RESOURCES *for the* FUTURE

Updated Estimates of the Social Cost of Greenhouse Gases for Usage in Regulatory Analysis

Brian Prest, Kevin Rennert, Richard Newell, William Pizer, and David Anthoff

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US Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, DC 20460

Dear Administrator Regan,

On behalf of Resources for the Future (RFF), I am pleased to share the accompanying comments to the Environmental Protection Agency on the *EPA External Review Draft of Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances*, which was included as supplementary material for the November 2022 update to the proposed *Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review*.

RFF is an independent, nonprofit research institution in Washington, DC. Its mission is to improve environmental, energy, and natural resource decisions through impartial economic research and policy engagement. RFF is committed to being the most widely trusted source of research insights and policy solutions leading to a healthy environment and a thriving economy.

While RFF researchers are encouraged to offer their expertise to inform policy decisions, the views expressed here are those of the individual authors and may differ from those of other RFF experts, its officers, or its directors. RFF does not take positions on specific legislative proposals.

The authors of these comments are:

- Brian Prest, RFF Fellow
- Kevin Rennert, RFF Fellow
- Richard Newell, RFF President and CEO
- William Pizer, RFF Vice President, Research and Policy Engagement, and
- David Anthoff, RFF University Fellow; Associate Professor, University of California, Berkeley.

If you have any questions or would like additional information, please contact Brian Prest at **prest@rff.org**.

Sincerely,

Richard G. Newell

President and CEO

Updated Estimates of the Social Cost of Greenhouse Gases for Usage in Regulatory Analysis

We write to state that EPA's proposed update to the estimates of the social cost of greenhouse gases (SC-GHGs), as included in the supplementary report entitled *EPA External Review Draft of Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances* (henceforth, "EPA report"), represents the best available science.

The EPA report comes in response to EO 13990, in which President Biden instructed his administration to update the federal government's estimates of SC-GHGs to reflect the best available science in consideration of the recommendations of the National Academies of Science, Engineering, and Medicine (NASEM) in a major report, *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide (2017)* (henceforth, "NASEM report"). The NASEM report included a set of near-term recommendations, including a call to separate the SCC estimation process into four "modules"—a socioeconomic module, climate system module, damage module, and discounting module—each of which would then be improved or developed by domain experts. The NASEM report summarized these recommendations as follows (emphasis added):

- "The **socioeconomic module** should use statistical methods and expert judgment for projecting distributions of economic activity, population growth, and emissions into the future.
- The **climate module** should use a simple Earth system model that satisfies well-defined diagnostic tests to confirm that it properly captures the relationships between CO_2 emissions, atmospheric CO_2 concentrations, and global mean surface temperature change and sea level rise.
- The **damages module** should improve and update existing formulations of climate change damages, make calibrations transparent, present disaggregated results, and address correlation between different formulations. This update should draw on recent scientific literature relating to both empirical estimation and process-based modeling of damages.
- The **discounting module** should incorporate the relationship between economic growth and discounting. The committee also recommends that the IWG provide guidance on how the SC-CO_2 estimates should be combined in regulatory impact analyses with other calculations."

In that context, we would like to highlight six specific points regarding the EPA's updated estimates and their methodology:

1. The EPA report is fully responsive to all of the NASEM's near-term recommendations.
2. We fully endorse the manner in which EPA used the Greenhouse Gas Impact Value Estimator, or GIVE, model (Rennert et al. 2022), a product of RFF and University of California, Berkeley's Social Cost of Carbon Initiative, in its analysis.

3. The EPA report's updated SC-GHG estimates are the best available SC-GHG estimates, consistent with the best available science, and should therefore replace the interim estimates reported by the Interagency Working Group in February 2021 (Interagency Working Group, 2021).

4. We commend EPA's use of multiple lines of largely independent evidence on the damage functions, and the DSCIM and Howard and Sterner damage functions reflect important research efforts on the SCC that are largely independent of our work.

5. EPA's updated approach to discounting is supported by peer-reviewed economic evidence and methods. Specifically, two such key justified updates are:

    a. The change of the central discount rate from 3 percent to 2 percent, reflecting changes in market interest rates since the 3 percent rate was originally calculated in 2003, and also reflecting the consensus from the economic literature (see, e.g., Giglio, Maggiori, and Stroebel 2015; Del Negro et al. 2017, Council of Economic Advisers 2017, Drupp et al. 2018, Bauer and Rudebusch 2020, Bauer and Rudebusch 2021).

    b. The use of "dynamic discounting," which links the discount rate to the rate of consumption growth using the parameters from Rennert et al. (2021). This is particularly important to accurately capture risk, in line with standard asset pricing theory (see, e.g. Gollier 2013).

6. The shadow price of capital (SPC) approach discussed in section A.2 of the appendix of the EPA report is the correct method to account for concerns that regulatory costs may displace investment rather than consumption. Indeed, Office of Management and Budget guidance document Circular A-4 calls the SPC approach "the analytically preferred method." While it remains common to proxy for capital displacement by using a higher 7 percent discount rate based on investment returns, Li and Pizer (2021) and Pizer (2021) demonstrate this approach is generally deeply flawed, especially when impacts are long-lived, such as in the case of climate change. Newell, Pizer, and Prest (2022b) provide an example of how flawed the use of an investment rate can be in such a context and demonstrate a practical example of how to implement the SPC approach in the context of a particular Regulatory Impact Analysis. We encourage analysts undertaking benefit-cost analysis at EPA and elsewhere to use the SPC approach to account for potential concerns around capital displacement, as detailed in Newell, Pizer, and Prest (2022b).

Additional Background on the Social Cost of Carbon Initiative

RFF's **Social Cost of Carbon Initiative** was established in 2017 as a multi-institutional, collaborative effort between RFF and UC Berkeley, with additional contributors from Duke University, Harvard University, Princeton University, and the University of Washington, among others. A key goal of the Initiative has been to improve the scientific basis of the SC-GHGs in a manner fully responsive to the near-term NASEM recommendations. The Initiative delivered on that goal in a major study published in the peer-reviewed journal *Nature* in September 2022 (Rennert et al. 2022), which produced a central estimate of the SC-CO_2 of $185 per metric tonne of CO_2, for a pulse of emissions in the year 2020. The Initiative has used GIVE, developed in Rennert et al. 2022, to produce SC-GHG estimates for other emission years and for the other two major GHGs:

methane and nitrous oxide, all of which are available at **https://www.rff.org/publications/data-tools/scc-explorer/**.

The GIVE model modularizes and updates each of the four modules of SCC estimation:

- **Modularization of SC-GHG estimation methodology**. We have accomplished the modularization of the SC-GHG estimation process and corresponding improvement of transparency of the estimates through the provision of a new open-source software framework (**Mimi.jl**) for building integrated assessment models.
- **Long-run socioeconomic projections**. We have used a combination of statistical information and expert judgment to generate long-run socioeconomic projections, with associated uncertainty bounds, of global emissions and regional economic growth and population that account for future policies and dependencies between the variables. This work was published in the peer-reviewed ***Brookings Papers on Economic Activity*** (Rennert et al. 2021).
- **Improved climate model**. We have implemented the Finite Amplitude Impulse Response (FAIR, Smith et al. 2018) model highlighted in the NASEM report as used in the Intergovernmental Panel on Climate Change Sixth Assessment Report (Forster et al. 2021), coupled with the BRICK model of sea level rise (Wong et al. 2017).
- **Updated damage functions**. We have implemented updated damage functions, which relate changes to the climate to economic impacts valued in dollars, for key sectors—temperature-driven human mortality, agricultural productivity, energy expenditures on heating and cooling buildings, and coastal impacts from sea-level rise—based on recent peer-reviewed scientific literature (Cromar et al. 2022; Moore et al. 2017; Clarke et al. 2018; Diaz 2016).
- **Economic discounting**. We have developed and implemented a methodology for empirically calibrating the key discounting parameters required for implementing NASEM recommendations to link discounting with uncertain economic growth projections, while also reflecting the empirical literature on the term structure of interest rates and being consistent with near-term rates associated with related federal discounting guidance. The methodology, described **here** and **here**, has completed peer-review and was published in 2022 in the ***Journal of the Association of Environmental and Resource Economists*** (Newell, Pizer, and Prest 2022a).

GIVE represents the combination of this work and produces central estimates of the SC-CO_2 of $185 per tonne CO_2, the SC-CH_4 of $1900 per tonne of CH_4, and $55,000 per tonne of N_2O, all for a 2020 emissions pulse. The EPA report uses GIVE as a major basis for the updated estimates in the EPA report, while also incorporating damage functions from the Data-Driven Spatial Climate Impact Model developed by the Climate Impact Lab and an aggregate damage function developed in Howard and Sterner (2017). The resulting central EPA estimates for 2020 are SC-GHGs of $190 per tonne CO_2, $1600 per tonne of CH_4, and $54,000 per tonne of N_2O (EPA report Table ES.1, where all figures rounded to two significant digits).

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