The Social Cost of Carbon and Carbon Taxes

"Pick a number, any number"

CO2 COALITION

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Executive Summary

Leaving aside its scientific and economic uncertainties, the government's Social Cost of Carbon is so sensitive to input assumptions that small, quite reasonable variations can produce almost any price you wish. As a result it is not a suitable tool for guiding public policy, including taxes on energy.

The U.S. Government requires that the benefits of any proposed regulation be greater than its costs to the economy. To make decisions in the energy sector, the Obama administration established a Social Cost of Carbon (SCC), which has been continued by the Trump administration. This price, currently set at $42, is an estimate of the discounted future costs to the world economy due to the atmospheric warming caused by a metric ton of carbon dioxide (CO_2) emissions.

CO_2 is a benign gas, a non-pollutant essential to all life, that is the byproduct of the conversion of fossil fuels into energy. A metric ton of CO_2 is roughly what a car emits every 2,500 miles. A dollar per metric ton of CO_2 is roughly equivalent to a penny a gallon tax on gasoline, and the SCC is often suggested as the logical starting point for a "carbon tax" to encourage the use of alternative sources of energy.

The government calculates the SCC with computer models that (a) estimate far into the future the increase of atmospheric temperature caused by industrial CO_2, (b) estimate the economic damages from a theorized increase in extreme weather, sea level rise, and other adverse impacts of the warming, and (c) calculate the value of those damages in today's terms.

The scientists in the CO_2 Coalition strongly dispute that expected emissions of CO_2 will cause dramatic increases in temperature and economic damage. Their review of government data from the past 30 years concludes that the "climate sensitivity" assumed by the SCC models – that a doubling of CO_2 levels leads to a 3.5 degree Celsius increase in temperature – is much too high. Recent CO_2 Coalition White Papers show that any adverse effects of CO_2 will likely be outweighed by its beneficial effects on plant growth and drought resistance, and by the health benefits of a warmer climate.

This White Paper, however, takes a different tack, demonstrating that even with the government's assumed temperature increases and resulting damages the SCC is extraordinarily dependent on financial assumptions that have nothing to do with climate or economics:

- *The discount rate* tells us how a "real" dollar (meaning one adjusted for inflation) in the future should be valued today. The choice of a discount rate is critical in evaluating potential damages that occur in the distant future. The SCC uses a discount rate of three percent per year, meaning that a real dollar that is available in one year should be valued at 1/1.03 or 97 percent of a dollar that is in hand, ready to use today. A real dollar two years from now would be worth $1/1.03^2$ or 94 percent and so on.

- *The time horizon* determines how far into the future we should attempt to calculate climate damages. Currently the government sets the SCC end year at 2300, 281 years from now. Most of the modeled damages occur far in the future, and we demonstrate that such projections are virtually impossible.

To be useful, a model should produce consistent results over a reasonable range of assumptions. Even if we accept the questionable climate science and economic damage theories of the SCC, reasonable variations in the assumptions on discount rate and time horizon can produce almost any SCC you wish.

We show in this White Paper that using equally valid choices for the discount rate, such as five percent versus three percent, and for the ending year, such as 2100 versus 2300, reduces the SCC by 84 percent. Changing the discount rate further, to the seven percent used at times by the Office of Management and Budget, virtually eliminates the SCC, cutting it by 95 percent.

But readers do not need to take our word for it. At Appendix 1 *http://co2coalition.org/2019/07/08/social_cost_of_carbon_and_carbon_taxes/* we provide an easy to use Excel spread sheet program that allows readers to change the discount rate and the ending year and, as "citizen economists," see the impact for themselves. The CO_2 Coalition is a strong believer in the motto of Britain's Royal Society, *nullius in verba* – "Don't take anyone's word for it."

Many have suggested that the SCC is the right level for a carbon tax on the American people. This proposal is dangerous. The current $42 SCC is high enough to inflict pain on American consumers (think a $0.42 additional tax on every gallon of gasoline), yet too low to close the high cost gap with renewables. For example, a carbon tax of about $1,000 per metric ton ($10 per gallon of gasoline) would be required to make electric cars cost-competitive with gasoline vehicles. A carbon tax at the government's current SCC would be "all pain and no gain", even if you accept the catastrophic view of climate change.

Furthermore, a carbon tax would be viewed by politicians as a quick and easy revenue generator. A $42 carbon tax would transfer over $200 billion a year from consumers' pockets to the federal government. Our elected officials, perpetually short of money, would always be tempted to "discover" that the SCC is not $40 but $60 or $80. The SCC as currently calculated by the US Government cannot serve as a useful guide to anything.

The principal researcher for this White Paper is Bruce Everett, Ph.D. During his 45-year career in international energy, Dr. Everett was an economist with the U.S. Department of Energy and an executive with ExxonMobil. He taught energy economics at the Georgetown University School of Foreign Service and is currently an Adjunct Associate Professor of International Business at the Fletcher School of Tufts University.

How the Government Estimates the Social Cost of Carbon

The U.S. Government requires that all proposed regulations be subjected to cost-benefit analysis. To meet this requirement for its proposed climate policies, in 2009 the Obama administration established a parameter called the Social Cost of Carbon (SCC). According to the Interagency Working Group (IAG)[1] tasked with developing the methodology, the SCC is an estimate of "the monetized damages associated with an incremental increase in carbon emissions in a given year." More precisely, the SCC tells us the cost to the global economy of increasing carbon dioxide emissions by one metric ton (1,000 kilograms, or 2,205 pounds).

The IAG uses "integrated assessment models" (IAMs) to calculate the SCC. An IAM is two connected models: a climate model that calculates global atmospheric temperatures from carbon dioxide emissions and a "damage function" that estimates economic costs and benefits as a function of the expected temperature increase in the models. The IAG uses three IAMs and five scenarios in its analysis and runs about 150,000 simulations with slight variations of key assumptions.

Although these simulations produce a wide range of values from less than $10 to over $180, the IAG offers a "central value" for the SCC at about $42 for the year 2020. This is essentially an average of the many simulations.

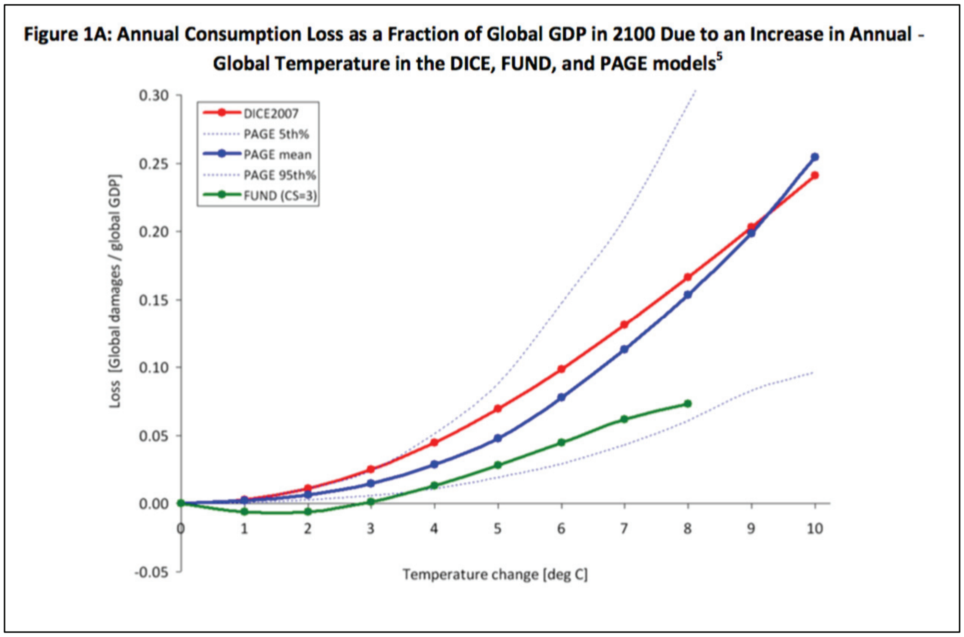
The modelers start by selecting one of five scenarios of future population growth, global Gross Domestic Product (essentially, total income), and CO_2 emissions. They plug these assumptions into the IAM, which then calculates the temperature profile based on projected CO_2 emissions. Then come the damage functions, which tally the economic costs and benefits projected from the warming, discounted to today's value. Finally, the SCC estimate is obtained by running the entire model again with an additional metric ton of CO_2 and subtracting the original result to find the marginal cost of the metric ton.

The three damage functions used in the IAM are: the Dynamic Integrated Climate-Economy model (DICE), developed by William Nordhaus[2], the Climate Framework for Uncertainty, Negotiation and Distribution model (FUND), developed by Richard Tol for use by European policy-makers and the Policy Analysis of the Greenhouse Effect (PAGE), developed by Chris Hope. These damage functions are based on rough estimates rather than actual data to date, and are rather speculative.

The shapes of the three damage functions are shown in Figure 1A, which is taken directly from the IAG's Technical Support Document. The horizontal axis is in degrees Celsius of CO_2-induced warming by the year 2100. The vertical axis shows the percent of global Gross Domestic Product lost due to that warming. It is instructive to note the substantial discrepancies between and within the functions, which underscore the problems involved in guessing the economic impacts of temperature in the absence of any empirical data:

- The FUND model acknowledges that a temperature increase of two degrees or less actually brings net economic benefits.
- At an eight degree increase, the DICE and PAGE models estimate damages of twice the roughly seven percent of GDP estimated by FUND.
- The fifth percentile of PAGE runs at eight degrees is nearly six times its 95th percentile calculation, a huge range arising from slightly differing assumptions.

Figure 1A: Damage Functions Used by the IAG



The IAG is careful to note that the SCC is valid only for incremental changes in CO_2 emissions and not for policies that effect fundamental changes. This is an important distinction, indicating that the SCC is appropriate, in theory, only for short-term, marginal regulatory decisions and not for consideration of policies that may dramatically reduce the use of fossil fuels or dramatically raise the price of energy. Unfortunately, the SCC has also figured into the climate policy debate writ large, including proposals that the SCC be used to set the value of a carbon tax.

The IAG members have put in a great deal of effort and the process is costly, but how meaningful is the SCC number? Computer models are essentially sets of equations that generate conclusions from input assumptions. The key issue with any model is whether its results reflect a fundamental understanding of the analytical issues involved or are simply a restatement of its assumptions. A simple test is whether the model's conclusions are valid over a wide range of reasonable assumptions.

Our "Citizen Economist" Model

The three damage functions (DICE, PAGE and FUND) used by the IAG are complicated and not at all user-friendly. All three operate on platforms that are generally inaccessible to outside analysts. As an alternative approach, we have built a simplified Excel model that follows the logic of the SCC calculations and produces similar temperature pathways and damage results. The model then allows easy testing of the impact of changing various assumptions. Our Excel model can be easily accessed on the CO_2 Coalition's website at Appendix 1 *http://co2coalition.org/2019/07/08/social_cost_of_carbon_and_carbon_taxes/* for use by "citizen economists." Users can insert different values for discount rate, time horizon, and climate sensitivity, and see their impact on the SCC.

In creating this Citizen Economist model, we use the four "business as usual" scenarios[3] chosen by the IAG for the SCC: IMAGE, MERGE-Optimistic, MESSAGE, and MiniCAM. These were developed at the EMF-22 Energy Modeling exercise conducted at Stanford University in 2009. Each scenario specifies a future pathway for global GDP, population, and CO_2 emissions. In the EMF-22 exercise, these pathways extend to the year 2100, but the IAG has extrapolated the assumptions to the year 2300. The values in the scenarios are provided in Table 1.

Table 1: Scenario definitions

	IMAGE	MERGE	MESSAGE	MiniCAM
2019 Global GDP (trillion $2018)	$92	$75	$87	$61
2300 Global GDP (trillion $2018)	$2,839	$968	$1,718	$2,839
2300 population (Billion)[4]	8.6	9.7	10.7	7.9
Ending per capita GDP ($2018)	$330,128	$99,781	$160,582	$359,380
Ending CO_2 emissions (Gt/yr)	35.0	100.0	20.0	35.0
Max CO_2 emissions (Gt/yr)	109.3	176.5	75.6	119.3
Year of max CO_2 emissions	2150	2200	2150	2150

According to the International Monetary Fund, global per capita income is $11,673 at present. Table 1 shows that, due to economic growth, average income is projected to increase between nine and 31 times over by 2300. Alleged climate damages, it must be remembered, will be imposed on future populations and governments with far more resources available to address them.

Losing a percentage of GDP is not so onerous when the GDP is much larger than today. Ironically, much of the projected growth depends on inexpensive, reliable power that is provided by the very fossil fuels whose byproduct, CO_2, drives the SCC models.

As noted above, our Excel model does not attempt to critique or improve on the climate models in the IAG's IAMs. The model is based on these key climate assumptions:

1. Atmospheric CO_2 concentrations are assumed to be 400 parts per million (ppm) in 2013.
2. Half the emitted CO_2 is assumed to remain in the atmosphere, with the other half absorbed by land and the oceans.
3. Residence time for CO_2 in the atmosphere is assumed to be indefinite.
4. Each additional 7.4 billion tons (Gt) of CO_2 retained in the atmosphere is assumed to increase atmospheric concentrations by 1 part per million.

5. Equilibrium Climate Sensitivity - the long-term temperature increase resulting from a doubling of CO_2 concentration - is assumed to be 3.5 degrees Celsius.

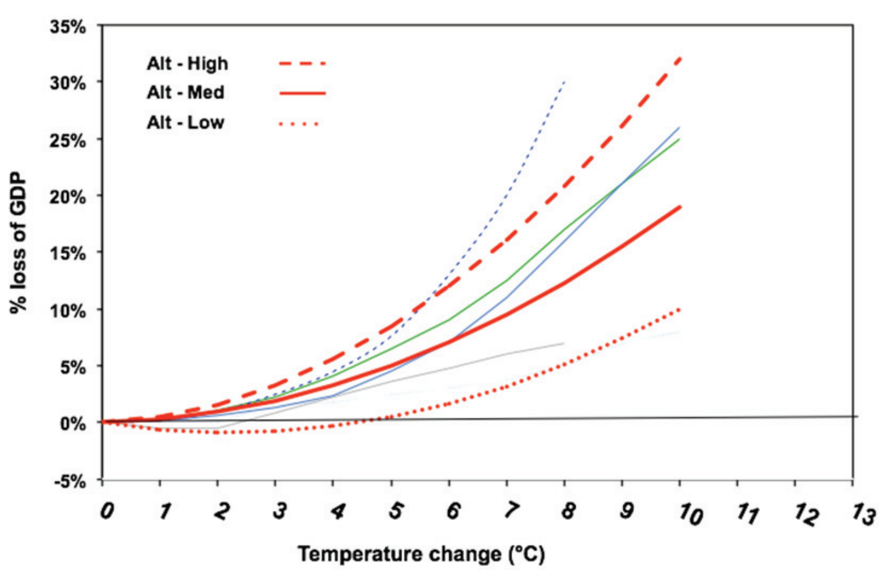
This last assumption is highly controversial, with empirical data suggesting values perhaps as low as one degree. These five climate assumptions generate the following increases in global mean temperature:

Table 2: Temperature profiles (°C versus 2019)

	IMAGE	MERGE	MESSAGE	MiniCAM
2050	1.0	1.2	1.0	1.0
2100	2.5	3.5	2.3	2.5
2150	4.3	5.9	3.6	4.3
2200	5.9	7.7	4.9	6.0
2250	6.8	8.9	5.5	7.0
2300	7.3	9.7	5.8	7.5

Our model then uses three damage functions, each in the shape of a parabola, and designated Alt-High, Alt-Medium and Alt-Low. Although these functions are arbitrary, the results are, by intention, quite similar to the damage functions used by the IAG. That is made clear in Figure 1B, in which our three damage functions are superimposed on the previous IAG Figure 1A.

Figure 1B: Alternative Damage Functions



Like the IAMs, the Excel model calculates the net present value (NPV) of the damages out to the year 2300, adds an additional billion metric tons (Gt) of CO_2 emissions in 2019, and then recalculates the resulting damages. The change in the NPV divided by one billion is the resulting SCC.

Recall that three assumptions drive the official SCC: (a) the discount rate for calculating NPV is 3 percent, (b) the year 2300 is the time horizon and (c) climate sensitivity has a mean value of 3.5. These input values produce the following SCC results in our model, as readers can see from the calculations page in the Excel program:

Table 3: SCC calculations for year 2019 ($/Metric Ton) – Base Case

End year = 2300 **Discount Rate = 3%** **Climate sens. = 3.5**	IMAGE	MERGE	MESSAGE	MiniCAM
Alt-High	$57.5	$40.0	$48.7	$52.0
Alt-Medium	$33.5	$23.3	$28.3	$30.3
Alt-Low	($11.0)	($6.3)	($13.1)	($8.0)
Average	$22.9			

The calculated SCCs vary from $57.5 in costs to $13.1 in benefits (parentheses indicate negative numbers) with an average value of $22.9. Note that all these SCCs are based on the same climate dynamics. The variations across each row reflect only the input scenarios, and the variations down the columns reflect only the choice of damage function. Note that the SCCs for each damage function are very similar across the four scenarios.

Now we will consider the impact of two key input assumptions, to test the validity of the government's SCC calculation.

Why the SCC is too Sensitive to the Discount Rate

How should we compare losses in the future to losses today? Economists use a parameter called the "discount rate", defined as the difference between the value of a dollar tomorrow and the value of a dollar today,[5] This concept is also known as "the time value of money" or "opportunity cost."[6] If the discount rate is three percent, the value of a dollar one year from now is 1/(1.03) or about 97 percent. The value of a dollar two years from now is $1/(1.03)^2$ or about 94 percent and so on.

Much of the discussion around the economic aspects of the climate debate has centered on which discount rate to use and whether the rate should be descriptive (how we *actually* value future costs and benefits compared to today), or normative (how we *should* value such costs and benefits).

Each approach has its merits and its drawbacks. For the near future, economists often use for a discount rate the nominal interest rate on 30-year U.S. Treasury bonds, which is roughly 2.6 percent as of this writing. Determining discount rates over centuries as opposed to decades, however, is methodologically daunting.

Historical interest rates are of little help. The compound interest rate on eight successive 30-year bonds does not provide much insight into how investors would view a 240-year bond.

Advocates of the descriptive approach note that the longest-term bonds in recent history were a 100-year bond issued by Walt Disney Corp in 1993 with a real interest rate of about 5.5 percent above inflation and a 100-year "century bond" offered in 2017 by Argentina with a real interest rate of about six percent.[7] Intuitively, the farther into the future you must go to capture all the benefits, the more uncertain those benefits are and the higher the discount rate should be. Nonetheless, some researchers[8] have argued that far future discount rates should be lower than today's.

The normative approach, as presented in the famous 2006 "Stern Review on the Economics of Climate Change,"[9] argues that the discount rate is a measure of intergenerational equity and that the use of higher discount rates shows a lack of concern for our progeny. The Stern Report suggested that climate analysis should apply a discount rate of 1.4 percent largely on ethical grounds, concluding, "… if you care little about future generations you will care little about climate change."[10] Some researchers[11] have even argued for the use of negative discount rates as more accurately reflecting the impacts of the worst-case climate scenarios on the most vulnerable segments of the population.

Why do economists argue so vehemently about this issue? Because the choice of discount rate makes a huge difference in the results. Let's consider for example, the effect on the highest SCC from Table 3, which uses the IMAGE scenario and the Alt-High damage function. Here are the calculated SCCs for that case at different discount rates:

Table 4: Calculated SCC ($/Metric Ton)

Discount rate	SCC
1%	$581.6
2%	$149.9
3%	***$57.5***
4%	$29.2
5%	$17.7
6%	$12.1
7%	$8.9

The IAG's assumption of a three percent discount rate generates an SCC of $57.5. Varying the discount rate, however, can change the SCC dramatically. The SCC of $581.6 for a one percent discount rate is 65 times higher than the SCC of $8.9 for a seven percent rate.

Table 5 recalculates Table 3 using a 5 percent discount rate instead of the IAG's three percent. Readers can confirm these results by entering five percent as the choice on the Excel program's calculations page.

Table 5: SCC calculations for year 2019 ($/Metric Ton)

End year = 2300 Discount rate =5%	IMAGE	MERGE	MESSAGE	MiniCAM
Alt-High	$17.7	$14.1	$16.2	$15.1
Alt-Medium	$10.1	$8.1	$9.3	$8.7
Alt-Low	($11.6)	($8.0)	($11.3)	($9.4)
Average	$4.9			

The result is an *80 percent decrease* in the average calculated SCC from $22.9 to $4.9.

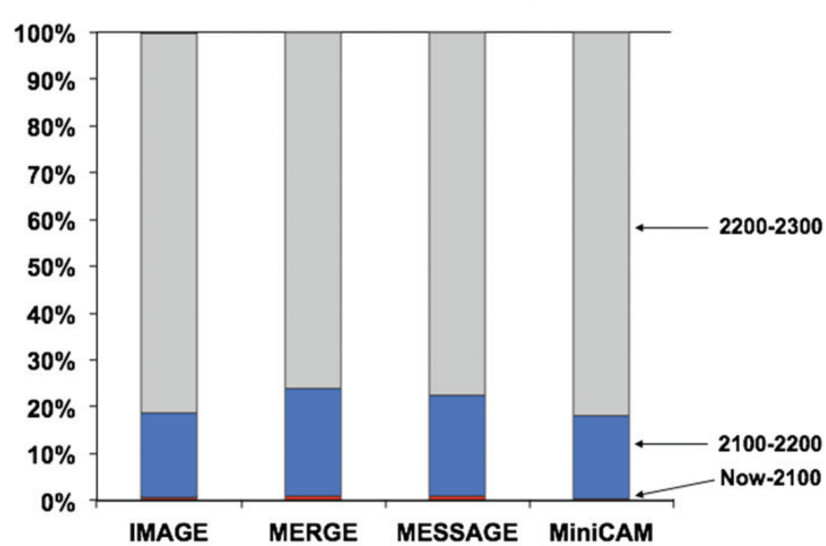
According to the IAG, the Office of Management and Budget specifies that agencies use discount rates of three percent and seven percent in policy evaluation, yet the IAG never applies the higher rate in their SCC analysis. Readers can confirm that at seven percent our model finds an average SCC for the 12 cases of $1.5, which in policy terms is essentially zero.

As another indication of the power of the discount rate, the Stern Report's proposed 1.4 percent discount rate produces an average SCC with these same scenarios and damage functions of $158.3, seven times higher than the three percent case.

Why the SCC is too Sensitive to the Time Horizon

The IAG's choice of 2300 as its time horizon is economically questionable but politically understandable. Generating a high SCC requires a high damage estimate, but the IAMs used by the government show little damage in the near-term. In fact, most of the economic losses calculated by these models occur in the distant future. Our Excel model shows the following breakdown of damage estimates for the four high-damage cases:

Figure 2: SCC Forecast Damages by Time Period (Undiscounted)



The small, almost invisible red bar at the bottom shows the model's estimate of economic damages between now and the year 2100. The blue bar shows the damages between 2100 and 2200 and the gray bar shows damages after the year 2200. In each case, less than five percent of the estimated damages occur within the next 80 years. This chart demonstrates why advocates of the climate crisis narrative insist on low discount rates, which place a high value on damages in the far distant future.

What would happen if we cut off the SCC projection at year 2100? Table 6 recalculates Table 3 but sets the target year at 2100 rather than 2300. Inputting that value while maintaining the SCC discount rate of three percent, readers can see that the SCC is then cut by 55 percent, or over half, from an average of $22.9 to $10.4.

Table 6: SCC calculations for year 2019 ($/Metric Ton)

End year = 2100 Discount rate =3%	IMAGE	MERGE	MESSAGE	MiniCAM
Alt-High	$32.3	$26.6	$29.7	$27.4
Alt-Medium	$18.6	$15.4	$17.1	$15.8
Alt-Low	($16.9)	($10.5)	($16.4)	($13.8)
Average	$10.4			

The discount rate and time horizon assumptions are not independent, so let's recalculate Table 3 with a five percent discount rate and the 2100 time horizon. The results are shown in Table 7.

Table 7: SCC calculations for year 2019 ($/Metric Ton)

End year = 2100 Discount rate =5%	IMAGE	MERGE	MESSAGE	MiniCAM
Alt-High	$15.2	$12.6	$14.2	$12.7
Alt-Medium	$8.6	$7.2	$8.1	$7.2
Alt-Low	($12.1)	($8.5)	($11.5)	($9.9)
Average	$3.7			

Changing both assumptions at the same time reduces the SCC by 84 percent, to $3.7. And using the seven percent discount rate mandated as one of the SCC choices by the Office of Management and Budget, along with the 2100 time horizon, the SCC is virtually eliminated, falling by 95 percent to $1.3.

By reasonable variations in the key assumptions, we can generate virtually any SCC we want without changing the economic scenarios or the damage functions. Furthermore, this wide range of outcomes doesn't even consider the key questions of climate dynamics. If we were to reduce the assumed climate sensitivity from 3.5 to 1.0, the average calculated SCC would be negative.

The extreme sensitivity of the SCC calculation to both discount rate and time horizon brings into question whether the IAG's calculations have any value at all.

The Difficulty of Looking Ahead Three Centuries

The issue of intergenerational equity over a period of 280 years is a difficult one to assess. The narrative of an "existential" climate crisis implies that carbon dioxide will make the planet unlivable, but that scenario does not appear in the IAG's framework. Let's consider the impact of our Alt-High damage function on the four scenarios.

Table 8: Economic impacts

	IMAGE	MERGE	MESSAGE	MiniCam
2019 Global GDP (trillion $2018)	$92	$75	$87	$77
2019 population (Billion)	7.5	7.4	7.6	7.4
2019 GDP per capita ($2018)	$12,300	$10,100	$11,400	$10,400
2300 Global GDP (trillion $2018)	$2,839	$968	$1,722	$2,840
2300 population (Billion)	8.6	9.7	10.7	7.9
2300 GDP per capita ($2018)	$330,000	$100,000	$160,000	$360,000
Estimated temperature increase by 2300	7.3°	9.7°	5.8°	7.5°
Estimated damages in 2300 (trillion $2018)	$490	$290	$190	$520
Impact on per capita GDP	(17%)	(30%)	(11%)	(18%)
2300 GDP per capita after damages ($2018)	$275,000	$70,000	$142,000	$295,000

The scenarios used by the IAG all share a fundamental underlying logic—continuous sustained economic growth far into the future. Even relatively low rates of economic growth (1-1.5 percent annually) will generate a huge global economy over a 280-year period. Year 2300 global GDP in these scenarios ranges from a low of 13 times today's economy in the MERGE scenario to 36 times in the MiniCAM scenario. The growth in per capita income is also massive, ranging from 10 times today's level in the MERGE scenario to 35 times in the MiniCAM scenario.

The estimated economic damages are high in absolute terms compared to today's economy. For example, the year 2300 damages in the IMAGE scenario are $490 trillion—more than five times today's global GDP. These same scenario parameters, however, suggest that our descendants will be enormously wealthy with a worldwide average per capita GDP of over $330,000 or over $1.3 *million*, in today's terms, for a family of four. And that's just the average. Wealthier people will presumably have even higher incomes. All this would provide massive tax revenues to governments to adapt to any climate changes.

Even with a temperature increase of over seven degrees, economic losses in the year 2300 would be about 17 percent of per capita GDP, leaving an average family of four with about $1.1 million a year to spend. The marginal utility of income decreases with wealth, so the climate losses mean no more than asking our descendants to settle for a Ferrari rather than a Lamborghini. Policies to raise the price of energy dramatically, which are currently under discussion, would represent a transfer of wealth from today's poor to tomorrow's rich.

How should we look at intergenerational equity when the question appears to be how rich future generations will be rather than how poor? The universe of scenarios used by the IAG for SCC calculations seems to bear no resemblance to the dire forecasts of climate advocates predicting an unlivable planet. Perhaps there are other scenarios, but the IAG doesn't consider them.

Apart from the question of how to value future economic activity, what do we really know about the next three centuries?

Predicting next year's election is a pretty daunting task, but how about guessing what the world looks like in 2100, 81 years from now. As a thought experiment, let's go 81 years back in time and consider asking a group of experts in 1938 to develop scenarios of what the world would look like in 2019. In 1938:

- Global population was about 2.3 billion—30 percent of today's level.
- World GDP (in today's dollars) was about $6 trillion—about 10 percent of today's level.
- GDP per capita was about $2,600 (in today's dollars) per year compared to $11,000 today.
- Most of the world's wealth was enjoyed by a small segment of the population in North America and Western Europe with the rest of the world miserably poor.
- The world economy was mired in a deep depression, U.S. GDP had fallen by about 10 percent over the previous decade, and U.S. unemployment was stuck at about 20 percent.
- Totalitarian ideologies were on the rise in Europe, the Soviet Union and Japan.
- The world was on the verge of a devastating war, which would cost 50 million lives and trillions of dollars in lost GDP followed by a global "Cold War" between the two emergent superpowers and a precipitous decline in the power and colonial dominance of Western Europe.
- China consisted of 300 million desperately poor peasants struggling to survive a brutal Japanese invasion.
- Many of today's common technologies were unknown or just glimmers, including computers, cell phones, television, antibiotics, contraception, nuclear weapons, polio vaccine, GPS, rocketry, robotics, and jet engines.

How well would those experts have done at developing scenarios even remotely resembling today's world?

How about predicting the world in the year 2200, which is equivalent to a group of experts in 1838 trying to understand today's world? How about predicting out 281 years to 2300, the equivalent of making predictions about today from 1738? Would we really expect that even the smartest people of their day could develop reasonable scenarios for the world of 2019?

In all probability, these experts would have done what 21st century climate analysts have done – extrapolate the current world into the future. Unfortunately, despite our modern methodologies and advanced statistical techniques, history is discontinuous and extremely unpredictable. Furthermore, the rate of technological and societal change is much greater today than it was a hundred or two hundred years ago. Even 30 years ago, no one had any notion of what the global communications revolution would imply for social media and its impact on politics. The chances of experts crafting an even remotely accurate scenario of what the world looks like one, two or three hundred years from now are zero.

The SCC and a Tax on Carbon Dioxide

What difference does this all make? It depends on what the SCC is used for. The IAG insists that the application of the SCC is limited to evaluating incremental regulatory changes. The federal government uses the SCC in its evaluations of land use, power plant emissions and efficiency standards for vehicle and appliances. Regulatory agencies in some states, including New York, Illinois and Colorado, require utilities to use the SCC in making investment and operational decisions.

If, for example, a utility is considering adding wind rather than gas turbines to its generating system, it would be entitled to claim a $40 credit for each metric ton of CO_2 saved. If the wind turbine cost ratepayers an additional $30,000,000, but saved one million metric tons of CO_2, the investment would be regarded as justified. Consumers would see the costs reflected immediately in their utility bills, but would presumably enjoy the benefits over time in reduced climate damage. The almost completely arbitrary nature of the SCC calculations brings this claim into serious question.

Some people, however, see the SCC as having a more ambitious purpose – such as setting a carbon tax level. For example, the Center for Climate and Energy Solutions says, "Economic theory suggests a carbon tax should be set equal to the social cost of carbon, which is the present value of estimated environmental damages over time caused by an additional ton of CO_2 emitted today. The tax rate should also rise over time to reflect the growing damage expected from climate change. An increasing price over time also provides a signal to emitters that they will need to do more and that their investments in more aggressive technologies will be economically justified."[12]

A recent *Wall Street Journal* op-ed by a group of distinguished economists, including several Nobel laureates and former Federal Reserve Board Chairmen, claimed, "A carbon tax offers the most cost-effective lever to reduce carbon emissions at the scale and speed that is necessary. By correcting a well-known market failure, a carbon tax will send a powerful price signal that harnesses the invisible hand of the marketplace to steer economic actors towards a low-carbon future."[13]

That sounds great, but let's take a look at the numbers. Assume we set a tax on carbon dioxide at the current government-calculated SCC of about $40. The U.S. currently emits about 5 billion metric tons per year of CO_2, so our $40 carbon tax would impose an immediate additional $200 billion per year burden on the economy or about $1,700 per household. Consumers would feel this tax not only in their utility and gasoline bills but also in the prices of everything they buy. For context, this increase would be larger than the impact of the 2017 tax cuts, estimated by the Tax Foundation at $180 billion per year over the next decade.[14] Few economists would dare to argue that this additional tax burden would have no impact on incomes or economic growth.

In fairness, the authors of the op-ed propose that the additional revenue be returned to taxpayers and that the carbon tax replace all existing subsidies and mandates. Such a proposal, however, must be viewed skeptically. The federal government rarely if ever surrenders a source of revenue or retracts a subsidy to a powerful constituency. Even during the brief period of budget surpluses in the 1990s, politicians refused to rebate the excess to consumers.

Regardless, would a $40 carbon tax, set at the IAG's SCC level, really lead us to a low-carbon future? U.S. energy consumption has five main components: petroleum in transportation, natural gas for electricity generation, natural gas for home heating, natural gas for industry and coal for electricity. These five components account for about two-thirds of U.S. energy use. As of this writing, U.S. gasoline prices were around $2.75 per gallon. A carbon tax of $40 would equate to about $0.40 per gallon on gasoline – a 15 percent increase from today's level and well within the normal annual variation in gasoline prices over the last ten years.

An analysis of the full cost of ownership and operation demonstrates that a carbon tax of close to $1,000 per metric ton – $10 per gallon – would be needed for electric cars to compete with conventional gasoline vehicles. We estimate that it costs about $2,700 more per year to use an electric car rather than a conventional one. This saves about 2,700 kg of CO_2, so each metric ton saved costs about $1,000. (The assumptions and calculations are shown on an Excel file attached to the on-line White Paper at Appendix 2 *http://co2coalition.org/2019/07/08/social_cost_of_carbon_and_carbon_taxes/*.)

Europeans pay on average $5-6 per gallon for gasoline and $4-5 per gallon for diesel. Europeans, however, typically do not drive electric cars or advanced, low-carbon vehicles. They just drive somewhat smaller gasoline and diesel-powered cars.

Electricity generated from natural gas today costs about 4¢ per kWh. A $40 tax on carbon dioxide would add about 25 percent to that cost. Calculations similar to the one for electric vehicles finds that to compete with natural gas for power generation, onshore wind turbines would need a tax of around $200 per metric ton and solar PV power generation would require a tax of over $500. (Those calculations are in an Excel file at Appendix 3 *http://co2coalition.org/2019/07/08/social_cost_of_carbon_and_carbon_taxes/*.)

We must conclude that a carbon tax of $40 per metric ton might reduce energy consumption slightly at the margin, but is nowhere near high enough to bring about a significant substitution of renewable fuels.

It is also important to recall that climate is not a national issue, but a global one. The United States, at 5 billion metric tons, currently accounts for about 15 percent of global CO_2 emissions. China, on the other hand, emits over 9 billion metric tons per year, which is over 25 percent of the world total. Yet China shows no inclination to reduce emissions, and has not in fact been asked to do so under the Paris Climate agreement until after the year 2030. Even the major reduction in U.S. CO_2 emissions that many American politicians claim is needed to avoid catastrophe would have little impact on global atmospheric concentrations.

Imposition of a U.S. carbon tax linked to the current value of the SCC would carry no benefits, but would cause some damage to the US economy. The greater danger, however, is the insatiable need of politicians on both sides of the aisle for more money to spend. The malleability of the SCC calculation would allow the federal government to “discover” that the SCC was actually $100 or $200 and to adjust the carbon tax accordingly. Taxes of that magnitude would be an economic disaster.

The argument put forward by the authors of the *Wall Street Journal* op-ed sounds great until you try to put a number on it. At the end of the day, since modest changes in assumptions unrelated to climate science or economic damages can turn the SCC into any number you choose, the Social Cost of Carbon, as calculated by the U.S. Government, cannot serve as a useful guide to anything.

Endnotes

1. Council of Economic Advisers, Council on Environmental Quality, Department of Agriculture, Department of Commerce, Department of Energy, Department of Transportation, Environmental Protection Agency. National Economic Council, Office of Energy and Climate Change, Office of Management and Budget, Office of Science and Technology Policy, Department of the Treasury.
2. For a more complete discussion of the issues surrounding the DICE model, see: Cohen, Happer and Lindzen, ”In the Climate Casino: An Exchange” in *The New York Review of Books*, April 26, 2012.
3. The excluded scenario posits that atmospheric CO2 concentrations have been stabilized at 550 ppm at little cost. Since this fifth case essentially assumes that there is no problem, calculation of the SCC becomes moot.
4. Although a growing population is often taken for granted, some studies, such as *Empty Planet* by John Ibbitson and Darrell Bricker, suggest that global populations may soon begin to decline.
5. The term “discount rate” is also used to denote the interest charged to banks by the Federal Reserve, but that definition is not applicable here.
6. Also note that this is a different concept from inflation. There would still be a time value of money at a zero inflation rate.
7. The nominal rates are 7.55 percent and 7.9 percent, respectively, and the current U.S. inflation rate is about two percent.
8. See, for example, Newell and Pizer, “Discounting the distant future: how much do uncertain rates increase valuations?”, J*ournal of Environmental Economics and Management,* 2003.
9. *https://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/sternreview_index.htm*
10. *Ibid.*, p. 48.
11. Fleurbaey and Zuber, and “Climate policies deserve a negative discount rate”, *Chicago Journal of International Law*, 2013.
12. *https://www.c2es.org/content/carbon-tax-basics/*
13. “Economists’ Statement on Carbon Dividends”, *Wall Street Journal*, January 16, 2019.
14. *https://taxfoundation.org/the-distributional-impact-of-the-tax-cuts-and-jobs-act-over-the-next-decade/*

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The mission of the CO2 Coalition is to promote broader understanding of the beneficial effects of more carbon dioxide in the atmosphere around the world. The Coalition fosters informed debate on the scientific evidence, as summarized in this Primer. The Coalition's initial paper, published in the fall of 2015, urged the public to "see for yourself."

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