Social cost of carbon: What is it, and why do we need to calculate it?

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The social cost of carbon can help us weigh the costs and benefits of climate regulations. Credit: Sandor Somkuti

There are many policies that could potentially curb carbon dioxide emissions and slow global warming. Some are projected to cost trillions

of dollars for governments and taxpayers. And yet, society will also pay a price if it doesn't do enough to combat climate change. According to a new survey, if we don't act fast, climate change could cost the world some $1.7 trillion a year by 2025, increasing to about $30 trillion a year by 2075. The Fourth National Climate Assessment found that if global temperatures rise 2.4˚C, it could result in a loss of 0.5 to 2.5% in GDP by 2090; if the temperature rise reaches 4.7˚C, GDP loss could reach 6%. (For comparison, millions of Americans lost their jobs and were thrust into poverty when the GDP fell by 3.5% in 2020. A study focusing on the U.S. estimated that the GDP would decrease by 1.2% for every 1˚C increase in global warming.

Since both paths present economic risk, it's essential to figure out what policies aimed at curbing climate change make sense from a cost-benefit perspective. The social cost of carbon (SCC) is used to estimate in dollars all economic damage that would result from emitting one ton of carbon dioxide into the atmosphere. It indicates how much it is worth to us today to avoid the damage that is projected for the future.

The social cost of carbon is used to help policy makers determine whether the costs and benefits of a proposed policy to curb climate change are justified. A higher SCC generally means that the benefits of a particular climate policy to cut CO_2 justify its cost; a low SCC makes a policy seemingly cost more than the benefits it ultimately delivers. Theoretically, the SCC should increase over time because physical and economic systems will become more stressed as the impacts of climate change accumulate.

How is the social cost of carbon calculated?

To arrive at the SCC dollar amount, information is fed into three computer models that link social, economic and physical features into one framework. The models integrate four types of information:

1. Socioeconomic predictions: For example, what will the population be in a given future year? How much will the economy grow? How much manmade carbon emissions will result?
2. Climate projections: How will the climate respond to emissions? How long will CO_2 remain in the atmosphere? How fast will sea levels and temperatures rise? What types of extreme weather could there be?
3. Benefits and costs: How will climate change affect agriculture? How much will adapting to sea level rise cost? How does additional warming affect energy use? How will workers' productivity be affected?
4. The discount rate: Since most benefits from policies will come in the form of avoided damage in the future, and the policy will be paid for today, the discount rate indicates the rate at which society is willing to trade present benefits for future ones. A high discount rate implies more greatly valuing the money in hand, and spending less today to allow future generations to bear more of the costs; a low discount rate indicates a willingness to spend more today to protect future generations.

In a 2015 survey of 197 economists, the majority favored a discount rate between 1 and 3%. Some economists would prefer using a discount rate pegged at the market rate of return, maintaining that we can only ensure that projects make economic sense if they are evaluated at the market rate.

What the social cost of carbon doesn't include

The amount of information from these four perspectives fed into the models that determine the social cost of carbon cannot be complete or comprehensive, however, because there are so many unquantifiable and uncertain climate impacts. For example, how much human conflict could

result from climate change impacts and what could that cost? What will be the effect of societies adapting to climate change? What will climate migration cost governments? The three models also make different projections about climate emissions and their impacts, and they inherently make political and moral judgments, such as how much do we value our children and grandchildren's welfare, or that of vulnerable populations in other countries. As a result, SCC estimates can vary greatly.

The three models are run hundreds of thousands of times using different values for uncertain variables and parameters. Because of the array of estimates that result, the SCC is usually represented as a range of values, not as a single number. For practical purposes, however, a central case value is chosen to be the SCC, which is the average of all of the estimates at a particular discount rate.

As we go forward, SCC models will continue to improve, incorporating updated science and data, but the addition of new uncertain elements into the calculation will also likely expand the range of the SCC.

Some economists oppose the SCC, arguing that the calculations are based on too many unknown factors and thus can be altered to justify any policy. Others say the models don't consider the benefits of increased carbon emissions, for example, on agricultural production. And still others say calculation of the SCC should not take global impacts of carbon emissions into consideration since most climate impacts will be experienced outside of the U.S. However, a 2016 court ruling upheld the legality of using the SCC for cost-benefit analyses of proposed regulations.

Evolution of the social cost of carbon

In 1981, President Ronald Reagan issued an executive order requiring

federal agencies to analyze the costs and benefits of the regulations they wanted to impose, and cost-benefit analyses have been essential to rulemaking ever since. However, climate impacts were not originally included.

That changed after the Center for Biological Diversity sued the federal government in 2008 over new fuel economy standards that were not set to the "maximum feasible" level, claiming that because the government had not accounted for the future costs of climate impacts, it had essentially valued the benefits of emissions reduction at zero. The court ruled in the center's favor, requiring federal agencies to thereafter include the impacts of the cumulative effects of greenhouse gas emissions in their cost-benefit analyses. An Interagency Working Group was established to develop an estimate for the social cost of carbon to be used by the federal government. Over the years, the group has periodically updated its modeling and the SCC to incorporate the latest science.

Trump disbanded the Interagency Working Group in 2017, so federal agencies had to rely on an "interim" SCC. During his administration, the SCC was cut to $1 a ton, a price too low to make climate policies economically justifiable. Trump's EPA reached this figure because it did not include global impacts in its calculations; it also used a 7% discount rate, which put more burden on future generations.

The Biden administration has given the interim SCC a value of $51 using a discount rate of 3%; this is the figure the Obama administration used, adjusted for inflation.

The reinstated Interagency Working Group will incorporate the latest scientific and economic information and finalize an updated SCC by January, 2022. This SCC iteration will incorporate updated science and impacts that have not been considered before, such as ocean

acidification, environmental justice for vulnerable groups, and the welfare of future generations.

The Interagency Working Group will also review the social costs of methane and nitrous oxide, which Biden has temporarily set at $1,500 per ton of methane emissions and $18,000 per ton of nitrous oxide. The values are higher than the SCC for carbon dioxide because these emissions cause more warming, health impacts, and economic damage in the short term.

Early in March, 12 mostly Republican states, concerned about the economic impacts of new regulations, filed a lawsuit against the Biden administration for setting the SCC. The suit contends that the Biden administration has violated the separation of powers because the right to dictate "binding values for the 'social cost of carbon'" rests not with the president, but with Congress.

How the social cost of carbon is used

Here's how the SCC is applied. For policies that potentially increase emissions, the tonnage of increased emissions is multiplied by the SCC; the result becomes part of the policy's cost. For policies that cut emissions, the decrease in tonnage is multiplied by the SCC and added to the benefits side of the equation.

For example, say new regulations for appliances are being proposed that are expected to cost $40 million, and cut carbon emissions by 1 million tons at a SCC rate of $51 per ton. Because the benefits would be worth $51 million, $11 million more than the cost, the policy would be justified. A lower SCC would result in the costs of the proposed regulation outweighing its benefits.

According to the Electric Power Research Institute, between 2008 and

2016, 65 federal rules and 81 subrules used the SCC to develop regulations for power plants, set energy efficiency requirements for appliances, and establish fuel economy standards, emissions standards for hazardous air pollutants, and performance standards for solid waste incineration facilities.

The Biden administration is expected to apply its new "final" SCC more extensively across the federal government to policies such as government procurement (for example, justifying the government purchase of electric vehicles), and the permitting of highways and pipelines.

The social cost of carbon's central value has also been used to set the dollar amount for carbon taxes and for subsidies, according to Noah Kaufman, formerly a research scholar at Columbia University's Center on Global Energy Policy, now a senior economist for Biden's Council of Economic Advisors. He said the SCC has been used in federal carbon tax proposals, Minnesota's solar subsidy for rooftop solar energy producers, and subsidies for nuclear power plants in New York and Illinois, to name a few examples.

The social cost of carbon and fighting climate change

"The SCC is very useful and essential in rule-making and how it is currently being used in the federal government," said Peter Marsters, a research associate at the Center on Global Energy Policy. "If you want to know the damages caused by a ton of carbon, and make sure that any rule or project that we do ends up being beneficial for society, you need the social cost of carbon in order to do that."

Some experts, however, believe the U.S. doesn't have the political will to set the social cost of carbon high enough to incentivize the transition away from fossil fuels that needs to happen over the next few decades. In 2006, economists Joseph Stiglitz and Lord Nicholas Stern wrote that

Obama's SCC was too low to justify the policies that are necessary to keep warming to 1.5˚ to 2˚C; they recommended an SCC of $100 per ton by 2030.

No matter how high the SCC is set, however, it alone will probably not get us where we need to go. To decarbonize society, Marsters believes that we need a large suite of policy tools—including a carbon price, standards to make production cleaner, massive investments in renewable technology, and research and development for new technologies. "If your goal is to reduce emissions quickly in the U.S., focusing on the exact social cost of carbon is a separate conversation," he said. "I think there's a lot of other policy tools that you don't need the social cost of carbon for that can effectively and efficiently reduce emissions."

In their 2020 paper, Marsters and Kaufman suggested an alternative to the SCC: Policy makers should set a date when they want to achieve net-zero emissions—which will allow temperatures to stabilize and warming to stop—then use models to figure out what the cost of carbon needs to be to get on that pathway. The process should be reiterated every 10 years to take into consideration rapidly changing technology. Tackling emissions in this way would enable jurisdictions to stay close to their desired emissions pathways without having to make policy decisions based on assumptions about long-term and uncertain variables.

"We have models that can take a look at the energy and emissions system—with enough certainty for policymakers to make decisions on—and if you put in some [specific value for a] carbon tax, can tell you how the markets and energy systems will respond," said Marsters. "That is a much simpler problem to solve than, say, looking at the global and generational damages of [climate change]."

In their paper's scenario, the researchers found that carbon prices of $32, $52 and $93 per metric ton (in 2018 U.S. dollars), if implemented in

2025, would achieve net-zero targets in 2060, 2050 and 2040, respectively.

The U.K. and the E.U. have already adopted this "target consistent" approach to setting a carbon price and are using it to assess policies. However, it can only work in countries that have legally defined emissions reduction targets.

"The target in our work is net-zero emissions," said Marsters. "The target in the social cost of carbon is climate damages. And damage from carbon will still be there, even if we get to net-zero. So, they're kind of asking two different questions." Ultimately, we need to address both to avoid climate catastrophe.

Marsters doesn't believe that identifying the proper SCC should be a hurdle to decarbonization. The more critical question is, can we even get a carbon tax, clean electricity standard or any significant climate legislation in place, given the current political makeup of Congress? There were 10 carbon tax bills proposed in Congress last year, he said, with prices ranging from $40 to $125 per metric ton. "All of them would reduce emissions significantly in the U.S., and would be by far the most ambitious climate policy the U.S. has ever proposed… [A]ll of them would deliver significant reductions. So don't let the perfect be the enemy of the good—if we could get the true social cost of carbon, great, that would work as a [carbon] tax rate. But the first order is making sure we can pass policies and get policies in place that get us on a pathway to net zero."

More information: Gauging Economic Consensus on Climate Change: policyintegrity.org/files/publ … pdf?utm_campaign=Hot%20News&utm_medium=email&_hsmi=118865891&_hsenc=p2ANqtz—GgVOSJDH92x66CMJUsCCqCJTLs0UdQt95g9D2rM4VndRobHpcBo-5gD_zH_SVXRw1NDuWvXKX3XEUs-

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