CHAPTER 16. MONETIZATION OF EMISSION REDUCTIONS BENEFITS

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 16. MONETIZATION OF EMISSION REDUCTIONS BENEFITS

16.1 INTRODUCTION

As part of its assessment of energy conservation standards, DOE considers the estimated monetary benefits likely to result from the reduced emissions of carbon dioxide (CO_2) and nitrogen oxides (NO_X) that are expected to result from the standard levels considered for furnace fans. This chapter summarizes the basis for the estimated monetary values used for each of these emissions.

16.2 MONETIZING CARBON DIOXIDE EMISSIONS

16.2.1 Social Cost of Carbon

Under Executive Order 12866, agencies must, to the extent permitted by law, "assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs."

The social cost of carbon (SCC) is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services. Estimates of the SCC are provided in dollars per metric ton of carbon dioxide.

The purpose of the SCC estimates presented here is to allow agencies to incorporate the monetized social benefits of reducing CO_2 emissions into cost-benefit analyses of regulatory actions that have small, or "marginal," impacts on cumulative global emissions. The estimates are presented with an acknowledgement of the many uncertainties involved and with a clear understanding that they should be updated over time to reflect increasing knowledge of the science and economics of climate impacts.

As part of the interagency process that developed these SCC estimates, technical experts from numerous agencies met on a regular basis to consider public comments, explore the technical literature in relevant fields, and discuss key model inputs and assumptions. The main objective of this process was to develop a range of SCC values using a defensible set of input assumptions grounded in the existing scientific and economic literatures. In this way, key uncertainties and model differences transparently and consistently inform the range of SCC estimates used in the rulemaking process.

The interagency group selected four SCC values for use in regulatory analyses. Three values are based on the average SCC from three integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth value, which represents the 95th percentile SCC estimate across all three models at a 3 percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. For emissions (or emission reductions) that occur in later years, these values grow in real terms over time, as depicted in Table 16.2.1.

Table 16.2.1 Social Cost of CO_2, 2010 – 2050 (in 2007 dollars per metric ton)

	Discount Rate			
	5% Avg	3% Avg	2.5% Avg	3% 95th
2010	4.7	21.4	35.1	64.9
2015	5.7	23.8	38.4	72.8
2020	6.8	26.3	41.7	80.7
2025	8.2	29.6	45.9	90.4
2030	9.7	32.8	50.0	100.0
2035	11.2	36.0	54.2	109.7
2040	12.7	39.2	58.4	119.3
2045	14.2	42.1	61.7	127.8
2050	15.7	44.9	65.0	136.2

When attempting to assess the incremental economic impacts of carbon dioxide emissions, the analyst faces a number of serious challenges. A recent report from the National Research Council[a] points out that any assessment will suffer from uncertainty, speculation, and lack of information about (1) future emissions of greenhouse gases, (2) the effects of past and future emissions on the climate system, (3) the impact of changes in climate on the physical and biological environment, and (4) the translation of these environmental impacts into economic damages. As a result, any effort to quantify and monetize the harms associated with climate change will raise serious questions of science, economics, and ethics and should be viewed as provisional.

Despite the serious limits of both quantification and monetization, SCC estimates can be useful in estimating the social benefits of reducing carbon dioxide emissions. Consistent with the directive quoted above, the purpose of the SCC estimates presented here is to make it possible for agencies to incorporate the social benefits from reducing carbon dioxide emissions into cost-benefit analyses of regulatory actions that have small, or "marginal," impacts on cumulative global emissions. Most Federal regulatory actions can be expected to have marginal impacts on global emissions.

For such policies, the agency can estimate the benefits from reduced (or costs from increased) emissions in any future year by multiplying the change in emissions in that year by the SCC value appropriate for that year. The net present value of the benefits can then be calculated by multiplying each of these future benefits by an appropriate discount factor and

[a] National Research Council. Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use. National Academies Press: Washington, DC. 2009.

summing across all affected years. This approach assumes that the marginal damages from increased emissions are constant for small departures from the baseline emissions path, an approximation that is reasonable for policies that have effects on emissions that are small relative to cumulative global carbon dioxide emissions. For policies that have a large (non-marginal) impact on global cumulative emissions, there is a separate question of whether the SCC is an appropriate tool for calculating the benefits of reduced emissions. DOE does not attempt to answer that question here.

It is important to emphasize that the interagency process is committed to updating these estimates as the science and economic understanding of climate change and its impacts on society improves over time. Specifically, the interagency group has set a preliminary goal of revisiting the SCC values within two years or at such time as substantially updated models become available, and to continue to support research in this area. In the meantime, the interagency group will continue to explore the issues raised by this analysis and consider public comments as part of the ongoing interagency process.

16.2.2 Social Cost of Carbon Values Used in Past Regulatory Analyses

To date, economic analyses for Federal regulations have used a wide range of values to estimate the benefits associated with reducing carbon dioxide emissions. In the final model year 2011 CAFE rule, the Department of Transportation (DOT) used both a "domestic" SCC value of \$2 per ton of CO_2 and a "global" SCC value of \$33 per ton of CO2 for 2007 emission reductions (in 2007 dollars), increasing both values at 2.4 percent per year. It also included a sensitivity analysis at \$80 per ton of CO_2. A domestic SCC value is meant to reflect the value of damages in the United States resulting from a unit change in carbon dioxide emissions, while a global SCC value is meant to reflect the value of damages worldwide.

A 2008 regulation proposed by DOT assumed a domestic SCC value of \$7 per ton of CO_2 (in 2006 dollars) for 2011 emission reductions (with a range of \$0-\$14 for sensitivity analysis), also increasing at 2.4 percent per year. A regulation finalized by DOE in October of 2008 used a domestic SCC range of \$0 to \$20 per ton CO_2 for 2007 emission reductions (in 2007 dollars). In addition, EPA's 2008 Advance Notice of Proposed Rulemaking for Greenhouse Gases identified what it described as "very preliminary" SCC estimates subject to revision. EPA's global mean values were \$68 and \$40 per ton CO_2 for discount rates of approximately 2 percent and 3 percent, respectively (in 2006 dollars for 2007 emissions).

In 2009, an interagency process was initiated to offer a preliminary assessment of how best to quantify the benefits from reducing carbon dioxide emissions. To ensure consistency in how benefits are evaluated across agencies, the Administration sought to develop a transparent and defensible method, specifically designed for the rulemaking process, to quantify avoided climate change damages from reduced CO_2 emissions. The interagency group did not undertake any original analysis. Instead, it combined SCC estimates from the existing literature to use as interim values until a more comprehensive analysis could be conducted.

The outcome of the preliminary assessment by the interagency group was a set of five interim values: global SCC estimates for 2007 (in 2006 dollars) of \$55, \$33, \$19, \$10, and \$5 per ton of CO_2. The \$33 and \$5 values represented model-weighted means of the published estimates produced from the most recently available versions of three integrated assessment models—DICE (Dynamic Integrated Climate Economy), PAGE (Policy Analysis of the Greenhouse Effect), and FUND (Climate Framework for Uncertainty, Negotiation and Distribution)—at approximately 3 and 5 percent discount rates. The $55 and $10 values were derived by adjusting the published estimates for uncertainty in the discount rate (using factors developed by Richard Newell and William Pizer)[b] at 3 and 5 percent discount rates, respectively. The $19 value was chosen as a central value between the $5 and $33 per ton estimates. All of these values were assumed to increase at 3 percent annually to represent growth in incremental damages over time as the magnitude of climate change increases.

These interim values represent the first sustained interagency effort within the U.S. government to develop an SCC for use in regulatory analysis. The results of this preliminary effort were presented in several proposed and final rules and were offered for public comment in connection with proposed rules, including the joint EPA-DOT fuel economy and CO_2 tailpipe emission proposed rules.

16.2.3 Current Approach and Key Assumptions

Since the release of the interim values, the interagency group reconvened on a regular basis to generate improved SCC estimates, which were considered for this proposed rule. Specifically, the group considered public comments and further explored the technical literature in relevant fields.

It is important to recognize that a number of key uncertainties remain, and that current SCC estimates should be treated as provisional and revisable since they will evolve with improved scientific and economic understanding. The interagency group also recognizes that the existing models are imperfect and incomplete. The National Research Council report mentioned above points out that there is tension between the goal of producing quantified estimates of the economic damages from an incremental ton of carbon and the limits of existing efforts to model these effects. There are a number of concerns and problems that should be addressed by the research community, including research programs housed in many of the agencies participating in the interagency process to estimate the SCC.

The U.S. Government intends to periodically review and reconsider estimates of the SCC used for cost-benefit analyses to reflect increasing knowledge of the science and economics of climate impacts, as well as improvements in modeling. In this context, statements recognizing the limitations of the analysis and calling for further research take on exceptional significance. The interagency group offers the new SCC values with all due humility about the uncertainties embedded in them and with a sincere promise to continue work to improve them.

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE intends to use the most recent interagency estimates of the potential global benefits resulting from reduced CO_2 emissions in 2010, expressed in 2010$, were $4.9, $22.3, $36.5, and $67.6 per metric ton avoided. For emission reductions that occur in later years, these

[b] R. Newell and W. Pizer. "Discounting the Distant Future: How Much Do Uncertain Rates Increase Valuations?" J. Environ. Econ. Manage. 46 (2003) 52-71)

values grow in real terms over time. Additionally, the interagency group determined that a range of values from 7 percent to 23 percent should be used to adjust the global SCC to calculate domestic effects, although DOE will give preference to consideration of the global benefits of reducing CO_2 emissions. To calculate a present value of the stream of monetary values, DOE will discount the values in each of the four cases using the discount rates that had been used to obtain the SCC values in each case.

DOE recognizes that scientific and economic knowledge continues to evolve rapidly as to the contribution of CO_2 and other GHG to changes in the future global climate and the potential resulting damages to the world economy. Thus, these values are subject to change.

16.3 VALUATION OF OTHER EMISSIONS REDUCTIONS

DOE considers the potential monetary benefit of reduced NOX emissions from new or amended energy conservation standards. As noted in chapter 15, new or amended energy conservation standards would reduce NO_X emissions in those 22 States that are not affected by the CAIR, in addition to the reduction in site NO_X emissions nationwide.

DOE will estimate the monetized value of NO_X emissions reductions resulting from each of the standard levels considered based on environmental damage estimates from the literature. Available estimates suggest a very wide range of monetary values for NO_X emissions, ranging from $370 per ton to $3,800 per ton of NO_X from stationary sources, measured in 2001$ (equivalent to a range of $450 to $4,623 per ton in 2010$).[c] In accordance with U.S. Office of Management and Budget (OMB) guidance, DOE will conduct two calculations of the monetary benefits derived using each of the economic values used for NO_x, one using a real discount rate of 3 percent and another using a real discount rate of 7 percent.[d]

DOE does not plan to monetize estimates of Hg reduction in this rulemaking. DOE is aware of multiple agency efforts to determine the appropriate range of values used in evaluating the potential economic benefits of reduced Hg emissions. DOE has decided to await further guidance regarding consistent valuation and reporting of Hg emissions before it once again monetizes Hg in its rulemakings.

[c] For additional information, refer to U.S. Office of Management and Budget, Office of Information and Regulatory Affairs, *2006 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities* (Available at: http://www.whitehouse.gov/sites/default/files/omb/assets/omb/inforeg/2006_cb/2006_cb_final_report.pdf).
[d] OMB, Circular A-4: Regulatory Analysis (Sept. 17, 2003).