EPA United States Environmental Protection Agency

The Social Cost of Carbon

Estimating the Benefits of Reducing Greenhouse Gas Emissions

EPA and other federal agencies use estimates of the social cost of carbon (SC-CO_2) to value the climate impacts of rulemakings. The SC-CO_2 is a measure, in dollars, of the long-term damage done by a ton of carbon dioxide (CO_2) emissions in a given year. This dollar figure also represents the value of damages avoided for a small emission reduction (i.e., the benefit of a CO_2 reduction).

The SC-CO_2 is meant to be a comprehensive estimate of climate change damages and includes changes in net agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning. However, given current modeling and data limitations, it does not include all important damages. The IPCC Fifth Assessment report observed that SC-CO_2 estimates omit various impacts that would likely increase damages. The models used to develop SC-CO_2 estimates, known as integrated assessment models, do not currently include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature because of a lack of precise information on the nature of damages and because the science incorporated into these models naturally lags behind the most recent research. Nonetheless, the current estimates of the SC-CO_2 are a useful measure to assess the climate impacts of CO_2 emission changes.

EPA and other federal agencies also use estimates of the social cost of methane (SC-CH_4) and the social cost of nitrous oxide (SC-N_2O) in analyses of regulatory actions that are projected to influence CH_4 or N_2O emissions in a manner consistent with how CO_2 emission changes are valued. The SC-CH_4 and SC-N_2O estimates are taken from a paper by Marten et al. (2015a and 2015b), which provided the first set of published SC-CH_4 and SC-N_2O estimates that are consistent with the modeling assumptions underlying the SC-CO_2 estimates. Both the methodology for valuing the damages from CH_4 and N_2O emissions and the application of the SC-CH_4 and SC-N_2O estimates to regulatory cost-benefit analysis have been subject to rigorous independent peer review and public comment. See the Addendum to the SC-CO_2 Technical Support Document (TSD) for further details.

As discussed in the 2010 SC-CO_2 TSD, estimates of the social cost of these greenhouse gases increase over time because future emissions are expected to produce larger incremental damages as physical and economic systems become more stressed in response to greater climatic change, and because GDP is growing over time and many damage categories are modeled as proportional to gross GDP.

The tables below present the current set of SC-CO_2, SC-CH_4 and SC-N_2O estimates used in Federal regulatory analyses to value emissions changes occurring in certain years. The full set of annual SC-CO_2 estimates between 2010 and 2050 is reported in the Appendix to the 2016 TSD. The Addendum to the TSD presents the full set of annual SC-CH_4 and SC-N_2O estimates between 2010 and 2050. The full set of model results for the SC-CO_2, SC-CH_4 and SC-N_2O are available on the

Office of Management and Budget's (OMB) website.

Social Cost of CO_2, 2015-2050 [a] (in 2007 dollars per metric ton CO_2)
Source: Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (May 2013, Revised August 2016)

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

[a]The SC-CO_2 values are dollar-year and emissions-year specific.

Social Cost of CH_4, 2015-2050[a] (in 2007 dollars per metric ton CH_4)
Source: Addendum to the Technical Support Document for the Social Cost of Carbon: Application of the Methodology to Estimate the Social Cost of Methane and the Social Cost of Nitrous Oxide (August 2016)

	Discount Rate and Statistic			
Year	**5% Average**	**3% Average**	**2.5% Average**	**High Impact (95th pct at 3%)**
2015	$450	**$1,000**	$1,400	$2,800

	Discount Rate and Statistic			
Year	**5% Average**	**3% Average**	**2.5% Average**	**High Impact (95th pct at 3%)**
2020	$540	**$1,200**	$1,600	$3,200
2025	$650	**$1,400**	$1,800	$3,700
2030	$760	**$1,600**	$2,000	$4,200
2035	$900	**$1,800**	$2,300	$4,900
2040	$1,000	**$2,000**	$2,600	$5,500
2045	$1,200	**$2,300**	$2,800	$6,100
2050	$1,300	**$2,500**	$3,100	$6,700

[a]The SC-CH_4 values are dollar-year and emissions-year specific.

Social Cost of N_2O, 2015-2050[a] (in 2007 dollars per metric ton N_2O)
Source: Addendum to the Technical Support Document for the Social Cost of Carbon: Application of the Methodology to Estimate the Social Cost of Methane and the Social Cost of Nitrous Oxide (August 2016)

	Discount Rate and Statistic			
Year	**5% Average**	**3% Average**	**2.5% Average**	**High Impact (95th pct at 3%)**
2015	$4,000	**$13,000**	$20,000	$35,000
2020	$4,700	**$15,000**	$22,000	$39,000
2025	$5,500	**$17,000**	$24,000	$44,000
2030	$6,300	**$19,000**	$27,000	$49,000

	Discount Rate and Statistic			
Year	**5% Average**	**3% Average**	**2.5% Average**	**High Impact (95th pct at 3%)**
2035	$7,400	**$21,000**	$29,000	$55,000
2040	$8,400	**$23,000**	$32,000	$60,000
2045	$9,500	**$25,000**	$34,000	$66,000
2050	$11,000	**$27,000**	$37,000	$72,000

[a]The SC-N_2O values are dollar-year and emissions-year specific.

EPA has used estimates of SC-CO_2 to analyze the carbon dioxide impacts of various rulemakings since 2008. The interagency group's recommended estimates, which were first issued in 2010, have been used to analyze both rulemakings directly targeting carbon dioxide emissions, such as the car and truck standards, as well as others that set standards for conventional or toxic pollutants that indirectly affect carbon dioxide emissions, such as the final rulemaking to control mercury and other air toxic pollutants (PDF, 510 pp, 8.3 MB) from power plants. The rulemakings directly targeting carbon dioxide emissions have projected notable climate-related benefits for society. For example, the projected net present value of carbon dioxide mitigation benefits over the next forty years from three vehicle rulemakings was estimated to range from $78 billion to $1.2 trillion ($2010), depending on which of the four SC-CO_2 estimates were used (i.e., the average SC-CO_2 at 5, 3, and 2.5 percent and the 95th percentile SC-CO_2 at 3 percent). These three rulemakings are:

- The Joint EPA/Department of Transportation Rulemaking to establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards (2012-2016)
- Joint EPA/Department of Transportation Rulemaking to establish Medium- and Heavy-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards
- Joint EPA/Department of Transportation Rulemaking to establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards (2017-2025)

EPA has also used the SC-CH_4 and SC-N_2O estimates to estimate the benefits of reductions in non-CO_2 greenhouse gas emissions in recent rulemakings, such as the final emission standards for New and Modified Sources in the Oil and Natural Gas Sector (see RIA Chapter 4).

For more information about the SC-CO_2, see the SC-CO_2 Fact Sheet, as well as the OMB Social Cost of Greenhouse Gases site, which presents the SC-CO_2 TSD, Addendum on non-CO_2 greenhouse gases, and the OMB response to the public comments received through its solicitation for comments

on the SC-CO_2 site estimates used in Federal regulatory analyses. In this response, OMB announced plans to obtain expert, independent advice from the National Academies of Sciences, Engineering, and Medicine EXIT on how to approach future updates to the estimates. In January 2016, the Academies issued an interim (Phase 1) report which recommended against a near-term update of the SC-CO_2 estimates within the existing modeling framework. Longer-term recommendations about how to approach a comprehensive update to the estimates, including research priorities, are expected in the Academies' final report in January 2017.

See also the following documents for information about ongoing research to improve the SC-CO_2.

- EPA and Department of Energy hosted a series of workshops to inform SC-CO_2: workshop one, workshop two.
- EPA funded a workshop EXIT on discounting, a critical SC-CO_2 modeling input. World-recognized experts discussed how the benefits and costs of regulations should be discounted for projects with long time horizons.

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