SC-GHG Data Files Description for February 2021 TSD

The file entitled "**tsd_2021_all_mc_runs.csv**" contains the simulated frequency distributions of the Social Cost of Carbon, Methane, and Nitrous Oxide (SC-CO_2, SC-CH_4, and SC-N_2O, respectively; collectively referred to as the "social cost of greenhouse gases" (SC-GHG)) developed by the United States Government's Interagency Working Group on Social Cost of Greenhouse Gases. These estimates were used for the February 2021 *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990* (2021 TSD). The SC-GHG is the monetary value of the net harm to society associated with adding a small amount of that GHG to the atmosphere in a given year. In principle, it includes the value of all climate change impacts, including (but not limited to) changes in net agricultural productivity, human health effects, property damage from increased flood risk natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services. The SC-GHG, therefore, reflects the societal value of reducing emissions of the gas in question by one metric ton. The marginal estimate of social costs differs by the type of greenhouse gas (such as carbon dioxide, methane, and nitrous oxide) and by the year in which the emissions change occurs. The SC-GHGs are the theoretically appropriate values to use in conducting benefit-cost analyses of policies that affect GHG emissions. More detail about the SC-GHG and the interagency process that developed these estimates can be found in the 2021 TSD, and earlier versions of the TSD (e.g., the 2016 TSD and Addendum), available on OMB's SC-GHG website.

The file "**tsd_2021_annual_unrounded.csv**" presents the annual unrounded set of four values for each gas over 2020-2050 that are to be used in calculations in regulatory and other analyses as described in the 2021 TSD.

The SC-GHG estimates presented in the 2021 TSD and accompanying data files described here are reported in 2020 dollars but are otherwise identical to those presented in the previous version of the TSD and its Addendum, released in August 2016. The values were converted from 2007 to 2020 dollars using the annual implicit GDP price deflator as reported by the U.S. Bureau of Economic Analysis, table 1.1.9.

There are 540 frequency distributions

In developing the SC-GHG estimates, three integrated assessment models (IAMs) were used:

- The Dynamic Integrated Climate and Economy (DICE) 2010 model, developed by William Nordhaus.
- The Climate Framework for Uncertainty, Negotiation, and Distribution (FUND) 3.8 model, developed by Richard Tol and David Anthoff.
- The Policy Analysis of the Greenhouse Gas Effect (PAGE) 2009 model, developed by Chris Hope.

Each of these models was run using:

- Three constant discount rates: 2.5, 3, and 5 percent.
- Five socioeconomic and emission scenarios from the Stanford Energy Modeling Forum exercise, EMF-22. There are four business-as-usual trajectories used by IMAGE, MESSAGE, the base scenario from MiniCAM, and the optimistic scenario from MERGE. There is also a 5th scenario representing the emissions pathway that achieves stabilization at 550 ppm CO2e.
- Four representative years for an incremental increase in carbon emissions: 2020, 2030, 2040, and 2050.

The models were run using a Monte Carlo approach, in which uncertain parameters are represented by random draws from defined probability distributions. Each modeling combination -- representing one IAM, one discount rate, one emission scenario, and one emission year -- was run 10,000 times with different random draws from the probability distributions specified for uncertain parameters. The random draws for each modeling combination are independent of each other, so the results across models are not related to each other.

This exercise produced 540 separate frequency distributions (180 distributions for each of the 3 greenhouse gases): the product of 3 gases (CO_2, CH_4, N_2O), 3 models, 3 discount rates, 5 emission scenarios, and 4 emission years. Each distribution contains 10,000 estimates of the SC-GHG per modeling combination.

The "tsd_2021_all_mc_runs.csv" file description

The "tsd_2021_all_mc_runs.csv" file is a comma-separated file, which means that the numbers and text are stored in plain ASCII text and separated by commas. This type of file can be read by most spreadsheet programs (for example, Microsoft Excel) and statistical software. The file layout is as follows:

- There are 10,005 lines. Each line has 541 data fields containing number or text separated by commas.
- If this file is imported by a spreadsheet (e.g. Microsoft Excel), the lines represent rows in the spreadsheet and the data fields represent columns. So there would be 10,005 rows and 541 columns.

- The first row contains the model name: DICE, FUND, or PAGE.
- The second row contains the emission year: 2020, 2030, 2040, or 2050.
- The third row contains the socioeconomic and emissions scenario: IMAGE, MERGE Optimistic, MESSAGE, MiniCAM Base, or 5th Scenario.
- The fourth row contains the greenhouse gas: CO_2, CH_4, and N_2O.
- The fifth row contains the discount rate: 2.5%, 3.0%, or 5.0%.
- The next 10,000 rows present the estimates of the SC-GHG for a given model, emission year, emission scenario, gas, and discount rate combination.

- The first column is a label or index number.
- Each of next 540 columns contain the frequency distributions for one model run.
- For CH_4 and N_2O model runs where there was a discontinuity identified, the cells where the corresponding SC-CH_4 and SC-N_2O values would be is left empty (missing). This is the case for 69 total cells within the spreadsheet; 23 monte-carlo runs with a discontinuity.

The "tsd_2021_annual_unrounded.csv" file description

The "tsd_2021_annual_unrounded.csv" file is a comma-separated file, which means that the numbers and text are stored in plain ASCII text and separated by commas. This type of file can be read by most spreadsheet programs (for example, Microsoft Excel) and statistical software. The file layout is as follows:

- There are 32 lines. Each line has 13 data fields containing number or text separated by commas.
- If this file is imported by a spreadsheet (e.g. Microsoft Excel), the lines represent rows in the spreadsheet and the data fields represent columns. So there would be 32 rows and 13 columns.

- The first row denotes the 4 final values selected by the Interagency Working Group for each gas (CO_2, CH_4, and N_2O): the average of the 5% discount rate based model runs, the average of the 3% discount rate based model runs, the average of the 2.5% discount rate based model runs, and the 95^{th} percentile of the 3% discount rate based runs.
- The next 31 rows present the annual unrounded 4 values for each gas over 2020 through 2050.

- The first column specifies the emissions year.
- Each of next 12 columns contain the SC-GHG values for emissions occurring in that year.