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CONGRESSIONAL TESTIMONY

Flaws in the Social Cost of Carbon, the Social Cost of Methane, and the Social Cost of Nitrous Oxide

Subcommittee on Energy and Mineral Resources

Committee on Natural Resources

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Nick Loris

Herbert & Joyce Morgan Fellow

The Heritage Foundation

My name is Nick Loris and I am the Herbert & Joyce Morgan Fellow at The Heritage Foundation. The views I express in this testimony are my own, and should not be construed as representing any official position of The Heritage Foundation. I would like to thank the House of Representatives Committee on Natural Resources for the opportunity to address the Transparency and Honesty in Energy Regulations Act of 2017 (H.R. 3117).

The legislation would prevent specific federal agencies from considering the social cost of carbon (SCC), methane, or nitrous oxide. H.R. 3117 is a step in the right direction for U.S. energy and climate policy. The Integrated Assessment Models used to justify the social cost of carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions are not credible for policymaking. The outputs change significantly with reasonable changes to the inputs. Congress and the Trump Administration should prohibit any agency from using estimates of the SCC in regulatory analysis and rulemaking.

What Is the Social Cost of Carbon and How Is It Used?

The SCC and other GHGs is the alleged external cost from emitting CO_2, methane, and other GHG emissions into the atmosphere. The logic behind the calculation is that the emissions of GHGs impose a negative externality by causing climate change, inflicting societal harm on the United States and the rest of the world.

When President Obama first took office, he created an Interagency Working Group to calculate the alleged monetary long-term damage of CO_2 emissions in a given year. Through an interagency working group, the Environmental Protection Agency (EPA) estimates the SCC; the social cost of methane (SCM); and the social cost of nitrous oxide (SCN_2O). The EPA defines these "social cost" metrics as the accumulated economic damages over the course of the next 300 years that are associated with the emission of one ton of the respective emissions in any given year.[1] For CO_2, the working group estimated the SCC to be $21 per ton; a few years later, the working group increased that cost to $36 per ton in 2015 and is roughly at $40 per ton today.

The Obama Administration increased the SCC with little transparency, something Members of Congress and individuals across the political spectrum criticized. The Administration made no public announcement nor did it welcome a comment period. It was only until the Department of Energy (DOE) granted the Landmark Legal Foundation's petition for reconsideration that the Administration opened the change to a comment period.[2]

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[1]The official definition of the social cost of carbon is the economic damages per metric ton of CO_2 emissions. For further discussion, see U.S. Environmental Protection Agency, "Social Cost of Carbon," Fact Sheet, December 2015, https://www3.epa.gov/climatechange/Downloads/EPAactivities/social-cost-carbon.pdf (accessed July 19, 2017).

[2]Landmark Legal Foundation, "Petition for Reconsideration," Energy Conservation Program for Consumer Products, http://www.landmarklegal.org/uploads/llf_reconsideration_petition.pdf (accessed July 21, 2017).

The federal government uses the SCC to calculate the climate benefit of abated CO_2 emissions from regulations. In effect, agencies project a monetary value for the "climate benefit" of regulations or a monetary "climate cost" for proposed projects. Federal and state regulators can use the SCC to justify a regulation or to stall or reject a new power plant or a pipeline. The EPA estimates the amount of CO_2 that would be emitted into the atmosphere over the lifetime of that project, multiplies that figure by $40, and generates a "global warming cost" to justify obstructing the project. In fact, as detailed later, a Colorado judge rejected a coal mine expansion because the regulators failed to take into consideration the SCC from building out some roads.

According to the Congressional Research Service, the use of the SCC underpins at least 150 regulations.[3] To give an example as to just how micro-managerial the federal government has become over energy conservation and the use of the SCC, the first regulation the Obama DOE proposed with the increased SCC figure was Energy Conservation Standards for Standby Mode and Off Mode for Microwave Ovens.[4] In other words, the regulation was to examine the energy use of the clock on a microwave.

Moreover, several economists have proposed a carbon tax equivalent to the SCC and Members of Congress called for carbon dioxide tax legislation, setting the tax close to the SCC.[5]

Flaws in the SCC Models

The EPA uses three statistical models, known as integrated assessment models (IAMs), to estimate the value of the SCC and other GHG emissions. These models are inadequate tools for policy analysis and regulatory rulemaking. Subjecting the models to reasonable inputs for climate sensitivity and discount rates dramatically lowers the figure for the SCC. Furthermore, attempts to forecast economic damages centuries into the future strains credibility when moving to the real world of policy implementation. Led by my colleague Kevin Dayaratna, PhD, Heritage analysts have run the Dynamic Integrated Climate-Economy (DICE) model for the SCC, SCM, and SCN_2O, and the FUND model to run the SCC, demonstrating just how variable the results are to quite reasonable changes in the inputs.[6]

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[3]Jane A. Leggett, "Federal Citations to the Social Cost of Greenhouse Gases," Congressional Research Service, March 17, 2017, https://fas.org/sgp/crs/misc/R44657.pdf (accessed July 20, 2017).
[4]James Broughel, "Energy Conservation Standards for Standby Mode and Off Mode for Microwave Ovens; Petition for Reconsideration," The Mercatus Center, September 16, 2013, https://www.mercatus.org/publication/energy-conservation-standards-standby-mode-and-mode-microwave-ovens-petition (accessed July 20, 2017).
[5]Timothy Cama, "Dems Propose Carbon Tax," *The Hill*, June 10, 2005, http://thehill.com/policy/energy-environment/244578-dems-propose-carbon-tax (accessed July 20, 2017).
[6]Kevin D. Dayaratna and David W. Kreutzer, "Unfounded FUND: Yet Another EPA Model Not Ready for the Big Game," Heritage Foundation *Backgrounder* No. 2897, April 29, 2014, http://www.heritage.org/research/reports/2014/04/unfounded-fund-yet-another-epa-model-notready-for-the-big-game; Kevin D. Dayaratna and David W. Kreutzer, "Loaded DICE: An EPA Model Not Ready for the Big Game," Heritage Foundation *Backgrounder* No. 2860, November 21, 2013, http://www.heritage.org/research/reports/2013/11/loaded-dice-an-epa-model-notready-for-the-big-game; and Kevin Dayaratna and Nicolas Loris, "Rolling the DICE on Environmental Regulations: A Close Look at the Social Cost of

Discount Rates

Discount rates are important to for projecting costs and benefits well into the future. People generally prefer benefits earlier instead of later and costs later instead of earlier. Hence, it is necessary to normalize costs and benefits to a common time. For example, if a 7 percent discount rate makes people indifferent to a benefit now versus a benefit later (e.g., $100 today versus $107 a year from now), then 7 percent is the appropriate discount rate to use.

Those of us who are alive today can take many actions that would be expected to provide benefits for those who will live decades or centuries from now. For example, we could pay down the national debt, increase investment in any number of industries, or simply save more in order to leave a larger bequest to our heirs.

The rationale for the EPA's economic regulations and the use of IAMs is that altering CO_2, methane, and nitrous oxide emissions today is a form of investment that provides benefits in the future.[7] As with any investment, however, the future benefits need to be compared to the value of alternative investments and not just to the plain dollar value of current costs. The tool for making that comparison is discounting, and the choice of discount rate is critical both to correctly comparing the costs and benefits of climate policy and to accurately estimating the SCC.

That discount rate should be one that reflects the best alternative return available, not the worst. As Cass Sunstein and David Weisbach have written, "If we are going to increase the amount we leave for the future, it is incumbent on us not to do [so] in a way that wastes resources."[8]

Investment in firms listed on the New York Stock Exchange has returned earnings of nearly 7 percent per year (after accounting for inflation) over the past two centuries. After adjusting for the impact of corporate taxes, the social rate of return on the New York Stock Exchange rises to more than 7.5 percent.[9] Although there is no guarantee that this rate of return will continue for centuries into the future, it is a reasonable benchmark.

In fact, the Office of Management and Budget (OMB) stipulates that a 7 percent discount rate be used as part of this type of cost-benefit analysis along with the 3 percent discount rate used by

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Methane and Nitrous Oxide," Heritage Foundation *Backgrounder* No. 3184, January 19, 2017, http://www.heritage.org/energy-economics/report/rolling-the-diceenvironmental-regulations-close-look-the-social-cost.

[7]It should be noted that the future impacts of cutting CO_2 are so uncertain as to be ambiguous even regarding sign. That is, it may well be that some future generations could be made better off with more current CO_2 emissions, which implies that the investment should take the form of subsidizing CO_2 emissions. See, for example, Dayaratna and Kreutzer, "Unfounded FUND."

[8]Cass R. Sunstein and David A. Weisbach, "Climate Change and Discounting the Future: A Guide for the Perplexed," Harvard Law School Program on Risk Regulation *Research Paper* No. 08-12, Harvard Law School Public Law and Legal Theory *Research Paper* No. 08-20, and Reg-Markets Center *Working Paper* No. 08-19, August 12, 2008, p. 26, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1223448 (accessed July 20, 2017).

[9]David W. Kreutzer, "Discounting Climate Costs," Heritage Foundation *Issue Brief* No. 4575, June 16, 2016, http://www.heritage.org/research/reports/2016/06/discounting-climate-costs.

the EPA. Other discount rates can also be used when justified.[10] Researchers at the EPA have ignored the OMB guidance and have estimated the SCC, SCM, and SCN_2O using only 2.5 percent, 3 percent, and 5 percent discount rates.[11]

Discount rates demonstrate how sensitive the SCC is to the discount rate. For example, with regard to analyzing the Clean Power Plan climate regulations on existing power plants, when changed from a 3 percent discount rate to a 5 percent discount rate, the EPA's $20 billion in projected climate benefits decreases to $6.4 billion—less than the EPA's egregiously low projection of $8.4 billion in compliance costs.[12] The tables under the section ***Changing Discount Rates*** attached at the end of the testimony demonstrate just how sensitive the SCC, SCM, and SCN_2O are to changes in discount rates.

Equilibrium Climate Sensitivity

Integrated assessment models also rely on equilibrium climate sensitivity (ECS) to calculate the social cost of different GHG emissions. ECS is an attempt to quantify the earth's temperature response to CO_2 emissions, answering the question: How does the earth's temperature change from a doubling of CO_2 in the atmosphere? Recent peer-reviewed literature estimates that the ECS is lower than the studies the EPA relied on, which are now more than a decade old.

Using more up-to-date ECS literature also significantly lowers the value of the SCC, SCM, and SCN_2O. According to one model, using a 7 percent discount rate combined with more updated ECS distribution decreases the SCC by $34 per ton (more than a 102 percent decrease) and in some instances, has a high probability of being negative (meaning there is a social benefit of increased CO_2 emissions).[13] The charts attached under the section ***Changing Discount Rates and Equilibrium Climate Sensitivity*** show how fluctuating projected costs are (and in some instances, benefits) using different discount rates and different ECS estimates.

Time Horizon

Projecting economic damages three centuries into the future is a nearly impossible task. Economic models have a difficult time forecasting several decades into the future, let alone centuries. Policymakers should be alarmed that these models have aided in justifying more than 150 regulations.

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[10]U.S. Office of Management and Budget, "Regulatory Analysis," and Knappenberger, "An Example of the Abuse of the Social Cost of Carbon."
[11]Alex L. Marten, Elizabeth A. Kopits, Charles W. Griffiths, Stephen C. Newbold, and Ann Wolverton, "Incremental CH4 and N2O Mitigation Benefits Consistent with the US Government's SC-CO2 Estimates," *Climate Policy*, Vol. 15, No. 2 (2015), pp. 272–298.
[12]U.S. Environmental Protection Agency, Regulatory Impact Analysis, p. ES-22, Table ES-9.
[13]Kevin Dayaratna and David Kreutzer, "Unfounded FUND: Yet Another EPA Model Not Ready for the Big Game," Heritage Foundation *Backgrounder* No. 2897, April 29, 2014, http://thf_media.s3.amazonaws.com/2014/pdf/BG2897.pdf.

Arch Coal and the SCC

One story of an attempted coal mine expansion demonstrates just how burdensome the use of the SCC has become. Arch Coal received initial consent from the Bureau of Land Management (BLM) but no final go ahead in 2012 to build temporary roads on the 30-square-mile lease in Gunnison County, Colorado, for the expansion of its West Elk coal mine. The company planned to build six miles of new road for a new drill pad. In 2014, federal Judge R. Brooke Jackson overturned the BLM's consent in favor of environmental activist organizations and struck down approval for the coal mine expansion.[14] Judge Jackson claimed that the Bureau of Land Management and the Forest Service violated the National Environmental Policy Act when they did not include the SCC in their assessment for the approval of the roads in the coal mine expansion.[15] The court found the agencies were "arbitrary and capricious."

In providing an explanation for their omission the agencies wrote,

> Regardless of the accuracy of emission estimates, accurately predicting the degree of impact any single emitter of GHGs may have on global climate change or the changes to biotic and abiotic systems that accompany climate change is not possible at this time. As such, the controversy is to what extent GHG emissions resulting from implementation of the Proposed Action may contribute to global climate change as well as the accompanying changes to natural systems. The degree to which any observable changes can or would be attributable to the Proposed Action cannot be reasonably predicted at this time.[16]

Judge Jackson argued that a tool did exist to estimate the climate effects: the SCC. Although the BLM included climate impacts in its preliminary Environmental Assessment (EA), it omitted them from the Final Environmental Impact Statement (FEIS) because BLM economists argued the use of the SCC was "controversial" and produced very different results in reasonable changes to inputs in the model.[17] Judge Jackson responded that "neither the BLM's economist nor anyone else in the record appears to suggest the cost is as low as $0 per unit. Yet by deciding

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[14]Dan Elliott, "Expansion Of Colorado's Largest Coal Mine Clears A Hurdle," Associated Press, December 4, 2016, http://denver.cbslocal.com/2016/12/04/expansion-of-colorados-largest-coal-mine-clears-a-hurdle/ (accessed July 20, 2017).

[15]Phil Taylor, "BLM Crafting Guidance on Social Cost of Carbon -- Internal Memo," Greenwire, April 15, 2015, http://www.eenews.net/stories/1060016810 (accessed July 20, 2017).

[16]*High Country Citizens' Alliance et al. v. United States Forest Service et al.*, case number 1:13-cv-01723, in the U.S.
District Court for the District of Colorado,
http://earthjustice.org/sites/default/files/files/91%20%20Order%20on%20Merits%20(2).pdf (accessed July 21, 2017).

[17]Ibid.

not to quantify the costs at all, the agencies effectively zeroed out the cost in its quantitative analysis."[18]

Perhaps the failure to explain that a zero cost is a legitimate estimate is the fault of the BLM, but evidence does suggest that the cost could in fact be zero. In fact, it could be positive. When my colleague re-ran one of the integrated assessment models used to quantify the SCC, he found that with reasonable changes the results are likely to be overwhelmingly *negative*, suggesting there is a social benefit, not a cost, to increased CO_2 emissions.[19] Therefore, no agency should include the use of the SCC in any regulatory analysis, as they are baseless tools for establishing credible estimates.

The Impact of a Carbon Tax Equivalent to the SCC

If the United States follows through with climate change regulations proposed and implemented during the Obama Administration or enforced a carbon tax equivalent to the SCC, the U.S. would incur significant economic damages. Using the Heritage Energy Model (HEM), a clone of the U.S. Energy Information Administration's National Energy Modeling System 2015 Full Release (NEMS), we quantified the economic impact of such a tax. To negate the analytical impacts of a tax's income transfer, the analysis returns 100 percent of carbon-tax revenue to taxpayers. By 2035, the HEM model projects:

- An overall average shortfall of nearly 400,000 jobs;
- An average manufacturing shortfall of over 200,000 jobs;
- A total income loss of more than $20,000 for a family of four;
- An aggregate gross domestic product loss of over $2.5 trillion; and
- Increases in household electricity expenditures between 13 percent and 20 percent.

Insignificant Climate Benefits

Ostensibly, the use of regulations or a tax to correct a negative externality should actually internalize that negative externality. With criteria pollutants such as soot, there are direct measurable human health and environmental impacts from reducing emissions. China is a clear

[18]Ibid.

[19]Kevin D. Dayaratna, "At What Cost? Examining the Social Cost of Carbon," testimony before the Subcommittee on Environment and Oversight, Committee on Science and Technology, U.S. House of Representatives, February 27, 2017, http://docs.house.gov/meetings/SY/SY18/20170228/105632/HHRG-115-SY18-WstateDayaratnaK-20170228.pdf (accessed July 21, 2017).

example where air pollution is a negative externality imposing societal costs and internalizing the externality would yield environmental improvements.[20]

Carbon dioxide and GHG emissions are different. Carbon dioxide is a colorless, odorless, nontoxic gas that does not have any direct human health impacts. It is questionable as to whether CO_2 is a negative externality (or a positive externality) and certainly up for debate as to how big or small that externality is. The only reason the federal government regulates CO_2 is because of its alleged contribution to warming and the impacts it could have. Therefore, if one believes CO_2 emissions are negative externality, one must ask what benefits the U.S. is gaining from climate change regulations or CO_2 taxes. Regulatory analyses can boast large CO_2 reduction figures, but they do not mean much if the regulations are not abating warming. U.S. climate regulations or a tax equivalent to the SCC would have negligible impacts on global temperatures. Using the same climate sensitivity (which is arguably higher than reality) as the IPCC assumes in its modeling, the world would only be 0.137 degrees Celsius cooler by 2100 if the U.S. cut its CO_2 emissions by 100 percent.[21]

Similarly, using the Model for the Assessment of Greenhouse-Gas Induced Climate Change (MAGICC), developed in part through funding from the EPA, we estimated the impacts of reducing methane and nitrous oxide emissions from the United States down to zero. Completely eliminating methane emissions from the United States would result in a reduction of less than 0.03 degrees Celsius and an overall reduction of less than 0.27 centimeters in sea-level rise. Eliminating all nitrous oxide concentrations from the United States would have an impact of less than 0.02 degrees Celsius on global temperatures and an impact of less than 0.17 centimeters on overall sea-level rise.[22]

Of course, the existence of an externality does not necessitate government action, whether it be through regulation or a tax. When analyzing any negative externalities or any supposed market failure, one must also consider the imperfections of a proposed government solution. Policymakers and regulators are driven by self-serving incentives like anyone else and therefore corrective government actions can often yield outcomes that are even more inefficient.

Conclusion

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[20]Through innovation and investment in new technologies, as well as through legislation, air and water quality have improved significantly in the United States. Pollutants known to cause harm to public health and the environment are declining; in fact, the aggregate emissions of six common pollutants decreased 69 percent during 1970–2014. See U.S. Environmental Protection Agency, "Overview of the Clean Air Act and Air Pollution," https://www.epa.gov/clean-air-act-overview (accessed July 20, 2017).

[21]Paul C. Knappenberger and Patrick J. Michaels, "Current Wisdom: We Calculate, You Decide: A Handy-Dandy Carbon Tax Temperature-Savings Calculator," Cato At Liberty, July 23, 2013, http://www.cato.org/blog/current-wisdom-we-calculate-you-decide-handy-dandy-carbon-tax-temperature-savings-calculator (accessed July 21, 2017).

[22]Kevin Dayaratna and Nicolas Loris, "Rolling the DICE on Environmental Regulations: A Close Look at the Social Cost of Methane and Nitrous Oxide." Heritage Foundation *Backgrounder* No. 3184, January 19, 2017, http://www.heritage.org/energy-economics/report/rolling-the-diceenvironmental-regulations-close-look-the-social-cost.

The integrated assessment models that the EPA uses to calculate the social costs of carbon dioxide, methane, and nitrous oxide are not legitimate for regulatory analysis. They are unsubstantiated tools that regulators can use to justify costly regulations or thwart new investments. Policymakers should therefore refrain from using these integrated assessment models in devising regulatory policy. Using these models would only mislead the public and their representatives as to the costs and benefits of regulations and government activities intended to counter global warming.

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Changing Discount Rates

TABLE 4

SCC Average 95th Percentile Averaged Across All Five Scenarios, Using Outdated Roe Baker (2007) Distribution

	DISCOUNT RATE			
Year	2.5%	3%	5%	7%
2010	$81.63	$49.06	$10.23	$3.23
2020	$89.70	$55.33	$12.54	$4.28
2030	$97.69	$61.54	$15.03	$5.46
2040	$105.55	$67.76	$17.61	$6.74
2050	$113.54	$74.11	$20.35	$8.14

Source: Calculations based on Heritage Foundation Monte Carlo simulation results using the FUND model.

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TABLE 2

SCC Average 95th Percentile Baseline, End Year 2300

Year	Discount Rate: 2.5%	Discount Rate: 3%	Discount Rate: 5%	Discount Rate: 7%
2010	$90.67	$56.70	$14.74	$6.18
2015	$101.78	$64.75	$17.79	$7.79
2020	$110.02	$70.92	$20.32	$9.12
2025	$118.18	$77.10	$22.81	$10.45
2030	$127.09	$83.88	$25.68	$12.04
2035	$135.97	$90.65	$28.55	$13.63
2040	$145.43	$97.95	$31.77	$15.45
2045	$154.76	$105.22	$34.98	$17.29
2050	$164.57	$112.89	$38.48	$19.32

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

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TABLE 2

Social Cost of Methane, 2020

ECS Distribution	3%	7%
Roe-Baker	$932.08	$270.04
Otto et al.	$540.67	$184.01
Lewis	$360.33	$138.93

SOURCE: Calculations based on Heritage Foundation simulation results using the DICE model.

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TABLE 3

Social Cost of N_2O, 2020

ECS Distribution	3%	7%
Roe-Baker	$12,632.40	$1,882.21
Otto et al.	$7,570.67	$1,295.90
Lewis	$5,175.93	$988.68

SOURCE: Calculations based on Heritage Foundation simulation results using the DICE model.

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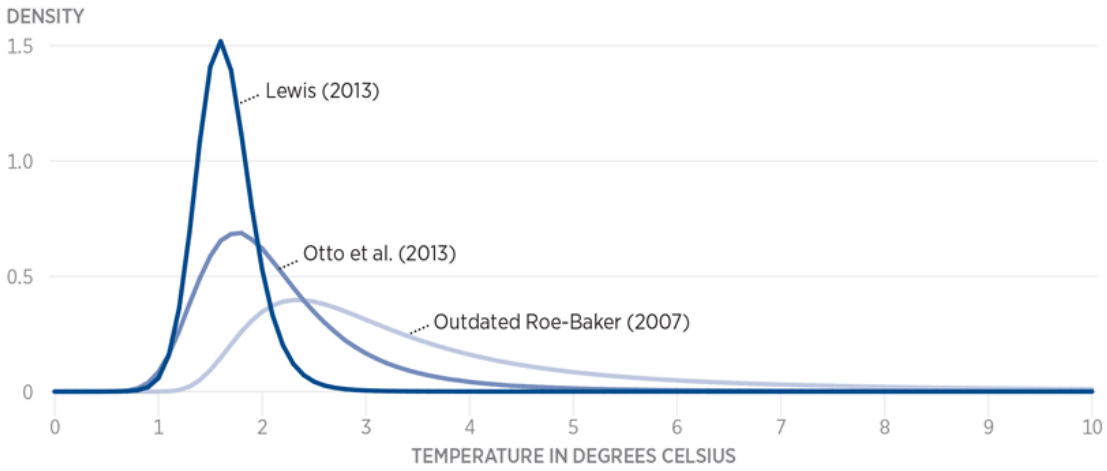
Changing Discount Rates and Equilibrium Climate Sensitivity

CHART 1

Probability Density Functions of Outdated-Roe Baker (2007), Otto et al (2013), and Lewis (2013) ECS Distributions



SOURCE: Authors' approximations based on Gerard Roe and Marcia Baker, "Why Is Climate Sensitivity So Unpredictable?" *Science*, Vol. 318, No. 5850 (October 2007), pp. 629–632; 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; and Alexander Otto et al., "Energy Budget Constraints on Climate Response," *Nature Geoscience*, Vol. 6, No. 6 (June 2013), pp. 415–416.

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TABLE 4

SCC Average 95th Percentile Averaged Across All Five Scenarios, Using Outdated Roe Baker (2007) Distribution

	DISCOUNT RATE			
Year	2.5%	3%	5%	7%
2010	$81.63	$49.06	$10.23	$3.23
2020	$89.70	$55.33	$12.54	$4.28
2030	$97.69	$61.54	$15.03	$5.46
2040	$105.55	$67.76	$17.61	$6.74
2050	$113.54	$74.11	$20.35	$8.14

Source: Calculations based on Heritage Foundation Monte Carlo simulation results using the FUND model.

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TABLE 5

Average SCC, Using Otto et al. (2013) Distribution

	DISCOUNT RATE			
Year	2.5%	3%	5%	7%
2010	$11.28	$6.27	$0.05	-$0.93
2020	$12.66	$7.30	$0.36	-$0.87
2030	$14.01	$8.35	$0.74	-$0.75
2040	$17.94	$11.08	$1.50	-$0.49
2050	$19.94	$12.69	$2.21	-$0.14

Source: Calculations based on Heritage Foundation Monte Carlo simulation results using the FUND model.

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