February 13th, 2023

To:	Environmental Protection Agency
Submitted By:	Natural Resources Defense Council (NRDC)
Subject:	EPA External Review Draft of Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances (Docket ID No. EPA-HQ-OAR-2021-0317)

NRDC respectfully submits the following comments on the Environmental Protection Agency's (EPA) External Review Draft of Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances ("EPA Draft Report" or "Draft Report") filed under docket no. EPA-HQ-OAR-2021-0317.[1] NRDC (Natural Resources Defense Council) is an international nonprofit environmental organization with more than 3 million members and online activists. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment.

The EPA should adopt the Draft Report's social cost of greenhouse gas (SC-GHG) estimates because they accurately reflect current scientific and economic consensus. The EPA's new modular methodology to calculate the SC-GHG also makes it easier for the EPA to update the SC-GHG periodically to reflect advances in science and economics. NRDC's comments are summarized as:

- The EPA Draft Report accurately implements necessary updates recommended by the National Academies of Sciences (NAS).
- The Draft Report's SC-GHG estimates are conservative and should thus be viewed as a least-regrets estimate.
- The SC-GHG values in the Draft Report correctly represent global damage of incremental greenhouse gas (GHG) emissions.

[1] https://www.epa.gov/system/files/documents/2022-11/epa_scghg_report_draft_0.pdf

- Methods for imputing willingness to pay for mortality risk reductions for other countries should evolve to fairly value mortality across the world
- Now that the EPA has developed this modular up to date analysis, they should update it regularly, at least every five years, to reflect latest economic and scientific consensus.

I. The EPA Draft Report Implements Necessary Updates Recommended by the National Academy of Sciences (NAS)

The EPA Draft Report's update of the SC-GHG is grounded in up-to-date science and economics. Specifically, the EPA appropriately applies recommendations made by the NAS[2] to update both how the SC-GHG analysis is conducted and key input parameters.

A. New modular approach

The Interagency Working Group on the Social Cost of Greenhouse Gases (IWG) developed their estimate of recommended SC-GHGs by aggregating the output of the three widely accepted simple integrated assessment models (IAM). Each IAM differs in how it handles key aspects of the SC-GHG analysis. This makes it hard to aggregate the output of these IAMs and to reflect probabilities of outcomes and uncertainties inherent in the analysis. The Draft Report employs a modular approach that enables better consistency, transparency, and the representation of uncertainty and probability ranges for estimates of the SC-GHG.

The modular approach also provides "a mechanism for incorporating new scientific evidence and for facilitating regular improvement of the framework modules and resulting estimates by engaging experts across the varied disciplines that are relevant to each module."[3] Simply put, this modular approach allows the EPA to get the best out of the suite of existing IAMs and supporting data, develop a comprehensive view of the impacts of GHG emissions, represent uncertainty in said estimates, and better analyze the sensitivity of the SC-GHG

[2] NAS, *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide*, (2017)
[3] Ibid. at 7.

estimates to different key parameters. It also will enable timely updates to the SC-GHG as new scientific literature becomes available.

B. Key parameter updates

The Draft Report's major parameter updates are:

- the socioeconomic module to account for best available forecasts of global gross domestic product (GDP) growth and expected GHG emissions,
- the climate module to represent the latest scientific consensus on the relationship between carbon emissions and temperature and sea-level rise,
- the updates to the existing damage functions that connect the dots between climate impacts to economic impacts,
- improved discounting of future economic impacts by revising starting point discount rates to reflect recent economic conditions and by incorporating the relationship between discount rates and economic growth.

Table 5.1 of the Draft Report summarizes the key parameter updates that inform these SC-GHG estimates.

1. Socioeconomic module improvement

Prior SC-GHG estimates relied on aggregating damage costs of incremental carbon emissions estimated by analyzing the impact of incremental GHG emissions on a set of five independent deterministic scenarios that forecast GHG emissions and related warming levels under different feasible futures. These future projections extend to 2100; application of these scenarios beyond 2100 requires extrapolation. The Draft Report improves upon this by applying socioeconomic (and related GHG emissions) projections developed under the Resources for the Future Social Cost of Carbon Initiative; these scenarios, called the RFF-SPs are consistent with the NAS recommendations for improving the socioeconomic module.[4] These scenarios provide inputs for modeling through 2300, are probabilistic, and consistently account for the

[4] Draft Report at 19.

interrelations between population, GDP, and GHG emissions among other improvements. The RFF-SPs provide at least three advantages over the status quo:

- They can be regularly updated to reflect the changing conditions and changes in expert predictions of economic growth. The probabilities assigned to different outcomes can be re-weighted accordingly.
- As RFF-SPs predict economic growth through 2300, they enable more accurate estimation of economic damages through 2300.
- Discount rates are contingent on both current and future projections of the economy; the RFF SPs thus link discount rates with expected economic growth and therefore also enable accounting for economic growth uncertainty in how future damages are discounted.

2. Climate module improvements

The updated climate module applies latest available science to update the Finite amplitude Impulse Response (FaIR) model; the FaIR model estimates how increases in emissions result in an increase in global temperature and other climate impacts such as sea level rise.[5] Past methods relied on aggregating results from three separate integrated assessment models (IAM). Different IAMs apply different approaches to estimating climate impacts of increasing carbon dioxide emissions.

As the Draft Report further explains, the updated FaIR model "provides, with high confidence, an accurate representation of the latest scientific consensus on the relationship between global emissions and global mean surface temperature under the wide range of socioeconomic emissions scenarios."[6] The resultant ranges of emissions and temperature increase better represent uncertainties in emissions projections, physical carbon cycle uncertainty, and physical climate uncertainty (all of which are built into FaIR)[7] than the status quo.

[5] See Draft Report at 26 for more details.
[6] Ibid. at 29.
[7] Ibid. at 30.

3. Damage module improvements

The damage module also reflects recent scientific updates and accounts for three different methodologies to convert climate impacts into economic damage; one of these methods is based on meta-analysis of existing literature on climate damages.[8] This update, to account for three different methodologies, produces three different economic damage estimates that taken together provide a more expansive view of the economic harms of climate change.

4. Discount rate improvements

The Draft Report improves how consumption discount rates are applied to value future climate damages. The EPA's Draft Report starts with appropriate, albeit conservative, discount rates (1.5%, 2%, and 2.5%) that reflect recent economic conditions, and then applies a dynamic Ramsey-like approach, calibrated to the starting point discount rates, to dynamically update the discount rates based on future economic conditions (using GDP growth as a proxy). The Ramsey approach accounts for the fact that consumption discount rates would change based on changing economic conditions; specifically, consumption discount rates would be lower when per capita GDP growth slows down and vice versa. Combined with the updated socioeconomic module, that projects and accounts for the interactions between population, GDP per capita, and emissions per capita, the Draft Report can now better understand how society may value future climate damages.

II. As the EPA Correctly Explains, Updated SC-GHG Estimates are Conservative

The Draft Report states numerous times that these updated SC-GHG estimates are conservative mostly because the full scope of damages due to GHG emissions haven't been quantified and monetized. The Draft Report is clear that the "modeling implemented in this report reflects conservative methodological choices, and, given both those choices and the numerous categories of damages that are not currently quantified and other model limitations, the resulting SC-GHG estimates likely underestimate the marginal damages from greenhouse gas

[8] Ibid. at 39.

pollution."[9] Table 3.2.1 of the Draft Report illustrates that the EPA proposed SC-GHG values don't include a majority of the foreseeable impacts of climate change.

Here, we specifically focus on three omitted damages that if accounted for would result in an even higher SC-GHG: wildfire related damages which are especially significant within the United States' borders, and the environmental and ecosystem services damages due to increasing GHG emissions.

A. Health related impacts are not completely quantified and monetized

As noted in section 3.2 of the EPA External Review Draft (Omitted Damages and Other Modeling Limitations), a number of known damages are not included in the updated SC-GHG due to a lack of available data at sufficient quality and spatial/temporal resolution. Specifically, Table 3.2.1 indicates that only heat- and cold-related mortality are incorporated in the updated SC-GHG metric. Extreme event-related mortality (from storms, wildfires, and flooding) is only partially captured, while other health damages sensitive to climate exposures (e.g., infectious diseases, morbidity related to malnutrition or allergies, displacement and migration-related health problems) are not included at all. Current evidence[10] indicates that health-related costs from these climate-sensitive exposures are substantial. Importantly, existing research indicates that climate-sensitive exposures relevant to health costs for incorporation into SC-GHG extend beyond health impacts identified in Table 3.2.1 to also include human health damages related to climate-sensitive air pollution exposures (e.g., tropospheric ozone[11]), mental health problems

[9] Ibid. at 84.
[10] Limaye, Vijay S., Wendy Max, Juanita Constible, and Kim Knowlton. "Estimating the Health-Related Costs of 10 Climate-Sensitive U.S. Events During 2012." GeoHealth 3, no. 9 (September 2019): 245–65. https://doi.org/10.1029/2019GH000202.
[11] Crooks, James L., Rachel Licker, Adrienne L. Hollis, and Brenda Ekwurzel. "The Ozone Climate Penalty, NAAQS Attainment, and Health Equity along the Colorado Front Range." Journal of Exposure Science & Environmental Epidemiology, September 10, 2021. https://doi.org/10.1038/s41370-021-00375-9.

triggered by extreme events,[12] and harmful algal blooms.[13] As evidence continues to emerge on the wide array of health-related economic damages linked to climate-sensitive events, it should be incorporated into future revisions of the SC-GHG.

B. Domestic impacts from climate change-influenced wildfire are significant

Wildfire damages can broadly be divided into market damages, non-market damages, and adaptation costs. Market damages include direct market losses of goods (such as timber), services (e.g., tourism), property damage, and infrastructure damage. Non-market damages include impacts to human health and the ecosystem. Adaptation costs include the costs of suppression, aid, rehabilitation, and reforestation. As a recent study by the Institute of Policy Integrity (IPI) explains, the "current scientific consensus is that wildfire risk will increase in many regions of the world as climate change leads to warmer temperatures, more frequent droughts, and changing precipitation patterns. Fires are expected to become more frequent and intense, and fire seasons are projected to last longer. Additionally, more areas are expected to face fire risk, and scientists expect an increase in fire sizes (in terms of area burned)."[14]

This IPI study estimates that climate change induced (incremental) wildfires will cause the United Sates between $10 billion and $62.5 billion of economic damage per year by 2050, with a central estimate of $22.5 billion. This translates to roughly 0.06 percent to 0.36 percent of projected U.S. GDP. They extrapolate this domestic analysis to estimate that global economic damages would amount to around $100 billion per year by 2050.[15]

Another study by Neuman et al estimated the economic value of the impact from climate change indued (incremental) wildfires. They find that the impact on mortality, primarily due to

---

[12] Bratu, Andreea, Kiffer G Card, Kalysha Closson, Niloufar Aran, Carly Marshall, Susan Clayton, Maya K Gislason, Hasina Samji, Gina Martin, and Melissa Lem. "The 2021 Western North American Heat Dome Increased Climate Change Anxiety among British Columbians: Results from a Natural Experiment." The Journal of Climate Change and Health 6 (2022): 100116.

[13] Hoagland, Porter, Di Jin, Lara Y. Polansky, Barbara Kirkpatrick, Gary Kirkpatrick, Lora E. Fleming, Andrew Reich, Sharon M. Watkins, Steven G. Ullmann, and Lorraine C. Backer. "The Costs of Respiratory Illnesses Arising from Florida Gulf Coast Karenia Brevis Blooms." Environmental Health Perspectives 117, no. 8 (August 2009): 1239–43. https://doi.org/10.1289/ehp.0900645.

[14] https://policyintegrity.org/files/publications/Flammable_Planet__Wildfires_and_Social_Cost_of_Carbon.pdf at 1

[15] Ibid. at 1.

particulate matter from wood smoke, ranges from $ 7 million per year to $ 43 million per year depending on the amount of future global GHG emissions.[16]

Translating these damages into an adder to apply the Draft Report's SC-GHG values is complex. Any new damages introduced into the SC-GHG should be calculated consistently by applying the same future socioeconomic scenarios as included in the Draft Report, and they should also be discounted with the same methodology as is in the draft report. However, it is reasonable to conclude that without these damages being accounted for, a large fraction of which are domestic, the SC-GHG GHG estimates in the Draft Report are conservative.

C. The Draft Report's SC-GHG estimates do not include values for environmental damages

The recent Sixth IPCC Report explains how GHG induced climate change will cause irreversible damage to our ecosystems and the biodiversity within these ecosystems.[17] The value of these damages, both market and non-market, haven't been accounted for in the Draft Report.[18] The Draft Report states that the GIVE model will attempt to incorporate some non-use biodiversity values in the future.[19] This update should be prioritized.

---

[16] James E Neumann, Meredith Amend, Susan Anenberg, Patrick L Kinney, Marcus Sarofim, Jeremy Martinich, Julia Lukens, Jun-Wei Xu, Henry Roman, *Estimating PM2.5-related premature mortality and morbidity associated with future wildfire emissions in the western US* (2021); https://pubmed.ncbi.nlm.nih.gov/33868453/

[17] IPCC, Sixth IPCC Report: Summary for Policy Makers (2022), at 13. "Near-term warming and increased frequency, severity and duration of extreme events will place many terrestrial, freshwater, coastal and marine ecosystems at high or very high risks of biodiversity loss (medium to very high confidence, depending on ecosystem). Near-term risks for biodiversity loss are moderate to high in forest ecosystems (medium confidence), kelp and seagrass ecosystems (high to very high confidence), and high to very high in Arctic sea-ice and terrestrial ecosystems (high confidence) and warm-water coral reefs (very high confidence). Continued and accelerating sea level rise will encroach on coastal settlements and infrastructure (high confidence) and commit low-lying coastal ecosystems to submergence and loss (medium confidence). If trends in urbanisation in exposed areas continue, this will exacerbate the impacts, with more challenges where energy, water and other services are constrained (medium confidence). The number of people at risk from climate change and associated loss of biodiversity will progressively increase (medium confidence). Violent conflict and, separately, migration patterns, in the near-term will be driven by socioeconomic conditions and governance more than by climate change (medium confidence)."

[18] Draft Report at 73. (Table 3.2.1)

[19] Ibid. at 44.

Impacts on ecosystems and the biodiversity therein are hard to quantify and monetize.[20] However, studies that do attempt to quantify these harms indicate that Americans place a significant value on environmental harms; for example, American households report that they are willing to pay up to $95 a year (in 1993 $) to protect spotted owls.[21] The fact that one of the gravest consequences of climate change isn't included in the SC-GHG is further evidence that the Draft Report's SC-GHG estimates are conservative. In terms of public health impacts, published research led by EPA scientists indicates that wildfire smoke-related economic damages to human health are substantial. Fann et al. (2018)[22] estimated short-term fire impacts on premature mortality at $11-20 billion per year between 2008 and 2012, and long-term smoke exposures were linked to even larger economic damages to health ($76-130 billion per year over the same period). Importantly, fire-related health costs are not confined to premature mortality stemming from smoke exposures. A NRDC-led 2019 study[23] identified significant additional health-related costs linked to wildfires in two states, including costs related to lost wages, fire-related healthcare needs in emergency rooms and hospitals, and ongoing healthcare needs. The morbidity-related health costs linked to climate-sensitive exposures, including fires but also risks such as extreme heat, coastal storms, and other hazards should be incorporated into future SC-GHG revisions to better capture the economic toll to human health.

III. The SC-GHG should be based on the economic impact of global damages

The EPA's Draft Report explains why an estimate of global damages due to marginal emissions should be adopted. To summarize, GHGs are a global pollutant and GHGs emitted within the continental United States, or anywhere else for that matter, will have a global impact.

---

[20] See, for example: Holzman, Accounting for Nature's Benefits: The Dollar Value of Economic Services (2012); Elizabeth Anderson, Values in Ethics and Economics (1993), and Beckerman and Pasek, Plural Values and Environmental Valuation (1997)

[21] Loomis and White, *Economic Benefits of Rare and Endangered Species: Summary and Meta Analysis*, Ecological Economics, September 1996; https://www.sciencedirect.com/science/article/abs/pii/0921800996000298

[22] Fann, Neal, Breanna Alman, Richard A. Broome, Geoffrey G. Morgan, Fay H. Johnston, George Pouliot, and Ana G. Rappold. "The Health Impacts and Economic Value of Wildland Fire Episodes in the U.S.: 2008–2012." Science of The Total Environment 610–611 (January 2018): 802–9. https://doi.org/10.1016/j.scitotenv.2017.08.024.

[23] Limaye, Vijay S., Wendy Max, Juanita Constible, and Kim Knowlton. "Estimating the Health-Related Costs of 10 Climate-Sensitive U.S. Events During 2012." GeoHealth 3, no. 9 (September 2019): 245–65. https://doi.org/10.1029/2019GH000202.

These global impacts will have both direct and indirect adverse effects on the American economy due to the presence of American assets abroad and the global nature of our economy. The Draft Report finds that "climate change will directly impact U.S. interests that are located abroad (such as U.S. citizens, investments, military bases and other assets, and resources in the global commons (e.g., through changes in fisheries' productivity and location)). An estimated 9 million U.S. citizens lived abroad as of 2020, and the U.S. direct investment abroad position totaled $6.15 trillion at the end of 2020. Nearly 40% of U.S. pension assets' equity holdings are in foreign stocks."[24]

Given the global nature of this problem, to the extent all nations apply an SC-GHG approach to value carbon in domestic regulation and to set carbon mitigation targets, the most efficient way to apply the SC-GHG to help curb global warming and its adverse effects is for each country to adopt the same global SC-GHG estimate. If each country would adopt a domestic value of GHG, a classic tragedy of the commons would occur. Each country's GHG emissions result in damage globally, only a fraction of which occurs within that country's geographic boundary. Most of the damage occurs outside the country's geographic boundary. So, if each country accounts solely for the damage caused by its own emissions within its own geographic boundary, in aggregate the severity of the global damage will be severely undercounted, and a global tragedy of the commons would lead to global climate degradation. This hypothesis is also easily proven mathematically.[25]

In addition to all the reasons listed by the EPA in the Draft Report, Howard and Schwartz provide a more detailed justification on the importance of international reciprocity as a justification for adopting the global SC-GHG estimate.[26] They explain how other countries, including Canada, Sweden, Germany, and the United Kingdom, have strategically selected a

[24] Draft Report at 11.
[25] Matthew Kotchen, Which Social Cost of Carbon? A Theoretical Perspective 7–8 (Aug. 12, 2016), https://cenrep.ncsu.edu/cenrep/wp-content/uploads/2015/07/Kotchenpaper.pdf [https://perma.cc/BH2A-7KGV] ("The result is intuitive: the marginal benefit of emissions is equated across all countries and equal to the sum of the marginal damages of emissions. . . . That is, all countries must internalize the GSC-GHG [global SC-GHG], which then defines a unique level of Pareto optimal emissions for each country.").
[26] Howard and Schwartz, *Think Global: International Reciprocity as a Justification for the Global Social Cost of Carbon* (2017) , at 221- 232; https://policyintegrity.org/files/publications/Think_Global.pdf

global SC-GHG, that the United States has benefited from other countries' policies to account for global damage from their own emissions, and, most importantly, they explain how the United States can foster an atmosphere of reciprocity by leading with a global SC-GHG. They explain how economic "models of strategic behavior and real-world experiments suggest the United States may be able to stimulate cooperative international action by leading by example; building trust, a reputation for equity, and a critical mass of initial actors; and promoting a tit-for-tat dynamic of mutually beneficial reciprocity between nations."[27]

Finally, a global SC-GHG estimate is consistent with the Clean Air Act. For example, the Act requires EPA to establish standards for emissions of air pollutants that contribute to air pollution that "may reasonably be anticipated to endanger public health or welfare," and welfare is expansively defined to include "effects on … climate." See, *e.g.*, Clean Air Act §§ 202(a)(1) and 302(h). Greenhouse gases are air pollutants under the Clean Air Act pursuant to Supreme Court decisions[1] and amendments enacted in the Inflation Reduction Act.[2] The adverse health and climate effects of greenhouse gas pollution generated in United States do not stop at our borders. There is thus no basis in the statute to limit the scope of "public health" and "welfare" to only those effects manifested inside the Nation's borders. For these reasons, EPA would fail its legal duty to adequately consider danger to health and welfare if it were to circumscribe its analysis to domestic impacts only.

IV. Methods for imputing willingness to pay for mortality risk reductions for other countries should evolve to fairly value mortality across the world

Climate extremes due to GHG emissions lead to increased increases in mortality risk. The Draft Report currently values this health damage using different willingness to pay (WTP)

---

[27] Ibid. at 227.
[1] *Massachusetts v. EPA*, 549 U.S. 497 (2007).
[2] IRA § 60101, adding Clean Air Act § 132(d)(4); § 60102, adding Clean Air Act § 133(d)(2); § 60103, adding Clean Air Act § 134(c)(2); § 60107, adding Clean Air Act § 135(c); § 60113, adding Clean Air Act § 136(i); § 60114, adding Clean Air Act § 137(c)(4). The same definition is included in IRA §§ 60105, 60106, 60108, 60111, 60112, & 60116, which appropriate funds to EPA for monitoring, reporting, and reducing greenhouse gas emissions under provisions of the Clean Air Act and other laws.

estimates for value of mortality risk reductions (VRR) in different countries. Because VRR analysis don't exist for the vast majority of nations, the EPA imputes a VRR for other countries through a benefits transfer approach by scaling the VRR on the basis of per capita gross domestic product (GDP). The Draft Report's rationale is that the as WTP to reduce risks is dependent on how much a person earns, it is reasonable to scale with the relative wealth of the target population.[28] This general theory is also backed by evidence cited by the Draft Report that finds elasticity of WTP to be 1 for nations with low GDP.[29]

It is important to recognize that this disparity in WTP for VRR is a function of global wealth inequality. If all nations had the same per capita GDP, then the EPA's methods would lead to a VRR that is the same across the globe. Moreover, it is further important to recognize that most of the heat related impacts would occur in developing nations with a lower per capita GDP than the United States; if the Draft Report were to value VRR in those nations the same as that of the United States, then the SC-GHG estimates would be higher than the Draft Report's current estimates.

As the Draft Report notes, economic theory indicates that to satisfy Kaldor-Hicks criterion WTP for VRR need to reflect the actual views of the target population.[30] However, it is unlikely that an assumed income elasticity of 1.0 holds true for VRR across all levels of GDP. Taken to the extreme, the current EPA method also implies that the country with the lowest per-capita GDP, Burundi, has a VRR that is 0.0031 or 0.3% of that of the United States.[31] Applying the EPA's domestic value for premature mortality of approximately $10 million, the Draft Report would value premature mortality in Burundi at only $31,000. Taken to an even greater extreme, a region with no formal economy and a per capita GDP that approaches zero will have an imputed VRR of zero. It is also important to note that a larger fraction of the economies of developing countries are informal, and the outputs of these informal economies aren't completely captured in the GDP.

[28] Draft Report at 41, 128-131
[29] Ibid. at 129.
[30] Ibid. at 128
[31] See: https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?most_recent_value_desc=false

Developing a VRR for other nations is an ethical and political issue as well as an economic one. Assigning a very low VRR to the citizens of other nations politically signals a lack of concern for their health. Moreover, it may be presumptuous to assume that governments of nations with very low per capita GDP would willingly apply or accept a very low VRR for their own basic services and internal regulations.

However, NRDC also recognizes that the VRR should scale with per capita GDP to some extent. This scaling approach correctly implies that as nations grow wealthier in the future, their WTP for VRR would increase. Assigning the same VRR globally would incorrectly imply that citizens of nations with higher per capita GDP than the United States wouldn't be willing to pay for reducing mortality risk any more than citizens of the United States.

There are at least three feasible paths forward. One for the EPA Draft Report to use an equity weighted approach to estimating the SC-GHG as described by Athoff et al.[32] This equity weight would imply that a dollar damage to a person for a less affluent country has a larger material impact than a dollar damage to a person in the United States. Equity weighting would mean that damages in less affluent countries are valued at a greater amount and would to some extent counterbalance the fact that the Draft Report applies low VRR in less affluent countries. Cromar et al demonstrate that including equity weights in SC-GHG analysis leads to higher weighing of health impacts in less affluent countries and leads to an overall increase in the aggregate SC-GHG estimate.[33]

The second option is for the EPA to apply a lower bound to VRR values globally to recognize that less affluent countries will have minimum standards for valuing risks to their citizens that wouldn't be met by a VRR scaled to their per capita GDP. That is, even though the WTP for citizens of a certain region is bounded by how much wealth they have, there is a minimum value to mortality globally that shouldn't be violated. To apply this, the EPA would still impute VRR for other nations in all socioeconomic scenarios by scaling the US domestic

[32] Draft Report at 121.
[33] Kevin Cromar, Peter Howard, Váleri N. Vásquez, David Anthoff, *Health Impacts of Climate Change as Contained in Economic Models Estimating the Social Cost of Carbon Dioxide* (2021); https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2021GH000405

VRR by per capita GDP, but if the result is lower than the preset lower bound then the VRR would default to that lower bound. There isn't literature or an existing analytical method to calculate this lower bound that we are aware of, and the EPA would have to work with experts to make a policy judgement to develop this value. One application of this method could be to set the lower bound at whatever the VRR is for citizens of the United States. The final option is for the EPA to apply only two VRRs: one for the United States and one globally weighted value that wouldn't discriminate between the VRR of nations by GDP per capita.

V. The SC-GHG estimates should be regularly updated

The EPA adopts the NAS recommendation to update the SC-GHG estimate every five years. The new modular structure makes it easier to update the SC-GHG to reflect the latest scientific and economic consensus.

The starting point for estimating the SC-GHG is the RFF-SP projections of future economic growth and related carbon emissions. These projections will evolve over time as both economic conditions change, and expert consensus of most likely future economic conditions evolve. Because the impact of carbon emissions is marginal to this RFF-SP baseline, the SC-GHG will change as this baseline changes. Over time, economic conditions may also necessitate updates to the set of starting point discount rates applied to present value future climate damages. If significant progress is made to further improve damage functions, to account for health and wildfire impacts for example, then the EPA could conduct an additional mid-term update instead of waiting for the next regular update cycle.

Regular updates provide the EPA with the opportunity to continue to update the climate and damage modules so that the SC-GHG is based on the best existing scientific knowledge. At a minimum, the EPA should prioritize including the economic damages due to wildfires, health, and ecosystem impacts.

CONCLUSION

For the foregoing reasons, it is appropriate for EPA to adopt these updated estimates of the SC-GHG.

Sincerely,

/s/ Mohit Chhabra

February 13th, 2023

Mohit Chhabra, Technical Lead and Advisor, NRDC, (mchhabra@nrdc.org)

David Doniger, Sr. Strategic Director, NRDC (ddoniger@nrdc.org)

Vijay Limaye, Senior Scientist, NRDC (vlimaye@nrdc.org)