Group should begin by defining clearly the key factors that it would be arbitrary to ignore in attempting to calculate a domestically-oriented social cost of greenhouse gases. The Working Group should then catalogue the best currently available empirical evidence and theoretical frameworks for estimating these factors. As the National Academies concluded, “It is important to consider what constitutes a domestic impact in the case of a global pollutant that could have international implications that impact the United States.”²³²

Based on the best currently available information, the Working Group should suggest a lower-bound estimate of the domestic social cost of greenhouse gases that agencies could use, if appropriate, in sensitivity analyses. The lower-bound domestic estimate will indicate the absolute minimum values that agencies could test in a sensitivity analysis—even as the agencies continue to focus on the full global values as best values to use in their main analyses. The Working Group should then chart a research path to develop better evidence about these key factors, which can then inform future updates of both the global values and domestic values.

IV.B.1. How to Estimate the Strategic Value of Reciprocity

The existing frameworks for estimating the value to the United States of reciprocal climate actions by foreign jurisdictions suggest the United States should strategically internalize a very high portion (or even the full amount) of the global values. As detailed above, Houser and Larsen estimate the Climate Reciprocity Ratio at 6.1-6.8, because each ton of emissions reduction that the United States has pledged has been accompanied by foreign pledges to cut at least 6.1-6.8 tons in return—all of which will benefit the United States. Houser and Larsen therefore suggest that any baseline domestically-oriented estimate should be multiplied by at least that 6.1.²³³ While there is some uncertainty about whether all these foreign policies will be implemented as planned, Houser and Larsen’s estimate may also be quite conservative. Their estimate omits any conditional pledges, any pledges that are not readily quantified into specific reductions, any actions from countries or local jurisdictions that have not formally submitted Nationally Determined Contributions to the United Nations, any reductions occurring after 2030, and any foreign actions already achieved before 2014 that may have motivated U.S. pledges in the first place.²³⁴ From that perspective, a multiplier of 6.1 could even be considered a minimum value.

"All countries will have a preferred social cost of carbon greater than their own domestic social cost of carbon."

— Matthew Kotchen
(2018)²³⁵

Matthew Kotchen has built a theoretical framework to estimate countries' "preferred" social cost of greenhouse gas values, based on strategic considerations.²³⁶ Kotchen finds that all countries have a preferred value greater than their own domestic-only value; in fact, many countries' "preferred" values even exceed the global values, because those countries benefit so much when other countries lower their emissions in turn that it is strategically beneficial for those countries to push the world toward even more ambitious climate policies than the global values alone would require.²³⁷ For the United States specifically, Kotchen calculates a preferred social cost of greenhouse gases that is 72.5% of the global values.²³⁸ And because the underlying model used by Kotchen does not value many significant inter-regional spillover effects—which would make the United States more susceptible to global climate damages and so increase its strategically preferred valuation—Kotchen's estimate could be considered a lower bound.

IV.B.2. How to Estimate International Spillover Effects

Categories of important international spillover effects include economic, health, migration, security, and transboundary resource effects. Existing evidence suggests ways to begin valuing some of these effects. Because the United States is a "large, hegemonic player," the country "internalizes a significant fraction of the global gains of climate change abatement,"²³⁹ and so accounting for international spillovers to U.S. interests should significantly (if not entirely) close the gap between a baseline domestically-oriented estimate and the full global estimate.

Economic Spillovers: Climate can affect the U.S. international trade through disruptions to supply and demand for imports and exports, overseas operations and supply chains (including U.S. trade and businesses that rely on foreign-owned infrastructure, services, and resources), and international financial markets and investors.²⁴¹

Historical examples can offer clues to the magnitude of economic spillover effects at stake. For example, when Thailand—the world's second-largest producer of hard-drives—experienced flooding in 2011, U.S. consumers faced higher prices for many electronic goods, from computers to cameras.²⁴² As a result, a U.S.-based company called Western Digital sustained \$199 million in losses and a 51% drop in hard drive shipments, and global hard drive prices doubled. The ripples continued, Ford had to temporarily halt production on vehicles, and Honda's production of vehicles in the United States and Canada decreased temporarily by 50%.²⁴³ Similarly, global wheat prices spiked when short-term climate extremes in 2010 and 2011 hit global wheat production.²⁴⁴ And a recent economic study explored how heat stress-induced reductions in productivity worldwide will ripple through the interconnected global supply network.²⁴⁵

The recent Covid-19 pandemic provides a case study of the economic impacts from disruptions in global supply chains.

In 2009, Jody Freeman and Andrew Guzman looked deeply at climate spillover effects on U.S. interests.²⁴⁶ Reviewing the available evidence, they concluded that economic spillover shocks were likely to last beyond the mere short-term, including long-term reductions in raw materials like water and energy; long-term effects to food supply; permanent reductions to productivity; and long-term contractions in investment, decreases in foreign lending, and higher interest rates.²⁴⁷ They noted that about 20% of American firms' profits were earned outside the country²⁴⁸—which remains true as of 2020 data.²⁴⁹ In recent years, exports were responsible for 12% of U.S. GDP, and imports for 15%.²⁵⁰ Looking at similar kinds of data in 2009 and assuming that climate change's disruptions to trade flows could reasonably have at least half the impact of the 2008 recession,

Freeman and Guzman estimated that export losses alone could potentially increase climate impacts by 1.5% of annual U.S. GDP.²⁵¹ Similar kinds of data, historical analogies, and reasonable assumptions could allow the Working Group to begin to monetize some of the likely economic spillovers from climate change.

Note that some spillover effects that may dramatically change domestically-oriented estimates may not necessarily affect the global valuations. For example, certain trade effects that could net to zero globally (for example, a decrease in exports by one country must correspond to a decrease in imports for another country) could still have important domestic effects to the United States, while many other trade impacts will affect both the overall level of global trade as well as the distribution among countries.²⁵²

Migration and Health Spillovers: Drought, sea-level rise, food shortages, political instability, and other climate-related disasters could trigger mass migrations. The migrations to the United States could in turn create economic and other kinds of effects, and will require resources to respond to an increase in climate refugees seeking asylum.²⁵³ Mass migrations or population displacements occurring outside the United States can still affect U.S. humanitarian and military resources, and may cause political instability abroad or trigger other spillover effects.

Past examples can offer clues about the magnitude of these kinds of effects. In 2013, climate change likely increased the severity of Typhoon Haiyan, which displaced 4 million people and prompted the U.S. military to commit 13,400 personnel to the relief efforts.²⁵⁴ Flooding in Bangladesh has previously pushed hundreds of thousands of refugees into Indian territory, triggering civil unrest and at least one violent massacre in which hundreds were killed.²⁵⁵ Models suggest that a 10% decline in crop yields could trigger the emigration of 2% of the entire Mexican population to other regions, mostly to the United States.²⁵⁶

"A large, hegemonic player like the United States internalizes a significant fraction of the global gains of climate change abatement."

— *Jody Freeman & Andrew Guzman (2009)*²⁴⁰

Rachel Warren has recommended developing a scenario-based approach to project future migration patterns from climate change.²⁵⁷

Health spillovers can result from increased pathogen transmission, changing habitats for disease-carrying pests, new diseases emerging from ecological changes, decreased resources available to contain diseases, and breakdowns in health infrastructure; all of these can be exacerbated by changing migration patterns and other effects. The ongoing Covid-19 pandemic can offer some evidence of the economic effects of a global pandemic, though researchers would need to estimate how likely it is that climate change will contribute to future pandemics of similar scales. Researchers are also working to improve the health estimates in the IAMs for infectious diseases,²⁵⁸ including those that could spill across borders. Beyond even the risk of pandemic, vector-borne diseases and agricultural, livestock, and environmental pathogens can start in other regions and spread to the United States.

Security and Humanitarian Spillovers: Climate change has already begun to exacerbate security risks, and some historical examples will shed insight on the likely magnitude of the effects.²⁵⁹ In 2010-11, drought conditions tripled bread prices in Egypt, which, combined with other factors “contributed to the civil unrest that ultimately resulted in the 2011 Egyptian revolution.”²⁶⁰ Drought similarly destroyed the livelihood of herders in Somalia, “leading some to join armed groups.”²⁶¹ Flooding in Bangladesh has also previously pushed hundreds of thousands of refugees into Indian territory, triggering civil unrest and at least one violent massacre in which hundreds were killed.²⁶² The Syrian conflict has also often been framed as triggered partly by climate change,²⁶³ with drought once again contributing to the social and political tensions that erupted into civil war,²⁶⁴ which triggered an international migration and humanitarian crisis.²⁶⁵ Many if not all such conflicts will directly implicate U.S. security interests and impose significant costs on the U.S. military and humanitarian relief efforts.

Climate change can also affect the scope of U.S. military missions and the deployment of U.S. resources. For example, as summer sea ice diminishes, the changing geopolitical significance of the Arctic may demand larger and logistically complicated military missions to the Arctic.²⁶⁶ Drought, desertification, and flooding will become “very important factors in mission execution” in Africa.²⁶⁷ Changing weather conditions may increase “no-go flight days” in various parts of the world.²⁶⁸

In 2009, Freeman and Guzman reviewed the spillover risks to national security and suggested they could “easily generate costs” in excess of 3.5% of annual GDP, a larger effect than accounting for export losses or even for the nonmarket costs currently omitted from IAMs.²⁶⁹ Using a more specific historical analogy, Freeman and Guzman suggested that “if climate change can be expected to cause one additional conflict like the Iraq War every twenty-five years, putting aside all other costs related to security threats, then the expected cost of climate change [from national security spillovers] is at least 1% of annual GDP.”²⁷⁰

Trans-Boundary Resources: Trans-boundary spillovers include wildfire smoke drifting across our borders, impacts to rivers and other resources shared with Canada or Mexico, and effects to shared resources in the global commons, including changing migration patterns of economically valuable fish and biodiversity losses that ripple through ecosystems and across borders. Some of these effects may be more

difficult than others to quantify and monetize, but a complete estimate of the domestic social cost of greenhouse gases requires more research into these topics.

IV.B.3. How to Estimate Extra-Territorial Interests

Extra-territorial interests include U.S. military bases and personnel located abroad, U.S. citizens or their relatives living abroad, U.S. ownership of foreign assets, and U.S. foreign assistance and humanitarian interests.

Military Interests: Many if not all military installation abroad face significant climate risks. On the risk of increased energy demand—and the attendant uncertainties and costs of procuring necessary energy—bases located in, for example, Djibouti,²⁷¹ Greenland,²⁷² Kuwait, and the Caribbean²⁷³ face particularly high risks.²⁷⁴ The Fourth National Climate Assessment concluded that “Climate impacts already affect U.S. military infrastructure,” and in the future damage to roads, runways, and waterfront infrastructure will only increase.²⁷⁵

According to a recent report, “U.S. military forces are present in almost every nation across the globe, and operate from ‘nearly 562,000 facilities on 4,800 sites worldwide and covering 24.9 million acres.’”²⁷⁶ Installations in the Asia-Pacific region are “especially exposed to severe weather events such as cyclones,”²⁷⁷ and the Department of Defense estimates the replacement value of their structures in the Pacific to be nearly \$180 billion.²⁷⁸ For example, the Marshall Islands host the Ronald Reagan Ballistic Missile Defense Test Site, “a pillar of U.S. Strategic Command” crucial for detecting foreign missile launches and acting as “a strategic territorial bulwark in a time when the Chinese military is growing”—and yet recent studies suggest that, due to climate change, the Marshall Islands may become “uninhabitable in mere decades.”²⁷⁹ Investigating replacement costs for military installations more broadly may help to assess a significant category of extra-territorial interests threatened by climate change affects occurring abroad.

Citizens and Relatives Abroad: About 9 million U.S. citizens live overseas.²⁸¹ Many live in the western hemisphere and Europe, with Canada, Mexico, the United Kingdom and France as top destinations, followed by Israel and Australia; however, over the last decade, the portions of U.S. citizens abroad choosing climate-vulnerable regions like Oceania, the Middle East, North Africa, and South-East Asia as their home have grown at particularly fast rates.²⁸² These citizens’ homes, livelihoods, and investments could all be threatened by climate change effects occurring outside U.S. borders.

The Ronald Reagan Ballistic Missile Defense Test Site on the Marshall Islands, “a pillar of U.S. Strategic Command,” may be “uninhabitable in mere decades.”

— *the Center for Climate & Security’s Military Expert Panel (2018)*²⁸⁰

A quarter of the U.S. population consists of either foreign-born immigrants or second-generation residents,²⁸³ and subsequent generations of Americans retain significant familial, cultural, economic, and religious ties to their ancestors' home nations across the world. Over \$100 billion is sent from the United States to other countries in remittances every year.²⁸⁴ Research into willingness to pay of U.S. citizens and residents to protect their relatives, ancestral homes, and cultural and religious sites located abroad could help reveal the magnitude of this category of extra-territorial interests.

Assets and Investments Abroad: U.S. citizens and companies have made billions of dollars in direct investment in foreign businesses.²⁸⁵ Those direct stakes in foreign businesses, as well as property and other kinds of investment, could all be threatened by various climate effects occurring overseas. The United States also makes billions of dollars in foreign assistance investments each year, as a "strategic, economic, and moral imperative for the United States and vital to U.S. national security."²⁸⁶ But climate effects in foreign countries can undermine the ability of those investments to achieve their economic, security, and other purposes.²⁸⁷ Researching the magnitude of these investments and making reasonable assumptions about the risks from climate change should inform an assessment of the extra-territorial interests of the United States threatened by climate change effects occurring abroad.

Humanitarianism and Global Obligations: As explained above, the United States has certain obligations under international law with respect to global commons, including Antarctica and the oceans. The United States government is also the largest government provider of humanitarian assistance worldwide, allocating over \$10 billion in 2020 for disaster relief, refugee support, and other assistance,²⁸⁸ with much of that aid directed to climate-vulnerable regions in Africa, the Middle East, and Central and South Asia.²⁸⁹ Private U.S. philanthropy and volunteerism may even exceed the scope of official government aid, and the Fourth National Climate Assessment concluded that "U.S. citizens have long been concerned about the welfare of those living beyond U.S. borders and their vulnerability to the global impacts of climate."²⁹⁰

Finally, as already mentioned above, U.S. citizens value natural resources and plant and animal lives abroad, even if they never use those resources or see those plants or animals. For example, the "existence value" of restoring the Prince William Sound after the 1989 Exxon Valdez oil tanker disaster—that is, the benefits derived by Americans who would never visit Alaska but nevertheless felt strongly about preserving the existence of this pristine environment—was estimated in the billions of dollars.²⁹¹ Though the methodologies for calculating existence value remain controversial,²⁹² U.S. citizens certainly have a non-zero willingness to pay to protect rainforests, charismatic megafauna like pandas, and other life and environments existing in foreign countries, as well as an altruistic willingness to pay to protect the health and welfare of unrelated foreign citizens and cultural and religious sites located abroad.²⁹³ Further research into these topics would help uncover the scale of U.S. humanitarian interests threatened by climate change.

IV.C. Applying Domestic Values in Sensitivity Analyses

As discussed above, even though focusing on the full global values is the best choice for U.S. agencies from the perspectives of economic efficiency, diplomatic strategy, practical methodology, and moral responsibility—and even though focusing on the full global values is legally permissible and may be legally required—legal risks may still remain. In particular, despite favorable judicial precedents that have upheld reliance on the global values as appropriate, litigation over the social cost of greenhouse gases can still stymie federal actions to address climate change. Lawsuits may delay implementation of important actions, and some federal judges may seek to block agency actions that rely on a cost-benefit analysis based exclusively on the global social cost of greenhouse gases.

The Working Group's Interim Technical Support Document already offers a robust defense for focusing on the global values, but the Working Group should go further to bolster its defense with additional justifications and supporting evidence, as detailed above. Agencies can then incorporate those arguments to support their own proceedings that rely on the global values, to prepare for likely legal challenges. But to further minimize legal risks, the Working Group should consider advising agencies to use, when appropriate, robust lower-bound estimates of a domestic value of the social cost of greenhouse gases in a sensitivity analysis.

The Working Group should disavow any prior suggestions on calculating a domestically-oriented value based on a 7-23% range. Instead, the Working Group should recommend a new domestic valuation of the social cost of greenhouse gases, as a lower-bound estimate for use in sensitivity analysis. The Working Group should be clear that agencies should focus on the global values in their main analyses and that use of the full global values will best promote U.S. interests and fulfill U.S. responsibilities. The domestic valuations are instead the *lower bound* estimates of the minimum that U.S. agencies need to value so as not to arbitrarily and illegally omit consideration of key factors like foreign reciprocity, international spillovers, and extra-territorial interests. The Working Group should make clear that the domestic values are optional and may be used, if appropriate, only in sensitivity analyses. Given the considerations above—including estimates of the Climate Reciprocity Ratio, the economic framework for calculating the “preferred” social cost of greenhouse gases, the scale of impacts to U.S. exports and imports, the risks to U.S. military installations and security interests, evidence from the recent pandemic on the impacts to U.S. interests from a global disruption, and other significant effects to U.S. interests that cannot be quantified or monetized—the Working Group should consider recommending a domestic valuation of at least 75% or more of the global values for optional use as a lower-bound estimate in sensitivity analysis.

This range is reasonable as a lower-bound, given the number and magnitude of effects to U.S. interests that cannot be quantified or monetized, and because in the economic frameworks for calculating a “preferred” social cost of greenhouse gases, under some sets of assumptions the “preferred” valuation could equal or exceed the global values. Though the U.S. share of climate damages is not necessarily a constant percentage of the global value and may change over time,²⁹⁴ this provisional range can be used in sensitivity analyses as a lower bound. Indeed, bearing in mind both that the global estimate itself is likely

an underestimate (due to omitted damages), and also that the scientific and economic understanding of inter-regional impacts is still developing, the Working Group should clarify that such domestic estimates remain provisional and may underestimate even the minimum strategic value to U.S. interests of addressing global climate change.

Conclusion

This report has shown that focusing on the global values is the best strategic, practical, ethical, and legal choice for federal agencies, to promote U.S. interests and fulfill U.S. responsibilities on climate change. To protect against legal risks, the Working Group should bolster its justifications for focusing on the global values, adopting the additional arguments and evidence presented above. But even with such a stronger defense, legal and political risks remain. Developing an updated domestic value of the social cost of greenhouse gases, and applying it when appropriate as a lower bound in sensitivity analyses, could provide a useful safeguard.

Moving toward more robust estimates of climate impacts to U.S. interests will require more research. The Working Group should catalogue the most important research needs to improve the estimates of both the domestic and global valuations. The Working Group should review what resources exist within its agency members to conduct the necessary additional research. If more funding is needed, the Working Group should communicate with the Office of Management and Budget and the National Science Foundation to appropriately aim their budget requests and grants toward these research priorities. Finally, the Working Group should outline where it needs public support in completing its research agenda, so academics, foundations, and other public research institutions can efficiently direct their efforts toward supporting these research priorities.

¹ Interagency Working Group on the Social Cost of Carbon, Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis at 4 (2010) [hereinafter 2010 TSD] (indicating the interim values from 2009 were “global SCC estimates”); Interagency Working Group on the Social Cost of Greenhouse Gases, Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis at 17 (2016) [hereinafter 2016 TSD].

² 2016 TSD, *supra* note 1, at 17.

³ *Zero Zone, Inc. v. Dept. of Energy*, 832 F.3d 654, 679 (7th Cir. 2016) (“According to DOE, national energy conservation has global effects, and, therefore, those global effects are an appropriate consideration when looking at national policy. . . . Therefore, DOE acted reasonably when it compared global benefits to national costs.”).

⁴ National Academies of Sciences, Engineering, and Medicine, Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide at 53 (2017) [hereinafter NAS].

⁵ Exec. Order No. 13,783 § 5(c), 82 Fed. Reg. 16,093, 16,096 (Mar. 31, 2017).

⁶ Bureau of Land Mgmt., Regulatory Impact Analysis for the Proposed Rule to Suspend or Delay Certain Requirements of the 2016 Waste Prevention Rule at 55 (2017), <https://perma.cc/2H7P-RQBF> [hereinafter BLM, 2017 RIA] (claiming that “[t]he domestic share of the global SC-CH₄—i.e., an approximation of the climate change impacts that occur within U.S.

borders—is calculated directly in both FUND and PAGE,” and assuming that damages within U.S. borders can be approximated from the DICE model by taking 10% of global values); *id.* at 25 (suggesting that, “[i]n accordance with E.O. 13783” and its interpretation of OMB’s *Circular A-4*, the agency must “present domestic rather than global impacts of climate change”); *accord* Envtl. Prot. Agency, Memorandum: Estimated Cost Savings and Forgone Benefits Associated with the Proposed Rule “Oil and Natural Gas: Emission Standards for New, Reconstructed, and Modified Sources: Stay of Certain Requirements” at 8, 15, Oct. 17, 2017, <https://perma.cc/L2JM-NNVR>. Some agency analyses during this period did include global estimates in a sensitivity analysis, *e.g.*, Nat’l Highway Traffic Safety Admin. & Envtl. Prot. Agency, Final Regulatory Impact Analysis: The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Year 2021-2026 Passenger Cars and Light Trucks at 1803 (2020), <https://perma.cc/Y7G3-EBB9>.

⁷ See Envtl. Prot. Agency, Technical Support Document: Airplane Greenhouse Gas Standards at 140, table 6-6 (2020), <https://perma.cc/NAH2-EWPK> (calculating the “Interim Domestic Social Cost of CO₂” at a 3% discount rate at \$6 per ton for year 2020 emissions in 2015\$). The value has been approximately adjusted for inflation using the CPI Inflation Calculator, <https://perma.cc/SH3E-BBZ5>.

⁸ See BLM, 2017 RIA, *supra* note 6, at 26, table 3.2 (calculating the “Interim Domestic SC-CH₄” at a 3% discount rate at \$176 per ton for year 2020 emissions in 2016\$). The value has been approximately adjusted for inflation using the CPI Inflation Calculator.

⁹ See EPA, TSD: Airplane Greenhouse Gas Standards, *supra* note 7, at 140, table 6-7 (calculating the “Interim Domestic Social Cost of N₂O” at a 3% discount rate at \$2100 per ton for year 2020 emissions in 2015\$). The value has been approximately adjusted for inflation using the CPI Inflation Calculator.

¹⁰ See Policy Integrity’s separate report on discount rates submitted to this docket: Peter Howard & Jason A. Schwartz, *About Time: Recalibrating the Discount Rate for the Social Cost of Greenhouse Gases* (Policy Integrity Report, 2021).

¹¹ *California v. Bernhardt*, 472 F.Supp.3d 573, 611-14 (N.D. Cal. 2020).

¹² These Working Group figures are taken from Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide—Interim Estimates under Executive Order 13990 at 5-6 (2021) [hereinafter 2021 Interim TSD], but are consistent with the estimates from the 2016 TSD and its addendum, once those 2016 estimates are adjusted for inflation to 2020\$.

¹³ 2021 Interim TSD, *supra* note 12, at 16.

¹⁴ *Id.* at 15-16.

¹⁵ *Id.* at 16 (“The IWG found previously and is restating here that because of the distinctive global nature of climate change that analysis of Federal regulatory and other actions should center on a global measure of SC-GHG.”).

¹⁶ See Robert E. Kopp & Bryan K. Mignone, *Circumspection, Reciprocity, and Optimal Carbon Prices*, 120 CLIMATE CHANGE 831, 838 (2013) (explaining that either full reciprocity or complete circumspection or the intermediate combination of the two can motivate use of the global values in a domestic analysis); *id.* at 841 (explaining that if marginal benefits are declining in global abatement (as would occur with greater-than-quadratic climate damages or the expectation of weakening carbon sinks), the global values can be more easily justified with either partial circumspection or partial reciprocity).

¹⁷ See Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243, 1244 (1968) (“[E]ach pursuing [only its] own best interest . . . in a commons brings ruin to all.”).

¹⁸ 2010 TSD, *supra* note 1, at 29 (calling ocean acidification a “potentially large” omitted damage category). Carbon dioxide also has the non-climate agricultural benefit of fertilization, but such effects are already included in the social cost of carbon dioxide. *Id.* at 8.

¹⁹ Interagency Working Group on the Social Cost of Greenhouse Gases, Addendum to Technical Support Document: Application of the Methodology to Estimate the Social Cost of Methane and the Social Cost of Nitrous Oxide at 11 (2016) [hereinafter 2016 Addendum] (recognizing that Sarofim et al. 2015 already values the global ozone-related mortality benefits of methane to be \$790 per metric ton, not counting additional welfare effects).

²⁰ *Id.* at 11-12 (explaining that nitrous oxide’s “effects on stratospheric ozone, UV fluxes, and hydroxyl radical levels . . . may also have effects on the atmospheric behavior of other pollutants as well as direct effects on human health”).

²¹ Some reliable estimates do already exist. See *supra* note 19.

²² See Matthew J. Kotchen, *Which Social Cost of Carbon? A Theoretical Perspective*, 5 J. ASSOC. ENVTL. & RES. ECON. 673, 678 (2017) (providing formulas for the “efficiency argument in support of all countries internalizing the GSCC [global social cost of carbon] for domestic policy”).

²³ Policy Integrity, *Foreign Action, Domestic Windfall: The U.S. Economy Stands to Gain Trillions from Foreign Climate Action* (2015), <https://perma.cc/T3WN-H42U>.

²⁴ Richard Revesz, Kenneth Arrow et al., *The Social Cost of Carbon: A Global Imperative*, 11 REV. ENVTL. ECON. & POL’Y 172, 172 (2017).

²⁵ Ted Gayer & W. Kip Viscusi, *Determining the Proper Scope of Climate Change Policy Benefits in U.S. Regulatory Analyses: Domestic versus Global Approaches*, 10 REV. ENVTL. ECON. & POL’Y 245, 256 (2016).

²⁶ *Id.*

²⁷ For example, in the Mercury and Air Toxics Standards, EPA concluded that a reduction of mercury emissions from U.S. power plants would generate health benefits for foreign consumers of fish, both from U.S. exports and from fish sourced in foreign countries. EPA did not quantify these foreign health benefits, however, due to complexities in the scientific modeling. Envtl. Prot. Agency, *Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards* at 65 (2011) (“Reductions in domestic fish tissue concentrations can also impact the health of foreign consumers . . . [and] reductions in U.S. power plant emissions will result in a lowering of the global burden of elemental mercury.”).

²⁸ In the analysis of the Cross-State Air Pollution Rule, EPA noted—though could not quantify—the “substantial health and environmental benefits that are likely to occur for Canadians” as U.S. states reduce their emissions of particulate matter and ozone—pollutants that can drift long distances across geographic borders. *Federal Implementation Plans to Reduce Interstate Transport of Fine Particulate Matter and Ozone*, 75 Fed. Reg. 45,210, 45,351 (proposed Aug. 2, 2010).

²⁹ Dept. of Transp., *Final Regulatory Analysis: Enhancing Airline Passenger Protections II* at 19 (2011), <https://perma.cc/6S79-KSFH> (“This analysis includes benefits and costs for foreign business and citizens.”); *id.* at 2 (presenting a summary of net benefits without distinguishing foreign versus domestic); Coast Guard, *Cruise Vessel Security and Safety Act Implementation*, 80 Fed. Reg. 2350, 2355-56 (Jan. 16, 2015) (tallying total industry costs all together, though reporting in a footnote separate foreign-based and U.S.-based costs); Fed. Aviation Admin., *Operations Specifications*, 76 Fed. Reg. 7482, 7485 (Feb. 10, 2011) (explaining that the “final rule will not impose costs on domestic operators since it only applies to foreign air carriers and foreign persons,” and qualitatively assessing the “reduction in costs for foreign air carriers” and “some benefits to foreign air carriers”).

³⁰ When estimating the risk of death from debris from the international space station, NASA focused on the risk to the global population. Nat’l Aeronautics & Space Admin., *Final Tier 2 Environmental Impact Statement for International Space Station* at 3-1, 3-7, 4-30 (1996), available at <https://perma.cc/T9VR-QTCE>. NASA did calculate the domestic risk separately, but most of the report emphasized the global risk. *Id.*

³¹ Most generally, it is individually rational for a country to fully internalize the global social cost of greenhouse gases “if a country expects a decrease in its own emissions to decrease that of all others in proportion to the ratio of its external cost of emissions to its internal costs.” Kotchen, *supra* note 22, at 683. Other economists have justified use of the global social cost estimates on more intuitive grounds. See, e.g., Tamara Carleton & Michael Greenstone, *Updating the United States Government’s Social Cost of Carbon* at 26-27 (Becker Friedman Institute Working Paper 2021-04, Jan. 2021), <https://perma.cc/H9EU-XWBX> (“The global SCC . . . is an ingredient in efforts to procure the necessary international action. . . . Even if policymakers decide that the effects of regulations on U.S. citizens are what matter (in terms of both law and policy), it would make sense to use the global measure, as it would protect U.S. citizens against a range of adverse effects from unmitigated climate change.”); William Pizer et al., *Using and Improving the Social Cost of Carbon*, 346 SCIENCE 1189, 1190 (2014) (explaining that the “potential to leverage foreign mitigation,” combined with moral, ethical, and security issues, provide “compelling reasons to focus on a global SCC but, more important, to make a strategic choice.”); Robert S. Pindyck, *Comments on Proposed Rule and Regulatory Impact Analysis on the Delay and Suspension of Certain Requirements for Waste Prevention and Resource Conservation*, Nov. 6, 2017, available at <https://perma.cc/HG8Q-MT6H> (“[W]hat treatment of international damages is in the United States’ self-interest? . . . The simplest answer is to find the value of the [social cost of carbon] that maximizes global welfare. . . . I continue to think that the global value is the appropriate

provisional value for use as research on this topic continues.”). Cf. Ted Gayer & Viscusi, *The Social Cost of Carbon: Maintaining the Integrity of Economic Analysis*, 11 REV. ENVTL. ECON. & POL’Y 174, 174 (2017) (questioning the current evidence on the “magnitude of the effect of reciprocity” but not the broader principle that “reciprocity . . . will influence the domestic benefits of climate policies”).

³² NAS, *supra* note 4, at 53.

³³ See generally Robert Axelrod, *The Evolution of Cooperation* 10-11 (1984) (on repeated prisoner’s dilemma games).

³⁴ See Peter Howard & Jason Schwartz, *Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon*, 42 COLUM. J. ENVTL. L. 203, App. B (2017) (cataloguing carbon valuations around the world); see also GAO, Social Cost of Carbon: Identifying a Federal Entity to Address the National Academies’ Recommendations Could Strengthen Regulatory Analysis, GAO-20-254, at 41, 44 (2020) (explaining that Germany and Canada have deliberately adopted global valuations, and France and the United Kingdom’s target-based values are tied to global goals); Norway Ministry of Finance, NOU 2012:16, Cost-Benefit Analysis at 9.5.4, <https://perma.cc/T9NX-MKPF> (explaining that Norway “assume[s] that the willingness of persons in both Norway and other countries to pay to avoid climate change shall be taken into account”).

Note also that a growing number of U.S. states have adopted the Working Group’s methodology for use in energy policy decisions. See The Cost of Carbon Pollution, States Using the SCC (last visited June 18, 2021),

<https://costofcarbon.org/states>. Every state has so far adopted a global valuation, and it is in the national interests of the United States for individual states to not seek their own state-specific estimates. If states were to ignore the climate externalities that their emissions inflict on other states and other countries, that would undermine U.S. interests. The federal government also has a reciprocal relationship with individual states in calculating the social cost of greenhouse gases.

³⁵ For example, Germany recommends values of €205 (at a 1% discount rate) and €670 (at a 0% discount rate) per ton of carbon dioxide-equivalent, for year 2030 emissions, in 2016€. Umweltbundesamt, Methodological Convention 3.0 for the Assessment of Environmental Costs at 8 (2019), <https://perma.cc/CQ8M-ZD47>.

³⁶ With some adaptations (for example, Canada excludes results from FUND from its calculation of the high-impact estimates, Envt. & Climate Change Canada, Technical Update to Environment and Climate Change Canada’s Social Cost of Greenhouse Gas Estimates at 13 (2016), http://publications.gc.ca/collections/collection_2016/eccc/En14-202-2016-eng.pdf), Canada has consistently used the Working Group’s global values in its regulatory analyses. *Id.* at 19 (copying the Working Group’s reasons for focusing on a global value); see also, e.g., Heavy-Duty Vehicle and Engine Greenhouse Gas Emission Regulations, SOR/2013-24, 147 C. Gaz. pt. II, 450, 544 (Can.) (Feb. 22, 2013), available at <http://canadagazette.gc.ca/rp-pr/p2/2013/2013-03-13/html/sor-dors24-eng.html> (“The values used by Environment Canada are based on the extensive work of the U.S. Interagency Working Group on the Social Cost of Carbon.”). Local Canadian jurisdictions have also used or cited the Working Group’s numbers. E.g., Quebec, Guide de L’Analyse: Avantages-Couts Des Projets Publics en Transport Routier—Parametres 7, 13 (2016), <https://perma.cc/X759-8ZJE>.

³⁷ Israel Ministry of Envtl. Protection, Green Book on External Costs of Air Pollutants (2020), [https://www.gov.il/BlobFolder/publicsharing/pc_external_costs_of_air_pollution/he/public_comments_2020_External_air_pollution_costs_pc_accessible.docx](https://www.gov.il/BlobFolder/publicsharing/pc_external_costs_of_air_pollution/he/public_comments_2020_Exernal_air_pollution_costs_pc_accessible.docx) (explaining that because “greenhouse gases have a global rather than a local effect,” it is appropriate to follow “the value recommended by the U.S. EPA,” and so adopting a value of NIS 140, or approximately \$43).

³⁸ In 2016, Mexico agreed to “align” its climate damage estimates with the United States. See Jason Furman & Brian Deese, *The Economic Benefits of a 50 Percent Target for Clean Energy Generation by 2025*, White House Blog, June 29, 2016 (summarizing the North American Leader’s Summit announcement). And as recently as 2017, Mexico used global values of climate damages in its regulatory analyses. See, e.g., Secretaria del Medio Ambiente y Recursos Naturales, Que Establece Los Limites Maximos Permisible de Emision de Monoxido de CarbonoAnexo: Beneficios (2017), <https://perma.cc/N6YH-ZYTM> (citing the Working Group’s estimates); Secretaria del Medio Ambiente y Recursos Naturales, Aviso Mediante el Cual Se Dan a Conocer los Parametros para el Calculo de las Emisiones de Bioxido de Carbono (CO2) en los Vehiculos Automotores Ligeros Nuevos con Peso Bruto Vehicular Que No Exceda Los 3857 Kilogramos, Que Utilizan Gasolina o Diesel como Combustible Cuyo Ano-Modelo SEA 2017 (June 15, 2016), <https://perma.cc/HV8H-62GU> (referencing “beneficios globales para las emisiones evitadas de CO2”). But in 2018, after the Trump Administration adopted a domestic-

only value, Mexico's analysis of regulations to reduce methane emissions from the oil and gas sector seemed to focus more on Mexico's domestic climate effects. Secretaria del Medio Ambiente y Recursos Naturales, Disposiciones Administrativas de Carácter General Que Establecen Los Lineamientos para la Prevención y el Control Integral de las Emisiones de Metano del Sector Hidrocarburos, Anexos II-III (2018), <https://perma.cc/M3Q9-NW9S> (basing benefits calculation on storm damages).

³⁹ In a 2020 report submitted to India's National Green Tribunal by a committee charged with assessing environmental damage caused by a manufacturer, the social cost of carbon values applied were adapted from the values "estimated by USEPA." Additional Report of Committee on Environmental Damage Assessment Due to Air Pollution Caused on Account of Explosion & FIR... in the Matter of OA No. 22 of 2020, at 12 (2020), https://cpcb.nic.in/NGT/ADDITIONAL_REPORT_Air_OA_22_of_2020-SEP-2020.pdf (citing to Hemant Bherwani et al., Framework for Environmental Damages Cost Assessment with Examples, Special Report on Monetizing Damages, Council of Scientific and Industrial Research-National Environmental Engineering Research Institute (2019), <https://perma.cc/N673-9QL2>, which is based on the Working Group's global damage approach).

⁴⁰ The Australian Capital Territory (which includes Canberra) is developing a social cost of carbon value to apply to "all ACT Government policies, budget decisions, capital works projects and procurements," citing the Working Group's values as an example. Austl. Cap. Terr. Env't, Plan. and Sustainable Dev. Directorate, ACT Climate Change Strategy 2019-2025 (2019), <https://perma.cc/487H-BHHC>; see also ACT Climate Change Council, The Social Cost of Carbon and public investment to reduce ACT greenhouse gas emissions (July 2018), <https://perma.cc/UPW3-EC55> (calling on the Minister for Climate Change to adopt the Working Group estimates).

⁴¹ New Zealand has cited the Working Group's values in comparison to the values it has used in regulatory cost-benefit analyses. Ministry of Transp., Preliminary CBA for Vehicle Fuel Efficiency Standard (2018), <https://perma.cc/Y7SS-3AG2>.

⁴² The IMF has in the past applied the Working Group's numbers in its policy reviews. See Benedict Clements et al., IMF, Energy Subsidy Reform: Lessons and Implications at 8 (2013). The World Bank also uses values in line with a global framework. See World Bank, 2017 Guidance Note on Shadow Price of Carbon in Economic Analysis, <https://perma.cc/6XUS-ZPZD>.

⁴³ The Asian Development Bank uses a value of \$36.30 per ton in 2016, increasing at 2% annually, based on the IPCC values, which in turn had taken note of the Working Group's estimates. ADB, Guidelines for the Economic Analysis of Projects (2017) at 44, <https://perma.cc/WH88-3KL8>.

⁴⁴ See Policy Integrity's separate report on the appropriate scope for application of the metrics, also submitted to this docket: Max Sarinsky et al., *Broadening the Use of the Social Cost of Greenhouse Gases in Federal Policy* (2021).

⁴⁵ Howard & Schwartz, *supra* note 34, at 229 (reporting evidence of the success of tit-for-tat strategies in various game theory models).

⁴⁶ Given the repeated nature of the negotiations, a temporary defection by one country or group of countries is not necessarily grounds for all other countries to retaliate in kind, so long as there is a reasonable expectation for future reciprocity. Note, however, that while during periods when the United States acted on climate change other countries often made reciprocal commitments, during periods when the United States retreated or took no action on climate policy (such as during the George W. Bush Administration and Trump Administration), there is at least anecdotal evidence that other countries made little progress or even backslid on their efforts to reduce emissions. See Economics of Climate Change: Hearing before the U.S. H. Comm. on Oversight & Reform's Subcomm. on Env't at 6 (Dec. 19, 2019) (testimony of Michael Greenstone), available at <https://perma.cc/HSJS-V4H6>.

⁴⁷ Howard & Schwartz, *supra* note 34, at 229.

⁴⁸ *Id.* at 228-29 (summarizing the literature).

⁴⁹ *Id.* at 230 (summarizing the literature).

⁵⁰ See Kotchen, *supra* note 22, at 685 (explaining that given the repeated game framework, countries that care enough about the future will rationally internalize more than the domestic social cost of greenhouse gases, because "if countries are concerned about the future and interact repeatedly, they will choose long-term cooperation over short-term gain"). The Working Group may therefore also consider whether the same arguments for a lower discount rate would, in the context of a

long-run repeated game, also support focus on global estimates of the social cost of greenhouse gases. See Policy Integrity's separate report on discount rates.

⁵¹ See, e.g., Jean Chemnick, *Border Carbon Taxes Loom, but not without pricing CO₂*, ClimateWire, Mar. 12, 2021, <https://perma.cc/5SKA-JEDF> (reporting possible European Commission carbon border adjustments to take effect by 2023, with tariffs also being considered by the United Kingdom and the United States).

⁵² See, e.g., Martin L. Weitzman, *Can Negotiating a Uniform Carbon Price Help to Internalize the Global Warming Externality?*, 1 J. ASSOC. ENVTL. & RES. ECON. 29, 32 n.4, 34 (2014) (recognizing that a legitimate expectation of reciprocity, such as through a binding uniform carbon price implemented by tax or other policies, counteracts free-riding and pushes a nation's desired internationally harmonized carbon price higher); see also William Nordhaus, *Climate Clubs: Overcoming Free-Riding in International Climate Policy*, 105 AM. ECON. REV. 1339, 1363-65 (2015) (modeling that with a sufficient tariff, a stable internationally cooperative regime would emerge, and under certain conditions the preferred social cost of carbon of the United States, to maximize domestic U.S. welfare, would actually exceed the global social cost of carbon).

⁵³ Howard & Schwartz, *supra* note 34, at 231-32 (summarizing the literature).

⁵⁴ Exec. Order No 13,990 § 5(a), 86 Fed. Reg. 7037, 7040 (signed Jan. 20, 2021; published Jan. 25, 2021).

⁵⁵ *Id.* at § 6(d). Though this subsection takes action on the Keystone XL Pipeline permit, its statement of diplomatic goals has much broader relevance.

⁵⁶ E.g., Sec'y of State Antony Blinken, Opening Remarks at the Virtual Leaders Summit on Climate (Apr. 22, 2021), available at <https://perma.cc/UEC6-WTZ7> ("[N]o country can overcome this existential threat alone. We're in this together. And what each of our nations does or does not do will not only impact people of our own country, but people everywhere.... We want every country here to know: We want to work with you to save our planet.").

⁵⁷ U.S. Dept. of State, Leaders Summit on Climate: Day 1, Apr. 22, 2021, <https://perma.cc/3X8A-KF4G>; Climate Action Tracker, *Warming Projections Global Update: May 2021* at 3 (2021), <https://perma.cc/7JYN-N2DU>.

⁵⁸ See U.N., Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (2016), <https://perma.cc/SEX3-HAQA> (last visited June 8, 2021).

⁵⁹ See, Eur. Comm'n, Expression of Willingness to Be Associated with the Copenhagen Accord and Submission of the Quantified Economy-Wide Emissions Reduction Targets for 2020 at 2, Jan. 28, 2010, <https://perma.cc/77DD-M4LS> (committing to a 20% reduction but "reiterat[ing] its conditional offer to move to a 30% reduction by 2020 compared to 1990 levels, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities"); Gov't of Mex. Ministry of Env't. and Nat. Res., Nationally Determined Contributions: 2020 Update at 22, <https://perma.cc/VF4A-KSHK> (making an unconditional pledge of 22% reduction of GHGs and 51% of black carbon by 2030; and making a conditional pledge of up to 36% reduction GHGs and 70% black carbon, conditioned on "an international price for carbon trading, adjustment of tariffs for carbon content" as well as technology transfers and financial resources).

⁶⁰ See, e.g., Kopp & Mignone, *supra* note 16, at 833 (2013) (citing implicit reciprocity in the 2009 North American Leaders' Declaration on Climate Change).

⁶¹ White House Office of the Press Secretary, "U.S.-China Joint Announcement on Climate Change, Nov. 11, 2014, <https://perma.cc/VB82-GJMY>.

⁶² White House, Fact Sheet: U.S. Reports Its 2025 Emissions Target to the UNFCCC, Mar. 31, 2015, <https://perma.cc/XK6N-Y9KM> ("Following that historic announcement, the European Union put forward an ambitious and achievable INDC to cut their emissions by 40% by 2030. And just last week, Mexico announced that it would peak its overall net greenhouse gases by 2026, backed by strong unconditional policies.").

⁶³ Greenstone, Testimony, *supra* note 46.

⁶⁴ Trevor Houser & Kate Larsen, *Calculating the Climate Reciprocity Ratio for the U.S.*, Rhodium Group, Jan. 21, 2021 (calling their estimate "deliberately conservative").

⁶⁵ The estimate is conservative because it omits any conditional pledges, any pledges that are not readily quantified into specific reductions, any actions from countries that have not formally submitted Nationally Determined Contributions to the

United Nations, any reductions occurring after 2030, and any foreign actions already achieved before 2014 that may have motivated U.S. pledges in the first place. *Id.*

⁶⁶ *Id.*

⁶⁷ See *Foreign Action, Domestic Windfall*, *supra* note 23, at 2 (calculating at least \$200 billion in benefits already delivered to the United States by foreign actions by 2015, plus another \$2 trillion excepted from existing policies).

⁶⁸ Houser & Larsen, *supra* note 64 (noting that if the Trump Administration's social cost of carbon estimate were multiplied by 6.1-6.8, the result would be \$60-\$67). Cf. Gayer & Viscusi, *supra* note 25, at 257-79 (conceding that reciprocity could be a justification for using the global social cost of carbon, but questioning whether there is enough evidence of reciprocity to support an increase of 4.4 to 14.3 times). Houser & Larsen's estimate suggests that Gayer & Viscusi's threshold likely has been reached.

⁶⁹ See Pizer et al., *supra* note 31, at 1190 (explaining there are "compelling reasons to focus on a global SCC but, more important, to make a strategic choice and to conduct periodic review"). Confirmed levels of international action may, at some point, also require adjustments to the baseline scenario. Fully revising the emissions scenarios may be beyond the scope of current work that the Working Group can realistically accomplish by January 2022. There may also be other considerations for maintaining the current baseline scenario. But the Working Group should periodically reevaluate levels of international reciprocity and action and, if appropriate, adjust emissions scenarios accordingly.

⁷⁰ Though some positive spillover effects are also possible, such as technology spillovers that reduce the cost of mitigation or adaptation, see S. Rao et al., *Importance of Technological Change and Spillovers in Long-Term Climate Policy*, 27 ENERGY J. 123-39 (2006), overall climate spillovers are likely strongly negative, see Jody Freeman & Andrew Guzman, *Climate Change and U.S. Interests*, 109 COLUM. L. REV. 1531 (2009).

⁷¹ U.S. Global Change Res. Prog., Fourth National Climate Assessment, Volume II: Impacts, Risks, and Adaptation in the United States, Chapter 16: Climate Effects on U.S. International Interests at 618 (2018) [hereinafter "NCA4"] (concluding there is "high confidence" in a variety of significant spillover effects); *id.* at 605 (reporting that "climate change, variability, and extreme events outside the United States" already "are affecting and are virtually certain to increasingly affect U.S. trade and economy, including import and export prices and businesses with overseas operations and supply chains").

⁷² *Id.* at 608.

⁷³ See Steven L. Schwarcz, *Systemic Risk*, 97 GEO. L.J. 193, 249 (2008) (observing that financial collapse in one country is inevitably felt beyond that country's borders).

⁷⁴ NCA4, *supra* note 71, at 605.

⁷⁵ See CNA Military Advisory Board, National Security and the Accelerating Risks of Climate Change (2014).

⁷⁶ U.S. Gov't Accountability Off., GAO-14-446, Climate Change Adaptation: DOD Can Improve Infrastructure Planning and Processes to Better Account for Potential Impacts (2014); Union of Concerned Scientists, The U.S. Military on the Front Lines of Rising Seas (2016).

⁷⁷ U.S. Dep't of Def., Report on Effects of a Changing Climate to the Department of Defense 8 (Jan. 2019), available at <https://perma.cc/4WPP-86EN>.

⁷⁸ U.S. Dep't of Def., Quadrennial Defense Review 2014 at vi, 8 (2014).

⁷⁹ NCA4, *supra* note 71, at 607.

⁸⁰ *Id.* at 615.

⁸¹ Peter Howard & Michael Livermore, *Climate-Society Feedback Effects: Be Wary of Unidentified Connections*, INT'L. REV. ENVTL. & RES. ECON. (forthcoming).

⁸² Peter Howard & Michael A. Livermore, *Sociopolitical Feedbacks and Climate Change*, 43 HARV. ENVTL. L. REV. 119, 122-23 (2019).

⁸³ *Id.*

⁸⁴ NCA4, *supra* note 71, at 621 (explaining that instability has economic effects, and economic risks create risk of conflict); Freeman & Guzman, *supra* note 70, at 1581-89; *id.* at 1581 (noting that climate-induced pandemics may cause political

instability); *id.* at 1564 n.157 (noting that cross-sectoral interactions will “reinforce” international spillovers and create “a costly multiplier effect”). Howard & Livermore, *Climate-Society Feedback Effects*, *supra* note 81.

⁸⁵ *California v. Bernhardt*, 472 F.Supp.3d at 614.

⁸⁶ See Kopp & Mignone, *supra* note 16, at 833 (2013) (explaining that the principle of “circumspection” can account for spillover effects and can then be used to justify a global SCC value).

Notably, in Katharine Ricke et al., *Country-Level Social Cost of Carbon*, 8 NATURE CLIMATE CHANGE 895 (2018), the authors concede that after factoring in spillovers and other considerations, an individual country’s interests may be better reflected in a global valuation than a country-specific valuation, and it may not be appropriate to use a country-specific valuation in setting climate policies:

Globalization and the many avenues by which the fortunes of countries are linked mean that a high CSCC in one place may result in costs as the global climate changes even in places where the CSCC is nominally negative. For many countries, the effects of climate change may be felt more greatly through transboundary effects, such as trade disruptions, large-scale migration, or liability exposure than through local climate damage. . . . These considerations suggest that country-level interests may be *more closely aligned to global interests than indicated by contemporary country-level contributions* to the SCC. . . . [A] host of other *strategic and ethical considerations* factor into the international relations of climate change mitigation. . . . We make no claim here regarding the utility of the CSCC in setting climate policies. CO₂ emissions are a global externality.

Id. at 899 (emphases added).

⁸⁷ “U.S. residents spend millions each year on foreign travel, including travel to places that are at substantial risk from climate change, such as European cities like Venice and tropical destinations like the Caribbean islands.” David A. Dana, *Valuing Foreign Lives and Civilizations in Cost-Benefit Analysis: The Case of the United States and Climate Change Policy* 10 (Northwestern Faculty Working Paper 196, 2009), <https://perma.cc/EW3B-NKYC>.

⁸⁸ 2021 Interim TSD, *supra* note 12, at 15 (citing a 2016 figure from Bureau of Consular Affairs, Dept. of State); *see also* Dept. of State, Consular Affairs by the Numbers (2020), <https://perma.cc/F3M8-EFSJ>.

⁸⁹ Ctr. for Climate & Sec., Military Expert Panel Report: Sea Level Rise and the U.S. Military’s Mission at 7 (2d ed. 2018), <https://perma.cc/ZM4R-ED89>.

⁹⁰ *Id.* (internal quotation marks omitted).

⁹¹ A bequest value captures willingness to pay to preserve a resource for a future generation. Existence value captures willingness to pay to preserve a resource even with no intention to ever use or bequeath the resource. Off. of Mgmt. & Budget, *Circular A-4* at 22 (2003).

⁹² *Id.*

⁹³ *Id.*

⁹⁴ Madrid Protocol on Environmental Protection to the Antarctic Treaty (1991), <https://perma.cc/TK73-MNNH>.

⁹⁵ U.S. Census Bureau, Characteristics of the U.S. Population by Generational Status: 2013 at 3 (2016), <https://perma.cc/AS3H-BCWK>; *see also* Pew Res. Ctr., *First- and second-generation share of the population, 1900-2017*, June 3, 2019, <https://perma.cc/Y9WT-75R4> (showing a growing percentage in recent years); *see also* Pew Res. Ctr., Key Findings About U.S. Immigration, Aug. 20, 2020, <https://perma.cc/8JEK-Y88S> (showing that 77% of the U.S. foreign-born population are naturalized U.S. citizens or permanent/temporary U.S. residents).

⁹⁶ See Pew Res. Ctr., *Remittance Flows Worldwide in 2017*, Apr. 3, 2019, <https://perma.cc/D684-7ZA8>.

⁹⁷ Many cultural sites are located near water because of how civilization developed, Yu Fang & James W. Jawitz, *The evolution of human population distance to water in the USA from 1790 to 2010*, 10 NATURE COMMUNICATIONS 1 (2019), and so such sites may be especially vulnerable to climate change, *see* Lee Bosher et al., *Dealing with multiple hazards and threats on cultural heritage sites: an assessment of 80 case studies*, 29 DISASTER PREVENTION AND MANAGEMENT: AN INTERNATIONAL JOURNAL 109 (2019). More broadly, there are clear cultural costs of climate change, W. Neil Adger et al., *Cultural dimensions of climate change impacts and adaptation*, 3 NATURE CLIMATE CHANGE 112 (2013), and a willingness to pay to protect culture, Ali Ardeshiri et al., *Conservation or deterioration in heritage sites? Estimating willingness to pay for preservation* (Working Paper, 2019).

⁹⁸ Richard Revesz & Michael Livermore, *Retaking Rationality* 129 (2008).

⁹⁹ See Arden Rowell, *Foreign Impacts and Climate Change*, 39 HARV. ENVT'L. L. REV. 371 (2015); Dana, *supra* note 87 (discussing U.S. charitable giving abroad and foreign aid, and how those metrics likely severely underestimate true U.S. willingness to pay to protect foreign welfare).

¹⁰⁰ See UNESCO, *Climate Change Now Top Threat to Natural World Heritage*, Dec. 2, 2020, <https://perma.cc/K9SW-XQDM>.

¹⁰¹ Datablog, *A History of CO₂ Emissions*, The Guardian (Sept. 2, 2009) (from 1900-2004, the United States emitted 314,772.1 million metric tons of carbon dioxide; Russia and China follow, with only around 89,000 million metric tons each).

¹⁰² See Off. Of Mgmt. and Budget, *Circular A-4* at 22 (“A general concern for the welfare of others should supplement benefits and costs equally; hence, it is not necessary to measure the size of general altruism in regulatory analysis. If there is evidence of selective altruism, it needs to be considered specifically in both benefits and costs.” Notably, in a recent survey, 64% of U.S. voters believe the United States should reduce its greenhouse gas emissions regardless of what other countries do. Yale Program on Climate Change Commc'n & Geo. Mason Univ. Ctr. for Climate Change Commc'n, *Politics & Global Warming* 4-5 (Dec. 2020) (surveying nearly a thousand registered voters after the 2020 presidential election). This majority of voters committed to unilateral U.S. action could be motivated by some combination of a preference for fairness given historic emission levels and altruism toward other countries, as well as a strategy of leading by example to promote international cooperation. *Id.*).

¹⁰³ Dept. of Treasury et al., *Foreign Portfolio Holdings of U.S. Securities* at B-3 (2020), <https://perma.cc/6VP6-PPG6>.

¹⁰⁴ Steve Rosenthal & Theo Burke, *Who's Left to Tax? U.S. Taxation of Corporations and Their Shareholders* at 2 (Urban-Brookings Tax Policy Center Working Paper, 2020), <https://perma.cc/YMR2-XREM>.

¹⁰⁵ See Dept. of Treasury et al., *Foreign Portfolio Holdings of U.S. Securities*, *supra* note 103, at exhibit 18 (detailing foreign holdings of U.S. securities by industry as of June 2019).

¹⁰⁶ For example, as of 2020, the Norway Government Pension Fund owned \$326 million in Dominion stock, Norway Government Pension Fund Global, Equity Investments, <https://perma.cc/8J66-CQHP> (last visited June 18, 2021), \$228 million in Southern Company stock, Norway GPFG, Equity Investments, <https://perma.cc/RK46-BFQV> (last visited June 18, 2021), and \$1.7 billion in Chevron stock, Norway GPFG, Equity Investments, <https://perma.cc/9QAQ-7KCD> (last visited June 18, 2021).

¹⁰⁷ See, e.g., EPA, Regulatory Impact Analysis for the Proposed Reconsideration of the Oil and Natural Gas Sector Emission Standards for New, Reconstructed, and Modified Sources at 3-13 (2018); EPA, Regulatory Impact Analysis for the Proposed Revised Cross-State Air Pollution Rule (CSAPR) Update for the 2008 Ozone NAAQS at 5-5 (2020).

¹⁰⁸ See, e.g., EPA, Draft Guidelines for Preparing Economic Analyses: Review Copy prepare for EPA's Science Advisory Board at 5-2 (2020), available at <https://perma.cc/3K86-M7AH> (“Limiting standing to citizens and residents of the United States can be complicated to operationalize in practical terms (e.g., how should multi-national firms with plants in the United States but shareholders elsewhere be treated?).”).

¹⁰⁹ Ctr. for Biological Diversity, 538 F.3d at 1198.

¹¹⁰ For example, the 1965 House of Representatives report on amendments to the Clean Air Act declared that the “United States cannot in good conscience decline to protect its neighbors from pollution which is beyond their legal control.” H.R. Rep. No. 89-899 at 5 (1965). And the Senate Report explained that “[i]t is important that we, in the interest of international amity and in fairness to the people of other countries, afford them the benefits of protective measures.” S. Rep. No. 89-192 at 6 (1965).

¹¹¹ Our World in Data, Who has contributed the most to global CO₂ emissions? (Oct. 1, 2019), <https://perma.cc/AK89-25X3>.

¹¹² See Kopp & Mignone, *supra* note 16, at 832 (explaining that the use of the global value can be motivated by an ethical principle as part of “circumspection”). Cf. Gayer & Viscusi, *supra* note 25, at 260-61 & n.8 (conceding that altruism has at least a “potential role” but suggesting it alone could not justify a global value); Gayer & Viscusi, *The Social Cost of Carbon:*

Maintaining the Integrity of Economic Analysis, *supra* note 31, at 174 (“[A]ltruism . . . will influence the domestic benefits of climate policies.”).

¹¹³ Cf. Robert W. Hahn & Robert A. Ritz, *Optimal Altruism in Public Good Provision* 23 (Cambridge Working Papers in Economics 1402, Jan. 2014) (finding a limited role for altruism in a non-cooperative framework, due to the potential for other countries to reduce their abatement efforts in response to a unilateral commitment by an individual country; but admitting that in a cooperative model, commitments can be strategic complements rather than substitutes, in which case it may be “optimal” for countries to “follow through on their altruistic preferences”)

¹¹⁴ Rowell, *supra* note 99, at 388.

¹¹⁵ See, e.g., David Anthoff et al., *Equity Weighting and the Marginal Damage Costs of Climate Change*, 68 ECOL. ECON. 836 (2009).

¹¹⁶ 2010 TSD at 11 & n.7.

¹¹⁷ *Motor Vehicle Manufacturers Ass'n. v. State Farm Mutual Auto. Ins. Co.*, 463 U.S. 29, 41-43 (1983) (emphasis added); see also *id.* (“[W]e must ‘consider whether the decision was based on a consideration of the relevant factors and whether there has been a clear error of judgment.’”).

¹¹⁸ *Id.* (internal quotation marks omitted).

¹¹⁹ A few courts have also applied arbitrary and capricious review to the use or non-use of the social cost of carbon in environmental impact statements under the National Environmental Policy Act. In *High Country Conservation Advocates v. Forest Service*, the U.S. District Court of Colorado found that it was “arbitrary and capricious to quantify the *benefits* of the lease modifications and then explain that a similar analysis of the *costs* was impossible when such an analysis was in fact possible”—specifically, by applying the IWG’s Social Cost of Carbon protocol. 52 F. Supp. 3d 1174, 1191 (D. Colo. 2014). The U.S. District Court of Oregon declined to follow suit in *League of Wilderness Defenders v. Connaughton*, but only because in that case the Forest Service had not conducted a quantitative analysis of either costs or benefits of climate change but rather addressed climate change qualitatively. No. 3:12-cv-02271-HZ (Dec. 9, 2014).

¹²⁰ 538 F.3d 1172, 1203 (9th Cir. 2008).

¹²¹ *Id.* at 1199.

¹²² 538 F.3d at 1199, 1201.

¹²³ See Average Fuel Economy Standards, Passenger Cars and Light Trucks; Model Years 2011-2015, 73 Fed. Reg. 24,351, 24,414 (May 2, 2008) (estimating that \$14 per ton of carbon dioxide approximated global benefits).

¹²⁴ 832 F.3d 654, 677 (7th Cir. 2016).

¹²⁵ *Id.* at 679.

¹²⁶ *California v. Bernhardt*, 472 F.Supp.3d at 613.

¹²⁷ *Id.*

¹²⁸ *Id.* at 611.

¹²⁹ *Id.* at 613.

¹³⁰ *Id.*

¹³¹ *Id.* at 611-12 (internal quotation marks omitted).

¹³² *Id.* at 613.

¹³³ *Wyoming v. Dept. of the Interior*, 2:16-cv-0286-SWS at 46-47 (D. Wyo. Oct. 8, 2020), available at <https://perma.cc/WG9Y-DU4Z> (italics original) (relying partly on the assumption that *Circular A-4* required separate reporting).

¹³⁴ *Id.* at 47.

¹³⁵ *Id.* at 45-46.

¹³⁶ *Id.* at 47.

¹³⁷ 42 U.S.C. §§ 4332(1) & (2)(f) (emphasis added).

¹³⁸ 42 U.S.C. § 4332(2)(f) (emphasis added).

¹³⁹ *Id.*

¹⁴⁰ *Id.*

¹⁴¹ The word “and” in this provision should be interpreted as disjunctive.

¹⁴² See *EDF v. Massey*, 986 F.2d 528, 536 (D.C. Cir. 1993) (“Section 102(2)(F) further supports the conclusion that Congress, when enacting NEPA, was concerned with worldwide as well as domestic problems facing the environment. . . . Compliance with one of the subsections can hardly be construed to relieve the agency from its duty to fulfill the obligations articulated in other subsections.”).

¹⁴³ See *NRDC v. NRC*, 647 F.2d 1345, 1387 (D.C. Cir. 1981) (J. Robinson, concurring; J. Wilkey wrote for the Court, but there was no majority opinion) (concluding that even if a conflict with another statute prevents the agency from conducting an environmental impact statement, that “does not imply that NRC may ignore its other NEPA obligations,” including the “provision for multinational cooperation” and the “policy of the United States with respect to the ecological well-being of this planet”; rather, the agency “should remain cognizant of this responsibility”).

¹⁴⁴ 42 U.S.C. § 4332(1).

¹⁴⁵ *NRDC v. NRC*, 647 F.2d 1345, 1385-86 (finding that a statutory deadline conflicted with the obligation to prepare an environmental impact statement).

¹⁴⁶ 42 U.S.C. § 4332(1).

¹⁴⁷ 42 U.S.C. § 4332(2)(f); *Greene County Planning Bd. V. Federal Power Comm'n*, 455 F.2d 412, 424 (2d Cir. 1972) (“The Commission’s ‘hands-off’ attitude is even more startling in view of the explicit requirement in NEPA that the Commission ‘recognize the worldwide and long-range character of environmental problems’ and interpret its mandate under the Federal Power Act in accordance with the policies set forth in NEPA.”).

¹⁴⁸ See, e.g., 42 U.S.C. §§ 7411(b)(1)(A), 7521.

¹⁴⁹ 42 U.S.C. § 7602(h); *Massachusetts v. EPA*, 127 S. Ct. 1438, 1447 (2007).

¹⁵⁰ Richard L. Revesz, *Bostock and the End of the Climate Change Double Standard*, 46 COLUMB.J. ENVTL.L. 1, 9 (2020). See also Howard & Schwartz, *supra* note 34, at 248 (addressing the history of the Clean Air Act). It is also notable that, since 1965, the Clean Air Act has explicitly required EPA and U.S. states to mitigate emissions that endanger the foreign welfare of countries that have granted the United States some reciprocal rights. 42 U.S.C. § 7415. Though Section 115 has not yet been invoked by EPA as authority for its climate regulations, should EPA fail through implementation of other regulations to adequately control the endangerment to other countries caused by U.S. emissions, EPA would arguably then be required to apply Section 115. Consequently, the global perspective incorporated into Section 115 should inform all regulatory actions developed under any section of the Clean Air Act. See Howard & Schwartz, *supra* note 34, at 248-49.

¹⁵¹ *Massachusetts v. EPA*, 127 S. Ct. at 1461 (emphasis added).

¹⁵² *Coalition for Responsible Regulation v. EPA*, 684 F.3d 102, 137-38 (D.C. Cir. 2012), aff'd in part, rev'd in part *sub nom. Util. Air Regulatory Grp. v. EPA*, 134 S. Ct. 2427 (2014).

¹⁵³ 49 U.S.C. § 32,902(f); accord 42 U.S.C. § 6295(o)(2)(B).

¹⁵⁴ See Howard & Schwartz, *supra* note 34, at 250-53 (reviewing relevant caselaw).

¹⁵⁵ 30 U.S.C. § 187.

¹⁵⁶ 43 U.S.C. § 1702(c) (defining “multiple use”); see also *id.* § 1701(a)(8) (declaring the congressional policy to include protection of “environmental, air and atmospheric . . . values”) (emphasis added).

¹⁵⁷ See Brief for the Institute for Policy Integrity as Amici Curiae Supporting Plaintiffs, *California v. Zinke*, No. 4:18-cv-05712-YGR at 11-15 (N.D. Cal. filed June 21, 2019), available at <https://perma.cc/6DQ4-2M2Z>; Howard & Schwartz, *supra* note 34, at 253-54 (making the case for interpreting these statutes consistent with the global social cost of greenhouse gases).

¹⁵⁸ See *supra* note 138 and accompanying text.

¹⁵⁹ S. Treaty Doc. No. 102-38; S. Exec. Rept. No. 102-55.

¹⁶⁰ U.N. Framework Convention on Climate Change art. 3(3), May 9, 1992, 1771 U.N.T.S. 107 (emphasis added); see also *id.* art. 3(1) (“The Parties should protect the climate system for the benefit of present and future generations of humankind, on the

basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities.”) (emphasis added); *id.* art. 4(2)(a) (committing developed countries to adopt policies that account for “the need for equitable and appropriate contributions by each of these Parties to the global effort”).

¹⁶¹ *Id.* art. 4(1)(f) (emphasis added); *see also id.* art. 3(2) (requiring parties to give “full consideration” to those developing countries “particularly vulnerable to the adverse effects of climate change”); *see also* North American Agreement on Environmental Cooperation art. 10(7), Jan. 1, 1994, 32 I.L.M. 1480 (committing the United States to the development of principles for transboundary environmental impact assessments).

¹⁶² Comment Letter from U.S. Sens. Feinstein, Snowe, Nelson, Cantwell, Sanders, Kerry, Durbin, Reed, Boxer, & Cardin to Mary Peters, Sec’y, U.S. Dep’t of Transp. on Proposed Rule for Average Fuel Economy Standards, Passenger Cars and Light Trucks; Model Years 2011–2015 (July 1, 2008).

¹⁶³ *Id.*

¹⁶⁴ See Philippe Sands, *Principles of International Environmental Law* 241 (2d ed. 2003) (noting that “the responsibility not to cause damage to the environment of other states or of areas beyond national jurisdiction has been accepted as an obligation by all states,” and that “there can be no questions but that Principle 21 [of the Stockholm Declaration on the Human Environment] reflects a rule of customary international law”).

¹⁶⁵ Indeed, taking a global approach to measuring climate benefits is consistent with the ideals of transboundary responsibility and justice that the United States commits to in other foreign affairs. *See* Paul Baer & Ambuj Sagar, *Ethics, Rights and Responsibilities, in CLIMATE CHANGE SCI. & POL’Y* 262–69 (Stephen Schneider et al. eds., 2009).

¹⁶⁶ Exec. Order No. 13,783 § 5(c), 82 Fed. Reg. 16,093, 16,096 (Mar. 31, 2017).

¹⁶⁷ *See supra* note 6.

¹⁶⁸ See Gayer & Viscusi, *supra* note 25, at 249 (citing Circular A-4 to argue against a global perspective on the social cost of carbon); *see also, e.g.*, Petitioners Brief on Procedural and Record-Based Issues at 70, *West Virginia v. EPA*, No. 15-1363 (D.C. Cir. filed Feb. 19, 2016) (challenging EPA’s use of the global social cost of carbon).

¹⁶⁹ The Working Group has also recognized this. 2021 Interim TSD, *supra* note 12, at 15 (“guidance towards a focus on impacts to U.S. citizens and residents is different than recommending that analysis be limited to the impacts that occur within the borders of the U.S.”).

¹⁷⁰ Off. of Mgmt. & Budget, *Circular A-4* at 3.

¹⁷¹ *Id.* at 38 (counting international transfers as costs and benefits “as long as the analysis is conducted from the United States perspective”).

¹⁷² *See* Howard & Schwartz, *supra* note 34, at 268-69.

¹⁷³ Off. of Mgmt. & Budget, *Circular A-4* at 1.

¹⁷⁴ Exec. Order No. 12,866 § 1(a), 58 Fed. Reg. 51735 (Oct. 4, 1993) (emphases added).

¹⁷⁵ *California v. Bernhardt*, 472 F.Supp.3d at 611.

¹⁷⁶ *Id.* at 612 (citing Executive Order 12,866).

¹⁷⁷ See 31 U.S.C. § 1105, Note on Annual Statement and Report on Rules and Regulations, Pub. L. 106-554, 114 Stat. 2763A-161. The authority of the Office of Management and Budget to “issue guidelines to agencies to standardize measures of costs and benefits” is limited for the purposes of “implement[ing] this section.” *Id.* § (c).

¹⁷⁸ Exec. Order No. 13,990 § 5(a), 86 Fed. Reg. 7037, 7040 (Jan. 25, 2021).

¹⁷⁹ *Id.* § 8(b), 86 Fed. Reg. at 7042.

¹⁸⁰ Complaint at 18, *Louisiana v. Biden*, No. 2:21-cv-01074 (W.D.La. filed Apr. 22, 2021), available at <https://perma.cc/KV66-YF7T> (“Circular A-4 directs agencies to consider domestic—rather than global—effects.”); *id.* at 24 (“[T]he relevant statutes direct agencies to consider domestic—not global—costs and benefits.”); *id.* at 37-38 (“[T]he IWG fails to justify its focus on global rather than domestic costs. . . . [T]he IWG does not consider that statutes require a focus on *domestic* considerations—not global ones.”).

¹⁸¹ See generally U.S. Global Change Res. Prog., *Climate Science Special Report: Fourth National Climate Assessment, Volume I* (2017) (substantiating that significant climate impacts are already underway in the United States and are projected to worsen); see also, e.g., Union of Concerned Scientists, *Underwater: Rising Seas, Chronic Floods, and the Implications for U.S. Coastal Real Estate* (2018).

¹⁸² See EPA, *Climate Change in the United States: Benefits of Global Action* at 7 (2015); see also EPA, Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment at 2 (2017) (quantifying physical and economic damages to multiple U.S. sectors, but acknowledging that only a “small portion of the impacts of climate change are estimated”).

¹⁸³ In November 2013, OMB requested public comments on the social cost of carbon. In 2015, OMB along with the rest of the Interagency Working Group issued a formal response to those comments. Interagency Working Group on the Social Cost of Carbon, *Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12,866* at 36 (July 2015) [hereinafter, OMB 2015 Response to Comments].

¹⁸⁴ 2010 TSD, *supra* note 1, at 11 (emphasis added).

¹⁸⁵ See *supra* notes 5-9 and accompanying text.

¹⁸⁶ 2010 TSD, *supra* note 1, at 11 (emphasis added).

¹⁸⁷ *Id.* (explaining that the IAMs, like FUND, do “not account for how damages in other regions could affect the United States (e.g., global migration, economic and political destabilization)”).

¹⁸⁸ See, e.g., Dept. of Defense, *National Security Implications of Climate-Related Risks and a Changing Climate* (July 23, 2015), <https://perma.cc/VA2Z-3JN2>.

¹⁸⁹ 2010 TSD, *supra* note 1, at 11.

¹⁹⁰ A domestic-only SCC would fail to “provide to the public and to OMB a careful and transparent analysis of the anticipated consequences of economically significant regulatory actions.” Off. of Info. & Reg. Aff., *Regulatory Impact Analysis: A Primer 2* (2011).

¹⁹¹ Tim Callen, *Gross Domestic Product: An Economy’s All*, IMF, <http://www.imf.org/external/pubs/ft/fandd/basics/gdp.htm> (last updated Feb. 24, 2020).

¹⁹² “U.S. residents spend millions each year on foreign travel, including travel to places that are at substantial risk from climate change, such as European cities like Venice and tropical destinations like the Caribbean islands.” Dana, *supra* note 87.

¹⁹³ *GNI, Atlas Method (Current US\$)*, THE WORLD BANK, <https://perma.cc/W2XN-8P4G>.

¹⁹⁴ *Id.*

¹⁹⁵ U.S. Off. of Mgmt. & Budget & Secretariat Gen. of the European Comm’n, *Review of Application of EU and US Regulatory Impact Assessment Guidelines on the Analysis of Impacts on International Trade and Development* at 12-13 (2008).

¹⁹⁶ OMB 2015 Response to Comments, *supra* note 183, at 36.

¹⁹⁷ NAS, *supra* note 4, at 52-53 (explaining that the 7-23% range intended to capture only impacts occurring within U.S. physical borders, which is incomplete, and that though domestic estimates may be “feasible in principle,” they are “limited in practice by the existing SC-IAM methodologies, which focus primarily on global estimates and do not model all relevant interactions among regions”).

¹⁹⁸ William Nordhaus, *Revisiting the Social Cost of Carbon*, 114 PROC. NATL. ACAD. SCI. 1518, 1522 (2017).

¹⁹⁹ Nordhaus, *supra* note 52, at 1353.

²⁰⁰ EPA, *Regulatory Impact Analysis for the Proposed Revised Cross-State Air Pollution Rule (CSAPR) Update for the 2008 Ozone NAAQS at 5A-3 to 5A-4* (2020).

²⁰¹ Christian Gollier & James K. Hammitt, *The Long-Run Discount Rate Controversy*, 6 ANNU. REV. RESOUR. ECON. 273, 287-289 (2014).

²⁰² See generally Howard & Schwartz, *supra* note 34.

²⁰³ See, e.g., Sidney I. Resnick, *A Probability Path* 203 (2013).

²⁰⁴ EPA, Regulatory Impact Analysis for the Proposed Revised Cross-State Air Pollution Rule (CSAPR) Update for the 2008 Ozone NAAQS at 5A-4 (2020).

²⁰⁵ 2016 TSD, *supra* note 1, at 17.

²⁰⁶ According to the CIA's World Factbook, <https://www.cia.gov/the-world-factbook/field/coastline/>, the coastline of the European Union plus the United Kingdom (which was in the European Union when the scaling factors were developed) is over three times longer than the U.S. coastline.

²⁰⁷ Solomon Hsiang et al., *Economic Damage from Climate Change in the United States*, 356 SCIENCE 1362–69 (2017).

²⁰⁸ David Anthoff & Richard S. J. Tol, *The Climate Framework for Uncertainty, Negotiation, and Distribution (FUND), Technical Description, Version 3.8* at 8 (2014).

²⁰⁹ *Id.* at 10.

²¹⁰ Nordhaus, *supra* note 198, at 1522.

²¹¹ GAO, Social Cost of Carbon: Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis, GAO-20-254 (June 2020).

²¹² *Id.* at 29.

²¹³ *Id.* at 26.

²¹⁴ *Id.*

²¹⁵ *California v. Bernhardt*, 472 F.Supp.3d at 614.

²¹⁶ *Id.* at 603.

²¹⁷ *Id.* at 613-14.

²¹⁸ *Id.* at 613.

²¹⁹ *Id.* at 614.

²²⁰ 2010 TSD, *supra* note 1, at 32 (explaining that FUND does include effects of migration from sea-level rise); 2021 Interim TSD, *supra* note 12, at 30 (“the incomplete way in which inter-regional and intersectoral linkages are modeled”).

²²¹ 2010 TSD, *supra* note 1, at 32.

²²² See NAS, *supra* note 4, at 51 (noting the future possibility to “calibrate global damage functions based on detailed regional and sectoral damage characterizations”); see also Ricke et al., *supra* note 86, at 895) (explaining that while the global social cost of carbon is “the right value to use from a global welfare perspective,” country-level estimates “allow us to better understand regional impacts” and “a higher spatial resolution estimation of climate damage and benefits can impact estimates of net global climate damage and its sensitivity to climate and socio-economic drivers”). Note that the Ricke et al. estimates do not capture spillover effects, *see id.* at Supplementary Table S5 (noting that “spillover” is “not fully captured”), *id.* at 899 (saying that Table S5 factors were “excluded”). Ricke et al. also concede that after factoring in spillovers and other considerations, an individual country’s interests may be more reflected in a global valuation than a country-specific valuation, and it may not be appropriate to use a country-specific valuation in setting climate policies. *See supra* note 86.

²²³ *California v. Bernhardt*, 472 F.Supp.3d at 611.

²²⁴ *Zero Zone*, 832 F.3d at 678-79.

²²⁵ *Wyoming v. Dept. of the Interior*, 2:16-cv-0286-SWS at 46-47 (D. Wyo. Oct. 8, 2020), available at <https://perma.cc/C3KT-4RQJ> (italics original) (relying partly on the assumption that *Circular A-4* required separate reporting).

²²⁶ *Id.* at 47.

²²⁷ Complaint at 18, *Louisiana v. Biden*, No. 2:21-cv-01074 (W.D.La. filed Apr. 22, 2021), available at <https://perma.cc/KV66-YF7T> (“Circular A-4 directs agencies to consider domestic—rather than global—effects.”); *id.* at 24 (“[T]he relevant statutes direct agencies to consider domestic—not global—costs and benefits.”); *id.* at 37-38 (“[T]he IWG fails to justify its focus on global rather than domestic costs. . . . [T]he IWG does not consider that statutes require a focus on *domestic* considerations—not global ones.”).

²²⁸ Dept. of Energy, Technical Support Document: Energy Efficiency Program for Consumer Products: Residential Central Air Conditioners and Heat Pumps at 14-3 & n.b., 14-6 to 14-7 (2016), <https://perma.cc/PDA2-Y2WK>.

²²⁹ *Id.*

²³⁰ H.R. 3117, 115th Cong. § 4(b)(2)(C) (2017).

²³¹ See Bureau of Land Mgmt., Regulatory Impact Analysis for the Final Rule to Rescind or Revise Certain Requirements of the 2016 Waste Prevention Rule at 7 (2018), <https://perma.cc/6XTU-8AYH> (admitting that its cost-benefit justification for the repeal turned “primarily” on “use of a domestic Social Cost of Methane, as opposed to the global values”).

²³² NAS, *supra* note 4, at 9 (continuing to say “[m]ore thoroughly estimating a domestic SC-CO₂ would therefore need to consider the potential implications of climate impacts on, and actions by, other countries, which also have impacts on the United States”).

²³³ See *supra* note 64.

²³⁴ See *supra* note 64.

²³⁵ Kotchen, *supra* note 22, at 689.

²³⁶ See generally *id.*

²³⁷ *Id.* at 688-89. Indeed, if countries could vote on a harmonized value for all countries to implement, aggregating individual countries’ preferred values and taking either the median vote, the population-weighted majority, or the GDP-weighted majority would all settle on a social cost of greenhouse gas value greater than the global estimate. *Id.* at 691.

²³⁸ *Id.* at 690 fig.3 (showing a U.S. preferred social cost of carbon of \$29 per ton versus a global value of \$40 per ton, which is based on the Interagency Working Group’s prior estimates of the global social cost of carbon at a 3% discount rate for year 2015 emissions in 2014\$, *id.* at 674). The precise percentage that Kotchen’s framework would estimate is strategically optimal to internal could change if different models produce different results about a country’s initial domestic-only share or about the total global value. But note that Kotchen assumes about the initial domestic-only shares that “the same percentages hold” whether the global social cost of carbon is \$20 per ton (from C-DICE) or \$40 per ton (from the Working Group). *Id.* at 677 n.5.

²³⁹ Freeman & Guzman, *supra* note 70, at 1542; see also Kopp & Mignone, *supra* note 16, at 833 (showing how the principle of circumspection, which can account of spillover effects, can move countries closer to a global valuation, especially when combined with strategic reciprocity); NAS, *supra* note 4, at 48 (“[I]t is now recognized that some of the most severe impacts of climate change on particular regions in specific sectors result from interactions between them and impacts in other regions or sectors (Oppenheimer et al., 2014).”).

²⁴⁰ Freeman & Guzman, *supra* note 70, at 1542.

²⁴¹ NCA4, *supra* note 71, at 608.

²⁴² See Charles Arthur, *Thailand’s Devastating Floods Are Hitting PC Hard Drive Supplies*, The Guardian (Oct. 25, 2011).

²⁴³ NCA4, *supra* note 71, at 609.

²⁴⁴ *Id.* at 608.

²⁴⁵ Leonie Wenz & Anders Levermann, *Enhanced Economic Connectivity to Foster Heat Stress-Related Losses*, SCI. ADVANCES (June 10, 2016).

²⁴⁶ Freeman & Guzman, *supra* note 70, at 1531.

²⁴⁷ *Id.* at 1568, 1569-70, 1574.

²⁴⁸ *Id.* at 1575.

²⁴⁹ See Bureau of Econ. Analysis, National Income and Product Accounts Table 6.16D, <https://perma.cc/WCC7-BXES>.

²⁵⁰ World Bank, World Development Indicators, Country Profiles, https://databank.worldbank.org/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zmn=n (2018 data; total GDP \$20,580 billion).

²⁵¹ Freeman & Guzman, *supra* note 70, at 1573-74, 1596.

²⁵² See, e.g., Paul R. Krugman, Maurice Obstfeld & Marc J. Melitz, *International Economics: Theory and Policy* (10 ed. 2015). Such changes could have an effect on overall levels of trade, in turn effecting global damage estimates.

²⁵³ Freeman & Guzman, *supra* note 70, at 1585-87.

²⁵⁴ NCA4, *supra* note 71, at 613.

²⁵⁵ Freeman & Guzman, *supra* note 70, at 1583-84.

²⁵⁶ Shuaizhang Feng, Alan B. Krueger & Michael Oppenheimer, *Linkages Among Climate Change, Crop Yields and Mexico-U.S. Cross-Border Migration*, 107 PROC. NAT'L ACAD. SCI. 14,257, 14,257-61 (2010).

²⁵⁷ Rachel Warren, *The Role of Interactions in a World Implementing Adaptation and Mitigation Solutions to Climate Change*, 369 PHIL. TRANS. R. SOC. 217, 229 (2011).

²⁵⁸ See Kevin Cromar et al., *Health Impacts of Climate Change as Contained in Economic Models Estimating the Social Cost of Carbon Dioxide* (forthcoming) (finding that improving the health-based portion of estimates, including incorporation of currently omitted health impacts, could substantially increase the magnitude of the social cost of greenhouse gas estimates).

²⁵⁹ NCA4, *supra* note 71, at 606, 613 (“[C]limate variability has been shown to affect conflict through intermediate processes, including resource competition, commodity price shocks, and food insecurity.”).

²⁶⁰ *Id.* at 613.

²⁶¹ *Id.*

²⁶² Freeman & Guzman, *supra* note 70, at 1583-84.

²⁶³ See NCA4, *supra* note 71, at 623 (concluding that the Syrian conflict may not be directly attributable to climate change).

²⁶⁴ See Ctr. for Am. Progress et al., *The Arab Spring and Climate Change: A Climate and Security Correlations Series* (2013); Colin P. Kelley et al., *Climate Change in the Fertile Crescent and Implications of the Recent Syrian Drought*, 112 PROC. NAT'L ACAD. SCI. 3241 (2014); Peter H. Gleick, *Water, Drought, Climate Change, and Conflict in Syria*, 6 WEATHER, CLIMATE & SOC'Y 331 (2014).

²⁶⁵ See, e.g., *Ending Syria War Key to Migrant Crisis, Says U.S. General*, BBC.COM (Sept. 14, 2015), <https://perma.cc/L8NR-PHF7>.

²⁶⁶ NCA4, *supra* note 71, at 613; U.S. Dep't of Def., Report on Effects of a Changing Climate to the Department of Defense 8-9 (Jan. 2019), available at <https://perma.cc/4WPP-86EN> (explaining that logistics and supply chains to the Arctic will be more complicated).

²⁶⁷ *Id.* at 8.

²⁶⁸ *Id.*

²⁶⁹ Freeman & Guzman, *supra* note 70, at 1597; see also *id.* at 1582 (noting it is difficult to put a value on a sense of safety and security).

²⁷⁰ *Id.* at 1583.

²⁷¹ Camp Lemonnier, a naval expeditionary base at the approach to the Suez Canal.

²⁷² Thule Air Base, support for NORAD; a “massive geographic area encompassing 2,400 acres of real estate.” *Security forces enhances situational awareness with Arctic command, control innovation*, U.S. AIR FORCE (May 5, 2012), <https://perma.cc/37JR-XSJ7>.

²⁷³ E.g., Guantanamo in Cuba.

²⁷⁴ Dept. of Defense, DOD Installation Exposure to Climate Change at Home and Abroad at 59 fig.45 (Apr. 19, 2021), <https://perma.cc/284V-UABN>.

²⁷⁵ NCA4, *supra* note 71, at 605, 613.

²⁷⁶ Ctr. for Climate & Security, Military Expert Panel Report: Sea Level Rise and the U.S. Military’s Mission at 7 (2d ed., 2018), <https://perma.cc/QMR3-CDBZ>.

²⁷⁷ *Id.*

²⁷⁸ *Id.* at 23.

²⁷⁹ *Id.* at 24. See also *id.* at 27 (providing Diego Garcia as a similar example: a low-lying atoll in the Indian Ocean that is home to a joint U.K.-U.S. military facility that provides logistics and operations support, but extremely vulnerable to sea-level rise and degradation of the surrounding coral that will cause wave attacks, erosions, and salinization of freshwater supplies).

²⁸⁰ *Id.* at 24.

²⁸¹ 2021 Interim TSD, *supra* note 12, at 15 (citing a 2016 figure from Bureau of Consular Affairs, Dept. of State); *see also* Bureau of Consular Aff., *Consular Affairs by the Numbers*, <https://perma.cc/6DLN-4UR3> (last updated Jan. 2020).

²⁸² GAO, Workplace Retirement Accounts: Better Guidance and Information Could Help Plan Participants at Home and Abroad Manage Their Retirement Savings, GAO-18-19, 60 tbl.2 (2018), <https://www.gao.gov/assets/gao-18-19.pdf>; Fed. Voting Assistance Prog., 2018 Overseas Citizen Population Analysis Report 6, 14 (2020), <https://perma.cc/N7WX-YVB9>.

²⁸³ U.S. Census Bureau, Characteristics of the U.S. Population by Generational Status: 2013 at 3 (2016), <https://perma.cc/4DX4-A9XD>; *see also* Pew Res. Ctr., *First- and second-generation share of the population, 1900-2017*, (June 3, 2019), <https://perma.cc/FTJ5-MQJA> (showing a growing percentage in recent years); *see also* Abby Budiman, *Key findings about U.S. immigrants*, PEW RESEARCH CENTER (Aug. 20, 2020), <https://perma.cc/U7U3-GVAK> (showing that 77% of the U.S. foreign-born population are naturalized U.S. citizens or permanent/temporary U.S. residents).

²⁸⁴ See Pew Res. Ctr., *Remittance flows worldwide in 2017*, (Apr. 3, 2019), <https://perma.cc/9HBT-V4ZS>.

²⁸⁵ Bureau of Econ. Analysis, *Direct Investment by Country and Industry*, <https://perma.cc/H3W4-9DUS> (last updated July 23, 2020) (reporting direct investments abroad—i.e., a U.S. investor owning at least 10 percent of a foreign business—as \$3.5 billion in Europe; \$0.95 billion in Asia/Pacific; \$0.91 billion in Latin America and Western Hemisphere besides Canada; and \$0.4 billion in Canada, as of 2019).

²⁸⁶ <https://foreignassistance.gov/> (last updated June 18, 2021).

²⁸⁷ NCA4, *supra* note 71, at 605 (explaining that socioeconomic effects in developing countries can undermine U.S. investments in humanitarian assistance and disaster relief).

²⁸⁸ State Dept., *Refugee and Humanitarian Assistance*, <https://perma.cc/25ZA-BTZA> (last visited June 18, 2021).

²⁸⁹ USAID, Where We Work, <https://perma.cc/KW32-4MR7> (last updated June 11, 2021); *see also* Foreignassistance.gov, HUMANITARIAN ASSISTANCE, <https://perma.cc/RFN3-5869> (last updated June 18, 2021) (showing, e.g., large awards to Ethiopia).

²⁹⁰ NCA4, *supra* note 71, at 608 (citing works on U.S. international volunteering and philanthropy, which note that private U.S. donations for overseas aid vastly outpaces any other country's donations and also exceeds the total official government aid).

²⁹¹ Richard Revesz & Michael Livermore, *Retaking Rationality: How Cost-Benefit Analysis Can Better Protect the Environment and Our Health* 121 (2008).

²⁹² *Id.* at 129.

²⁹³ See Rowell, *supra* note 99; Dana, *supra* note 87 (discussing U.S. charitable giving abroad and foreign aid, and how those metrics likely severely underestimate true U.S. willingness to pay to protect foreign welfare).

²⁹⁴ See 2010 TSD, *supra* note 1, at 11 (“There is no *a priori* reason why domestic benefits should be a constant fraction of net global damages over time.”). Similarly, given the different timescales during which pollutants like methane inflict their climate damages, the percentage relationship could be slightly different for the strategic social cost of methane as compared to the strategic social cost of carbon. See 2021 Interim TSD, *supra* note 12, at 25 n.32 (critiquing prior direct transfers of the U.S. share of the social cost of carbon to estimate the U.S. share of the social cost of methane). But for the reasons above, this is a reasonable lower bound range for all gases, as it is likely an underestimate.



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