Q&A: The social cost of carbon

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The social cost of carbon (SCC) has been called "the most important number you've never heard of" because it underpins climate regulations in countries including the US and Canada. It's one way to put a price on CO2 emissions – but the Trump administration may try to amend it.

In this detailed Q&A, Carbon Brief looks at the basics, the science and the politics of the social cost of carbon, as well as the legal situation in the US. You can read all the way through the piece, or jump straight to the section you need with the droplinks, below.

Carbon Brief has also produced a timeline, above, showing the key dates in the scientific, regulatory and legal history of the social cost of carbon. You can scroll through the slides using the arrows in the timeline.

What is the social cost of carbon?

Scientists expect climate change to have increasingly negative consequences for society, from rising sea levels to more frequent heatwaves. There is broad agreement that initial, modest benefits – for instance, increased yields for some crops in some regions – will be outweighed by costs as temperatures rise.

Even those who see climate change as a relatively minor problem agree that damages will exceed benefits above 1.1C of warming. Moreover, the world is already experiencing record-hot temperatures around 1C above pre-industrial levels. So how much should we be willing to pay to avert future climate damages?

One way to get a handle on this question is through the social cost of carbon (SCC), which tries to add up all the quantifiable costs and benefits of emitting one additional tonne of CO2, in monetary terms. This value can then be used to weigh the benefits of reduced warming against the costs of cutting emissions.

As we will see, estimates of the SCC are highly uncertain. This does not mean the SCC is zero. In fact, there is an argument that this uncertainty actually increases the SCC. This implies that the most rational response would be to mitigate against the risks of warming as a form of climate insurance. To borrow a phrase, the SCC could well be the worst way to value CO2 – except for all the other ways to do it.

Before we move on, a couple of important technical points. First, since CO2 emitted today will persist in the atmosphere for thousands of years, the SCC incorporates future costs, discounted into today's money. We'll take a look at discounting, below.

Second, strictly speaking, the SCC is the social cost of CO2, not simply carbon, and it is usually measured in dollars, pounds or euros per metric tonne of CO2. You might see it shortened to SC-CO2, to distinguish it from estimates of the social cost of methane (SC-CH4). We use SCC throughout this article, referring to CO2.

What's the point of the social cost of carbon?

Climate change is a classic market failure. The costs of emitting CO2 are borne by society at large, whereas the benefits accrue to those burning fossil fuels. In order to correct the market failure – for instance, with a carbon tax – we need to know the social cost of those CO2 emissions.

Moreover, when governments measure the costs and benefits of a policy or investment decision, they need a value for CO2 emissions. If the SCC is high, then the benefits of cutting CO2 are large and costly climate actions will be justified. If the SCC is low, regulations might be more trouble than they're worth.

If the world acts like a perfect economic model, then the "optimum" amount of climate effort is where the additional costs of cutting further emissions are balanced by the benefits of limiting further warming. Again, if we are uncertain about the optimum level of mitigation, this doesn't mean the correct answer is "zero".

How do you calculate the social cost of carbon?

Scientists estimate the social cost of carbon using models that represent our society, the world's climate and the ways they interact. This is a marriage of physics and economics. There are three main models in use – DICE, FUND and PAGE. See below for more on the models and how they differ.

These integrated assessment models (IAMs) join together four elements.

First, there are socioeconomic projections: How many people will be alive in 2150? How fast will the economy grow next century? How much CO2 will humans emit?

Second, there is a "climate module": How will the climate change in response to CO2 emissions? How quickly will sea levels or temperatures increase? What about rainfall patterns and extreme weather events?

Third is benefits and damages: How will climate change affect crop yields? What is the cost of living with, or adapting to sea level rise? How do increased temperatures affect labour productivity or energy use for heating and cooling? How can we value non-market impacts, such as loss of species and habitats?

Finally, the fourth element uses discounting to value future benefits and costs in today's money. Future damages tend to dominate SCC estimates, because CO_2 persists in the atmosphere for thousands of years and damages increase as temperatures rise. As a result, discounting has a big impact, see below for more.

Each of the four elements in the models is uncertain and incomplete. They also interact strongly. For instance, sea level rise could damage property and reduce future economic growth. See below for more details on how these issues affect our understanding of the social cost of carbon.

Why do SCC estimates vary?

Estimates of the social cost of carbon vary because of different assumptions about future emissions, how climate will respond, the impacts this will cause and the way we value future damages. As an example, the chart below shows the wide variation between model estimates of benefits and damages caused by each tonne of CO_2.

Climate damages increase with economic growth, which tends to put more assets at risk and creates wealthier people who are more willing to pay to avoid impacts. This means that IAMs' assumptions and equations for GDP growth are important, too.

The models calculate how much GDP is cut by climate impacts, but often do not allow damages to alter the rate of GDP growth. This means they could tend to underestimate the severity of economic losses.

Climate impacts are also non-linear, so the impacts of moving from 1.5C to 2C are greater than an increase from 0.5C to 1C. This means that the social cost of carbon will be lower if emissions are tightly controlled, whereas it will be higher if they are not. This complicates the idea that the SCC can be seen as the amount we should be willing to pay to avoid future damages.

How important is climate sensitivity?

Part of the calculation for SCC is a basic calculation of how scientists think the global climate responds to CO_2 emissions. This is known as the equilibrium climate sensitivity (ECS) and is defined as how much the temperature rises if we double CO_2 above preindustrial levels (from ~280ppm to 560ppm).

In its latest report, the Intergovernmental Panel on Climate Change (IPCC) put the likely value for ECS in the range 1.5-4.5C. (Note this isn't total expected warming, it's the warming per doubling of CO_2. If emissions stay as high as they are, we're on course to more than triple the preindustrial concentration by 2100.)

However, the three models used to calculate SCC (see later section) are built around the ECS range from an earlier IPCC report published in 2007. That version had an ever-so-slightly higher likely range for ECS of 2-4.5C, which has led to claims by some climate sceptics that the SCC should be recalculated.

The US National Academies of Science, Engineering and Medicine (NAS) examined just this question, as part of its recent examination of whether the SCC needed an update. The answer was no, since updating the change in ECS "would not significantly improve the estimates", all other things being equal.

In other words, while scientists agree on the need to refine the value of climate sensitivity, it is not a major source of difference between estimates of SCC. Far bigger influences come from how the models represent the climate system, the expected costs for a given temperature rise and the discount rate.

There is another way to look at climate sensitivity, too. Rather than what the temperature would be once the climate system balances out completely, there is a simpler metric known as the Transient Climate Response (TCR). This is the temperature at the time when we reach a doubling of CO2, assuming an idealised situation where the concentration rises by 1% per year. The TCR doesn't allow for very slow processes, such as the exchange of heat between the atmosphere and deep ocean.

Some scientists argue that the TCR is a more appropriate metric for calculating how the climate responds to emissions on timescales of a few decades and, therefore, a better measure for estimating the social cost of carbon, though the two metrics are directly linked. Observations tend to offer tighter agreement on the TCR than the ECS, suggests Prof Myles Allen, a professor of climate system science at the University of Oxford who helped compile the recent NAS report. "On this first step of calculating the social cost of carbon…there is actually much higher consensus than probably most people think," he tells Carbon Brief.

How important is the discount rate?

Discount rates are one of the most contentious and consequential aspects of social cost of carbon estimates. The effects of climate change will be felt over many hundreds of years, whereas cutting emissions costs money now.

How should we weigh the value today of costs and benefits in future? Economists approach this question using discounting. One way to measure this is "social time preference", reflecting human impatience. People would rather have $100 now than $100 in 10 years. They might even take $70 now over $100 in 10 years.

A second approach is the "social opportunity cost" of a choice between alternative investments. If you invest $70 at an interest rate of 5%, you would have $114 after 10 years. Some argue that investing in climate mitigation ought to give a better rate of return than the market. Others ask if high, debt-fuelled returns can last and, additionally, argue that uncertainty about future growth translates into lower discount rates.

The choice of discount rate strongly affects the social cost of carbon. The current US SCC ranges from $10 at a 5% discount rate through to $50 at 2.5% (see below). The conservative thinktank the Heritage Foundation calls for a 7% rate, which it says would reduce the SCC by 80%.

A high discount rate suggests those alive today are worth more than future generations. A third approach to discounting, based on ethics, says this is wrong, and argues for a very low or even zero rate. This is why the Stern Review on the economics of climate change published in 2006 adopted a rate of 1.4%.

US government guidance is to use discount rates of both 3% and 7% for valuing costs and benefits within a single generation of, say, 30 years. It suggests using a lower rate, for time horizons that cross generations.

UK government guidance from HM Treasury is to use a 3.5% rate. However, it says: "The received view is that a lower discount rate for the longer term (beyond 30 years) should be used." It sets out a sliding scale falling to 1% for time periods greater than 300 years.

In a major survey of 197 economists, the average long-term discount rate was 2.25%. The survey found almost all were happy with a rate of between 1 and 3%, whereas only a few favoured higher figures.

To learn more, check out David Roberts' fun piece on discounting and otters, which introduced one of the thought experiments above. For a longer treatment, try this OECD paper on approaches to carbon valuation.

What's missing from the SCC models?

The US government uses three publically available IAMs to work out the value of SCC (see later section). IAMs work by translating greenhouse gas emissions into climate change impacts and then calculating a monetary cost to those impacts in dollars per year.

As well as changes in global temperature, IAMs account for changes to agricultural productivity, sea level rise, rainfall changes, extreme weather and risks to human health, to varying extents.

Such impacts are "quantifiable", in the sense that they can be assigned a monetary value. But the IAMs used by the US government to calculate SCC aren't generally considered fully up to date in terms of the latest science. They are predominantly based on literature from the 1990s and early 2000s, since which time the science has evolved substantially. Sea level rise, heat extremes, tropical cyclones, agriculture and labour productivity are among the topics where IAMs fall short, according to the NAS.

To date, the gradual acidification of the oceans as they absorb excess CO2 – a process known as ocean acidification – is not accounted for in any of the models used to calculate SCC. Ocean acidification is recognised as a global problem because of the damage it does to fisheries and ecosystem services.

Some climate impacts can have socioeconomic impacts that are troublesome to translate into a dollar cost. Falling into this category of "identifiable but hard to quantify" impacts are, for example, civil conflict and human migration. Others, such as biodiversity loss and ecosystem services, may be included partially or in some models but not others. Such limitations have led to the criticism that the IAMs are inherently skewed towards inaction, since it is easier to see the costs of mitigation than the benefits of not emitting.

To some extent, IAMs are also limited in how effectively the different "modules" talk to each other. As such, some models only partially account of climate impacts that scientists think can, in turn, raise or lower emissions, known as "feedbacks". One example is the extra greenhouse gas burden from methane escaping from thawing Arctic permafrost. Collapse of the polar ice sheets, the switch of the Amazon from a rainforest to a savannah and permafrost thaw are all examples of climatic "tipping points"- critical thresholds which, if crossed, can trigger an "abrupt" shift from which it is difficult or impossible to return.

Pinpointing the timing and impact of these thresholds in the real world is far from straightforward, though some have tried. One recent attempt at accounting for five potential tipping points caused the carbon cost to rise around 50%, from $37 to $56. A similar attempt using a different model saw the baseline CO2 price to jump by around 35%. But other IAMs exclude tipping points altogether, leading to the argument that the overall calculation of SCC downplays the potential for extreme damages from climate change.

Understanding of complex human-climate interactions, such as how competition for resources influences food prices, is building in the scientific literature, but these links are beyond the capabilities of the simplified IAMs used to calculate SCC. This also goes for impacts in one sector or region that spill over into another.

Some argue that until such a time that IAMs are better able to reflect the full depth and range of known climate impacts, they grossly underestimate the risks and remain "untethered from economic realities".

How else can we price CO2 emissions?

The social cost of carbon is an attempt to put a price on CO2 emissions. For all the reasons set out above, the SCC is extremely uncertain, posing problems for policymakers and investors.

One alternative is to choose a temperature limit first, drawing together scientific and economic evidence along with political and ethical considerations. This, in a nutshell, is how world leaders agreed on the 2C limit that was tightened to "well below 2C" in the Paris Agreement, which pledges efforts towards 1.5C.

Working backwards, it's then possible to set a path for emissions consistent with these warming limits and, subsequently, to determine the carbon price that would be needed to move onto that path. The UK, for instance, has adopted a "target consistent" carbon price that it uses to weigh different policy options.

This approach has two key advantages over the SCC. First, it avoids many of the uncertainties that plague SCC calculations. These uncertainties, the UK government argued, include some "potentially catastrophic" impacts of warming. Second, it makes it more likely the UK will actually reach its carbon targets.

The EU has also moved away from policy appraisal based on the SCC towards a target-consistent approach. However, this is only an option for countries or blocs with an agreed, legally defined emissions reduction target. This does not apply to the US.

Some countries use a mixture of approaches, combining SCC estimates, target-consistent pricing, carbon taxes or market pricing determined via cap-and-trade schemes.

A survey of 23 richer OECD nations and the European Union found wide variations in the approach to and level of carbon valuations. For policy appraisal, it found countries including Chile, Canada, the US, France, the UK and Germany using an average 2014 price of $56/tCO2, rising to $115 in 2050.

Canada has adopted the US approach to calculating the SCC, but also recently agreed a national price of C$10/tCO2 ($8), rising to C$50 in 2022 ($38 at current exchange rates). Provinces are allowed to apply the price as a direct carbon tax or via a carbon cap-and-trade scheme.

China will start the world's largest carbon market later in 2017, when its national cap-and-trade scheme opens. Thousands of major companies also use an internal carbon price, including Shell ($40/tCO2), BP ($40) and Exxon ($80). This hedges their investments if a CO2 tax were to be adopted.

It's important to remember that even those that ignore carbon pricing are making a choice about the price of CO2 emissions, which they are implicitly putting at zero.

Why does the US have a SCC?

In 2009, it was Barack Obama who ordered a uniform US social cost of carbon be drawn up for the first time, but, indirectly, Americans also have Ronald Reagan, Bill Clinton and George W Bush to thank for the measure.

In 1981, Ronald Reagan enacted Executive Order 12291, which required all agencies to assess the costs and benefits of their intended regulations. This was later revised under Executive Order 12866, brought in by Bill Clinton in 1993.

Neither were directed towards climate change policies, specifically, but they did lay the groundwork for later efforts under the George W Bush administration to incorporate a cost of carbon into policymaking.

This came in 2006, when the Department of Transport said that its new fuel economy standards would cut millions of tonnes of CO2. However, it deemed the economic benefits of reductions too uncertain to estimate and, therefore, set them to zero.

The US Court of Appeals disagreed. "While the record shows that there is a range of values, the value of carbon emissions reduction is certainly not zero," it ruled, after the Center For Biological Diversity challenged the government in court, setting the stage for the incorporation of the SCC into future policies.

The task then remained to determine what the SCC should be. The agencies of the Bush administration began using a variety of methodologies to determine the right dollar figure to incorporate into new regulations.

It was under Obama that the government started taking a consolidated approach, with an Interagency Working Group on the Social Cost of Carbon set up in 2009 to develop a single set of estimates that could be incorporated into US policymaking.

How did the US government calculate the SCC?

In 2017, the government makes policy based on the assumption that each tonne of CO2 costs $39. It's a simple number that is calculated in a complicated way — and it changes every year, rising as climate change causes greater stress to the planet and the economy.

Each annual figure, for each discount rate, is pulled from 150,000 estimates. These are based on 10,000 runs of each of the three models, with a different value of climate sensitivity picked at random each time, for five socioeconomic scenarios. Each model is given equal weight.

The values for 2010, 2020, 2030, 2040 and 2050 are calculated by combining all outputs for all scenarios and models for a given discount rate, with the years in between estimated based upon these figures. The 95th percentile is also given to indicate the potential for less likely, but more extreme, impacts.

How has the US SCC changed over time?

While the official US SCC was calculated in 2010, the number that the Interagency Working Group came up with was never intended to be static. The researchers acknowledged that the state of science and economics would improve over time and so, too, could their estimates.

They set themselves a goal of revisiting the SCC "within two years or at such time as substantially updated models become available".

Over the following seven years, the researchers made good on this goal, updating the SCC several times. These adjustments range from minor tinkerings to major changes. The first update, in May 2013, saw the social cost of carbon rise by 55-71% for the three discount rates (from $7 to $12, $26 to $43, and $42 to $65 for discount rates of 5%, 3%, and 2.5%).

The major increase in SCC in 2013 was a result of updates to the three models, including the representation of damage from sea level rise, updated assumptions on adaptation and a revision in the treatment of potentially abrupt shifts in the climate.

The National Academies of the Sciences, Engineering and Medicine (NAS) are also closely involved in updating the SCC, in particular in providing advice on the methodology used to calculate it.

It has been responsible for providing two reports so far. The first, published in 2016, suggested ways to enhance transparency and improve the characterisation of uncertainty — which have been incorporated into the SCC — and the second, recent report, which suggested broader changes to the calculation process.

What are PAGE, DICE, FUND, and how do they differ?

To calculate SCC, the Interagency Working Group (IWG) pools the outputs from three different Integrated Assessment Models (IAMs).

DICE (Dynamic Integrated Climate-Economy model) is developed by William Nordhaus, a professor of economics at Yale University. FUND (Framework for Uncertainty, Negotiation and Distribution model) was originally developed by Richard Tol, a professor at the University of Sussex, but is now co-developed by Tol and David Anthoff, assistant professor at the University of California. PAGE (Policy Analysis of the Greenhouse Effect model) is developed by Chris Hope from the University of Cambridge, UK.

These three IAMs are specifically built for estimating the impact of climate change on human welfare, which makes them most appropriate for calculating SCC, though they were not developed solely for this purpose. All three models are fundamentally built in the same way, in that they contain the same four basic "modules" – socioeconomic, climate, damages and discounting. But there are major differences.

Big discrepancies arise in the way each model translates emissions into warming. Given an incremental increase in emissions in 2020, the temperature response by 2040 is almost twice as high in DICE than in FUND. With all three models using a common climate sensitivity distribution, these differences are largely down to how they deal with the carbon cycle and non-CO2 factors, such as methane and black carbon.Even bigger differences between the models come in their estimation of the expected damages from climate change. For the same amount of warming and societal conditions, economic damages in the models vary by a factor of three over the next century, as the graphic below shows. Annual global damages grow substantially beyond 2100 in all three models, but much faster in DICE and PAGE than FUND. DICE and PAGE predict the largest damages from sea level rise, despite FUND projecting the largest increase in sea levels. This is because FUND assumes much of the damage is avoided through adaptation. FUND is the only model to predict net benefits at low levels of warming. In some cases, differences between the models are less a reflection of scientific uncertainty and more a result of "uncoordinated modeling choices" by the individual model developers, according to the NAS. FUND's developers, for example, say on their website the model "reflects its developer's world views" and is, therefore, "regularly contrary to the rhetoric of politicians and occasionally politically incorrect".

Overall, the version of PAGE used by the IWG in its latest assessment (PAGE09) projects the highest value for SCC in 2020, with $74 per tonne of CO2 at a discount rate of 3%. This is nearly twice as high as DICE (DICE-2010R) at $40, and more than three times higher than FUND (FUND3.8) at $22.

In general, the IWG has incorporated new versions of the three models in its various updates. But since the last major computation, both the DICE and FUND models have had new iterations.

The SCC in the latest version of DICE (DICE-2016) has a considerably higher SCC than previous incarnations. For a discount rate of 3%, the SCC in DICE2016 is 75% higher than DICE-2013R ($87 compared to $50), which is itself 25% higher than DICE2010R, the version used by the IWG ($40).

Among the changes in the newest version of DICE is an update to the damage function to account for some errors in an underlying study by one of the developers of the FUND model, Richard Tol, which implied that warming up to 2C had net benefits. This raises the important point that the three IAMs are not entirely independent of each other, relying partly on damage estimates from each other.

Why is the SCC an important influence in US policymaking?

In the US, the SCC is more than just an academic exercise — it informs how the government makes its policies.

According to a search of the government Federal Register, the SCC is currently a factor in 69 final rules and a further 80 proposed rules. According to a recent paper, regulations written to include the SCC in the US have more than $1tn of benefits. Such regulations generally consist of energy-saving programs, forest conservation, fuel-economy standards, and emissions performance standards, including the Clean Power Plan.

Agencies are encouraged to consider all four calculated values for the SCC when drawing up rules, reflecting the different discount rates and the one high-end scenario.

What's the future for the SCC under the Trump administration?

There have been early indications that Trump's team will target the SCC, as they go about the process of trying to unravel Obama's climate policies.

Trump's personal engagement with the SCC has been brief, but to the point. In 2016, at the start of his campaign, he gave the following answers to a questionnaire sent by the American Energy Alliance:

It's clear that those surrounding him are no fans of the metric. A questionnaire sent by Trump's transition team, which they later disavowed, to the Department of Energy asked:

"Can you provide a list of all Department of Energy employees or contractors who have attended any Interagency Working Group on Social Cost of Carbon meetings? Can you provide a list of when those meetings were and any materials distributed at those meetings, email associated with those meetings, or materials created by Department employees or contractors in anticipation of or as a result of those meetings?"

In addition, Tom Pyle, head of Trump's transition energy team, sent out a memorandum referencing the SCC. Under the heading, "Ending the use of the social cost of carbon in federal rulemakings", it says:

"The Obama administration aggressively used the social cost of carbon (SCC) to help justify their regulations. During the Trump administration the SCC will likely be reviewed and the latest science brought to bear. If the SCC were subjected to the latest science, it would certainly be much lower than what the Obama administration has been using."

Many Republicans are against the SCC. A bill introduced by West Virginian representative Evan Jenkins, co-sponsored by 24 Republicans, attacked the SCC on the grounds that its use wasn't transparent and "ignores sound science in order to eliminate the exploration, mining, production, and use of our abundant domestic sources of fossil fuel energy"

Why do opponents object to the SCC?

Opponents to the SCC have focused on several lines of attack.

One point frequently raised is that the SCC in the US considers global costs of CO2 emissions, rather than the impacts that merely afflict the US. Calculating the SCC based on domestic costs alone would significantly decrease the value, since the majority of the impacts of climate change will not be felt within US borders. Regulations using the SCC "appear to pass cost/benefit tests when they actually do not confer net benefits on Americans," Robert Murphy, an economist at the Institute for Energy Research, told a senate committee.

In response to this criticism, the US Court of Appeals has said that "global effects are an appropriate consideration when looking at a national policy." There is obviously an ethical argument to be made. By reducing spending on climate change, many elements of the natural world — endangered and species old-growth forests, for example — could be consigned to history. Their value cannot be captured purely through a dollar figure. Meanwhile, worse climate change will increase suffering in developing countries.

Another common contention is the discount rate, with many suggesting that the current discounting options overprioritise future generations. David Kreutzer, from the conservative think-tank Heritage Foundation, has argued that the discount rate should be 7%, which would dramatically lower the SCC value compared to the current central value of 3%.

Other economists, however, have argued that only a zero discount rate, valuing future generations at the same level as today's, is ethically justifiable. US and UK government guidance suggests using low discount rates when looking at long time periods, see above for more details.

There are also geographical factors to consider. Using a high discount rate assumes that the money saved on mitigation will be invested elsewhere, generating more wealth for future generations. But where will this future wealth be concentrated? The main beneficiaries are unlikely to be those in countries that will be most impacted by climate change.

Others on the right have argued that the models do not take into account the "benefits" of increased CO2 emissions, or that the models overestimate the impact of CO2 on global warming (see discussion of climate sensitivity and modelling above). The latter point has been dismissed by Cambridge economist Chris Hope, developer of the PAGE model. Often, it is simply argued that the SCC is too uncertain to be used in government regulations, with the final outcome too dependent on factors such as discount rates and long-term predictions of climate impact and the economy, to be meaningful.

"The social cost of carbon is a concept which is easily gamed to fit the desires of the user," writes Paul Knappenberger, of the Cato Institute, a libertarian think-tank founded by Charles Koch. This is also the line taken by IER, headed by Tom Pyle, who led Trump's energy transition team. Laying out its position on the SCC, it says: "We have been arguing that the very concept itself is far too dubious to be used in federal policymaking."

Each of these arguments was tested leading up to a April 2016 ruling by an administrative judge in Minnesota, which found that the US federal social cost of carbon was "reasonable and the best available measure". The case heard from 15 witnesses, including seven on behalf of coal giant Peabody Energy.

It offers a preview of the likely battlegrounds ahead, including the very existence of man-made climate change, which Peabody asserted was either not happening, not man-made or in any case likely to be beneficial. The ruling not only backed the use of the current US federal SCC [FSCC], it found that "the preponderance of the evidence demonstrates that the FSCC understates the full environmental cost of CO2."

How secure is the SCC legally?

The SCC was bred from both the executive orders demanding the integration of cost-benefit analysis in new regulations and the CBD lawsuit, which established that such analysis could not ignore CO2 emissions.

The most significant legal challenge to the SCC so far was brought by Zero Zone, a refrigeration company that objected to the Department of Energy's new energy conservation standards. The calculations of the policy's benefits were based upon the social cost of carbon.

Zero Zone questioned the SCC from a number of angles. In attacking the standards, it suggested that the DOE had been "arbitrary and capricious" in even using the SCC, that the calculations used to come up with the SCC were "irredeemably flawed", that the analysis overestimated the benefits and underestimated the costs of cutting carbon, and that it was wrong to consider the global, rather than national, impacts of climate change.

In each case, the judges — all Republican appointees — found that the DOE had acted correctly and that the use of the SCC was correct and reasonable.

These legal precedents may prove one of the greatest obstacles to Trump's efforts to weaken the SCC. "He can't get rid of the court decision…You can't get around the need to have a cost-benefit analysis," Denise Grab, a senior attorney at the Institute for Policy Integrity, told Carbon Brief.

There are, however, weak points — areas where there is no case law to support a particular element of the SCC, as it currently stands. There is no case law, for example, to support the use of any particular discount rate. Increasing it to a higher percentage could dramatically reduce the SCC. Nor does the Zero Zone case say that the government should be using a global, rather than a domestic figure, but merely that the DOE "acted reasonably" when it chose the former.

There is also the fact that the status of the SCC calculations — a "technical support document" — means it can be unilaterally withdrawn by the president and those who run the Office of Management and Budget in his administration.

But that could leave the government in hot water when it comes to meeting its obligations to account for the SCC, says Richard Lazarus, a professor of law at Harvard. He tells Carbon Brief: "If the document is formally withdrawn and agency decisions disclaim any reliance on its reasoning, those decisions will be subject to judicial challenge to the extent that they no longer account for the social cost of carbon in a reasonable way and those decisions could be invalidated on that ground."

The past is also more secure than the future. "There are regulations in place using that number and they can't be undone with the stroke of a pen," adds Grab. The SCC could be used differently in future regulations, however, if Trump does decide to make a point of unwinding it.