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CLIMATE CHANGE

How do we define climate pollution's cost to society?

Every year, the government recalculates how much money a metric ton of carbon costs us.

Elizabeth Shogren | DC DISPATCH | Jan. 27, 2016 | Web Exclusive

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In a 2007 [ruling](#) on a dispute concerning fuel economy standards for cars, a judge sent a clear message to federal agencies. They could no longer continue business as usual and fail to account for climate change when assessing the costs and benefits of regulations. “The value of carbon emissions reduction is certainly not zero,” Judge Betty B. Fletcher wrote in her opinion for the U.S. Court of Appeals for the Ninth Circuit. And by treating it as such, her opinion declared, the government was acting in an arbitrary and capricious fashion.

So, if the cost of polluting is not zero, what is it? Fletcher’s ruling challenged government officials to come up with a dollar amount that represents how much a ton of carbon pollution will “cost” society over the long run. Economists refer to this as the *social cost of carbon*.

The concept is still evolving and will only become more important to understand as governments grapple with how to address climate change in the most effective and least costly manner.

It was in early 2009 that White House officials decided it was time to develop a unified way for agencies to estimate the social cost of carbon. They knew passing comprehensive climate legislation during the Great Recession would be difficult. They wanted a plan B that would help President Obama address global warming through regulations if legislation failed.

But regulations would force industries to adopt low-carbon energy options, which would be costly. Thus, the administration needed a way to prove that the benefits of reducing carbon dioxide emissions would be worth it. “We needed a way to convert carbon dioxide into dollars,” recalls [Michael Greenstone](#), a University of Chicago economist who, at the time, was the chief economist on the White House Council of Economic Advisors. Greenstone led a multiagency working group to come up with the government’s approach.

Calculating a social cost of carbon is complicated. First off, climate change affects many aspects of society, including public health, environment, agriculture, natural disasters and economies. Also, scientists are still figuring out many basic questions of climate science, such as exactly how much pollution it takes to increase concentrations of carbon dioxide in the atmosphere and boost temperature on Earth. A puff of carbon dioxide emitted today stays in the atmosphere for a couple hundred years, continuing to contribute to climate change. The damages from the concentration of greenhouse gases in the atmosphere — everything from heat waves to sea level rise — are felt across the globe. So the social cost of carbon has to reflect a stream of damages across time and around the globe.

The interagency group turned to academic researchers who had been studying the economics of climate change and calculating its social cost for decades. Their methods and outcomes differed. So, the government opted to utilize three widely-used models, taking the average of the three to derive the federal government’s official estimate.

First, the models estimate how a metric ton of carbon pollution will impact concentrations of greenhouse gases in the atmosphere. Second, the models estimate how those concentrations will affect temperature on Earth. Third, they analyze how increases in temperature will translate into a range of impacts such as the loss of usable dry land because of sea level rise; stresses to agriculture from droughts; and increased need for air conditioning.

Discount Rate

To account for the fact that carbon emitted today will have impacts decades from now, the models require a [discount rate](#), which tries to answer the question: How much money is it worth to today’s society to avoid damages for future societies?

A discount rate works basically like an interest in a bank account, explains UC Berkeley research fellow [Danny Cullenward](#). Imagine that climate change will result in a heat wave in 2100 that causes \$1 billion in destruction, in 2100 dollars. How much would you be willing to pay now, in 2015, to avoid those damages? With a 2.5 percent discount rate, you would need to invest almost \$123 million today in order to have \$1 billion in 2100. With a 3 percent discount rate you would only need to invest \$81 million, and with a 5 percent discount rate, \$16 million. A lower discount rate calculates a higher cost of carbon.

Revised Social Cost of CO₂, 2010 – 2050 (in 2007 dollars per metric ton of CO₂)

Discount Rate Year	5.0% Avg	3.0% Avg	2.5% Avg	3.0% 95th
2010	11	33	52	90
2015	12	38	58	109
2020	12	43	65	129
2025	14	48	70	144
2030	16	52	76	159
2035	19	57	81	176
2040	21	62	87	192
2045	24	66	92	206
2050	27	71	98	221

Social costs of carbon, calculated by year and by the various discount rates. For instance, in 2015, the cost with the 5% rate was \$12 per ton of carbon.

Interagency Working Group on Social Cost of Carbon. United States Government

The working group couldn’t agree on one discount rate. So the [group recommends](#) that agencies consider four social costs of carbon per year, when crafting regulations. That’s one for each of the three interest rates and a fourth to reflect the possibility that the planet will heat up faster and damages will be greater than currently expected.

Government agencies just need to multiply these numbers by the tons of carbon their regulations are expected to either reduce or increase. And voila, they have the carbon costs or benefits of their regulations.

For example, if the social cost of carbon in 2030 is \$48, the EPA could multiply that by 413 million short tons (this regulation uses the measurement short tons instead of metric tons) of carbon dioxide, which is the amount the agency expects will be kept out of the atmosphere that year under the Clean Power Plan. That means the regulation that year theoretically will save society \$20 billion.

That’s with the 3 percent discount. But because the government uses four social costs of carbon, regulations designed to reduce carbon emissions show a broad range of possible benefits. For example, the Environmental Protection Agency’s [analysis](#) of its [Clean Power Plan](#) cites benefits in carbon dioxide reductions in 2030 that range from \$6 billion to \$60 billion.

Uncertainty

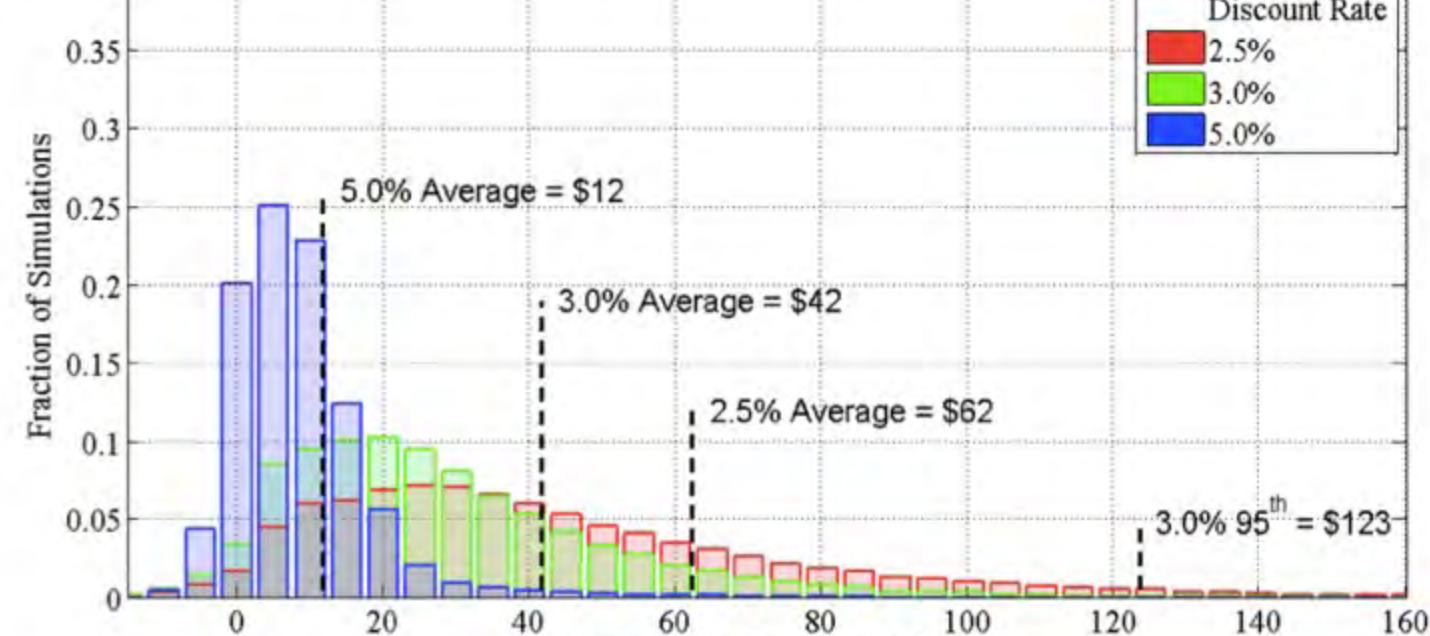
There’s lot of uncertainty that goes into estimating the social cost of carbon. For instance, climate scientists still are figuring how sensitive global temperatures are to increases in carbon pollution. So, when calculating its social cost of carbon, the government ran the models thousands of times using various temperature projections. The science also continues to evolve on the many damages expected from climate change such as forest fires, floods, sea-level rise and heat waves.

The government also used five different estimates of economic and population growth.

Distribution of USG SCC Estimates for 2020



- For 2020, the SCC values are: \$12, \$42, \$62, & \$123 (2007\$/metric ton CO₂)*



NCEE * Includes November 2013 and July 2015 technical corrections.

The government’s range of social cost of carbon estimates for the year 2020. The highest discount rate predicts \$12 per ton of carbon, and the lowest rate predicts \$62.

Courtesy Environmental Protection Agency

“These models are guesses at best; there’s an enormous amount of uncertainty,” says David Weisbach, a University of Chicago economist. Not only are the estimates uncertain, but they evolve over time. In 2013, the government revised its estimates to reflect updates in climate science, and in 2015, made additional tweaks. To make the cost more transparent, Weisbach’s research group [created a website](#), which anyone can use to see how widely the social cost of carbon can vary depending on the assumptions applied.

Weisbach is an author of one of a handful of recent academic articles that argue that the government’s numbers are far too low because the models the government uses assume that the global economy will continue to grow over the next 200 to 300 years, even in the face of extreme climate change. One of these [articles](#), published in 2015 by the journal *Nature Climate Change*, found that social costs of carbon should be several times higher to reflect the impact severe climate change likely would have on economic growth.

Given these and other criticisms, the interagency working group asked advice from the [National Academy of Sciences, Engineering and Medicine](#), which appointed a group of engineers, climate scientists and economists to review the government’s estimates and consider ways to update the methodology. Its first report, in January 2016, did not recommend any major short-term changes but suggested ways to better communicate uncertainties. A more comprehensive and final report is expected in 2017.

While the government’s approach to assessing the social cost of carbon is imperfect, it represents a huge improvement from 2007 when Judge Fletcher called out the government for failing to assess the cost of climate change impacts. “This is 100 percent better than zero,” Cullenward says.

The University of Chicago’s Greenstone [argues](#) that the government would do well to start using its social cost of carbon to set rates for royalties and leasing federal fossil fuels. His calculations suggest such a policy would have little impact on oil and gas, but huge implications for coal because its market value is a fraction of the cost of the climate damages from extracting and burning it.

Elizabeth Shogren is HCN’s Washington, DC, correspondent. [Follow @shogrene](#)

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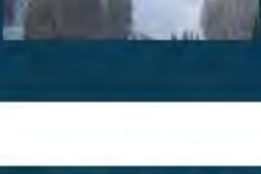
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