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PUBLIC INTEREST COMMENT

# THE INTERAGENCY WORKING GROUP ON THE SOCIAL COST OF GREENHOUSE GASES SHOULD BE TRANSPARENT ABOUT THE VALUE JUDGMENTS BEHIND ITS ESTIMATES AND ACKNOWLEDGE THEIR COST

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Notice of Availability and Request for Comment on "Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990"
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The Office of Management and Budget (OMB) is seeking comments on behalf of the Interagency Working Group on the Social Cost of Greenhouse Gases (IWG) regarding a recent update made to estimates of the social cost of carbon, methane, and nitrous oxide in a technical support document (TSD) issued by the IWG.[1] The IWG intends for federal regulatory agencies to use the values from the TSD in regulatory impact analyses to justify regulations targeting greenhouses gas emissions.

The Mercatus Center's Fourth Branch project is dedicated to advancing knowledge about the effects of regulation on society. As part of its mission, scholars conduct careful and independent analyses that employ contemporary economic scholarship to assess regulations and their effects on economic opportunities and societal well-being. This comment provides guidance to OMB and to the IWG about ways to improve the social cost of greenhouse gases (SCGG) estimates in the TSD, in particular by providing transparency about the nature of value judgments embedded in the process of selecting SCGGs, as well as about the substantial cost that use of these estimates is likely to impose on the American public. Throughout this comment, recommendations will be written in bold, so it is clear what is being recommended to these federal agencies.

1. Office of Management and Budget, Notice of Availability and Request for Comment on "Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990," 86 Fed. Reg. 24669 (May 7, 2021); Interagency Working Group on Social Cost of Greenhouse Gases, *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990,* February 2021.

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## THE IWG REPORT ON THE SOCIAL COST OF GREENHOUSE GASES IS AN ECONOMICALLY SIGNIFICANT REGULATORY ACTION

Under executive order 12866, an economically significant regulatory action, as defined in Section 3(f)(1) of the order, is "any regulatory action that is likely to result in a rule that may . . . have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety or State, local or tribal governments or communities."[2] Economically significant regulatory actions require a full regulatory impact analysis, which includes an assessment of benefits, costs, and alternatives.[3]

The TSD on the SCGG meets the definition of an economically significant regulatory action under executive order 12866 because it "is likely to result in a rule that may . . . have an annual effect on the economy of $100 million or more."[4] As evidence, according to a 2017 law review article, the Obama administration used the social cost of carbon (SCC) or social cost of methane (SCM) metrics in economic analysis for at least 83 regulatory proceedings.[5] The total cost of these 83 regulatory actions is estimated to be between $447 billion and $561 billion (in 2020 dollars), on the basis of regulatory agencies' own impact analyses (see appendix A of this comment for these calculations). This estimate may be conservative because it is unclear whether the list of 83 regulatory proceedings is comprehensive,[6] and because some regulatory analyses from these proceedings include only cost estimates for benchmark years (as opposed to calculating total cost across all years). The perpetuity value of $447 billion at a 7 percent interest rate is $31.3 billion, implying that if these costs were spread across an infinite time horizon, annual costs would still be 30 times higher than the threshold for economic significance, according to executive order 12866. Therefore, a regulatory impact analysis is required and should be made available for public scrutiny.

> **Recommendation 1:** OMB should withdraw the TSD so that the TSD may be reintroduced, supplemented with a regulatory impact analysis, and made available for public comment.

## THE SOCIAL WELFARE FUNCTION USED BY THE IWG TO CALCULATE THE SCGG IS ARBITRARY AND LACKS JUSTIFICATION

The SCGG values in the TSD are calculated using a social welfare function, the selection of which is normative in nature. The selection of the particular social welfare function used by the IWG is problematic for several reasons.

First, any number of alternative social welfare functions could be used to assign a value to the effects of greenhouse gas emissions on societal well-being, because the selection of the social welfare function is a value judgment made by analysts. Alternative social welfare functions are

2. Exec. Order No. 12866, 58 Fed. Reg. 190 (October 3, 1993).
3. Exec. Order No. 12866, § 6(a)(3)(C).
4. Exec. Order No. 12866, § 3(f)(1).
5. Peter Howard and Jason Schwartz, "Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon," *Columbia Journal of Environmental Law* 42, issue S (2017): 203–94.
6. The law review article that serves as the source of the identified rules says "at least" these rules have used the SCC or SCM in their analyses. Howard and Schwartz, "Think Global," 219.

available in the academic literature.[7] The IWG has not provided sufficient explanation for why it chose to use the particular social welfare function that it did.

Second, the social welfare function used (which is drawn from the Ramsey growth model) conflicts with a directive from President Biden regarding modernizing regulatory review.[8] Biden has directed OMB to produce a set of recommendations that "promote . . . the interests of future generations," which is clearly at odds with the social welfare function being used by the IWG, which treats the present generation as a dictator (more discussion of this issue comes later).[9]

To demonstrate the arbitrariness of the IWG's current approach, consider the following social welfare function:

$$SW_i = B_i - C_i + \$51 \times \sum_{t=0}^{\infty} TON_{GHG_i} \tag{1}$$

Equation (1) states that social welfare from a policy *i* is equivalent to the total nongreenhouse-gas-related benefits from the policy minus total nongreenhouse-gas-related costs, plus the change in tons of greenhouse gases emitted owing to the policy, multiplied by the value of $51 per ton. In this social welfare function, greenhouse gas emissions enter as a *benefit* rather than a cost (and therefore reductions in greenhouse gases constitute a cost).

I am not necessarily recommending that the IWG use the social welfare function in the equation (although greenhouse gas emissions may be correlated with things that people value); I present this equation only to point out the completely arbitrary nature of the social welfare function currently being used by the IWG. One could just as easily identify a social welfare function that reaches completely opposite policy conclusions—as I have just shown with equation (1). Without any explanation, how can one know which social welfare function is superior?

**Recommendation 2:** The IWG should be explicit about which social welfare function it is using, and it should explain why it selected that particular social welfare function.

Additionally, the social welfare function utilized by the IWG is not consistent with producing "an assessment of the potential costs and benefits" of a regulatory action, as is required under executive order 12866. Thus, the values in the TSD should not be used in any benefit-cost analysis. This is the case because, rather than assessing the dollar value of impacts, the TSD filters greenhouse gas impacts through a social planner's welfare function before final headline numbers are reported. The values reported in the TSD are estimates of *a social planner's well-being*, not estimates of benefits or costs (which are measured in dollars). This issue leads to confusion throughout OMB and IWG documentation. For example, the *Federal Register* notice from OMB announcing the opening of the comment period on the IWG report states "the Executive Branch has developed a set of estimates that represent the monetized impact to society associated with an incremental change in greenhouse gas emissions." This statement is incorrect as written, as what is being reported is not a money value. In fact, calculations of the SCC, SCM, and social cost of

7. W. J. Wouter Botzen and Jeroen C. J. M. van den Bergh, "Specifications of Social Welfare in Economic Studies of Climate Policy: Overview of Criteria and Related Policy Insights," *Environmental and Resource Economics* 58 (2014): 1–33.
8. Executive Office of the President, Modernizing Regulatory Review, 86 Fed. Reg. 7223 (January 20, 2021).
9. James Broughel, "The Unlikely Story of American Regulatory Socialism," *Quarterly Journal of Austrian Economics* 24, no. 1 (2021): 147–65.

nitrous oxide are incorrectly labelled throughout the TSD as well, including in tables ES-1, ES-2, and ES-3, where the primary values are reported. The numbers in these tables are reported in dollar terms, but what are actually being measured are estimates of well-being. Values represent units of the well-being of a social planner (or someone similar), and they should be reported as such.

> **Recommendation 3:** The IWG should report units accurately when reporting the SCGG values. The IWG should make clear that the units the SCGG values are measured in which are units of the well-being of a social planner or of society. Alternatively, the term "well-being dollars" would be appropriate.

> **Recommendation 4:** The IWG should make clear that the SCGG values are inappropriate for use in any benefit-cost analysis, where the relevant impacts are measured in US dollars.

The IWG should acknowledge the normative nature of the SCGG metrics, given that they are statements of what policy *should* aim to do according to analyst preferences, not a statement of what greenhouse gas emissions *actually* do to the environment or the economy.[10] As such, I also recommend the following:

> **Recommendation 5:** The IWG should acknowledge that the SCGG values are normative statements of analysts' political priorities, divorced from objective science.

## THE SOCIAL DISCOUNT RATES USED BY THE IWG TO CALCULATE THE SCGG ARE ARBITRARY AND LACK JUSTIFICATION

Like the social welfare function, the social discount rate is a normative input in benefit-cost analysis.[11] To its credit, the IWG acknowledges that certain ethical values go into the selection of this rate, but it falls short of acknowledging the full truth, which is that selection of this rate is entirely dependent on value judgments. There is no objective scientific way to arrive at the rates currently being used by the IWG.

The TSD identifies several ways in which the selection of the social discount rate could occur. One approach is to follow OMB's guidance in *Circular A-4*,[12] which is to base the social discount rate on market interest rates.[13] There are at least two problems with this approach. First, there is no compelling reason why one should rely on market interest rates to select the social discount rate, as opposed to any other method. This is especially true of policies (like those related to greenhouse gases) with intergenerational consequences. Future generations cannot participate in present markets, so present markets will not reflect their preferences. Second, OMB's discount rate guidelines in *Circular A-4* are flawed and should not be replicated. For example, *Circular A-4* discounting guidance leads regulatory agencies to fail to account for the opportunity cost of capital

10. James Broughel, "What Is vs. What Should Be in Climate Policy: The Hidden Value Judgments Underlying the Social Cost of Carbon" (Mercatus Policy Brief, Mercatus Center at George Mason University, Arlington, VA, April 2021).
11. On the normative nature of the social discount rate, see M. S. Feldstein, "The Social Time Preference Discount Rate in Cost-Benefit Analysis," *Economic Journal* 74, no. 294 (1964): 360–79; M. S. Feldstein, "The Inadequacy of Weighted Discount Rates," in *Cost-Benefit Analysis: Selected Readings*, ed. Richard E. Layard (Baltimore, MD: Penguin, 1972), 311–32.
12. Office of Management and Budget, *Circular A-4*, September 17, 2003.
13. The IWG argues that because market interest rates have declined in recent years, a lower social discount rate might be appropriate. Interagency Working Group on Social Cost of Greenhouse Gases, *Technical Support Document*, 19–21.

properly, because *Circular A-4* conflates two concepts: the social discount rate and the opportunity cost of capital.[14] If anything, aspects of the discounting guidelines in *Circular A-4* should be abandoned, not given more legitimacy by being cited in the TSD.

**Recommendation 6:** The IWG should not double down on the most problematic aspects of OMB *Circular A-4*, such as its social discounting guidance.

**Recommendation 7:** The IWG should make clear that the consumption rate of interest used to discount the SCGG and the opportunity cost of capital are two different concepts.

**Recommendation 8:** The IWG should make clear that there is no objective reason why market interest rates should be the basis for selecting the social discount rate.

In addition to discussing basing the social discount rate on market interest rates, the TSD discusses using the Ramsey equation to select a social discount rate.[15] Following this approach, the social discount rate is "approached from the perspective of a social planner who wishes to maximize the social welfare of society."[16] The discount rate in this method is the planner's rate of time preference, and it serves as a device to convert benefits and costs from dollar values into units of the planner's well-being.[17]

The Ramsey equation provides a useful way to explain the role of the social discount rate in a benefit-cost analysis. The social planner abstraction is used as a proxy to represent the current generation's well-being. However, the parameters of the Ramsey equation still require ethical judgments for their selection, and there is no reason to believe that the analysts who work on the IWG have any particular expertise in this area.

Given these facts, I recommend the following.

**Recommendation 9:** The IWG should acknowledge the normative nature of the social discount rate and be upfront that ethical judgments, which likely fall outside the expertise of analysts, are required to identify a social discount rate.

**Recommendation 10:** The IWG should acknowledge that the social discount rate is often interpreted as the rate of time preference of a social planner.[18]

14. In environmental benefit-cost analysis, the opportunity cost of capital is addressed using a shadow price, not a social discount rate. Feldstein, "The Inadequacy of Weighted Discount Rates"; David F. Burgess, "The Appropriate Measure of the Social Discount Rate and Its Role in the Analysis of Policies with Long-Run Consequences" (Mercatus Symposium, Mercatus Center at George Mason University, Arlington, VA, December 2018); James Broughel, "Cost-Benefit Analysis as a Failure to Learn from the Past," *Journal of Private Enterprise* 35, no. 1 (2020): 105–13.
15. Interagency Working Group on Social Cost of Greenhouse Gases, *Technical Support Document*, 21.
16. Kenneth J. Arrow et al., "How Should Benefits and Costs Be Discounted in an Intergenerational Context? The Views of an Expert Panel" (RFF DP No. 12-53, Resources for the Future, Washington, DC, December 2012).
17. James Broughel, "Cost-Benefit Analysis as a Failure to Learn from the Past."
18. Although aspects of the discounting guidelines in *Circular A-4* are problematic (such as how they deal with the issue of opportunity cost), other aspects make sense. For example, according to *Circular A-4*, the 3 percent social discount rate is "society's" rate of time preference (society is used in quotes in the original). *Circular A-4* does not make clear what society is, but it is reasonable to conclude that society is the agent in the Ramsey growth model. That agent can be understood as either a social planner or a representative of the collection of individuals comprising the current generation of citizens. Broughel, "The Unlikely Story of American Regulatory Socialism."

**Recommendation 11:** The IWG should acknowledge that what is being measured after social discounting is the well-being of a social planner or of society, either one being an abstraction meant to capture the welfare of the current generation of citizens.

## CONCLUSION

There is a very real danger that the values reported in the TSD will be perceived as objective scientific inputs in regulatory analysis, as opposed to what they are: statements reflecting the political priorities of analysts. No doubt some serious scholars have been involved in the calculation of these values, but when they work in this context, they are stepping outside of the domain of scholarship and entering into the domain of political advocacy. There is nothing wrong with political advocacy, per se, but political advocacy should not masquerade as objective science, and there is a danger of this occurring with the SCGG values in the TSD.

The IWG should be explicit and transparent about the value-laden nature of the metrics it is producing, or it should cease to use these metrics altogether and focus on scientifically based measures of the impacts of greenhouse gases instead, measures that should be consistent with objective assessments of benefits and costs.

## ATTACHMENTS (2)

"The Social Discount Rate: A Primer for Policymakers" (Mercatus Policy Brief, Mercatus Center at George Mason University, Arlington, VA, June 2020)

"What Is vs. What Should Be in Climate Policy: The Hidden Value Judgments Underlying the Social Cost of Carbon" (Mercatus Policy Brief, Mercatus Center at George Mason University, Arlington, VA, April 2021)

## APPENDIX A: COST ESTIMATES FOR OBAMA-ERA REGULATORY PROCEEDINGS UTILIZING THE SOCIAL COST OF CARBON OR SOCIAL COST OF METHANE

It is estimated that the Obama administration employed the SCC or SCM metrics to justify regulatory proceedings with an estimated total cost of between $447 billion and $561 billion (in 2020 dollars). This analysis uses a list of 83 rulemaking actions found in a 2017 paper by Peter Howard and Jason Schwartz that is presented in table A-1. The authors note that at that time, "at least eighty-three separate regulatory or planning proceedings conducted by six different federal agencies have used the SCC or SCM in their analyses."[19]

Using this list of 83 regulatory proceedings as a starting point, I employ the following methodology to calculate the cost of these rules. I collect the *Federal Register* notices for each of the 83 items (or, if the item is not a regulation, I collect the relevant primary document). Next, I identify cost estimates in the regulatory agencies' regulatory impact analyses. These numbers are found either in the preamble of the rulemaking notice or in a separate regulatory impact analysis document. The usual practice of regulatory agencies is to calculate costs using 3 percent and 7 percent discount rates, so I collect both sets of cost estimates. In cases where the agency calculates a range of costs, I take the average of the range calculated at each discount rate.

19. Howard and Schwartz, "Think Global," 219.

Some costs are reported by the agency as a present value, whereas others are reported in annualized form. Meanwhile, still other estimates are calculated for specific benchmark years only. For annualized costs, I identify the time horizon of the analysis and convert costs from annualized to present value using the relevant discount rate. For those rules with cost estimates in specific benchmark years, I assume costs occurred in only those years (which clearly underestimates the costs of these rules). However, for one rule, a series of benchmark years are presented over a 10-year time frame, so I interpolate costs for the missing years using the benchmark year values. Finally, I adjust all values for inflation to 2020 dollars and then aggregate the estimates. The range of estimates, $447 billion to $561 billion, reflects estimates calculated at the 7 percent and 3 percent discount rates, respectively.

There are a number of issues relating to uncertainty surrounding these cost estimates that should be noted. First, these are ex ante cost estimates, meaning that these are forecasts made by the regulating agency prior to a rule going into effect. Forecasts of the future can turn out to be incorrect. Moreover, numerous analytical assumptions go into these agency calculations, any number of which could turn out to be wrong or biased in some manner. Some regulations on the list are duplicates. Cost estimates from duplicate regulations are dropped from the total cost estimate. Some items are not regulations. For example, there are several environmental impact studies on the list. I assume that these items have zero cost. Some regulations are insignificant, or they otherwise do not have a cost estimate associated with them. I assume these have zero cost. Finally, some regulations are proposals, meaning that they were either later finalized or may not have been finalized. I include cost estimates for these regulations because they are regulatory actions that are supported using the SCC or SCM metrics.

## TABLE A-1: COST ESTIMATES FOR OBAMA-ERA REGULATORY PROCEEDINGS USING THE SCC OR SCM

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 1 | Energy Conservation Standards for Refrigerated Bottled or Canned Beverage Vending Machines | 74 Fed. Reg. 44,914 (finalized Aug. 31, 2009) RIN 1904-AB58 | Yes | - | - | $23.1 | $24 | 44916 | 2008 | 31 | $462 | $301 | $556 | $362 |
| 2 | Light-Duty Vehicle Greenhouse Gas Standards and Corporate Average Fuel Economy Standards | 74 Fed. Re. 49,454 (proposed Sept. 28, 2009); 75 Fed. Reg. 25,323 (finalized May 7, 2010) RIN 2127-AK50; RIN 2127-AK90; RIN 2060-AP58 | Yes | $51,800 | $51,800 | - | - | 25343 | 2007 | - | $51,800 | $51,800 | $64,666 | $64,666 |
| 3 | Energy Conservation Standards for Dishwashers, Dehumidifiers, Microwave Ovens, Electric & Gas Kitchen Ranges and Ovens, and Commercial Clothes Washers | 74 Fed. Reg. 57,738 (proposed Nov. 9, 2009); 75 Fed. Reg. 1121 (finalized Jan. 8, 2010) RIN 1904-AB93 | Yes | - | - | $22.7 | $23.4 | 1124 | 2008 | 31 | $454 | $293 | $546 | $353 |
| 4 | Energy Conservation Standards for Small Electric Motors | 74 Fed. Reg. 61,410 (proposed Nov. 24, 2009); 75 Fed. Reg. 10,874 (finalized Mar. 9, 2010) RIN 1904-AB70 | Yes | - | - | $263.9 | $263.7 | 10877 | 2009 | 31 | $5,278 | $3,305 | $6,367 | $3,987 |
| 5 | Changes to Renewable Fuel Standard Program | 75 Fed. Reg. 14,669 (Mar. 26, 2010) RIN 2060-A081 | Yes | $90.5 | $90.5 | | | 4, 5, 0827 of RIA | 2007 | - | $90.5 | $90.5 | $113 | $113 |
| 6 | FIP to Reduce Interstate Transport of Fine Particulate Matter and Ozone | 75 Fed. Reg. 45,209 (proposed Aug. 2, 2010); 76 Fed. Reg. 48,207 (finalized Aug. 8, 2011) RIN 2060-AP50 | Yes | - | - | $810 | $810 | 48215, p. 2 RIA | 2007 | 1 | $810 | $810 | $1011 | $1011 |
| 7 | Energy Conservation Standards for Residential Refrigerators, Refrigerator-Freezers, and Freezers | 75 Fed. Reg. 59,470 (proposed Sept. 27, 2010); 76 Fed. Reg. 57,515 (finalized Sept. 15, 2011) RIN 1904-AB79 | Yes | $23,300 | $13,300 | | | 57519, 57520 | 2009 | - | $23,300 | $13,300 | $28,108 | $16,045 |

## TABLE A-1 (CONTINUED)

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 8 | NSPS and Emission Guidelines for Sewage Sludge Incineration Units | 75 Fed. Reg. 63,260 (proposed Oct. 14, 2010); 76 Fed. Reg. 15,372 (finalized Mar. 21, 2011) RIN 2060-AP90 | Yes | $55 | $55 | - | - | 15398, p. 3 PDF | 2008 | 1 | $55 | $55 | $66 | $66 |
| 9 | GHG Emission Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles | 75 Fed. Reg. 74,152 (proposed Nov. 30, 2010); 76 Fed. Reg. 57,105 (finalized Sept. 15, 2011) RIN 2060-AP61; RIN 2127-AK74 | Yes | $8,100 | $8,100 | - | - | 57111 | 2009 | - | $8,100 | $8,100 | $9,772 | $9,772 |
| 10 | NESHAP: Mercury Emissions from Mercury Cell Chlor-Alkali Plants | 76 Fed. Reg. 13,852 (proposed Mar. 14, 2011) RIN 2060-AN99 | No, supplemental proposed rule | $0 | $0 | - | - | 13867 | 2007 | - | $0 | $0 | NA | NA |
| 11 | NESHAP: Industrial, Commercial, and Institutional Boilers (Area Sources) | 76 Fed. Reg. 15,554 (Mar. 21, 2011) RIN 2060-AM44 | Yes | - | - | $490 | $490 | 15558, 15582 | 2008 | 1 | $490 | $490 | $589 | $589 |
| 12 | NESHAP: Industrial, Commercial, and Institutional Boilers and Process Heaters (Major Sources) | 76 Fed. Reg. 15,607 (Mar. 21, 2011) RIN 2060-AQ25 | Yes | $1,500 | $1,500 | - | - | 15611 | 2008 | - | $1,500 | $1,500 | $1,804 | $1,804 |

## TABLE A-1 (CONTINUED)

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 13 | NSPS and EG: Commercial and Industrial Solid Waste Incineration Units | 76 Fed. Reg. 15,704 (Mar. 21, 2011) RIN 2060-AO12 | Yes | $290 | $290 | - | - | 15713, 15746 | 2008 | - | $290 | $290 | $349 | $349 |
| 14 | Energy Conservation Standards for Fluorescent Lamp Ballasts | 76 Fed. Reg. 20,090 (proposed Apr. 11, 2011); 76 Fed. Reg. 70, 547 (finalized Nov. 14, 2011) RIN 1904-AB50 | Yes | $6,910 | $3,680 | - | - | 70551, 70552 | 2010 | - | $6,910 | $3,680 | $8,202 | $4,368 |
| 15 | Energy Conservation Standards for Residential Clothes Dryers and Room Air Conditioners | 76 Fed. Reg. 22,324 (proposed Apr. 21, 2011); 76 Fed. Reg. 22,453 (direct final rule, Apr. 21, 2011); 76 Fed. Reg. 22,454 (direct final rule, May 26, 2011) RIN 1904-AA89 | Yes | - | - | $166.4 | $160 | 22458 | 2009 | 30 | $3,262 | $1,985 | $3,935 | $2,395 |
| 16 | Energy Conservation Standards for Residential Furnaces and Residential Central Air Conditioners and Heat Pumps | 76 Fed. Reg. 37,549 (proposed June 27, 2011); 76 Fed. Reg. 37,407 (direct final rule, June 27, 2011) RIN 1904-AC06 | Yes, plus a proposed rule | - | - | $711.9 | $669.1 | 37413, 37414 | 2009 | 30 | $13,954 | $8,303 | $16,833 | $10,016 |
| 17 | Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone | 76 Fed. Reg. 48,207 (Aug. 8, 2011) 2060–AP50 | Yes | 0 | 0 | - | - | 48215 | 2007 | - | NA | NA | NA | NA |

## TABLE A-1 (CONTINUED)

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 18 | NSPS and NESHAP for Oil and Natural Gas Sector | 76 Fed. Reg. 52,738 (proposed Aug. 23, 2011); 77 Fed. Reg. 49,489 (finalized Aug. 16, 2012) RIN 2060-AP76 | Yes | - | - | -$11 | -$11 | 49492 | 2008 | - | -$11 | -$11 | -$13 | -$13 |
| 19 | 2017+ Model Year Light-Duty Vehicle Greenhouse Gas Standards and Corporate Average Fuel Economy Standards & DOT's environmental impact statement | 76 Fed. Reg. 74,854 (proposed Dec. 1, 2011); 77 Fed. Reg. 62,623 (finalized Oct. 15, 2012) RIN 2060-AQ54; RIN 2127-AK79 | Yes | $150,000 | $144,000 | - | - | 62629 | 2010 | - | $150,000 | $144,000 | $178,042 | $170,920 |
| 20 | Commercial and Industrial Solid Waste Incineration Units | 76 Fed. Reg. 80,452 (proposed Dec. 23, 2011) RIN 2050-AG44; RIN 2060-AR15 | Proposed/reconsideration of final | $0 | $0 | - | - | | | - | NA | NA | NA | NA |
| 21 | Energy Conservation Standards and Test Procedures for Commercial Heating, Air-Conditioning, and Water-Heating Equipment | 77 Fed. Reg. 2356 (proposed Jan. 17, 2012); 77 Fed. Reg. 28,927 (finalized May 16, 2012) RIN 1904-AC47 | Yes | no cost estimate | | | | 28972, 28973 | 2011 | - | NA | NA | NA | NA |
| 22 | Energy Conservation Standards for Distribution Transformers | 77 Fed. Reg. 7281 (proposed Feb. 10, 2012); 78 Fed. Reg. 23,335 (finalized Apr. 18, 2013) RIN 1094-AC04 | Yes | - | - | $282 | $266 | 23426 | 2011 | 30 | $5,527 | $3,301 | $6,361 | $3,799 |
| 23 | Energy Conservation Standards for Standby Mode and Off Mode for Microwave Ovens | 77 Fed. Reg. 8526 (proposed Feb. 14, 2012); 78 Fed. Reg. 36,316 (finalized June 17, 2013) RIN 1904-AC07 | Yes | $1,341 | $776 | - | - | 36318, 36320 | 2011 | - | $1,341 | $776 | $1,543 | $893 |

## TABLE A-1 (CONTINUED)

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 24 | NESHAP from Coal- and Oil-Fired Electric Utility Steam Generation Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units | 77 Fed. Reg. 9303 (Feb. 16, 2012) RIN 2060-AP52; RIN 2060-AR31 | Yes | $9,600 | $9,600 | - | - | 9306 | 2007 | - | $9,600 | $9,600 | $11,984 | $11,984 |
| 25 | Energy Conservation Standards for Battery Chargers and External Power Supplies | 77 Fed. Reg. 18,477 (proposed Mar. 27, 2012); 79 Fed. Reg. 7845 (finalized Feb. 10, 2014) RIN 1904-AB57 | Yes | - | - | $162 | $147 | 7925, 31921 | 2012 | 30 | $3,175 | $1,824 | $3,580 | $2,057 |
| 26 | Energy Conservation Standards for Residential Dishwashers | 77 Fed. Reg. 31,964 (proposed May 30, 2012); 77 Fed. Reg. 31,917 (direct final rule, May 30, 2012); 77 Fed. Reg. 59,712 (direct final rule, Oct. 1, 2012) RIN 1904-AC64 | Yes, final and proposed | $881 | $522 | - | - | 31920 | 2010 | - | $881 | $522 | $1046 | $620 |
| 27 | Energy Conservation Standards for Residential Clothes Washers | 77 Fed. Reg. 32,381 (proposed May 31, 2012); 77 Fed. Reg. 32,307 (direct final rule, May 31, 2012) RIN 1904-AB90 | Yes, final and proposed | - | - | $212 | $185 | 32311 | 2010 | 30 | $4,155 | $2,296 | $4,932 | $2,725 |
| 28 | Performance Standards for Petroleum Refineries | 77 Fed. Reg. 56,422 (Sept. 12, 2012) RIN 2060-AN72 | Yes | -$79 | -$79 | - | - | 56425 | 2006 | - | -$79 | -$79 | -$101 | -$101 |
| 29 | NESHAP for Industrial, Commercial, and Institutional Boilers and Process Heaters (Major Sources) | 78 Fed. Reg. 7138 (Jan. 31, 2013) RIN 2060-AR13 | Yes | $1,500 | $1,500 | - | - | 7139 | 2008 | - | $1,500 | $1,500 | $1,804 | $1,804 |

**TABLE A-1 (CONTINUED)**

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 30 | Energy Conservation Standards for Distribution Transformers | 78 Fed. Reg. 23,335 (Apr. 18, 2013) RIN 1904-AC04 | Yes | - | - | - | - | 23342 | - | DUPLICATE | NA | NA | NA | NA |
| 31 | Effluent Limitation Guidelines and Standards for the Steam Electric Power Generating Point Source Category | 78 Fed. Reg. 34,431 (proposed June 7, 2013); 80 Fed. Reg. 67,837 (finalized Nov. 3, 2015) RIN 2040-AF14 | Yes | - | - | $480 | $471 | 67842, 67887 | 2013 | 24 | $8,129 | $5,402 | $9,033 | $6,002 |
| 32 | Environmental Assessment of Montana Oil and Gas Lease Sales | Envtl. Assessment (July 24, 2013) DOI-BLM-MT-0010-2013-0022-EA | No | - | - | - | | | | - | NA | NA | NA | NA |
| 33 | Energy Conservation Standards for Metal Halide Lamp Fixtures | 78 Fed. Reg. 51,463 (proposed Aug. 20, 2013); 79 Fed. Reg. 7745 (finalized Feb. 10, 2014) RIN 1904-AC00 | Yes | $721 | $465 | - | - | 7749, 7750 | 2012 | - | $721 | $465 | $813 | $524 |
| 34 | Energy Conservation Standards for Walk-In Coolers and Freezers | 78 Fed. Reg. 55,781 (proposed Sept. 11, 2013); 79 Fed. Reg. 32,049 (finalized June 3, 2014) RIN 1904-AB86 | Yes | $9,800 | $5,500 | - | - | 32053, 32054 | 2013 | - | $9,800 | $5,500 | $10,889 | $6,111 |
| 35 | Energy Conservation Standards for Commercial Refrigeration Equipment | 78 Fed. Reg. 55,889 (proposed Sept. 11, 2013); 79 Fed. Reg. 17,725 (finalized Mar. 28, 2014) RIN 1904-AC19 | Yes | $4,890 | $2,770 | - | - | 17729, 17730 | 2012 | - | $4,890 | $2,770 | $5,513 | $3,123 |
| 36 | Energy Conservation Standards for Residential Furnace Fans | 78 Fed. Reg. 64,067 (proposed Oct. 25, 2013); 79 Fed. Reg. 38,129 (finalized July 3, 2014) RIN 1904-AC22 | Yes | $6,189 | $3,385 | - | - | 38132, 38133 | 2013 | - | $6,189 | $3,385 | $6,877 | $3,761 |

## TABLE A-1 (CONTINUED)

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 37 | Energy Conservation Standards for Commercial and Industrial Electric Motors | 78 Fed. Reg. 73,589 (proposed Dec. 6, 2013); 79 Fed. Reg. 30,933 (finalized May 29, 2014) RIN 1904-AC28 | Yes | $12,500 | $6,900 | - | - | 30939, 30940 | 2013 | - | $12,500 | $6,900 | $13,889 | $7,667 |
| 38 | Standards of Performance for Greenhouse Gas Emissions from New, Modified, and Reconstructed Stationary Sources: Electric Utility Generating Units | 79 Fed. Reg. 1429 (proposed Jan. 8, 2014); 80 Fed. Reg. 64,509 (finalized Oct. 23, 2015) RIN 2060-AQ91 | Yes | $0 | $0 | - | - | 5-34, 4-1 RIA | | - | $0 | $0 | NA | NA |
| 39 | Energy Conservation Standards for Commercial Clothes Washers | 79 Fed. Reg. 12,301 (proposed Mar. 4, 2014); 79 Fed. Reg. 74,491 (finalized Dec. 15, 2014) RIN 1904-AC77 | Yes | $0.24 | $0.46 | - | - | 74494, 74495 | 2013 | - | $0 | $0 | $0 | $0 |
| 40 | Energy Conservation Standards for Automatic Commercial Ice Makers | 79 Fed. Reg. 14,845 (proposed Mar. 17, 2014); 80 Fed. Reg. 4645 (finalized Jan. 28, 2015) RIN 1904-AC39 | Yes | $411 | $224 | - | - | 4650, 4651 | 2013 | - | $411 | $224 | $457 | $249 |
| 41 | Affordability Determination—Energy Efficiency Standards | 79 Fed. Reg. 21,259 (notice of preliminary determination, Apr. 15, 2014); 80 Fed. Reg. 25,901 (final determination, May 6, 2015) RIN 2501-ZA01 | No, not a regulation | - | - | - | - | 25921 | - | - | NA | NA | NA | NA |

## TABLE A-1 (CONTINUED)

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 42 | Energy Conservation Standards for General Service Fluorescent Lamps and Incandescent Reflector Lamps | 79 Fed. Reg. 24,067 (proposed Apr. 29, 2014); 80 Fed. Reg. 4041 (finalized Jan. 26, 2015) RIN 1904-AC43 | Yes | $13,500 | $9,170 | - | - | 4045, 4046 | 2013 | - | $13,500 | $9,170 | $15,001 | $10,189 |
| 43 | Environmental Assessment for the Miles City Oil and Gas Lease Sale | Envtl. Assessment (May 19, 2014) DOI-BLM-MT-C020-2014-0091-EA | No | - | - | | | 76 [BLM report] | 2011 | - | NA | NA | NA | NA |
| 44 | Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units | 79 Fed. Reg. 34,829 (proposed June 18, 2014); 80 Fed. Reg. 64,661 (finalized Oct. 23, 2015) RIN 2060-AR33 | Yes | $26,500 | $26,500 | - | - | 64680, 64681, 3-22 RIA | 2011 | - | $26,500 | $2,6500 | $30,497 | $30,497 |
| 45 | National Pollutant Discharge Elimination System: Cooling Water Intake Structures at Existing Facilities | 79 Fed. Reg. 48,300 (Aug. 15, 2014) RIN 2040-AE95 | Yes | - | - | $274.9 | $297.3 | 48304, 6-3 RIA | 2011 | 40 | $6,354 | $3,964 | $7,313 | $4,561 |
| 46 | Energy Conservation Standards for Packaged Terminal Air Conditioners and Packaged Terminal Heat Pumps | 79 Fed. Reg. 55,537 (proposed Sept. 16, 2014); 80 Fed. Reg. 43,161 (finalized July 21, 2015) RIN 1904-AC82 | Yes | - | - | - | - | 43176, 43194 | - | - | $0 | $0 | NA | NA |
| 47 | Energy Conservation Standards for Small, Large, and Very Large Air-Cooled Commercial Package Air Conditioning and Heating Equipment | 79 Fed. Reg. 58,947 (proposed Sept. 30, 2014); 81 Fed. Reg. 2419 (direct final rule, Jan. 15, 2016) RIN 1904-AC95; RIN 1904-AD11 | Yes | $14,900 | $7,700 | - | - | 2424, 2425 | 2014 | - | $14,900 | $7,700 | $16,293 | $8,420 |

## TABLE A-1 (CONTINUED)

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 48 | Fossil Fuel-Generated Energy Consumption Reduction for New Federal Buildings and Major Renovations of Federal Buildings | 79 Fed. Reg. 61,693 (proposed Oct. 14, 2014) RIN 1904-AB96 | No | - | - | $574.6 | $479.4 | 61720 | 2012 | 30 | $11,262 | $5,949 | $12,698 | $6,707 |
| 49 | Carbon Pollution Emission Guidelines for Existing Stationary Sources: EGUs in Indian Country and U.S. Territories | 79 Fed. Reg. 65,481 (proposed Nov. 4, 2014) RIN 2060-AR33 | No, proposed | - | - | - | - | 65485, 65486 | 2011 | - | NA | NA | NA | NA |
| 50 | Energy Conservation Standards for Residential Dishwashers | 79 Fed. Reg. 76,141 (proposed Dec. 19, 2014) RIN 1904-AD24 | No, proposed | $7,100 | $3,900 | - | - | 76144, 76145 | 2014 | - | $7,100 | $3,900 | $7,764 | $4,265 |
| 51 | Energy Conservation Standards for Single Package Vertical Air Conditioners and Heat Pumps | 79 Fed. Reg. 78,613 (proposed Dec. 30, 2014); 80 Fed. Reg. 57,437 (finalized Sept. 23, 2015) RIN 1904-AC85 | Yes | $770 | $420 | - | - | 57442 | 2014 | - | $770 | $420 | $842 | $459 |
| 52 | Energy Conservation Standards for Single Package Vertical Air Conditioners and Heat Pumps | 79 Fed. Reg. 78,613 (proposed Dec. 30, 2014); 80 Fed. Reg. 57,437 (finalized Sept. 23, 2015) RIN 1904-AC85 | Yes | - | - | - | - | - | - | - | NA | NA | NA | NA |
| 53 | Energy Conservation Standards for Commercial Heating, Air-Conditioning, and Water-Heating Equipment | 80 Fed. Reg. 1171 (proposed Jan. 8, 2015); 80 Fed. Reg. 42,613 (finalized July 17, 2015) RIN 1904-AD23 | Yes | - | - | - | - | 42659 | - | NOT SIGNIFICANT | NA | NA | NA | NA |
| 54 | Energy Conservation Standards for Commercial Warm Air Furnaces | 80 Fed. Reg. 6181 (proposed Feb. 4, 2015) RIN 1904-AD11 | No, proposed version of earlier rule | - | - | - | - | 6185, 6186 | - | - | NA | NA | NA | NA |
| 55 | Energy Conservation Standards for Hearth Products | 80 Fed. Reg. 7081 (proposed Feb. 9, 2015) RIN 1904-AD35 | No, proposed rule | $1,004 | $505 | - | - | 7085, 7086 | 2013 | - | $1,004 | $505 | $1,116 | $561 |

## TABLE A-1 (CONTINUED)

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 56 | Environmental Assessment of Little Willow Creek Protective Oil and Gas Leasing | Envtl. Assessment (Feb. 10, 2015) DOI-BLM-ID-B010-2014-0036-EA | No, EIA | - | - | - | - | - | - | - | NA | NA | NA | NA |
| 57 | Energy Conservation Standards for Residential Furnaces | 80 Fed. Reg. 13,119 (proposed Mar. 12, 2015) RIN 1904-AD20 | No, proposed rule | $12,270 | $6,130 | - | - | 13123, 13125 | 2013 | - | $12,270 | $6,130 | $13,634 | $6,811 |
| 58 | Energy Conservation Standards for Residential Boilers | 80 Fed. Reg. 17,221 (proposed Mar. 31, 2015); 81 Fed. Reg. 2319 (finalized Jan. 15, 2016) RIN 1904-AC88 | Yes | $278 | $154 | - | - | 2324, 2326 | 2014 | - | $278 | $154 | $304 | $168 |
| 59 | Energy Conservation Standards for Pumps | 80 Fed. Reg. 17,825 (proposed Apr. 2, 2015); 81 Fed. Reg. 4367 (finalized Jan. 26, 2016) RIN 1904-AC54 | Yes | $300 | $200 | - | - | 4372, 4373 | 2014 | - | $300 | $200 | $328 | $219 |
| 60 | Final Environmental Impact Statement for Four Corners Power Plant and Navajo Mine Energy Project | Envtl. Impact Statement (May 1, 2015) EIS No. 20150119 | No | - | - | - | - | - | - | - | NA | NA | NA | NA |
| 61 | Energy Conservation Standards for Residential Dehumidifiers | 80 Fed. Reg. 31,645 (proposed June 3, 2015); 81 Fed. Reg. 38,337 (finalized June 13, 2016) RIN 1904-AC81 | Yes | $190 | $110 | - | - | 38340, 38341 | 2014 | - | $190 | $110 | $208 | $120 |
| 62 | Energy Conservation Standards for Residential Conventional Ovens | 80 Fed. Reg. 33,029 (proposed June 10, 2015) RIN 1904-AD15 | No, proposed rule | $600 | $300 | - | - | 33033; 33034 | 2014 | - | $600 | $300 | $656 | $328 |
| 63 | Energy Conservation Standards for Commercial Prerinse Spray Valves | 80 Fed. Reg. 39,485 (proposed July 9, 2015); 81 Fed. Reg. 4747 (finalized Jan. 27, 2016) RIN 1904-AD31 | Yes | $2 | $2 | - | - | 4751, 4752 | 2014 | - | $2 | $2 | $2 | $2 |

## TABLE A-1 (CONTINUED)

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 64 | GHG and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, Phase 2 & DOT's environmental impact statement | 80 Fed. Reg. 40,137 (proposed July 13, 2015) RIN 2060-AS16; RIN 2127-AL52 | No, proposed rule | $26,300 | $17,600 | - | - | ES-11 of RIA, 40143 | 2012 | - | $26,300 | $17,600 | $29,652 | $19,843 |
| 65 | Pipeline Safety: Expanding the Use of Excess Flow Valves in Gas Distribution Systems to Applications Other than Single-Family Residences | 80 Fed. Reg. 41,460 (proposed July 15, 2015) RIN 2137-AE71 | No, proposed rule | - | - | $13 | $11 | 41468, 41469, 27 and 35 in RIA | 2012 | 50 | $334 | $152 | $377 | $171 |
| 66 | Energy Conservation Standards for Ceiling Fan Light Kits | 80 Fed. Reg. 48,623 (proposed Aug. 13, 2015); 81 Fed. Reg. 579 (finalized Jan. 6, 2016) RIN 1904-AC87 | Yes | $70 | $60 | - | - | 583, 582, 584 | 2014 | - | $70 | $60 | $77 | $66 |
| 67 | Energy Conservation Standards for Refrigerated Bottled or Canned Beverage Vending Machines | 80 Fed. Reg. 50,461 (proposed Aug. 19, 2015); 81 Fed. Reg. 1027 (finalized Jan. 8, 2016) RIN 1904-AD00 | Yes | $34 | $18 | - | - | 1031, 1032 | 2014 | - | $34 | $18 | $37 | $20 |
| 68 | Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills | 80 Fed. Reg. 52099 (proposed Aug. 27, 2015) RIN 2060-AS23 | Yes | $680 | $620 | - | - | Table ES-3 RIA | 2012 | - | $680 | $620 | $767 | $699 |
| 69 | NSPS for Municipal Solid Waste Landfills | 80 Fed. Reg. 52,162 (proposed Aug. 27, 2015) RIN 2060-AM08 | No, this is a supplement to a proposed rule | - | - | - | - | - | - | - | NA | NA | NA | NA |
| 70 | Energy Conservation Standards for Battery Chargers | 80 Fed. Reg. 52,849 (proposed Sept. 1, 2015); 81 Fed. Reg. 38,265 (finalized June 13, 2016) RIN 1904-AB57 | Yes | $200 | $100 | - | - | 38269, 38270 | 2013 | - | $200 | $100 | $222 | $111 |

## TABLE A-1 (CONTINUED)

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 71 | NSPS for Oil and Natural Gas Sector | 80 Fed. Reg. 56,593 (proposed Sept. 18, 2015); 81 Fed. Reg. 35,823 (finalized June 3, 2016) RIN 2060-AS30 | Yes | - | - | $520 | $530 | 1-6 of RIA | 2012 | 25 | $9,055 | $6,176 | $10,209 | $6,964 |
| 72 | Federal Plan for GHG from EGUs | 80 Fed. Reg. 64,965 (proposed Oct. 23, 2015) RIN 2060-AS47 | No, proposed rule | - | - | - | - | 65053, 1-15 RIA | 2011 | - | NA | NA | NA | NA |
| 73 | Roadless Area Conservation in Colorado & the Supplemental Environmental Impact Statement | 80 Fed. Reg. 72,665 (proposed Nov. 20, 2015) RIN 0596-AD26 | No, proposed rule | - | - | - | - | 72668 | - | - | NA | NA | NA | NA |
| 74 | Cross-State Air Pollution Rule Update for the 2008 Ozone NAAQS | 80 Fed. Reg. 75,705 (proposed Dec. 3, 2015) RIN 2060-AS05 | No, proposed rule | - | - | $93 | $93 | 75711, ES-15 & 16 of RIA | 2011 | 1 | $93 | $93 | $107 | $107 |
| 75 | Energy Conservation Standards for Ceiling Fans | 81 Fed. Reg. 1687 (proposed Jan. 13, 2016) RIN 1904-AD28 | No, proposed rule | $2,400 | $1,400 | - | - | 1691, 1692 | 2014 | - | $2,400 | $1,400 | $2,624 | $1,531 |
| 76 | Waste Prevention, Production Subject to Royalties, and Resource Conservation & accompanying regulatory impact analysis and environmental assessment | 81 Fed. Reg. 6615 (proposed Feb. 8, 2016) RIN 1004-AE14 | No, proposed rule | - | - | $139 | $156 | 6620 FR Rule, p.4 and 7 of RIA | 2012 | 10 | $1,186 | $1,096 | $1,337 | $1,235 |
| 77 | Energy Conservation Standards for General Service Lamps | 81 Fed. Reg. 14,527 (proposed Mar. 17, 2016) RIN 1904-AD09 | No, proposed rule | -$1,400 | -$900 | - | - | 14532, 14533 | 2014 | - | -$1,400 | -$900 | -$1,531 | -$984 |
| 78 | Energy Conservation Standards for Commercial Packaged Boilers | 81 Fed. Reg. 15,836 (proposed Mar. 24, 2016) RIN 1904-AD01 | No, proposed rule | $863 | $512 | - | - | 15840, 15841 | 2014 | - | $863 | $512 | $944 | $560 |
| 79 | Pipeline Safety: Safety of Gas Transmission and Gathering Pipelines | 81 Fed. Reg. 20,722 (proposed Apr. 8, 2016) RIN 2137-AE72 | No, proposed rule | $47.4 | $39.8 | - | - | 20724 | 2015 | 15 | $47 | $40 | $52 | $43 |

## TABLE A-1 (CONTINUED)

| NO. | RULEMAKING | PUBLICATION DATE AND CITATION | FINAL RULE | TOTAL COST PRESENT VALUE (MILLIONS) | | TOTAL COST ANNUALIZED (MILLIONS) | | SOURCE PAGE NUMBER | DOLLAR YEAR | YEARS COVERED | TOTAL COST PV (MILLIONS OF CURRENT DOLLARS) | | TOTAL COST PV (MILLIONS OF 2020$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3% | 7% | 3% | 7% | | | | 3% | 7% | 3% | 7% |
| 80 | Energy Conservation Standards for Compressors | 81 Fed. Reg. 31,679 (proposed May 19, 2016) RIN 1904-AC83 | No, proposed rule | $200 | $100 | - | - | 31685, 31686 | 2015 | - | $200 | $100 | $218 | $109 |
| 81 | Energy Conservation Standards for Commercial Water Heating Equipment | 81 Fed. Reg. 34,439 (proposed May 31, 2016) RIN 1904-AD34 | No, proposed rule | $2,500 | $1,500 | - | - | 34446, 34447 | 2014 | - | $2,500 | $1,500 | $2,734 | $1,640 |
| 82 | Energy Conservation Standards for Portable Air Conditioners | 81 Fed. Reg. 38,397 (proposed June 13, 2016) RIN 1904-AD02 | No, proposed rule | $510 | $270 | - | - | 38401, 38402 | 2014 | - | $510 | $270 | $558 | $295 |
| 83 | Energy Conservation Standards for Manufactured Housing | 81 Fed. Reg. 39,755 (proposed June 17, 2016) RIN 1904-AC11 | No, proposed rule | - | - | $277 | $220 | 39761 | 2015 | 30 | $5,429 | $2,730 | $5,930 | $2,982 |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | TOTAL | $560,530 | $446,718 |

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POLICY BRIEF

# The Social Discount Rate: A Primer for Policymakers

*James Broughel*

June 2020

The social discount rate used in cost-benefit analysis (CBA) is an interest rate applied to benefits and costs that are expected to occur in the future in order to convert them into a present value. This conversion is done to ascertain what those benefits and costs are worth today. The social discount rate is widely considered to be one of the most important inputs in CBA in that small changes in this rate can result in large swings in present-value calculations, thereby having a major influence on whether a project passes or fails a cost-benefit test. However, the social discount rate is widely misunderstood for a variety of reasons. This primer explains the basic conceptual issues involved with the social discount rate and tries to clear up some common misunderstandings.

## BASIC CONCEPTS

The two core discounting concepts in CBA are the "consumption rate of interest" and the "investment rate of interest."[1] The investment rate of interest accounts for the marginal social rate of return to capital in the economy. The intuition behind this rate is that investments earn positive, compounding rates of return. The consumption rate of interest, meanwhile, represents the rate at which a unit of consumption in the present is traded for a unit of consumption in the future. This interest rate reflects consumers' time preferences and, in certain circumstances, may be represented by the risk-free market interest rate.[2] The standard approaches to discounting in CBA all rely on these two interest rate concepts.[3] For the sake of clarity, when this article refers to "the social discount rate" in CBA, it is the consumption rate of interest for all of society that is being referenced.

The investment rate of interest will generally be higher than observable market interest rates (and by extension the consumption rate) because the minimum required rate of return demanded by businesses will tend to exceed their costs of borrowing, owing to taxes. If the expected after-tax rate of return on a project falls below businesses' cost of borrowing, they will not undertake certain investments that might still be profitable from a societal point of view. In this way, taxes create allocative distortions in the economy that limit the amount of overall investment.

The risk-free market interest rate can deviate from the natural rate that reflects consumer time preferences, owing to factors such as inflation or market inefficiencies (e.g., externalities). Small adjustments can be made in an analysis to account for such factors. However, discounting consumption in CBA also becomes much more complicated in an intergenerational context, because while all human beings exhibit some degree of time preference, they only exhibit positive time preference during the time they are alive. No one is impatiently waiting to be born. So while there is a potential case to be made on *positive* grounds for discounting consumption for policies that only have impacts within a lifetime or perhaps a within a generation, it does not follow that this rationale extends to policies with *intergenerational* consequences. Most often, how much value society should place on consumption in the future is an ethical question.

## THE POWER OF COMPOUND INTEREST

The consumption and investment rates of interest are different from a discount rate used in financial analysis in that they are applied to real resources, which are distinct from financial resources. The consumption rate of interest is used to discount resources that are consumed, and the investment rate of interest applies to resources that are invested. Any interest rate, be it applied to money or anything else, is important owing to the power of compound interest.

Tables 1 and 2 demonstrate the influence small changes in the discount rate have on present-value calculations. As is evident from table 1, an investment paying $1 million in 100 years is worth just $72.45 in present-value terms at a 10 percent discount rate, $1,152.45 at a 7 percent rate, and $52,032.84 at a 3 percent rate.

The primary reason for discounting cash flows is the time value of money. Since cash can be invested and earn interest, the sooner money is earned the better, otherwise interest and its subsequent returns are forgone. While the time value of money also applies to investment returns in CBA (when they come in a pecuniary form), the case for discounting nonpecuniary consumption is based on a different set of rationales than the time value of money.

**Table 1. Present Value of $1 Million Earned 100 Years in the Future, at Various Rates of Interest**

| Investment rate of interest | 0% | 1% | 3% | 7% | 10% |
|---|---|---|---|---|---|
| Present value | $1,000,000.00 | $369,711.21 | $52,032.84 | $1,152.45 | $72.57 |

Source: Author's calculations.

On the one hand, there is the observable fact that people tend to exhibit positive time preference. That is, they prefer consumption sooner rather than later. However, as discussed earlier, this provides little justification for discounting benefits and costs to those not yet born. Common arguments for using a positive social discount rate in an intergenerational context are that people in the future will be richer than those in the present, so, owing to the phenomenon of diminishing marginal utility, a unit of consumption—including a life—can be expected to generate less utility to future citizens than to present citizens. Or sometimes it is simply stated that the well-being of people in future should be discounted at compounding exponential rates since future utility matters less than present utility.

Table 2 highlights the importance of the discounting when comparing lives saved in the future to an equivalent number of lives saved in the present. For example, 10,000 lives saved in 100 years are worth 198 lives in the present at a 3 percent social discount rate and worth just 1 life using a 10 percent social discount rate.

**Table 2. Present Value of 10,000 Lives Saved 100 Years in the Future, at Various Social Discount Rates**

| Social discount rate (society's consumption rate of interest) | 0% | 1% | 3% | 7% | 10% |
|---|---|---|---|---|---|
| Present value (lives saved) | 10,000 | 3,697 | 520 | 12 | 1 |

Note: Human lives are not divisible into parts. Hence, lives are rounded to nearest whole number.
Source: Author's calculations.

## WHEN TO USE EACH RATE

When conducting a CBA, one must be careful to use appropriate rates in their appropriate contexts. Nonpecuniary aspects of life cannot be invested in an account, so they should never be treated as if they will compound in value at the marginal rate of return to capital. At the same time, returns to capital often *can* be reinvested, so it is entirely appropriate to treat capital investments as if their returns compound in value at the investment rate.

Guidelines from the federal government conflate these two discounting concepts by recommending that regulatory agencies apply a single social discount rate to all benefits and costs, irrespective of whether those benefits and costs are like capital investments or like consumption.[4] This is a problem because it means analysts are essentially treating all benefits and costs as if they are either consumption or investment,[5] when rarely is this the case. Treating consumption and investment equally gives too much weight to consumption relative to a comparable amount of investment because, in general, one dollar of investment is more valuable to society than one dollar of consumption.[6]

The way to resolve this issue is to use the two different rates in their different contexts, which means separating consumption and investment in the analysis. Positive and negative incremental investment can be kept on one side of the ledger (out of convention this is often the cost side), and consumption can be kept on the other side of the ledger (the benefits side).[7] Then the two different interest rates can be applied distinctly to their respective benefits or costs.[8]

## SOME MISCONCEPTIONS ABOUT SOCIAL DISCOUNTING

### Misconception #1: Analysts Are Discounting Money Rather Than Lives

Some commenters argue what is being discounting in CBA is money rather than lives saved.[9] This confusion arises because benefits and costs are valued in monetary terms in order to compare them to one another. The undiscounted dollar values in CBA refer to monetary equivalents; i.e., the value individuals place on certain resources in terms of what they are willing to spend for them. Using such a valuation technique does not convert those resources into something that can be invested, like money. Dollars are simply a convenient measuring stick to make comparisons in value.

Consider, for example, the similar practice of adjusting the value of resources for inflation when they occur in different years (which also occurs in CBA). After an inflation adjustment, resources have a dollar value assigned to them, but those dollars actually represent bundles of real resources, hence the use of the term "real" when referring to inflation-adjusted values. Lives are not literally being converted into money when they are expressed as monetary equivalents in CBA. Real resources are ultimately what is being valued.

### Misconception #2: The Opportunity Cost of Capital Is the Basis for Social Discounting

Other observers assert that a social discount rate is necessary in CBA because of the opportunity cost of capital; i.e., because capital earns a rate of return in the future. For example, government guidelines recommend regulatory agencies use a 7 percent social discount rate that "approximates the opportunity cost of capital."[10]

Capital's rate of return cannot be the basis for social discounting, however, because the rate at which individuals discount future consumption shapes household savings patterns and by extension determines capital's rate of return.[11] Basing the social discount rate on the opportunity cost of capital rate involves circular reasoning. Moreover, an optimum is achieved when capital investment is increased to such an extent that the investment rate of interest falls to meet the social discount rate. At this point, the additional utility generated from an incremental unit of capital investment is zero, which, again, provides no particular basis for social discounting.[12]

### Misconception #3: Only Regulatory Benefits Have Intergenerational Consequences

Social discounting often comes up in the context of climate change policy or other environmental contexts such as nuclear waste disposal, where society has to wait a long time for the benefits of a government regulation to pay off.[13] This can create an impression that the social discount rate matters most for environmental projects or only for projects with nonpecuniary *benefits* far in the future. In fact, costs often have intergenerational consequences as well, though these costs often go unaccounted for in analysis. Even small amounts of investment displaced by government projects today can have significant long-acting consequences, owing to the power of compound interest.

Moreover, people are continually being born and dying, so what constitutes a "generation" may in fact be a relatively short period of time. While deciding how much weight to give to the consumption of future generations is based on a value judgment, a commitment to assessing the benefits and costs of policy as they actually occur requires acknowledgment of the impacts of policies through this investment channel.

## A NOTE ABOUT DECLINING DISCOUNT RATES

Some economists have suggested that, owing to uncertainty, the government should consider using a social discount rate that declines over time.[14] There are two rationales for declining discount rates that do not involve any suboptimal, or irrational, decision-making.[15] One rationale takes the perspective of a social planner that centrally plans the economy. The discount rate of the social planner may decline over the investment horizon owing to the combination of the social planner being risk averse and there being fluctuations in and uncertainty about the rate of economic growth in the future.[16]

A second rationale for declining discount rates is called the Expected Net Present Value approach, and it asserts that in the presence of uncertainty, a declining discount rate is equivalent to a constant rate under certainty.[17] Consider the possibility that there is a 50 percent chance that the social discount rate is 3 percent and a 50 percent chance that it is 7 percent. To account for this uncertainty, one could calculate the present value of the project at 3 percent, then at 7 percent, and then obtain the expected value; i.e., the average of these present values. It turns out that the implied certainty-equivalent discount rate consistent with this average present value is lower than 5 percent, the average of the two social discount rates. Furthermore, as the time horizon extends into the future, this implied discount rate gets closer and closer to 3 percent, the low end of possible discount rates. Therefore, accounting for uncertainty can entail use of a declining discount rate that is equivalent to a constant rate under certainty.

The first argument for declining discount rates, based on the preferences of a social planner, is explicitly normative. Whether to adopt this method or not is a value judgment because this rationale depends on ethical choices about the social planner's welfare function. The second argument is more compelling because it is simply a mathematical property that follows from taking the expected value of a function, although aspects of this argument are normative as well.[18]

In either case, however, if an analyst uses a declining social discount rate owing to uncertainty, he or she must also adjust the estimation of the opportunity cost of capital over time in the analysis, since it will vary with the social discount rate. In general, a lower social discount rate means a higher estimated opportunity cost of capital and vice versa, which is why low and declining discount rates need not encourage more regulation. If the opportunity cost of capital is accounted for in analysis, regulatory costs can be very large when the social discount rate is low or declining. However, these costs often go overlooked, leading to the common view that a low social discount rate encourages more regulation.

## CONCLUSION

This primer has sought to provide some clarity on the topic of the social discount rate and to clear up common misconceptions about this rate. Misunderstandings often stem from conflating the two main discounting concepts: the consumption and investment rates of interest. Indeed, even government guidelines on regulatory analysis seem to make, or at least encourage, such mistakes.

Moreover, some aspects of discounting are inherently normative; that is, they involve value judgments. Analysts should always be clear about what aspects of their analysis involve value judgments. For example, if the preferences of a hypothetical social planner are important determinants of present-value calculations, this fact should be made transparent in the analysis. Furthermore, the opportunity cost of capital should always be accounted for in any analysis, and analysts should understand that estimates of the opportunity cost of capital will tend to vary with the social discount rate used, rather than the other way around.

Adhering to these basic principles could potentially resolve many common problems found in modern CBA.

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## NOTES

1. These are sometimes referred to as the "net" and "gross" rates of interest, respectively.
2. Absent distortions, the risk-free rate can be thought to reflect a natural rate of interest that embodies current consumers' time preferences.
3. David F. Burgess, "The Appropriate Measure of the Social Discount Rate and Its Role in the Analysis of Policies with Long-Run Consequences" (Mercatus Symposium, Mercatus Center at George Mason University, Arlington, VA, 2018); Mark A. Moore and Aidan R. Vining, "The Social Rate of Time Preference and the Social Discount Rate" (Mercatus Symposium, Mercatus Center at George Mason University, Arlington, VA, 2018).
4. Office of Management and Budget, *Circular A-4*, 2003.
5. It could also mean the analyst is assuming that the economy has reached the optimal amount of investment, such that $1 of incremental investment will yield no more social utility than $1 of consumption.
6. Richard A. Williams and James Broughel, "Toward an Improved OMB Annual Report on Federal Regulations," *Regulation* 42, no. 4 (2019–2020): 20–24.
7. Capital also comes in different forms. The term often refers simply to physical capital—productive machines and equipment—but can also include human capital, social capital, and natural resources (which some call natural capital). Each will produce different rates of return depending on whether the returns are temporary or ongoing and whether some portion of the return can be reinvested.
8. It is sometimes argued that it is inappropriate to discount benefits occurring in the same year at different rates. For example, a 2017 report from the National Academies of Sciences states, "consistency requires that the same discount rate must be applied to all benefits and costs that occur in the same year." However, as Liqun Liu correctly notes, it is entirely appropriate to discount consumption and investment at different rates owing to their different rates of return. On the inappropriateness of using two discount rates, see Kenneth J. Arrow et al., "Determining Benefits and Costs for Future Generations," *Science* 341, no. 6144 (2013): 349–50; National Academies of Sciences, Engineering, and Medicine, *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide* (Washington, DC: National Academies Press, 2017). On the correctness of using two discount rates, see Liqun Liu, "A Marginal Cost of Funds Approach to Multi-Period Public Project Evaluation: Implications for the Social Discount Rate," *Journal of Public Economics* 87, no. 7(2003): 1707–18.
9. According to Arden Rowell and Cass Sunstein, "So long as monetary values are assigned to the relevant variables, it is only money, and not any variable, that is being discounted." Kip Viscusi, citing Rowell and Sunstein, similarly states, "What is being discounted is not the number of lives, but a monetary amount equal to the willingness to pay to reduce risks to life." Arden Rowell and Cass R. Sunstein, "On Discounting Regulatory Benefits: Risk, Money, and Intergenerational Equity," *University of Chicago Law Review* 74, no. 1 (2007): 171–208; W. Kip Viscusi, "Rational Discounting for Regulatory Analysis," *University of Chicago Law Review* 74, no. 1 (2007): 209–46.
10. Office of Management and Budget, *Circular A-4*.
11. Tyler Cowen and Derek Parfit, "Against the Social Discount Rate," in *Justice Between Age Groups and Generations*, ed. Peter Laslett and James S. Fishkin (New Haven, CT: Yale University Press, 1992), 151.
12. Cowen and Parfit, "Against the Social Discount Rate."
13. See the various Intergovernmental Panel on Climate Change reports or the 2006 Stern report on climate change. Nicholas Stern, *The Economics of Climate Change: The Stern Review* (London: Her Majesty's Treasury, 2006).
14. Kenneth J. Arrow et al., "Should Governments Use a Declining Discount Rate in Project Analysis?," *Review of Environmental Economics and Policy* 8, no. 8 (2014): 145–63.
15. At first glance, declining discount rates sound a lot like "hyperbolic discounting," which is a behavioral anomaly that can lead to suboptimal, or "time inconsistent," decisions, whereby a different decision would be made depending on the time in which the decision is made. The rationales for declining discount rates mentioned here do not suffer these problems. On hyperbolic discounting, see David Laibson, "Golden Eggs and Hyperbolic Discounting," *Quarterly Journal of Economics* 112, no. 2 (1997): 443–77.

16. For a detailed description of this social planner perspective, see Christian Gollier, *Pricing the Planet's Future: The Economics of Discounting in an Uncertain World* (Princeton, NJ: Princeton University Press, 2012).

17. Martin L. Weitzman, "Gamma Discounting," *American Economic Review* 91, no. 1 (2001): 260–71; Martin L. Weitzman, "Subjective Expectations and Asset-Return Puzzle," *American Economic Review* 97, no. 4 (2007): 1102–30; Richard Newell and William Pizer, "Discounting the Benefits of Climate Change Mitigation: How Much Do Uncertain Rates Increase Valuations?," *Journal of Environmental Economics and Management* 46, no. 1 (2003): 52–71.

18. For example, if one instead evaluates projects in future-value terms (rather than present-value terms), the phenomenon reverses. That is, the social discount rate rises toward its highest possible value. Resolving the paradox requires, again, assumptions about the social planner's welfare function, including assumptions about risk aversion and consumption smoothing. Martin L. Weitzman and Christian Gollier, "How Should the Distant Future Be Discounted When Discount Rates Are Uncertain?," *Economics Letters* 107, no. 3 (2010): 350–53.

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POLICY BRIEF

# What Is vs. What Should Be in Climate Policy: The Hidden Value Judgments Underlying the Social Cost of Carbon

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The social cost of carbon (SCC) is a measure that describes the harm a ton of carbon dioxide ($CO_2$) emissions has on society when it is emitted into the atmosphere. The SCC is perhaps most prominently used as an input in benefit-cost analysis, which is produced for many regulations, including those targeting $CO_2$ emissions. The Biden administration recently updated its estimate of the SCC to $51 per ton,[1] and the administration is expected to use this updated figure when determining how much society should spend implementing regulations and other policies targeting global warming.

Although calculating the SCC involves using complex models (known as integrated assessment models) that rely on scientific inputs as parameters, these calculations also contain certain value judgments that one who is not careful could confuse with objective scientific facts. The purpose of this policy brief is to explain two such value judgments that go into the calculation of the SCC: the choice of the social welfare function, which determines how costs and benefits are aggregated across individuals to assess an overall impact on well-being; and the choice of the social discount rate, which determines how much weight future benefits and costs should receive relative to present ones.

## THE SOCIAL WELFARE FUNCTION

The SCC is an estimate of the impact $CO_2$ has on social welfare, and it is used in economic analysis to assess whether policies intended to reduce the harm of $CO_2$ pollution are worth their cost. For example, if the SCC is set at $51 a ton (the Biden administration's estimate), and if a regulation reduces $CO_2$ emissions by one million tons today, then an economist might say that social welfare would fall if society spends more than $51 million implementing this regulation.

Although sometimes the SCC is described as a measure of the dollar value of the societal cost associated with a ton of $CO_2$ emissions, this description is not technically accurate. Although it is theoretically possible to express the SCC in terms of dollars, in practice most people express the SCC in units of social welfare, or what might be called *well-being dollars* (though the *well-being* descriptor is often conveniently dropped).

Despite having a dollar symbol in front of it, the SCC figure is calculated using a *social welfare function*, which describes how the well-being of society is affected by activities, such as public policies. It is a method of ranking policies or other outcomes in terms of their desirability. Although social welfare functions are controversial among some economists,[2] and there is no social welfare function that is universally agreed upon among economists for use in policy, they are also used extensively in economics, including in the fields of social choice, optimal redistributive tax policy, growth theory, and, relevant for the purposes of this brief, climate change economics.[3]

The main challenge with social welfare functions is selecting the one that is appropriate for the task at hand, as there are many different social welfare functions one could use. Also challenging is reaching any kind of consensus about this choice, since the selection of this function involves making value judgments.

For instance, one of the more famous social welfare functions is the *utilitarian social welfare function*. In this approach, welfare is measured by adding up the utility of each member of society. However, the choice to give equal weight to everyone's utility, as the utilitarian social welfare function does, could be viewed as controversial. Thus, some alternative social welfare functions give priority to certain individuals, such as those who are least well off.

The selection of the social welfare function is normative. That is to say, it is an ethical choice, not a scientific one, because it depends on one's values. Normative claims in analysis are distinct from positive claims in that they express some moral judgment, not objective scientific facts. For example, the claim "the shirt is red" is an objective fact that can verified, whereas the claim "the shirt is ugly" is a normative claim, because it depends on a value judgment.

The social welfare function that the SCC relies on comes from economic growth theory, specifically from a popular growth model known as the Ramsey model,[4] named after the early 20th-century mathematician Frank Ramsey. The social welfare function the Ramsey model uses is called the *discounted utility model*. In this model, society as a whole is treated as having preferences like a single person, so the social welfare function for society is simply an individual's welfare function.

One interpretation of the individual in the Ramsey model is that it represents the current generation of citizens. Economic growth models sometimes make a simplifying assumption that each generation can be encapsulated into a single agent.[5] Thus, each agent in the model represents a collection of members of society alive at a given moment in time. The Ramsey model accounts for the well-being of just one agent who is meant to approximate the current members of society.

In the social choice literature, the discounted utility model is seen as describing a "dictatorship of the present."[6] The single agent in the Ramsey model (and, by extension, in the integrated assessment models that estimate the SCC) can be viewed as a dictator whose preferences are for the moment all that matters. The intuition here is that the present generation gets to be the dictator while it is living, and subsequent generations will get their turn to be dictator eventually.[7]

The choice to use a model in a climate change context that describes a dictatorship of the present is strange given that the purported aim of many climate policies is to increase well-being in the future. The Biden administration, for example, has asserted that a goal of its regulatory reforms is to promote the "interests of future generations,"[8] which would seem to be at odds with its choice to update and expand the use of the SCC; taking the perspective that the current generation is a dictator would seem, at least on the face of it, inconsistent with the administration's stated goals.

## THE SOCIAL DISCOUNT RATE

One of the most important inputs into the calculation of the SCC is the *social discount rate*. The social discount rate describes how much less a future benefit should count relative to a present benefit. It forms a critical part of the social welfare function used to calculate the SCC because the social discount rate is the device that converts future impacts from monetary units into units of the agent's (in the Ramsey model) well-being.[9] Recall that the units in which the SCC is typically calculated are units on a social welfare scale. Social discounting is how outcomes across individuals and time are ranked so that they can be compared to one another on a common social welfare scale.

At a practical level, different social discount rates can result in huge swings in the value of the future benefits, owing to compounding. For example, 10,000 lives saved in 100 years are worth about 3,700 lives saved today using a 1 percent social discount rate, but those 10,000 lives are worth only about 1 life today at a 7 percent social discount rate.[10] As should be obvious from this example, the social discount rate is an ethical choice about how much weight benefits such as future health, well-being, and lives saved should receive in analysis. The selection of the social discount rate, like the selection of the social welfare function, depends on one's values.

Recently there has been a push toward using lower social discount rates, both in the context of the social cost of carbon and, more generally, in benefit-cost analysis.[11] Historically, conservatives and libertarians have been skeptical of using low social discount rates,[12] but it does not follow that low social discount rates necessarily correspond with more government intervention in the economy, and the SCC offers a prime example why that is so. Before discounting, integrated assessment models express $CO_2$ impacts in *consumption equivalent* form, meaning in terms of impacts on society's consumption. Often overlooked is that if the social discount rate falls low enough, what matters from an efficiency perspective is investment. This is the famous "r must be greater than g" condition that has received considerable attention in recent years, owing to the influential work of French economist Thomas Piketty;[13] it is a convergence condition underlying economic growth models.

If a growth model fails to converge,[14] then a dollar of investment produces a consumption equivalent stream that is unbounded (i.e., infinite). In that case, any finite amount of consumption generally has no bearing on whether a project passes a benefit-cost test, because any amount of ongoing investment, no matter how small at the start, has a higher opportunity cost. With a low-enough social discount rate, the SCC actually drops out of the analysis because, according to the integrated assessment models, $CO_2$'s impact can be expressed purely in consumption form. Thus, it would be inefficient to displace even a dollar of investment to obtain the benefits of reducing $CO_2$ pollution.[15]

## CONCLUSION

There are many uncertainties associated with calculating the SCC, including forecasts about the extent of future emissions and the effects of those emissions as much as 200 years in the future. The aim of this policy brief is not to question those scientific inputs into analysis, but instead to bring attention to the assumptions that depend on value judgments. These are assumptions that lie outside the domain of objective facts that can be discovered through scientific exploration. As a result, they likely lie outside the competence and expertise of federal regulators.

The choice of the social welfare function, which aggregates benefits and costs across individuals, and the choice of the social discount rate, which ranks benefits and costs across time, are two examples of such value judgments. Although it is critical to assess the merits of the scientific assumptions and uncertainties inherent in the SCC calculations, the merits of the ethical and moral assumptions embedded in analysis may be even more important. When value judgments are confused with scientific claims, an illusion is created that policy is guided by objective scientific facts, when in fact it is expressing the preferences of analysts. Distinguishing positive and normative claims can help address this ever-looming challenge in modern climate policy.

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## NOTES

1. Interagency Working Group on Social Cost of Greenhouse Gases, *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990*, February 2021.

2. For a recent discussion critiquing the use of social welfare functions to guide policy, see Christopher J. Coyne, Thomas K. Duncan, and Abigail R. Hall, "The Political Economy of State Responses to Infectious Disease," *Southern Economic Journal* 87, no. 4 (2021): 1119–37.

3. John A. Weymark, "Social Welfare Functions," in *The Oxford Handbook of Well-Being and Public Policy*, ed. Matthew D. Adler and Marc Fleurbaey (New York: Oxford University Press, 2016), 126–59.

4. David Romer, "Infinite-Horizon and Overlapping-Generations Models," chap. 2 in *Advanced Macroeconomics*, 4th ed. (New York: McGraw-Hill, 2012), 49–100.

5. Peter Diamond, "National Debt in a Neoclassical Growth Model," *American Economic Review* 55, no. 5 (1965): 1126–50.

6. Graciela Chichilnisky, "An Axiomatic Approach to Sustainable Development," *Social Choice and Welfare* 13, no. 2 (1996): 231–57.

7. On this matter, see Kenneth J. Arrow, "Inter-Generational Equity and the Rate of Discount in Long-Term Social Investment," in *Contemporary Economic Issues*, vol. 4, *Economic Behaviour and Design*, ed. Murat R. Sertel (London: Palgrave Macmillan, 1999), 89–102.

8. Executive Office of the President, Modernizing Regulatory Review, 86 Fed. Reg. 7223 (January 20, 2021).

9. James Broughel, "Cost-Benefit Analysis as a Failure to Learn from the Past," *Journal of Private Enterprise* 35, no. 1 (2020): 105–13.

10. James Broughel, "The Social Discount Rate: A Primer for Policymakers" (Mercatus Policy Brief, Mercatus Center at George Mason University, Arlington, VA, June 2020).

11. Interagency Working Group on Social Cost of Greenhouse Gases, *Technical Support Document*; Michael Greenstone and James H. Stock, "The Right Discount Rate for Regulatory Costs and Benefits," *Wall Street Journal*, March 4, 2021.

12. James Broughel, "The Unlikely Story of American Regulatory Socialism," *Quarterly Journal of Austrian Economics* 24, no. 1 (forthcoming).

13. Thomas Piketty, *Capital in the Twenty-First Century* (Cambridge, MA: Harvard University Press, 2014).

14. In economic growth theory, this is known as the transversality condition.

15. It should be stressed here that this result—the SCC dropping out of the analysis—is an implication of the integrated assessment models, not a result of any claims being made by this author about the effects of $CO_2$ pollution. The integrated assessment models assume carbon dioxide pollution does not have growth rate effects, but this assumption could easily turn out not to be true. See Robert S. Pindyck, "Climate Change Policy: What Do the Models Tell Us?," *Journal of Economic Literature* 51, no. 3 (2013): 860–72; Richard G. Newell, Brian C. Prest, and Steven E. Sexton, "The GDP-Temperature Relationship: Implications for Climate Change Damages," *Journal of Environmental Economics and Management* (preprint, available online March 20, 2021).