The New US Social Cost of Carbon is Still Too Low

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The burning of fossil fuels clearly has costs in the form of damages resulting from climate change. However, human society has derived and continues to derive enormous benefits from the use of such fuels. The social cost of carbon (SCC) is a number that seeks to answer the critical question: In the face of climate change, how many of these benefits should we be willing forego in order to reduce carbon emissions? More specifically, the SCC is a measure of the net damages to society, as measured in dollars, caused by the release of one additional ton of CO2 into the atmosphere. An accurate estimate of the SCC is essential to determine how strictly greenhouse gas emissions should be regulated; a higher number implies that stricter regulation is optimal, while a lower number implies that the costs of such regulation may not be worth the benefits.

One of the most important individual estimates of the SCC is maintained by the US government. Since 2010, the US SCC has been a key feature of the cost benefit analyses for more than 60 finalized regulations, including vehicle, appliance, and power plant emissions standards (Rennert et al. (2021)). In addition to directly informing policy in the US, the country with the second highest annual greenhouse gas emissions, this estimate has influenced several other countries in the development of their own SCCs, with some simply adopting the US number (Carleton and Greenstone (2022); Gilfillan and Marland (2021)). In late 2022, the EPA released a technical report proposing that the US SCC be raised from $51 to $190 per ton (EPA (2022)). This nearly fourfold increase would update the US SCC to be consistent with the latest science on climate change, the damages it will cause society, and monetary valuation of those damages. However, it still dramatically understates the true costs of climate change and thus encourages systematic underregulation of carbon emissions.

To see why even this dramatically higher number is an underestimate, it first necessary to understand how estimates of the SCC are produced. The SCC is most often calculated through the use of integrated assessment models (IAMs) which model future interactions between atmospheric CO2, climate conditions, and the resulting damages to society (Carleton and Greenstone (2022)). To calculate the damages caused by an additional ton of CO2 emissions, they first estimate the present value of damages caused by climate change under currently projected emissions scenarios. They then produce another estimate of climate damages, this time using those same scenarios, but with an additional pulse of CO2 emissions. By taking the difference between the damages with and without the additional pulse of emissions, we arrive at an estimate of the social cost of carbon.

In the past few years, improvements in computing, empirical methods in the natural and social sciences, and theory surrounding the valuation of risk and optimal discounting have been incorporated into estimates of the SCC (Carleton and Greenstone (2022); NASEM (2017); Rennert et al. (2021)). These improved methodologies are what lead to the EPA’s new $190 estimate, and they have made estimates of the damages modeled by IAMs more credible than ever before (EPA (2022)). The problem, however, is the damages which remain unmodeled.

The IAMs used to produce the EPA’s new estimate have a key flaw: they only account for a small subset of the ways in which climate change will impact society. These include changes in crop production, labor supply, energy consumption, extreme temperature induced mortality, and sea level rise. They do not include changes in extreme weather events, migration, forestry, ocean acidification, water supply, fisheries, livestock health, recreation, crime, national security, trade and logistics, biodiversity, provision of ecosystem services, or patterns of disease. This is a simple result of the fact that while broad strokes changes in these excluded categories are foreseeable, they are much more difficult to reliably quantify and monetize.

This systematic exclusion of the most uncertain consequences of climate change causes underestimation of the SCC for two reasons.

First, these factors can be expected to have a net negative impact on society. While the ability to quantify damages and benefits from these pathways is limited, most of them seem more likely to cause harm than good (Interagency Working Group (2021)). The most notable exception to this is that as of now, humans’ ability to adapt to climate conditions has only been partially modeled (EPA (2022)). Completely accounting for adaptation costs and benefits has the potential to decrease climate-related damages. However, the view that the additional costs will outweigh any benefits from unmodeled adaptation is held by the authors of the 2022 EPA report themselves (EPA (2022)).

Additionally, the limited information that is available about the magnitude of unmeasured impacts indicates that they could account for a large portion of the damages caused by emissions. The Framework for Evaluating Damages and Impacts (FrEDI), a system developed by the EPA for modeling climate change impacts in the contiguous US, includes a larger variety of impacts. By 2090, FrEDI predicts that out of $600 billion of damages annually due to climate change, $142 billion will be from transportation related damages from flooding, $90 billion will be from deaths caused by changes in atmospheric ozone, and $28 billion will be from property damage caused by hurricane winds (EPA (2022)). None of these categories are included in the EPA’s global estimate.

Second, independent of whether or not the excluded factors are expected to have a negative effect on average, the high levels of risk associated with these little-understood impacts should increase the value of the SCC. This is a result of risk-aversion, the idea that we prefer certain prospects to uncertain ones with the same expected level of consumption on average. On the individual level, risk aversion is a direct implication of diminishing marginal utility of wealth (the fact that an additional dollar is worth more to people who have less to start). For example, one thousand dollars is much more valuable to an impoverished person than a billionaire despite the fact that it is the same amount of money. Therefore, as the uncertainty associated with a given lottery increases and there is an increasing potential for very high losses, the expected utility of the outcome decreases even if these high-loss cases are equaled in expectation by the potential for very large gains. As the losses become larger, each additional unit of loss becomes more harmful, while as the gains become larger, each additional unit of gain becomes less beneficial.

Estimates of the SCC already account for some sources of uncertainty in their calculations. In practice, economists value risk in a given distribution of possible outcomes by computing a “certainty equivalent.” That is, the certain level of wealth which would make a risk averse agent indifferent to taking their chances with the uncertain distribution. In recognition of the high levels of uncertainty associated with climate change, this style of explicit risk valuation has recently become standard practice in contemporary IAMs (Interagency Working Group (2021)). This in turn has led to significantly increased estimates of the SCC and is one of the forces behind the EPA’s proposed increase (Lemoine (2020); EPA (2022)).

However, excluding poorly understood sources of climate damages also means excluding large sources of uncertainty. Even if we have no idea whether these currently unmodelled consequences of climate change can be expected to benefit or harm society on average, they still add a large amount of societal risk to further emissions of greenhouse gasses. Thus, even assuming that the expected value of the influence of unmodeled factors on net damages is 0, a highly conservative assumption, explicitly acknowledging the fact that the actual number could be either above or below the expectation would increase the certainty-equivalent value of the SCC. In fact, the current approach amounts to excluding the largest sources of climate damage uncertainty (selected precisely because so little is known that they cannot be easily modelled) from the risk valuation process.

It is important to recognize and appreciate that the proposed change to the US SCC is a solid improvement on past estimates. If implemented, it would strengthen the justification for serious emissions reduction policy, and the conservative modelling choices made by the EPA make it more resilient to legal challenges from groups that benefit economically from polluting activities. At the same time, it is simply not good enough. As long as the SCC is both influential and underestimated, governments will be making suboptimal policy decisions that disproportionately value short term economic benefits over the health of the planet that we depend on to survive. Luckily, this may not be inevitable. The EPA’s 2022 report states an intent to regularly update the US SCC in the future (EPA (2022)). In subsequent estimates, the agency should seek to explicitly model more of these currently excluded damages or use other methods to value uncertainty caused by their existence.

References

Carleton, T., & Greenstone, M. (2022). A guide to updating the us government’s social cost of carbon.

Review of Environmental Economics and Policy, 16(2).

Gilfillan, D., & Marland, G. (2021). CDIAC-FF: global and national co2 emissions from fossil fuel

combustion and cement manufacture: 1751–2017. Earth System Science Data, 13(4), 1667–1680. doi: 10.5194/essd-13-1667-2021

Interagency Working Group. (2021, February). Technical support document: Social cost of carbon,

methane, and nitrous oxide interim estimates under executive order 13990 (Tech. Rep.).

Lemoine, D. (2020, April). The climate risk premium: How uncertainty affects the social cost of carbon

(Working Paper No. 15-01). University of Arizona.

National Academies of Science, Engineering, and Medicine. (2017). Valuing climate damages: Updating

estimation of the social cost of carbon dioxide (Tech. Rep.). Washington, DC. doi: 10.17226/24651

Rennert, K., Wagner, G., Pindyck, R. S., Sterner, T., Anthoff, D., Cropper, M., . . . others (2021).

Comprehensive evidence implies a higher social cost of co2. Nature. doi: 10.1038/s41586-022-05224-9

United States Environmental Protection Agency: National Center for Environmental Economics. (2022,

September). Report on the social cost of greenhouse gases: Estimates incorporating recent scientific advances (Tech. Rep.). Washington, DC 20460.