Report recommends new framework for estimating the social cost of carbon

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To estimate the social cost of carbon dioxide for use in regulatory impact analyses, the federal government should use a new framework that would strengthen the scientific basis, provide greater transparency, and improve characterization of the uncertainties of the estimates, says a new report by the National Academies of Sciences, Engineering, and Medicine. The report also identifies a number of near- and longer-term improvements that should be made for calculating the social cost of carbon.

The social cost of carbon (SC-CO2) is an estimate, in dollars, of the net damages incurred by society from a 1 metric ton increase in carbon dioxide emissions in a given year. The SC-CO2 is intended to be a comprehensive estimate of the net damages from carbon emissions —that is, the net costs and benefits associated with climate change impacts such as changes in net agricultural productivity, risks to human health, and damage from such events as floods. As required by executive orders and a court ruling, government agencies use the SC-CO2 when analyzing the impacts of various regulations, including standards for vehicle emissions and fuel economy, regulation of emissions from power plants, and energy efficiency standards for appliances.

The federal Interagency Working Group on the Social Cost of Greenhouse Gases (IWG) developed in 2010 a methodology to estimate the SC-CO2. The National Academies committee that authored the report was charged with examining potential approaches for a comprehensive update to this methodology to ensure that SC-CO2

estimates reflect the best available science. The committee was not asked to estimate a value for the social cost of carbon.

The IWG's methodology uses three distinct models to estimate the economic consequences of CO2 emissions. First, a baseline of CO2 emissions is defined along with projections of underlying socioeconomic factors—global economic growth and population—decades into the future. Then, a small increase in CO2 emissions is added to the baseline for each of the three models, which is translated into an increase in atmospheric CO2 and a resulting increase in global mean temperature. These results are used to estimate potential net damages in dollars, using discounting to convert future damages into present dollars. The final IWG analysis averages the results from the three models.

The report recommends that the IWG "unbundle" this process and instead use a framework in which each step of the SC-CO2 calculation is developed as one of four separate but integrated "modules": the socioeconomic module, which generates projections of greenhouse gas emissions based on its estimates of population and world economic output; the climate module, which translates changes in emissions into changes in temperature; the damages module, which estimates the net impact of temperature changes in dollar terms; and the discounting module. Data generated by the socioeconomic module would feed into each of the other three modules, and the temperature changes generated by the climate module would inform the damages module. Each module would be developed based on expertise in the relevant scientific disciplines to reflect the most up-to-date research. The report offers detailed recommendations about how the IWG should develop each of the modules and how the proposed framework could include feedbacks between and interactions within the modules.

The current SC-CO2 methodology uses constant discount rates of 2.5 percent, 3.0 percent, and 5.0 percent. The report notes that differences

in the discount rates have large impacts on the estimates; the SC-CO2 estimates per metric ton emitted in 2020 is $62 using a 2.5 percent rate, $42 using a 3.0 percent rate, and $12 using the 5.0 percent rate (in 2007 dollars).

Instead of using fixed discount rates, the discounting module should incorporate the relationship between economic growth and discounting for calculating the rates, which would help account for uncertainty surrounding discount rates over long time periods, the committee said. The IWG should clearly state how the SC-CO2 estimates should be combined with other types of cost-benefit estimates in regulatory impact analyses.

The committee outlined several other recommendations that would be feasible to implement in the next two to three years and would improve the analysis:

- The socioeconomics module should use statistical methods and expert input for projecting distributions of economic activity, population growth, and emissions into the future.
- The climate module should employ a simple Earth system model that satisfies well-defined diagnostic tests to confirm that it properly captures the relationships over time between CO2 emissions, atmospheric CO2 concentrations, and global mean surface temperature change and sea-level rise.
- The damages module should improve and update existing formulations of climate change damages. This update should draw on recent scientific literature related to both empirical estimation and process-based modeling of damages.

Efforts by the IWG to estimate the SC-CO2 focus primarily on total global damages because the impacts of CO2 emissions are global regardless of where they originate. While estimating net damages per ton

of CO2 emissions to the United States alone is "feasible in principle," the report says, these efforts are limited by existing SC-CO2 methodologies. Thorough estimates of U.S.-specific damages would need to consider how climate change and CO2 reductions in other parts of the world could also impact the United States - for example, through increased migration because of economic or political destabilization, and through reciprocal actions by other countries in response to U.S. emission reductions.

The IWG should update the SC-CO2 roughly every five years following a regular, three-step process. This process will ensure that for each update, the components of each module, module feedbacks and interactions, and the SC-CO2 framework itself are consistent with the current state of scientific knowledge as reflected in peer-reviewed literature. Key uncertainties and sensitivities should be adequately identified and represented in technical support documentation, and uncertainties that cannot be or have not been quantified should also be identified. In addition, documentation should explain and justify choices, and the presentation of results should be transparent.

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