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UNDER THE WEATHER: DIAGNOSING THE HEALTH COSTS OF CLIMATE CHANGE

HEARING BEFORE THE COMMITTEE ON THE BUDGET UNITED STATES SENATE ONE HUNDRED EIGHTEENTH CONGRESS FIRST SESSION

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UNDER THE WEATHER: DIAGNOSING THE HEALTH COSTS OF CLIMATE CHANGE

WEDNESDAY, APRIL 26, 2023

COMMITTEE ON THE BUDGET,
U.S. SENATE,
Washington, DC.

The hearing was convened, pursuant to notice, at 10:15 a.m., in the Dirksen Senate Office Building, Hon. Sheldon Whitehouse, Chairman of the Committee, presiding.

Present: Senators Whitehouse, Kaine, Van Hollen, Padilla, Grassley, Crapo, Johnson, Marshall, Braun, and R. Scott.

Also present: Democratic staff: Dan Dudis, Majority Staff Director; Alexandra Gilliland, Climate Policy Expert; Dan Ruboss; Senior Tax and Economic Advisor and Member of Outreach Director.

Republican staff: Chris Conlin, Deputy Staff Director; Krisann Pearce, General Counsel; Jordan Pakula, Professional Staff Member; Nic Pottebaum, Professional Staff Member.

Witnesses:

The Honorable Stephanie Smith, Esq., Member of the House of Delegates, District 45, Baltimore City, Maryland

Dr. Katelyn Moretti, Assistant Professor of Emergency Medicine, Brown Emergency Medicine

Dr. Michael Greenstone, Milton Friedman Distinguished Service Professor in Economics, and Director, Becker Friedman Institute, and the Energy Policy Institute, University of Chicago

Dr. Carl J. Schramm, University Professor, Syracuse University
Mr. Michael Shellenberger, Founder & President, Environmental Progress

OPENING STATEMENT OF CHAIRMAN WHITEHOUSE¹

Chairman WHITEHOUSE. Let me call the hearing to order, and welcome Ranking Member Grassley and our witnesses and guests to our seventh Committee hearing. Today we will continue our series on the economic costs of climate change, costs that are already affecting workers, families and governments across the country.

Today we explore the climate harms to public health and the associated economic and budgetary burdens. As we've heard throughout this series, the climate crisis brings with it what witnesses have repeatedly called systemic risks, ones that cascade beyond a particular troubled sector to harm the entire economy and pose serious threats to the federal budget.

¹Prepared statement of Chairman Whitehouse appears in the appendix on page 36.

Their warnings aren't for future lawmakers; they're for us in this room to protect against. Health care costs related to combustion of fossil fuels are estimated to total nearly \$820 billion in the United States annually. Over the ten-year budget window, that's over \$8 trillion.

The direct costs of health care, doctor's appointments, emergency room visits, rehabilitation and home health support, prescription drugs, strain the pocketbooks of American families. The indirect economic costs from lost work and school days, reduced productivity and increased economic instability all add to that \$8 trillion budgetary burden.

If you care about deficits or economic growth, you have to care about climate change and its costs and risks. Yet with evidence of the economic dangers of climate change piling up around us, House Republicans propose eliminating clean energy tax credits and investments.

They have completely lost their grip on reality, and are so subservient to fossil fuel overlords that they're willing to eliminate hundreds of thousands of clean energy jobs, cause trillions in climate harm and shrink our economy by letting China build the technologies of tomorrow.

Their non-starter of a default plan would escalate carbon pollution, raising temperatures around the world. In Rhode Island in the last century, the average temperature is up three degrees. Rhode Island emergency rooms see a rise in hospital visits any time there are multiple 80 plus degree days in a row.

On average, there are 702 heat-related deaths and over 67,000 emergency room visits each year in America due to heat. Extreme temperatures are more frequent and severe, and that costs lives and dollars. The Pacific Northwest's deadly heatwave in 2021 saw approximately 600 additional deaths in one week in Oregon and Washington state. A heat wave of that intensity would have been virtually impossible without human-caused climate change.

Higher temperatures also encourage smog formation and contribute to higher levels of airborne particulate matter and pollen. The combination of heat and poor air quality increases cardiovascular and respiratory risk, and the likelihood and severity of asthma attacks.

Warming climates expand disease vectors northwards, particularly insects that carry disease like Lyme disease, West Nile virus, dengue fever and Zika. Indeed, there is evidence that climate shifts are the driving force behind more frequent disease outbreaks.

Climate upheaval brings more frequent and extreme weather events, which bring their own health care costs. The news reports regularly how hurricanes, wildfires, floods and droughts lead to death, injury and illness. Hurricane Sandy is estimated to have cost \$3.3 billion in health costs, including nearly 4,700 emergency room visits, over 6,600 hospital admissions and 273 deaths.

The public health harms from climate change fall most heavily on the elderly, on children, on people of color, on the poor and on people with pre-existing conditions. Climate change is a multiplier, both of illness rates and economic disparities. As a result, it will worsen economic inequality and widen gaps in health outcomes and life expectancy between poor and wealthy.

Federal programs like Medicare and Medicaid will be heavily impacted, given the populations they serve. In 2021, Medicare and Medicaid constituted almost 40 percent of all U.S. health care spending, and almost 20 percent of all federal spending. Of course, these climate-related health care costs come on top of the many other climate costs we've heard about at previous hearings.

Witnesses have warned us of risks that could take down the economy. The risk of a coastal property values crash, the risk of a similar wipeout in property values in wildfire country, the risk of insurance collapse as unpredictability drives insurers out of markets, the risk of the carbon bubble bursting in a disorderly transition from fossil fuel.

These are not alternative scenarios, they all could happen. We're playing with dangerous stakes. The consulting firm Deloitte has pegged the difference between getting climate right and getting it wrong at a more than \$220 trillion swing. In a world in which those long warned-of evils have come to pass, the \$8 trillion health care cost burden will likely grow, as a crashed economy and budget will shrink. Not a good combination.

As this hearing will make clear, the effects of climate crisis on our nation's public health are dangerous and costly to families, to businesses and to the federal government, and this problem will only get worse and become more expensive unless we act now. I turn now to our distinguished Ranking Member, Senator Grassley.

OPENING STATEMENT OF SENATOR GRASSLEY²

Senator GRASSLEY. Thank you, Senator Whitehouse, Mr. Chairman. I want you to know that last week's hearing on tax policy was really refreshing. Revenues are a critical part of the federal budget, and we should remain very focused on the pressing fiscal issues facing our country.

My Republican colleagues in the other body introduced legislation to lift the debt ceiling and curb our federal spending. This week, I don't agree with every item in the bill. In fact, I have read only excerpts of it. But things are clear. America's fiscal problems are serious and Republicans are working to tackle those problems head on.

The U.S. is facing public debt that in a few years will surpass record levels set in the wake of World War II. Even if we don't agree with all the contents of the House bill, Republicans are following through with concrete solutions to address our dire fiscal situation and to reduce inflation.

It's been 88 days since President Biden and the Speaker of House McCarthy met down at the White House as an initial meeting to deal with these issues. No meeting has taken place since then. So I see President Biden refusing to even enter a negotiation room with Speaker McCarthy. Senate Democrats haven't lifted a finger to prevent us from going head-long off the fiscal cliff.

The Budget Committee is currently holding its sixth hearing on climate change. Let's now work together to write a budget that has guardrails to rein in federal spending. I have a reputation for traveling to each of the 99 counties, holding a Q and A with my con-

²Prepared statement of Senator Grassley appears in the appendix on page 38.

stituents in each of those counties 42 years in a row. 28 counties so far this year.

Not every Iowan agrees with every decision I make as a Senator, but I'm always willing to have a conversation about the topics that matter most to them and our country. Health care concerns often come up. Now, however, the health effects of climate change isn't one that I've heard much, if at all.

Our government health care programs, including Medicare, Medicaid and public health, are projected to spend \$21 trillion over the next ten years. I do hear a lot from my constituents about preserving Medicare, and I agree that we should be doing that.

We need to ensure that these taxpayers funds that we call Social Security, Medicare and Medicaid are used wisely to address pressing health issues facing Americans, and we should be doing that right now. If Members are really interested in a bipartisan conversation about public health challenges and health care financing, I suggest that we focus on the key health challenges facing Americans right now, and some of these are the 107,000 Americans that died from drug overdose, particularly fentanyl, killing 70,000 of that 107,000, how to lower prescription drug costs so patients don't delay treatment and save money, how to improve access to rural health care as hospitals and clinics are struggling to stay afloat, and how to address the leading cause of death in America, which happens to be heart disease.

We have significant health care challenges right now. A climate change mandate from Washington, D.C. won't solve the public health and health care finance challenges that we face this very day. I look forward to hearing testimony of Mr. Shellenberger. He was invited to serve as an expert reviewer by the Intergovernmental Panel on Climate Change.

He's also been recognized by Time magazine as quote-unquote "a hero of the environment." The majority argues that climate change will catastrophically lead to more heat-related illnesses and deaths. They argue it will dramatically amplify global disease, damage respiratory health and harm more Americans from natural disasters. I'm confident that Mr. Shellenberger will be able to separate their alarm from reality.

Dr. Schramm, I also welcome you back to the Committee. You remember when the Budget Committee focused on budgetary matters. You testified as a witness on the Reagan administration budget proposal in 1983.

That year, the Committee held six hearings in one month as we prepared a budget resolution, and when Reagan and Tip O'Neill got together in 1983 to solve that problem, I doubt if they thought that they were doing it for a whole half century. But it works out that Social Security won't run out of surplus money until 2033, then afterwards we're in a crisis because people will only be getting 77 percent of what they're getting right now.

Dr. Schramm, you founded the nation's first research organization dedicated to understanding health care financing, and I'm interested in exploring your current work to ensure our public health institutions focus on their core mission where they've been failing. I yield.

Chairman WHITEHOUSE. Thank you. We have five witnesses today, including a witness from Maryland, who will be introduced by Senator Van Hollen. I want to thank Delegate Stephanie Smith for being here, and turn to Senator Van Hollen for his introduction.

STATEMENT OF SENATOR VAN HOLLEN

Senator VAN HOLLEN. Thank you Mr. Chairman and Ranking Member Grassley. Welcome to all our witnesses today. I have the special honor of being able to introduce a colleague and friend from the state of Maryland, Delegate Stephanie Smith, who's a member of the Maryland House of Delegates representing District 45.

Delegate Smith was just reelected to serve a second term representing a part of Baltimore City. She serves on the Maryland House Appropriations Committee and chairs the Education and Economic Development Subcommittee. She's also the chair of the Baltimore City delegation in Annapolis, and I congratulate her on wrapping up a very successful 90 day session.

But Delegate Smith is here not only because she's a skilled legislator, but more important for today's purposes she's a federal policy expert and an advocate on many of the issues that the Committee will cover today, especially her understanding and knowledge of the negative health impacts that climate change will have broadly, but especially in American cities and especially the rising health care costs due to urban heat.

So Mr. Chairman, Members of the Committee, thank you for inviting her to be with us today. I look forward to returning to try to ask questions of both Delegate Smith and other members of the panel. But welcome and thank you Mr. Chairman and Members for inviting a very important witness today.

Chairman WHITEHOUSE. Thank you Senator Van Hollen and thank you Delegate Smith. Our other witnesses are Dr. Katelyn Moretti. She's an Assistant Professor in the Department of Emergency Medicine at Brown University, and a board-certified emergency medicine physician, practicing in Providence, Rhode Island.

She founded and co-chairs the Rhode Island Medical Society's Climate Change and Health Committee. We look forward to her testimony and her unique perspective as an emergency medicine physician.

Next we have Dr. Michael Greenstone, who is the Milton Friedman Distinguished Service Professor in Economics, as well as the Director of the Becker Friedman Institute and the Director of the Energy Policy Institute at the University of Chicago.

His research focuses on uncovering the benefits and costs of environmental quality and society's energy choices. Dr. Greenstone, thank you for being here. We look forward to your testimony.

Next we have Dr. Carl Schramm, who is a university professor in the School of Information Studies at Syracuse University. He previously served on the faculty of the Johns Hopkins School of Hygiene and Public Health, where he focused on public policy in hospital finance.

Additionally, he has founded and co-founded several companies in health care finance and information technology. We welcome him and look forward to his testimony.

Finally, we'll hear from Michael Shellenberger, who is the founder and president of Environmental Progress. He is also the co-founder of the Breakthrough Institute, where he served as president from 2003 to 2015. We welcome him as well.

Delegate Smith, you have five minutes to deliver your testimony. Your full statement will be made a part of the official record. Please proceed.

**STATEMENT OF THE HONORABLE STEPHANIE SMITH, ESQ.,
MEMBER OF THE HOUSE OF DELEGATES, DISTRICT 45, BAL-
TIMORE CITY, MARYLAND³**

Delegate SMITH. Good morning Chairman Whitehouse, also good morning, Ranking Member Grassley and to all the distinguished Members of the Committee. For the record, I'm Delegate Stephanie Smith. I properly represent Maryland's 45th state legislative district in Baltimore City, and as you heard from my great Senator Van Hollen, I am honored to serve on the Appropriations Committee and also chair of the Baltimore City House delegation.

But outside of my work as a legislator, I've spent my career for nearly two decades at the intersection of environmental health, urban planning and community development, and today I will share observations about the public health costs of climate change, and that will come from both my professional ends, as well as the experiences of my neighbors.

Baltimore's average temperature has risen three degrees over the last century, nearly twice as much as the national, as the nation at large and beyond overall increases in average temperature. Baltimore is one of the leading U.S. cities rather for the urban heat island effect.

Urban heat islands are hyper-local pockets of elevated temperatures within a city that can exacerbate adverse health outcomes for residents with diabetes, cardiovascular conditions and respiratory health challenges, just to name a few. A concentration of paved surfaces, buildings and industrial activities amplify rising temperatures, and Baltimore's urban heat islands make our city the ninth hottest urban hot zone in the United States.

Residents inside Baltimore's urban heat islands are more likely to be people of color, low income and live shorter lives. My district is home to landmarks like Pennsylvania Station and Johns Hopkins Medical Center, as well as communities that have faced the policy harm of redlining and disinvestment.

The top of my district boasts mature trees and significant green spaces like Herringbone Park. However, I live at the bottom of my district in East Baltimore, which is home to dense rowhome communities with the hottest temperatures in Baltimore City.

As climate change delivers more extreme heat days, Baltimore is on pace to see a sixfold increase in these very hot days in the next 15 years. In East Baltimore, communities like Madison-Eastend and Mcelderry Park, this can mean more emergency medical calls for chronic conditions.

As the heat index approaches 103 degrees, emergency calls for congestive heart failure can double. I personally live in a 123 year-

³Prepared statement of Hon. Smith appears in the appendix on page 40.

old rehabbed rowhome with my husband, my young children and my mother, who has a chronic heart condition. Thankfully, our home has central air conditioning that can maintain her comfort on the hottest days.

All of my neighbors deserve to live with the dignity and the baseline resilience needed to survive extreme heat. Unfortunately, news reports have detailed some of the difficulties my neighbors face as extreme heat days multiply.

In July 2019, the University of Maryland put sensors inside of Mcelderry Park homes and recorded interior temperatures as high as 97 degrees, with a heat index of 119 degrees. Parents are keeping children confined in hot homes or do not install window air conditioning units on the first floor, due to concerns about public safety.

Tammy Jackson, a resident of Mcelderry Park lamented the interior temperature was 92 degrees on a 100 degree day. With asthmatic grandchildren, Jackson doesn't know where to find relief. She simply exclaimed "This is too much! Lord, this is too much." Yes, the scope of this challenge can feel like it's too much, but I do have good news to share.

While climate change continues to increase temperatures, there are investments that we can make at every level of government, including increasing the urban tree canopy, prioritizing green roofs and surfaces and construction, providing more accessibility to cooling centers, and proactively reaching out to our most vulnerable community members during Code Red days.

While this problem is enormous, mitigating adverse health impacts of extreme heat can mean cost savings from reduced Medicaid claims, reduced emergency medical care for the uninsured, and increased economic productivity from improved healthiness.

The state of Maryland through our Climate Solutions Now Act of 2022 invested in five million urban tree plantings and encouraged green infrastructure. But we will need local, state and federal strategies and investments to blunt the aggressive harm extreme heat poses to urban centers.

I'm honored to have the opportunity to speak today, and to lift up the experiences of my neighbors, and thank you again for your time.

Chairman WHITEHOUSE. Thank you very much, Delegate. I appreciate you being here. Dr. Moretti, please proceed.

STATEMENT OF DR. KATELYN MORETTI, ASSISTANT PROFESSOR OF EMERGENCY MEDICINE, BROWN EMERGENCY MEDICINE⁴

Dr. MORETTI. Thank you Chairman Whitehouse, Ranking Member Grassley, and honorable Members of the Committee for this invitation to speak with you today. As an emergency physician, I see the impacts of climate change on my patients every day right now. However, the health consequences are so vast and varied that the role of climate change is often hidden.

At times, the relationship is clear. For example, I treated a young man who suffered heat stress while working in construction.

⁴Prepared statement of Dr. Moretti appears in the appendix on page 43.

With his body temperature elevated to unsafe levels, he required rapid cooling through IV fluids. He suffered muscle breakdown and poisoned his kidney, requiring a hospital admission.

But other times, this link is not as clear. Consider my 85 year-old patient who presented with a heart attack. It was only because of astute EMS providers that we were able to connect her heart condition to an overheated apartment that lacked air conditioning, coupled with her inability to leave.

Climate change is a threat multiplier, with health impacts happening through many different pathways such as temperature extremes, air pollution or disruptions in supply chains. Climate change is also a threat magnifier, worsening chronic diseases such as heart disease, and causing acute flares of other conditions such as asthma exacerbations.

Because these effects are so widespread, it makes calculating the total magnitude of these impacts difficult. Therefore, the economic impacts are severely underestimated. Only easily quantifiable disasters and their infrastructure or crop damages are typically considered.

Health-related costs are seldom if ever included in the math on climate change economic impacts. In addition, climate repercussions are not felt equally. When I come to work during a heat wave, I worry about the elderly. I worry about the blue collar workers outside, and I worry about my pregnant patients unable to regulate their body temperatures.

I worry about their unborn children, as heat increases the risk of fetal death, premature labor and long-term health problems after birth. Similarly, when I consider the potential effects of a hurricane in my home state, I worry about my patients that lack the resources to evacuate.

I worry about my patients with disabilities that rely on electricity for their health, those that need breathing machines or dialysis. Notably, the patients that are most at risk are the same patients most likely to be on Medicaid or Medicare and least able to afford these costs. While we may not know the total cost of climate change on health, we know they are immense and growing.

Nearly every child in the world is at risk from one climate threat, and Medicaid covers almost 40 percent of children in the U.S. Children and infants have increased vulnerability to climate change. For example, smaller airways are more sensitive to swelling from air pollution. Children are at increased risk for mental and physical trauma from disasters, and they bear the consequences of these impacts for many more years to come.

This spring, I have seen the same teen on multiple occasions for her asthma. On one visit, her breathing was so bad we needed to put her on a breathing machine, pushing air into her lungs. Her asthma is worsened by an extended pollen season, and her house close to the highway puts her at constant exposure to air pollution.

Recently, there were brushfires in western Rhode Island, and I expect to see her again in the Emergency Department. In the Medicare population, chronic conditions such as disabilities, increased vulnerability to climate change, age and heart disease are risk factors alone. However, in addition, medications for chronic diseases can limit the body's ability to respond to heat stress. Mobility

issues may limit access to cooling centers or safe evacuations during a disaster.

Disruptions in infrastructure and supply chains limits these patients' ability to access the care they need to maintain their health. When we consider specific climate hazards, heat is often the first to come to mind. Where I live and work in Rhode Island, we are experiencing increasing use of hospital resources, emergency visits and mortality as summer temperatures rise, and these trends are nationwide.

We also need to consider disruption in health care delivery. During COVID-19, I witnessed this firsthand. I cared for a patient, a young woman with COVID, who presented in decompensated diabetes because she could not access insulin. In the span of four hours, she went from speaking on the phone with her family to dead. I still think about her small children and how different their lives would have been if she had just had access to insulin.

These similar barriers have been documented for both Hurricane Katrina as well as Hurricane Harvey. These health complications are not only tragic, but they are costly, and we have only scratched the surface. Consider worsening vector board diseases, wildfires, droughts, food security. The impacts are broad, substantial and worsening, and the economic impacts are immense.

In 2008, the Congressional Budget Office presented this evaluation. For the federal government, rising health care costs constitute the principle challenge of fiscal policy. No other single factor will exert more influence over the long-term balance of the federal budget.

In closing, I'd like to leave you with these two reiterated points. The economic toll of climate change health effects are immense, but under-recognized and under-quantified. Medicaid and Medicare recipients will bear the brunt of these consequences. My patients depend on your action. Thank you.

Chairman WHITEHOUSE. Thank you, Doctor. Now Dr. Greenstone.

STATEMENT OF DR. MICHAEL GREENSTONE, MILTON FRIEDMAN DISTINGUISHED SERVICE PROFESSOR IN ECONOMICS, AND DIRECTOR, BECKER FRIEDMAN INSTITUTE, AND THE ENERGY POLICY INSTITUTE, UNIVERSITY OF CHICAGO⁵

Dr. GREENSTONE. Thank you Chairman Whitehouse, Ranking Member Grassley and Members of the Committee for inviting me to testify today. I appreciate the opportunity to speak with you about the temperature-related impacts of climate change and public health and our economy.

The health impacts are likely to be some of the dominant costs of climate change. So what impacts would temperature changes due to climate change have on public health? This is a topic of some research of mine that was done with the Climate Impact Lab that I co-founded. It's a team of about 30 economists, climate scientists and computational experts.

The headline finding is that the projected mortality risk from temperature changes due to climate change are at least in order of

⁵Prepared statement of Dr. Greenstone appears on page 50.

magnitude larger than has previously been understood. This finding holds whether one uses a high emissions scenario that likely overstates the future growth of emissions, or a moderate emissions scenario that likely understates it.

As supported by recent work at the IPCC, the true impacts of climate change are likely to lie between the estimates based on these two emissions pathways. There are four main points that come out of my written testimony. First, global mortality risk is projected to increase by 85 deaths per 100,000 people by 2100, if the world is on the high emissions trajectory.

This is larger than the current global mortality rate due to all infections and parasitic diseases. Under a moderate emissions trajectory, the increase in global mortality risk would remain significant at 14 deaths per 100,000, similar to the current global diabetes mortality rate. Some of this is illustrated in the slide that we've put up here.

Two. Second, in the United States, the projected increase in mortality risk from higher temperatures under the high emissions scenario is about ten deaths per 100,000, about on par with the current fatality rate due to auto accidents.

In contrast this change, and I'm going to come back to this, is roughly zero under the moderate emissions scenario, though this overall figure masks meaningful increases in some places and meaningful declines in others. I've included a table in my written testimony with data for each state under both scenarios, to give a sense of the risk that your constituents face.

There are also global and domestic maps of projected changes in mortality risks that are displayed here. But some examples might be instructive. In my home town of Chicago, the mortality risk is projected to decline by about 35 to 40 deaths per 100,000 by 2100.

Over time, we'll see fewer cold days, decreasing mortality risks during the winter, which will outweigh the risks of more hot days. However, other places will be harmed in that. Henrico County, Virginia, represented by Senators Warner and Kaine, has projected to experience is high mortality risk under both emissions scenarios, about 35 under the high one and 17 under the moderate one.

Johnson County, Kansas, represented by Senator Marshall, is projected to see an increase of 31 deaths per 100,000 under the high emissions one, and about 11 under the moderate emissions one.

The third main finding, and this is important, is that the level of emissions is not a law of physics. It reflects policy choices to restrict emissions and technical advances that can also be influenced by policy. It's therefore useful to consider what policy might be able to accomplish or unlock in terms of benefits.

An illustrative example is that a policy moving the world from the high emissions scenario outlined on the graph there to the moderate emissions one, would reduce the attendant global mortality risk by about 84 percent at the end of the century. In the United States, temperature-related mortality risk due to climate change would be eliminated by moving from the high to the moderate.

The point is that robust climate policy offers the potential for some of the most significant public health gains in human history.

Fourth, following the National Academy of Sciences 2017 recommendations, the Climate Impact Lab has developed new methods to estimate climate damages. A key output of these efforts is an estimate of the social cost of carbon or SEC, which is the monetary cost of the damages caused by the release of an additional ton of carbon dioxide into the atmosphere.

The SEC provides a value which can be used in cost benefit analyses, regulatory policy and for determining efficient prices for market-based policies, such as a carbon tax or cap and trade system. The CIL's approach produces an estimated SEC of \$190 per metric ton. This means that every ton of CO₂ abated reduces climate damages by \$190.

The use of frontier climate—this use of frontier climate science in economics leads to a social cost that is significantly higher than either President Trump's estimate or President Obama's. Finally, in conclusion, given the scale of the climate challenge, I want to underscore that our nation would be well-served to seek out the least expensive reductions in greenhouse gases.

Markets have been shown time and time again to be the most successful tool to find these opportunities. This means that markets would allow us to confront the climate challenge without imposing unnecessary costs in American families. Thank you for allowing me to speak today. I look forward to your questions.

Chairman WHITEHOUSE. Thank you very much. I turn now to Mr. Shellenberger, sorry Doctor. No, I'm sorry, I'm out of order. Dr. Schramm.

**STATEMENT OF DR. CARL J. SCHRAMM,
UNIVERSITY PROFESSOR, SYRACUSE UNIVERSITY⁶**

Dr. SCHRAMM. Thank you, Mr. Chairman, and thank you Ranking Member Grassley for inviting me to come and speak with you today.

I am pleased to speak about the implications of climate change that may be imposed on the nation's public health. Much of my career has been devoted to studying health care costs, especially in the context of how these expenditures may or may not be proportionally related to improvements in the public health.

In the interest of time, I'll skip over much of my biography only to point out that the last time I was here Mr. Grassley, I was running the Johns Hopkins Center for Hospital Finance and Management. I served on the faculty of the Public Health School there for 16 years.

I left Hopkins for a career focused on health insurance, including being president of the Time Insurance Company, now known as Assurant, headquartered in Milwaukee. For the last few years, my research has been focused principally on the question of COVID and the performance of the Centers for Communicable Diseases.

I've been a member of the COVID Crisis Group and only yesterday we published our final report, which is called the Lessons from the COVID War. At this very moment, the report is being debuted at the National Academy of Sciences.

⁶Prepared statement of Dr. Schramm appears in the appendix on page 65.

As the Committee considers the question of public health implications of global warming, I want to emphasize two issues. First, the efforts to expand the idea of what public health is and why it is seen by many to be failing. As most of us would agree, the CDC, the nation's principal agency charged with protecting public health, failed to effectively control the COVID pandemic.

I believe the principal reason is that both the CDC and the country's larger public health establishment, including the public health schools, have expanded the scope and definition of public health such that its boundaries are nearly meaningless to the public.

Consider that the CDC currently deals with a wide range of problems that are not encompassed by traditional definitions of public health, the science and art of preventing disease, prolonging life and promoting health.

Instead, the CDC deals with a long list of "epidemics" that are not related to communicable pathogens, and cannot be corrected by traditional public health tools. Among these are epidemics of gun death, traffic fatalities, obesity, domestic violence, workplace accidents and a long list of issues distant, far distant from traditional public health threats.

In addition, we find the CDC working on problems that again cannot be solved by the traditional tools used to prevent the transmission of communicable disease. Two of the newest involve the CDC's attempt to ameliorate the "social determinants of health," and its commitment to promoting health equity.

Simply, the CDC is the archetype of an agency beset by mission creep. Thus, even if global warming presented a clear and present danger to the health of every American, there is little that the CDC can do to mitigate such a threat.

Among other things, the agency's managerial focus is so diffused it is unlikely that it could effectively absorb another issue, particularly one in which the correlation between global warming and the public's health is so ambiguous.

My research on the CDC budget suggests that only about one in seven of its employees work or are engaged in traditional efforts to identify and control contagious pathogens. Far more CDC professionals work on international health issues that may or may not be related to protecting the U.S. population from communicable threats.

Now on the brighter side, I've included two charts, one that shows that we have continuously grown GDP rather extensively over the last 50 years since the passage of the Clean Air Act, and at the same time reduced virtually all of the noxious particulates that we breathe, showing that we can in fact grow the economy and make the entire society and our nation much healthier at the same time.

Similarly, important to global health and the argument that we are witnessing the implications of global warming on global health, I'm including a chart that shows that over the last 50 years, we have been on a course of making virtually all of our GDP growth with much less fossil fuel burn.

This is a huge achievement. It's an achievement of engineering, among other things, and this is a time to salute the engineers in

public health that have brought us clean water, clean sanitation and clean air. Thank you.

Chairman WHITEHOUSE. Thank you, Dr. Schramm. Next, we'll hear from Mr. Shellenberger.

**STATEMENT OF MICHAEL SHELLENBERGER,
FOUNDER AND PRESIDENT, ENVIRONMENTAL PROGRESS⁷**

Mr. SHELLENBERGER. Chairman Whitehouse, Ranking Member Grassley and Committee members, thank you for requesting my testimony. I'm honored to be able to provide it. High per capita use of cheap and abundant energy is essential to lifting people out of poverty. There is no rich, low energy nation and no core high energy one.

Adapting to higher temperatures, excuse me, adapting to higher temperatures requires cheap energy so people and nations can afford air conditioners, irrigation, desalination and other technologies. The bottom line today is that cheap and abundant energy is the key to a better future, including reducing deaths from heat waves, disease and pollution.

The good news is we know how to do this. Between 2005 and 2020, U.S. carbon emissions declined by 21.5 percent, which is 4.5 percentage points more than what the U.S. promised to reduce as part of the United Nations Paris Climate Agreement, and 4.5 percentage points more than what was promised under the 2009 Waxman-Markey Cap and Trade legislation.

61 percent of those reductions were due to the shift from coal to natural gas, and 39 percent came from intermittent renewables backed up by natural gas, which was required in most situations. The relationship goes in the opposite direction as well. Thanks to natural gas shortages and higher costs in 2021, coal-fired electricity increased 22 percent as compared to 2020.

Carbon emissions are thus following the same trajectory as other air pollutants. As a result of cleaner-burning coal, the transition to natural gas, cleaner vehicles and other technological changes, developed nations have seen major improvements in air quality. Between 1980 and 2018, the U.S. carbon monoxide levels decreased by 83 percent, led by 99 percent, nitrogen dioxide by 61 percent, ozone by 31 percent, sulfur dioxide by 91 percent.

While death rates from air pollution can rise with industrialization, they declined with higher incomes, better access to health care and reductions in air pollution.

Contrary to the assumptions of people who want to make energy more expensive, we moved towards cleaner energy sources by making them cheaper and more abundant. Thanks to fracking, natural gas became cheap and abundant during the first decade of this century. The same has been the case with nuclear. France and other nations built large, standardized nuclear plants, reducing the construction times and bringing the cost down.

Better nutrition, better health care, more air conditioning massively outweigh climate change as factors determining health. Over a decade ago, the World Health Organization predicted the global burn of disease will have declined by 30 percent between 2004 and

⁷ Prepared statement of Mr. Shellenberger appears in the appendix on page 69.

2030, which is amazing news, and we are on track to do that, and said the WHO “Mortality rates will continue to fall in most countries, so long as economic growth continues.”

In its report last year, IPCC noted, the Intergovernmental Panel on Climate Change, noted that nations have adapted well to heat, thanks to “heat warming systems, increased awareness and improved quality of life.” That included particularly air conditioners.

Quote, this is from the IPCC, “Evidence suggests a general decrease in the impact of heat on daily mortality,” as well as “a decline in the relative risk attributable to heat,” and “an increase in the minimum mortality temperature.” We should be celebrating this.

It’s true there have been more heat waves in the United States since 1960, but what determines whether people die in heat waves is primarily whether they have air conditioning. Proof of this comes from the fact that heat-related deaths in the United States declined by between 50 and 75 percent since 1960, thanks almost entirely to air conditioning, even as heat waves grew in frequency, intensity and length. Kind of amazing that I’m the first speaker to even mention that.

I want to now point out something. This is profoundly misleading, and I want to explain why. This picture, this map combines two things that the IPCC says not to combine. It’s the shared socioeconomic pathway 3—I may need my glasses now to read the fine print, and RCP 8.5.

Those two things are not supposed to be combined. Look, this is the IPCC combination of these two different scenarios, RCPs and SSP. In SSP 3, there is no 8.5 combination because it’s so implausible to have a situation of low economic growth and high emissions, unless you were somehow using all of your GDP to produce emissions deliberately, which is so ridiculous the IPCC doesn’t conclude it.

It’s been stated that we’re somehow between RCP 4.5 and 8.5. That’s not what the IPCC says. This is the most recent report that came out last November, and you can see here it shows that we’re on track to be below RCP 4.5. So I think it’s very misleading to suggest we’re somehow between RCP 4.5 and 8.5.

I will just end by saying I think we all agree that the future is not written, that we decide what will occur based on our actions. That means we need abundant natural gas to continue to transition away from coal, and we need a national nuclear power build-out based on what we did in the 1960’s and 70’s, and based on France, Sweden and other nations have done since then. Thank you very much.

STATEMENT OF SENATOR PADILLA

Senator PADILLA. Thank you Mr. Shellenberger, and to all the witnesses for your testimony. We now turn to questions from the Committee, and as I’ve been asked to sit in as chair until Chairman Whitehouse returns, that means I get to ask my questions first.

Dr. Moretti, take a deep breath, because I’m going to tap into your experience and expertise here on a couple of topics. I want to discuss the increasing risks to the health and safety of workers

who are exposed to dangerous heats and conditions, and the absence of adequate workplace protections.

And despite Mr. Shellenberger's testimony, not all career paths enjoy the luxury of air conditioning. Farmworkers are disproportionately at risk and die from heat-related illness at a rate 20 times greater than the average worker. That's why last session I co-led the legislation with Senator Brown to direct OSHA to more swiftly establish a national standard to protect workers and ensure common sense workplace protections during extreme heat conditions.

Farmworker is just one example. A lot of times truck drivers, warehouse workers, others are exposed to extreme heat. This and other efforts to protect workers are critical policy components of climate adaptation. So Doctor, as global temperatures continue to rise, what impacts should we expect to see on workers and what additional steps can we take to protect the vulnerable individuals, especially those in agriculture?

Dr. MORETTI. Thank you very much Senator for the question. I think you hit on a very important point, which is that there are certain populations that are very vulnerable, outdoor workers in particular. When they show up to the Emergency Department with heat stress or heatstroke, we treat them with IV fluids and we cool them down.

But then we discharge them home, and they go home and they go back to work, and they're put at the same risk. The problem is is that adaptation only gets us so far. We can only adapt to a certain level before those adaptation mechanisms start to fail us, and here's a prime example. The way that we protect those workers is that they don't work on really hot days where our bodies are not safe.

That means they're not working. That means they're not earning a wage, and it hurts our economy. So that's a severe limitation as our temperature starts to rise.

Senator PADILLA. And if you can just expand on that for a second. Outside of mortality cost, that's what people tend to focus on, can you just speak for a minute on the economic impacts or lost labor productivity as a result of unsafe working conditions?

Dr. MORETTI. Correct. So there—I don't have exact numbers, but I am happy to find them for you. But these are patients that I would tell not to work. I tell them not to work on certain heat days if possible, and I will tell you that there is a subset of my population that will not be able to listen to me, that will go to work regardless and that will come back to the Emergency Department with the same problem I sent them out with.

This is a huge actually example. Out west, I was speaking to a college of mine during the wildfires, who was treating asthmatics as a revolving door. He would treat them, they would get better, he would send them back out into the smoke, and a day later they would come back, because he couldn't treat the underlying cause. He couldn't get to that root cause to treat them.

So we (1) have increasing health costs, because a lot of them are covered on Medicare and Medicaid, (2) we have their lost labor and they're unable to work, out with sick days. And so we're losing, we're losing economic drive on multiple fronts.

Senator PADILLA. You're such an expert, you anticipated my next question, which is this, you know. Fire, excuse me, extreme heat often leads to fire.

Along with fire, we get a lot of smoke, and Californians in the fire-prone areas of this state are exposed to smoke for an average of about three months per year, resulting in poor health outcomes that you've begun to describe in addition to the economic losses and a reduced quality of life.

As climate change continues to increase, the frequency and severity of wildfires, more and more communities beyond just the western United States are impacted by these harmful effects. I know the last couple of years, I'll get occasional calls from colleagues in the Midwest complaining about the smoke emanating from large fires in California, even the colleagues on the east coast.

A recent study in *Nature* suggests that wildfire particulate matter may be ten times more harmful than other sources of pollution. So given that wildfires are only growing more extreme and frequent, how can we better mitigate the impact of smoke-related health risks for underserved and rural communities that are often most at risk?

Dr. MORETTI. So we talk about mitigation and we talk about adaptation. To mitigate these risks, we need to mitigate climate change, and we need to limit our fossil fuel combustion and that which is emitted.

As an adaptation mechanism, we need to identify these at-risk populations and we need to start to put in public health policies that protect them, such as allowing them to be indoors with air conditioners when it's safe, air purifiers when PM 2.5 levels get to dangerous levels. But these treatments happen before they get to me in the Emergency Department.

Senator PADILLA. Thank you very much. Senator Grassley.

Senator GRASSLEY. Thank you Senator, Mr. Chairman. I'm going to read to Mr. Shellenberger three or four sentences from a July, 2021 Wall Street Journal op ed, and ask if you can give a short answer that it's right or wrong from your point of view.

"Heat deaths are actually a bigger problem than the news reports would suggest. Most heat deaths happen without a news crew to document them. Studies show that heat kills about 2,500 people every year in the United States and Canada. Each year, more than 100,000 people die from cold in the United States, and 13,000 in Canada, which is more than 40 cold deaths for every heat death.

"On a worldwide basis, cold deaths vastly outnumber heat deaths." The last sentence says "Globally every year, about 300,000 deaths are caused by heat, whereas about 1⁷/₁₀ million people die of cold."

Mr. SHELLENBERGER. Yes sir, that's accurate.

Senator GRASSLEY. Okay. Then I want to—I was going to ask Dr. Greenstone a question, but I'm just going to make a statement about some testimony that he gave in 2020 before the House Oversight Committee. He claimed that the mortality rate under a quote-unquote "high emissions scenario" will be ten deaths per 100,000 Americans by 2100, similar to today's mortality rate from car accidents.

The CDC recently published this graph for the ten leading causes of death in America, and as you can see, each of the ten deadliest public health conditions currently have mortality rates above your worst case scenario for climate change.

Now to Dr. Schramm, let me read you a few headlines of the past six months from the New York Times. “Deaths from substance abuse rose sharply among older Americans in 2020. Following a two year decline, suicide rates rose again in 2021. Alcohol deaths claim lives of working age Americans. These are real public health challenges. However, many on the left have become accustomed to labeling everything from sexism to gun violence to President Trump somehow as a public health challenge.

So Dr. Schramm, what sort of data framework or methodology should policymakers use to determine what is or is not a public health challenge?

Dr. SCHRAMM. Senator, thank you. I think perhaps the best way to approach this to think about whether or not public health can intervene in those problems. So for example, the question of elderly drug abuse or substance abuse, how is that they can be dealt with by the CDC or by public health officials?

It’s not clear that traditional methods of intervention, that is case finding and case tracking, can modify or mitigate this problem. The real issue has to go to denying our population these drugs. This is a huge issue and that’s where the real costs are imposed on the public budget.

Secondly, it goes in the same direction for suicide. It’s very difficult for the CDC to effectively mount a program that would reduce suicide. The tools of public health just don’t go there. Suicide reflects much larger conditions in the society, some of which actually Dr. Moretti points to in terms of the implications of disease on emotional stability and emotional security.

These are difficult issues, and they are really difficult when we consider them in the context of the federal budget, because we spend huge amounts of money needlessly and without any effect, and don’t point to the issues that could really be changed if we could in fact mitigate these by the control of substances.

Senator GRASSLEY. Thank you. Mr. Shellenberger, in your testimony, you say “Poor people and people of color are disproportionately impacted by climate policy restricting energy consumption.” Could you elaborate on how climate policies implemented in the name of disadvantaged groups often harm more than help such groups?

Mr. SHELLENBERGER. Yeah, absolutely. I mean one of the main ways is just by making electricity more expensive, which makes it—which means that people use air conditioning less. So one of the ways that people end up dying is that they, they can’t afford to turn on the air conditioner or they can’t afford air conditioning. So anything that makes electricity expensive is going to result in less air conditioning and higher deaths.

Senator GRASSLEY. Thank you, Mr. Chairman.

Senator PADILLA. Thank you. Senator Johnson.

STATEMENT OF SENATOR JOHNSON

Senator JOHNSON. Thank you Mr. Chairman. Dr. Moretti, in your testimony you said that the health consequences are so vast and varied that the role of climate change is often hidden. Then you go on to say “but sometimes, the relationship to climate change is very clear.” Then you talk about a construction worker who was overcome by heat.

Well, I think it’s very clear that that construction worker was overcome by heat, but as Mr. Shellenberger talked about, a heat wave that tops out at 110, is it going to be that much more threatening than a heat wave that tops out at 109?

And then you go on. Again, you just made it seem like climate change is causing all these things with such certainty it kind of amazes me. I’m not a climate change denier; I’m just not a climate change alarmist. You seem to be an alarmist.

Dr. MORETTI. I think that’s because I’ve seen it. We’ve had seven years in Rhode Island of worsening, record-setting heat. We know that temperatures are rising because of climate change. We know that the main—

Senator JOHNSON. But that’s actually disputed, okay? I mean I know you know it, but it’s disputed. Let me ask you a question. Do you know how many deaths have been reported worldwide on the Vaccine Adverse Reporting System related to the COVID-19 vaccine? Do you know how many worldwide deaths are reported?

Dr. MORETTI. I do not, Senator.

Senator JOHNSON. You should, but let me tell you. It’s 35,152. Now most people don’t know that because it’s been largely suppressed and censored. 8,743 of those deaths have occurred on either day of vaccination or within one or two days. That’s 25 percent of those 35,000 deaths reported on VARS, associated with COVID-19 vaccines.

Now our federal health agencies, who have not been honest and transparent with us, they’ve not made the correlation. As a doctor I want to ask you, would you be—are you concerned when you hear, you weren’t aware of those statistics and I’m just giving them to you.

Would you be concerned if there is any kind of drug intervention where you have reported to our federal health agencies 35,000 deaths and 25 percent of those occurring within two days of the administration of that drug? Would that concern you? Would that be something you’d want to investigate?

Dr. MORETTI. I would need to understand more about the statistics of where those numbers came from.

Senator JOHNSON. Okay well—

Dr. MORETTI. I do know that we’re seeing rising temperatures in Rhode Island, increasing heat waves with increasing frequency, and increasing stress on the Emergency Department with worsened outcome.

Senator JOHNSON. So now I’m aware there are all kinds of, and you know, climate change alarmists are leaping to all kinds of conclusions to scare the you know what out of the American public, to spend trillions of dollars, money we don’t have that are much better spent in other ways.

Mr. Greenstone, I actually found that chart of yours somewhat comforting for at least America. When you take a look at the mortality, and again these are all projections. I don't, I don't put any stock in them whatsoever.

But by your own projections, throughout the United States because of climate change, we're going to actually have a reduced risk of mortality overall in the United States, and wouldn't that be a tie-in with what the study from Lancet in 2021 said, that we suffer about 600,000 deaths due to heat every year, but 4.5 million deaths because of cold?

So in terms of excess deaths, a warming globe is actually beneficial. In my own state, your study shows that we would have a reduction in mortality of somewhere between 54 and 56 people per I guess it's 100,000. Why wouldn't we take comfort in that?

Dr. GREENSTONE. So thanks for the question, Senator Johnson, and what the work shows and the chart is that the effects of climate change are going to very unequal, and absolutely Wisconsin, Chicago where I live, the reduction in cold days, the benefits from that will outweigh the damages from the hot days.

But if you look more carefully at that, there's large swatches of the country where the damages will be much larger, and in fact—

(Simultaneous speaking.)

Senator JOHNSON. But again do you want—if you want to balance, if you want to balance—if you want to balance it all out globally, if you're trying to mitigate harm globally, isn't it true that the number of deaths, according to this Lancet study, the number of deaths caused by heat are 600,000 per year; deaths caused by cold are 4.5 million annually?

In terms in global health, in terms of excess death, we're actually—you're in a better position to prevent death by having the climate increase in temperature a little bit, right?

Dr. GREENSTONE. So Senator, I'm not familiar with that study. What I am familiar with is my study. Your characterization of it is incorrect.

Senator JOHNSON. Well your study is very favorable to my state. Our mortality—

(Simultaneous speaking.)

Dr. GREENSTONE. Wisconsin will benefit in terms of mortality. There are 49 other states in the United States. Many of them will suffer. Many of them will suffer more than Wisconsin will gain, and that is—that is the nature of climate change. It's very unequal.

Senator JOHNSON. According to your study, you're concerned if you're in the hot region of Africa, but in terms of the United States and most of Europe, we're in pretty good shape. We're all blue. We have reduced risk of death.

Dr. GREENSTONE. If you look carefully at the top of that figure, a large section of the country is not blue. Those are the areas where some of your colleagues represent people, and those people are going to face increased risk of mortality.

Senator JOHNSON. Thank you, Mr. Chairman.

Chairman WHITEHOUSE. Thanks Senator. Delegate Smith, the effect you mentioned of the three percent increase in temperature, 3 degree increase in temperature in Maryland being exacerbated by

urban heat islands, do you have any rough quantification of how much beyond the 3 degrees the urban heat island effect can take a neighborhood?

Delegate SMITH. Thank you so much for the question. So the City of Baltimore has over the past century seen a 3 degree increase, but that's larger than the average across Maryland as a state, and also it's about double the national average for the country.

And so that's pretty alarming for the communities I represent, particularly because as you've noted from some of the other testimony and responses, when you do not have a lot of green space nearby, it makes it very difficult to cool. Personally, when I lived at the top of my district, I did not have central AC. I was in another home almost 100 years old, but the trees were mature, there was grass all around, and I could just put a fan on and be relatively comfortable.

But one of the things that makes rowhomes great in the winter is that they trap heat, which is good in the winter. However in the summer, and now that I live in a row home, it can be incredibly hot and these are communities quite frankly, there's been research to show that the same communities that were impacted by redlining are disproportionately the overheated parts of the city presently that are experiencing the urban heat island effect, and my communities are no different from that.

So communities that were redlined are less likely to have trees in them, and as many of us know it takes a while for a community to get the full benefit of a tree, right? And so we need to make these investments yesterday, and I know that just in the past few years and we've seen tree plantings in my part of East Baltimore, you're seeing more comfort for those that are situated nearby.

But quite frankly, if we do not simply provide more green attributes to communities like the ones I represent, you can have all the AC you want, but you're really not getting to the root of the problem. We can't be resilient and we can't reduce emissions if we're not looking at some new avenues.

Chairman WHITEHOUSE. And your constituents in urban heat islands are likely to turn where for health care, to federal programs?

Delegate SMITH. Absolutely. As a city, approximately 60 percent of residents in Baltimore City are on Medicare and Medicaid, and particularly the communities that are closely situated near me in East Baltimore. These are some of the communities that have some of the lowest life expectancies in the city.

So even though they have proximity to world class health care at Johns Hopkins, it doesn't mean they always have access. And so yes, federal programs are instrumental and often under strain when extreme heat and other challenges present.

Chairman WHITEHOUSE. As we saw in Oregon and Washington, where they've had to actually revamp Medicaid programs to address with the risk after the heat waves out there, the deadly heat waves out there.

Dr. Moretti, last summer was the hottest August on record in Rhode Island. How did that play out in your emergency room?

Dr. MORETTI. So thank you Senator for the question. We are struggling. Health care is tenuous and has not recovered since COVID. I think that we saw how fragile our health system can be

with COVID-19, and I am concerned as we continue to see more climate hazards, to what this will do to the health care system.

Last summer, the Emergency Department was full. My bosses were on local television asking patients to seek care elsewhere whenever possible because we were struggling to treat the patients that showed up to our door. We were seeing patients in waiting rooms, we were seeing patients in hallways.

(Pause.)

Dr. MORETTI. This was exacerbated by the heat, and it's worsened by poor staffing since COVID. I am concerned what will happen as we continue to see increased climate hazards. In emergency medicine, we define a disaster as an event, such as a climate hazard, whatever it may be, that overcomes our resources. Right now, the health care system nationally is perpetually on the edge of a disaster.

Chairman WHITEHOUSE. There have been roughly speaking two ways that the reporting about health harms from heat have been quantified. One has been to look at the actual diagnosis or the cause of death report, and pick out the causes that reference heat.

Separate from that, in Rhode Island, by Brown University as I recall and also out in California and perhaps others, there have been studies that looked at the statistical coincidence of various morbidities and mortalities during heat wave events, and then looking at those additional deaths and illnesses, and going back and seeing could that correlated.

Could you talk a little bit about what that second round of inquiry has established, and then I'll turn to Senator Van Hollen it looks like.

Dr. MORETTI. Yeah, thank you Senator. So because heat impacts health through many different mechanisms, we cannot only look for heat stress or heatstroke within the medical records. Similarly, the patient I talked about who suffered heat stress working in construction, it's very likely that in his hospitalization, his diagnosis was coded as rhabdomyolysis and acute kidney injury, with no mention of heat.

So even as clinicians when we know heat is playing a factor, it may not be coded correctly within the medical records. So when we do the second methodology that you're talking, when we look at a population level and look for increasing, increases in hospitalizations over all diagnoses, we see much greater effects, up to 37 percent increase in visits, which is missed in that first mechanism of only pulling out diagnoses of heat illness and heatstroke.

Chairman WHITEHOUSE. So the statistical method is more reliable?

Dr. MORETTI. It captures a larger patient population. However, that does not allow us to look at individual patient characteristics.

Chairman WHITEHOUSE. Senator Van Hollen.

Senator VAN HOLLEN. Thank you, Mr. Chairman. Good to be back. So Delegate Smith, I do want to follow up on some of the points you made in your testimony regarding the impact of climate change and how it's affected temperatures in Baltimore City, and the heat islands that it's created, and measures that we can try to take to mitigate that, right, even as we also try to address the overall issues.

Can you speak to some of the issues the Chairman raised, and I appreciate him talking at the outset about the House Republican plan that may be voted on this week, that would essentially undo entirely the climate benefits of the Inflation Reduction Act, including investments in energy efficiency and providing rebates for homeowners to make their homes more energy efficient, which not only has air quality benefits but also saves people in their pocket-books.

If you could just talk to the role of federal investments in trying to address some of the issues that you've raised?

Delegate SMITH. Thank you Senator for the question. The investments that are in peril that you've highlighted are incredibly important to the people I represent. So you know that in many instances, seniors are over-represented in the vulnerable groups that we've been discussing today as we—in regards to heat.

And so having some of those energy efficiency rebates made available means so much to legacy residents that want to be able to age with dignity and comfort in the homes that they're living in.

But also in Baltimore City, it's the most transit-dependent part of the state of Maryland. So many people, roughly a third, do not have access to a vehicle. So the investments we're making in just infrastructure to be safer for pedestrians and bikers, those are also relevant to people I represent, because we want to ensure that we're doing things that allow people to move safely, but also reduce emissions that bring them harm.

From my residents that have to stand at bus stops, it's going to be advantageous to have buses go by that are not emitting the same amount of pollution as others. So it's been critical to see that investments in green infrastructure and having community-led initiatives around climate resilience that are also going to create jobs in communities.

So the same communities that are most exposed to the harm, could also be at the forefront of the remedies. I know we have great organizations like the Baltimore Tree Trust and Civic Works that are at the forefront of, you know, planting trees and also doing other installations related to climate resilience that the Inflation Reduction Act are making possible.

And so I want to thank this body. It was a bipartisan effort that made that Act possible, and it's going to have real benefits for the communities I represent, and other communities across this country that bear a disproportionate burden because of heat exposure.

Senator VAN HOLLEN. Thank you, Delegate Smith. So there have been a number of studies obviously that look into the health impacts of climate change. There was a study done by Johns Hopkins in our state of Maryland and MIT's Laboratory for Aviation and the Environment, indicating that Baltimore's asthma hospitalization rate is one of the highest in the country, and that the city's premature death rate due to air pollution is also one of the highest in the country.

Dr. Moretti, can you discuss that link between climate change and how it acts as a threat multiplier and threat magnifier for communities like Baltimore?

Dr. MORETTI. Thank you Senator for the question. So we see climate change acting to impact our health through many different

mechanisms. It's a threat multiplier in that regard. So increasing temperature in and of itself has increasing health harms.

But at the same time, it increases levels of PM 2.5 air pollution, which are toxic when we breathe them in and cause airway inflammation. Secondly, we can see other effects as we see disasters that affect supply chains, disrupt health care systems and those affect health.

We see decreased number of days for growing and so we see increasing food insecurity globally, as we're having increasing droughts. So through all of these different mechanisms, we see climate health impacts. However, certain populations are more at risk for these, and so we get risk upon risk upon risk for vulnerable populations.

For example, heat is a risk. That heat risk is magnified in an urban heat island. At the same time, that urban heat island is next to a highway, where you have increased air pollution and increased PM 2.5 levels. Moms were exposed to that level, which means that transmit that risk to baby, who has an increased risk of asthma before birth. Then at birth they live in an environment which augments this risk even further.

Senator VAN HOLLEN. Thank you. I appreciate your testimony. Thank you all for being here.

Chairman WHITEHOUSE. I'm going to do a quick second round, since I haven't had the chance to speak with all of the witnesses yet.

Dr. Greenstone, your testimony I believe was that some of the dominant economic impacts from climate change occur in health costs. I observed the fossil fuel industry's latest strategy to argue that climate safety policies are too expensive, that studiously ignoring the climate harm side of the balance sheet. What does your research say about the economic costs of ignoring climate harms?

Dr. GREENSTONE. Thank you for the question Senator, and again for the invitation. So I do think it's worth saying that climate policy will have costs. There's no question about that. But what comes out of my research, as you were suggesting, is the other side of the ledger, the benefits.

And what my latest research is indicating is that we had and the U.S. government had been grossly understating the costs of or the benefits of reducing greenhouse gas emissions. And so I think a clear way to think about the problem is that every ton of CO₂ that gets reduced, it will cost something, but it's going to generate benefits of \$190 per ton.

And we know from the operation of the RGGI greenhouse gas market along the Atlantic coast and in California, it's quite possible to get reductions in CO₂ at much lower prices. So the price in RGGI is maybe \$15; in California it's 20–30 dollars. So you can get benefits that exceed costs by a factor of six or seven to one. That's kind of the bottom line for my research.

Chairman WHITEHOUSE. Thanks, and with respect to Dr. Moretti's observation about the difference between the two methods of determining health-related harms, do you agree that that's a cause of the understatement of the health harms?

Dr. GREENSTONE. I absolutely agree with that, Dr. Moretti. The evidence is very clear. The challenge if you're trying to count up

deaths from heat waves is it's not written on the death certificate, and it actually doesn't just lead to premature mortality the day of the heat wave, but can take a couple of days or even a week.

And so you have to use statistical methods to add all that up, and that is why we end up with much larger numbers from the second approach.

Chairman WHITEHOUSE. You closed your comments with an affirmation of the importance of markets in making these decisions. You're also the Milton Friedman chair I think is the right term. My recollection is that it was Milton Friedman's teaching that you didn't get a proper market signal if you didn't put the costs of pollution into the price of the product that was causing the pollution.

Is that a correct layman's summary of the economics of market pricing and negative externalities?

Dr. GREENSTONE. Yeah. So Senator Whitehouse, you've far surpassed being a student at the University of Chicago, but that would certainly be an A at the University of Chicago, and I think the broader point, which I'd like to pick up on is—which I actually found quite interesting in Mr. Shellenberger's testimony, is that he ended with a call for there to be a use or reliance on lower fossil fuel, energy sources that lower fossil fuels, and I want to connect it to your question.

You know, I personally don't believe in fairies and I don't believe in unicorns, and I don't think rainbows happen just because you want them. And so in order to make the transition, there has to be, and in a reliable way there has to be a market signal exactly along the lines that you suggested Senator.

And that will unleash the creativity and the entrepreneurialism of people in the energy industry, and produce exactly what Mr. Shellenberger was asking for, and lead to lower emissions, benefits at \$190 per ton and minimizing costs for American families.

Chairman WHITEHOUSE. Just to put a bit of a quantification out there, my recollection is that the latest study on the effective subsidy supporting fossil fuel consumption in the United States, which was performed by the International Monetary Fund, which I think you'll agree is a credible economic agency.

Dr. GREENSTONE. Yes, I do. It would not be an A like you, but A minus we'll say.

Chairman WHITEHOUSE. Great, is that the subsidy, the effective subsidy for fossil fuel runs to \$660 billion just in the United States annually, and that the bulk of that subsidy comes from this point that we were talking about, which is that they get to pollute for free, and don't have to put the cost of the harm quantified in my opening statement at \$800 billion per year in health care costs, into the cost of their product.

And around here, there's an entire political party dedicated to protecting them as they pollute for free. I'll turn it back to Senator Johnson, if he wishes to have another round. But before I do, let me just be clear. Does anyone on this panel contend that there is not a reliable correlation between carbon emissions and increasing global temperatures?

(No response.)

Chairman WHITEHOUSE. Zero for five. No one contends that. Okay. Senator Johnson, you wanted to take another round.

Senator JOHNSON. Thank you, Mr. Chairman. Dr. Greenstone, I have to admit I was surprised you've done all this research and you weren't aware of the Lancet July 2021 article comparing deaths caused by heat versus cold. But let me give you another question here.

In a previous hearing, I asked the witnesses whether they knew how much we had already spent on climate change. You're saying there's a, you know, six or seven dollar benefit for every dollar spent. So first of all, do you know how much we've already spent combatting climate change globally? Do you have an estimate for that?

Dr. GREENSTONE. I'm unaware of a reliable estimate, Senator.

Senator JOHNSON. Okay. Anybody here? I'll tell you, we had a witness that says about \$5 trillion. So if your multiplier is accurate, we should have already seen about a 30 to 35 trillion dollar economic benefit from that \$5 trillion.

By the way in the Inflation Reduction Act here, supposedly we got a little under \$400 billion of energy credits and dollars going to what I would call green energy boondoggles. Goldman Sachs estimated that cost about \$1.2 trillion. So you directly understate how much we're going to spend on this, in what I would say is a futile effort to try and hold back the tides.

Dr. Shellenberger, I read your book, *Apocalypse Never*, and I don't want to summarize it for you but I will. Seemed like you were making the point that economic progress and having a strong economy is probably the most important thing to concentrate on and spending like \$5 trillion, to apparently have no impact on our environment because they're still, you know, people are still saying it's going to—the world's going to end in 12 years. It's wasting limited resources. Does that pretty well typify your views?

Mr. SHELLENBERGER. Yeah, that's definitely one way of describing it. I think the way to think about this issue in general is around energy transitions, and we go from wood and dung to coal, hydro, oil and gas, to nuclear. Each step along the way, those transitions are made by the new fuel becoming cheaper and more abundant than the older fuel.

It's simply not the case that we got a transition from coal to natural gas by making coal expensive. We didn't have a carbon price. I mentioned that we did not pass Waxman-Markey Cap and Trade, and yet we reduced our emissions by almost 22 percent.

That's the story everywhere in the world. So these economic models are very misleading in that sense, and just to make one other point here, the Chairman—Chairman Whitehouse mentioned this IMF study. That is an absolute garbage study, and I assure you that Mr. Greenstone, I do not think that he agrees with that study.

That study counted as a subsidy for fossil fuels the externalities of fossil fuels. It counted externalities and relabeled them "subsidies," and it did not count the benefits. So it was a cost analysis, not a cost-benefit analysis.

Senator JOHNSON. So let's talk about the costs of green energy. Let's talk about the cobalt mining in the Congo utilizing child labor. Let's talk about the mining of other rare earth minerals. We don't even have close to enough currently to produce what's being envisioned. Can you just kind of speak to I would call it the fantasy

nature of what is being proposed right now and what's being imposed on our economy?

Mr. SHELLENBERGER. Absolutely. So the supply chains for renewables and batteries are a total human rights and environmental nightmare. Starting in the Congo with cobalt mining, which is absolutely barbaric. Many people have seen the videos of people being buried alive.

Ensuring that the solar panels being made predominantly by Uyghur Muslims in concentration camps. That's a part of China that the Biden administration says the Chinese government is committing genocide against the Uyghur Muslim minority there. That's how our solar panels are being made.

The calculations and the carbon intensity of solar panels appear to be totally incorrect, because they're based on a cleaner European grid rather than the coal-based China grid. So a total nightmare, and then the other final problem with renewables is because sunlight and wind are energy dilute. It requires three to eight hundred times more land and a significantly higher number of projects to produce the same amount of energy as you would from a nuclear natural gas plant.

That's why there's 8,000 solar, wind and battery projects in the United States right now that are not hooked up to the grid, because they can't get enough transmission because of all the different land use problems and regulatory and cost burdens associated with moving from energy dense to energy dilute fuels.

Senator JOHNSON. So I'm highly concerned about the corruption of scientific inquiries, scientific studies, because they're being funded by organizations, sometimes government that know what they want in terms of result. Can you just kind of speak to the problem that we're experiencing in terms of, for example, scientific studies that can't be repeated?

Mr. SHELLENBERGER. Yeah.

Senator JOHNSON. The corruption from medical journals, these other scientific journals?

Mr. SHELLENBERGER. Absolutely. I mean we need evidence-based policymaking, not policy-based evidence making, and yet that's what we've seen here. We've seen it with the IMF study, seen it in many other studies where people have an outcome in mind like 100 percent renewables, and then they proceed along a course to do things like shutting down nuclear power plants, increasing carbon emissions, making electricity expensive, preventing poor people from having access to air conditioning.

So you're absolutely right. We need to have evidence-based policymaking, not policy-based evidence making.

Senator JOHNSON. Thank you Mr. Chairman.

Chairman WHITEHOUSE. Mr. Greenstone, you seem to be wanting to respond.

Dr. Greenstone. Oh, there's—thank you, Senator. There's a lot to unpack here. I think I would just say I'll return to the peer-reviewed scientific literature that I've participated in, and the evidence is quite clear that reducing carbon emissions, and I think Senator Johnson makes an important point.

Climate change isn't going to just go away. It's a massive problem. The whole world is contributing to it. So if the test is will X

dollars cause climate change to forever more disappear, the answer is always going to be no. But what the evidence is clear about is that policies have reduced emissions. There's a wide berth for them to have benefits that are many times larger than their costs, and I think that's the—you know, God grant me the wisdom to know the difference between the things I can control and the things I can't.

The things I can control or the things that the United States can control are its emissions, and those reductions in those emissions have the potential to be one of the largest public health benefits in human history, and have the potential to have benefits that would vastly exceed their costs.

Chairman WHITEHOUSE. Thank you. Mr. Shellenberger, first thanks for being here. It seems that there are some areas where you and I agree, so let's start with your assertion that climate change is happening. Is that correct?

Mr. SHELLENBERGER. Yes sir, and I think we also agree on the importance of nuclear energy. So I'd like to acknowledge that agreement as well.

Chairman WHITEHOUSE. And you believe that humans are contributing to climate change?

Mr. SHELLENBERGER. Oh absolutely.

Chairman WHITEHOUSE. Through carbon emissions.

Mr. SHELLENBERGER. I have for 30 years sir.

Chairman WHITEHOUSE. And to quote you the cause of climate change is rising energy consumption using fossil fuels; correct?

Mr. SHELLENBERGER. Correct.

Chairman WHITEHOUSE. And you also argue in your testimony that "It would be best for global temperatures to remain stable"?

Mr. SHELLENBERGER. Yeah.

Chairman WHITEHOUSE. And that's because there are risks and dangers associated with rising temperatures globally?

Mr. SHELLENBERGER. Any, really any change. It would be risk of global cooling as well.

Chairman WHITEHOUSE. Yeah, but that's not the risk we're presently facing, is it?

Mr. SHELLENBERGER. Correct.

Chairman WHITEHOUSE. With respect to the IPCC, do you consider their work to be solid and reliable?

Mr. SHELLENBERGER. Yeah absolutely for the most part, and I rely almost entirely on it.

Chairman WHITEHOUSE. You claim that renewable energy is always expensive. One of your critiques is its cost, yet I repeatedly see studies that renewable energy is now less expensive, less costly than various fossil fuel sources, and that comparison showing clean energy to be less expensive does not even take into account the question of the negative externalities.

Are you sure that it is true that renewable energy is always expensive compared to fossil fuel?

Mr. SHELLENBERGER. So my claim is that renewable, that intermittent renewables, excluding hydro, make electricity expensive. But let me ask you sir, if solar and wind are so much cheaper than existing energy, why did the Congress approve \$370 billion to subsidize solar and wind?

Chairman WHITEHOUSE. I would argue because it's such a tiny fraction, to give it half a chance against the \$660 billion subsidy for fossil fuel.

Mr. SHELLENBERGER. But if it's already cheaper, then why would you need any subsidy?

(Simultaneous speaking.)

Chairman WHITEHOUSE. It's pretty basic economics that negative externalities belong in the price, and therefore are a subsidy, everything from Milton Friedman to the IPCC to the IMF. So you and I are just going to have to disagree on that.

You have expressed skepticism about the relationship between climate change and various extreme weather events.

Mr. SHELLENBERGER. Skepticism wouldn't be the word I would use.

Chairman WHITEHOUSE. What word would you use? I want to make sure I say it right.

Mr. SHELLENBERGER. Evidence-based. I mean everything that I—every statement I've made is either in the IPCC or peer-reviewed scientific literature. So it depends on the extreme weather you're talking about.

Chairman WHITEHOUSE. So you have former colleagues and collaborators who are actual climate scientists, which you are not, who have said some things about these claims of yours. Zeke Hausfather—

Mr. SHELLENBERGER. He's never been a colleague of mine.

Chairman WHITEHOUSE [continuing]. Who worked at the Breakthrough—you worked with him at the Breakthrough Institute, did you not?

Mr. SHELLENBERGER. He was never a colleague of mine.

Chairman WHITEHOUSE. Okay. He wrote "Shellenberger's claims that climate plays no role in natural disasters and wildfires fly in the face of a large peer-reviewed scientific literature showing clear links between climate change and extreme heat events, drought and extreme rainfall, as well as links between hotter and drier conditions and wildfire areas burned in many regions of the world."

And Kerry Emanuel, professor at MIT who provided you a blurb for your book, wrote "The cleanest way to look at climate effects on natural phenomena is to look at the phenomena themselves. Here, there is strong and mounting evidence that climate change is increasing precipitation extremes, floods and droughts, conditions for wildfires and the incidence of strong hurricanes. Whichever way one looks at it, Shellenberger's statement is not defensible."

Mr. SHELLENBERGER. Do I have time to respond, or are you not going to let me?

Chairman WHITEHOUSE. Well, I'll give you a minute to respond.

Mr. SHELLENBERGER. Okay. So first of all Tom Woodley, the co-founder of climate science modeling called Apocalypse Never "perhaps the best environmental book ever written." Kerry Emanuel, as you mentioned, also blurb'd the book and I've been working with James Hanson to save nuclear power plants around the world for the last several years.

(Simultaneous speaking.)

Chairman WHITEHOUSE. I didn't say you were wrong about everything. I just said you were wrong about that.

Mr. SHELLENBERGER [continuing]. Natural disasters, there's a single—there's a single source of data on natural disasters globally called the EM-DAT Data Center in Belgium. It shows natural disasters going down over the last 22 years. Do you know why that is? It's because what we classify as disaster's costs and deaths, and those have been going down because human resilience has been going up.

So the conflation of extreme weather and natural disasters is extremely misleading. Yes, I agree with more heat waves, greater temperature extremes, greater precipitation, absolutely. But no increase in landfalling hurricanes in the United States. Anybody who claims different is lying to you.

Chairman WHITEHOUSE. Isn't that truly the measure, when you count the actual harm from the hurricanes like—

(Simultaneous speaking.)

Mr. SHELLENBERGER. Yeah, because when you factor in—when you factor in more—when you factor in more wealth and more people in harm's way, you do not see an increase. In fact, we're seeing a decline.

Chairman WHITEHOUSE. Did you factor in increased rainfall and increased wind speed?

Mr. SHELLENBERGER. Yeah, absolutely. I mean look, there's a single source of data on it. You can check it yourself. I'm sorry, what is the question?

Chairman WHITEHOUSE. Do you factor in increased rainfall and increased wind speed in your analysis?

Mr. SHELLENBERGER. It's not in my research. There's only one—I mean there's only—and we're looking at landfalling hurricanes, is that what we're talking about? It's flat, okay. So it's not like there's—it's not like there's multiple studies. There's just counting landfall, and the best study is by NOAA. NOAA predicts—

Chairman WHITEHOUSE. Well, you keep changing the subject back to landfalling hurricanes.

Mr. SHELLENBERGER. What do you want to talk about sir?

Chairman WHITEHOUSE. I asked you about increased precipitation from those hurricanes and increased wind speed?

Mr. SHELLENBERGER. Yeah.

Chairman WHITEHOUSE. With more wind speed and more precipitation, you get more damage, even if it were correct—

Mr. SHELLENBERGER. No, not if you have rising resilience you don't sir. In other words, and if you look at NOAA, they predict five percent increase in intensity of hurricanes, 25 percent decline in frequency, both of which are predictable by the physics. There's not really a debate. But I agree. We will see more precipitation because of climate change.

Chairman WHITEHOUSE. Correct. Senator Kaine. Saved by the bell.

Senator KAINE. This is one of these days where I have made four committee hearings between 9:30 and 11:45, and when I do that, my staff rewards me by allowing me to start tomorrow at 6:45 a.m. instead of 6:30.

But I'm sorry that I've missed the entire discussion. I'm very, very interested in this topic, and I guess maybe—

Chairman WHITEHOUSE. On that subject Senator Kaine, if you don't mind I will—I have another meeting to get to.

Senator Kaine. Oh okay.

Chairman WHITEHOUSE. If you don't mind closing is up, we have the closing materials.

Senator Kaine. That's what I'll do.

Chairman WHITEHOUSE. Finish your questioning, and then we're ready to go.

Senator JOHNSON. Well, I do get another round here, correct Mr. Chairman?

Senator Kaine. Yes.

Chairman WHITEHOUSE. You did.

Senator JOHNSON. No. You've had three now. I'm going to have—I get another round of questions, especially after you badgered our witness. We'll talk a little bit of reality when I get around to it.

Chairman WHITEHOUSE. I'm going to add these documents to the record.⁸

STATEMENT OF SENATOR KAINE

Senator KAINE. You will get more questions and out of delusions of grandeur, I've decided to move up to dais, to take advantage of Sheldon Whitehouse's departure. Virginia's a state that really sees a lot of climate effects, and it's interesting that over my time in public life, the dialogue in Virginia has gone from likely effects in the near future to today.

And the two areas of the state that are seeing it the most, but not only these two areas of the state, are the Hampton Roads area, which is so vulnerable to sea level rise, and the Appalachian area, which because of the narrowness of the valleys is really vulnerable to intense flooding. The rainfall in some of these areas in Virginia is not changing over time. You can look at annual rainfall.

It's not changing very much, but it's just being produced in fewer extreme storms, and the infrastructure that we have, schools, roads and health care infrastructure frankly in a part of the state where people often have less access to infrastructure, including health care. The infrastructure just isn't suited for it.

I think there has already been some testimony from Delegate Smith about this issue of urban heat islands. I live in the city of Richmond, and we're a pretty green city compared to many but—in terms of tree cover. But I wonder if as we look to the future in your experience, what more can local, state and federal agencies do together to deal with this heat island issue, which would have a whole range of health effects on people's livelihoods?

Delegate SMITH. Thank you Senator for the question, and actually there's been a lot of coverage about Richmond and Baltimore specifically in the heat and rising heat and temperatures. So I know that there are pockets of both cities that have great tree canopy, right, but there are still parts that are lagging far behind.

I want to lift up—I know you're just coming into the hearing right now, but I think we've talked a lot about the seriousness of premature death because of heat, but I think we need to lift up the fact that quality of life. Sometimes people are merely surviving,

⁸Documents submitted by Chairman Whitehouse appear in the appendix on page 92.

they're not thriving, and I think that as policymakers we don't want people to simply be existing in our jurisdictions and states. We want them to be living their optimal life.

And so what heat islands can really mean in an urban context is if you already have a pre-existing condition like asthma, who wants to have more asthma attacks than you need to because you're constantly being triggered right? We also know for families of school-aged children, asthma is the number one reason for chronic absenteeism from schools, right?

And so as we have rising temperatures, there's not just an impact to the mother or father or the guardian's ability to work in a healthy manner; there's also implications for the young people in the home to be able to thrive as students and learners in the community.

So some of the things that we can do at the local and state and federal level with strategic investments is improve tree canopy. Also, painting roofs white. Sometimes these are simple things we could be doing to reduce the absorption of heat into some of these areas of the city. And then also I know that there's a lot of conversation about where do you put solar energy, right?

And so one of the bills I was successful in passing was really just reducing some of the tax implications for using the unusable, parking decks, other compromised lands, you know, installing solar.

Senator KAINE. Rooftop spaces.

Delegate SMITH. Absolutely, yeah.

Senator KAINE. Uh-huh, and the nice thing about these is they can help you on the health side, but they also are income producers. Somebody with a parking deck that has a roof that's not being used, you can do solar. Somebody can paint a roof white.

They're going to find that not only might that have a positive health effect, it would have an effect on the utility bills as well.

Delegate SMITH. That's right.

Senator KAINE. Dr. Moretti, I want to ask you about one topic, and then I'm going to come to Senator Johnson. As I interact with young people, you know, and I've stopped just thinking of myself like a young person when I got a Medicare card six weeks ago, and when I interact with young people, there is a palpable sense of anxiety among many, dread, fear, kind of an existential one.

Earth Day was Saturday, and I noticed that in my—I live in Richmond, the large public university, Virginia Commonwealth University, had a very sizeable student Earth Day activism, and you know, we have these every year. I see the messaging and it might be pro-recycling messaging or—

But I see some of the messaging getting more and more distraught and more and more anxious. We're living in an anxious time. COVID was tough. Young people in particular, I think, have had a challenging last few years. It's been a time of isolation, COVID, and that's not good for young people or seniors.

But talk a little bit about mental health impacts. As we're talking about COVID effects on health care, I want to make sure we give enough attention to mental health issues, and particularly mental health issues with young people. So what are you seeing in your practice?

Dr. MORETTI. So we're seeing—thank you Senator for the question, and I think you've done a very nice summary of how people feel and how young people feel. We're seeing rising depression and rising anxiety levels in our youth, in our teens, and I think that this is multifactorial.

I think as you pointed out, COVID has had a huge impact and I think that climate change and this recognition of climate change, concerns about the future, add a baseline depression and anxiety to our population. But similarly as we've talked about today, climate change acts through many different mechanisms.

So we have this baseline concern about climate change and rising overall mean temperatures, but on top of that we have mental health outcomes from disasters. So wildfires, hurricanes, etcetera.

Senator KAINE. Yep, shootings.

Dr. MORETTI [continuing]. That augments this. We also see increasing depression and suicide attempts with heat waves and temperature. So there's a physiologic link between these changes as well. So we're seeing changes in mental health through many different mechanisms.

Senator KAINE. And before I turn to Senator Johnson, I guess the other thing I would say is while there are challenges, there are also some upside opportunities in the mental health space being involved as part of solutions, knowing that there are some solutions you can do in your own house, in your own neighborhood, being able to take part in solutions can have a positive impact on mental health because people don't just feel helpless and that it's beyond them.

They believe that they in fact can have a hand in solving it. In Virginia, we've seen this in a significant way. We were never a big producer of alternative energy, low and no carbon energy. Coal yes, natural gas yes, but we were bottom ten solar and no wind compared to other states.

And so when we talk about climate in Virginia, we tended to talk about what I led with, which was the challenges of climate change. Now we've moved into the top quarter in the nation in deployment of solar, and we are going to be the east coast center of excellence for offshore wind, and that is producing not only some jobs; it's also producing a little bit of a positive, you know, kind of can-do attitude.

We're not just a climate change problem child; we're also going to be an innovator. It's going to help not only Virginians and others, and there's a positive mental health side to being a problem solver in something like this. I will yield to Senator Johnson and note that I do not believe I badgered any witness.

Senator JOHNSON. I appreciate that. Here's one proposed solution, by the way, if you want to decrease the stress level in our children. It would be nice if climate change alarmists would stop scaring the you know what out of our children by telling them that the world is going to end in a dozen years, okay. It's not.

But let's talk about some realities. Does anybody here expect either India or China to quit trying to drive, bring their people out of poverty and stop using fossil fuels? Anybody here think that's going to happen?

(No response.)

Senator JOHNSON. Does anybody dispute that by their own models, if we were to eliminate all CO₂ in America, it would have a negligible impact on global temperatures. Anybody want to dispute that one?

(No response.)

Senator JOHNSON. Can somebody explain to me—you know, I look at just some basic facts. Again, this is—I don't deny climate change. I'm just not an alarmist. I look at the Vostok ice core sample, and I see we're in the fifth cycle now. Very consistent, 22.7 degree temperature variations over the span of 440,000 years.

The Greenland ice core sample, the number of them. About 6.7 degrees over the last ten to twenty thousand years since the last glaciation period. This is the one that always shocks audiences, it shocked me, because we're always concerned about sea level rise.

But the increase in sea level in the Bay of San Francisco since that last glaciation period, 390 feet. So any of our witnesses think that there's anything mankind could do or could have done to hold back the tides?

(No response.)

Senator JOHNSON. The answer is no, there's nothing we could have done. So again, like Bjorn Lomborg talks about, is we have limited resources. Dr. Schramm talked about we've been very effective at reducing some of these noxious pollutants that obviously impact health. Spend money on that, you know. Spend money on cheaper energy, nuclear, right? I totally agree.

But the environmental left generally has shut down nuclear plants. So if you're really concerned about CO₂ and I'm not; I think it's a plant food, we'll adapt. But there's far better ways of spending money. Mr. Shellenberger, would you like to comment on that?

Mr. SHELLENBERGER. Yeah. I mean absolutely. I think that the nuclear issue just shows that maybe the people that are raising the alarm about this, there's an ulterior motive going on here. Something else is going on. I mean we've got some big problems with renewables that we need to deal with.

I mean we have Steve Hayes from NOAA, who is a top scientist at NOAA that said that you can't have any more industrialization of the eastern seaboard without threatening the extinction of the North Atlantic white whale. It's extremely troubling. We're seeing a high number of dolphin and whale strandings, beachings since industrial wind activity occurred.

So you know, I know that many people here support nuclear power, but we still don't have a plan to expand it, and that's the easiest and fastest way to transition away from fossil fuels without increasing electricity prices.

Senator JOHNSON. What big wind towers are ever repaired and put back in service, and what is the life of one of these wind towers? And how much copper goes into that, and what do we do with them? Again, we're just ignoring. There was a really good hearing, I saw a clip of it, talking about these large trucks need two batteries. Each weigh 8,000 pounds.

Mr. SHELLENBERGER. Absolutely, I mean these—we talk about the externalities of fossil fuels, but what are the externalities of renewables? It's not like you can put solar panels on a compost bin

and hope that they'll, you know, decompose. There is no end of use for solar panels.

Europeans dump them on African nations. Ours go to landfills. Same thing with used wind turbine blades. It's because it's not cost effective to recycle them. So you have a huge waste problem from these solar panel and wind turbines and batteries that nobody's talking about.

Senator JOHNSON. So Dr. Greenstone, that would be a really good analysis for your research, is again, take a look at the externalities and the cost of all this green energy, what's being proposed. Have you looked at that?

Dr. GREENSTONE. That's an excellent question, and I think one thing that I'm a little confused about the exchange with Mr. Shellenberger here is I don't—the planet doesn't care if we run solar or if we run wind or nuclear for that matter. The planet only cares about CO₂, and so I think that's why many climate, people interested in climate, certainly including myself, advocate for a market-based solution that penalizes the release of CO₂ is causing damages.

So I find the debate about particular technologies a little confusing, and then I just want to add one point that—where I feel like there should be some agreement with Mr. Shellenberger and I, but I'm a little perplexed by it.

He seems to be a big proponent of nuclear, and was engaged in a kind of heated exchange with Senator Whitehouse, well if solar and wind are so great, they would—the market would just adopt them. Well the same challenge applies to the advocacy of nuclear. Nuclear is not—nuclear plants aren't running, they're not being built because they're out of the money. The reason they're out of the money is they cost more than fossil fuels and so fossil fuels have this kind of free subsidy.

So I've just come back to we should aim for a level playing field that does not treat any technology better than the other, and stay focused on what the planet cares about, that's CO₂. It's not a particular technology.

Senator JOHNSON. But nuclear, we kind of regulated up the cost of that. Mr. Shellenberger, you should be able to respond to that.

Mr. SHELLENBERGER. Yeah. I mean look, the planet does care if you use three to eight hundred times more land for producing energy from solar and wind than you do at a nuclear, the planet does care. The North Atlantic white whales do care about that.

If you produce solar panels in China with coal, those are high carbon-intensive solar panels in contrast if you made them in a place and you made them in France, which is mostly nuclear. So of course it matters. So these—as nuclear as you mentioned.

I mean California was shutting down a nuclear plant not because it was expensive, but because of anti-nuclear phobias that date back to the 60's. So nuclear is fundamentally just an issue of public concern. We over-regulated it.

The people that pushed for that over-regulation were pushing for it because they were ostensibly scared of it, but they really favored renewables. There's a whole regulatory paradigm here that has to be taken into consideration.

Senator JOHNSON. And what about the economic or the environmental impact of mining?

Mr. SHELLENBERGER. Massive. I mean that's why—that's why you look at what's happening in the Congo. I mean just go online and look at cobalt mining in the Congo. It's a shame. What's happening in China, it's an absolute travesty. We should not be importing any more solar panels or batteries produced in China to the United States. It's just a fundamental human rights issue.

Senator JOHNSON. Thank you very much. Thank you, Mr. Chairman.

Senator KAINE. Well, I'll just conclude. When I have a Republican witness who suddenly seems to be against all of the above, I'm curious. And to have a Republican witness take up for the whales, it's the first time in my career in public life where someone has done that.

So I'm assuming it's a Road to Damascus experience. I come from——

Mr. SHELLENBERGER. I've been interested in conservation my entire life, with all due respect.

Senator KAINE. Right, that's great. That's great. I'm from a state that's 35 percent nuclear, probably double what the national average is. We're perfectly fine with it. Helps us with climate and we're really proud to be producing more battery-powered heavy duty trucks than any state in the country, and doing offshore wind and growing in solar.

So I—look, American innovation is again rocketing us forward on clean energy. That's such an exciting thing. It's creating jobs, creating opportunities, going to lead to a cleaner planet, gonna lead to better health care and that's exciting.

We've got, you know, we have policy challenges we have to work out around regulations, statutes, taxes, benefits, etcetera. But I kind of go back to Dr. Greenstone. We're probably approaching a point where we could, within a few years, the histories of subsidies of one form of industry over another, we may be nearing the end of that and we may be able to just have complete even playing field on energy, removing all subsidies and tax breaks.

And as you say, let innovation and the market drive where we go. I have a pretty strong feeling if that were to happen where we would go.

Well, I want to thank the witnesses for appearing before the Committee. Full written statements will be included. As information for all Senators, questions for the record would be due by noon tomorrow, with signed hard copies delivered to the Committee Clerk in Dirksen 624. Email copies also accepted.

We ask witnesses to respond to questions for the record if there are within seven days of receipt. With no further business of the Committee, the hearing is adjourned.

(Whereupon, at 12:03 p.m. Wednesday, April 26, 2023, the hearing was adjourned.)

**Opening Statement of Chairman Sheldon Whitehouse
Senate Committee on the Budget
“Under the Weather: Diagnosing the Health Costs of Climate Change”
April 26, 2023**

Ranking Member Grassley, members of the committee, witnesses, and guests, welcome to our seventh committee hearing. Today, we will continue our series on the economic costs of climate change, costs that are already affecting workers, families, and governments across the country. Today we explore the climate risks to public health and the associated economic and budgetary burdens.

As we’ve heard throughout this series, the climate crisis brings with it what witnesses have repeatedly called “systemic risks,” ones that cascade beyond a particular troubled sector to harm the entire economy and pose serious threats to the federal budget. Their warnings aren’t for future lawmakers; they’re for us, in this room, to protect against.

Healthcare costs related to combustion of fossil fuels are estimated to total nearly \$820 billion in the U.S. annually. Over the ten-year budget window, that’s over \$8 trillion. The direct costs of health care — doctor’s appointments, emergency room visits, rehabilitation and home health support, prescription drugs — strain the pocketbooks of American families. The indirect economic costs — from lost work and school days, reduced productivity, and increased economic instability — all add to that \$8 trillion burden.

If you care about deficits or economic growth, you have to care about climate change and its costs and risks. Yet with evidence of the economic dangers of climate change piling up around us, House Republicans propose eliminating clean energy tax credits and investments. They have completely lost their grip on reality, and are so subservient to their fossil fuel overlords that they’re willing to eliminate hundreds of thousands of clean energy jobs, cause trillions in climate harm, and shrink our economy by letting China build the technologies of tomorrow.

Their nonstarter of a plan would escalate carbon pollution, raising temperatures around the world. In Rhode Island in the last century, the average temperature is up three degrees. Rhode Island emergency rooms see a rise in hospital visits anytime there are multiple 80-plus-degree days in a row. On average there are 702 heat-related deaths and 67,512 emergency room visits each year in America due to heat. Extreme temperatures are more frequent and severe, and that costs lives and dollars. The Pacific Northwest’s deadly heatwave in 2021 saw approximately 600 additional deaths in one week in Oregon and Washington State. A heat wave of that intensity would have been virtually impossible without human-caused climate change.

Higher temperatures encourage smog formation and contribute to higher levels of airborne particulate matter and pollen. The combination of heat and poor air quality increases cardiovascular and respiratory risk, and the likelihood and severity of asthma attacks.

Warming climates expand disease vectors northward, particularly insects that carry diseases like Lyme disease, West Nile Virus, dengue fever, and Zika. More insects means more transmission,

and indeed there is evidence that climate shifts are the driving force behind more frequent disease outbreaks.

Climate upheaval brings more frequent and extreme weather events, which bring their own health care costs. The news reports regularly how hurricanes, wildfires, floods, and droughts lead to death, injury and illness. Hurricane Sandy is estimated to have cost \$3.3 billion in health costs—this included nearly 4700 emergency room visits, over 6600 hospital admissions, and 273 deaths.

The public health harms from climate change fall most heavily on the elderly, on children, on people of color, on the poor, and on people with preexisting conditions. Climate change is a multiplier both of illness rates and economic disparities. As a result, it will worsen economic inequality and widen gaps in health outcomes and life expectancy between poor and wealthy. Federal programs like Medicare and Medicaid will be heavily impacted given the populations they serve. In 2021, Medicare and Medicaid constituted almost 40% of all U.S. healthcare spending, and almost 20% of all federal spending.

Of course, these climate-related healthcare costs come on top of the many other climate costs we've heard about at previous hearings. Witnesses have warned us of risks that could take down the economy: the risk of a coastal property values crash; the risk of a similar wipeout in property values in wildfire country; the risk of insurance collapse as unpredictability drives insurers out of markets; the risk of the "carbon bubble" bursting in a disorderly transition from fossil fuel. These are not alternatives. They all could happen. We're playing with dangerous stakes. Deloitte has pegged the difference between getting climate right and getting it wrong at more than \$220 trillion. In a world in which those long-warned-of evils have come to pass, that \$8 trillion health cost burden will likely grow, as a crashed economy and budget will shrink. Not a good combination.

As this hearing will make clear, the effects of climate crisis on our nation's public health are dangerous and costly—to families, to businesses, and to the federal government. And this problem that will only get worse and more expensive unless we act now.

**Prepared Opening Statement by Senator Chuck Grassley of Iowa
Ranking Member, Senate Budget Committee
Hearing on “Under the Weather: Diagnosing the Health Costs of Climate Change”
April 26, 2023
[VIDEO](#)**

Last week’s hearing on tax policy was really refreshing. Revenues are a critical part of the federal budget, and we should remain very focused on the pressing fiscal issues facing our country.

Our Republican colleagues in the House introduced legislation to lift the debt ceiling and curb our federal spending this week. I don’t agree with every item in the bill, but two things are clear: America’s fiscal problems are serious; and Republicans are working to tackle those problems head on.

The U.S is facing public debt that, in a few years, will surpass record levels set in the wake of World War II. Even if we don’t agree with all the contents of the House bill, Republicans are following through with concrete solutions to address our dire fiscal situation and reduce inflation.

It’s been 88 days since President Biden and the Speaker McCarthy met down at the White House as an initial meeting to deal with these issues. No meeting has taken place since then.

I see President Biden refusing to even enter a negotiation room with Speaker McCarthy. Senate Democrats haven’t lifted a finger to prevent us from going headlong off the fiscal cliff.

The Budget Committee is currently holding its sixth hearing on climate change. Let’s now work together to write a budget that has guard rails to reign in federal spending.

I have a reputation for traveling to each of the 99 counties in Iowa holding a Q&A with my constituents in each of those counties. I’ve traveled 42 years in a row – 28 counties so far this year. Not every Iowan agrees with every decision I make as a Senator, but I’m always willing to have a conversation about the topics that matter most to them and our country.

Health care concerns often come up. However, the health effects of climate change isn’t one that I’ve heard much, if at all.

Our government health care programs – including Medicare, Medicaid, and public health – are projected to spend \$21 trillion over the next 10 years.

I do hear a lot from my constituents about preserving Medicare, and I agree that we should be doing that.

We need to ensure that these taxpayer funds that we call Social Security, Medicare and Medicaid are used wisely to address pressing health issues facing Americans. And we should be doing that right now.

If members are really interested in a bipartisan conversation about public health challenges and health care financing, I’d suggest that we focus on the key health challenges facing Americans right now. Some of these are:

- The 107,000 Americans that die from drug overdoses – particularly fentanyl, killing 70,000 of that 107,000;
- How to lower prescription drug costs, so patients don't delay treatment and save money;
- How to improve access to rural health care as hospitals and clinics are struggling to stay afloat; and
- How to address the leading cause of death in America, which happens to be heart disease.

We have significant health care challenges right now. A climate change mandate from Washington, D.C. won't solve the public health and health care financing challenges that we face this very day.

I look forward to hearing the testimony of Mr. Shellenberger. He was invited to serve as an expert reviewer by the Intergovernmental Panel on Climate Change. He's also been recognized by *Time Magazine* as a "Hero of the Environment."

The majority argues that climate change will catastrophically lead to more heat-related illness and deaths. They argue it will dramatically amplify global disease, damage respiratory health and harm more Americans from natural disasters. I'm confident that Mr. Shellenberger will be able to separate their alarm from reality.

Dr. Schramm, I also welcome you back to the committee. You remember when the Budget Committee focused on budgetary matters. You testified as a witness on a Reagan administration budget proposal in 1983. That year, the committee held six hearings in one month as we prepared a budget resolution.

And when Reagan and Tip O'Neill got together in 1983 to solve that problem, I doubt if they thought that they were doing it for a whole half-century. It works out that Social Security won't run out of surplus money until 2033, then afterwards we're in a crisis, because people will only be getting seventy-seven percent of what they're getting right now.

Dr. Schramm, you founded the nation's first research organization dedicated to understanding health care financing. I'm interested in exploring your current work to ensure our public health institutions focus on their core mission, where they've been failing.



STEPHANIE SMITH
Legislative District 45
Baltimore City

HOUSE PARLIAMENTARIAN

Appropriations Committee

Subcommittees

Capital Budget

Chair, Education and Economic
Development

Oversight Committee on Pensions

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April 26, 2023

STATEMENT OF MARYLAND DELEGATE STEPHANIE SMITH (D-45)
U.S. Senate Budget Committee Hearing

Good morning, Chairman Whitehouse, Ranking Member Grassley and distinguished members of the committee. I appreciate the opportunity to provide testimony and share the concerns of my constituents.

I am Delegate Stephanie Smith and I proudly represent Maryland's 45th State Legislative District in Baltimore City. In the Maryland General Assembly, I serve on the House Appropriations Committee, Chair the Education and Economic Development Subcommittee and also Chair the Baltimore City House Delegation. Outside of my work as a legislator, I have spent my career at the intersection of environmental health, urban planning and community development. Today, I will share observations about the public health costs of climate change from both my professional lens and the lived experiences of my neighbors.

Baltimore's average temperature has risen 3 degrees over the last century—nearly twice as much as the nation at-large. Beyond overall increases in average temperature, Baltimore is one of the leading US cities for the urban heat island effect. Urban heat islands are hyperlocal pockets of elevated temperatures within a city that can exacerbate adverse health outcomes for residents with diabetes, cardiovascular conditions and respiratory health challenges. A concentration of paved surfaces, buildings and industrial activities amplify rising temperatures. Baltimore's urban heat islands make our city the 9th hottest urban hot zone in the United States. Residents inside Baltimore's urban heat islands are more likely to: be people of color, have lower-incomes, and live shorter lives.

My district is home to landmarks like Pennsylvania Station and Johns Hopkins Medical Center as well as communities that have faced the policy harm of redlining and disinvestment. The Northeast communities at the top of my district are comprised of yards, mature trees and boast significant green spaces like Herring Run Park. However, I live at the bottom of my district in East Baltimore which is home to dense rowhome neighborhoods with the hottest temperatures in Baltimore City.

As climate change delivers more extreme heat days, Baltimore is on pace to see a six-fold increase in these very hot days in the next 15 years. In East Baltimore communities like Madison-Eastend and McElderry Park, this can mean more emergency medical calls for chronic conditions. As the heat index approaches 103 degrees, emergency calls for congestive heart failure can double.

I personally live in a 123-year-old, rehabbed rowhome with my husband, young sons and my mother who has a chronic heart condition. Thankfully, our home has central air conditioning that can maintain her comfort on the hottest days. All my neighbors deserve to live with the dignity and baseline resilience needed to survive extreme heat.

Unfortunately, news [reports](#) have detailed some of the difficulties my neighbors face as extreme heat days multiply:

- Row homes trap heat, which is a benefit in the winter, but poses significant harm in the summer. In July 2019, the University of Maryland put sensors inside of McElderry Park homes and recorded interior temperatures as high as 97 degrees with a heat index of 119 degrees.
- Parents keep children confined in the hot homes or do not install window air conditioning units on the first floor due to concerns about public safety.
- Tammy Jackson in McElderry Park laments the interior temperature of 92 degrees on a 100-degree day. With asthmatic grandchildren, Jackson doesn't know where to find relief. She simply exclaims "This is too much. Lord, this is too much."

Yes, the scope of this challenge can feel like it is "too much." But I do have good news to share, while climate change continues to increase temperatures, there are investments we can make at every level of government including:

- Increasing urban tree canopy,
- Prioritizing green roofs and surfaces in construction,
- Providing more accessibility to cooling centers and
- Proactively reaching out to our most vulnerable community members during Code Red days.

While this problem is enormous and mitigating the adverse health impacts of extreme heat can mean cost savings from:

- Reduced Medicaid claims,
- Reduced emergency medical care for the uninsured, and
- Increased economic productivity from improved healthiness.

The state of Maryland through our Climate Solutions Now Act of 2022 invested in 5 million urban tree plantings and encouraged green infrastructure but we will need local, state and federal strategies and investments to blunt the aggressive harm extreme heat poses to urban centers.

Written Testimony for the United States Senate Committee on the Budget

Hearing: “Under the Weather: Diagnosing the Health Costs of Climate Change”

April 26, 2023

Testimony of:

Katelyn Moretti, MD ScM
Assistant Professor of Emergency Medicine
Brown Emergency Medicine

Thank you, Chairman Whitehouse, Ranking Member Grassley and honorable members of the committee, for the invitation to speak with you today.

As an emergency physician, I see the impact of climate change on my patients every day. However, the health consequences are so vast and varied, that the role of climate change is often hidden.

Sometimes, the relationship to climate change is clear. For example, I treated a patient, a young man, who suffered severe heat stress while working in construction during the summer. With his body temperature elevated to a dangerous level, he required rapid cooling and fluids through the IV. He suffered muscle breakdown in the heat, poisoning his kidneys and requiring hospital admission.

However, the link between climate change and our health is not always so readily apparent. Consider my 85-year-old patient who presented with a heart attack. It was only because of astute EMS providers that we were able to connect her heart attack to an overheating apartment which lacked air conditioning, coupled with her inability to leave. Her body’s physiologic cooling center could not overcome the oppressive heat. The resulting strain was more than her heart could handle.

Climate change is a *threat multiplier* with health impacts happening through a variety of mechanisms including worsening temperature extremes, wildfires, coastal storms, spikes in air pollution, and vector borne diseases, as well as disruptions to supply chains, safe housing, safe working conditions, safe water, nutrition, and healthcare.¹ Climate change also acts as a *threat magnifier* worsening chronic diseases such as heart and lung disease, or mental illness. It leads to acute flares of other conditions such as asthma exacerbations, heat exhaustion, or kidney injury. Because the effects of man-made climate change are so widespread and varied, it makes recognizing and tallying the total magnitude of these worsening impacts difficult. We are often unable to see the forest through the trees. Thus, the economic impacts of poor health outcomes

are severely underestimated, as only easily quantifiable climate-linked disaster events and their infrastructure or crop damage consequences are typically considered.² Health-related costs are seldom if ever included in the math on climate change impacts.

These climate repercussions and costs to human lives are not felt equally. When I come to work during a heat wave, I worry about the elderly. I worry about the blue-collar workers outside on hot days. I worry about my pregnant patients who are less able to regulate their body temperatures and I worry about their unborn children as the worsening heat increases the risk of fetal death and premature labor.³

Similarly, when I consider the effects of a hurricane in my home state, I worry about my patients who lack the resources or social support to evacuate or find alternate housing.⁴ I worry about my patients with disabilities who rely on electricity for breathing machines or require refrigeration for medicines. Others need nebulizer treatments, or dialysis.

Notably, the patients who are most at risk from climate hazards, are also the same patients most likely to be on Medicaid or Medicare^{5,6} and least able to afford these costs. It is the socially and economically vulnerable, the disabled, children and the elderly who will bear the brunt of climate change impacts. While we may not know the exact total social and monetary costs of climate change on health, we know these costs—to Americans seeking care in emergency rooms, hospitals, and other healthcare settings-- are immense, and growing.

Vulnerable Patients: Medicaid and Medicare Recipients

Globally, nearly every child in the world is at risk from at least one climate threat.⁷ That includes children right here in the US. Medicaid covers almost 40% of children in the US.⁸ Children and infants are highly vulnerable to climate change through many different pathways. For example, their smaller airways are more sensitive to swelling from air pollution and toxins; children inhale more air relative to their body mass, resulting in increased pollution exposure. Their thermoregulation is immature and less able to manage environmental temperature extremes. They are at increased risk for mental and physical trauma from disasters and they bear the consequences of these impacts for many years to come.⁹

We also know negative climate impacts happen even before birth. Climate stress to mom translates to many medical problems for baby, such as neurodevelopment disorders, heart problems, diabetes and lung problems.¹⁰ All of these impacts are costly. As just one small example, researchers calculated the costs of childhood asthma to be \$4 billion nationally in 2008 alone. Of this, \$2.2 billion were made up of direct healthcare costs attributable to environmental factors such as air pollution.¹¹

This spring, I have seen the same teen on multiple occasions as her asthma has been increasingly difficult to control. She presents struggling to breathe, fear and fatigue written across her face. On one of her visits, we needed to put her on a BIPAP machine, pushing air into her lungs as she struggled. We were worried she would become too tired to breathe on her own. Climate change is worsening her asthma through an extended pollen season, and her home, close to the highway puts her in constant exposure to air pollution. With brush fires in Western Rhode Island last week, I expect to see her again.

Chronic conditions, most common in the Medicare population of older adults, increase one's vulnerability to climate change. Age, heart disease, and diabetes alone are risk factors for climate change health impacts. However, these risks are worsened through additional pathways. Medications such as diuretics, high blood pressure pills or antidepressants limit the body's ability to respond to heat stress.¹² Disruptions in supply chains or healthcare systems from natural disasters, wildfires or extreme weather can limit a patient's ability to access care needed to maintain their health. Mobility issues reduce one's ability to adapt in the face of extreme weather, such as accessing cooling centers or safely evacuating.

When we consider populations most likely to be covered by Medicaid such as those with disabilities or in lower socioeconomic standing, we find a vulnerable population with higher exposure to air pollution, which increases the risk of asthma or COPD (chronic obstructive pulmonary disease). They are more likely to live in an urban heat island, work in manual jobs outside and are less likely to have access to adaptive strategies such as air conditioning. We find patient populations that require more frequent access to healthcare facilities, dialysis, or rely on electricity for medical equipment at home.

Specific Climate Threats

Where I live and work in Rhode Island, we are experiencing increasing utilization of prehospital resources, emergency department visits and increased mortality as summer temperatures rise.^{13,14} However, we are not unique. Increasing temperatures and heatwaves are worsening nationwide.⁶

It is important to note that people across the country are already shouldering a significant economic burden to respond to the health costs of climate change. In July 2012, Wisconsin experienced a 1-week heat wave of record high temperatures. **From this 1 event**, there were over 1,620 emergency room visits and 27 deaths were recorded *when considering direct heat related illnesses only*. Total health-related costs, including indirect costs such as lost wages, were estimated to be over \$250,000,000. The direct costs to **Medicare** were estimated at \$900,000 and \$700,000 for Medicaid with an additional \$1,000,000 in costs to the uninsured.¹⁵ Given that this Wisconsin analysis did not consider the exacerbation of chronic diseases from extreme heat, such

as heart attacks or renal failure, I suspect that the true health costs of that heatwave were far greater.

When we consider climate-sensitive disasters such as hurricanes, droughts, floods or wildfires, health impacts also occur through many mechanisms. There are the direct impacts from the event such as drownings or traumas. However, there are also the cascading secondary effects leading to harm and death. Some examples include infrastructure damage resulting in lack of access to healthcare for baseline occurring health emergencies. People may be unable to find safe drinking water, which can result in water-borne diarrheal diseases. Unsafe and moist home environments can result in respiratory problems or physical injury. People with chronic illness may lose access to their home medications or electronic medical devices resulting in rising morbidity. These secondary effects lead to a subsequent rise in healthcare costs, but those costs are currently difficult to quantify because our nation is not carefully and comprehensively tracking the health harms and health-related financial costs of climate impacts.¹⁶ In addition, people may lose their jobs due to health consequences, social consequences, or direct infrastructure damage leading to indirect costs in the form of lost wages.

With climate change, access to healthcare is often disrupted.¹⁷ During COVID-19, I witnessed the effects of healthcare disruptions on my patients firsthand. Unable to access insulin, a young woman with COVID presented with decompensated diabetes, a situation I would see again and again. In the span of 4 hours, she went from speaking on her phone with family to dead despite our best efforts to stabilize her. I still think about her small children and how different their lives would have been had she just had insulin. Her inability to access healthcare contributed to her death. Similar lack of access to medications has been documented for both Hurricane Katrina in 2005 and Hurricane Harvey in 2017.¹⁸ The health complications that result are not only tragic, but also costly.

In 2003, Florida experienced 4 hurricanes. The cost of direct provider care was estimated at \$312 million. With the inclusion of all health-related costs, this increased to \$1.5 billion.¹⁹ In 2012, Hurricane Sandy, with sea level rise amplified by climate change²⁰, hit the Northeastern United States. In *New Jersey alone*, the **Medicare costs** were estimated over \$280 million and **Medicaid** over \$37 million with total healthcare costs above \$530 million.

Above are just some of the impacts of climate change on health and, subsequently, our healthcare costs. There are many others: the spreading transmission of vector borne diseases, dangerous wildfires and the toxic, far-reaching smoke plumes that they generate, reduced drinking water access and water quality because of intensifying droughts, reduced food security and risks of malnutrition. The impacts of climate change on our health are broad, substantial, and worsening. Consequently, the economic impacts—in the form of direct medical bills to patients,

cost burdens on public and private health insurers and employers, and long-term costs to society are immense and worsening.¹⁶

In 2008, the Congressional Budget Office presented this evaluation: “For the federal government, rising health care costs constitute the principal challenge of fiscal policy—no other single factor will exert more influence over the long-term balance of the federal budget.”²¹ A recent report estimated the annual health related costs of fossil fuel-generated air pollution alone as ***\$820 billion***.²² While this estimate includes indirect costs to society, such as the economic toll of premature deaths, it gives a sense of the magnitude of the problem. We cannot fix the health of our nation or our healthcare system without also addressing climate change.

Similarly, we cannot adapt without also mitigating. I strongly support adaptive measures such as water conservation, cooling centers, or subsidized air conditioning for vulnerable populations. However, we must also mitigate climate change and curb our greenhouse gas emissions. Without a transition away from fossil fuels and carbon emissions, the health consequences and associated healthcare costs will exponentially worsen. We can only build the sea wall so high. The trees planted will not provide shade if they are dead from drought and heat stress.

As a physician, I see firsthand the devastating impact of climate change on my patients and their families. It has changed how I practice medicine. I now inquire about the safety of my patient’s environment. Frequently, I recommend walking outside to treat anxiety, depression, obesity, or low back pain. However, recognizing the negative impacts of fossil fuel combustion and resultant climate change, I ask about their home location first. Do they live by a highway? Are they in an urban heat island where temperature effects are magnified? Similarly, for my high-risk patients, such as the 90-year-old who is managing at home with only the support of her neighbors, are her medications increasing her risk of heat related illness? Can she seek out cooling centers, libraries, or grocery stores during a heat wave? And, without air conditioning, what will she do at night as temperatures no longer cool to safe levels?

Climate change harms are burdening the United States from coast to coast, and we are paying for this problem through lost lives, destroyed livelihoods, and expensive healthcare bills. These costs are already staggering, and they are poised to grow substantially in the years to come. We cannot afford to wait any longer to address this urgent threat. I urge you to make climate action a top priority. It is not only the moral decision, but also the fiscally responsible one. Our legacy and the health of our nation depends on it.

1. Romanello M, Di Napoli C, Drummond P, et al. The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels. *The Lancet* 2022;400(10363):1619–54.
2. Hutton G. The economics of health and climate change: key evidence for decision making. *Global Health* 2011;7:18.
3. Bekkar B, Pacheco S, Basu R, DeNicola N. Association of Air Pollution and Heat Exposure With Preterm Birth, Low Birth Weight, and Stillbirth in the US: A Systematic Review. *JAMA Network Open* 2020;3(6):e208243.
4. Lieberman-Cribbin W, Gillezeau C, Schwartz RM, Taioli E. Unequal social vulnerability to Hurricane Sandy flood exposure. *J Expo Sci Environ Epidemiol* 2021;31(5):804–9.
5. Layton JB, Li W, Yuan J, Gilman JP, Horton DB, Setoguchi S. Heatwaves, medications, and heat-related hospitalization in older Medicare beneficiaries with chronic conditions. *PLOS ONE* 2020;15(12):e0243665.
6. Crimmins A, Balbus J, Gamble JL, et al. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment [Internet]. U.S. Global Change Research Program; 2016 [cited 2023 Apr 19]. Available from: <https://health2016.globalchange.gov/downloads>
7. The impacts of climate change put almost every child at risk | UNICEF [Internet]. [cited 2023 Apr 6]; Available from: <https://www.unicef.org/stories/impacts-climate-change-put-almost-every-child-risk>
8. Bureau UC. More Children Were Covered by Medicaid and CHIP in 2021 [Internet]. Census.gov. [cited 2023 Apr 14]; Available from: <https://www.census.gov/library/stories/2022/09/uninsured-rate-of-children-declines.html>
9. Perera F, Nadeau K. Climate Change, Fossil-Fuel Pollution, and Children’s Health. *New England Journal of Medicine* 2022;386(24):2303–14.
10. Pacheco SE. Catastrophic effects of climate change on children’s health start before birth. *J Clin Invest* 2020;130(2):562–4.
11. Trasande L, Liu Y. Reducing The Staggering Costs Of Environmental Disease In Children, Estimated At \$76.6 Billion In 2008. *Health affairs (Project Hope)* 2011;30:863–70.
12. Kenny GP, Yardley J, Brown C, Sigal RJ, Jay O. Heat stress in older individuals and patients with common chronic diseases. *CMAJ* 2010;182(10):1053–60.
13. Moretti K, Marin BG, Soliman LB, Asselin N, Aluisio AR. Increased Temperatures Are Associated with Increased Utilization of Emergency Medical Services in Rhode Island. *CLIMATE CHANGE* :6.

14. Kingsley SL, Eliot MN, Gold J, Vanderslice RR, Wellenius GA. Current and Projected Heat-Related Morbidity and Mortality in Rhode Island. *Environmental Health Perspectives* 2016;124(4):460–7.
15. Limaye VS, Max W, Constible J, Knowlton K. Estimating the Health-Related Costs of 10 Climate-Sensitive U.S. Events During 2012. *GeoHealth* 2019;3(9):245–65.
16. Limaye VS, Max W, Constible J, Knowlton K. Estimating The Costs Of Inaction And The Economic Benefits Of Addressing The Health Harms Of Climate Change. *Health Affairs* 2020;39(12):2098–104.
17. Salas RN, Jha AK. Climate change threatens the achievement of effective universal healthcare. *BMJ* 2019;366:15302.
18. Zilbermint M. Diabetes and climate change. *Journal of Community Hospital Internal Medicine Perspectives* 2020;10(5):409–12.
19. Knowlton K, Rotkin-Ellman M, Geballe L, Max W, Solomon GM. Six Climate Change–Related Events In The United States Accounted For About \$14 Billion In Lost Lives And Health Costs. *Health Affairs* 2011;30(11):2167–76.
20. Sweet W, Zervas C, Gill S, Park J. Hurricane Sandy Inundation Probabilities Today and Tomorrow. *Bulletin of the American Meteorological Society* 2013;94:S17–20.
21. Congressional Budget Office. Technological Change and the Growth of Health Care Spending. 2008; Available from: <https://www.cbo.gov/sites/default/files/cbofiles/ftpdocs/89xx/doc8947/01-31-techhealth.pdf>
22. Raimi D, Saha D, Moore R. The Costs of Inaction: The Economic Risks of Climate Change in the United States. National Resources Defence Council [Internet] 2018; Available from: <https://www.nrdc.org/sites/default/files/costs-inaction-burden-health-report.pdf>

Statement of Michael Greenstone
 Milton Friedman Distinguished Service Professor in Economics, University of Chicago
 Director, Becker Friedman Institute
 Director, Energy Policy Institute at the University of Chicago
 Co-Director, The Climate Impact Lab

To be presented to:
 United States Senate Committee on the Budget

Thank you, Chairman Whitehouse, Ranking Member Grassley, 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 research focuses on estimating the costs and benefits of societies' energy and environmental choices.

I appreciate the opportunity to speak with you today about the projected health costs of climate change and the impacts of climate change on the broader economy.

Over the last year, the world has been experiencing record hot temperatures: Summer 2022 was the second hottest ever recorded in the Northern Hemisphere. A weather station in Death Valley, California, clocked a scorching 53°C (127°F) in September, one of the hottest temperatures ever observed on Earth. Officials from Delhi to Tokyo to Baghdad, cities where past heat waves have claimed hundreds of lives, are bracing for dangerously hot periods. And yet, this is nothing new. Year after year heat records are broken all over the world.

Temperature's toll on public health, particularly the toll from extreme temperatures, is likely to be one of the dominant costs of climate change. Thus, given our ability today to alter the path of temperature change through the release of greenhouse gases, understanding the relationships between temperature change, mortality, and the monetary costs of this mortality, is essential to determining appropriate responses to climate change. So, what impact will temperature have on public health, and how much will it cost? The paper, "Valuing the Global Mortality Consequences of Climate Change Accounting for Adaptation Costs and Benefits" that I authored with my colleagues at the Climate Impact Lab, and which was published in *The Quarterly Journal of Economics* last year, addresses these critical questions.

I want to emphasize from the outset one data challenge with the paper's results that is due to the state of climate science. This research produces local (e.g., at the U.S. county level) climate impact estimates and thus requires local projections of what will happen to temperatures in the future. Such climate projections are only available for two climate scenarios: RCP8.5 which is considered a "high-emissions scenario" and RCP4.5 which is considered a "moderate-emissions scenario." Given current trends and policies, the high-emissions pathway likely overstates the growth of emissions, while the moderate-emissions pathway likely understates it. Throughout the testimony I will present results using both pathways, but the true impacts of climate change from our current trajectory are likely to lie between the estimates based on these two emissions pathways.

In the remainder of my statement, I will make the following points:

1. 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 40 countries accounting for 38% of the global population. We divided the world into more than 24,000 regions that are each about the size of a U.S. county.
2. We found that the global mortality risk is projected to increase by 85 deaths per 100,000 people by 2100 under the high-emissions scenario in which average global temperatures increase by around 3.7°C (6.7°F) relative to 2001-2010 temperatures. This is greater than the current global mortality rate—66 deaths per 100,000 people—from all infectious and parasitic diseases combined (excluding COVID-19). Under the moderate-emissions scenario—which is expected to increase temperatures by 1.6°C (2.9°F)—the global mortality risk is projected to increase by 14 deaths per 100,000 people, comparable to the global mortality rate from diabetes (19 per 100,000). The mortality consequences will be the largest in places that today are hot and/or poor.
3. In the United States, and under the high-emissions scenario, the mortality risk is projected to increase by 10 deaths per 100,000, about on par with our current fatality rate from auto accidents. Many areas will experience mortality risks that are significantly higher, including areas represented by members of this committee, which I will detail. In contrast, some areas will benefit as the number of deadly cold days declines, but again on average mortality risk will increase. Although the average mortality risk in the United States under the moderate-emissions scenario is projected to be essentially unchanged, there remain substantial geographic differences in these impacts, with many areas expected to see sizable increases in mortality risk and others expected to see declines.
4. On our current emissions trajectory—which lies in-between these two representative scenarios—we can expect climate-induced mortality risk to be in-between the two estimates. In this regard, 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 the Paris Agreement’s long-term targets—would reduce expected warming by around 2.1°C (3.8°F) at the end of the century and the attendant global mortality risk by 83% compared to the high-emissions pathway. As I highlighted above, under this moderate-emissions scenario, the total mortality risk due to climate-induced temperature changes would be eliminated in the United States.
5. This research is the basis for the new social cost of carbon estimates showing that the Trump and Obama administrations have underestimated the full social cost of carbon, in the former case dramatically so. As a part of a recent rulemaking, the Environmental Protection Agency (EPA) has proposed updating its estimate of the social cost of carbon to \$190 from the Biden administration’s interim value of \$51. This revision is an accurate reflection of recent advances in the literature on climate change and its economic impacts and incorporates recommendations made by the National Academies of Science, Engineering, and Medicine in 2017 (U.S. EPA 2022). The advances include those detailed in this testimony.

1 Mortality Consequences of Climate Change

1.1 Research Design and Relationship between Temperatures and Mortality Rates

Before detailing our research findings about the relationship between mortality risk and climate change, let me first explain how we produced our results. The study uses mortality records to quantify how death rates around the world have been affected by observed climate-induced temperature changes. We do so by compiling the largest sub-national vital statistics database in the world, detailing 399 million deaths across 40 countries accounting for 38% of the global population. We combine these records with decades of detailed daily and local temperature observations.

The data reveal a U-shaped relationship where extreme cold and hot temperatures increase mortality rates, especially for the elderly. Further, the effects of extreme cold and hot temperatures are attenuated by both higher incomes and adaptation to local climate (e.g., robust heating systems in cold climates and cooling systems in hot climates).

We then use these estimates of the mortality-temperature relationship to generate projections of the future impacts of climate-induced temperature changes on mortality rates, dividing the world into 24,378 regions containing roughly 300,000 people each—about the size of a U.S. county. With a new technique to measure the total cost of adaptive behaviors and technologies, these projections capture the full mortality risk of climate-induced temperature changes. In other words, this is the first study to account for direct mortality impacts and both the benefits and costs of adaptation.

These estimates include three projections for future income and population growth and simulations from 33 climate models, allowing for an assessment of the uncertainty surrounding any particular projection. The full estimates also reflect statistical uncertainty related to the underlying economic and health data.

To reiterate a point made above, we obtain estimates of mortality impacts using two different trajectories of future greenhouse gas emissions. The first is a high-emissions scenario, where temperatures are projected to rise by around 3.7°C (6.7°F) by 2100 relative to 2001-2010 levels. The second is a more moderate-emissions scenario, where temperatures would rise by around 1.6°C (2.9°F). Given current trends and policies, the high-emissions pathway likely overstates the growth of emissions, while the moderate-emissions pathway likely understates it. Our current emissions trajectory lies in between these two scenarios. Ultimately, advances in technology, policy choices in countries around the world, and their interaction will determine the planet's emissions path.

1.2 Mortality Risk under Moderate and High-Emissions Scenarios

Under the high-emissions scenario (RCP8.5) our research finds that the full 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 above the 2000-2010 average. Under the moderate-emissions scenario (RCP4.5) this mortality risk is projected to increase by 14 deaths by 100,000 people. I say full mortality risk because our projections reflect changes in both the number of deaths and the money and time people will spend to protect themselves against high and low temperatures through adaptation.

As I noted in my opening, the projected impact of temperature on mortality at the end of the century under the high-emissions scenario is greater than the current death rate for all infectious and parasitic diseases (except COVID-19)—including tuberculosis, HIV, malaria, dengue, yellow fever, and diseases transmitted by ticks, mosquitoes, and parasites—combined: approximately 66 deaths per 100,000 globally (See Figure 1). It is smaller than, but comparable to, the overall cancer mortality rate, which is 121 deaths per 100,000 globally (World Health Organization 2020). Under the moderate-emissions scenario, the projected increase in mortality risk is comparable to the global diabetes mortality rate, which is around 19 deaths per 100,000.

An especially striking finding is that the damages from climate-induced temperature changes discussed above will be unevenly distributed both globally and within the United States, as Figure 2 and Figure 3 illustrate for the high-emissions and moderate-emissions scenarios, respectively. 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, in Accra, Ghana, climate change is predicted to lead to approximately 100 more days a year with the day's average temperature above 32°C (90°F) under the 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 there under this scenario is projected at roughly 160 additional deaths per 100,000 people. Under the moderate-emissions scenario, this figure is 35 additional 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 under the high-emissions scenario, and 140 lives per 100,000 people under the moderate-emissions scenario. 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.

Another feature of the global projections is that the distribution of benefits and costs is troubling from a geopolitical or international relations perspective. The places that are expected to benefit (e.g., Northern Canada and Russia) are relatively sparsely populated, while the locations that are projected to become much more lethal (e.g., India, Pakistan, and Sub-Saharan Africa) are densely populated and home to several billion people. It is not difficult to imagine the possibility of substantial migration from these newly relatively more dangerous locations to the newly relatively more desirable areas. This kind of climate-induced migration could be at a scale that political systems are unable to accommodate without disruption. The precise consequences are difficult to predict but highly negative ones cannot be dismissed. These costs are outside the analysis that I'm discussing today but would nevertheless be real.

Turning to the United States, it is projected to see its mortality risk rise by 10 deaths per 100,000 at the end of the century under the high-emissions scenario. This mortality risk is about on par with the current fatality rate from auto accidents in the U.S.—roughly 12 deaths per 100,000 (World Health Organization 2018). Under the moderate-emissions scenario, this mortality risk would decrease by 0.1 deaths per 100,000. Again, it is important to highlight here that our current trajectory lies in between these two standardized scenarios; on it, we should expect to see a mortality risk in between these two numbers.

Domestically, risk differs depending on where you live. Table 1 shows mortality risks for each state under each emissions scenario. I will list some county-level examples here.

In my hometown of Chicago, the mortality risk is projected to decrease by about 34 lives per 100,000 by 2100 under the high-emissions scenario, and 39 lives per 100,000 by 2100 under the moderate-emissions scenario. 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 will see fewer of those cold days, decreasing mortality risk during the winter and—combined with the additional adaptation measures—giving Chicago a net benefit.

Orange County, California (which is represented by Senator Padilla), on the other hand, does not 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 will not be enough to offset the loss of life. There, temperature-related mortality risk is projected to increase by 38 deaths for every 100,000 people under the high-emissions scenario and 20 deaths for every 100,000 people under the moderate-emissions scenario. The mortality risk under the high-emissions scenario is on par with the current U.S. mortality rate for Alzheimer's disease (37 deaths per 100,000; Kochanek et al. 2019).

Washington, D.C., is also projected to experience a higher mortality risk under either scenario—around 32 deaths per 100,000 by 2100 under the high-emissions scenario, and 13 deaths per 100,000 by 2100 under the moderate-emissions scenario. In Henrico County, Virginia (which is represented by Senators Warner and Kaine), there is a projected increase of about 35 deaths per 100,000 under the high-emissions scenario and 17 deaths per 100,000 under the moderate-emissions scenario. Caddo Parish, Louisiana (which is represented by Senator Kennedy) is projected to face an increase of about 28 and 16 deaths per 100,000 under the high-emissions and moderate-emissions scenario, respectively; similarly, Johnson County, Kansas (which is represented by Senator Marshall) will see an increase of 31 and 11 deaths per 100,000 under the high-emissions and moderate-emissions scenario, respectively. In all of these cases, the mortality risk is comparable to the current U.S. mortality rate for diabetes (26 deaths per 100,000) and for the flu and pneumonia (17 deaths per 100,000; Kochanek et al. 2019).

In sum, both here in the United States and around the world climate-induced temperature changes will leave some regions as winners and others as losers. But the clear message from the data is that, under the high-emissions scenario, the United States and the world as a whole will lose on net. However, the data also reveal that the moderate-emissions scenario would dramatically lower the mortality costs of climate change. These findings highlight the value of policy that reduces emissions.

1.3 Policy has the Potential to Deliver High Returns

The level of greenhouse gas emissions is not a law of physics but rather reflects policy choices about restricting emissions and technical advances that can be accelerated by policy. It is therefore instructive to consider the benefits of different potential policies, one of which would be a policy moving us from a high-emissions path to a moderate-emissions (RCP4.5) path—reducing warming at the end of the century from 3.7°C to 1.6°C (or 6.7°F to 2.9°F). Given the high-emissions path (RCP8.5) likely overstates emissions growth, this evaluation will overstate the gains of moving from the current emissions pathway to the moderate-emissions path; still, we use it here as an illustrative example of the substantial health and mortality benefits from robust policy reducing emissions.

This illustrative reduction in warming, which still falls short of achieving the Paris Agreement’s long-term targets, would lead to dramatically lower mortality risks compared to the high-emissions scenario. For example, the projected end of century total global mortality risk from climate-induced temperature change falls 84% relative to a scenario of continued high emissions (from 85 to 14 additional deaths per 100,000). Accra, Ghana would see its mortality risk sink from 160 deaths per 100,000 people to 35 deaths per 100,000 people.

In the United States, the increased mortality risk would be completely eliminated, with -0.1 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. Orange County reduces its temperature-related mortality risk from 38 deaths per 100,000 to 20 deaths. Washington, DC sees its mortality risk more than cut in half—from 33 deaths per 100,000 to 13. Similar decreases occur in Henrico County (35 deaths to 17 deaths), Caddo Parish (28 deaths to 16 deaths), and Johnson County (31 deaths to 11 deaths).

The bottom line is that this illustrative example demonstrates that policies reducing greenhouse gas emissions have the potential to bring some of the most significant public health gains in human history, both domestically and globally. Our example of policies moving from a high-emissions trajectory to a moderate-emissions trajectory would reduce global mortality risk by 71 deaths per 100,000, as shown in Figure 4. Using the same benchmarks as previously, this reduction is similar to eliminating all deaths from infectious and parasitic diseases other than COVID-19 (66 deaths per 100,000) and on a similar scale to eliminating all deaths from cancer (121 per 100,000).

2 Projected Climate Damages and the Social Cost of Carbon as a Guidepost

How can these reductions in emissions be achieved? A key instrument for any climate policy is an estimate of the social cost of carbon (SCC) that is based on a frontier understanding of climate science and economics. The SCC is the monetary cost of the damages, present and future, caused by the release of an additional ton of carbon dioxide into the atmosphere. Simply put, it reflects the cost of climate change—accounting for elevated mortality rates as well as the destruction of property from storms and floods, declining agricultural and labor productivity, 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. For example, if the value of the social cost of carbon

was \$51 as the Obama administration set it (and also equal to the Biden administration’s interim value), a regulation that reduces carbon dioxide emissions by 10 tons would have societal benefits of \$510. These benefits can then be compared to the costs that the regulation imposes to determine whether the regulation is on net socially desirable.

Since the establishment of the United States Government’s SCC in 2010, it has been used to guide the design of more than 80 regulations. These regulations have resulted in more than \$1 trillion of gross benefits (Nordhaus 2017).

Critically, the SCC can also be used to determine an efficient price for market-based policies for combating 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 the costs. A great appeal of these approaches is that they unleash market forces to uncover the least expensive ways to reduce emissions without requiring an *ex-ante* knowledge of which sector these reductions will come from, thereby minimizing costs to the economy.

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 detail how we get there, it is important to first understand where the SCC came from and how it has evolved.

2.1 The History of the Social Cost of Carbon

The development of the SCC 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 that the Department of Transportation needed to update its regulatory impact analysis for fuel economy rules with an estimate of the SCC.¹ 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 the EPA began to incorporate a variety of individually developed estimates of the SCC into their regulatory analyses. These estimates were derived from the 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 (U.S. Government Accountability Office 2020).

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 and now a professor at Harvard, assembled and co-led an interagency working group to determine a single government-wide SCC. The team consisted of 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.

The process of 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 experts from across the federal government. It also included 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 a central estimate of \$21 per metric ton. That estimate has since been revised to reflect updates of the models that underlie it and as of 2016 was about \$51; I believe this is the basis for the Biden administration’s choice of an interim value.

To ensure that the next SCC update keeps up with the latest available science and economics, in 2015 the Office of Management and Budget directed the National Academy of Sciences (NAS) to help in providing advice on approaches to future updates. In 2017, the NAS released its recommendations after a comprehensive assessment informed by ongoing public comments and peer-reviewed literature, for which I served as a reviewer. The NAS report identified important ways to take advantage of an improved understanding of the social and economic impacts of climate change. It proposed a new framework that strengthened the scientific

1. *Center for Biological Diversity v. National Highway Traffic Safety Administration* 2008.

basis of the calculation, provided greater transparency in the process, and improved the characterization of the uncertainties of the estimates.

In March 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 estimate between \$1 and \$7. To arrive at this number, the EPA 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.

In the absence of federal leadership, I joined with Trevor Houser from Rhodium Group, Solomon Hsiang from the University of California, Berkeley, and Robert Kopp from Rutgers University to co-found a multi-disciplinary research institute, the Climate Impact Lab (CIL), in 2014. The CIL includes more than 30 climate scientists, economists, data engineers, and other experts. We are producing the world’s first empirically derived estimate of the social cost of carbon that is in line with the latest evidence in climate science and economics.

2.2 A Frontier Approach to Estimating Climate Damages and the SCC

The CIL has combined an immense body of historical data on social, economic, and climate indicators with climate models to develop projections of the long-term impacts of climate change in five core sectors: human mortality (which I have summarized today), agricultural productivity, energy consumption, labor disutility, and coastal flooding. All these projections cover local regions across the globe.

These projections are monetized to determine the total costs of climate change and the social cost of carbon: the cost that emitting an additional ton of carbon imposes on current and future society. For instance, the monetization of the full mortality risk uses the EPA’s value of a statistical life (VSL), which is then scaled across the globe using country-level incomes (Carleton et al. 2022).

Following the NAS guidelines, the CIL has developed a process to aggregate these sector-specific cost estimates. This process takes into account multiple dimensions of uncertainty, the ways in which people in the future will adapt to help in coping with climate change, and the implications of differences in damages across regions. Specifically, it factors in the existence of low-probability, high-impact temperature changes and the fact that poorer regions, for which damages have relatively larger welfare impacts, will face disproportionate climate damages.

The CIL’s aggregation of climate damages leveraging NAS guidance leads to an estimated SCC of \$190 per metric ton. The CIL SCC calculations uses socioeconomic and climate projections from Resources for the Future (RFF) (Rennert et al. 2022), which provides a single pathway taking into account some of the most up to date climate projections. (These projections are unfortunately not available at the local level.) As a basis of comparison, the full set of RFF projections resemble the moderate RCP4.5 emissions pathway when it is combined with a particular set of other socioeconomic assumptions.

This updated SCC estimate, based on frontier science and economics, is significantly higher than either President Trump’s estimate of \$7 per metric ton or President Obama’s \$51, as shown in Figure 5. A substantial portion of this difference comes from our updated understanding of mortality risk. This is especially striking because mortality risk only accounted for 4% of the Obama SCC of \$51.²

Different assumptions can result in higher or lower SCCs, but our judgment is that the CIL assumptions are grounded in the latest scientific and economic knowledge. That said, the analysis used to derive our estimates has some important limitations—it does not account for geopolitical risk resulting from climate

2. Differences in the valuation of future damages also drive part of the gap between these SCCs; the EPA proposed \$190 based on a 2% target discount rate, while the Obama and Trump administration’s estimates used rates between 3% and 7%. Even with comparable discount rates, the CIL and EPA SCCs remain meaningfully higher than those used by previous administrations.

disruptions or migration as described above, trade-related responses to climate change are also excluded, and it does not include all possible sectors in which damages may occur. Overall, including such factors in our analysis is likely to result in an even higher estimate of the SCC.

3 Conclusion

Climate-induced temperature changes will have dramatic impacts on human life, with the high-emissions trajectory raising global mortality risk by 85 deaths for every 100,000 people by the end of the century, comparable to, or even greater than, the mortality impacts of all infectious and parasitic diseases today, outside of COVID-19. On this trajectory, the United States is projected to see its temperature-related mortality risk increase by 10 deaths for every 100,000 people by 2100, on par with the U.S. fatality rate from auto accidents today. Even on the moderate-emissions trajectory global mortality risk rises by 14 deaths for every 100,000 people, comparable to the global mortality impact of diabetes. Domestically, this trajectory would leave total mortality rates essentially unaffected, though this masks meaningful increases in some places and decreases in others. Thus, a robust climate policy that restricts emissions to a moderate trajectory or that even more stringently restricts emissions has the potential to deliver some of the greatest public health gains in human history.

Finally, a key guidepost to setting climate policy is a scientifically validated social cost of carbon, like the one that the Climate Impact Lab has constructed. This new research suggests that climate damages are about four times larger than was previously understood or reflected in United States policy. It is encouraging that the EPA's recently proposed revision of the social cost of carbon draws from the CIL estimate and in so doing aims to return it to the frontier of understanding.

Thank you for the opportunity to share this work with the Committee.

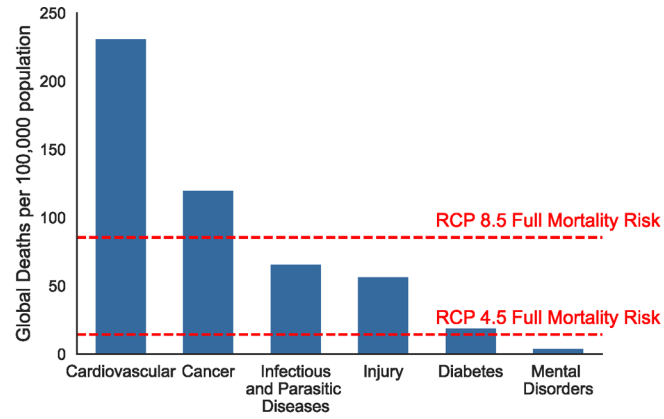
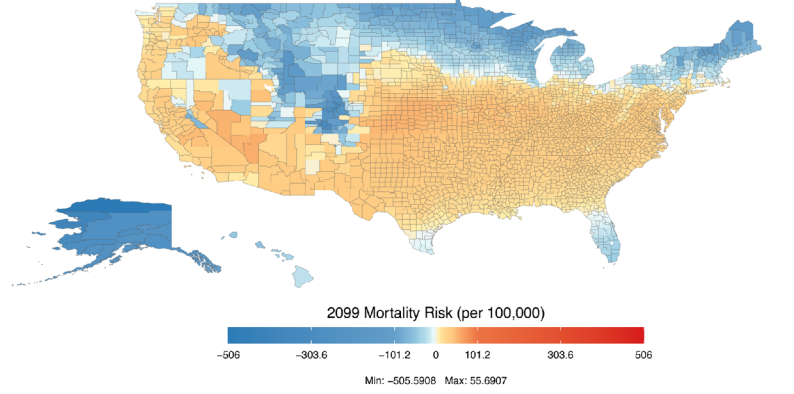
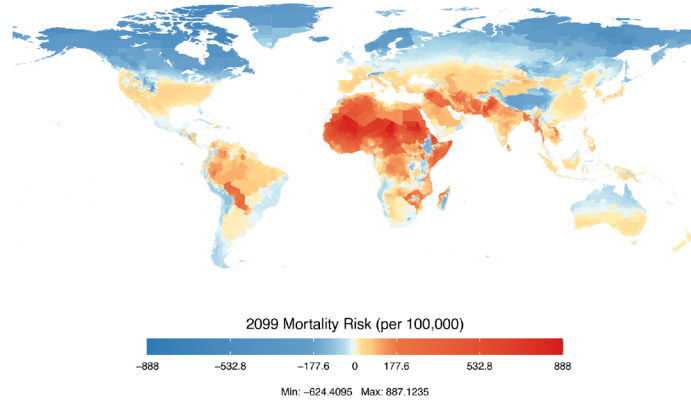


Figure 1: **The Mortality Impact of Climate Change in 2099 is Comparable to Contemporary Leading Causes of Death.** Projected mortality impacts of climate change (red) are calculated for the year 2099 under both the moderate and high-emissions scenarios (SSP3-RCP4.5 and SSP3-RCP8.5, respectively) and include changes in death rates in addition to adaptation costs measured in death equivalents. Blue bars indicate average mortality rates globally in 2019, with values from World Health Organization (2020).



(a) RCP8.5 United States Spatial Distribution of Climate-Induced Mortality Risk at County Level



(b) RCP8.5 Global Spatial Distribution of Climate-Induced Mortality Risk at Impact Region Level

Figure 2: **High-Emissions Scenario (RCP8.5) Full Mortality Risk of Future Climate Change.** The maps indicate the full mortality risk of climate change, measured in units of deaths per 100,000 population, in the year 2099. 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 direct change in death rate as well as the costs and benefits of adaptation. The map shows the climate model weighted mean estimate across Monte Carlo simulations conducted on 33 climate models. All values shown refer to the RCP8.5 emissions scenario and the SSP3 socioeconomic scenario. Figure adapted from Carleton et al. (2022).

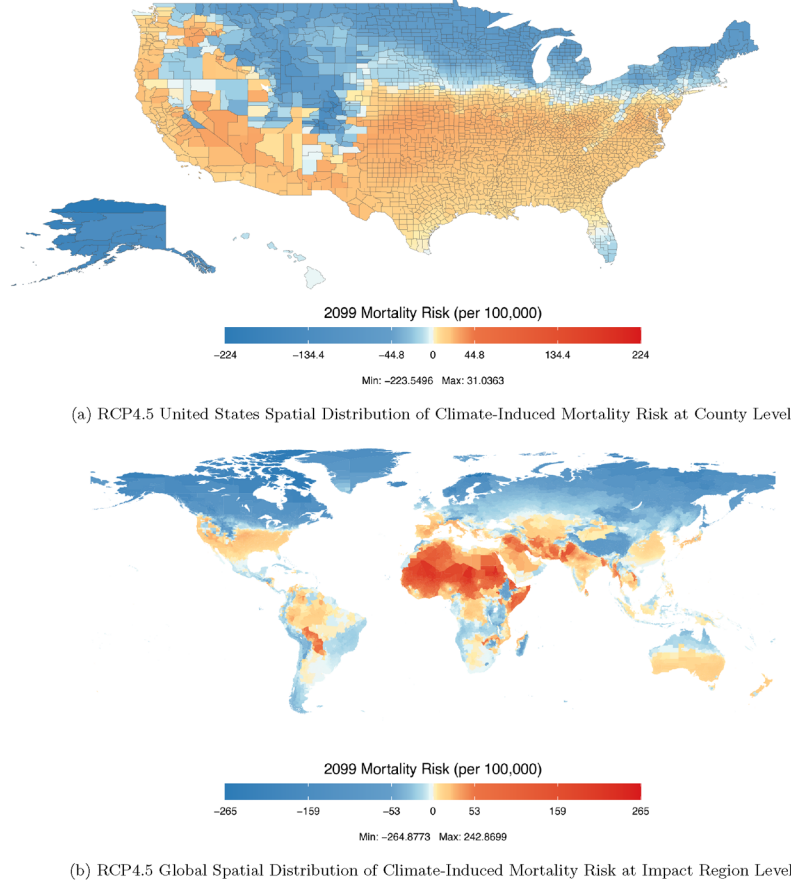


Figure 3: **Moderate-Emissions Scenario (RCP4.5) Full Mortality Risk of Future Climate Change.** The maps indicate the full mortality risk of climate change, measured in units of deaths per 100,000 population, in the year 2099. Panel (a) displays risk results for the United States, while Panel (b) displays results for the world. Estimates come from a model accounting for both direct change in death rate as well as the costs and benefits of adaptation. The map shows the climate model weighted mean estimate across Monte Carlo simulations conducted on 33 climate models. All values shown refer to the RCP8.5 emissions scenario and the SSP3 socioeconomic scenario. Figure adapted from Carleton et al. (2022).

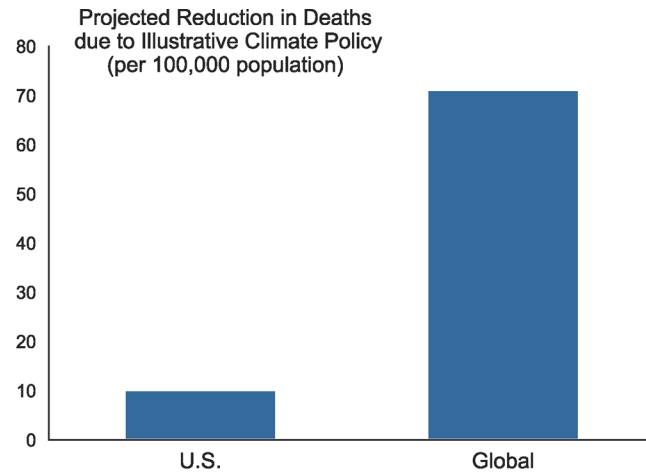


Figure 4: **Full Mortality Risk Avoided in 2099 Under Illustrative Climate Policy.** Illustrative climate policy is defined as a climate policy that aligns global emissions with the moderate-emissions scenario (RCP4.5) moving from the high-emissions scenario (RCP8.5). Hence, deaths avoided represent the difference between projected mortality impacts in 2099 under the high-emissions scenario (RCP8.5) and the moderate-emissions scenario (RCP4.5). Both include changes in death rates in addition to adaptation costs measured in death equivalents.

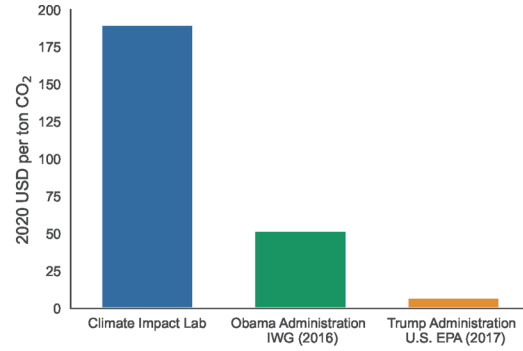


Figure 5: **Estimates of the Social Cost of Carbon (SCC)**. The Climate Impact Lab (CIL) uses Data-driven Spatial Climate Impact Model (DSCIM) (Climate Impact Lab (CIL) 2022; Carleton et al. 2022; Rode et al. 2021) accounting for mortality, labor, coastal, agriculture, and energy sectors. Socioeconomic and emissions projections were developed by Resources for the Future (Rennert et al. 2022). Additionally, the CIL's SCC assumes Ramsey discounting with a 2% target and age-varying VSL. Obama administration and Trump administration estimates account for all sectors of climate change impacts and both assume a 3% discount rate and RCP8.5 climate projections. Trump administration SCC values include only damages within the United States, while all others shown reflect global damages.

Table 1: End of Century Climate-Induced Full Mortality Risk by State.

State	Mortality Risk Per 100,000	
	Moderate Emissions (SSP3-RCP4.5)	High Emissions (SSP3-RCP8.5)
Alabama	15.48	24.81
Alaska	-127.88	-217.22
Arizona	18.78	34.48
Arkansas	19.92	37.37
California	16.70	31.09
Colorado	-22.02	-24.72
Connecticut	-10.67	0.80
Delaware	13.63	32.34
District of Columbia	12.97	32.46
Florida	-3.43	-19.14
Georgia	16.84	26.76
Hawaii	-8.39	-45.36
Idaho	-3.74	1.25
Illinois	-23.76	-11.44
Indiana	-2.39	18.64
Iowa	-17.28	4.54
Kansas	20.34	41.68
Kentucky	16.47	35.08
Louisiana	11.28	17.10
Maine	-49.04	-58.95
Maryland	13.16	32.98
Massachusetts	-21.01	-15.18
Michigan	-36.39	-30.08
Minnesota	-65.95	-77.28
Mississippi	15.24	25.21
Missouri	15.59	37.38
Montana	-42.91	-48.65
Nebraska	-6.61	14.07
Nevada	17.25	37.13
New Hampshire	-37.30	-36.42
New Jersey	1.93	18.33
New Mexico	11.56	25.38
New York	-10.58	2.69
North Carolina	17.11	30.63
North Dakota	-61.83	-77.67
Ohio	-9.68	7.80
Oklahoma	21.97	41.17
Oregon	14.46	19.74
Pennsylvania	-3.73	14.06
Rhode Island	-9.94	-0.18
South Carolina	15.94	25.02
South Dakota	-29.62	-16.37
Tennessee	18.63	34.53
Texas	15.29	26.73
Utah	-9.00	-5.73
Vermont	-60.27	-70.44
Virginia	16.59	34.19
Washington	12.30	17.92
West Virginia	12.11	30.95
Wisconsin	-53.75	-56.37
Wyoming	-47.59	-60.69
United States	-0.08	10.05

Note: Projected mortality risk (per 100,000 people) from climate change in 2099 for each state under moderate emissions (RCP4.5) and high emissions (RCP8.5). These values include changes in death rate and adaptation costs converted to death equivalents, and both use the SSP3 socioeconomic scenario. States with bold names are those with Senators on this committee.

References

- Carleton, Tamma, Amir Jina, Michael Delgado, Michael Greenstone, Trevor Houser, Solomon Hsiang, Andrew Hultgren, et al. 2022. "Valuing the Global Mortality Consequences of Climate Change Accounting for Adaptation Costs and Benefits*." *The Quarterly Journal of Economics* 137, no. 4 (November): 2037–2105.
- Center for Biological Diversity v. National Highway Traffic Safety Administration. 2008, No. 06-71891, August.
- Climate Impact Lab (CIL). 2022. "Data-Driven Spatial Climate Impact Model User Manual, Version 092022-EPA."
- Kochanek, Kenneth D., Sherry L. Murphy, Jiaquan Xu, and Elizabeth Arias. 2019. "Deaths : Final Data for 2017." Edited by National Center for Health Statistics (U.S.). Division of Vital Statistics. (Hyattsville, MD), National Vital Statistics Reports ; v. 68, No. 9, 68, no. 9 (June).
- Nordhaus, William D. 2017. "Revisiting the Social Cost of Carbon." *Proceedings of the National Academy of Sciences* 114, no. 7 (February): 1518–1523.
- Rennert, Kevin, Frank Errickson, Brian C. Prest, Lisa Rennels, Richard G. Newell, William Pizer, Cora Kingdon, et al. 2022. "Comprehensive Evidence Implies a Higher Social Cost of CO₂." *Nature* 610, no. 7933 (October): 687–692.
- Rode, Ashwin, Tamma Carleton, Michael Delgado, Michael Greenstone, Trevor Houser, Solomon Hsiang, Andrew Hultgren, et al. 2021. "Estimating a Social Cost of Carbon for Global Energy Consumption." *Nature* 598, no. 7880 (October): 308–314.
- U.S. EPA. 2022. *EPA External Review Draft of "Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances"*. <https://www.epa.gov/environmental-economics/scghg>. Announcements and Schedules, September.
- U.S. Government Accountability Office. 2020. *Social Cost of Carbon: Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis* — U.S. GAO. Technical report. June.
- World Health Organization. 2018. *Global Status Report on Road Safety 2018*. 403 p. World Health Organization. Publications.
- . 2020. *Global Health Estimates 2020: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2019*. <https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death>.

Testimony of Carl J. Schramm, Ph.D., J.D.
Before the Senate Committee on the Budget
April 26, 2023

“Under the Weather: Diagnosing the Health Costs of Climate Change”

Chairman Whitehouse, Ranking Member Grassley, Honorable Members of the Committee:

I am pleased to come before you to speak about the implications that climate change may impose on the nation's public health. Much of my career has been devoted to studying healthcare costs, especially in the context of how these expenditures may or may not be proportionately related to improvements in the public's health.

I began my professional life on the faculty of The Johns Hopkins School of Public Health. I was part of a small cadre of economists interested in healthcare costs, an area of inquiry that exploded with the passage of Medicare and Medicaid in 1965. Both programs proved to be much more inflationary than had ever been estimated and the focus of research ever since has been cost control. While at Hopkins I founded The Johns Hopkins Center of Hospital Management and Finance, which pioneered research in all-payor hospital rate setting, hospital antitrust theory, and hospital capital markets.

After fifteen years, I left Hopkins to manage a business that I had started that analyzed hospital accounting and clinical data. Subsequently, I was asked to head the Health Insurance Association of America, now known as America's Health Insurance Plans. Following HIAA, I became president of Fortis Healthcare, a private carrier. In 1985 I founded a consultancy that advised venture investors in new companies managing healthcare risk. In 2002, I assumed the presidency of the Ewing Marion Kauffman Foundation, the nation's only philanthropy focused on promoting entrepreneurship as a means of economic expansion.

For the last ten years I have served as University Professor at Syracuse. Pertinent to today's hearing, for more than two years my principal area of research has focused on the effectiveness of the nation's response to COVID. Also for two years I have served as a member of the COVID Crisis

Group operated from the University of Virginia, which only yesterday published our findings, *Lessons from the COVID War: An Investigative Report*.

As the Committee considers the question of the public health implications of global warming, I want to emphasize two issues. The first involves efforts to expand the idea of what “public health” is and why it is seen by many to be failing. As most of us would agree, the CDC, the nation’s principal agency charged with protecting public health, failed to effectively control the COVID pandemic. I believe the principal reason is that both the CDC and the country’s larger public health establishment, reflecting in part initiatives of Congress and major philanthropies, have expanded the scope and definition of public health such that its boundaries are nearly meaningless to the public.

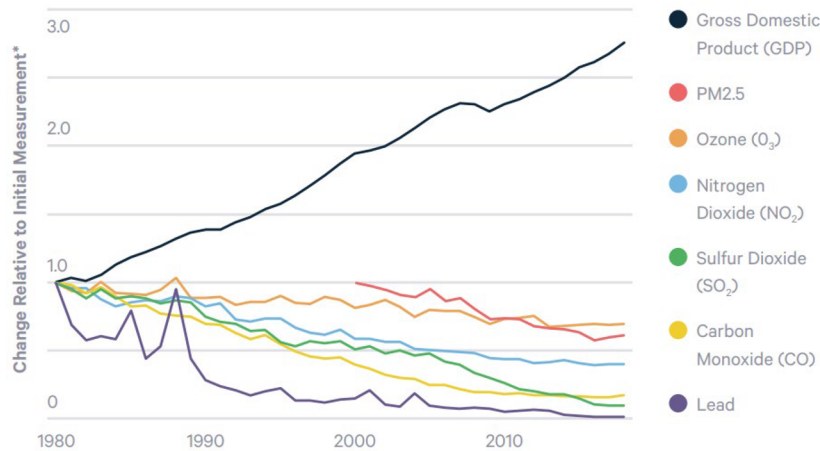
Consider that the CDC currently deals with a wide range of problems that are not encompassed by the traditional definition of public health, which is “the science and art of preventing disease, prolonging life and promoting health.” Instead it deals with a long list of “epidemics” that are not related to communicable pathogens and cannot be corrected by traditional public health tools. Among these are these “epidemics” are gun deaths, traffic fatalities, obesity, domestic violence, workplace accidents, and a long list of issues distant from traditional public health threats. In addition, we find the CDC working on problems that, again, cannot be solved by the tools used to prevent the transmission of diseases. Two of the newest involve the CDC’s attempting to ameliorate the “social determinants” of health, and its commitment to promoting health equity. Simply, the CDC is the archetype of an agency beset by “mission creep.”

Thus, even if global warming presented a clear and present danger to the health of every American, there is little that the CDC can do to mitigate such a threat. Among other things, the agency’s managerial focus is so diffuse that it is unlikely that it could effectively absorb another issue, particularly one in which the correlation between global warming and population health is so ambiguous.

My research on the CDC budget suggests that only about seven to eight percent of its workforce is engaged in traditional efforts related to identifying and controlling contagious biological threats. Far more CDC professionals labor on international health issues that may or may not be related to protecting the US population from communicable threats.

On the brighter side, however, there is evidence that human intervention, targeted at making the air the nation's citizens breathe, a critical aspect of global warming, has likely produced significant gains in public health. Here the US record is decidedly positive. Since the passage of the Clean Air Act in 1970, dangerous particulates have fallen significantly. Simply, the US makes every new unit of GDP with fewer noxious agents that threaten the public's health. Among other obvious benefits is the precipitous decline in lung cancer. In both women and men lung cancer accounts for 22% of all cancer deaths. Yet, lung cancer mortality has declined, with the death rate 30% and 54% lower in 2018 than it was at its peak in women in 2002 and men in 1990, respectively.

Figure 1. Change in Gross Domestic Product and Six Common Air



Pollutants, 1980–2018

What's more, during a similar period, our economy has become substantially less dependent on carbon as the energy source for economic expansion, significantly reducing the US's actual contribution to overall global warming.



Figure 2. Total Energy Spending as Share of US GDP

The lesson here is critical: Economic growth can be sustained with increasingly less reliance on fossil fuels. Just as in times past when sanitarians and civil engineers designed our nation's water and sewer systems, achievements on which fundamental public health advances continue to be based, today's environmental engineers are reducing the health threats that global warming may represent.

Let me conclude by emphasizing the importance of keeping the CDC's work focused on the detection and prevention of communicable diseases. In my opinion, the CDC does not now have the scientific footing to undertake a vaguely described concern over the possible links between global warming and its impact on the nation's public health, if any. If the past is prologue, however, the agency would be enthusiastic about adding more to its portfolio. As the committee considers this question, I would respectfully suggest that there are other agencies that are better suited to such considerations, the Environmental Protection Agency being one. In many ways, as you consider the future of the CDC, it seems to me that the Congress would be well advised to supervise the management focus of that agency to ensure that its primary interest is in protecting American health in the face of potential and traditional pandemics related to biological threats.

Air Conditioners for Humanity

Why we need cheap and abundant energy to save
lives, reduce pollution, and lift people out of
poverty

Testimony by Michael Shellenberger, Founder &
President of Environmental Progress

Before the Senate Budget Committee

On the topic of
“Under the Weather:
Diagnosing the Health Costs of Climate Change”

April 26, 2023

Chairman Whitehouse, ranking member Grassley, and committee members thank you for requesting my testimony. I am honored to be asked to provide it.

High per capita use of cheap and abundant energy is essential to our prosperity and lifting the poorest in the world out of poverty. There is no rich low-energy nation and no poor high-energy one. Adapting to higher temperatures requires cheap energy so people and nations can afford air conditioners, irrigation, desalination, and other technologies. The bottom line is that cheap and abundant energy is the key to a better future, including reducing deaths from heat waves, disease, and pollution.

The good news is that we know how to do this. Between 2005 and 2020, U.S. carbon emissions declined by 21.5 percent, which is 4.5 percentage points more than what the U.S. promised as part of its United Nations Paris Climate Change commitments,¹ and by 4.5 percentage points more than what was promised under the 2009 Waxman-Markey “cap and trade” legislation.²

Sixty-one percent of the reduction was due to the shift from coal to natural gas and electricity production, and the 39 percent reduction that came from intermittent renewables back-stopped by natural gas, which is required in most situations to provide power when the sun is not shining, and the wind is not blowing.³ The relationship goes in the opposite direction, as well. Thanks to natural gas shortages and higher costs in 2021, coal-fired electricity increased 22 percent as compared to 2020.⁴

Carbon emissions are thus following the same trajectory as other air pollutants. As a result of cleaner-burning coal, the transition to natural gas, cleaner vehicles, and other technological changes, developed nations have seen major improvements in air quality. Between 1980 and 2018, US carbon monoxide levels decreased by 83 percent, lead by 99 percent, nitrogen dioxide by 61 percent, ozone by 31 percent, and sulfur dioxide by 91 percent. While death rates from air pollution can rise with industrialization, they decline with higher incomes, better access to health care, and reductions in air pollution.⁵

Contrary to the assumptions of people who want to make energy more expensive, we move toward cleaner energy sources by making them cheaper and more abundant. Thanks to fracking, natural gas became cheap and abundant during the first decade of this century. And the same has been the case with nuclear. France and other nations built large, standardized nuclear plants, reducing the construction times and bringing the costs down.⁶

Better nutrition, better health care, and more air conditioning massively outweigh climate change as factors determining health. Over a decade ago, the World Health Organization (WHO) accurately predicted the global burden of the disease will have declined by 30 percent between 2004 and 2030, which we are on track to do, and that “mortality rates will continue to fall in most countries,” so long as economic growth continues.⁷

All else being equal, it would be best for global temperatures to remain stable. We should not want them to either rise or decline. We have built our civilization of farms, cities, and protected areas based on current temperatures. But all else isn't equal. The cause of climate change is rising energy consumption using fossil fuels. And that energy consumption has been necessary for the more than 90 percent decline in natural disaster deaths,⁸ a 25 percent global food surplus,⁹ and a 30 percent decline in the global burden of disease.

In its report last year, IPCC noted that nations have adapted well to heat thanks to “heat warning systems, increased awareness and improved quality of life,” defined to include air conditioners.¹⁰ “Evidence suggests a general decrease in the impact of heat on daily mortality,” noted the IPCC, as well as “a decline in the relative risk attributable to heat” and “an increase in the minimum mortality temperature (MMT).”¹¹

It's true that there have been more heat waves in the United States since 1960¹², but what determines whether people die in heat waves is primarily whether or not they have air conditioning, not whether temperatures rose to 111° instead of 109°, or for a few more days a year. Proof of this comes from the fact that heat-related deaths declined in the US by 50% to 75%¹³ since 1960 thanks entirely to air conditioning, even as heat waves grew in frequency, intensity, and length.¹⁴

Air conditioning and energy generally save lives, and yet many climate activists say we have too much of both. “The World Wants Air-Conditioning,” warned the New York Times in 2018, “That Could Warm the World.”¹⁵ Two years ago, the Natural Resources Defense Council (NRDC) published a report arguing that “skyrocketing cooling demand in India may also worsen the country's health risks from dangerous air pollution, extreme heat, and climate change.”¹⁶ At no point in its report did NRDC mention the inconvenient fact that air conditioning had slashed heat-related deaths in the US and other nations and that it would also do so in India.

The main way climate activists seek to slow the spread and use of air conditioning is by making electricity more expensive, either directly, through energy taxes or carbon taxes, or indirectly, through regulations and subsidies for renewables.

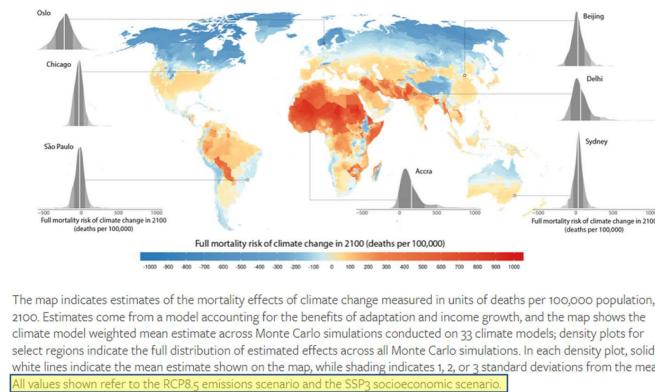
Models Are Manipulated to Overestimate Future Warming

IPCC and others produce projections of future climate change and its potential impacts, including on health. These scenarios are used to predict how hot it is likely to get and how much adaptation to higher temperatures is expected to cost, both in terms of lives and dollars.

The models tend to assume that the most significant health impacts of climate change is from higher temperatures, and so it is the main factor for determining things like the so-called "social cost" of carbon emissions and, likewise, the potential benefits of reducing emissions. And so, the U.S. Environmental Protection Agency (EPA) noted in a recent paper, "national total damages in 2090 are primarily driven by the valuation of premature mortality attributable to climate-driven changes in extreme temperature..."¹⁷

Of late, there has been a rash of studies using highly implausible scenarios, including ones showing high emissions and low economic growth, which contradicts over 200 years of recent human history. Consider one recent study, Carleton et al. 2022.¹⁸ It projects future impacts of extreme heat based on just such a scenario. The authors produced this frightening map to accompany their modeling exercise.

The Mortality Effects of Future Climate Change



There is no reality to the high-emissions and low-economic growth ("SSP3-8.5") scenario. "It is a contrived scenario that maximizes future impacts," notes Roger Pielke, who, with coauthors, has done a review of the scenarios literature and found that there is no scenario that can produce this combination of a pessimistic societal change and a pessimistic climate outcome, which should be understood as great news.

But the world is *not* on track for a high-emissions, low-GDP scenario. Even models cannot produce that outcome. And yet many studies assume the world is on track for precisely that scenario. "The combination of SSP3 and RCP8.5 was considered implausible by the SSP developers," notes Pielke and a coauthor.¹⁹ Carleton et al. also use a lower emissions (RCP 4.5) scenario in their report. One of the coauthors to Carleton et al said, "It is misleading to suggest that our work only looks at RCP 8.5. All of our work also looks at RCP 4.5." But even RCP 4.5, notes Pielke, "is above a worst-case trajectory at present on current policies, and their work still lacks a current policies trajectory."²⁰

That should have been the end of such an absurd combination but it wasn't. "Since the RCP8.5 scenario was the worst-case for greenhouse gas concentrations among the RCPs," noted Pielke, "there is sustained motivation to study the climate impacts of such a high level of greenhouse gases. Yet now the socioeconomics of the updated SSP5-8.5 indicate this climate forcing pathway is no longer truly a worst-

case, because under the characteristics of the scenario the incredibly wealthy society which produces it could conceivably have ample resources to readily adapt to resulting changes in climate. Thus, a growing body of research utilizes the implausible SSP3-8.5 chimera which projects a poor and vulnerable global society in a high climate impact environment."²¹

In other cases, studies trick their readers by not calculating the benefits of air conditioning and other forms of adaptation. "Assumptions are made that the climate will change," notes Pielke, "but people's behavior will not." A recent EPA study carefully hid the fact that it did not model adaptation.²² Why don't people model adaptation? Because, notes World Health Organization, "the attributable mortality is zero when 100% adaptation is assumed."²³

Notes Carleton et. al coauthor Michael Greenstone, "A major component of our work is to estimate what turns out to be substantial net benefits of adaptation and accounting for costs and benefits."²⁴

The incidence of malaria, notes IPCC, "has declined globally due to non-climatic socioeconomic factors and health system responses." Climate change could increase malaria deaths and infections compared to a hypothetical, "all else being equal" scenario. But as noted above, not all else is equal. "Between 2007 and 2017, DALYs [disability adjusted life years] for malaria have decreased by 39% globally." Declines like those could continue in the future as they have in the past by draining wetlands, moving away from malarial areas, using mosquito nets, and other methods. The same dynamic is at play with dengue fever.²⁵

The IPCC notes that these and other diseases might increase due to climate change, but their impacts are overwhelmed by non-climate factors, from broad land-use changes to the existence or non-existence of interventions. "Several chronic, non-communicable respiratory diseases are climate-sensitive," says IPCC, but "climate change is not the dominant driver in all cases." IPCC notes that "increases in air temperature enhance ozone formation" but that "there is low confidence in the projections of surface ozone and PM [particulate matter] under climate change."²⁶

Some have suggested that climate change will make diseases like COVID-19 more frequent or more severe, but the main factors behind the novel-coronavirus pandemic had nothing to do with climate change and everything to do with the failure of the Chinese regime to protect public health.

Governments and farmers have known what “biosecurity” measures to take for decades and enacted them, partly in response to the 2005 avian flu (H5N1) epidemic. These measures cover both the zoonotic spillover and lab leak hypotheses and include: hardened facilities to prevent, for example, bats, from entering buildings; the regular testing of animals and workers; disallowing live animals from being transported and sold at markets; and protecting laboratories like the Wuhan virology lab.²⁷

The Impact of Climate Policies on Health

Why do such modelers make such wrong assumptions? So they can demand a higher “price on carbon,” making energy more expensive than the public currently wants. Unfortunately, the US and nations worldwide have put in place, or are considering adopting, climate policies that threaten economic growth, as well as social and racial equity, and will lead to greater air pollution. As such, climate policies in many cases may threaten human health and well-being more than climate change itself.

Subsidies and mandates for renewables result in higher electricity prices and the net transfer of wealth from lower to upper-income citizens. Like taxes on food, taxes on energy are regressive. The University of Chicago found four years ago that consumers in states with renewable energy mandates paid \$125 billion more for electricity in the seven years after passage than they would have otherwise.²⁸

Renewables contributed to electricity prices rising six times more in California than in the rest of the US since 2011, the state’s “take-off” year for rapid growth in wind and solar — a price increase that occurred despite the state’s reliance during the same years on persistently-low-priced natural gas.²⁹ And California’s amount of zero-carbon electricity was flat from 2011 to 2021 because of the drought, reducing hydroelectricity, and the closure of a single nuclear plant.

Renewables have the same impact everywhere in the world. They have caused electricity prices to rise 50 percent in Germany since 2007, the first year the country got more than 10 percent of its power from subsidized wind, solar, and biomass. By 2019, German household electricity prices were 45 percent higher than the European average.³⁰

Solar and wind make electricity more expensive because they are unreliable, requiring 100 percent backup, and energy dilute, requiring extensive land, transmission lines, and mining, and more costs related to overcoming community opposition. Solar and wind developers do not pay for the costs they create but rather pass them on to electricity consumers and other producers.³¹

Poor people and people of color are disproportionately impacted by climate policies restricting energy consumption. In May, a California civil rights coalition filed a lawsuit against the state to prevent the implementation of climate law aimed at reducing driving. The coalition calculates that the proposed law will increase the cost of a home by anywhere from \$40,000 to \$400,000. "Latino, African American, and Asian American families," the coalition wrote in a letter to the governor, "are disproportionately victimized by the confluence of massively destructive state, regional and local housing policy choices."³²

Making energy expensive is especially harmful to poor nations. Certain climate change policies are more likely to hurt food production and worsen rural poverty than climate change itself, a large team of scientists found, even at 4 to 5 degrees warming. The "climate policies" the authors refer to would make energy more expensive and result in more bioenergy (the burning of biofuels and biomass), which would increase land scarcity and drive up food costs. "Although it is projected that the negative effects of climate change will increase over time, our conclusions that the effect on agriculture of mitigation is stronger would probably hold even if moving the time horizon to 2080 and considering the strong climate change scenario RCP8.5," concluded the scientists.³³

Moreover, widespread alarmism contributes to anxiety and depression, particularly among young people, even though most environmental trends are going in the right direction. Today, 36 percent of Americans surveyed believe climate change will make Earth uninhabitable for all life, and 31 percent believe climate change will lead to human extinction, claims that are causing severe anxiety in some children.³⁴

And yet neither the IPCC nor any other reputable scientific body makes such apocalyptic claims. Indeed, the best-available science finds: global carbon dioxide emissions were flat over the last decade³⁵; U.S. landfalling hurricanes have not increased since 1900³⁶; there is no overall trend in U.S. heat wave frequency or

magnitude since 1900³⁷; and there is no increase in flooding, decreasing flood mortality, and decreasing flood costs as a proportion of GDP around the world.³⁸

While some extreme weather events are increasing globally, notably heat waves and extreme precipitation events (but not flooding according to the IPCC), data collected by EM-DAT in Belgium, the main source for data on global disasters, show that weather-related *disasters* declined by about 10 percent between 2000 to 2021.³⁹ The reason for this is because EM-DAT, the United Nations Intergovernmental Panel on Climate Change (IPCC), the U.S. National Climate Assessment, and every other reputable scientific body measures disasters as deaths and economic costs relative to GDP, both of which have been declining as societies have become more resilient and less vulnerable.⁴⁰

Again, all things being equal, we should want to reduce temperatures and emissions as much as possible. But we should also acknowledge the progress made protecting ourselves, and our ecosystems, from the consequences of higher temperatures.

Deaths globally from natural disasters declined from an average of 550,000 per year in 1920, when the global human population was less than 2 billion, to 8,200 in 2020.⁴¹ We prevent flooding through flood management. We survive droughts through water storage, water recycling, and desalination. And we prevent high-intensity fires through forest management, such as through selective mechanical cutting and prescriptive burns.⁴²

Other scientists find similar outcomes. The UN Food and Agriculture concludes that food production will rise 30 percent by 2050 unless “sustainable practices” are adopted — in which case it would rise just 10 to 20 percent.⁴³ And a paper published in *Nature* last month found that “agro-ecological” farming, which has long been promoted by European governments, US NGOs, and the UN, does not improve the agricultural productivity of small African farmers.⁴⁴

Unreliable electricity from solar and wind energies has been unable to compensate for the loss of reliable, near-zero pollution nuclear energy. A 2016 study found that the electricity lost from the closure of the San Onofre nuclear plant was mostly replaced by burning natural gas, which increased air pollution in southern California and raised the costs of generating electricity from natural gas by \$350 million.⁴⁵

In 2012, 2017, and 2021 the National Academies of Science and Engineering published three separate reports on threats to the grid, resilience, and the future of electricity.⁴⁶ In its 2017 report, the Academies warned that U.S. electrical grids were increasingly "complex and vulnerable."⁴⁷ Over the last 25 years, increasingly decentralized electricity generation in restructured electricity markets, along with growth in the number of regulatory institutions, has resulted in "divergent interests of federal, state, regional and local authorities," wrote the Academies in the 2021 report. Electricity experts are not able to answer the question, "Who is in charge of planning, developing, and ensuring the integrity of the future power system?"⁴⁸

A crucial question for Congress to consider is whether the increased use of weather-dependent renewables today increases the risk of blackouts. According to the North American Electric Reliability Council (NERC) and Midcontinent Independent System Operator (MISO), which manages the Midwest electrical grid, lack of reliable power plants may force it to cut power.⁴⁹ The grid operator warned of similarly tight conditions in Texas during a heat wave. In May, NERC warned that large regions of the U.S. are at high risk of blackouts.⁵⁰

The US could lose half to two-thirds of its nuclear energy over the next decade. By 2025, the US will close twelve reactors, which constitute 10.5 gigawatts of low-carbon power.⁵¹ This should be extremely troubling for anyone concerned about air pollution and climate change. Deep decarbonization of the US energy supply will require receiving 100 percent of electricity from zero-emissions sources and replacing all natural gas and petroleum used in transportation, cooking, and heating, which constitute roughly two-thirds of total primary energy. The cheapest and fastest way to achieve this decarbonization is to add nuclear reactors at existing nuclear power plants. Closing those plants will foreclose that future option.

Recommendations

The dominant form of climate policy in international bodies and among nations worldwide emerged from 1960s-era environmental policies aimed at constraining food and energy supplies. These policies are correctly referred to as Malthusian in that they stem from the fears, first articulated by the British economist Thomas Malthus in 1798,

that humans are at constant risk of running out of food. Real-world experience has repeatedly disproven Malthusianism. If it hadn't, we wouldn't be nearly eight billion. Worse, Malthusian ideas have been used to justify unethical policies that worsen socioeconomic inequality by making food and energy more expensive, including closing down nuclear plants.⁵²

Policymakers should explicitly reject policies that significantly raise food and energy prices, directly or indirectly. Republicans and Democrats alike should affirm their commitment to human flourishing and prosperity, both of which depend on cheap food and energy and the rising productivity of inputs to agriculture and electricity generation, including labor, land, and capital.

The large reductions in air pollution, including carbon emissions, in recent decades came overwhelmingly from making natural gas cheap, not from making fossil fuels more expensive. Short-term and focused subsidies and mandates may help accelerate technological innovation. But the main focus must be on making the new energy source affordable.

There are also national and economic considerations that must be considered alongside health. Nuclear energy is a dual-use technology. If nations partner with China and Russia rather than the US or other Western nations to build nuclear plants, America's national security is undermined. Similarly, becoming overly dependent upon solar panels imported from China may not be in the best interests of American workers.

Congress has to date, failed to take steps to keep America's nuclear plants operating, even as it has repeatedly subsidized industrial solar and wind energy. I urge Congress to take reasonable measures to keep all of America's nuclear plants operating. In addition, I encourage Congress to explore creating a state-owned enterprise to build new nuclear plants in the US and abroad, as it may be needed to compete with the Russian and Chinese state-owned companies.

American energy policy should be oriented toward global competitiveness and even "dominance," not just improved health outcomes. Such a plan would seek to replace the natural gas burned domestically with nuclear energy and to increase the export of natural gas abroad. Such a policy would also support the health and climate goals of using natural gas rather than coal.

And most of all, our goal should be to provide cheap energy for Americans and the rest of humanity. Cheap energy is essential to improving human and

environmental outcomes, including through the provision of air conditioning for all who need it.

Thank you for inviting my testimony.

Notes

¹ Kate Larsen et al., "Preliminary U.S. Greenhouse Gas Emissions Estimates for 2020," Rhodium Group, January 12, 2021, <https://rhg.com/research/preliminary-us-emissions-2020/>

² Center for Climate and Energy Solutions, "Waxman Markey Short Summary," June 2009, <https://www.c2es.org/document/waxman-markey-short-summary/>

³ U.S. Energy Information Administration and International Energy Outlook, 2021, 2019.

⁴ U.S. EIA, "Annual U.S. coal-fired electricity generation will increase for the first time since 2014," October 18, 2021; International Energy Agency, "Global coal demand is set to return to its all-time high in 2022," July 28, 2022.

⁵ United States Environmental Protection Agency, "Air Quality – National Summary," 2020, <https://www.epa.gov>.

⁶ Jessica Lovering et al., "[Historical construction costs of global nuclear power reactors - ScienceDirect](#)," Energy Journal, April 2016.

⁷ WHO, *Climate change and health: Resolution of the 61st World Health Assembly*, Geneva, World Health Organization, 2008a.

⁸ Giuseppe Formetta and Luc Feyen, "Empirical evidence of declining global vulnerability to climate-related hazards," *Global Environmental Change* 57 (July 2019), <https://doi.org/10.1016/j.gloenvcha.2019.05.004>.

⁹ United Nations Food and Agriculture Organization (FAO), *The future of food and agriculture—Alternative pathways to 2050* (Rome: Food and Agriculture Organization of the United Nations, 2018), 76–77.

¹⁰ Cissé, G., R. McLeman, H. Adams, P. Aldunce, K. Bowen, D. Campbell-Lendrum, S. Clayton, K.L. Ebi, J. Hess, C. Huang, Q. Liu, G. McGregor, J. Semenza, and M.C. Tirado, 2022: Health, Wellbeing, and the Changing Structure of Communities. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1041–1170, doi:10.1017/9781009325844.009.

¹¹ Cissé, G., R. McLeman, H. Adams, P. Aldunce, K. Bowen, D. Campbell-Lendrum, S. Clayton, K.L. Ebi, J. Hess, C. Huang, Q. Liu, G. McGregor, J. Semenza, and M.C. Tirado, 2022: Health, Wellbeing, and the Changing Structure of Communities. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1041–1170, doi:10.1017/9781009325844.009.

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- ¹² Environmental Protection Agency, Climate Change Indicators, Heat Waves, 1961-2021 <https://www.epa.gov/climate-indicators/climate-change-indicators-heat-waves>
- ¹³ Alan Barreca et al, "Adapting to Climate Change: The Remarkable Decline in the US Temperature-Mortality Relationship over the Twentieth Century, *Journal of Political Economy*, 2016. <https://www.journals.uchicago.edu/doi/abs/10.1086/684582>
- ¹⁴ Environmental Protection Agency, Climate Change Indicators, Heat Waves, 1961-2021 <https://www.epa.gov/climate-indicators/climate-change-indicators-heat-waves>
- ¹⁵ "The World Wants Air-Conditioning. That Could Warm the World," *The New York Times*, 2018
- ¹⁶ [Protecting Health as Cooling Demand Skyrockets in India](#), NRDC, 2021
- ¹⁷ T. Hartin, [Advancing the estimation of future climate impacts within the United States](#), 2023.
- ¹⁸ Tamma Carleton, et al, "Valuing the Global Mortality Consequences of Climate Change Accounting for Adaptation Costs and Benefits," *The Quarterly Journal of Economics*, Volume 137, Issue 4, November 2022.
- ¹⁹ Pielke, et al, Distorting the view of our climate future," *Energy Research and Social Science*, 2021.
- ²⁰ Roger Pielke, April 24, 2023. <https://rogerpielkejr.substack.com/p/public-health-and-climate-change/comment/15164815>
- ²¹ Pielke, et al, Distorting the view of our climate future," *Energy Research and Social Science*, 2021.
- ²² Hartin et al, "Advancing the estimation of future climate impacts within the United States," January 2023. <https://egusphere.copernicus.org/preprints/2023/egusphere-2023-114/egusphere-2023-114.pdf>
- ²³ World Health Organization, [Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s](#), 2014.
- ²⁴ Michael Greenstone, telephone interview with the author, April 24, 2023
- ²⁵ Cissé, G., R. McLeman, H. Adams, P. Aldunce, K. Bowen, D. Campbell-Lendrum, S. Clayton, K.L. Ebi, J. Hess, C. Huang, Q. Liu, G. McGregor, J. Semenza, and M.C. Tirado, 2022: Health, Wellbeing, and the Changing Structure of Communities. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1041–1170, doi:10.1017/9781009325844.009.
- ²⁶ Cissé, G., R. McLeman, H. Adams, P. Aldunce, K. Bowen, D. Campbell-Lendrum, S. Clayton, K.L. Ebi, J. Hess, C. Huang, Q. Liu, G. McGregor, J. Semenza, and M.C. Tirado, 2022: Health, Wellbeing, and the Changing Structure of Communities. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1041–1170, doi:10.1017/9781009325844.009.

- ²⁷ "Should We Domesticate Wild Animals to Prevent Disease Pandemics? An Interview with Peter Daszak," *Environmental Progress*, May 21, 2020.
- ²⁸ Michael Greenstone and Ishan Nath, "Do Renewable Portfolio Standards Deliver?" *Energy Policy Institute at the University of Chicago* 62 (May 2019): 1-45, <https://epic.uchicago.edu/wp-content/uploads/2019/07/Do-Renewable-Portfolio-Standards-Deliver.pdf>.
- ²⁹ "California," *Environmental Progress*, accessed July 25, 2020, <https://environmentalprogress.org/california>. Calculations based on data from "Electricity Data Browser: Retail Sales of Electricity Annual," United States Energy Information Administration, accessed January 10, 2020, <https://www.eia.gov/electricity/data/browser>.
- ³⁰ Eurostat, "Electricity prices for household consumers - bi-annual data (from 2007 onwards)" December 1, 2019, accessed January 20, 2020, https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_pc_204&lang=en.
- ³¹ Steven M. Grodsky, "Reduced ecosystem services of desert plants from ground-mounted solar energy development," *Nature*, July 20, 2020.
- ³² Jim Jakobs, "Latest State 'Green' Edict Discriminates Against Minorities: Lawsuit," *GV Wire*, May 7, 2020.
- ³³ Hans van Meijl, "Comparing impacts of climate change and mitigation on global agriculture by 2050," *Environmental Research Letters*, 2018, <https://iopscience.iop.org/article/10.1088/1748-9326/aabdc4/pdf>
- ³⁴ YouGovAmerica, "Nearly two in five Americans say it's likely climate change will make the Earth uninhabitable," April 13-19, 2022, <https://today.yougov.com/topics/society/articles-reports/2022/04/22/americans-say-climate-change-earth-uninhabitable>; Jason Plautz, "The Environmental Burden of Gen Z," *Washington Post*, February 3, 2020; Reuters, "One in five UK children report nightmares about climate change," March 2, 2020; Michael Shellenberger, "Why Climate Alarmism Hurts Us All," *Forbes*, December 4, 2019.
- ³⁵ Zeke Hausfather, "Global CO2 emissions have been flat for a decade, new data reveals," *Carbon Brief*, April 11, 2021, <https://www.carbonbrief.org/global-co2-emissions-have-been-flat-for-a-decade-new-data-reveals/>
- ³⁶ Philip J. Klotzbach et al, "Continental U.S. Hurricane Landfall Frequency and Associated Damage: Observations and Future Risks," *Bulletin of the American Meteorological Society*, July 2018.
- ³⁷ U.S. Global Change Research Program, "Chapter Six: Temperature Changes in the United States," Fourth National Climate Assessment, 2017; <https://science2017.globalchange.gov/chapter/6/>
There is evidence that heat waves, temperature extremes, and heavy precipitation are increasing at a global scale, but heavier rainfall does not necessarily mean more flooding, and IPCC expresses low to medium confidence in changes to meteorological and hydrological droughts, and to agricultural and ecological droughts, respectively. United Nations Intergovernmental Panel on Climate Change, Assessment Report 6, Working Group I, 2021.
- ³⁸ The IPCC has "low confidence" of climate change influence on flood events. Sonia I. Seneviratne, et al., "Weather and Climate Extreme Events in a Changing Climate," IPCC, Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment

Report of the Intergovernmental Panel on Climate Change; Shiqiang Du, "Brief communication: Rethinking the 1998 China floods to prepare for a nonstationary future," *Nat. Hazards Earth Syst. Sci.*, 19, 715–719, 2019; Muhammed Yaseen et al., "Contemporary Trends in High and Low River Flows in Upper Indus Basin, Pakistan," *Water Journal*, January 24, 2022; Roger Pielke, Jr. "US Flood Damage as Proportion of GDP, 1940-2019 based on US National Weather Service flood loss database, *Natural Hazards Review*, 6, 2020; D. Paprotny et al., "Trends in flood losses in Europe over the past 150 years," *Nature Communications*, 1985.

³⁹ EM-DAT, The International Disaster Database, Centre for Research on the Epidemiology of Disasters, Accessed September 14, 2022, <https://www.emdat.be>

⁴⁰ Hannah Ritchie and Max Roser, "Natural Disasters," Our World in Data, accessed September 14, 2022. As the authors of a major 2019 paper note, "Improved protection against hazards has counter-balanced the effects of increasing exposure on disaster risk, with the global average 2007–2016 multi-hazard human mortality and loss rates dropping of about 6.5 and nearly 5 times as compared to the period 1980–1989, respectively." Giuseppe Formetta et al., "Empirical evidence of declining global vulnerability to climate related hazards," *Global Environmental Change*, July 2019.

⁴¹ Munich Re, "Natural Catastrophes in 2020," January 2021, https://www.munichre.com/content/dam/munichre/mrwebsiteslaunches/natcat-2021/2020_Jahresuebersicht_Welt_e.pdf/jcr_content/renditions/original./2020_Jahresuebersicht_Welt_e.pdf; Hannah Ritchie and Max Roser, "Natural Disasters," Our World in Data, accessed September 14, 2022; Giuseppe Formetta et al., "Empirical evidence of declining global vulnerability to climate related hazards," *Global Environmental Change*, July 2019.

⁴² Michael Shellenberger, "Forests that survive megafires prove good management trumps climate change," *Forbes*, September 13, 2020.

⁴³ United Nations Food and Agriculture Organization (FAO), *The future of food and agriculture—Alternative pathways to 2050* (Rome: Food and Agriculture Organization of the United Nations, 2018), p. 76–77.

⁴⁴ Marc Corbeels, et al., "Limits of conservation agriculture to overcome low crop yields in sub-Saharan Africa," July 16, 2020. For examples of efforts to promote agroecology see Shiny Varghese, "Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition," Institute for Agriculture and Trade Policy, June 26, 2019.

⁴⁵ Lucas Davis et al., "Market impacts of a nuclear power plant closure," *American Economic Journal, Applied Economics*, 2016, p. 92–122.

⁴⁶ National Academies of Sciences, Engineering, and Medicine, *Terrorism and the Electric Power Delivery System* (Washington, DC: The National Academies Press, 2012);

National Academies of Sciences, Engineering, and Medicine, *Enhancing the Resilience of the Nation's Electricity System* (Washington, DC: The National Academies Press, 2017), <https://doi.org/10.17226/24836>

National Academies of Sciences, Engineering, and Medicine, *The Future of Electric Power in the United States* (Washington, DC: The National Academies Press, 2021).

⁴⁷ National Academies of Sciences, Engineering, and Medicine, *Enhancing the Resilience of the Nation's Electricity System* (Washington, DC: The National Academies Press, 2017), <https://doi.org/10.17226/24836>, p. vi.

⁴⁸ National Academies of Sciences, Engineering, and Medicine, *The Future of Electric Power in the United States* (Washington, DC: The National Academies Press, 2021), p. 51.

⁴⁹ Robert Walton, "MISO prepares for 'worst-case scenarios,' heads into summer with insufficient firm generation," *Utility Dive*, April 29, 2022.

⁵⁰ NERC, "2022 Summer reliability assessment," May 2022, https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_SRA_2022.pdf

⁵¹ U.S. Energy Information Administration, "Despite closures, U.S. nuclear electricity generation in 2018 surpassed its previous peak," March 21, 2019.

⁵² Michael Shellenberger, *Apocalypse Never: Why Environmental Alarmism Hurts Us All*, HarperCollins, 2020, p. 222-249.


Charles E. Grassley
United States Senator

Questions for the Record from Senator Chuck Grassley
To: Honorable Stephanie Smith, Esq
“Under the Weather: Diagnosing the Health Costs of Climate Change”
April 27, 2023
Senate Budget Committee

Question #1:

Are drug overdose and alcohol-related deaths a public health challenge in Maryland? Based on 2020 data, nearly 3,000 residents in Maryland died of drug or alcohol poisoning. What legislation have you led to reduce drug and alcohol related deaths?

Question #2:

You have tweeted that gun violence, racism, misogyny, and President Trump are all public health problems, public health emergencies, or threats to public health. How do you define a public health issue? Are there any limits to your definition?


Charles E. Grassley
United States Senator

Questions for the Record from Senator Chuck Grassley
To: Dr. Katelyn Moretti
“Under the Weather: Diagnosing the Health Costs of Climate Change”
April 27, 2023
Senate Budget Committee

Question #1:

You work with Brown University’s Climate Solutions Lab. A policy advocated by your colleague at the Climate Solutions Lab is for President Biden to declare climate change a national emergency. Do you support this policy? Why should the government operate under emergency authority?

Response:

Thank you for your question. While declaring climate change a national emergency would be symbolically consistent with the United Nations’ many reports and statements on the urgency of the climate crisis, in my capacity as a medical doctor, I don’t comment on the legal implications of a Presidential declaration of national emergency. The Climate Solutions Lab report that suggested considering a National Emergency declaration, which as you noted, I was not a part of, was written before the 2020 elections for very specific conditions that no longer apply. Specifically, the report was planning for a scenario of Congressional gridlock on climate, such that legislation like the Inflation Reduction Act or even the Bipartisan Infrastructure Law would not be possible, which is a scenario that never came to pass. My own view as a citizen is that the President and Congress should work together to address the climate crisis as a top priority.

Katelyn Moretti, MD ScM


 Charles E. Grassley
 United States Senator

Questions for the Record from Senator Chuck Grassley
 To: Dr. Carl J. Schramm
 “Under the Weather: Diagnosing the Health Costs of Climate Change”
 April 27, 2023
 Senate Budget Committee

Question #1:

What is public health’s core mission? Is the Centers for Disease Control & Prevention (CDC) under the Biden Administration adequately addressing our core public health challenges?

The core mission of public health is to protect the entire population from infection by communicable diseases when and if they appear and to develop methods to prevent the occurrence of such diseases. This critical role has been overlooked by the CDC for many years for a number of reasons. Among them are that no communicable diseases have emerged on a scale of the Spanish Flu epidemic of 1918 that have required the traditional methods of public health practice to be vigorously engaged.

These traditional and effective methods were slowly developed from trial and error starting before the age of microbiology and the germ theory. The dawn of public health practice is determined by the effective intervention in a localized epidemic of cholera in London in 1854. By denying surrounding residents water from a cholera-infected well, the epidemic ended and the quest for cause-effect knowledge of what caused communicable diseases and how they spread was underway.

The practical outcome were the canonical steps to stop communicable diseases which by themselves define what might be called the interventional practice of public health. The first step is the detection of a communicable disease in a population. Second, the site of the initial outbreak of the disease is identified. Often this process is abbreviated to identifying “patient zero” -- the individuals who were the first to report symptoms indicating infection. Once a communicable disease as been detected in a population, the mapping person-to-person contact is required. This third tool, “case tracing,” is the central means to identify persons who might be carriers, often without them having knowledge of their infection or the risk they pose to others. Finally, those who are infected or might be, who operate as “carriers,” are quarantined so they can no longer operated as agents of infection.

Many consider vaccines as a fifth tool in controlling communicable diseases. Only in the case of COVID was a vaccine useful in controlling an epidemic in real time. This is so because the vaccine was produced much faster than the four to five years needed to produced most vaccines. Success with a number of vaccines in controlling particularly deadly communicable disease, e.g., smallpox and measles, and the development of powerful antibiotics that reduce the fatality risk in other communicable diseases including annually recurring influenzas, have lead to an implicit level

of confidence among public health professionals that they are able to protect the entire population against epidemics.

The foregoing, as suggested, comprise the core of "interventional" public health practice. Its companion, "preventive" public health practice is of equal or greater importance in preventing disease. The creation of modern water supply and sewage systems are based on the contributions mostly of engineers at the turn of the last century. Significantly, those engaged in these efforts were known at the time as "sanitarians," and represented a separate discipline in the first public health schools.

The success of interventional and preventive public health practice is one reason why public health's focus has become so sufficiently defused that perhaps only about eight percent of the CDC's workforce is devoted to detecting and controlling communicable disease. The balance of the agency's staff are deployed on a host of "false" epidemics and other fashionable efforts, e.g., social determinants of health, that have little to do with preventing disease or disability. The definition of an epidemic should be determined by whether the traditional four step process can be engaged to reduce or eliminate the identified threat, one that inexorably is caused by a communicable pathogen, and whether a vaccine will be effective in preventing its recurrence.

Thus, the CDC's embrace of "epidemics" of gun violence, traffic fatalities, obesity, and loneliness, to use but a few examples, demonstrates why its ability to effectively intervene in epidemics and pandemics caused by microbial and viral agents failed in controlling COVID. Simply, it was unprepared for the return of a deadly communicable disease, a failure related to the agency undertaking many programs that are unrelated or tangentially related to protecting the American population from the threat of future epidemics.

Question #2:

Iowa hospitals report to me they face the following challenges: reimbursement, government red tape, 340B, workforce, cybersecurity, telehealth, mental health, and maternity care. For a rural hospital struggling to remain open and provide access to emergency care, where does climate change rank on the overall list of priorities?

Faced with endless regulatory requirements imposed by Medicare and Medicaid and an endless list of agencies, both public and private, every hospital is deluged with demands that have nothing to do with providing care to patients. This problem is more acute in rural settings. Large urban hospitals while burdened in a similar way, their size protects them somewhat from the costs of compliance.

To impose further costs on rural hospitals of complying with regulations meant to protect the environment is nearly unthinkable. What steps can a small hospital take that could produce any gain in protection of the environment, certainly in a way where climate change could be diminished in any discernible way?


Charles E. Grassley
United States Senator

Questions for the Record from Senator Chuck Grassley
To: Mr. Michael Shellenberger
“Under the Weather: Diagnosing the Health Costs of Climate Change”
April 27, 2023
Senate Budget Committee

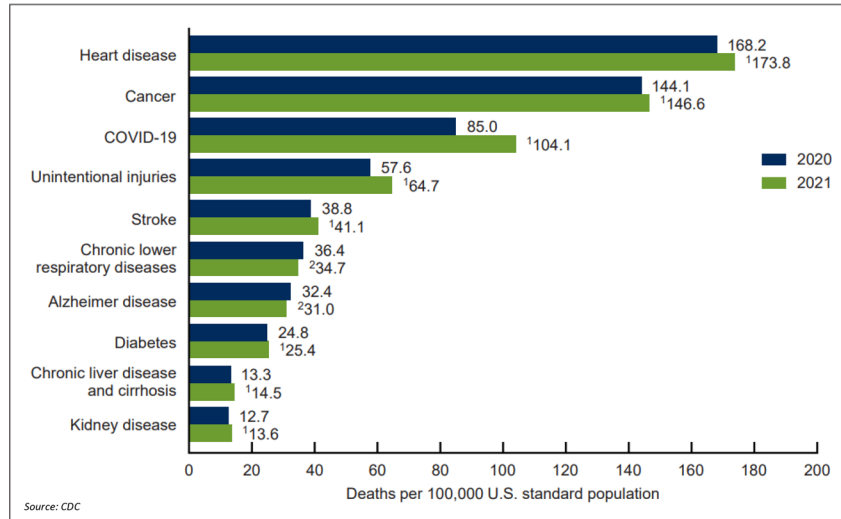
Question #1:

A study in [The Lancet](#) suggests young people feel “sad, anxious, angry, powerless, helpless, and guilty” about climate change. Climate alarmism can only exacerbate this problem and distract from tangible economic growth solutions. Does climate alarmism impact young people’s mental health? If so, how does this impact morale and unnecessary fear among young people instead of focusing on practical solutions that address the problem?

Yes, studies find that climate alarmism is contributing to rising anxiety and depression, particularly among children. In 2017, the American Psychological Association diagnosed rising eco-anxiety and called it “a chronic fear of environmental doom.” In September 2019, British psychologists warned of the impact on children of apocalyptic discussions of climate change. In 2020, a large national survey found that one out of five British children was having nightmares about climate change.

Giving children psychiatric disorders also makes them less likely to engage in positive environmental actions, like advocating for the continued operation and new construction of nuclear power plants, which is the most important thing that can be done to address climate change.

Figure 4. Age-adjusted death rate for the 10 leading causes of death in 2021: United States, 2020 and 2021



The New York Times

Following a Two-Year Decline, Suicide Rates Rose Again in 2021

Suicide increased among younger Black, Hispanic and Native American people, and declined among whites and older people, the C.D.C. reported.

The New York Times

Alcohol Deaths Claim Lives of Working-Age Americans

A C.D.C. study estimates that, over five years, one in eight deaths of people ages 20 to 64 occurred because of alcohol-related injuries or illness.

The New York Times

Deaths From Substance Abuse Rose Sharply Among Older Americans in 2020

In the pandemic's first year, death rates linked to alcohol and drugs climbed among seniors as lockdowns and isolation spread.

The NEW ENGLAND
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EDITORIAL

Call for Emergency Action to Limit Global Temperature Increases, Restore Biodiversity, and Protect Health

Lukoye Atwoli, Abdullah H. Baqui, Thomas Benfield, Raffaella Bosurgi, Fiona Godlee, Stephen Hancocks, Richard Horton, Laurie Laybourn-Langton, Carlos Augusto Monteiro, Ian Norman, Kirsten Patrick, Nigel Praities, Marcel G.M. Olde Rikkert, Eric J. Rubin, Peush Sahni, Richard Smith, Nick Talley, Sue Turale, and Damián Vázquez et al.

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Introduction

THE UNITED NATIONS GENERAL ASSEMBLY IN SEPTEMBER 2021 WILL BRING COUNTRIES together at a critical time for marshalling collective action to tackle the global environmental crisis. They will meet again at the biodiversity summit in Kunming, China, and at the climate conference (COP26) in Glasgow, United Kingdom. Ahead of these pivotal meetings, we — the editors of health journals worldwide — call for urgent action to keep average global temperature increases below 1.5° C, halt the destruction of nature, and protect health.

4/24/23, 3:12 PM

Call for Emergency Action to Limit Global Temperature Increases, Restore Biodiversity, and Protect Health | NEJM

Health is already being harmed by global temperature increases and the destruction of the natural world, a state of affairs health professionals have been bringing attention to for decades.¹ The science is unequivocal: a global increase of 1.5° C above the pre-industrial average and the continued loss of biodiversity risk catastrophic harm to health that will be impossible to reverse.^{2,3} Despite the world's necessary preoccupation with Covid-19, we cannot wait for the pandemic to pass to rapidly reduce emissions.

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Reflecting the severity of the moment, this editorial appears in health journals across the world. We are united in recognizing that only fundamental and equitable changes to societies will reverse our current trajectory.

The risks to health of increases above 1.5° C are now well established.² Indeed, no temperature rise is "safe." In the past 20 years, heat-related mortality among people over 65 years of age has increased by more than 50%.⁴ Higher temperatures have brought increased dehydration and renal function loss, dermatological malignancies, tropical infections, adverse mental health outcomes, pregnancy complications, allergies, and cardiovascular and pulmonary morbidity and mortality.^{5,6} Harms disproportionately affect the most vulnerable, including children, older populations, ethnic minorities, poorer communities, and those with underlying health problems.^{2,4}

Global heating is also contributing to the decline in global yield potential for major crops, which has fallen by 1.8 to 5.6% since 1981; this decline, together with the effects of extreme weather and soil depletion, is hampering efforts to reduce undernutrition.⁴ Thriving ecosystems are essential to human health, and the widespread destruction of nature, including habitats and species, is eroding water and food security and increasing the chance of pandemics.^{3,7,8}

The consequences of the environmental crisis fall disproportionately on those countries and communities that have contributed least to the problem and are least able to mitigate the harms. Yet no country, no matter how wealthy, can shield itself from these impacts. Allowing the consequences to fall disproportionately on the most vulnerable will breed more conflict, food insecurity, forced displacement, and zoonotic disease — with severe implications for all countries and communities. As with the Covid-19 pandemic, we are globally as strong as our weakest member.

Rises above 1.5° C increase the chance of reaching tipping points in natural systems that could lock the world into an acutely unstable state. This would critically impair our ability to mitigate harms and to prevent catastrophic, runaway environmental change.^{9,10}

Global Targets Are Not Enough

Encouragingly, many governments, financial institutions, and businesses are setting targets to reach net-zero emissions, including targets for 2030. The cost of renewable energy is dropping rapidly. Many countries are aiming to protect at least 30% of the world's land and oceans by 2030.¹¹

These promises are not enough. Targets are easy to set and hard to achieve. They are yet to be matched with credible short- and longer-term plans to accelerate cleaner technologies and transform societies. Emissions reduction plans do not adequately incorporate health considerations.¹² Concern is growing that temperature rises above 1.5° C are beginning to be seen as inevitable, or even acceptable, to powerful members of the global community.¹³ Relatedly, current strategies for reducing emissions to net zero by the middle of the century implausibly assume that the world will acquire great capabilities to remove greenhouse gases from the atmosphere.^{14,15}

This insufficient action means that temperature increases are likely to be well in excess of 2° C,¹⁶ a catastrophic outcome for health and environmental stability. Critically, the destruction of nature does not have parity of esteem with the climate element of the crisis, and every single global target to restore biodiversity loss by 2020 was missed.¹⁷ This is an overall environmental crisis.¹⁸

Health professionals are united with environmental scientists, businesses, and many others in rejecting that this outcome is inevitable. More can and must be done now — in Glasgow and Kunming — and in the immediate years that follow. We join health professionals worldwide who have already supported calls for rapid action.^{1,19}

Equity must be at the center of the global response. Contributing a fair share to the global effort means that reduction commitments must account for the cumulative, historical contribution each country has made to emissions, as well as its current emissions and capacity to respond. Wealthier countries will have to cut emissions more quickly, making reductions by 2030 beyond those currently proposed^{20,21} and reaching net-zero emissions before 2050. Similar targets and emergency action are needed for biodiversity loss and the wider destruction of the natural world.

To achieve these targets, governments must make fundamental changes to how our societies and economies are organized and how we live. The current strategy of encouraging markets to swap dirty for cleaner technologies is not enough. Governments must intervene to support the redesign of transport systems, cities, production and distribution of food, markets for financial investments, health systems, and

much more. Global coordination is needed to ensure that the rush for cleaner technologies does not come at the cost of more environmental destruction and human exploitation.

Many governments met the threat of the Covid-19 pandemic with unprecedented funding. The environmental crisis demands a similar emergency response. Huge investment will be needed, beyond what is being considered or delivered anywhere in the world. But such investments will produce huge positive health and economic outcomes. These include high-quality jobs, reduced air pollution, increased physical activity, and improved housing and diet. Better air quality alone would realize health benefits that easily offset the global costs of emissions reductions.²²

These measures will also improve the social and economic determinants of health, the poor state of which may have made populations more vulnerable to the Covid-19 pandemic.²³ But the changes cannot be achieved through a return to damaging austerity policies or the continuation of the large inequalities of wealth and power within and between countries.

Cooperation Hinges on Wealthy Nations Doing More



In particular, countries that have disproportionately created the environmental crisis must do more to support low- and middle-income countries to build cleaner, healthier, and more resilient societies. High-income countries must meet and go beyond their outstanding commitment to provide \$100 billion a year, making up for any shortfall in 2020 and increasing contributions to and beyond 2025. Funding must be equally split between mitigation and adaptation, including improving the resilience of health systems.

Financing should be through grants rather than loans, building local capabilities and truly empowering communities, and should come alongside forgiving large debts, which constrain the agency of so many low-income countries. Additional funding must be marshalled to compensate for inevitable loss and damage caused by the consequences of the environmental crisis.

As health professionals, we must do all we can to aid the transition to a sustainable, fairer, resilient, and healthier world. Alongside acting to reduce the harm from the environmental crisis, we should proactively contribute to global prevention of further damage and to action on the root causes of the crisis. We must hold global leaders to account and continue to educate others about the health risks of the crisis. We must join in the work to achieve environmentally sustainable health systems before 2040, recognizing that this will mean changing clinical practice. Health institutions have already divested more than \$42 billion of assets from fossil fuels; others should join them.⁴

The greatest threat to global public health is the continued failure of world leaders to keep the global temperature rise below 1.5° C and to restore nature. Urgent, society-wide changes must be made and will

lead to a fairer and healthier world. We, as editors of health journals, call for governments and other leaders to act, marking 2021 as the year that the world finally changes course.

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Editor's note: This editorial is being published simultaneously in many international journals. Please see the full list here: <https://www.bmj.com/content/full-list-authors-and-signatories-climate-emergency-editorial-september-2021>.

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Supplementary Material

Disclosure Forms

PDF

4134KB

References (23)

1. Health Recovery. In support of a #HealthRecovery. May 26, 2020 (<https://healthyrecovery.net>). Google Scholar

2. Intergovernmental Panel on Climate Change. Summary for policymakers. In: Global warming of 1.5°C. 2018 (<https://www.ipcc.ch/sr15/>).
Google Scholar
3. Diaz S, Settele J, Brondizio ES, et al. The global assessment report on biodiversity and ecosystem services: summary for policymakers. Bonn, Germany: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2019 (https://ipbes.net/sites/default/files/2020-02/ipbes_global_assessment_report_summary_for_policymakers_en.pdf).
Google Scholar
4. Watts N, Amann M, Arnell N, et al. The 2020 report of the Lancet countdown on health and climate change: responding to converging crises. *Lancet* 2021;397:129-170.
Crossref Web of Science Medline Google Scholar
5. Rocque RJ, Beaudoin C, Ndjaboue R, et al. Health effects of climate change: an overview of systematic reviews. *BMJ Open* 2021;11(6):e046333-e046333.
Crossref Web of Science Medline Google Scholar
6. Haines A, Ebi K. The imperative for climate action to protect health. *N Engl J Med* 2019;380:263-273.
Free Full Text Web of Science Medline Google Scholar
7. United Nations Environment Programme, International Livestock Research Institute. Preventing the next pandemic: zoonotic diseases and how to break the chain of transmission. Nairobi: United Nations Environment Programme, 2020 (https://72d37324-5089-459c-8f70-271d19427cf2.filesusr.com/ugd/056cf4_b5b2fc067f094dd3b2250cda15c47acd.pdf).
Google Scholar
8. Intergovernmental Panel on Climate Change. Summary for policymakers. In: Climate change and land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. 2019 (<https://www.ipcc.ch/srccl/chapter/summary-for-policy-makers/>).
Google Scholar
9. Lenton TM, Rockström J, Gaffney O, et al. Climate tipping points — too risky to bet against. *Nature* 2019;575:592-595.
Crossref Web of Science Medline Google Scholar

10. Wunderling N, Donges JF, Kurths J, Winkelmann R. Interacting tipping elements increase risk of climate domino effects under global warming. *Earth Syst Dynam* 2021;12:601-619.
Crossref Google Scholar
11. High Ambition Coalition home page (<https://www.hacformatureandpeople.org>).
Google Scholar
12. The Global Climate and Health Alliance. Are national climate commitments enough to protect our health? (<https://climateandhealthalliance.org/initiatives/healthy-ndcs/ndc-scorecards/>).
Google Scholar
13. Carbon Brief. Climate strikers: open letter to EU leaders on why their new climate law is 'surrender.' 2021 (<https://www.carbonbrief.org/climate-strikers-open-letter-to-eu-leaders-on-why-their-new-climate-law-is-surrender>).
Google Scholar
14. Fajardy M, Köberle A, Mac Dowell N, Fantuzzi A. BECCS deployment: a reality check. Grantham Institute briefing paper no. 28. London: Imperial College London, January 2019 (<https://www.imperial.ac.uk/media/imperial-college/grantham-institute/public/publications/briefing-papers/BECCS-deployment---a-reality-check.pdf>).
Google Scholar
15. Anderson K, Peters G. The trouble with negative emissions. *Science* 2016;354:182-183.
Crossref Web of Science Medline Google Scholar
16. Climate Action Tracker home page (<https://climateactiontracker.org>).
Google Scholar
17. Secretariat of the Convention on Biological Diversity. Global biodiversity outlook 5. 2020 (<https://www.cbd.int/gbo5>).
Google Scholar
18. Steffen W, Richardson K, Rockström J, et al. Sustainability. Planetary boundaries: guiding human development on a changing planet. *Science* 2015;347:1259855-1259855.
Crossref Web of Science Medline Google Scholar
19. UK Health Alliance on Climate Change. Our calls for action (<http://www.ukhealthalliance.org/cop26/>).
https://www.nejm.org/doi/full/10.1056/NEJMe2113200?query=featured_home

4/24/23, 3:12 PM

Call for Emergency Action to Limit Global Temperature Increases, Restore Biodiversity, and Protect Health | NEJM

[Google Scholar](#)

20. Climate Action Tracker. Warming projections global update. May 2021 (https://climateactiontracker.org/documents/853/CAT_2021-05-04_Briefing_Global-Update_Climate-Summit-Momentum.pdf).
[Google Scholar](#)
21. Emissions gap report 2020. Nairobi: United Nations Environment Programme, December 2020.
[Google Scholar](#)
22. Markandya A, Sampedro J, Smith SJ, et al. Health co-benefits from air pollution and mitigation costs of the Paris Agreement: a modelling study. *Lancet Planet Health* 2018;2(3):e126-e133.
[Crossref](#) [Medline](#) [Google Scholar](#)
23. Paremoer L, Nandi S, Serag H, Baum F. Covid-19 pandemic and the social determinants of health. *BMJ* 2021;372:n129-n129.
[Crossref](#) [Medline](#) [Google Scholar](#)

[Close References](#)

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The Costs of Inaction: The Economic Burden of Fossil Fuels and Climate Change on Health in the United States



Overview

Fossil fuel combustion and global climate change are harming our health on multiple fronts. Air pollution from burning fossil fuels is one of the leading causes of illness and premature deaths in the United States and the world.¹ Beyond air pollution, the burning of fossil fuels is changing our climate by increasing levels of heat-trapping pollution such as carbon dioxide in the Earth's atmosphere. Those rising temperatures are fueling more extreme weather and contributing to dangerous heat waves, dramatic spikes in air pollution, and increases in tick and mosquito-borne infectious disease outbreaks. These impacts are projected to increase in frequency, intensity, duration, and/or geographic range in the decades to come, with the potential to trigger profound increases in harm to public health in the U.S.²

The climate crisis is a dangerous and costly problem, and it threatens much more than just property values and infrastructure: it's fueling substantial and sometimes irreversible damage to public health in terms of illnesses, injuries, expensive medical bills, and deaths. A wealth of scientific research indicates that this problem will contribute to an extraordinary rise in a wide variety of health problems and demand for medical care if we don't take action to avert the climate crisis. The growing burden of health harms and healthcare costs is already straining people and communities,³ which is especially worrisome given that more than half of U.S. adults currently report medical financial hardship⁴ — that is, the inability to afford medical care, no matter how necessary it is. Climate change is a “threat multiplier”⁵ that is worsening existing health and economic burdens, particularly for the most vulnerable among us, including children, low-income communities, and people of color.⁶

In this report, we conclude that the health costs of air pollution and climate change already far exceed \$800 billion per year and are expected to become even more expensive in years to come without a stronger societal response to address this crisis. This price tag most likely vastly underestimates the true total costs of these problems, due to limited available health data. These large and growing financial costs—as well as the major health harms of air pollution and climate change—are often overlooked. Now is the time to recognize how much these linked problems are costing us.

Reducing heat-trapping pollution and investing in community preparedness can provide valuable immediate and long-term safeguards to our health and wellbeing. These actions can be supported by fully accounting for the sizeable financial and health costs of climate inaction. This report summarizes scientific evidence of the large health burden of recent climate change-related events in the United States, describes how those health problems trigger large treatment costs that burden people and families *right now*, and offers recommendations for ways to weave health and economic arguments into advocacy for climate action.



How do fossil fuels and climate change harm health?

Coal, oil, and natural gas are major types of fossil fuels — energy sources derived from burning the remains of prehistoric plants and animals.⁷ The extraction, refining, transport, and combustion of fossil fuels release toxic pollution into the air, soil, and water.⁸ The combustion emission components with the greatest impact on human health which are the focus of this report include sulfur oxides, nitrogen oxides, and microscopic particle pollution. These pollutants can each harm health directly, while also contributing to the formation of additional particle pollution and ground-level ozone smog — further amplifying the potential health harms of these emissions.

The climate crisis fuels dangerous environmental changes that are harming people and families across the country, like more extreme weather and stronger hurricanes, increasingly severe wildfires, intense heat waves, more dangerous air pollution episodes, an expanded range for insect-borne infectious diseases, and longer allergy seasons.⁹ These climate change-related events are expected to increase in frequency, intensity, duration, and/or geographic range in the future, absent strong reductions in greenhouse gas pollution.² The health consequences of a rapidly changing climate are here and now, and they are dangerous and costly for people to treat and recover from.



The Health Costs of Inaction on Climate Change 2

What are the types of health costs from fossil fuels and climate change?

Medical treatment and recovery from the many types of health problems worsened by climate change is expensive and burdens patients, employers, public and private insurers, and health system operators. Extreme weather events commonly require people to seek medical care in emergency rooms, hospitals, and non-emergency healthcare settings. When patients are admitted to a hospital to treat severe illnesses and injuries, they may also forego income at work, triggering hardship for themselves and their families. The costs can continue to add up once patients are discharged from hospitals, because of the possible need for ongoing outpatient care and medications. Research on the health costs of climate change related-events categorizes how these staggering costs add up:



PREMATURE DEATHS

Climate change-related events like heat waves, wildfires, and hurricanes are often deadly. To assign value to the economic risk of premature deaths, the U.S. federal government applies a metric called the Value of a Statistical Life. The economic burden of early deaths is typically the major driver of costs in climate and health cost assessments.



MEDICAL CARE FOR TREATMENT OF PHYSICAL AND MENTAL HEALTH CONDITIONS

Direct treatment costs in hospitals, emergency rooms, and clinics can come with a steep price tag for patients. Mental health treatment for people experiencing conditions like post-traumatic stress disorder (PTSD) after a disaster is another component of these costs.



REHABILITATION AND HOME HEALTH CARE

Even after completion of immediate treatment, some patients require continuing medical care to manage and recover from their health problems, including mental health counseling or physical therapy.



PRESCRIPTION MEDICATIONS

Filling prescriptions for medications (sometimes more than once) can be costly for patients.



LOST WAGES AND WORKER PRODUCTIVITY

While patients are receiving necessary medical care, they may lose wages at work. Unscheduled medical absences and stress-related lack of productivity tied to healthcare needs also affect worker productivity and business operations.



DOWNSTREAM HEALTH COSTS

Climate events can harm health and trigger other costs in complex ways by destabilizing individuals, families, and communities. People can suffer from other health problems after climate disasters, including those linked to delayed care and homelessness.

Who is paying these health costs from fossil fuels and climate events?

According to the U.S. Global Change Research Program,¹⁰ populations at higher risk of climate harms (and associated health costs) include economically disadvantaged groups, some communities of color, immigrant groups (especially those with limited English proficiency), Indigenous peoples, children and pregnant women, older adults, outdoor workers, persons with disabilities, and persons with preexisting or chronic medical conditions. These vulnerabilities stem from a combination of factors, including lack of access to affordable health insurance and care, systemic racism, longstanding and inequitable land use and zoning rules, the concentration of polluting facilities in economically marginalized areas, health status, and occupational risks.

Additionally, many people lack the resources to prepare for and adapt to the multiple, sometimes cascading and compounding health risks of a changing climate.¹¹ Research indicates that Medicare and Medicaid patients are not only among the most vulnerable groups to the health effects of climate change, but also shoulder the highest share of climate-sensitive health costs to treat illness.¹² Because these public health insurance programs are funded by taxpayer dollars, we are all shouldering the health costs of climate change. The climate crisis could also trigger a demand for more home health care needs, an essential function that is often performed by women, people of color, and often inadequately compensated.¹³ In short, the health costs of the climate crisis widen existing economic inequality.

How much are these air pollution- and climate change-fueled health costs?

Estimating the national health cost of fossil fuels and climate change is challenging because of limited data availability on injuries and illnesses resulting from specific weather extremes.¹⁴ As a result, U.S. government estimates of the cost of climate/weather disasters tend to omit the health-related costs altogether.¹⁵ Importantly, existing cost estimates often focus on impacts that are immediate and most easily quantified, underestimating the total health impacts (and costs) of the long-term disease burden.¹⁶

Despite this gap, peer-reviewed scientific literature shows that people in the United States are already burdened by health costs of air pollution and climate change that far exceed \$800 billion per year. Unfortunately, many Americans likely experience multiple climate change-related events and associated costs simultaneously. The following set of tables provides a list of major health threats linked to fossil fuel-triggered air pollution and climate change-related events, along with a sample of cost estimates for these types of health harms, if available (normalized to 2020 USD).¹⁷





Health Costs of Poor Air Quality

PARTICULATE MATTER

Fossil fuel burning (coal in particular) releases deadly particulate matter (PM) and PM precursors, and climate change affects PM through increases in airborne dust and wildfires in parts of the United States.¹⁸ PM and PM precursors are the most deadly and costly major components of air pollution.¹⁹ PM_{2.5} exposure is associated with cardiovascular disease and respiratory conditions such as lung cancer. It is also associated with altered nervous system, metabolic, reproductive, and developmental outcomes.²⁰

GROUND-LEVEL OZONE (SMOG)

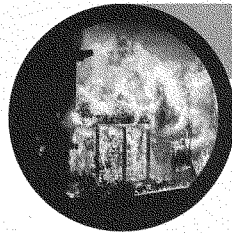
Precursors emitted by fossil fuel combustion, combined with higher temperatures fueled by climate change, increase ozone production.²¹ Ozone is known to cause harmful respiratory outcomes such as asthma exacerbation, and may also worsen cardiovascular, metabolic, nervous system, and reproductive outcomes.²²

AIRBORNE ALLERGENS

Rising temperatures and higher carbon dioxide concentrations are increasing the duration, geographic extent, and intensity of pollen seasons. Fossil fuel pollution exposure in humans can worsen allergic responses. These factors can exacerbate allergic diseases such as asthma, hay fever, rhinitis, and atopic dermatitis.²³

EXPOSURE/EVENT	HEALTH IMPACTS MEASURED	ESTIMATED HEALTH COSTS (2020 USD)
PM_{2.5} AIR POLLUTION AND PRECURSORS (Nationwide, 2011)	107,000 premature deaths	\$820 billion ²⁴
GROUND-LEVEL OZONE (SMOG) (Nationwide, 2002)	795 premature deaths, 4,150 respiratory-related hospitalizations, 485 asthma-related ER visits 365,468 other outpatient encounters	\$7.9 billion ²⁵
ALLERGENIC OAK POLLEN (Southeast, Northeast, and Midwest, 2010)	21,200 asthma-related ER visits	\$11.4 million ²⁶





Health Costs of Extreme Climate Events

WILDFIRES

Rising temperatures, drought conditions, and insect outbreaks linked to climate change are projected to increase the frequency and intensity of large wildfires.³³ From 1984 to 2015, climate change doubled the area of burned land from forest fires in the Western United States.³⁴ Wildfires can cause premature death and injuries, and endanger respiratory and cardiovascular health through the generation of toxic air pollution.³⁵

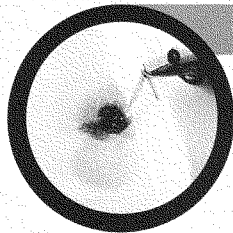
HEAT

Climate change drives higher average temperatures and more intense heat waves.² Climate change has at least doubled the likelihood of record-breaking hot summer days in the United States between 1961-2010.³¹ Heat stress leads to hyperthermia-related conditions such as heatstroke, can worsen existing cardiovascular, respiratory, cerebrovascular, and diabetes-related conditions, and can harm perinatal outcomes.³²

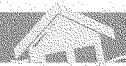
EXTREME PRECIPITATION, HURRICANES, AND COASTAL STORMS

Climate change has contributed to increases in the frequency and intensity of heavy rainfall, North Atlantic hurricanes, and flooding over the past several decades.² These disasters cause trauma and death directly and can exacerbate chronic conditions. Infrastructure loss after a disaster can lead to pathogenic food and water-borne infections.³⁵ In the aftermath, the recovery process poses a heavy toll on the mental health of survivors, particularly for those who are already vulnerable, such as pregnant women.³⁶

EXPOSURE/EVENT	HEALTH IMPACTS MEASURED	ESTIMATED HEALTH COSTS (2020 USD)
EXTREME HEAT (Wisconsin, 2012)	27 deaths, 155 hospital admissions, 1,620 ER visits, 57 other outpatient encounters	\$263 million¹²
WILDFIRE SMOKE (Nationwide, 2010)	6,200 annual respiratory hospital admissions, 1,700 PM _{2.5} -related deaths from short term smoke exposures	\$16 billion³⁷
HURRICANE SANDY (New York and New Jersey, 2012)	273 premature deaths (in NY, NJ and nearby states), 6,602 hospital admissions, 4,673 ER visits, 2,444 outpatient encounters	\$3.3 billion¹³



Additional Health Costs



Beyond these documented costs, other climate change-related health problems likely burden people with additional health-related costs. These costs include:

HEALTH PROBLEMS LINKED TO FOOD AND WATER

Atmospheric carbon dioxide, rising temperatures, and extreme climate/weather events increase risk of (1) pathogenic and chemical contamination of food and water, (2) decreased protein and mineral content in some crops, and (3) disruption of critical supply chains.³⁸ Despite health threats from gastrointestinal illness (e.g. harmful algal blooms), neurological damage (e.g. methylmercury in seafood), and food insecurity, the health cost implications have only been estimated in a few instances.

MENTAL HEALTH PROBLEMS

Climate/weather-related disasters, extreme heat, and climate change-associated anxiety (“ecological grief”) can have far-reaching mental health implications.³⁹ However, few studies estimate the associated costs. Mental health issues are a highly costly medical condition in the United States,⁴⁰ so the mental health costs of climate change-related events are an important area for future investigation.

Decarbonizing Our Energy, Transportation, and Food Systems Improves Health and Reduces Costs

The existing evidence is clear: the climate crisis and fossil fuel use are extremely costly, both in terms of damage to human health and economic hardship on vulnerable communities. But smart climate actions now to reduce fossil fuel emissions and prepare communities for climate change-related health harms can reduce suffering and transform health costs into major financial savings.⁴⁴ The following recommendations identify climate solutions for public health across three groups: individuals, health professionals, and policymakers.

What Many of Us Can Do

Most everyone can engage in climate solutions by making small, health-positive improvements to their daily habits.

USE ACTIVE TRANSPORTATION

Substituting active transportation (walking and biking) and public transportation (bus, subway, trains) for car use, when possible, reduces pollution emissions and improves people’s health. Ridesharing when active and public transportation options are unavailable can cut costs and emissions as well.

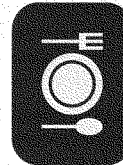
- Physical inactivity costs the United States an estimated \$27 billion annually in productivity losses and healthcare for preventable conditions such as coronary artery disease and type II diabetes.⁴¹



ADOPT SUSTAINABLE AND HEALTHY DIETS

Eating healthy foods, reducing meat consumption, and increasing consumption of fruits, vegetables and whole grains can improve people's health, reduce healthcare costs, and reduce food-related climate pollution.

- Global adoption of the low carbon planetary health diet (reduces animal-source foods in lieu of plant-based foods) would prevent about 11 million deaths globally each year.⁴²



What Health Professionals Can Do

As trusted messengers on health issues, health professionals can communicate the health risks and costs of climate change and fossil fuel use to patients and colleagues. Health professionals can help to strengthen climate action through specific efforts:

PUSH TO DECARBONIZE THE HEALTH SECTOR

In the United States, health care produces a large and growing amount of heat-trapping pollution, but the healthcare sector's large climate footprint can be reduced without compromising quality.⁴³

- In 2018, U.S. healthcare sector greenhouse gas emissions made up 8.5% of total countrywide domestic greenhouse gas emissions. Emissions from the U.S. healthcare sector are among the highest (in absolute and per capita terms) of any healthcare sector in the world.^{44,45}



ADVOCATE FOR CLIMATE READY HEALTH SYSTEMS

Building resilience to climate/weather-related disasters in the healthcare sector and beyond will help treat patients more effectively and reduce health problems and costs in a warming world.

- Advocate for strong emergency preparedness protocol within healthcare facilities, to ensure swift adaptation to the devastating health and infrastructure damage from climate/weather-related disasters such as wildfires, floods, and hurricanes.
- Be aware of local health-promoting adaptation measures such as early heat warning systems and public cooling centers, and share this information with patients.



INTEGRATE CLIMATE CHANGE INTO HEALTHCARE AND PUBLIC HEALTH PRACTICE

We must factor in the changing climate into our diagnostic and treatment plans, and teach our trainees to do the same, to reduce the severity of climate-fueled health harms.

- Whenever appropriate, provide patients with health-positive recommendations that are climate-positive as well — such as using active transport when possible, and reducing consumption of meat and processed foods.
- Incorporate environmental/occupational health into history taking, including attention towards air conditioner access and vulnerable workers (including outdoor laborers) during the summer months.
- Understand the effects of climate change on medication — for example, the impact of certain antipsychotics, beta-blockers, and antihistamines on heat intolerance.⁴⁶



What Policymakers Can Do

Elected leaders at the local, state, and federal levels have an important role to play in reducing systemic environmental inequality and ensuring that climate and health solutions are accessible to everyone. Climate policy should include measures to reduce climate change-related health problems and their high costs. Specifically, policymakers and policy advocates can advance policy changes on several fronts:

IMPLEMENT POLICIES THAT SUPPORT CLEAN, LOW-CARBON ENERGY, TRANSPORTATION, AND FOOD SYSTEMS.

A just transition away from fossil fuel use in energy, transportation, and food systems (while increasing reliance on renewable energy sources such as wind, solar, and geothermal energy) will curb harmful and costly emissions. Building resilience against climate change-related events will reduce damage in the future.



ENERGY

From 2007 to 2015, wind energy avoided 6,700 premature deaths from air pollution, with an estimated value of \$59.1 billion.⁴⁷ Equitable access to clean energy will curb the toxic effects of fossil fuel emissions, particularly in disenfranchised communities where emissions take the largest toll.⁴⁸



TRANSPORTATION

Nationwide zero-emission transportation would reduce air pollution and avoid up to an estimated \$76.7 billion in health costs in 2050 from 6,300 averted premature deaths, 93,000 averted asthma attacks, and 416,000 averted missed work days.⁴⁹ Particular attention is needed to ensure a just transition and improve safe access to zero-emission transportation options, including sidewalks, bike lanes, and zero-emission public transportation.



DIETS

Improving access and demand for affordable, high-quality planet-friendly foods can support the health of communities and the climate. Solutions include expanding food waste reduction efforts, community composting programs, and local food production, and incentivizing the purchase of planet-friendly foods.⁵⁰



BUILDING HEALTH RESILIENCE

Invest more aggressively in climate change preparedness efforts at the local level, including heatwave and wildfire smoke early warning systems, cooling centers, and other health-centered climate adaptation programming.

The climate crisis is extremely costly, in terms of both damage to human health and the economic hardship that climate-fueled problems impose on vulnerable individuals and communities. By recognizing the dangerous and expensive health consequences of climate change, we can make the case for climate policies that will reduce costly suffering — now, and for years to come.

A Deeper Look at Our Reporting Methods

We would like to provide some more information to further clarify the methods we used in our climate-health cost valuation report so that its findings are more clearly interpreted, summarized, and reported.

Headlines and stories generated from the report's initial release suggested or directly stated that climate change is tied to more than \$820 billion in health care costs per year. This prompted us to provide the following, in which we highlight four points with a more detailed description of the cost estimates and clarification on the nature of the costs we report.

1. DIFFERENTIATING BETWEEN THE ECONOMICS OF REDUCING MORTALITY RISK VS. HEALTH CARE COSTS TO TREAT ILLNESS

Overall, the vast majority of the health costs identified in our report come from a method that provides a valuation of reducing premature mortality risk, known as the "Value of a Statistical Life (VSL)."⁵¹ These mortality-related cost estimates are not the same as those related to traditional health care that are typically incurred to treat illnesses.

The VSL estimates comprise the vast majority of the total damages identified in our report and provide an important way to represent premature loss of life in economic terms.

When we discuss the costs of premature mortality measured by this VSL, our cited publications applied an estimation method for the economic valuation of premature death, rather than an out-of-pocket cost or medical bill for health services. For example, one could say that the VSL indicates how much a large group of people would be willing to pay to avoid or reduce the risk of premature death from health harms caused by environmental conditions.

To emphasize this distinction again: the overwhelming majority of the costs estimated in our report are those associated with premature mortality, via the VSL method.

For More Information on the VSL Method Visit:

<https://www.epa.gov/environmental-economics/mortality-risk-valuation#means>

2. WHO IS PAYING FOR THE HEALTH CARE COSTS WE IDENTIFIED?

For the illness-related costs, the expected payer can sometimes be determined from the datasets used to assemble the cost estimates. The report does not intend to imply that all of the estimated costs are borne by vulnerable people, nor by the general public through Medicare and Medicaid premiums, to which taxpayers contribute. The VSL estimates associated with premature deaths are not out-of-pocket expenses being directly paid by individuals, and those costs comprise the vast majority of the total economic burden identified in the report.

3. THE DIFFERENCE BETWEEN FOSSIL FUEL-GENERATED AIR POLLUTION AND CLIMATE CHANGE-RELATED COSTS

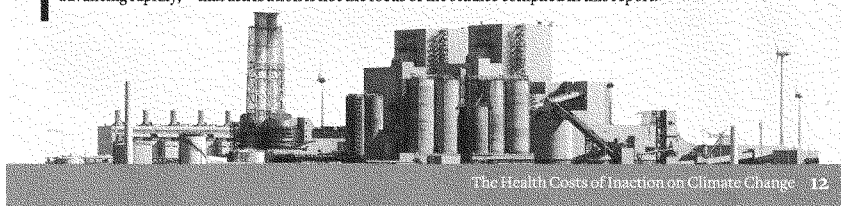
This report includes both the health costs of fossil fuel-related air pollution and the health costs related to events sensitive to climate change, to varying degrees. Today, fossil fuel-related air pollution generates the majority of these costs, largely derived from the economic value of air pollution-related premature deaths. For example, the \$820 billion figure highlighted in our report refers exclusively to the economic impact of premature deaths associated with fossil fuel-generated air pollution. Other cost estimates identified in our report (above and beyond the \$820 billion) encompass both premature mortality and illness-related costs for specific types of climate-related events. We did not sum together the other cost estimates presented in each exposure category, because they are derived from different studies over different years that employed distinct methodologies.

But in the future, say 30 years from now when today's children are middle-aged, and assuming that cleaner, non-polluting energy sources are more prevalent, fossil fuel-related health harms would decline. However, climate change-related health costs are projected to rise to tens to hundreds of billions annually by the end of this century,⁵² greater than those same costs today. The good news is, if we move away from reliance on fossil fuels now, we can limit both types of costs – both today's fossil fuel air pollution costs; and the future costs from a range of climate change-sensitive health hazards exacerbated by the impact of fossil fuel-related greenhouse gas emissions on climate change.

4. THE DIFFERENCE BETWEEN CLIMATE CHANGE-RELATED AND CLIMATE CHANGE-CAUSED HEALTH IMPACTS

The report might seem to suggest that people are paying out over \$800 billion dollars from their pockets every year, for health costs caused by climate change. This interpretation, however, blurs the distinction between climate-attributable (caused) health outcomes and what the report identifies as “climate change-related” (elsewhere referred to as “climate-sensitive”⁵³) health outcomes. To help avert confusion, we’re providing this clarification.

The report combined findings from prior studies that were not causal climate change “attribution” analyses. Climate attribution studies apply statistical modeling techniques in order to quantitatively examine the link between climate change's influence on a particular event and associated health harms. Rather, this report compiled information from prior studies on a range of climate-sensitive health problems – those expected to worsen in frequency, intensity, duration, or areal extent in the future, due to climate change. For example, in the report, substantial costs are associated with vector-borne diseases whose climate change attribution is unknown, and likely limited at this time.⁵⁴ To be clear, climate change is not currently responsible for 100% of the costs that were tallied in the report. While research in attributing climate change's contribution to specific environmental events is advancing rapidly,⁵⁵ that attribution is not the focus of the studies compiled in this report.



References & Acknowledgements

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REFERENCES

1. Lelieveld J, Klingmüller K, Pozzer A, Burnett RT, Haines A, Ramanathan V. Effects of fossil fuel and total anthropogenic emission removal on public health and climate. *PNAS*. 2019;116(4):7192-7197. <https://doi.org/10.1073/pnas.1819081116>
2. Reidmiller DR, Avery CW, Easterling DR, et al. Impacts, risks, and adaptation in the United States: The fourth national climate assessment, Volume II. U.S. Global Change Research Program; 2018. <https://doi.org/10.7930/JSCA.2018>
3. Hsiang S, Kopp R, Jina A, et al. Estimating economic damage from climate change in the United States. *Science*. 2017;356(6345):1362-1369. <https://doi.org/10.1126/science.1244369>
4. Yabroff, KR, Zhao J, Han X, et al. Prevalence and correlates of medical financial hardship in the USA. *J Gen Intern Med*. 2019;34:1494-1502. <https://doi.org/10.1007/s11366-019-05002-w>
5. U.S. Department of Defense. National security implications of climate-related risks and a changing climate, July 23, 2015. https://archive.defense.gov/pubs/150724 congressional_report_on_national_implications_of_climate_change.pdf
6. Ebi KL, and Hess JJ. Health risks due to climate change: Inequity in causes and consequences. *Health Affairs*. 2020;39(12):2056-62. <https://doi.org/10.1137/hlthaff.2020.01185>
7. U.S. Department of Energy. Energy sources - Fossil. U.S. Accessed April 12, 2021. https://www.energy.gov/science/innovation/energy-sources/fossil/#_content=Page%20energy%20sources%20including%20oil%20buried%20by%20layers%20of%20rock
8. Union of Concerned Scientists. The hidden costs of fossil fuels. Published July 15, 2008. <https://www.ucsusa.org/resources/hidden-costs-fossil-fuels>
9. Crimmins A, Balbus J, Gamble JL, et al. The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program; 2016. <http://doi.org/10.7930/JCR49XQX>
10. Gamble JL, Balbus J, Berger M, et al. Ch. 9: Populations of concern. The impacts of climate change on human health in the United States: A scientific assessment. US Global Change Research Program. 2016; 247-286. <http://doi.org/10.7930/JCR49XQX>
11. Martinich J, Crimmins A. Climate damages and adaptation potential across diverse sectors of the United States. *Nat. Clim. Chang*. 2019;9(5):397-404. <https://doi.org/10.1038/s41558-019-0444-6>
12. Limaye VS, Max W, Constible J, Knowlton K. Estimating the health-related costs of 10 climate-sensitive U.S. events during 2012. *GeoHealth*. 2019;3(9):245-265. <http://doi.org/10.1029/2019JG002604>
13. PHI National. U.S. home care workers: Key facts. PHI National, September 3, 2019. <https://phinational.org/resource/u-s-home-care-workers-key-facts-2019/>
14. Limaye VS, Max W, Constible J, Knowlton K. Estimating the costs of inaction and the economic benefits of addressing the health harms of climate change. *Health Affairs*. 2020;39(12):2098-2104. <https://doi.org/10.1137/hlthaff.2020.01109>
15. Smith AB, Katz RW. US billion-dollar weather and climate disasters: data sources, trends, accuracy and biases. *Nat Hazards*. 2013;67(2):387-410. <http://doi.org/10.1007/s11060-013-0565-5>
16. Hutton G. The economics of health and climate change: key evidence for decision making. *Global Health*. 2011;7:18. <http://doi.org/10.1186/1744-8603-7-18>
17. U.S. Bureau of Economic Analysis. Personal Consumption Expenditures: Chain-Type Price Index. FRED, Federal Reserve Bank of St. Louis, <https://fred.stlouisfed.org/series/PCE337L>. Note: Inflation adjustments were performed with the PCE price index using January 1 of the original cost estimate year from source studies and scaling to the U.S. dollar value on December 31, 2020.
18. Fann N, Brennan T, Dolwick P, et al. Ch. 3: Air quality impacts. The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program. 2016;69-98. <http://doi.org/10.7930/JCR49XQX>
19. Jaramillo P, Muller NZ. Air pollution emissions and damages from energy production in the U.S.: 2002-2011. *Energy Policy*. 2016;90:202-211. <https://doi.org/10.1016/j.enpol.2015.12.035>
20. U.S. EPA. Integrated science assessment (ISA) for particulate matter. Published Dec 2019. <https://www.epa.gov/isa/integrated-science-assessment-isa-particulate-matter>
21. Kinney PL. Interactions of climate change, air pollution, and human health. *Curr Envir Health Rpt*. 2018;5(1):179-186. <https://doi.org/10.1007/s40572-018-0188-z>
22. U.S. EPA. Integrated science assessment (ISA) for ozone and related photochemical oxidants. Published Apr 2020. <https://www.epa.gov/isa/integrated-science-assessment-si-ozone-and-related-photochemical-oxidants>

23. Bielory L, Lyons K, Goldberg R. Climate change and allergic disease. *Curr Allergy Asthma Rep.* 2012;12(6):485-494. <https://doi.org/10.1007/s11882-012-0314-5>
24. Goodkind AL, Tessum CW, Coggins JS, Hill JD, Marshall JD. Fine-scale damage estimates of particulate matter air pollution reveal opportunities for location-specific mitigation of emissions. *Proc Natl Acad Sci USA.* 2019;116(18):8775-8780. <https://doi.org/10.1073/pnas.1816102116>. Note: Mortality estimate for PM_{2.5} from all sources, about 20% of which are not fossil fuel combustion. Fossil fuel-related PM_{2.5} health costs total \$820 billion in 2020 USD. More recent estimates of annual PM_{2.5} air pollution-related premature mortality range from about 50,000 (EPA 2020) to 350,000 (Vohra et al. 2021), with premature mortality damages valued at a range of \$443 billion-\$3.4 trillion (2020 USD). See: U.S. Environmental Protection Agency. Policy Assessment for the Review of the National Ambient Air Quality Standards for Particulate Matter (Table 3-5). January 2020. https://www.epa.gov/sites/production/files/2020-01/documents/final_policy_assessment_for_the_review_of_the_pm_25_naaqs_c1_2020.pdf
25. Vohra K, Vodonos A, Schwartz J, Marais EA, Sulprizio MP, Mickley LJ. Global mortality from outdoor fine particle pollution generated by fossil fuel combustion: Results from GEOS-Chem. *Environmental Research.* 2021;195:110754. <https://doi.org/10.1016/j.envres.2021.110754>
26. Knowlton K, Rotkin-Ellman M, Geballe L, Max W, Solomon GM. Six climate change-related events in the United States accounted for about \$1.4 billion in lost lives and health costs. *Health Affairs.* 2011;30(11):2167-2176. <https://doi.org/10.1377/hlthaff.2011.0229>
27. Anenberg SC, Weinberger KR, Roman H, et al. Impacts of oak pollen on allergic asthma in the United States and potential influence of future climate change. *GeoHealth.* 2017;1(3):80-92. <https://doi.org/10.1002/2017GH000055>
28. Beard CB, Eisen RJ, Barker GM, et al. Ch. 5: Vectorborne diseases. The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program. 2016:129-156. <https://doi.org/10.7930/JG76517X>
29. Feder HM, Johnson EJB, O'Connell S, Shapiro ED, Steere AC, Wormser GP. A critical appraisal of "Chronic Lyme disease." *N Engl J Med.* 2007;357(14):1422-1430. <https://doi.org/10.1056/NEJMe072023>
30. Adibi JJ, Marques ETA, Cartus A, Beigi RH. Teratogenic effects of the Zika virus and the role of the placenta. *The Lancet.* 2016;387(10027):1587-1590. [https://doi.org/10.1016/S0140-6736\(16\)00650-1](https://doi.org/10.1016/S0140-6736(16)00650-1)
31. Adrien ER, Aucott J, Lemke KW, Weiner JP. Health Care Costs, Utilization and Patterns of Care following Lyme Disease. *PLOS ONE.* 2015;10(2):e0116767. <https://doi.org/10.1371/journal.pone.0116767> Note: Study authors analyzed cost data between 2006 and 2010 but did not normalize dollar values. Our adjustment was made assuming a 2008 USD average, given the range of cost estimates used in the original study. Also see: Hinckley, Allison F, Neeta P. Connally, James I. Meek, Barbara J. Johnson, Melissa M. Kemperman, Katherine A. Feldman, Jennifer L. White, and Paul S. Mead. "Lyme Disease Testing by Large Commercial Laboratories in the United States." *Clinical Infectious Diseases* 59, no. 5 (September 1, 2014): 676-81. <https://doi.org/10.1093/cid/ciu392>
32. Diffenbaugh NS, Singh D, Mankin JS, et al. Quantifying the influence of global warming on unprecedented extreme climate events. *PNAS.* 2017;114(19):9881-9886. <https://doi.org/10.1073/pnas.1618081114>
33. Sarofim MC, Saha S, Hawkins MD, et al. Ch. 2: Temperature-related death and illness. The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program. 2016:43-68. <https://doi.org/10.7930/JG76517X>
34. Bell JE, Herring SC, Jantarassami L, et al. Ch. 4: Impacts of extreme events on human health. The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program. 2016:99-128. <https://doi.org/10.7930/JG76517X>
35. Tett SFB, Falk A, Rogers M, et al. Anthropogenic forcings and associated changes in fire risk in western North America and Australia during 2015/16. *Bulletin of the American Meteorological Society.* 2018;99(1):S60-S64. <https://doi.org/10.1175/BAMS-D-17-0096.1>
36. Alderman K, Turner LR, Tong S. Floods and human health: A systematic review. *Environment International.* 2012;47:37-47. <https://doi.org/10.1016/j.envint.2012.05.003>
37. Zahran S, Peek L, Snodgrass JG, Weiler S, Hempel L. Economics of disaster risk, social vulnerability, and mental health resilience. *Risk analysis.* 2011;31(7):1107-1119. <https://doi.org/10.1111/j.1539-5998.2010.01580.x>
38. Fann N, Alsan B, Broome RA, et al. The health impacts and economic value of wildland fire episodes in the U.S.: 2008-2012. *Science of The Total Environment.* 2018;610-611:802-809. <https://doi.org/10.1016/j.scototenv.2017.08.024>
39. Ziska L, Crimmins A, Auclair A, et al. Ch. 7: Food safety, nutrition, and distribution. The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program. 2016:189-216. <https://doi.org/10.7930/JG76517X>
40. Dodgen D, Donato D, Kelly N, et al. Ch. 8: Mental health and well-being. The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program. 2016:217-246. <https://doi.org/10.7930/JG76517X>
41. Roehrig C. Mental disorders top the list of the most costly conditions in the United States: \$201 billion. *Health Affairs.* 2016;35(6):1130-1135. <https://doi.org/10.1377/hlthaff.2015.1659>
42. Ding D, Lawson KD, Kolbe-Alexander TL, et al. The economic burden of physical inactivity: a global analysis of major non-communicable diseases. *The Lancet.* 2016;388(10051):1311-1324. [https://doi.org/10.1016/S0140-6736\(16\)30383-5](https://doi.org/10.1016/S0140-6736(16)30383-5)
43. Willett W, Rockström J, Loken B, et al. Food in the anthropocene: the EAT-Lancet commission on healthy diets from sustainable food systems. *The Lancet.* 2019;393(10190):447-492. [https://doi.org/10.1016/S0140-6736\(18\)31854-4](https://doi.org/10.1016/S0140-6736(18)31854-4)
44. Eckelman MJ, Sherman JD. Estimated global disease burden from US health care sector greenhouse gas emissions. *American Journal of Public Health.* 2018;108(Suppl 2):S120. <https://doi.org/10.2105/AJPH.2017.303846>
45. Healthcare Without Harm. Healthcare's climate footprint. Published Sept 2019. https://noharm.global.org/sites/default/files/documents/files/5061/HealthCaresClimateFootprint_092319.pdf
46. Pichler P-P, Jaccard IS, Weisz U, Weisz H. International comparison of health care carbon footprints. *Environ Res Lett.* 2019;14(6):064004. <https://doi.org/10.1088/1748-9326/ab1901>
47. Stölberger C, Lutz W, Finsterer J. Heat-related side-effects of neurological and non-neurological medication may increase heatwave fatalities: Drug-induced heatwave fatalities. *European Journal of Neurology.* 2009;16(7):879-882. <https://doi.org/10.1111/j.1468-1331.2009.02551.x>
48. Millstein D, Wiser R, Bollinger M, Barbose G. The climate and air-quality benefits of wind and solar power in the United States. *Nature Energy.* 2017;2(9). <https://doi.org/10.1038/nenergy.2017.134>
49. Mikati I, Benson AF, Luben TJ, Sacks JD, Richmond-Bryant J. Disparities in Distribution of Particulate Matter Emission Sources by Race and Poverty Status. *Am J Public Health.* 2018;108(4):480-485. <https://doi.org/10.2105/AJPH.2017.304397>
50. American Lung Association. Road to Clean Air: Benefits of a Nationwide Transition to Electric Vehicles. Published 2020. <https://www.lung.org/clean-air/electric-vehicle-report>
51. Hallström, Elinor, Quentin Gee, Peter Scarborough, and David A. Cleveland. "A Healthier US Diet Could Reduce Greenhouse Gas Emissions from Both the Food and Health Care Systems." *Climatic Change* 142, no. 1 (May 1, 2017): 199-212. <https://doi.org/10.1007/s10584-017-1912-5>

51. U.S. Environmental Protection Agency. "Mortality Risk Valuation." Overviews and Factsheets. US EPA, 2014. <https://www.epa.gov/environmental-economics/mortality-risk-valuation>.
52. Martinich, J., B.J. DeAngelo, D. Diaz, B. Elwurtzel, G. Franco, C. Frisch, J. McFarland, and B. O'Neill, 2018: Reducing Risks Through Emissions Mitigation. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp.1346–1386. doi: 10.7930/NCAR4.2018.CH29
53. For further discussion on "climate-sensitive" exposures, see: Limaye, Vijay S., Wendy Max, Juanita Constible, and Kim Knowlton. "Estimating the Health-Related Costs of 10 Climate-Sensitive U.S. Events During 2012." *GeoHealth* 3, no. 9 (September 2019): 245–65. <https://doi.org/10.1029/2019GH003020> and Limaye, Vijay S., Wendy Max, Juanita Constible, and Kim Knowlton. "Estimating the Costs of Inaction and the Economic Benefits of Addressing the Health Harms of Climate Change." *Health Affairs* 39, no. 12 (2020): 2098–2104. <https://doi.org/10.377/hlthaff.2020.01109>.
54. For further discussion on this topic, see: Campbell-Lendrum, Diarmid, Lucien Manga, Magaran Bagayoko, and Johannes Sommerfeld. "Climate Change and Vector-Borne Diseases: What Are the Implications for Public Health Research and Policy?" *Philosophical Transactions of the Royal Society B: Biological Sciences* 370, no. 1666 (April 5, 2015): 20130552. <https://doi.org/10.1098/rstb.2013.0552>.
55. For an example of climate change attribution on health impacts, see: Vicedo-Cabrera, A. M., N. Scovronick, F. Sera, D. Royé, R. Schneider, A. Tobias, C. Astrom, et al. "The Burden of Heat-Related Mortality Attributable to Recent Human-Induced Climate Change." *Nature Climate Change*, May 31, 2021. <https://doi.org/10.1038/s41558-021-01058-x>.



Written Testimony of
 The National Ski Areas Association (NSAA)
 Submitted to the Senate Budget Committee
Under the Weather: Diagnosing the Health Costs of Climate Change

April 26, 2023

Chairman Whitehouse, Ranking Member Grassley, and members of the Committee, thank you for the opportunity to submit testimony for the April 26th hearing: ***Under the Weather: Diagnosing the Health Costs of Climate Change***. NSAA has over 330 ski area members which operate across 37 states. The ski industry contributes \$58B to the economy annually and provides over 500,000 jobs. Of the 21 members of the Senate Budget Committee, 17 have ski areas operating in your state.

The Health Benefits of Mountain Recreation

Public demand for skiing, snowboarding and other mountain recreation activities is spiking at this time. Last season (2021/2022), the ski industry experienced record visitation, with 60.7 million skier/snowboarder visits. Demand is high for outdoor recreation because people value the physical, mental and wellness benefits that come with recreating outdoors in nature. Ski areas provide tremendous recreation opportunities in winter, a time when people tend to be least active. Ski areas also provide healthy outdoor recreation opportunities for people in summer, including mountain biking, hiking, ziplining and other mountain-based activities. We need help from Congress in solving climate change to preserve these recreation opportunities and allow ski areas to continue to provide a healthy outlet in nature for millions of people on a year-round basis.

Tackling Climate Change

Climate change is a daunting challenge for ski area operators with the expected climate impacts of rising temperatures, precipitation shifts from snow to rain, increasing threat of wildfire, and extreme weather events. Ski areas have taken significant steps to reduce their own carbon emissions in addition to doing significant advocacy work to raise the visibility of the impacts of climate on our operations and the mountain economies in which they operate. Ski areas are setting carbon targets and participating in NSAA's [Climate Challenge](#) and other recognized emissions reporting platforms. They are also investing in: on and off-site renewable energy

installations; lighting retrofits; efficiency improvements to snowmaking and grooming operations; green building; building controls and automation; high efficiency heating equipment and pumps; recycling and composting; transportation projects such as apps to help encourage carpooling, shuttles, mass transit, ski trains, and electric vehicle charging infrastructure. The bottom line is that ski resorts are impacted by climate change more significantly than they contribute to it, and we can't solve climate change alone.

Ski areas are investing in climate resiliency, and that work benefits everyone in their community. Resiliency work is collaborative and focuses on year-round forest stewardship, partnerships on wildfire preparedness and mitigation, protecting drinking water supply and many other important environmental services for downstream communities. In addition to snowmaking advances and water investments, ski areas are successfully transitioning to a four-season business model. Operating on a year-round basis and diversifying activities not only helps meet increasing public demand for recreation, it also boosts resiliency for mountain communities and mountain economies impacted by climate change.

Health & Resiliency of Rural Economies

Healthy interaction with the natural environment is at stake with the challenge of climate change, and so are thousands of jobs and the economic health of rural communities. Ski area operations and capital improvements drive jobs and economic growth in rural communities. The benefits extend well beyond the actual ski area in remote rural regions in the areas of property management, retail, lodging and restaurant, real estate, construction, plowing, landscaping and maintenance. Many businesses in a ski town are dependent on the success and resiliency of the ski area.

As businesses on the front lines of climate change, we urge Congress to take bold and swift action on climate solutions. Thank you for your consideration of our testimony.

