COMPETITIVE ENTERPRISE INSTITUTE

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Comments to the Office of Management and Budget on the proposed update to Circular A-4: Regulatory Analysis; ID OMB-2022-0014-0001

Comments Submitted by Marlo Lewis, Senior Fellow, Competitive Enterprise Institute

Thank you for the opportunity to submit comments on the Office of Management and Budget's (OMB's) Draft for Public Review of its proposed update of Circular A-4 regulatory analysis guidelines.[1] My comments focus on the Draft's implications for social cost of carbon estimation in federal agency benefit-cost analysis.

I. Transparency, Baseline, and Modeling Issues—Overview

OMB's Draft Circular A-4 barely touches on the social cost of carbon (SCC)—the estimated present value of projected cumulative damages from one ton of carbon dioxide (CO_2) emitted in a particular year, or conversely, the benefit of eliminating that ton of CO_2 emissions. The term "social cost of carbon" occurs only four times in the Draft Circular, each time in footnotes to sources addressing "probabilistic analysis" or "expert solicitation" as methods for addressing uncertainties in long-term projections in general.[2]

OMB's reticence about the SCC as a component of benefit-cost analysis (BCA) is incongruous. By one estimate, as of June 2021, federal agencies had used the SCC to calculate climate benefits in at least 80 rules.[3] SCC estimates are routine components of regulatory impact analyses (RIAs) at the Environmental Protection Agency (EPA) and the Departments of Energy, Transportation, and Interior. President Biden's "whole-of-government approach to the climate crisis"[4] is bound to expand the use of SCC analysis in federal regulation. The Inflation Reduction Act's authorization of $369 billion to $1.2

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[1] OMB, Draft for Public Review, Circular A-4, April 6, 2023, https://www.whitehouse.gov/wp-content/uploads/2023/04/DraftCircularA-4.pdf (hereafter OMB Draft Circular A-4).

[2] OMB Draft Circular A-4, p. 70, fn. 127; p. 82, fn. 170.

[3] Marshall Burke and Lawrence Goulder, Stanford Explainer: Social Cost of Carbon, June 7, 2021, https://news.stanford.edu/2021/06/07/professors-explain-social-cost-carbon/.

[4] The White House, Fact Sheet: President Biden Takes Executive Actions to Tackle the Climate Crisis at Home and Abroad, Create Jobs, and Restore Scientific Integrity Across the Federal Government, January 27, 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/01/27/fact-sheet-president-biden-takes-executive-actions-to-tackle-the-climate-crisis-at-home-and-abroad-create-jobs-and-restore-scientific-integrity-across-federal-government/.

trillion in "clean energy" spending[5] may make SCC calculations a common feature of fiscal policy deliberation and advocacy as well.

Although the Draft Circular A-4 says little directly about SCC analysis, certain statements regarding transparency, objectivity, baselines, discount rates, analytic choices, sensitivity analysis, and the distinction between domestic and global benefits are pertinent to the ongoing debate over SCC methodology. Such statements include:

> You should aim for transparency about the key methods, data and other analytical choices you make in your analysis.[6]
>
> Your analysis should be credible, objective, realistic, and scientifically balanced…. Objectivity refers to whether the disseminated information is accurate, reliable, and unbiased as a matter of presentation and substance.[7]
>
> The benefits and costs of a regulation are generally measured against a no-action baseline: an analytically reasonable forecast of the way the world would look absent the regulatory action being assessed, including any expected changes to current conditions over time.[8]
>
> Agencies are encouraged to consider the likely path of future government programs and policies when relevant and appropriate, either reflecting them in the primary or in a supplemental baseline (in either approach, carefully describe the ways in which the future government programs or policies may affect your analysis).[9]
>
> If the analytic results are sensitive to a given assumption or data source, alternative modeling assumptions or data sources can be used to demonstrate the sensitivity of the results . . . Your presentation should also generally explain, when relevant, how your analytical choices have significantly affected your results.[10]

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[5] U.S. Department of Energy, The Inflation Reduction Act Drives Significant Emissions Reductions and Positions America to Reach Our Climate Goals, DOE/OP-0018, August 2022, https://www.energy.gov/sites/default/files/2022-08/8.18%20InflationReductionAct_Factsheet_Final.pdf; Goldman Sachs, The U.S. Is Poised for an Energy Revolution, April 17, 2023, https://www.goldmansachs.com/intelligence/pages/the-us-is-poised-for-an-energy-revolution.html.

[6] OMB Draft Circular A-4, p. 4.

[7] OMB Draft Circular A-4, pp. 67, 83.

[8] OMB Draft Circular A-4, p. 12.

[9] OMB Draft Circular A-4, p. 13.

[10] OMB Draft Circular A-4, p. 67.

> Sensitivity analysis can be used to find "switch points," critical parameter values at which estimated net benefits change sign or the alternative with the most net benefits switches.[11]
>
> In certain contexts, it may be particularly appropriate to include effects experienced by noncitizens residing abroad in your primary analysis. Such contexts include, for example … regulating an externality on the basis of its global effects supports a cooperative international approach to the regulation of the externality by potentially inducing other countries to follow suit or maintain existing efforts.[12]
>
> When your primary analysis focuses on the global effects of the regulation, it is generally appropriate to produce a separate supplementary analysis of the effects experienced by U.S. citizens and residents, unless you determine that such effects cannot be separated in a practical and reasonably accurate manner, or that the separate presentation of such effects would likely be misleading or confusing in light of the factors detailed above.[13]

Since OMB has been team leader of the Interagency Working Group (IWG) on the Social Cost of Carbon since 2009, the implications of those statements for SCC analysis could not have escaped OMB's attention.

The present comments identify several problematic features of the IWG's work on the SCC. CEI respectfully requests that OMB address those concerns in the final revised Circular A-4.

The comments raise the following issues:

- The opacity and increasing implausibility of the emission baselines used in the IWG's 2010, 2013, 2016, and 2021 technical support documents (TSDs) render any regulatory decision informed by the IWG's estimates vulnerable to challenge as arbitrary and capricious.

- In the EPA's proposed revision of federal SCC analysis, baseline CO_2 emissions during 2000-2300 are *less than one-third* those projected by the IWG, yet the EPA's SCC estimates are *more than three times higher*. How do dramatic reductions in projected emissions yield much larger climate damage estimates? Far from

[11] OMB Draft Circular A-4, p. 70.
[12] OMB Draft Circular A-4, pp. 9-10.
[13] OMB Draft Circular A-4, p. 10.

explaining this less-is-more social cost paradox, the EPA does not even acknowledge it. That is not transparent.

- SCC estimates are highly sensitive to the modeler's choice of assumptions and inputs. The IWG's analytic choices with regard to emission baselines, climate sensitivity, time horizons, CO_2 fertilization, discount rates,[14] and future adaptive capabilities are tendentious. All increase the estimated social costs of emissions and climate benefits of emission-reduction policies.

- The IWG does not provide sensitivity analyses to show how its analytic choices drive the results. A recent peer-reviewed sensitivity analysis finds that substituting reasonable alternative estimates of just two variables—climate sensitivity and CO_2 fertilization—produce strong probabilities that the SCC is negative (i.e. net-beneficial) through the mid-21st century. The IWG and the EPA omit such studies from their lists of references. That is not balanced.

- The alleged analytic and strategic merits of estimating the global benefits of U.S. greenhouse gas (GHG) regulations do not excuse agencies from estimating the domestic benefits of such policies. Comparing apples (domestic costs) to oranges (global benefits) is a form of presentation bias, inflating the perceived net benefits Americans supposedly reap from U.S. climate policies.

- Federal agencies typically claim SCC estimates are solely for informational purposes and do not inform regulatory decisions. That posture ceases to be reasonable (or believable) when the social cost-based climate benefits comprise most or even all monetized regulatory benefits (the EPA's proposed oil and gas industry methane emission standards are a recent case in point).

- A more fundamental issue is whether climate benefit estimates should have any role in regulatory decisions. SCC estimates are so sensitive to various speculative assumptions that political manipulation is virtually unavoidable.

- Moreover, the climate change impacts avoided by any individual regulation are too small to be detected by scientists or experienced by people and other living things. Undetectable, non-experiential effects are "benefits" in name only and

[14] My CEI colleague James Broughel's comments discuss in detail the interrelated issues of discount rates, opportunity cost of capital, and shadow pricing. I am still studying his analysis and so confine my remarks here to the IWG's failure to provide meaningful sensitivity cases.

should not be netted against multi-billion-dollar compliance costs that verifiably impose measurable burdens on identifiable people and businesses.

- The increasing prominence of SCC estimates in agency rulemakings endangers the scientific integrity of federal benefit-cost analysis. OMB should begin to consider how to contain, scale back, or extricate SCC analysis as a factor in regulatory justification.

II. Baseline Problems

Opacity

Since 2010, the IWG has estimated SCC values with emission baselines fraught with issues known only to a handful of specialists.

As described in the 2010 TSD,[15] to calculate the incremental impact of an additional ton of CO_2 emissions, the IWG uses a baseline based on five emission trajectories. Four are no-policy emission scenarios from a 2009 Stanford Energy Modeling Forum study known as EMF-22.[16] The fifth is a policy future in which CO_2 concentrations stabilize at 550 parts per million (ppm) in 2100. The IWG weighs the five baselines equally.[17] By implication, SCC values are computed against the average of the five baselines.

The Electric Power Research Institute (EPRI) in 2014 published a technical review of the 2010 and 2013 TSDs.[18] EPRI identified several problematic features in the IWG baselines. To begin with, "Equal weighting of all socioeconomic and emission futures may not be appropriate if all futures are not equally likely." While assigning probabilities is difficult, EPRI acknowledges, "it is possible to recognize unreasonable futures that are unlikely or less likely."[19] The IWG sheds no light about the reasonableness (internal consistency and plausibility) of the socioeconomic storylines driving the four EMF-22 emission scenarios.

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[15] Interagency Working Group on the Social Cost of Carbon, Technical Support Document, Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866, February 2010, pp. 15-16, https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf.

[16] Leon Clarke et al. 2009. International climate policy architectures: Overview of the EMF 22 International Scenarios. *Energy Economics* Volume 31, Supplement 2, S64-S81, https://www.sciencedirect.com/science/article/pii/S0140988309001960?via%3Dihub.

[17] 2010 TSD, p. 25.

[18] EPRI, Understanding the Social Cost of Carbon: A Technical Assessment, October 2014, https://www.epri.com/research/products/3002004657 (hereafter EPRI 2014).

[19] EPRI 2014, 4-2.

EPRI further notes that the IWG's 550-ppm policy baseline is not strictly speaking a "scenario." The IWG constructed it by running the four EMF-22 models with a 550-ppm stabilization target, and averaging the results. That is problematic because each model is "designed specifically to produce a scenario," and each scenario aims to provide "a complete and cohesive story with internal consistency between emissions drivers and emissions such that there are well defined relationships." Averaging the four models' population, income, fossil-intensity, trade, and other projections produces a mishmash. Consistency is destroyed and the "result is no scenario at all."[20]

Although EPRI does not say so, the same criticism presumably applies to the IWG's overall averaging of the five baselines, since there is no consistency between the storylines generating the emission totals in the four EMF-22 baselines.

In any event, even more problematic is the IWG's extension of the five baselines, which run from 2000 to 2100, out to the year 2300. Socioeconomic storylines drive the four EMF-22 emission trajectories through 2100. What drives the IWG's baselines after 2100? The extensions appear to be more or less arbitrary extrapolations. "As a group," EPRI comments, "the extensions lack a coherent, viable, and intuitive storyline (or set of storylines) that drive all of the extensions from 2100 to 2300.[21]

Worse, the IWG offers no criteria or context for assessing the plausibility of the five 300-year emission projections. Fortunately, EPRI does so. The chart below compares the five baselines (labeled USG1-USG5) to the potential CO_2 emissions of the world's estimated fossil fuel reserves.

Table 4-6
Cumulative fossil and industrial CO_2 emissions in the USG assumptions and estimated fossil fuel reserves

Cumulative CO_2 emissions ($GtCO_2$)		
	By 2200	By 2300
USG1	11,207	16,741
USG2	20,024	33,023
USG3	8,113	10,864
USG4	14,092	20,504
USG5	3,691	4,843
Estimated reserves ($GtCO_2$)		3,674 - 7,113

Source: *EPRI (2014)*

[20] EPRI 2014, 4-14.
[21] EPRI 2014, 4-14.

Average cumulative emissions in the five 300-year baseline scenarios is 17,195 $GtCO_2$—roughly 2.4 to 4.6 times estimated fossil reserves. That should have raised eyebrows even in 2010.

To produce emission totals that high, the same governments that negotiated the Kyoto Protocol and Copenhagen Agreement would have to abandon "climate action" over a period of almost 300 years, and do so despite the IWG's expectation of increasingly damaging climate change impacts. That is improbable, and inconsistent with OMB's current advice to "consider the likely path of future government programs and policies."[22]

Far from the IWG being transparent about emission baselines, the 2013 TSD does not mention the baselines' (loose) derivation from the EMF-22 scenarios,[23] the 2016 TSD does not address or even acknowledge EPRI's critique,[24] and the 2021 TSD is silent about the baselines' reasonableness (or lack thereof).[25]

This persistent lack of transparency is arbitrary and capricious. As it happens, the IWG's average baseline substantially overshoots current forecasts.

Implausibility

A preference for inflated emission scenarios is hardly unique to the IWG. Coal-centric scenarios have dominated the climate impacts literature—and climate advocacy—for the past two decades. Although the Shale Revolution began in 2007,[26] many scenarists assumed until quite recently that learning-by-extraction and economies of scale would make coal the increasingly affordable backstop energy for the global economy.[27]

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[22] OMB Draft Circular A-4, p. 13.

[23] Interagency Working Group on the Social Cost of Carbon, Technical Support Document: - Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis -
Under Executive Order 12866, May 2013, Revised July 2015,
https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf.

[24] Interagency Working Group on the Social Cost of Greenhouse Gases, Technical Support Document: - Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis -
Under Executive Order 12866, August 2016, https://www.epa.gov/sites/default/files/2016-12/documents/sc_co2_tsd_august_2016.pdf.

[25] Interagency Working Group on the Social Cost of Greenhouse Gases, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990
https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf.

[26] U.S. Energy Information Administration, Natural Gas, U.S Shale Production, 2007-2021, December 30, 2022, https://www.eia.gov/dnav/ng/hist/res_epg0_r5302_nus_bcfa.htm.

[27] Justin Ritchie and Hadi Dowlatabadi, The 1,000 GtC Coal Question: Are Cases of High Future Coal Combustion Plausible? Resources for the Future, RFF DP 16-45, 2016, https://media.rff.org/documents/RFF-DP-16-45.pdf;

The Intergovernmental Panel on Climate Change (IPCC) and the U.S. Global Change Research Program (USGCRP) have been the main legitimizers and popularizers of the two most influential "return to coal" emission scenarios used in climate impact assessments—RCP8.5 and SSP5-8.5.[28]

RCP8.5 is the high-end emission scenario in the IPCC's 2013 Fifth Assessment Report (AR5), the USGRCP's 2017 Fourth National Climate Assessment, and the IPCC's 2018 *Special Report on Global Warming of 1.5°C*. SSP5-8.5 is the high-end shared socioeconomic pathway used in the IPCC's Sixth Assessment Report (AR6). It is the socioeconomic scenario designed to match the forcing trajectory of RCP8.5.

RCP8.5 derives from A2r, a scenario used in the IPCC's 2007 Fourth Assessment Report (AR4). A2r assumes that energy supply during 2000-2100 "is increasingly focused on low grade, regionally available resources (i.e., primarily coal), with post-fossil technologies (e.g., nuclear) only introduced in regions poorly endowed with resources."[29] RCP8.5 tacitly assumes global coal consumption increases almost tenfold during 2000-2100.[30]

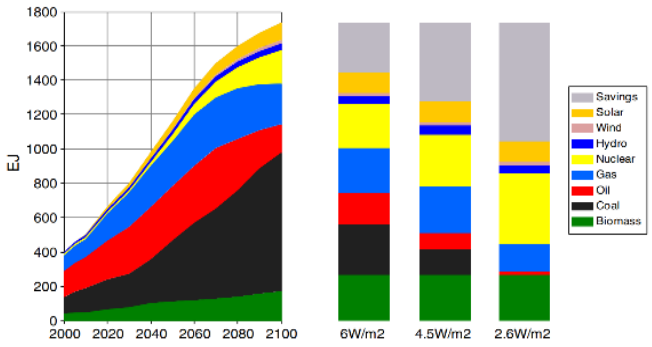


Fig. 5 Development of global primary energy supply in RCP8.5 (*left-hand panel*) and global primary energy supply in 2100 in the associated mitigation cases stabilizing radiative forcing at levels of 6, 4.5, and 2.6 W/m^2 (*right-hand bars*). Note that primary energy is accounted using the direct equivalent method

Source: *Riahi et al. 2011*

Justin Ritchie and Hadi Dowlatabi. 2017. Why Do Climate Change Scenarios Return to Coal? *Energy* 140: 1276-1291, https://www.sciencedirect.com/science/article/abs/pii/S0360544217314597.

[28] RCP stands for "Representative Concentration Pathway." An RCP is a projection of the future GHG emissions and atmospheric concentrations required to achieve a specific "radiative forcing" (warming pressure), calibrated in watts per square meter (W/m^2). An RCP is "representative" in the sense that some socioeconomic scenarios in the literature have similar forcing trajectories. SSP stands for Shared Socioeconomic Pathway. An SSP is a socioeconomic scenario designed to match the forcing of a specific RCP.

[29] Kewan Riahi and Arnulf Grubler. 2007. Scenarios of long-term socio-economic and environmental development under climate stabilization. *Technological Forecasting and Social Change*, 74(7): 887-935, https://www.researchgate.net/publication/222702915_Scenarios_of_long-term_socio-economic_and_environmental_development_under_climate_stabilization.

[30] Kewan Riahi, Shilpa Rao, Volker Krey, Cheolhung Cho, Vadim Chirkov, Guenther Fischer, Georg Kindermann, Nebojsa Nakicenovic, and Peter Rafaj. 2011. RCP8.5—A Scenario of Comparatively High Greenhouse Gas Emissions. *Climate Change* 109: 33-57, https://link.springer.com/article/10.1007/s10584-011-0149-y.

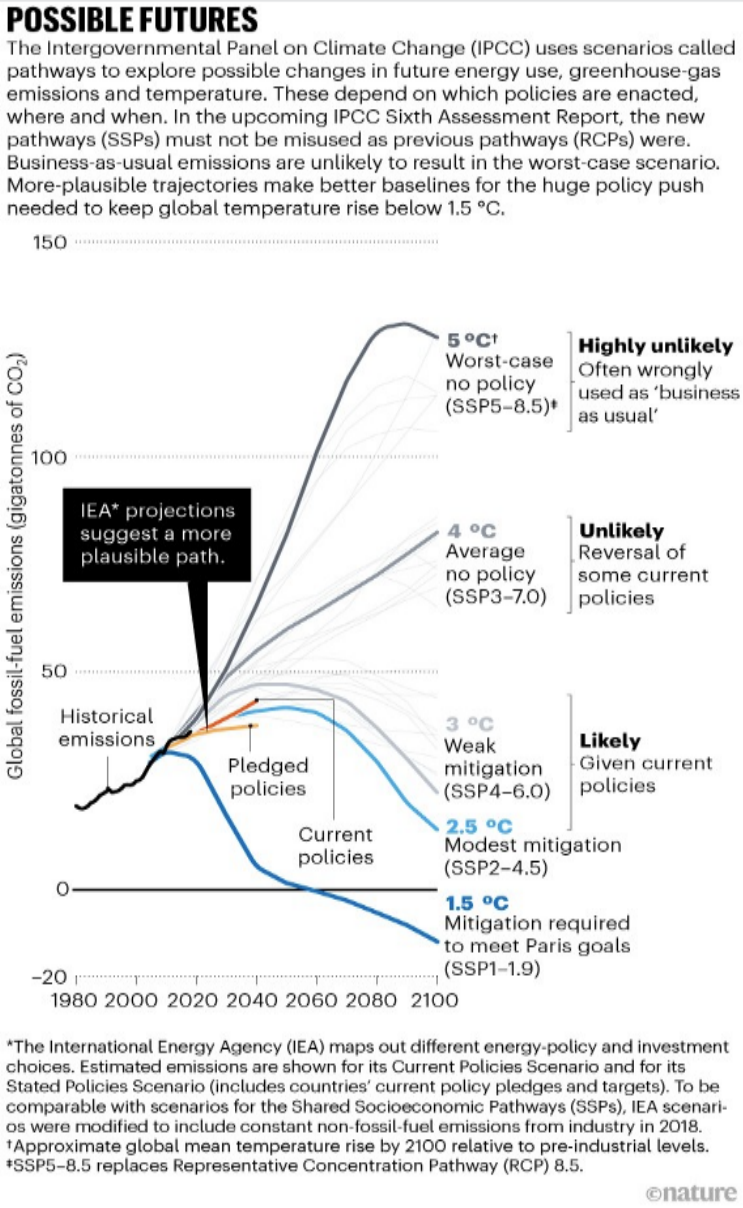
Nothing like that is happening or expected to happen. For example, in RCP8.5, global coal consumption roughly doubles during 2020-2050. In contrast, in the Energy Information Administration's (EIA's) most recent International Energy Outlook, global coal consumption during 2020-2050 increases by 13.5 percent.[31]

The increasing affordability of natural gas and the plethora of policies mandating and subsidizing renewables invalidate RCP8.5 as a baseline emission scenario, but so do rising coal extraction costs. As can be seen in the chart below, real coal producer prices more than doubled during 2000-2010 and are now 3.5 times higher than in 2000.

Source: *St. Louis Federal Reserve*[32]

As shown in the chart below by Zeke Hausfather of the Breakthrough Institute and Glenn Peters of the CICERO Center for International Climate Research, midcentury CO_2 emissions in the International Energy Agency's (IEA's) baseline scenarios ("current policies" and "pledged policies") are less than half those projected by SSP5-8.5.[33]

[31] EIA, International Energy Outlook 2021, Table A2: World total energy consumption by region and fuel, reference case, https://www.eia.gov/outlooks/ieo/data/pdf/ref/A02_r.pdf.
[32] St. Louis Federal Reserve, Producer Price Index by Industry: Coal (accessed 6/19/2023), https://fred.stlouisfed.org/series/PCU21212121.
[33] Zeke Hausfather and Glenn P. Peters, "Emissions – the 'business as usual' story is misleading," *Nature*, January 29, 2020, https://www.nature.com/articles/d41586-020-00177-3.

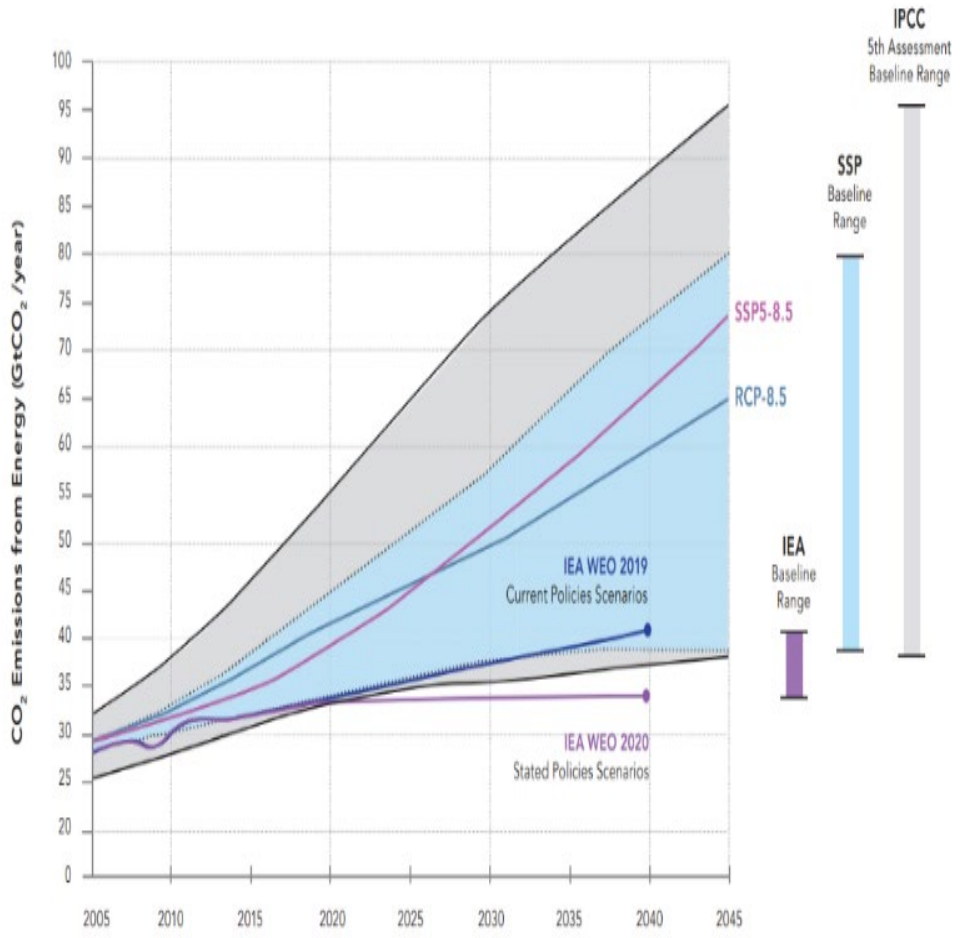


Source: *Hausfather and Peters (2020).*

To put this another way, the potential range of emissions in SSP5-8.5 and RCP8.5 lie almost entirely outside the range of the IEA's emission baselines, as shown in the chart below by University of Colorado professor Roger Pielke, Jr. and University of British Columbia research fellow Justin Ritchie.[34]

[34] Roger Pielke, Jr. and Justin Ritchie, "How Climate Scenarios Lost Touch with Reality," *Issues in Science & Technology*, Vol. XXXVII, No. 4, Summary 2021, https://issues.org/climate-change-scenarios-lost-touch-reality-pielke-ritchie/.

Figure 2. **IPCC BASELINE EMISSIONS SCENARIOS FROM 2005 TO 2040**



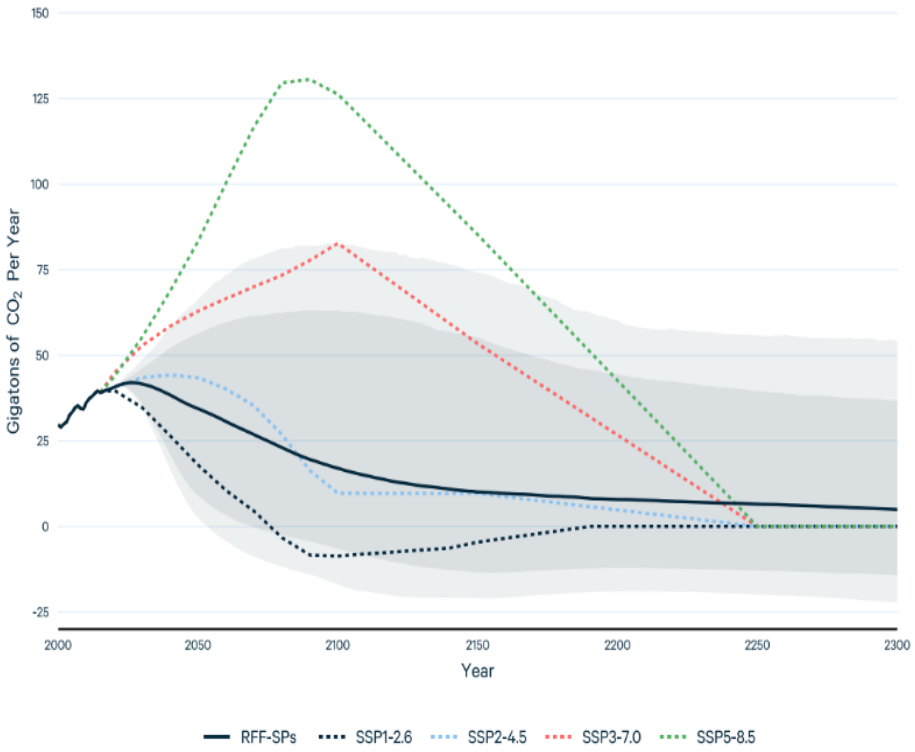
The range of fossil fuel baseline emissions projected by the International Energy Agency in 2019 and 2020 lie almost entirely outside the full range of baseline scenarios for the IPCC Fifth Assessment Report and the SSP scenarios shaping the IPCC Sixth Assessment Report.

Source: *Roger Pielke, Jr. and Justin Richie (2021).*

The next chart is by Kevin Rennert and his team at Resources for the Future (RFF).[35] Annual CO_2 emissions in the new RFF baselines are less than half those projected by SSP5-8.5 in 2050 and less than one-fifth those projected by SSP5-8.5 in 2100.

[35] Kevin Rennert et al. *The Social Cost of Carbon: Advances in Long-Term Probabilistic Projections of Population, GDP, Emissions, and Discount Rates, Resources for the Future*, October 2021, https://www.rff.org/publications/working-papers/the-social-cost-of-carbon-advances-in-long-term-probabilistic-projections-of-population-gdp-emissions-and-discount-rates/.

Figure 8. Net Annual Emissions of CO_2 from RFF-SPs and SSPs



Notes. Lines represent median values, and dark and light shading represent the 5th to 95th (darker) and 1st to 99th (lighter) percentile ranges of the RFF-SPs.

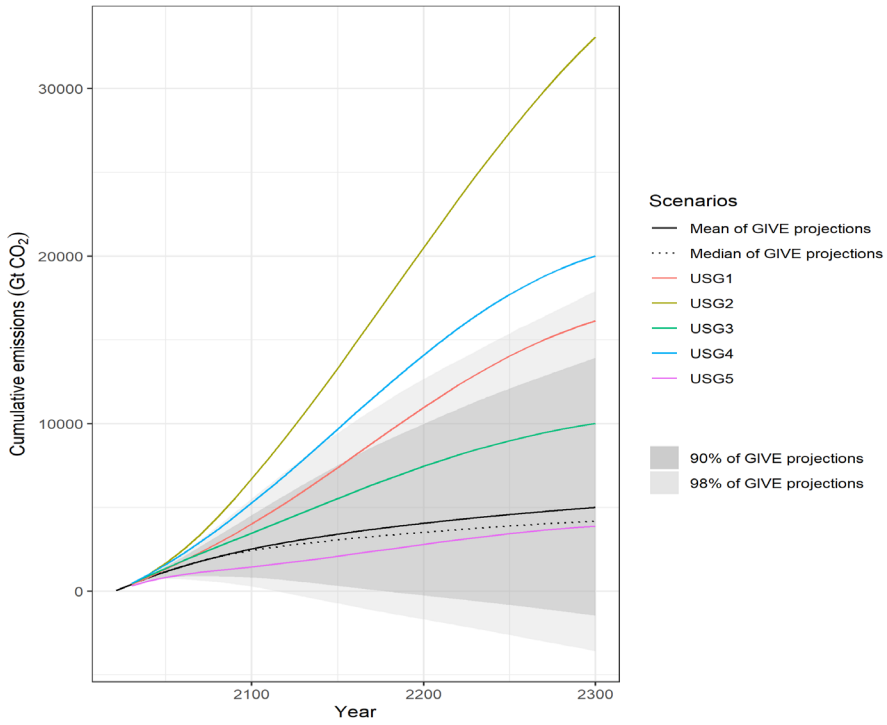
Source: *Kevin Rennert et al. (2021)*

OMB should be aware that the EPA considers the RFF long-term (300-year) emission baselines to be the most rigorous available, and intends to use those projections in future calculations of the social cost of greenhouse gases (SC-GHG).[36]

Comparing the RFF and IWG baselines underscores the implausibility of the latter. The RFF baselines for 2000-2300 (labeled "GIVE" in the chart below) project less than one-third of the CO_2 emissions previously assumed in the IWG's 2010, 2013, 2016, and 2021 TSDs.[37]

[36] EPA, External Review Draft of the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances, September 2022, p. 19, https://www.epa.gov/system/files/documents/2022-11/epa_scghg_report_draft_0.pdf.

[37] My calculation based on the chart below, sent to me by Dr. Rennert on 12/2/2022.



Source: *Kevin Rennert. The mean projection of GIVE in 2300 is 5,000 GtCO₂—less than one-third of the USG1-5 mean of 17,195 GtCO₂.*

It is difficult to exaggerate the extent to which inflated emission baselines have distorted climate science, needlessly scared the public, and misled policymakers. According to Google Scholar, researchers have published 40,800 papers featuring RCP8.5 and 4,600 papers featuring SSP5-8.5.[38] Cursory sampling suggests that very few papers challenge the plausibility of those scenarios. Of the first 50 entries for RCP8.5, only one paper is critical,[39] another rebuts that paper, and 48 use the scenario to model climate change impacts. Of the first 50 entries for SSP5-8.5, all use the scenario to model climate change impacts.

The pervasive use of unrealistic emission baselines in official and academic climate impact assessments corrupts both science and politics. The projected quantity of emissions is the central variable in climate assessments. Inflated emission baselines not only bias all climate impact and SCC calculations; they also fuel the climate crisis narrative, which in turn mobilizes support for global governance, regulatory overreach, political control of private capital investment, and intolerance of viewpoint diversity.

[38] Google Scholar, accessed 6/4/2023.
[39] Hausfather and Peters (2020), cited above.

In AR6, the IPCC finally acknowledged the "low" likelihood of RCP8.5 and SSP5-8, citing "recent developments in the energy sector" and the IEA's baseline emission scenarios.[40] However, old habits die hard.

As Pielke, Jr. observed: "Despite acknowledging the low likelihood of the most extreme scenarios RCP8.5 and SSP5-8.5, which were the dominant focus of the 2013 IPCC report, the extreme scenarios dominate the current report as well. This is obvious from the table below which shows the number of mentions of various scenarios in the new report."[41]

SCENARIO	MENTIONS	PCT of MENTIONS
SSP5-8.5 & RCP8.5	1359	41.5%
SSP1-2.6 & RCP2.6	733	22.4%
SSP2-4.5 & RCP4.5	571	17.4%
SSP3-7.0	378	11.5%
SSP1-1.9	200	6.1%
RCP6.0	32	1.0%

Source: *Roger Pielke, Jr. (August 10, 2021)*

Pielke, Jr. summarized: "The extreme scenarios RCP8.5 and SSP5-8.5 account for more than 40 percent of all scenario mentions across the 3,000+ page report. Add in the extreme scenario SSP3-7.0 and the total gets to over 50 percent."

Less-Is-More-Social Cost Paradox

The EPA's proposed revision of the IWG's SC-GHG estimates endorses the RFF baselines, which on average project less than one-third of the CO_2 emissions in the IWG's mean baseline. Yet, the EPA's revised SCC values are more than three times higher than the IWG's 2021 estimates. As with any paradox, this one calls for explanation. Instead, the EPA does not even take note of it.

Let's look at the numbers. The central SCC estimate in the 2021 TSD is $85 per ton in 2050. In the EPA's proposed revision, the central estimates are $290-$330 per ton.

[40] IPCC, Sixth Assessment Report, *Climate Change 2021: The Physical Science Basis*, Chapter 1, pp. 238-239, https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter01.pdf.
[41] Roger Pielke, Jr., "How to Understand the New IPCC Report: Part 1, Scenarios," The Honest Broker, Substack, August 10, 2021, https://rogerpielkejr.substack.com/p/how-to-understand-the-new-ipcc-report?s=r.

Table ES-1: Social Cost of CO_2, 2020 – 2050 (in 2020 dollars per metric ton of CO_2)[3]

Emissions Year	Discount Rate and Statistic			
	5% Average	3% Average	2.5% Average	3% 95th Percentile
2020	14	51	76	152
2025	17	56	83	169
2030	19	62	89	187
2035	22	67	96	206
2040	25	73	103	225
2045	28	79	110	242
2050	32	85	116	260

Table 3.1.1: Social Cost of Carbon (SC-CO_2) by Damage Module, 2020-2080 (in 2020 dollars per metric ton of CO_2)

Emission Year	Near-Term Ramsey Discount Rate and Damage Module								
	2.5%			2.0%			1.5%		
	DSCIM	GIVE	Meta-Analysis	DSCIM	GIVE	Meta-Analysis	DSCIM	GIVE	Meta-Analysis
2020	110	120	120	190	190	200	330	310	370
2030	140	150	150	230	220	240	390	350	420
2040	170	170	170	280	250	270	440	390	460
2050	210	200	200	330	290	310	500	430	520
2060	250	220	230	370	310	350	550	470	570
2070	280	240	250	410	340	380	600	490	610
2080	320	260	280	450	360	410	640	510	650

Sources: *IWG 2021 TSD, p. 5; EPA 2022 External Review Draft, p. 67*

No one supposes climate-related damages more than tripled between February 2021 and September 2022. How did the EPA derive much larger social costs from much smaller emission projections?

The shift in the central discount rate from 3.0 percent to 2.0 percent undoubtedly has something to do with it. However, that is not the whole story, as becomes apparent when we compare the IWG's and EPA's respective SCC estimates discounted at 2.5 percent. Under the 2.5 percent discount rate, the SCC in 2050 is $116 in the IWG's calculation and $200-210 in the EPA's calculation, i.e., 73-84 percent larger.

The EPA does not clarify which analytic choices make which percentage contributions to the overall increase in estimated social costs. As in the IWG exercise, the EPA's bottom-line is not transparent. OMB should insist on layman-friendly transparency in both SCC analysis and CBA generally.

III. Other Methodological Biases

Reliance on unrealistic emission scenarios is not the only methodological bias inflating SCC-based climate benefit estimates. Other tendentious practices include:

- Run the climate damage calculators (called "integrated assessment models" or IAMs) with low discount rates;

- Use climate sensitivity estimates derived from models that persistently overshoot observed warming;

- Project cumulative damages over a 300-year period—well beyond the limits of informed speculation;

- Minimize the agricultural benefits of atmospheric CO_2 fertilization by averaging the results of three IAMs, two of which do not estimate such effects;[42]

- Low-ball human adaptive capabilities by ignoring the 96 percent decadal average decrease in climate-related deaths since the 1920s,[43] the nearly five-fold decrease in climate damages per exposed GDP since the 1980s,[44] and the doubling of combined global maize, wheat, rice, and soybean output since 1980;[45]

- Further inflate SCC estimates by including an IAM—the PAGE model—that unrealistically assumes adaptation is powerless to mitigate the costs of climate change once 21st century warming and sea-level rise exceed 1°C and 10 inches, respectively; [46] and,

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[42] The Dynamic Integrated Climate-Economy (DICE) and Policy Analysis of the Greenhouse Effect (PAGE) models effectively assign a dollar value of zero to the agricultural benefits of CO_2 fertilization. The Climate Framework for Uncertainty, Negotiation and Distribution (FUND) model does estimate CO_2 fertilization benefits, but based on studies conducted in the 1990s, which underestimate CO_2 fertilization effects on rice yields. See Dayaratna et al. (2020).

[43] Bjorn Lomborg, "We're Safer from Climate Disasters than Ever Before," *Wall Street Journal*, November 3, 2021, https://www.wsj.com/articles/climate-activists-disasters-fire-storms-deaths-change-cop26-glasgow-globalwarming-11635973538; "Fewer and fewer people die from climate-related natural disasters, January 1, 2022, https://www.facebook.com/bjornlomborg/posts/475702943914714/?paipv=0&eav=Afb6AZGC-3Y_7LOQ_QWHSm2R72EHVYCgbJr9vadQf9qh63Bt6diHDBmkgiKOHnFd9yY&__rdr.

[44] Giuseppe Formetta and Luc Feyen. 2019. Empirical Evidence of Declining Global Vulnerability to Climate-Related Hazards, *Global Environmental Change*, 57: 1-9, https://www.researchgate.net/publication/333507964_Empirical_evidence_of_declining_global_vulnerability_to_climate-related_hazards.

[45] Kevin D. Dayaratna, Ross McKitrick, and Patrick J. Michaels. 2020. Climate sensitivity, agricultural productivity and the social cost of carbon in FUND. *Environmental Economics and Policy Studies* (2020) 22:433–448, https://link.springer.com/article/10.1007/s10018-020-00263-w (hereafter Dayaratna et al. (2020)).

[46] The PAGE model's adaptation assumptions are discussed on pp. 14-15 of the IWG's 2016 TSD, https://www.epa.gov/sites/default/files/2016-12/documents/sc_co2_tsd_august_2016.pdf. For a more robust view of human adaptive capability, see Hinkel et al. 2014. Coastal flood damage and adaptation costs under 21st century sea-level rise. *PNAS* 111: 3292- 3297, https://www.pnas.org/doi/epdf/10.1073/pnas.1222469111, and Bjorn Lomborg's commentary thereon, "Climate Change Calls for Adaptation, Not Panic," *Wall Street Journal*,

- Confuse the public by comparing domestic costs (apples) to global benefits (oranges) in regulatory net-benefit calculations.

There are reasonable alternatives to all of the IWG's methodological choices. As noted above, under the Draft Circular A-4, "If the analytic results are sensitive to a given assumption or data source, alternative modeling assumptions or data sources can be used to demonstrate the sensitivity of the results." Moreover, OMB seems to suggest, sensitivity analysis is most valuable when it finds "switch points" that change not just the size of net benefits but even their "sign."

None of the IWG TSDs provide sensitivity cases in which SCC values are calculated with reasonable alternative assumptions regarding climate sensitivity, discount rates, length of analysis period, carbon dioxide fertilization, or human adaptive capabilities. The IWG also never funded or commissioned studies to quantify the domestic as distinct from global benefits of U.S. GHG regulations. No agency will ever separate such effects in "a practical and reasonably accurate manner"[47] if no agency is budgeted and tasked to do so.

OMB should insist that agency SCC reports provide sensitivity analyses for all basic analytic choices, or else the linkages between modelers' assumptions and results will never be transparent.

IV. Sensitivity Cases

Heritage Foundation Chief Statistician Kevin D. Dayaratna has published several sensitivity analyses, including three in the peer reviewed literature,[48] examining how SCC estimates change when reasonable alternatives are substituted for the IWG's assumptions. The "references" sections in the IWG's 2021 TSD and the EPA's 2022 SC-GHG list hundreds of studies from the peer-reviewed literature. Neither list includes any of Dayaratna's studies. Such omissions flout basic standards of objectivity and balance. For OMB's benefit, I now summarize some of Dayaratna's sensitivity analyses.[49]

October 21, 2021, https://www.wsj.com/articles/climate-change-adaptation-panic-exaggerating-disaster-11634760376.

[47] OMB Draft Circular A-4, p. 10.

[48] Kevin D. Dayaratna and David Kreutzer. 2014. "Environment: Social Cost of Carbon Statistical Modeling Is Smoke and Mirrors," *Natural Gas & Electricity*, Vol. 30, No. 12, pp. 7–11, https://onlinelibrary.wiley.com/doi/abs/10.1002/gas.21771; K. Dayaratna, R. McKitrick, and D. Kreutzer. 2017. "Empirically Constrained Climate Sensitivity and the Social Cost of Carbon," *Climate Change Economics*, Vol. 8, No. 2 pp. 1-12, https://www.worldscientific.com/doi/abs/10.1142/S2010007817500063 (hereafter Dayaratna et al. (2017); and Dayaratna et al. (2020).

[49] The following comments draw freely from joint comments I submitted with Dayaratna and my late colleague Patrick J. Michaels on the IWG 2021 TSD, June 21, 2021, https://cei.org/wp-content/uploads/2021/06/Comments-OMB-Technical-Support-Document-Social-Cost-of-Carbon.pdf.

Discount Rates

The IWG used discount rates of 2.5 percent, 3.0 percent, and 5.0 percent, despite the existing Circular A-4's requirement that agencies use rates of 3.0 percent and 7.0 percent. The EPA's proposed revision drops the IWG's central rate from 3.0 percent to 2.0 percent. The effect, of course, is to increase SCC values. Dayaratna et al. (2017) ran the DICE and FUND models using a 7.0 percent discount rate. Below are the results published in *Climate Change Economics*:

	DICE Model Average SCC – Baseline, End Year 2300			
Year	**Discount Rate 2.5%**	**Discount Rate 3.0%**	**Discount Rate 5.0%**	**Discount Rate 7.0%**
2020	$56.92	$37.79	$12.10	$5.87
2030	$66.53	$45.15	$15.33	$7.70
2040	$76.96	$53.26	$19.02	$9.85
2050	$87.70	$61.72	$23.06	$12.25
	FUND Model Average SCC – Baseline, End Year 2300			
Year	**Discount Rate 2.5%**	**Discount Rate 3.0%**	**Discount Rate 5.0%**	**Discount Rate 7.0%**
2020	$32.90	$19.33	$2.54	–$0.37
2030	$36.16	$21.78	$3.31	–$0.13
2040	$39.53	$24.36	$4.21	$0.19
2050	$42.98	$27.06	$5.25	$0.63

SCC estimates are drastically reduced when the models are run with a 7.0 percent discount rate. In fact, in the FUND model, the estimates are negative through 2030 and very low through 2050.

The IWG and the EPA offer several reasons for not discounting climate benefits at 7.0 percent. But what is the harm in providing a 7.0 percent sensitivity case, if only in an

appendix? Is there no legitimate interest in finding out what happens when SCC values are discounted at the long-term rate of return on the New York Stock Exchange?[50]

Time Horizon

The IWG and the EPA base their SCC estimates on projections of climate change damages over a 300-year period (2000-2300). That in itself should disqualify SCC analysis as a basis for imposing multibillion-dollar burdens on the public.

Human beings use technology to adapt to environmental conditions. Consequently, the damage functions in SCC analysis depend on assumptions about how adaptive technologies develop and deploy as the world warms. It is dauntingly difficult to forecast technology change over a period of decades, much less centuries.

To test the sensitivity of SCC estimates to the time horizon chosen, Dayaratna and his former Heritage Foundation colleague David Kreutzer ran the DICE model with a significantly shorter, albeit still unrealistic, analytic horizon of 150 years.[51]

Here are the DICE-estimated SCC values with a baseline ending in 2300:

TABLE 1

Average SCC Baseline, End Year 2300

Year	Discount Rate: 2.5%	Discount Rate: 3%	Discount Rate: 5%	Discount Rate: 7%
2010	$46.57	$30.04	$8.81	$4.02
2015	$52.35	$34.32	$10.61	$5.03
2020	$56.92	$37.79	$12.10	$5.87
2025	$61.48	$41.26	$13.60	$6.70
2030	$66.52	$45.14	$15.33	$7.70
2035	$71.57	$49.03	$17.06	$8.70
2040	$76.95	$53.25	$19.02	$9.85
2045	$82.34	$57.48	$20.97	$11.00
2050	$87.69	$61.72	$23.06	$12.25

Source: Calculations based on Heritage Foundation Monte Carlo simulation results using the DICE model. B 2860 heritage.org

Source: *Dayaratna and Kreutzer (2013)*

Here are the results with a baseline ending in 2150:

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[50] David Kreutzer, "Biden Administration's Social Cost of Carbon and 'Intergenerational Equity' Policies Inefficient, Unfair," *Daily Signal*, April 12, 2021, https://www.dailysignal.com/2021/04/12/biden-administrations-social-cost-of-carbon-and-intergenerational-equity-policies-are-completely-inefficient-and-unfair/.

[51] Dayaratna and Kreutzer, *Loaded DICE: An EPA Model Not Ready for the Big Game*, Backgrounder No. 2860, The Heritage Foundation, November 21, 2013, https://www.heritage.org/environment/report/loaded-dice-epa-model-not-ready-the-big-game.

TABLE 3

Average SCC, End Year 2150

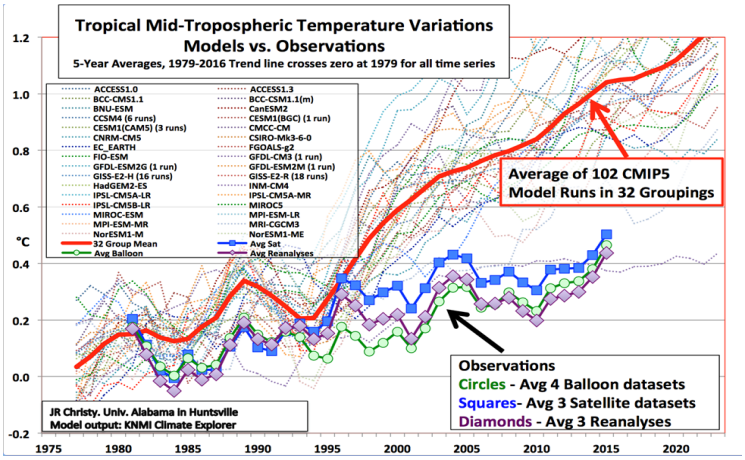
Year	Discount Rate: 2.5%	Discount Rate: 3%	Discount Rate: 5%	Discount Rate: 7%
2010	$36.78	$26.01	$8.66	$4.01
2015	$41.24	$29.65	$10.42	$5.02
2020	$44.41	$32.38	$11.85	$5.85
2025	$47.57	$35.11	$13.28	$6.68
2030	$50.82	$38.00	$14.92	$7.67
2035	$54.07	$40.89	$16.56	$8.66
2040	$57.17	$43.79	$18.36	$9.79
2045	$60.27	$46.68	$20.16	$10.92
2050	$62.81	$49.20	$22.00	$12.13

Source: Calculations based on Heritage Foundation Monte Carlo simulation results using the DICE model. B 2860 heritage.org

As the charts show, with a 3 percent discount rate, replacing the IWG's 300-year analysis period with a 150-year period reduces the SCC in 2050 by almost 21 percent.

Climate Sensitivity

The key climate specification used in estimating the SCC is the equilibrium climate sensitivity (ECS) distribution. Such distributions probabilistically quantify the earth's temperature response to a doubling of CO_2 concentrations. IAMs do not generate climate sensitivity estimates but rather use estimates from general circulation models (GCMs) and earth system model (ESMs) as inputs when calculating changes in global annual average temperatures and other climate variables. Nearly all such models overshoot observed temperatures in the tropical mid-troposphere. As shown in the chart below, the CMIP5 models used in AR5 on average project more twice the mid-troposphere warming during 1979-2016.[52]



Source: *John Christy (2017)*

[52] Christy, J.R.: 2017, [in "State of the Climate in 2016"], *Bull. Amer. Meteor. Soc*. 98, (8), S16-S17, https://journals.ametsoc.org/view/journals/bams/98/8/2017bamsstateoftheclimate.1.xml.

The ECS distribution used by the IWG is based on a paper published in the journal *Science* sixteen years ago by Gerard Roe and Marcia Baker.[53]

Since 2011, several newer and empirically-constrained distributions have been published in the peer-reviewed literature. The chart below compares the sensitivity range and average of 24 empirically constrained studies to the Roe-Baker distribution and median of climate models used in AR5.[54]

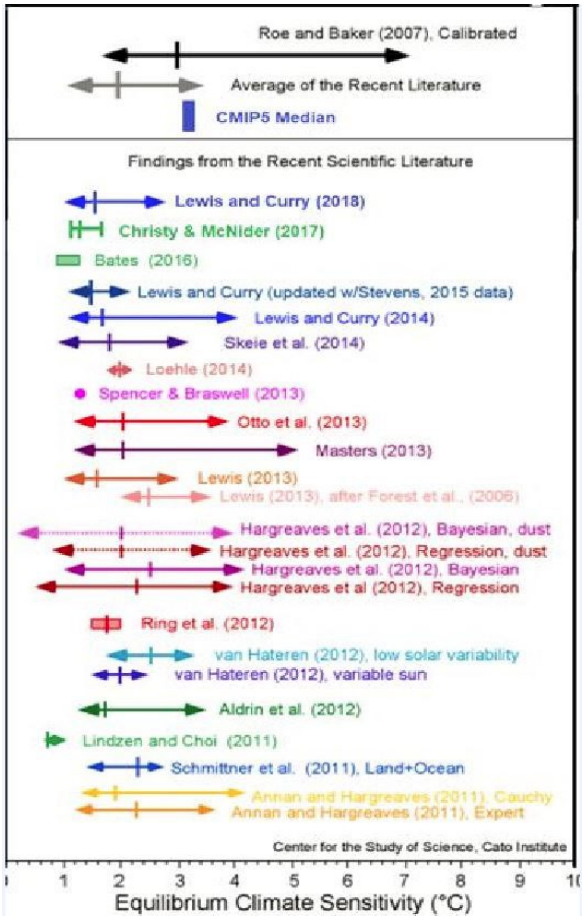


Figure Source: *Patrick J. Michaels and Ryan Maue, March 6, 2019. The median (indicated by the small vertical line) and 90% confidence range (indicated by the horizontal line with arrowheads) of the Roe-Baker ECS distribution is indicated by the top black arrowed line. The median value in Row-Baker is 3°C. The mean ECS in the 24 studies is 2°C.*

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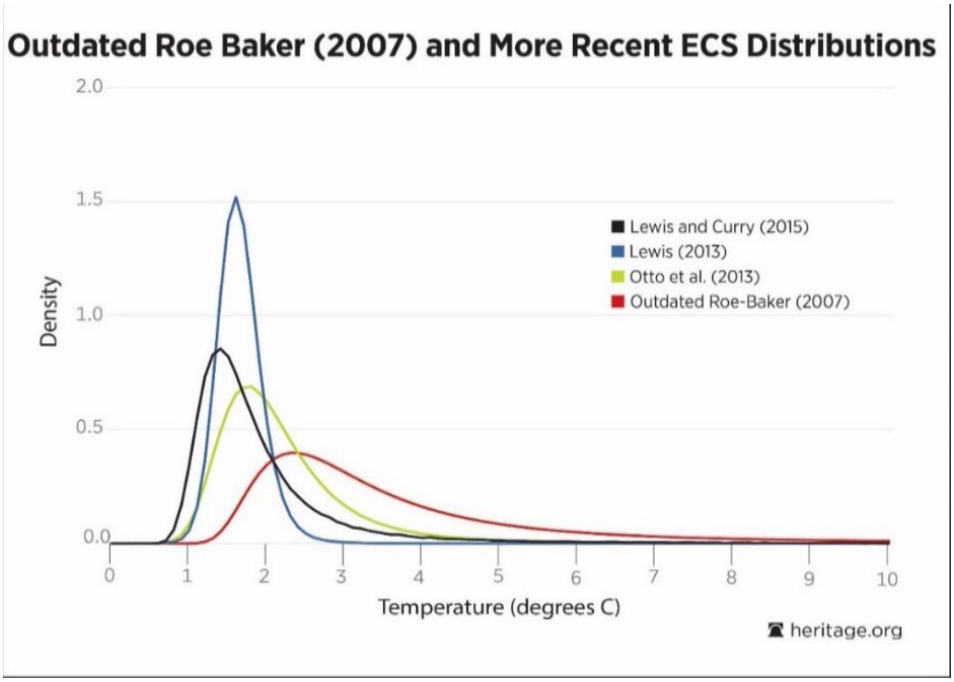
[53] Gerard H. Roe and Marcia B. Baker. 2007. Why Is Climate Sensitivity So Unpredictable? *Science*, Vol. 318, No. 5850, pp. 629–632, https://science.sciencemag.org/content/318/5850/629.

[54] Patrick J. Michaels, "An Analysis of the Obama Administration's Social Cost of Carbon," testimony before the Committee on Natural Resources, U.S. House of Representatives, July 22, 2015, https://www.cato.org/publications/testimony/analysis-obama-administrations-social-cost-carbon (accessed September 23, 2020).

Not only is the average sensitivity lower in the empirically-constrained distributions, so is the probability of extreme warming and, thus, of climate tipping points.

The next chart compares the probability of high-end warming in Roe and Baker to three prominent empirically constrained distributions.[55]



Source: *Kevin Dayaratna, Congressional Testimony, February 27, 2017*[56]

The areas under the curves between two temperature points represent the probability that the earth's temperature will increase between those amounts in response to a doubling of CO_2 concentration. For example, the area under the curve from 4°C onwards (known as right-hand "tail probability") represents the probability that the earth's temperature will warm by more than 4°C in response to doubled CO_2 concentration. Note that the more up-to-date ECS distributions have significantly lower tail probabilities than the Roe-Baker distribution used by the IWG.

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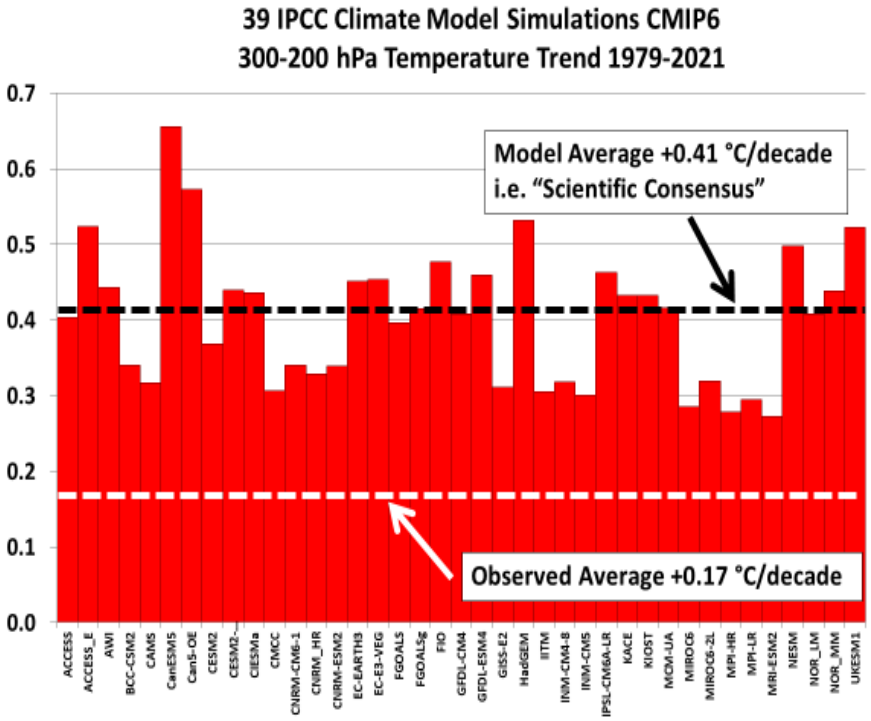
[55] The three empirically-constrained ECS distributions are: Nicholas Lewis, "An Objective Bayesian Improved Approach for Applying Optimal Fingerprint Techniques to Estimate Climate Sensitivity," *Journal of Climate*, Vol. 26, No. 19 (October 2013), pp. 7414–7429, https://journals.ametsoc.org/view/journals/clim/26/19/jcli-d-12-00473.1.xml; Alexander Otto et al., "Energy Budget Constraints on Climate Response," *Nature Geoscience*, Vol. 6, No. 6 (June 2013), pp. 415–416, https://www.nature.com/articles/ngeo1836; Nicholas Lewis and Judith A. Curry, "The Implications for Climate Sensitivity of AR5 Forcing and Heat Uptake Estimates," *Climate Dynamics*, Vol. 45, No. 3, pp. 1009–1923, http://link.springer.com/article/10.1007/s00382-014-2342-y.

[56] Testimony of Kevin D. Dayaratna, Methods and Parameters Used to Establish the Social Cost of Carbon, Hearing before the Subcommittee on Environment and Oversight, House Committee on Science and Technology, February 27, 2017, https://republicans-science.house.gov/_cache/files/1/2/127ca9f6-78d1-4c07-bfa0-5659613d81b7/E1582E7C86D389076DF7BFD232728E4B.hhrg-115-sy18-wstate-kdayaratna-20170228.pdf.

One might assume an ECS distribution based on today's state-of-the-art GCMs and ESMs would be more realistic than the Roe and Baker ECS. Not so. The CMIP6 models used in AR6 project on average about 2.4 times the observed warming in the tropical mid-troposphere. Moreover, all CMIP6 models significantly exceed the observational average.[57]



Source: *John Christy, CMIP6 Models vs. Observations*

OMB should note that the tropical mid-troposphere is uniquely suited for testing the validity of climate models. That is because: (1) all models predict a strong positive feedback in that atmospheric layer; (2) the region is well-monitored by satellites and weather balloons; (3) the mid-troposphere is too distant from the surface to be influenced by land use changes; and (4) the models were not previously "tuned" to match the historical climatology in that region, so they are genuinely independent of the data used to test them.[58]

Here is the 2016 TSD's SCC estimates for 2020-2050:

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[57] McKitrick and J. Christy. 2020. Pervasive Warming Bias in CMIP6 Tropospheric Layers. *Earth and Space Science* Volume 7, Issue 9, https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2020EA001281.

[58] R. McKitrick and J. Christy. 2018. A Test of the Tropical 200- to 300-hPa Warming Rate in Climate Models, *Earth Space and Science*, 5, 529–536, https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2018EA000401.

Table ES-1: Social Cost of CO_2, 2010 – 2050 (in 2007 dollars per metric ton of CO_2)

Year	5% Average	**3% Average**	2.5% Average	High Impact (95th Pct at 3%)
2010	10	**31**	50	86
2015	11	**36**	56	105
2020	12	**42**	62	123
2025	14	**46**	68	138
2030	16	**50**	73	152
2035	18	**55**	78	168
2040	21	**60**	84	183
2045	23	**64**	89	197
2050	26	**69**	95	212

In *Climate Change Economics*, Dayaratna et al. (2017) re-estimated the SCC in DICE and FUND using the more up-to-date ECS distributions and obtained the following results:

	DICE Model Average SCC – ECS Distribution Updated in Accordance with Lewis and Curry (2015), End Year 2300			
Year	**Discount Rate 2.5%**	**Discount Rate 3.0%**	**Discount Rate 5.0%**	**Discount Rate 7.0%**
2020	$28.92	$19.66	$6.86	$3.57
2030	$33.95	$23.56	$8.67	$4.65
2040	$39.47	$27.88	$10.74	$5.91
2050	$45.34	$32.51	$13.03	$7.32

	FUND Model Average SCC – ECS Distribution Updated in Accordance with Lewis and Curry (2015), End Year 2300			
Year	**Discount Rate 2.5%**	**Discount Rate 3.0%**	**Discount Rate 5.0%**	**Discount Rate 7.0%**
2020	$5.86	$3.33	–$0.47	–$1.10
2030	$6.45	$3.90	–$0.19	–$1.01
2040	$7.02	$4.49	–$0.18	–$0.82
2050	$7.53	$5.09	$0.64	–$0.53

The sensitivity analysis clearly shows that using a reasonable alternative ECS distribution substantially lowers the estimated SCC. In DICE, SCC values are about half

the 2016 TSD estimates. In FUND, the SCC remains low through 2050 under all discount rates, and is negative through 2040 under a 5 percent rate.

CO_2 Fertilization

As noted, the IWG averages the results of three IAMs, two of which (DICE and PAGE) effectively assign a dollar value of zero to the agricultural benefits of CO_2 atmospheric enrichment. That is simply unscientific. It is common knowledge that CO_2 is plant food. As of 2017, terrestrial plants were converting 31 percent more CO_2 into organic matter than they did before the Industrial Revolution.[59] Thousands of empirical studies show that elevated CO_2 concentrations enhance the growth of hundreds of food crops by increasing their internal water use efficiency and photosynthetic activity.[60]

Dayaratna et al. (2020) ran the FUND model with updated empirical information regarding climate sensitivity and carbon dioxide fertilization.[61] The SCC drops to very low numbers with substantial probabilities of being negative through 2050. A negative SC-CO_2 is another way of saying a net benefit.

Note, low and even negative SC-CO_2 values result even when FUND is run with the IWG's lowest discount rate (2.5%). For example, replacing the Roe and Baker (2007) ECS with Lewis and Curry (2018) and increasing FUND's CO_2 fertilization function by 30 percent yields a 51 percent probability that the SCC in 2050 is -$0.55 (i.e., a net-benefit of $0.55 per ton).

	FUND Model Average SC-CO2, agricultural component updated - Discount Rate – 2.5%			
	Roe Baker (2007)	**Lewis and Curry (2018)**	**Lewis and Curry (2018) + 15%**	**Lewis and Curry (2018) + 30%**
2020	$32.90	$3.78 / 0.46	$0.62 / 0.53	-$1.53 / 0.59
2030	$36.16	$4.69 / 0.44	$1.25 / 0.51	-$1.02 / 0.57

[59] J. E. Campbell, J. A. Berry, U. Seibt, S. J. Smith, S. A. Montzka, T. Launois, S. Belviso, L. Bopp & M. Laine. 2017. Large historical growth in global terrestrial gross primary production. *Nature* 544, 84–87, https://www.nature.com/articles/nature22030.

[60] Center for the Study of Carbon Dioxide and Global Change, Plant Growth Database, http://co2science.org/data/plant_growth/plantgrowth.php (accessed 6/14/2023).

[61] Although FUND has a strong CO_2 fertilization function for wheat, soybeans, and corn, recent studies also find a strong fertilization effect for rice. Based on those studies, Dayaratna et al. (2020) boost the FUND CO_2 fertilization function by 15 percent and 30 percent.

2040	$39.53	$5.76 / 0.42	$2.03 / 0.48	-$0.33 / 0.54
2050	$42.98	$6.98 / 0.39	$2.96 / 0.46	-$0.55 / 0.51

Figure Source: *Dayaratna et al. (2020). FUND model's CO_2-fertilization coefficients updated to increase agricultural benefits by 15 percent and 30 percent and run with the updated ECS distribution of Lewis and Curry (2018).*[62] *Numbers to the right of backslashes are probabilities.*

Domestic vs. Global Benefits

Although international trade, investment, and tourism create "spillover pathways" that can make other nations' problems our problems as well, and the use of global SCC values may facilitate international climate policies,[63] the fact remains that Americans bear most of the costs of U.S. climate regulations while non-Americans reap most of the purported benefits.

Thus, however valid it may be to estimate global benefits, those should be reported separately from estimated domestic benefits, to facilitate comparing domestic costs and benefits. That is the approach favored by the existing Circular A-4; it should be retained.[64] There is no scientific or ethical justification for hiding the comparatively smaller domestic benefits from the American people.

V. Conclusion: Deeper Issues

Federal agencies typically claim SCC estimates are solely for informational purposes and do not inform regulatory decisions. For example, towards the end of the EPA's proposed methane emission standards for oil and gas infrastructure, the EPA asserts that its climate-benefit calculations are not a factor influencing regulatory stringency: "However, we emphasize that the monetized benefits analysis is entirely distinct from the statutory BSER determinations proposed herein and is presented solely for the purposes of complying with E.O. 12866."[65]

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[62] Lewis and Curry. 2018. The impact of recent forcing and ocean heat uptake data on estimates of climate sensitivity. *Journal of Climate* Vol. 31: 6051-6071, https://journals.ametsoc.org/view/journals/clim/31/15/jcli-d-17-0667.1.xml.

[63] IWG, 2021 TSD, pp. 3, 15-16; OMB Draft Circular A-4, pp. 9-10.

[64] "Where you choose to evaluate a regulation that is likely to have effects beyond the borders of the United States, these effects should be reported separately." OMB, Circular A-4, September 13, 2003, p. 15, https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4/.

[65] EPA, Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing sources: Oil and Gas Sector Climate Review; Supplemental Notice of Proposed Rulemaking, 87 FR 74702,

Such disclaimers are unconvincing. For one thing, E.O. 12866 itself serves a more basic rule of reason. As the Supreme Court stated in its review of the Mercury Air Toxics Standards (MATS) rule in *Michigan v. EPA*: "One would not say that it is even rational, never mind 'appropriate,' to impose billions of dollars in economic costs in return for a few dollars in health or environmental benefits . . . No regulation is 'appropriate' if it does significantly more harm than good."[66]

The Court's admonition applies all the more forcefully to a regulation, like the EPA's methane standards proposal, in which 100 percent of projected monetized benefits, totaling $55 billion, are social cost-based climate benefits.[67] Absent such benefits, it would be very hard to justify the imposition of the rule's anticipated $13 billion in compliance costs on the regulated industry.

Given the Biden administration's "whole of government approach to the climate crisis," we may expect an increasing number of regulations will depend for their purported rationality on social cost-based climate benefits.

But there's the rub. When we attempt to grasp the substance of those benefits, we cannot verify or perceive their existence in human or natural events. This makes climate benefits different from conventional environmental benefits, which in general are fairly traceable to their causes and can be experienced (e.g. improvements in air quality) within the lifetimes of the intended beneficiaries.

For example, the EPA's proposed methane standards are projected to eliminate 910 million metric tons (MMT) of carbon dioxide-equivalent (CO_2e) emissions during 2023-2035.[68] Plugging that reduction into the EPA's climate policy calculator (MAGICC),[69] the proposal would avert 0.004°C of warming by 2050 and 0.011°C by 2100, assuming 3°C climate sensitivity.[70] For perspective, the standard deviation for measuring changes in

74843, December 6, 2022, https://www.govinfo.gov/content/pkg/FR-2022-12-06/pdf/2022-24675.pdf. The acronym BSER stands for "best system of emission reduction."

[66] *Michigan v. E.P.A.*, 576 U.S. 743, 752 (2015), https://supreme.justia.com/cases/federal/us/576/14-46/case.pdf.

[67] EPA, Regulatory Impact Analysis for the Proposed Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review (hereafter RIA), October 2021, Table 5-4, p. 5-7, https://www.epa.gov/system/files/documents/2021-11/proposal-ria-oil-and-gas-nsps-eg-climate-review_0.pdf.

[68] EPA, RIA Methane Standards Rule, Table 1-3, p. 1-10.

[69] https://magicc.org/.

[70] For calculation details, see Comments Submitted by Marlo Lewis (Competitive Enterprise Institute) and Kevin Dayaratna (Heritage Foundation), Docket No. EPA–HQ–OAR–2021–0317-1460, February 13, 2023, https://cei.org/wp-content/uploads/2023/02/CEI-Comments-on-Methane-Performance-Standards-for-the-Oil-and-Gas-Sector-corrected-2-17-23.pdf.

global annual average surface temperature is 0.11°C.[71] The rule's purported effects are too small to be detected by scientists or experienced by people and other living things.

Undetectable, non-experiential effects are "benefits" in name only. Such imperceptible effects are too conjectural to be netted against multi-billion-dollar compliance costs that impose verifiable burdens on identifiable people and businesses.

Moreover, as may be gathered from Sections II-IV above, SCC estimates are so sensitive to alternative models and inputs that political manipulation is virtually unavoidable. And incentives to manipulate are obvious and powerful. Progressives dominate the social cost fraternity, and the progressive movement champions the Net-Zero agenda.[72] In addition, by adjusting the knobs and dials, social cost modelers can, in principle, make fossil fuels look unaffordable no matter how cheap, and climate regulations look like a bargain at any price.

Whatever value SCC analysis may have as an academic exercise, it is too dependent on modelers' non-validated analytic choices to inform regulatory decisions.[73] The growing prominence of SCC estimates in agency rulemakings endangers the intellectual integrity of federal benefit-cost analysis.

Initiatives to contain, scale back, or extricate SCC analysis as a factor in regulatory justification are not possible in the current administration. However, political conditions may be more propitious in the near future. These comments are intended to help OMB begin to consider the case for such a course correction and how to implement it.

Respectfully,

Marlo Lewis, Jr., Ph.D.
Senior Fellow Energy and Environmental Policy
Competitive Enterprise Institute
202-331-1010; marlo.lewis@cei.org

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[71] J. Hansen, et. al. 1999. GISS Analysis of Surface Temperature Change. *Journal of Geophysical Research*, Vol. 104, No. D24, 30,997-31,022, https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/1999JD900835.

[72] Nicholas Stern, Joseph Stiglitz, Kristina Karlsson, and Charlotte Taylor openly advocate making SCC analysis the handmaid of the Net-Zero agenda. See their paper, "A social cost of carbon consistent with a net-zero climate goal," *Creative Commons*, January 2022, https://rooseveltinstitute.org/wp-content/uploads/2022/01/RI_Social-Cost-of-Carbon_202201-1.pdf.

[73] IAMs "are so deeply flawed as to be close to useless as tools for policy analysis. Worse yet, their use suggests a level of knowledge and precision that is simply illusory, and can be highly misleading." Robert S. Pindyck, Climate Change Policy: What Do the Models Tell Us? NBER Working Paper Series, Working Paper 19244, July 2013, https://www.nber.org/system/files/working_papers/w19244/w19244.pdf.