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To be presented to: Select Committee on the Climate Crisis, hearing on "Making the Case for Climate Action: The Growing Risks and Costs of Inaction"

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Thank you Chair Castor, Ranking Member Graves, and members of the Committee for inviting me to speak today.

My name is Michael Greenstone, and I am the Milton Friedman Distinguished Service Professor in Economics and Director of the Becker Friedman Institute and Energy Policy Institute at the University of Chicago. I also serve as co-director of the Climate Impact Lab, a multi-disciplinary collaboration of researchers working to quantify the long-term impacts of climate change. My own research focuses on estimating the costs and benefits of environmental quality, with a particular emphasis on the impacts of government regulations.

I appreciate the opportunity to speak with you today about the growing risk of climate change and the costs of inaction.

The best way to summarize the economic impacts of climate change and the benefits of regulations to slow it is with a number known as the social cost of carbon (SCC). The SCC is the monetary cost of the damages caused by the release of an additional ton of carbon dioxide into the atmosphere. Simply put, it reflects the monetary cost of inaction—measured in the destruction of property from storms and floods, declining agricultural and labor productivity, elevated mortality rates, and so forth.

The SCC is arguably the most important component of regulatory policy in this area because, by calculating the costs of climate change, the social cost of carbon allows for the calculation of the monetary benefits of regulations that reduce greenhouse gases. So, for example, a regulation that reduces carbon dioxide emissions by 10 tons would have societal benefits of $510 if the value of the social cost of carbon was $51, which is the value currently being used by the Biden administration. These benefits can then be compared to the costs that the regulation imposes to determine whether the regulation is beneficial on net. Since the establishment of the United States Government's SCC in 2010, it had been used to guide the design of more than 80 regulations as of 2017. These regulations have resulted in more than $1 trillion of gross benefits.[1]

[1] Nordhaus, William D. "Revisiting the social cost of carbon." *Proceedings of the National Academy of Sciences* 114, no. 7 (2017): 1518-1523.

Critically, the SCC can also be used to determine an efficient price for market-based policies for combatting climate change, such as a carbon tax or cap-and-trade system. If set at the value of the SCC, these pricing approaches will ensure that we are pursuing policies where the benefits exceed their costs. A great appeal of these approaches is that they unleash market forces to uncover the least expensive ways to reduce emissions, thereby minimizing the costs to the economy, and do not require the ex-ante knowledge of which sector they will emerge from.

Regardless of the policy approach used, a social cost of carbon based on the best available peer reviewed research is a key ingredient in beneficial policy to confront climate change. To detail how we get there, it's important to first understand where the SCC came from, what it tells us about the costs of inaction, and how it can be improved to better guide policy action. In the remainder of my statement, I will make the following points:

1. The original SCC was created in 2010 after a year-long process that included intense assessment of the best available peer-reviewed research and careful consideration of public comments. Updated to reflect scientific advances, it was set at $51 per ton in 2016. The Trump administration then lowered the SCC to roughly $4 based on decisions that were not scientifically justified and ran counter to recommendations from the National Academy of Sciences issued in 2017. Following an executive order on the first day of the Biden administration, the SCC was returned to $51 in February on an interim basis while they evaluate the advances in economics and science.

2. An interdisciplinary team I co-direct, the Climate Impact Lab (CIL), is calculating an updated, data-driven social cost of carbon. Its broad aim is to capture the rapid advances in the economics and science of climate change that have taken place over the last decade and use them to update the SCC.

3. Our approach seeks to project changes in mortality, energy use, agricultural yields, labor productivity, and coastal vulnerability due to an additional ton of CO2; and then monetize those costs to society. The first sector-specific projections relate to climate change's impact on mortality, finding that continuing a high emissions trajectory raises global mortality risk by 85 deaths per 100,000 people by 2100.[2] To put this in context, it is roughly between the annual mortality risk of cancer and infectious diseases.

4. The mortality consequences will be largest in places that today are hot and/or poor. In the United States, the mortality risk will be 10 deaths per 100,000, about on par with the current fatality rate from auto accidents in the United States. Many areas will experience mortality risks that are significantly higher. That includes areas represented by members of this committee, which I will detail.

5. Policy has the potential to deliver some of the most significant public health gains in human history. Bringing global emissions down to moderate levels—not even as low as

[2] Mortality risk is a measure that accounts for the increase in death rates and the costs of adaptation. Our research finds that climate-induced temperature changes raise global death rates by 73 deaths per 100,000 and will cost society 12 death-equivalents per 100,000 in adaptation expenditures, for an overall total of 85 deaths per 100,000.

the Paris Agreement's long-term targets—would reduce the mortality risk by 84% compared to the high emissions pathway. Under this moderate emissions scenario, climate-induced temperature changes are projected to be responsible for 14 additional deaths per 100,000 globally at the end of the century. In the United States, that risk would be 1.3 deaths per 100,000, eliminating almost all of the mortality risk.[3]

6. We estimate that the release of an additional metric ton of CO2 will cause about $37 worth of mortality damages—about three-quarters of the overall or total SCC used by the Obama administration and by the Biden administration on an interim basis. The fact that this is almost twenty times larger than the mortality costs underlying the current SCC underscores the need to update the SCC.

7. As the Biden administration comprehensively updates the SCC, I recommend several changes to the way the SCC is calculated. These include using the latest climate modeling, applying a new valuation of climate damages, employing lower discount rates, accounting for uncertainty and equity, and better incorporating socioeconomic projections.

8. While my work suggests that the social costs from climate change are projected to be large—both in dollars and in terms of human lives— robust climate policies guided by an updated SCC based on the latest knowledge would lay the foundation for some of the greatest public policy benefits in history.

The Social Cost of Carbon as a Guidepost

The development of the social cost of carbon has a history that goes back to my time as the Chief Economist for President Obama's Council of Economic Advisors. In 2008, the 9th Circuit Court of Appeals ruled[4] that the Department of Transportation needed to update its regulatory impact analysis for fuel economy rules with an estimate of the SCC. The court directed that, "while the record shows that there is a range of values, the value of carbon emissions reduction is certainly not zero." So, the Department of Energy, the Department of Transportation and EPA began to incorporate a variety of individually developed estimates of the SCC into their regulatory analyses. These estimates were derived from academic literature and ranged from zero—which they were instructed by the court to no longer use—to $159 per metric ton of carbon dioxide emitted.[5]

To improve consistency in the government's use of the SCC, I, along with Cass Sunstein, then the Administrator of the White House Office of Information and Regulatory Affairs, assembled and co-led an interagency working group to determine a consistent government-wide SCC. The team consisted of the top economists, scientists and lawyers from four other offices in the Executive Office of the President and six federal agencies, including the EPA and the Departments of Agriculture, Commerce, Energy, Transportation and Treasury.

[3] This value is an average of the impacts from 2095 to 2099.
[4] *Center for Biological Diversity v. National Highway Traffic Safety Administration*, 538 F. 3d 1172 (9th Cir. 2008).
[5] United States Government Accountability Office, "Social Cost of Carbon: Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis," 2020.

The process for developing the SCC took approximately a year and included an intense assessment of the best available peer-reviewed research, and significant debate and discussion amongst the team of climate scientists, economists, lawyers and other experts across the federal government. It also included a careful consideration of public comments on the interim values that agencies had been using and an interim value determined by the interagency group. Ultimately, the interagency working group determined[6] a central estimate of $21 per metric ton. That estimate was later revised to reflect scientific advances and as of 2016 was about $51.

To ensure that the next SCC update kept up with the latest available science and economics, in 2015 the Office of Management and Budget directed the National Academies of Sciences (NAS) to help in providing advice on the pros and cons of potential approaches to future updates, informed by ongoing public comments and the peer-reviewed literature. In 2017, the NAS released its recommendations[7] after a comprehensive assessment, for which I testified and served as a reviewer. The NAS report identified important ways to take advantage of improved understanding of the social and economic impacts of climate change. It proposed a new framework that strengthened the scientific basis of the calculation, provided greater transparency in the process, and improved characterization of the uncertainties of the estimates.

In March of 2017, President Trump's Executive Order 13783 disbanded the Interagency Working Group on Social Cost of Greenhouse Gases, withdrawing its official estimates of the SCC. In 2018, the EPA released a regulatory impact analysis for greenhouse gas emission guidelines that established a new SCC between $1 and $7.[8] To arrive at this number, the Trump administration made methodological changes that in my judgment cannot be justified by science or economics and in this respect moved the SCC away from the frontier of understanding. During the Trump administration, the controversial and substantially lower SCC estimates paved the way for the rollback of key environmental regulations, such as fuel economy standards.

The Biden administration has since made important steps to bring the SCC back to the frontier of understanding. On his first day in office, President Biden released an "Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis." Among the actions included, President Biden restored the Interagency Working Group and set a deadline for an interim SCC within 30 days, as well as a new, robust SCC based on the latest climate science and economics no later than January 2022. On February 26, President Biden returned the SCC—on an interim basis—to the Obama estimate of $51.

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[6] Interagency Working Group on Social Cost of Carbon, United States Government, Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. (February 2010).

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

[8] U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Health and Environmental Impact Division, Regulatory Impact Analysis for the Proposed Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program (August 2018).

Measuring the Costs of Inaction

a. Climate Impact Lab Overview

While the SCC is a valuation of what inaction could look like in the form of dollars and cents, unfolding the layers of that number illustrates how climate change will impact real people and communities. To both quantify those impacts and use that rigorous data to produce the world's first empirically derived estimate of the social cost of carbon, I joined with Trevor Houser from the Rhodium Group, Solomon Hsiang from the University of California, Berkeley, and Robert Kopp from Rutgers University to establish a multi-disciplinary research institute, the Climate Impact Lab (CIL).

The Climate Impact Lab includes more than 20 climate scientists, economists, data engineers, and other experts who are combining an immense body of historical data on social, economic and climate indicators with climate models to develop projections of the long-term effect of a "high emissions" climate change scenario.[9] We are examining five core sectors—labor productivity, coastal vulnerability, energy, agriculture, and mortality—in each of about 25,000 local regions spanning the globe, which are each about the size of a U.S. county. These sector-specific projections are then monetized and aggregated across all regions to determine the cost that emitting an additional ton of carbon imposes on a future society and economy.

b. Key Climate Impact Lab Findings

The first sector-specific projections we have thus far relate to climate change's impact on mortality. Climate change has a demonstrable impact on mortality rates, as extreme temperatures, both hot and cold, affect health outcomes such as heat stroke and cardiovascular disease. To measure the impact of climate-driven temperature changes on mortality risk, my colleagues and I compiled the largest sub-national vital statistics database in the world, detailing 399 million deaths across 41 countries accounting for 55% of the global population.

If we continue on a trajectory of high emissions, increasing average global temperatures by around 4.8°C (8.6°F) at the end of the century, relative to pre-industrial temperatures, our research finds that temperature-related global mortality risk is projected to rise by the equivalent of 85 deaths per 100,000 people in 2100, compared to a world with no warming.[10] I say full mortality risk, because our projections reflect changes in both the number of deaths and the resources people devote to protect themselves against high and low temperatures through adaptation. When this increase in mortality risk is monetized using standard techniques, the costs are equal to roughly 3.2% of global economic output in 2100.

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[9] All discussed CIL projections follow the RCP8.5, or "high emissions", scenario from the IPCC's 2014 "Mitigation of Climate Change: Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change". Cambridge, United Kingdom: Cambridge University Press.

[10] Carleton, et al. "Valuing the global mortality consequences of climate change accounting for adaptation costs and benefits." (2018).

The projected impact of temperature on mortality at the end of the century is on par with the current death rate for all infectious diseases (except the novel coronavirus)—including tuberculosis, HIV, malaria, dengue, yellow fever, and diseases transmitted by ticks, mosquitos, and parasites—combined: approximately 74 deaths per 100,000 globally (See Figure 1). It is smaller, but comparable to, the overall cancer mortality rate, which is 126 deaths per 100,000 globally.[11] The damages from climate-induced temperature changes discussed above will be unevenly distributed among populations on both a global and national scale, as illustrated in Figure 2.

Globally, we find that the mortality risk of climate-induced temperature changes disproportionately falls on regions that are poorest and hottest today, exacerbating existing inequality. For example, Accra, Ghana, is projected to see an increase in days above 32°C (90°F) from one to 102 days per year by the end of the century under a continued high emissions scenario. This increase raises the city's mortality rate by about 19%. The climate-induced temperature-related mortality risk at the end of the century is projected at roughly 160 deaths per 100,000 people.

In contrast, colder and relatively wealthier Oslo, Norway, is projected to see benefits equivalent to saving approximately 230 lives per 100,000 people. These differences reflect Oslo's means to adapt to additional warm days, as a wealthy nation, and the benefit that the population experiences as climate change reduces the number of deadly cold days. In fact, in high-income places such as Oslo, the mortality-related risks of climate-induced temperature changes are mainly damages to the economy because of increased adaptation costs. In contrast, in low-income places like Accra, the damages of climate-induced temperature changes are projected to be felt as significant increases in death rates on hot days.

The United States is projected to see its mortality risk rise to 10 deaths per 100,000 by the end of the century under a high-emissions scenario. That's about on par with the current fatality rate from auto accidents in the U.S.—roughly 12 deaths per 100,000.[12]

Again, risk differs depending on where you live. I have included a table **(**See Table 1) with the data for each of the Members of this committee's district to give you a sense of the risks your constituents are projected to face. I will list some examples here.

In my hometown of Chicago (which includes the district of Representative Casten), the mortality risk decreases by about 34 lives per 100,000 by 2100. My city will see more hot days, and it will pay to adapt to them. But, it also typically sees a lot of extremely cold days. Over time, we'll see fewer of those cold days, decreasing mortality risk during the winter and—combined with the additional adaptation measures—giving Chicago a net benefit.

Richmond, Virginia (which includes the district of Representative McEachin), on the other hand, doesn't have the chance to benefit from a reduction in cold days—there are few already. People there can pay to adapt to additional hot days, but it won't be enough to offset the loss of life.

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[11] World Health Organization. "Global Health Estimates 2016: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2016". Geneva, 2018.

[12] World Health Organization. "Global Status Report on Road Safety 2018." Geneva, 2018.

There, temperature-related mortality risk is projected to increase by 36 deaths for every 100,000 people. That is on par with the current U.S. death rate for Alzheimer's disease (37 deaths per 100,000).

Raleigh, West Virginia (which includes the district of Representative Miller) is also projected to experience a higher mortality risk under this scenario—around 27 deaths per 100,000 by 2100. In El Paso (which includes the district of Representative Escobar), it's 42 deaths per 100,000. Jefferson, Alabama (which includes the district of Representative Palmer) is projected to increase by about 29 deaths per 100,000. In all of these cases, the mortality risk is higher than the current U.S. mortality rate for diabetes (26 deaths per 100,000) and for the flu and pneumonia (17 deaths per 100,000).[13]

Here in the United States and around the world, climate-induced temperature changes will leave some regions as winners and others as losers—with more losers than winners. But the clear message from the data is that on net the world and the United States will lose.

Policy Projected to Deliver High Returns

The level of greenhouse gas emissions is not a law of physics, but rather reflects policy choices. It is therefore instructive to consider the benefits of policy that would lead to a moderate emissions path—reducing warming at the end of the century from 4.8°C to 2.6°C (or 8.6°F to 4.7°F).

This reduction in warming, which falls short of the Paris Agreement's long-term targets, would still lead to dramatically lower mortality risks compared to the high-emissions scenario. For example, the projected total global mortality impact of climate-induced temperature changes falls by 84% by the end of the century, relative to a scenario of continued high emissions. Under this moderate emissions scenario, projections show climate-induced temperature changes would be responsible for 14 additional deaths per 100,000 by the end of the century. Accra, Ghana would see the increase in its mortality risk sink from 160 deaths per 100,000 people to 29 deaths per 100,000 people.

In the United States, the risk to mortality would be almost completely eliminated, with just 1.3 deaths for every 100,000 people instead of 10 deaths per 100,000.

Looking around the country, Chicago sees a slight improvement. But the real gains happen in higher risk areas. Richmond reduces its temperature-related mortality risk increase from 36 deaths per 100,000 to 20 deaths. In Jefferson, the mortality risk increase falls from 29 deaths per 100,000 to 17 deaths per 100,000. Raleigh, West Virginia, sees even greater improvements from lower emissions, with the mortality risk increase falling from 27 deaths per 100,000 to just 10 deaths per 100,000. And, El Paso sees its mortality risk increase cut by about half—from 42 deaths per 100,000 to 22 deaths.

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[13] Centers for Disease Control and Prevention. "Deaths: Final Data for 2017." National Vital Statistics Reports, 2019, 68(9).

It is apparent that reducing emissions offers substantial benefits both globally and in the United States. Put plainly, our research suggests that some of the most significant public health gains in human history could be achieved by cutting greenhouse gas emissions.

Bringing the Social Cost of Carbon to the Frontier of Knowledge

Using the Climate Impact Lab's new approach, we're able to calculate the mortality-only impact from the cost of a ton of carbon, which comes to $36.60 under a scenario of continued high emissions. That is about three-quarters of the overall or total SCC used by the Obama administration and by the Biden administration on an interim basis (See Figure 3). It is also almost twenty times larger than the mortality costs underlying the Obama and Biden administration's metric. Within their total estimate of $51 per ton, mortality risk is worth only about $2.[14]

Comparing old and new projections of the costs from mortality damages underscores that the old estimates significantly understate the costs. Figure 3 also reveals that our understanding of the damages to agriculture and energy use has also changed significantly. This is because, in the decade since the SCC was first established, the scientific and economic understanding about climate change has evolved dramatically.

As the Biden administration's Interagency Working Group completes the process of fully updating the SCC in the months ahead, there are several essential changes they should make, and other useful changes that should be considered. I detailed these changes in a recent paper co-authored by Tamma Carleton from the University of California, Santa Barbara.[15] I will outline those here:

a. **Essential Updates Based on Advances in Understanding**

1. First, the Biden administration should acknowledge the profound changes in capital markets over the last two decades and use a discount rate of no higher than 2%. The choice of a discount rate is so vital because it determines how much we value the climate that our children and grandchildren will face. If we choose a discount rate that is too low, then we will pay too much today for mitigation efforts. If we choose a discount rate that is too high, then we will impose higher costs on our children and grandchildren than we intend. Without any other modifications, changing the discount rate to 2% would increase the SCC to $125 per ton from $51.

2. Second, it is essential that the SCC rely on modern climate models to more accurately reflect the effect of emissions on the climate system. The climate models behind the current SCC substantially underestimate the speed of temperature increase. A simple Earth system model that can conduct uncertainty analysis while also matching

[14] Carleton, Tamma, et al. "Valuing the global mortality consequences of climate change accounting for adaptation costs and benefits." No. w27599. National Bureau of Economic Research, 2020.
[15] Carleton, Tamma, and Michael Greenstone. "Updating the United States Government's Social Cost of Carbon." University of Chicago, Becker Friedman Institute for Economics Working Paper No. 2021-04. (2021).

predictions from more complex, state-of-the-art models is necessary. This model can be paired with semi-empirical models of sea level rise.

3. Finally, it is essential that the measurement of economic damages from changes in the physical climate, for example, temperature and sea level rise, be updated to meet three important criteria. Damage functions in the current SCC are derived from ad-hoc assumptions and simplified relationships. But large-scale empirical evidence has since deepened our understanding of the economic impacts of climate change. An updated damage function should: i) be derived from empirical estimates that reflect plausibly causal impacts of weather events on socioeconomic outcomes; ii) capture local-level nonlinearities for the entire global population (not just high-income, temperate regions); and iii) account for future adaptation.

b. Important Changes Justified by Advances in Understanding

Other changes to the SCC are merited.

1. Any SCC calculation relies on a set of predictions regarding how the global economy, population, and CO2 emissions will evolve in the future. Unfortunately, there has been only modest scientific progress in developing these scenarios due to the stubborn difficulties in making long-run population and economic growth projections. An updated SCC should either combine standard socioeconomic projections (e.g., SSPs) with the RCP emissions scenarios, or use new probabilistic estimates relying on statistical and expert elicitation approaches.

2. An updated SCC should reflect the costs of uncertainty, just as people pay to purchase insurance to protect against uncertainty of fires and auto accidents. There are several sources of uncertainty in the calculation of the SCC (i.e. future socioeconomics, the sensitivity of the climate to emissions, economic damages from climate change). Previous SCC estimates, however, chose not to account for uncertainty in valuing climate damages. Due to recent advances in computing, it is now possible to characterize these uncertainties and to incorporate their value into the calculation of the SCC.

3. Finally, climate impacts are projected to be highly unequal. Recent research suggests that the poorest 5% of U.S. counties will experience nine times the economic damages experienced by the richest 5%.[16] It is possible to have the SCC reflect that damages to the poor are of greater concern than damages to the rich and I would recommend doing so. However, conducting equity weighting would represent a significant departure from standard United States cost-benefit analysis. As such, this change should probably be considered as part of a holistic overview of the approach to regulatory cost-benefit analysis.

[16] Hsiang, Solomon, Robert Kopp, Amir Jina, James Rising, Michael Delgado, Shashank Mohan, D. J. Rasmussen et al. "Estimating economic damage from climate change in the United States." Science 356, no. 6345 (2017): 1362-1369.

Conclusions

Ultimately, society needs to balance the costs to our economy of mitigating climate change today with climate damages. The social cost of carbon, estimated using the best available evidence, is a key tool in this balancing act. My ongoing work with the Climate Impact Lab suggests that the social costs are large, both in dollars and in terms of human lives. Further, it reveals that the current SCC does not reflect the frontier of understanding about climate economics and science—the interests of the American people would be best served by returning the SCC to the frontier. This is because robust climate policies guided by a social cost of carbon based on the latest knowledge can change our trajectory—delivering some of the greatest public health gains in human history and preventing a wide range of other climate damages in our nation and around the world.

Thank you for the opportunity to share my views with the Committee.

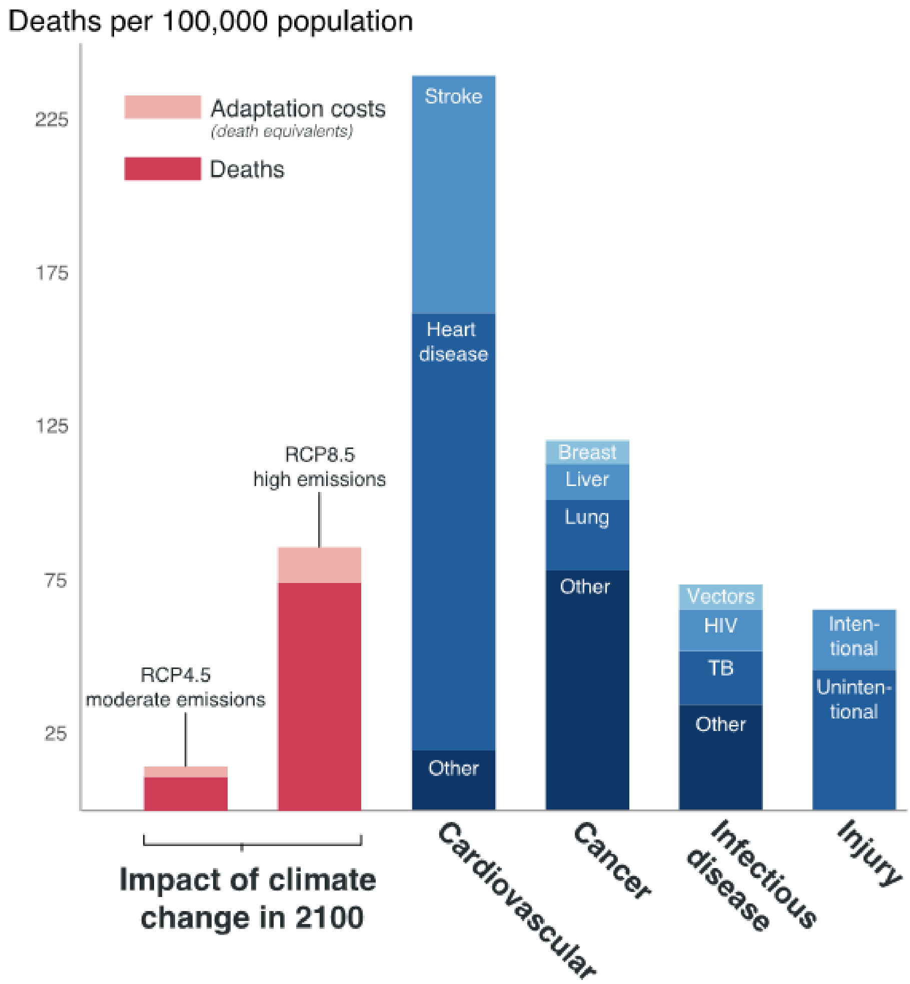
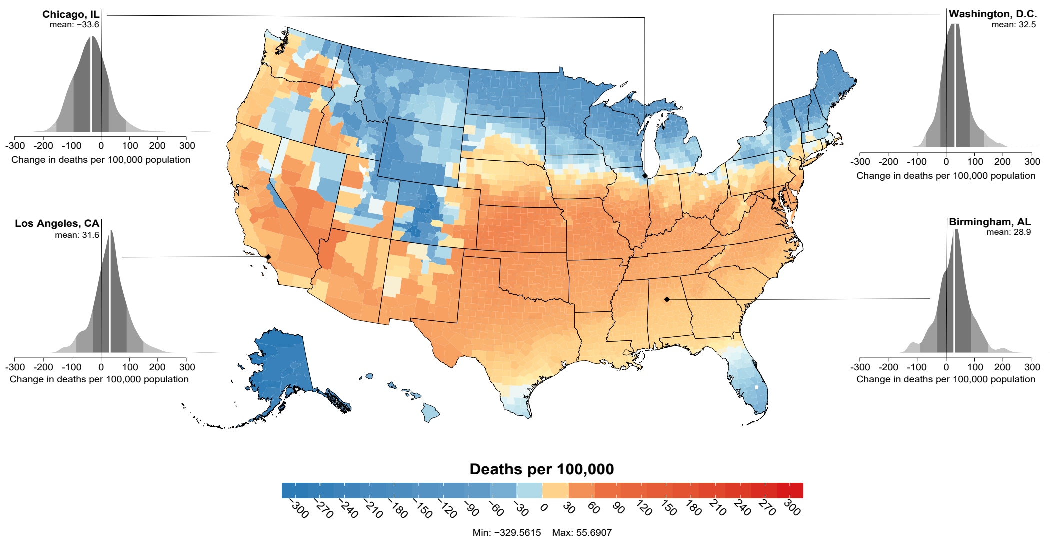
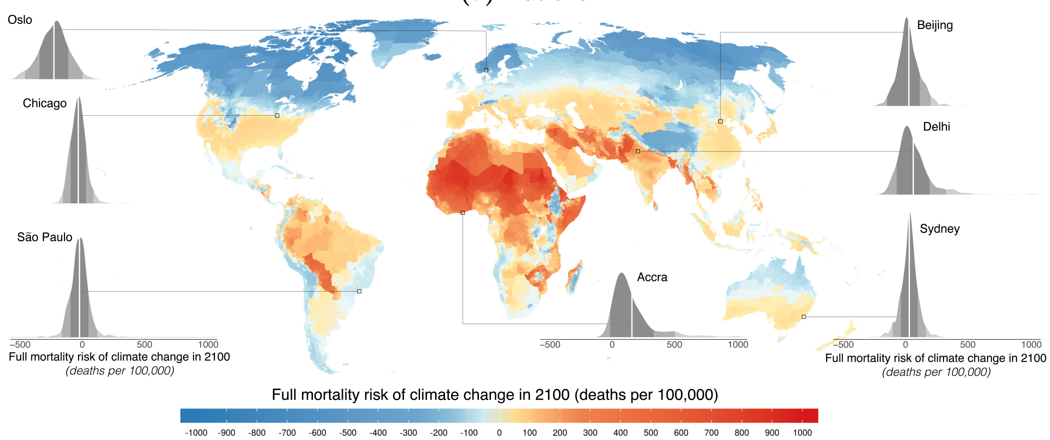


Figure 1: The impact of climate change in 2100 is comparable to contemporary leading causes of death. Impacts of climate change (coral) are calculated for the year 2100 under the high emissions scenario (SSP3-RCP8.5) and moderate emissions scenario (SSP3-RCP4.5) and include changes in death rates (solid colors) and changes in adaptation costs, measured in death-equivalents (light shading). Blue bars on the right indicate average mortality rates globally in 2018, with values from WHO (2018). Figure from Carleton, Tamma, et al. "Valuing the global mortality consequences of climate change accounting for adaptation costs and benefits" (2020).



(a) National



(b) Global

Figure 2: The mortality risk of future climate change. The maps indicates the full mortality risk of climate change, measured in units of deaths per 100,000 population, in the year 2100. Panel A displays risk results for the United States, while Panel B displays results for the world. Estimates come from a model accounting for both the costs and the benefits of adaptation, and the map shows the climate model weighted mean estimate across Monte Carlo simulations conducted on 33 climate models; density plots for select regions indicate the full distribution of estimated impacts across all Monte Carlo simulations. In each density plot, solid white lines indicate the mean estimate shown on the map, while shading indicates one, two, and three standard deviations from the mean. All values shown refer to the RCP8.5 emissions scenario and the SSP3 socioeconomic scenario. Figure adapted from Carleton, Tamma, et al. "Valuing the global mortality consequences of climate change accounting for adaptation costs and benefits" (2020).

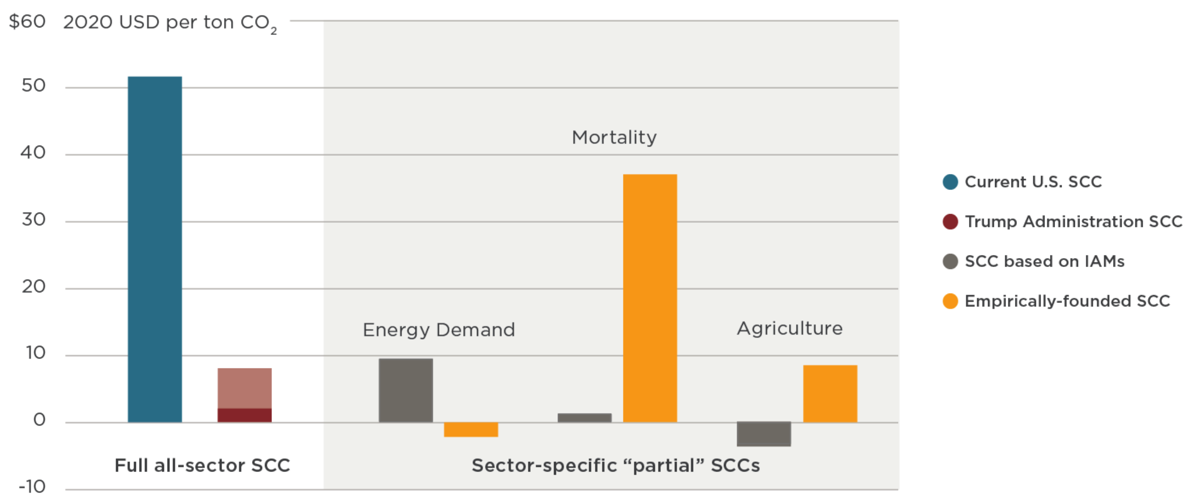


Figure 3: Estimates of partial Social Costs of Carbon (SCC), compared to existing US SCC estimates. The figure compares current and past U.S. federal SCCs to those produced by recent scientific and economic research. The full all-sector SCCs shown on the left are U.S. federal SCCs by the Trump administration (dark red/light red) and as the interim estimate under the Biden administration (blue). Sector-specific "partial" SCCs on the right come from the Interagency Working Group (IWG) 2013 implementation of the FUND model (grey) and recent scientific literature (yellow). Sources: Rode et al. (2020b), Carleton et al. (2020), Moore et al. (2017), and Anthoff and Tol (2014), as decomposed by Diaz (2014). All estimates indicate the willingness-to-pay to avoid an increase in emissions in the year 2020, rely on an approximate "business-as-usual" emissions scenario (e.g., RCP8.5), and use the discount rate preferred by each set of authors or each administration. The Trump administration did not choose a central estimate, so estimates using a 3 percent discount rate (light red) and a 7 percent discount rate (dark red) are both shown. Estimates not originally stated in 2020 USD are converted to 2020 USD using the annual GDP Implicit Price Deflator values in the U.S. Bureau of Economic Analysis' (BEA) National Income and Product Accounts Table 1.1.9.

				Mortality Risk Per 100,000	
Representative	State	District	County	High Emissions	Moderate Emissions
Armstrong	North Dakota	At Large	Cass	-75.7	-52.1
Bonamici	Oregon	1	Washington	20.3	15.5
Brownley	California	26	Ventura	22.4	12.6
Carter	Georgia	1	Chatham	18.9	13.4
Casten	Illinois	6	Cook	-33.6	-31.6
Castor	Florida	14	Hillsborough	-13.8	-1.6
Crenshaw	Texas	2	Harris	23.3	14.8
Escobar	Texas	16	El Paso	42.1	21.7
Gonzalez	Ohio	16	Cuyahoga	-21.2	-24.0
Graves	Louisiana	6	East Baton Rouge	18.9	12.8
Huffman	California	2	Marin	20.7	13.9
Levin	California	49	San Diego	17.2	10.7
McEachin	Virginia	4	Richmond	36.3	19.6
Miller	West Virginia	3	Raleigh	27.0	9.9
Neguse	Colorado	2	Boulder	-33.4	-25.8
Palmer	Alabama	6	Jefferson	28.9	16.5
	United States			10.1	1.3

Table 1: Climate-Induced Mortality Risk Impacts for Select Counties at End of Century. Mortality risk estimates are from Carleton et al.'s "Valuing the global mortality consequences of climate change accounting for adaptation costs and benefits" (2020). Table includes one county for each Representative's congressional district. The high emissions and moderate emissions columns compare the effect of increased temperatures on mortality risk for SSP3 under the RCP8.5 and RCP4.5 emissions scenarios, respectively, from the IPCC's 2014 "Mitigation of Climate Change: Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change". Impacts of climate change are calculated for the year 2100 for RCP8.5, and are averaged across the five end-of-century years for RCP4.5. Impacts include changes in mortality risk accounting for adaptation costs and benefits.