



## Thinking About The Social Cost Of Carbon

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On Tuesday, the House Science Committee held a hearing to examine the Social Cost of Carbon (SCC). The SCC is an estimate of the total impact—most of which will occur in the future—from an additional ton of CO<sub>2</sub> emitted today. To advance its climate agenda, the Obama Administration built an interagency working group (IWG) to calculate the SCC (presently \$39 per ton) and used the value to justify regulating greenhouse gas emissions. The SCC faces an uncertain, but probably bleak, future as a regulatory tool under the Trump Administration, and it is not clear that it deserves a better fate. But it is still worth thinking about the statements offered to the committee and what SCC calculations tell us about the scale of climate risks.

The Republican majority invited testimony from Patrick Michaels of the Cato Institute, Kevin Dayaratna of the Heritage Foundation, and Ted Gayer from the Brookings Institution. Their critiques emphasized that the SCC is essentially arbitrary, mostly reflective of the political agenda of the IWG, and too high. The main objections levied by Michaels and Dayaratna were that the Obama Administration's calculations assume too much warming from CO<sub>2</sub> emissions, underestimate the positive effects of increased CO<sub>2</sub>, and favor low discount rates to accentuate damages in the far future. Gayer argued that it is inappropriate for domestic rules to be justified by accounting that emphasizes global damages over domestic damages.

Building a model to calculate the SCC is hard, because climate change is most harmful in the future. Every analyst engaged in this exercise faces choices over how to estimate future emissions of CO<sub>2</sub>, how to properly calibrate the climate response to those emissions, and how to relate the climate response to economic and environmental costs. That series of assumptions can make the calculations appear arbitrary.

In the course of calculating the economic harms of climate change, moreover, everyone knows such calculations are incomplete. For every climate activist who objects that ocean acidification or biodiversity loss are not included in these calculations, there is a climate skeptic objecting to the exclusion of CO<sub>2</sub> fertilization of plant crops or the localized benefits of warming. The

National Academies of Sciences just completed a multi-year study on how such calculations can be brought to firmer footing, but the answer involves a lot more research.

At best, the models we have now could be thought of as representing the *reasonably quantifiable* impacts of CO<sub>2</sub> emissions, hopefully on the back of a well calibrated climate model, and a guess at how climate change will affect economic and social well being.

On top of these more technical matters, one can't avoid normative choices about how highly we should value future damages in the present, how to weigh the risk that climate change could be more or less harmful than expected, and how to account for inequality in how climate damages are distributed economically and geographically.

There are three leading models that are used to calculate the SCC, and their authors present SCC values over a wide range. A new paper from economist William Nordhaus puts the SCC at \$30 per ton (nearly double his previously published value from 2015). Richard Tol forwarded values as low as \$13 per ton in a paper earlier this year. Climate economist Chris Hope cites values of \$250 per ton in the United States. The models produced by those three economists (each has his own collaborators) were the backbone of the Obama Administration's SCC estimates. The IWG SCC calculations aimed to harmonize those models with a common set of inputs and still found their SCC values could vary by a factor of 2 or 3 (telling you that the technical disagreement is perhaps smaller than the ethical choices being made).

If the peer-reviewed literature yields estimates that vary by so much, based on who is doing the calculation, what is the policymaker to think? How can we discriminate between what can be done in the realm of climate economics modeling and what should be done as a matter of public policy?

This criticism is important because it underlies one of the key arguments we see from opponents of climate action: that the costs of climate change are impossible to know, or too hard to estimate, and could be small. For many on the Right, when the potentially small benefits of climate action are held against the (unjustifiably) certain and large costs of climate action, the benefits of climate action might not be worth the risks.

Consider the examples offered during Tuesday's hearing. They laid forth a non-exhaustive list of factors that could, in some combination, lead to a small SCC for regulatory purposes:

- The response of the climate to additional CO<sub>2</sub> will be modest.
- The discount rate for climate damages should be high.
- Only domestic damages should be considered.

Let's examine each in turn and ask if it is a reasonable—or at least defensible—proposition.

One way of arriving at a lower SCC is to choose lower end values of climate response to CO<sub>2</sub>, or climate sensitivity. The latest IPCC report holds that doubling atmospheric CO<sub>2</sub> will eventually lead to temperature increases in a likely range of 1.5-4.5 °C, but doesn't specify a probability distribution. Kevin Dayaratna's testimony favored low probability distributions for climate

sensitivity, all based on empirical studies of recent warming. The study of **Lewis and Curry**, for example, offers some of the lowest credible values for sensitivity, **1.24-2.45 °C**. Unsurprisingly, Dayaratna's analysis finds much lower values of SCC, because each ton of CO<sub>2</sub> causes relatively less warming when sensitivity is low.

It is not clear, however, that a low climate sensitivity is actually a better choice for calibrating an SCC calculation. The method used to calculate such low values of climate sensitivity fails to include important regional dynamics in the climate response, and this has been shown to bias it toward low values. Moreover, by relying on only one (low) measure of climate sensitivity, we are arguably embracing a probability distribution that is inconsistent with the 4-5°C temperature increase between the last ice age and today. We are also arguably accepting, without evidence, the story that future warming will be significantly moderated by cloud formation or some unknown stabilizing force.

Even if some lower values of climate sensitivity are acceptable, the SCC remains at just about half of its original value—though it can be made lower by increasing the discount rate (placing a relatively higher value on the wellbeing of present generations than future ones). The study cited above shows that at discount rates of 5 or 7%, one of the models used by the IWG can even produce negative SCC values (in combination with lower climate sensitivity), implying that CO<sub>2</sub> emissions are a net positive and could justifiably be subsidized.

Debates over discounting are longstanding in climate analysis, but as my colleague Jerry Taylor wrote last year, economists who study climate change are inclined to choose lower discount rates because of the inter-generational transfers and long timescales associated with climate change. Higher discount rates are suitable for short-term analyses because they match returns in markets, but such high discount rates would trivialize even very large future damages. They also ignore uncertainty, and thus considerations of risk.

Under more moderate estimates of climate sensitivity and conventionally applied discount rates, the SCC as presented by most economists is a global value. When confined only to domestic damages, Ted Gayer explained that the SCC is estimated to be between 4-14 times less than the global value, so less than \$5 per ton if you accept the IWG numbers.

In the course of evaluating federal regulations, the arguments for presenting the domestic benefits that result from cutting emissions, which bears a domestic cost, make some sense. And yet, the character of climate change is that damages will be largely experienced outside our borders. It is not clear why this should be ignored, both for altruistic reasons and strategic considerations. Altruistic reasoning would compel us to consider the global costs of our actions, even without reciprocal action from other countries. Basic game theory argues that if we have any hope of encouraging other countries (e.g., China and India) to maintain or accelerate climate action, then the United States should show some willingness to price carbon near a reasonable global value for the SCC.

Analysts on any side of the climate debate can find problems with the SCC as a regulatory instrument. The damages from climate change that will accrue 50, 100, or 250 years into the future are impossible to verify, and how much present value to assign them is purely a matter of social preference. Hence, why not adopt a low value for the SCC and rest it on the assumptions

that the climate response to CO<sub>2</sub> will be as mild as currently thought possible? Why not decide that climate damages in the future can be heavily discounted? And why not ignore climate damages outside our borders? The same questions, however, can be asked of skeptics. Why not assume, out of caution, that climate sensitivity is at the higher end of possible range? Why not decide that future damages should not be so heavily discounted? Why not care about what we are doing to the planet (and people) outside of our borders?

Congress has left those choices with the administrative state for now, but they are values disputes that are best wrestled with directly by Congress. Why the conservative or libertarian position in those values disputes is to act without precaution, handwave damages to posterity, or to endorse acting with total disregard for the pain and suffering our emissions will cause people abroad is a mystery to many.