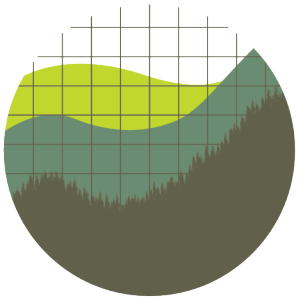

Institute *for*
Policy Integrity
NEW YORK UNIVERSITY SCHOOL OF LAW

March 20, 2017

California Air Resources Board

VIA ELECTRONIC SUBMISSION

Subject: Comments on California's Advanced Clean Cars Midterm Review (Jan. 18, 2017)

The Institute for Policy Integrity at New York University School of Law[1] ("Policy Integrity") respectfully submits the following comments[2] on the California Air Resource Board's ("ARB") Advanced Clean Cars Midterm Review.[3] Policy Integrity is a non-partisan think tank dedicated to improving the quality of government decisionmaking through advocacy and scholarship in the fields of administrative law, economics, and public policy. Policy Integrity regularly conducts economic and legal analysis on the appropriate use of the social cost of carbon, among other environmental and economic topics.

In 2012, ARB adopted the Advanced Clean Cars ("ACC") program and requested a preemption waiver from the U.S. Environmental Protection Agency ("EPA") for the program. EPA granted California's waiver request to enforce its ACC program through model year 2025.[4] ARB released a report on its Midterm Review of the program in January 2017. Recently, Scott Pruitt, the new EPA administrator, has made statements indicating that he may undertake a process to consider whether to revoke California's waiver.[5]

These comments summarize: (1) the strong legal basis for ARB's authority to enforce these standards and EPA's lack of authority under the Clean Air Act to retract the waiver; and (2) the importance of considering the full economic effects of these measures, including the substantial economic benefits of greenhouse gas reductions, before making changes to the program.

[1] No part of this document purports to present New York University School of Law's views, if any.
[2] These comments incorporate by reference into the record all of the documents cited herein.
[3] Cal. Air Res. Bd., California's Advanced Clean Cars Midterm Review (Jan. 18, 2017) [hereinafter "Midterm Review"].
[4] *See* 78 Fed. Reg. 2112, 2145 (Jan. 9, 2013).
[5] *See* Richard Revesz, *According to Scott Pruitt, States Only Have the Right to Pollute, Not Protect Their Environments*, LOS ANGELES TIMES (Mar. 20, 2017); Stuart Leavenworth, *Trump's EPA Pick Won't Guarantee California's Right to Tougher Auto Emission Rules*, SACRAMENTO BEE (Jan. 18, 2017).

ARB has legal authority to apply these standards, and the Clean Air Act does not grant EPA authority to retract the waiver

In 2012, ARB adopted the ACC program, which included Low-Emission Vehicle III ("LEV III") regulations requiring reductions in criteria pollutants and greenhouse gas emissions and Zero-Emission Vehicle ("ZEV") regulations requiring increasing numbers of electric vehicles, and requested a preemption waiver from EPA for the program. Under the Clean Air Act, California can obtain such a waiver if ARB determines that its standards will be, in the aggregate, at least as protective of public health and welfare as applicable federal standards—unless EPA finds that California's determination "is arbitrary and capricious"; that California "does not need the standards to meet compelling and extraordinary conditions"; or that the standards and accompanying enforcement procedures "are not consistent with section 7521(a)."[6] Automobile manufacturers[7] opposed some aspects of the program (primarily the ZEV amendments as they applied to model years beyond 2017), and dealers[8] opposed most aspects of the program. Opponents of California's waiver bore the burden of showing that the criteria for denial has been met.[9]

EPA granted California's waiver request to enforce its ACC program through model year 2025.[10] EPA determined that opponents to California's request failed to meet their burden of proving (1) that ARB's conclusion on the program's protectiveness was arbitrary and capricious, (2) that a separate California motor vehicles program was not needed to meet compelling and extraordinary conditions, or (3) that the program was not technologically feasible under section 7521(a).

In particular, after considering ARB's comprehensive review of costs, emission reductions, and associated environmental impacts and benefits,[11] EPA determined that ARB's conclusions had a reasoned basis.[12] EPA also concluded that California continues to have a need for a separate motor vehicle emission program given, among other things, its geographical and climatic conditions and large numbers and high concentrations of automobiles.[13] In so doing, EPA noted ARB's evidence on the continued existence of such conditions in California, including its evidence on California's poor air quality and its nonattainment with national ambient air quality standards for fine particulate matter and ozone; evidence of "[r]ecord-setting fires, deadly heat waves, destructive storm surges, [and] loss of winter snowpack" that California has experienced in the past decade; evidence on the expected increasing frequency and intensity of "extreme events such as floods, heat waves, droughts and severe storms" that "have the potential to dramatically affect human health and well-being, critical infrastructure, and natural systems"; and evidence on

[6] 42 U.S.C. § 7543(a).
[7] Manufacturers include the Association of Global Automakers and the Alliance of Automobile Manufacturers, which submitted joint comments.
[8] Dealers refers to the National Automobile Dealers Association, which submitted comments.
[9] *See* 78 Fed. Reg. 2112, 2116 (Jan. 9, 2013).
[10] *See id.* at 2145.
[11] *Id.* at 2122.
[12] *Id.* at 2125.
[13] *Id.* at 2129. EPA noted that it received no comments regarding any evidence to suggest that these special conditions no longer existed.

potential "dramatic sea level rises and increases in temperatures."[14] Finally, EPA concluded that opponents did not meet their burden of establishing that the ACC program is technologically infeasible and therefore inconsistent with the Clean Air Act's section 202(a),[15] especially in light of the sufficient lead time, the lack of evidence that costs would be excessive, and ARB's confidence in increased consumer demand in the future and adequate infrastructure.[16]

The Clean Air Act does not explicitly allow EPA or any other federal agency to revoke a preemption waiver that has already been granted. This omission is telling because in other cases the Clean Air Act not only contemplates revocation or revision but also provides a clear process for making any such changes. For example, the Clean Air Act outlines a "[State Implementation Plan] call" procedure under which EPA may notify a state of inadequacies in an already approved implementation plan and require the state to submit a revised plan.[17] An implied and unguided power to revoke a preemption waiver would not adequately protect legitimate reliance interests of California's citizens (as well as citizens of states that adopt California's standards). It would also disincentivize vehicle manufacturers from making necessary investments to comply with standards applicable to future model years adopted pursuant to a waiver; manufacturers might instead hold out hope that a future administration might revoke the waiver.

In this case, as discussed above, the Clean Air Act *requires* EPA to grant a preemption waiver to California if its standards are at least as protective as federal standards, carving out three narrow circumstances in which EPA could deny a waiver. The Clean Air Act's silence on the possibility of revocation under this provision reveals that revocation is simply not an option.

Reducing greenhouse gases provides significant economic benefits, which should be considered as part of a comprehensive economic analysis before any changes are made to the program

Scientific studies show that climate change will have, and in some cases has already had, severe consequences for society, like the spread of disease, increased food insecurity, and coastal destruction. These damages from emitting greenhouse gases are not reflected in the price of fossil fuels, creating what economists call "externalities." In order to maximize social welfare, policymakers must ensure that the market properly accounts for all externalities, like greenhouse gas pollution. By failing to account fully for carbon pollution, for example, policymakers would tip the scales in favor of dirtier energy sources, letting polluters pass the costs of their carbon emissions onto the public.

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[14] *Id.*; *see also* PETER HOWARD, COST OF CARBON PROJECT, FLAMMABLE PLANET: WILDFIRES AND THE SOCIAL COST OF CARBON (2014) (describing some of the health, environmental, and other damages caused by wildfires in California and noting that California could experience a "36 to 74 percent increase in area burned by 2085" if greenhouse gas emissions continue to be high).
[15] *See* 78 Fed. Reg. at 2144-45; *see also* 42 U.S.C. § 7521(a)(2).
[16] *See* 78 Fed. Reg. at 2135, 2142-44.
[17] 42 U.S.C. § 7410(k)(5). *See also* Am. Methyl Corp. v. E.P.A., 749 F.2d 826, 834-40 (D.C. Cir. 1984) (declining to find an implied power to revoke waivers under section 211(f) of the Clean Air Act).

The social cost of carbon ("SCC") is a metric designed to quantify climate damages, representing the net economic cost of carbon dioxide emissions. The SCC can be used to evaluate policies that affect greenhouse gas emissions. Simply put, the SCC is a monetary estimate of the damage done by each ton of carbon dioxide that is released into the air. The SCC is substantial: the current central federal estimate is about $42 per metric ton of CO_2 in 2017 dollars,[18] and that number likely represents a lower bound for the costs of climate change because the models omit several categories of damage.[19] The National Academies of Sciences completed a robust review of the SCC calculation in 2017, lending additional credibility to the metric and endorsing several updates that would likely lead to a higher SCC estimate.[20] Incorporating the SCC into policy analysis removes the bias in favor of dirtier energy sources by accounting for the costs of greenhouse gas pollution. Additional information on the SCC can be found in Policy Integrity's fact sheet on the Social Costs of Greenhouse Gases, attached as Appendix A.

Insofar as the Advanced Clean Cars program is expected to reduce greenhouse gas emissions, it will result in economic benefits. Before ARB undertakes a plan to alter or eliminate the standards, it should conduct a comprehensive economic analysis that considers the greenhouse gas benefits of the program, preferably using the SCC.

Conclusion

ARB's ACC Midterm Review lays out the significant progress that California has made toward achieving its clean car goals laid out in 2012. Though the new EPA administrator has suggested that he may reconsider California's waiver to proceed with these standards, ARB is on solid legal ground to continue enforcing these standards. Moreover, from a policy perspective, reducing greenhouse gases provides significant economic benefits, which ARB should consider as part of a comprehensive economic analysis before any changes are made to the program.

Respectfully submitted,

Caroline Cecot
Denise A. Grab

Institute for Policy Integrity
New York University School of Law

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[18] See INTERAGENCY WORKING GROUP ON SOCIAL COST OF GREENHOUSE GASES, UNITED STATES GOVERNMENT, TECHNICAL SUPPORT DOCUMENT: TECHNICAL UPDATE OF THE SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 at 4 tbl. ES-1 (2016) (updated to reflect 2016 dollars using the Bureau of Labor Statistics' CPI Inflation Calculator, https://data.bls.gov/cgi-bin/cpicalc.pl).

[19] PETER HOWARD, COST OF CARBON PROJECT, OMITTED DAMAGES: WHAT'S MISSING FROM THE SOCIAL COST OF CARBON (2014).

[20] *See* THE NATIONAL ACADEMIES OF SCIENCES, VALUING CLIMATE DAMAGES: UPDATING ESTIMATION OF THE SOCIAL COST OF CARBON DIOXIDE (2017); Chelsea Harvey, *Scientists have a new way to calculate what global warming costs. Trump's team isn't going to like It*, THE WASHINGTON POST (Jan. 12, 2017).

Appendix A

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Social Costs of Greenhouse Gases

FEBRUARY 2017

Climate change imposes significant costs on society.

Scientific studies show that climate change will have, and in some cases has already had, severe consequences for society, like the spread of disease, increased food insecurity, and coastal destruction. These damages from emitting greenhouse gases are not reflected in the price of fossil fuels, creating what economists call "externalities." **The social cost of carbon (SCC) is a metric designed to quantify climate damages, representing the net economic cost of carbon dioxide emissions.** The SCC can be used to evaluate policies that affect greenhouse gas emissions. Simply, the SCC is a monetary estimate of the damage done by each ton of carbon dioxide[1] that is released into the air.

In order to maximize social welfare, policymakers must ensure that the market properly accounts for all externalities, like greenhouse gas pollution. By failing to account fully for carbon pollution, for example, policymakers would tip the scales in favor of dirtier energy sources, letting polluters pass the costs of their carbon emissions onto the public. **Incorporating the SCC into policy analysis removes that bias by accounting for the costs of such pollution.**

The Social Cost of Carbon is a critical tool, offering information to help assess policies.

The SCC allows federal agencies to weigh the benefits of mitigating climate change against the costs of limiting carbon pollution when they conduct regulatory analyses of federal actions that affect carbon emissions. To date, the SCC has been used to evaluate approximately 100 federal actions.

Any effort to limit the use of the SCC, or alter its value so it no longer reflects the best available science, would be detrimental to the public interest. Such efforts would threaten an important policy tool and conceal the economic impacts of climate change.

A federal court ruling spurred the development of the official U.S. SCC.

A ruling by the U.S. Court of Appeals for the Ninth Circuit in 2008 required the federal government to account for the economic effects of climate change in a regulatory impact analysis of fuel efficiency standards.[2] As a result, President Obama convened an Interagency Working Group (IWG) in 2009 to develop an SCC value for use in federal regulatory analysis. The SCC is now used in agencies' regulatory cost-benefit analyses and environmental impact statements of federal actions that affect greenhouse gas emissions. More recently, a 2016 ruling by the U.S. Court of Appeals for the Seventh Circuit upheld the Department of Energy's use of the SCC in its analysis of a rule on energy efficiency standards for commercial refrigerators.[3]

The SCC was developed through an academically rigorous, regularly updated and peer-reviewed process.

The IWG developed the SCC values using the three most widely cited climate economic impact models that link physical impacts to the economic damages of CO_2 emissions. All of these integrated assessment models—known as DICE, FUND, and PAGE[4]—have been extensively peer reviewed in the economic literature.[5] Each model translates emissions into changes in atmospheric carbon concentrations, atmospheric concentrations into temperature changes, and temperature changes into economic damages.[6] The IWG gives each model equal weight in developing the SCC values.[7]

The IWG used a robust, rigorous process, incorporating peer review of the estimates underlying the models and other inputs. Since its inception, **the IWG has met several times to update its modeling to incorporate new scientific literature, and has sought input from experts to ensure that the SCC is based on the latest science.** The most recent update by the IWG in 2016 reflects recommendations on the SCC from the National Academy of Sciences, and expands the group's analysis to include two additional potent greenhouse gases: methane and nitrous oxide.[8]

The National Academy of Sciences completed a robust review of the SCC calculation in 2017, lending additional credibility to the metric and endorsing several changes that would likely lead to a higher SCC estimate.[9] The National Academy of Sciences' full recommendations lay out future steps for the IWG to ensure that the SCC reflects the best available science and economics. The recommendations support the use of both declining discount rates (which would likely increase the SCC value) and a global damage calculation (more on both topics below). **Because the federal SCC estimates have been based on rigorous and peer-reviewed science and economics, these values are a good basis for thoughtful policy analysis.**

The SCC is the most accurate existing estimate of the external cost of carbon dioxide emissions.

The central SCC estimate of around $41 per ton of CO_2 (in 2016 dollars) is the best available estimate. Of course, there is uncertainty over the science and economics of climate change. This uncertainty is due to the complexity of the climate system, the difficulty of placing a monetary value on environmental services, the long time horizon over which climate change occurs, and the unprecedented amount of carbon emissions that have entered the atmosphere since the industrial revolution. As science and economics improve and progress, this uncertainty will decline, but **uncertainty can never be fully eliminated from future predictions. The fact that there is uncertainty about the exact impacts of climate change does not mean that there is no social cost of carbon dioxide emissions.** In fact, according to the models that calculate the SCC, uncertainty implies a higher SCC value and a need for more stringent climate policies.[10]

The SCC increases over time to reflect how the effects of climate change will intensify as more greenhouse gases accumulate in the atmosphere. The IWG's central estimate for 2050 will be almost $70.[11]

Several categories of climate damages are omitted from the SCC.

While the 2016 IWG estimate is the best available SCC figure, it **likely represents a lower bound for the costs of climate change** because the models omit several categories of damage. Many omissions result from a lack of readily available monetary damage estimates for certain climate impacts. Damages currently omitted from the models include the effects of climate change on fisheries; the effects of increased pest, disease, and fire pressures on agriculture and forests; and the effects of climate-induced migration. Additionally, these models omit the effects of climate change on economic growth and the rise in the future value of environmental services due to increased scarcity.[12]

U.S. states and corporations also use a value for the cost of carbon in their decisionmaking and planning.[13]

Increasingly, **U.S. states are using the federal SCC.** California, Illinois, Minnesota, Maine, New York, and Washington have begun using the federal SCC in energy-related decisionmaking.[14] Different states make different choices for what SCC estimates to use: Minnesota uses a range of SCC values; New York uses the "central" estimate (with a 3% discount rate); and Washington uses a higher estimate (based on a 2.5% discount rate). The importance of choosing the right SCC value is explored below.

Many major companies also quantify the cost of carbon pollution in their financial planning. According to a 2013 Carbon Disclosure Project (CDP) report, 29 prominent companies based in or doing business in the United States reported that they use an internal price on carbon pollution in their financial planning, to help weigh risks and opportunities related to climate change.[15]

Decisionmakers can choose from multiple SCC values.

The federal SCC estimates are not a single number, but instead a range of four estimates, based on three discount

rates, plus a 95th percentile estimate that represents catastrophic, low-probability outcomes.[16] Discount rates allow economists to measure the value of money over time—the tradeoff between what a dollar is worth today and what a dollar would be worth in the future.[17] Higher discount rates result in a lower SCC; if future climate damages are discounted at a high rate, we would be placing less value on avoiding those damages today. The IWG uses discount rates of 5, 3, and 2.5 percent.[18] The fourth value is taken from the 95th percentile of the SCC in all models with the 3-percent discount rate, which represents catastrophic but unlikely situations.[19] Frequently, agencies will conduct their economic analyses using a range of SCC values.[20] Other analyses will focus on a "central" estimate of the SCC.[21] The SCC estimate using the 3-percent discount rate is considered to be the "central" estimate.[22]

Choosing the most appropriate discount rate is crucial to obtaining the best SCC estimate. A policymaker might decide that the uncertainty associated with climate damages warrants using a discount rate that declines over time, leading to a higher SCC.[23] A consensus has emerged among leading climate economists that a declining discount rate should be used for climate damages, to reflect long-term uncertainty in interest rates. The National Academy of Sciences January 2017 recommendations to the IWG support this approach.[24] Furthermore, because several types of damage from climate change are missing or poorly quantified in the SCC estimates, **the federal SCC estimate associated with a 3-percent discount rate should be interpreted as a lower bound on the central estimate**.[25]

Finally, the global nature of climate change affects the scope of damages that go into the SCC calculations. Some commentators have argued that the SCC should include only domestic damages.[26] However, the IWG and many others have concluded that the SCC should reflect global climate damages, citing numerous reasons including the trans-border nature of most damages and the need to encourage international coordination to address climate change.[27] As the National Academy of Sciences and others have shown, disaggregating domestic damages from the models is exceedingly complex, and current approaches tend to ignore the interconnectedness of the global economy.[28] **Using a domestic-only SCC would underestimate the true extent of climate damages.**

The SCC includes benefits from climate change.

Some have argued against using the SCC because climate change might have some beneficial effects, which they imply are being ignored in the SCC. But many categories of benefits that might result from climate change, such as potential increases in agricultural yields, are already captured in the SCC estimate. Other benefits are omitted, such as the increased availability of oil due to higher temperatures in the Arctic and the potential for fewer transportation delays from snow and ice. However, **omitted negative impacts almost certainly counteract any omitted benefits**.[29] Other benefits from the use of fossil fuels that are unrelated to climate change (e.g., economic output) are omitted from the SCC estimates, but are included in any cost-benefit analysis in which the SCC is used. In such an analysis, the cost of a regulation, such as the potential loss of output, is always balanced against the benefits of carbon emissions reductions.

There are social cost estimates for other greenhouse gases.

The IWG has also developed robust federal estimates of the social cost of methane ($SC\text{-}CH_4$) and social cost of nitrous oxide ($SC\text{-}N_2O$). The $SC\text{-}CH_4$ and $SC\text{-}N_2O$ methodologies build directly on the IWG's SCC methodology, and replace the less accurate methodology of multiplying the SCC by these gases' relative global warming potential. Therefore, the same rigorous, consensus-based, transparent process used for the federal SCC has shaped the federal $SC\text{-}CH_4$ and federal $SC\text{-}N_2O$ estimates. Just as the federal SCC likely underestimates the true social cost of carbon, the

federal SC-CH_4 and SC-N_2O are **likely to underestimate the true social cost of these other greenhouse gases** due to omitted damages and uncertainties regarding the scope of the effects in the underlying models.[30] Nonetheless, the 2016 IWG SC-CH_4 and SC-N_2O are the best available estimates of the social costs associated with the emission of those greenhouse gases.

Endnotes

1 There are many ways to measure a ton (2000 pounds) of carbon dioxide. Simply, a ton of carbon dioxide is the amount of carbon dioxide that the average U.S. car emits in 2 to 2.5 months. An important distinction is that, because carbon dioxide consists of carbon and oxygen, 3.67 tons of carbon dioxide is equivalent to 1 ton of carbon.

2 *Ctr. for Biological Diversity v. Nat'l Highway Traffic and Safety Admin.*, 538 F.3d 1172 (9th Cir. 2008).

3 *Zero Zone, Inc. v. U.S. Dep't of Energy*, Case No. 14-2147 (7th Cir. Aug. 8, 2016).

4 More specifically: DICE (Dynamic Integrated Climate and Economy), developed by William Nordhaus (more information *available at* http://www.econ.yale.edu/~nordhaus/); PAGE (Policy Analysis of the Greenhouse Effect), developed by Chris Hope; and FUND (Climate Framework for Uncertainty, Negotiation, and Distribution), developed by Richard Tol (more information *available at* http://www.fund-model.org/). *See* Interagency Working Group On Social Cost Of Greenhouse Gases, United States Government, Technical Support Document: Social Cost Of Carbon For Regulatory Impact Analysis Under Executive Order 12866, at II-3 (2010) 14A-5 n.b. [hereinafter 2010 TSD].

5 *See id.* at 14A-4.

6 *Id.* at 14A-6.

7 *Id.* at 14A-5.

8 Interagency Working Group On Social Cost Of Greenhouse Gases, United States Government, Technical Support Document: Technical Update Of The Social Cost Of Carbon For Regulatory Impact Analysis Under Executive Order 12866 (2016) [hereinafter 2016 TSD].

9 *See* Chelsea Harvey, *Scientists have a new way to calculate what global warming costs. Trump's team isn't going to like It*, The Washington Post (Jan. 2017), *available at* https://www.washingtonpost.com/news/energy-environment/wp/2017/01/12/scientists-have-a-new-way-to-calculate-what-global-warming-costs-trumps-team-isnt-going-to-like-it.

10 William D. Nordhaus, *Revisting the Social Cost of Carbon*, 514 Proc. Natl. Acad. Sci. U.S.A. 7 (2017).

11 EPA, The Social Cost of Carbon: Estimating the Benefits of Reducing Greenhouse Gas Emissions, *available at* https://perma.cc/94LF-5M7D.

12 Peter Howard, Cost Of Carbon Project, Omitted Damages: What's Missing From The Social Cost Of Carbon (2014), *available at* http://costofcarbon.org/files/Omitted_Damages_Whats_Missing_From_the_Social_Cost_of_Carbon.pdf [hereinafter Omitted Damages].

13 Many other nations also use the SCC or similar concepts in making regulatory decisions, including France, Germany, Norway, and the United Kingdom. Canada and Mexico have harmonized their SCC estimates with the U.S. federal estimates, while many other countries estimate their own SCC; Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations, SOR/2012-167, 146 Can. Gazette pt. II, 1951, 2000, 2044 (Can.), *available at* http://www.gazette.gc.ca/rp-pr/p2/2012/2012-09-12/html/sor-dors167-eng.html.

14 *See* Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision, New York Public Service Commission Case No. 14-M-0101, Institute for Policy Integrity Comments on Staff White Paper on Benefit-Cost

Analysis in the Reforming Energy Vision Proceeding, Filing No. 447, at 22 (Aug. 21, 2015).

[15] These companies include Microsoft, General Electric, Walt Disney, ConAgra Foods, Wells Fargo, DuPont, Duke Energy, Google, Delta Air Lines, Walmart, and PG&E. The Exxon Mobil Corporation uses $80 for a metric ton of CO_2 emissions in 2040 (http://www.eenews.net/climatewire/2016/12/16/stories/1060047318); this exceeds the central U.S. SCC estimate for 2040.

[16] 2010 TSD *supra* note 4; 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 (2013); 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 (2015); 2016 TSD *supra* note 8.

[17] If offered $1 now or $1 in a year, almost everyone would choose to receive the $1 now. Most individuals would only wait until next year if they were offered more money in the future. The discount rate is how much more you would have to receive to wait until next year.

[18] The IWG correctly excluded a 7% discount rate, a standard private sector rate of return on capital, in its SCC calculations for two main reasons. First, typical financial decisions, such as how much to save in a bank account, focus on private decisions and use private rates of return. However, in the context of climate change, analysts are concerned with social discount rates because emissions mitigation is a public good, where individual emissions choices affect public well-being broadly. Second, climate change is expected to primarily affect consumption, not traditional capital investments.

[19] *See* Environmental Defense Fund, Institute for Policy Integrity at New York University School of Law, Natural Resources Defense Council, and Union of Concerned Scientists. Comments on Proposed Exception to the Colorado Roadless Rule (RIN 0596-AD26) and Supplemental Draft Environmental Impact Statement (November 2015) to Forest Service; Council on Environmental Quality; Office of Information and Regulatory Affairs to describe importance of 95th percentile value.

[20] *See, e.g.*, Energy Conservation Program: Energy Conservation Standards for Miscellaneous Refrigeration Products, 81 Fed. Reg. 75,194 (Oct. 26, 2016); Cross-State Air Pollution Rule Update for the 2008 Ozone NAAQS, 81 Fed. Reg. 74,504 (Oct. 26, 2016).

[21] *See, e.g.*, Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision, Order Establishing the Benefit Cost Analysis Framework, New York Public Service Comm'n Case No. 14-M-0101 (Jan. 21, 2016).

[22] According to the 2010 TSD, the 3% discount rate estimate is considered the central estimate because it uses the central (i.e., middle) discount rate and is based on an average, rather than worse-than-expected, climate outcome; the average climate outcome is the standard assumption made by the IWG 2010 TSD, *supra* 4 note.

[23] *See* Martin L. Weitzman, *Gamma Discounting*, 91 Am. Econ. Rev. 260, 270 (2001); Kenneth J. Arrow et al., *Determining Benefits and Costs for Future Generations*, 341 Science 349 (2013); Kenneth J. Arrow et al., *Should Governments Use a Declining Discount Rate in Project Analysis?*, 8 Rev Envtl. Econ. & Policy 1 (2014); Maureen L. Cropper et al., *Declining Discount Rates*, 104 Am. Econ. Rev. 538 (2014); Christian Gollier & Martin L. Weitzman, *How Should the Distant Future Be Discounted When Discount Rates Are Uncertain?* 107 Economics Letters 3 (2010). Policy Integrity further explores the use of declining discount rates in its recent comments to the National Academies of Sciences. *See* Institute for Policy Integrity at NYU School of Law. Recommendations for Changes to the Final Phase 1 Report on the Social Cost of Carbon; Recommendations in Anticipation of the Phase 2 Report on the Social Cost of Carbon to the National Academies of Sciences (April 29, 2016).

[24] National Academies of Sciences, Engineering and Medicine, *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide,* National Academies Press (January 2017) [hereinafter *Valuing Climate Damages*].

[25] *See* Omitted Damages, *supra* note 12; Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 Nature 173 (2014) (co-authored with Nobel laureate Kenneth Arrow).

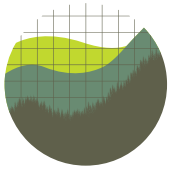
[26] Ted Gayer & W. Kip Viscusi, *Determining the Proper Scope of Climate Change Benefits* (Vanderbilt Law and Economics Working Paper 14-20, 2015).

[27] E.g., Peter Howard and Jason Schwartz, *Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon* (Institute for Policy Integrity at NYU School of Law Working Paper, 2016).

[28] *Valuing Climate Damages*, *supra* note 24 at 12-13.

[29] *See* Omitted Damages, *supra* note 11.

[30] Marten, A.L., E.A. Kopits, C.W. Griffiths, S.C. Newbold and A. Wolverton, *Incremental CH4 and N2O Mitigation Benefits Consistent with the U.S. Government's SCC Estimates*, Climate Policy (2014), DOI: 10.1080/14693062.2014.912981; Environmental Defense Fund, Institute for Policy Integrity at New York University School of Law, Natural Resources Defense Council, and Union of Concerned Scientists Comments on EERE-2015-BT-STD-0016, Energy Conservation Standards for WICF Refrigeration System and EERE-2014-BT-STD-0031, Energy Conservation Standards for Residential Furnaces (November 7, 2016).



Institute *for*
Policy Integrity
NEW YORK UNIVERSITY SCHOOL OF LAW

For more information contact Derek Sylvan – derek.sylvan@nyu.edu

Institute for Policy Integrity
New York University School of Law
Wilf Hall, 139 MacDougal Street, New York, New York 10012
policyintegrity.org