

**CLIMATE-RELATED ECONOMIC RISKS AND
THEIR COSTS TO THE FEDERAL BUDGET
AND GLOBAL ECONOMY**

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

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CLIMATE-RELATED ECONOMIC RISKS AND THEIR COSTS TO THE FEDERAL BUDGET AND GLOBAL ECONOMY

WEDNESDAY, FEBRUARY 15, 2023

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

The hearing was convened, pursuant to notice, at 10:00 a.m., via Webex and in Room SD-106, in the Dirksen Senate Office Building, Hon. Sheldon Whitehouse, Chairman of the Committee, presiding.

Present: Senators Whitehouse, Merkley, Kaine, Van Hollen, Padilla, Grassley, Crapo, Graham, Johnson, Romney, Marshall, Braun, Kennedy, R. Scott, and Lee.

Also present: Democratic staff: Dan Dudis, Majority Staff Director; Joshua P. Smith, Budget Policy Director; Melissa Kaplan-Pistiner, General Counsel.

Republican staff: Kolan Davis, Republican Staff Director and Chief Counsel; Matthew Giroux, Deputy Staff Director; Krisann Pearce, General Counsel; Erich Hartman, Economist; Jordan Pakula, Professional Staff Member.

Witnesses:

Dr. Mark Carney, Former Governor, Banks of England and Canada

Dr. Robert Litterman, Founding Partner, Kepos Capital, and Chair, Climate-Related Market Risk Subcommittee, U.S. Commodity Futures Trading Commission

Dr. Douglas Holtz-Eakin, President, American Action Forum

OPENING STATEMENT OF CHAIRMAN WHITEHOUSE¹

Chairman WHITEHOUSE. I am delighted to kick off the first Budget Committee hearing of this year by welcoming Ranking Member Grassley, who I serve with also on the Finance and Judiciary Committees, so we have a lot of experience together and I'm very happy that he's the Ranking Member.

I want to welcome all the colleagues who will be in and out of the hearing this morning. We have multiple hearings going on and so you will be getting attendance sporadically from a considerable number of our members. I want to particularly welcome our new members to what I hope will be a busy, revived, impactful, and lively Budget Committee.

¹Prepared statement of Chairman Whitehouse appears in the appendix on page 34.

I want this to be your surprise favorite committee. We have important work to do on bipartisan healthcare reforms, on reforming this Committee's process to fit the basic arithmetic of the budget and on issues important to each of you as members.

We're going to begin with a series of hearings on the looming costs and economic risks of climate upheaval. Almost exactly five years ago, I sent around this binder to all of my Senate colleagues in which I compiled some of the compelling warnings about the economic risks associated with climate change.

Last week I sent your staffs an updated version of the binder. Here it is. As you can see, the warnings keep piling up. Have fun with the light reading. These warnings come from central bankers, economists, assets managers, insurance companies, investment banks, credit rating agencies, and leading management consultations. Folks with a lot of credibility when it comes to economics, finance, corporate risks and their effects on government spending and revenues. These will be our witnesses, economists, scientists, business leaders, and other financial and risk experts, many of whose work is in this binder.

I've said that science provides the headlights for society. That it's scientists who illuminate the way for us to navigate into the future. Think of the economists and scientists we'll hear from as the headlights for the United States Congress as this Committee helps navigate our long-term budget and fiscal priorities.

Look at our national debt. One thing that stands is how much of it was incurred as a result of exogenous shocks to the economy. Consider the 2008 financial crisis which blew up the financial security of families and businesses across the country and reduced government revenues for a decade. Two years after the recession, CBO found that projected revenues fell by \$4.4 trillion and projected spending rose by \$800 billion to spur that recovery.

Consider the pandemic. The Committee for a Responsible Federal Budget estimates that the federal response to the pandemic which brought COVID under control, protected families, and jumpstarted our economy recovery will add \$5.5 trillion to our deficits. That doesn't factor in lost revenue or lost economic activity, so the total economic cost is actually higher.

We came through both. But together those two exogenous shocks contributed \$10 trillion to the federal debt, more than 40 percent of the total, proof of how catastrophic events can and do effect the federal budget and the economy and how life has a way of upsetting best laid plans and 10-year budget baselines.

Headlights and better attention to what they illuminated could've help. Plenty of financial experts saw the 2008 mortgage mess coming. Plenty of epidemiologist warned that the country was woefully unprepared for a pandemic.

Now, we have all these warnings. Warnings of crashes in coastal property values as rising seas and more powerful storms hit the 30-year mortgage horizon. Warnings of insurance collapse from more frequent, intense, and unpredictable wildfires. A dangers interplay between the insurance and mortgage markets hitting real estate markets across the country.

Inflation from decreased agricultural yields, massive infrastructure demand, trouble in municipal bond markets, stranded assets,

and a carbon bubble. The most dangerous risks are called systemic. We mean that they will cascade out into the broader economy as the mortgage problem did in 2008, and it's big. It predicts the differential between being responsible and reckless about climate could come to more \$220 trillion, globally, between now and 2070.

Some of these warn of risks are already upon us. Already climate-related national disasters increase federal spending on disaster assistance, flood insurance, crop insurance, and other programs we fund. But this is just the beginning. It will certainly get worse, much worse particularly if warming exceeds 1.5 degrees. We are on a bad trajectory. It's time for us all to wake up and face the problem before coastal cities flood with water or southwest cities can't get water. I hope we can finish that off with action if we snap into focus on the danger.

We're all familiar with the tragedy of the Commons. In 2015, our opening witness, Dr. Carney, gave a speech entitled The Tragedy of the Horizon because some of the gravest dangers of climate change, which we could head off today, come to past years or decades out. Ryan's coastline will be gone, reshaped into an Acapulco by 2100.

You say, ah, who cares? What's that? It's an eternity. Well, almost exactly a year ago I became a grandfather for the first time. Baby Vera, God willing, will be alive in 2100. When I look at her, I'm looking at that future. Walk by any elementary school, the faces you see on the playground, God willing, will be alive in 2100. How will those little ones remember our less than greatest generation? We owe it to kids on playgrounds all across America to pay attention to get this right.

By the end of this series of hearings, if we hear these expert witnesses, if we treat their testimony as our headlights, then our path, I hope, will be clear. Thank you and let's get to work.

Chairman WHITEHOUSE. I turn to my Ranking Member, Senator Grassley.

OPENING STATEMENT OF SENATOR GRASSLEY²

Senator GRASSLEY. Senator Whitehouse, I compliment you on your leadership on this Committee and look forward to the two years ahead. I'm pleased to be here with all of you as Ranking Member. Despite our political differences, and they aren't as great as the public believes between Republicans and the Democrats, and particularly between Grassley and Whitehouse. I know that we can find common areas of agreement to work on together.

One area of agreement must be that our budget and appropriation process is broken. This sentiment isn't new at all nor is it particularly partisan. No person could look at last year's process and say that things are working. For Fiscal Year 2023, Congress didn't adopt a budget. The Senate Appropriations Committee didn't mark up a single bill and not one of the 12 individual appropriation bills was debated in the Senate floor.

Instead, we were presented with a \$1.7 trillion omnibus just a few days before Congress. Things need to change. Now, maybe we shouldn't be surprised because when the Senate goes into session

²Prepared statement of Senator Grassley appears in the appendix on page 36.

at 3 o'clock on Monday and has one vote, hardly any business, and then you work all day Tuesday and all day Wednesday and adjourn at 1:45 on Thursday, you can't get a lot of session work done when you are just in session two and a half weeks compared to when I came to the United States Senate started no later than noon on Monday, debated on Monday, Tuesday, Wednesday, Thursday, went home Friday at 4:00. So, I think there needs to be some reanalysis of the work that we're putting—I mean not the work because there's plenty of work for senators, but the amount of time that we're in session.

I want to applaud two leaders in this process, Senator Murray and Collins, for publicly announcing their commitment to regular order, including debating appropriation bills on the Senate floor. We need to do our part to make that happen. We should also agree that our nation's fiscal outlook is dire.

The Congressional Budget Office will release an updated budget projection this afternoon. Every indication is that their new projections will be as bad as or worse than last summer's projection. This is what they told us last summer. Within 10 years, public debt, as a share of our economy, will exceed World War II record highs. However, unlike after World War II, when spending and debt subsided, our public debt is projected to climb even higher.

Our public debt will reach 110 percent of our economy in 2032 and grow to 185 percent by 2052. Trillion-dollar annual deficits will be replaced by two trillion deficits within a few years. Simply servicing the debt will lead record-breaking annual costs of more than \$1 trillion within 10 years.

So, Mr. Chairman, your immediate predecessor refused to bring in CBO to discuss the overall budget outlook. This was a mistake. So, I urge under your leadership to hold a hearing with CBO on the latest outlook. Nobody benefits from just burying our heads in the sand. I acknowledge that a changing climate is a historic and scientific fact. I also recognize that most scientists agree man-made emissions contribute to climate change.

Throughout my career, I've advocated for renewable and alternative energy solutions. Being the father of the Wind Energy Tax Credit in 1992, I think maybe I was doing that 10 years before climate change was much of an issue. And so, today in Iowa we get 60 percent of our electricity from wind and in four years American Energy, Des Moines, Iowa, will be getting 80 percent, 85 percent maybe more accurately, of their energy from wind.

This being said, even if the entire U.S. stopped emitting greenhouse gas tomorrow, projected temperatures would only be three-tenths degrees Fahrenheit lower come 2100. Even in this unrealistic scenario, the U.S. would still need major polluters like China and India to pull their weight. As we look to address climate and energy issues, the nation must also address our fiscal health.

There's plenty of blame to go around for how we got into our current situation. Republican or Democrats have to share this blame. For decades, Congress turned a blind eye as our nation walked toward a fiscal cliff, but Democrats turned that walk into a sprint. In March 2021, Democrats to advantage an emergency situation to pass a \$2 trillion partisan spending bill, even as our economy showed strong signs of recovery. Then as inflation started to a 40-

year high, they doubled down spending trillions more on their liberal wish list.

They pushed through omnibus appropriation bills with take it or leave mantra for two years. Each time growing the size of the government when not using fast-track procedures or government shut-down as leverage, the Administration drove deficits through unilateral action like long giveaways that could cost taxpayers a trillion dollars.

Congress needs then, it's very obvious, a fiscal reality check. And I know our Chairman is trying to bring that fiscal reality check by bringing up all of the issues that climate change is going to add to the budget and that's the correct thing to do. But this reality check has to start with this Committee getting back to performing core functions.

This includes holding hearings on federal fiscal matters, examining programs and authorizations that have been on autopilot for decades and performing robust oversight of agency spending. No government entity should be exempt.

Now finally, I welcome the opportunity to work with you, Senator Whitehouse, on budget process reform. You are a well-established leader on this issue. I appreciate your stated interest in working with the rest of us on this issue starting, and I'll be ready to join you anytime, from where we left off with Senator Enzi in 2019. It was bipartisan process then and I think we can build to get it over the finish line with this Congress.

Needless to say, we have our work cut out for us to get our fiscal house in order. To paraphrase former fed chairman Paul Volcker, cutting spending may be painful, but the pain for all of us will be much greater if it isn't accomplished. So, I look forward to our work over the next two years.

Thank you and let's get to work.

Chairman WHITEHOUSE. Thank you, Senator Grassley, so do I. And I mentioned the budget process reform in my opening remarks for a reason. I look forward to working on that and think there's plenty of blame to go around for where we are in terms of the deficit, but having a Budget Committee that actually looks at the elements of that in an arthritically correct way is a very, very good start.

I am pleased to have three very distinguished witnesses here to testify before us today. Joining us remotely is Dr. Mark Carney, the former Governor of the Bank of Canada and the Bank of England. For those not familiar with that role, that's effectively the CEO. Dr. Carney is a world renown central banker and has long been sounding the alarm about the economic risks posed by climate change.

Following Dr. Carey's testimony we'll hear from Dr. Bob Litterman, who chaired the Commodity Futures Trading Commission's Climate-Related Market Risk Subcommittee, which in 2020 issued an authoritative report on this subject.

Following Dr. Litterman, we will hear from Dr. Douglas Holtz-Eakin, former Director of the Congressional Budget Office and President of the American Action Forum. I note that back in 2003 CBO prepared a report on the economics of climate change under Dr. Holtz-Eakin's leadership.

Dr. Carney, if we have you here remotely, please take five minutes to deliver your remarks. Your prepared remarks are in the record of the proceeding.

**STATEMENT OF DR. MARK CARNEY, FORMER GOVERNOR,
BANKS OF ENGLAND AND CANADA**³

Dr. CARNEY. Thank you very much, Chairman Whitehouse, Ranking Member Grassley, members of the Committee for the honor of this invitation to address the risks and economic costs of climate change.

During my terms as Governor of the Bank of England and as Chair of the Financial Stability Board, I headed committees with responsibility for understanding and addressing the principal risk to financial stability. Risks such as the Chair referred to in his opening comments.

About a decade ago, these bodies became increasingly concerned about the rising economic risk from climate change and the fact that the financial system lacked the information, the tools, and the markets to manage them. So, over the following years a wide range of regulatory authorities and private financial institutions had worked to develop the building blocks of a financial system that can manage these risks on behalf of their depositors, pensioners, clients, and shareholders.

But while the pace of change has picked up, it's not yet equal to the scale of the challenge. Due to the undiversifiable nature of climate risks, governments will bear many of the costs of extreme weather and of adaptation. And moreover, the longer adjustment is delayed the greater the impact will be on financial stability, inflation, jobs, and growth.

Diversely, transitioning to a low-carbon economy will reduce the impact of climate change, create jobs of the future, and promote a resilient financial system. I won't read it into the record the fact that the fiscal impacts of climate change are rising. I've reference in my testimony of the data collected by the EPA, the NRAA, NASA, amongst others, that provides a snapshot of how it's already impacting the United States.

Climate change is having an increased impact on Americans. Adjusted for inflation, the number of billion dollar disasters has risen sixfold from the first half of the 1980s to an average of 18 per year over the past five years. Annual inflation adjusted cost of these disasters has risen seven times from \$18 billion to \$120 billion.

Increased flooding and coastal erosion are causing significant damage already. Increases in weather-related disasters have led to insurance becoming less available, more expensive for American families and businesses. Extreme weather is reducing incomes for farmers and raising food costs for families and the increased frequency and intensity of flooding and disasters disrupts and damages critical infrastructure, and in turn, supply chains hurting American businesses and raising costs again for American families.

There is ample scientific evidence that these trends are expected to worsen as each additional fraction of degree warming means more frequent and intense hurricanes, coastal floodings,

³Prepared statement of Dr. Carney appears in the appendix on page 38.

heatwaves, and wildfires. Estimates suggest that over the balance of this century climate change could reduce the level of global GDP per capita by between 10 to 20 percent without further efforts to limit warming. Similar estimates have been found for the United States.

As economically significant as these estimates are, it's instructive to examine what's not included in them, both assets outside of the market economy, such as biodiversity and human health, as well as critical economic channels, including disrupted supply chains, risk to monitoring and financial stability, and economic impacts of rising risks to the national security.

As temperatures increase and extreme weather events worsen, the cost to governments will increase further. Ultimately, governments—state, local and federal—will better cost the private households and businesses and markets are unable to shoulder, including meeting emergency needs, financing disaster recovery, and building resilience to future extreme weather.

To conclude, the costs to property, agriculture, and livelihoods are already high and expected to grow materially. The hit to GDP growth from unmitigated climate change is expected to be significant and many of the most severe impacts to human health, to livelihoods, to natural heritage, are not included in these calculations.

But there's one final risk from climate change, a negative risk, better known as an opportunity. Increased recognition of the risks of climate change is no galvanizing efforts to address the issue. Last year over a trillion dollars was invested in the energy transition, representing over 1 percent of global GDP and those investments are expected to rise significantly, creating more jobs and higher incomes.

In short, while ignoring climate change will lead to significant costs, climate solutions are becoming one of the greatest commercial opportunities of our time. Thank you for your attention. I'll be pleased to answer your questions.

Chairman WHITEHOUSE. Thanks, Dr. Carney. We turn now to Dr. Litterman.

STATEMENT OF DR. ROBERT LITTERMAN, FOUNDING PARTNER, KEPOS CAPITAL, AND CHAIR, CLIMATE-RELATED MARKET RISK SUBCOMMITTEE, U.S. COMMODITY FUTURES TRADING COMMISSION⁴

Dr. LITTERMAN. Thank you, Chairman Whitehouse, Ranking Member Grassley, and members of the Committee. Thank you for inviting me to address the economic risks associated with climate change and the tremendous cost they may impose on Americans.

This summer I visited Greenland to study the melting of the ice sheet. The icebergs calving from the glaciers are beautiful, but they represent the very beginning of what sadly, will be an inevitable acceleration of sea level rise, the timing of which, however, is both highly uncertain and depends critically on the actions that we take today.

I want to focus your attention on time because time is a scarce resource in managing risks. Climate change is a long-term global

⁴Prepared statement of Dr. Litterman appears in the appendix on page 46.

risk management failure, but it must be addressed immediately because we don't know how much time we have. The United States has an urgent responsibility to do much more than it has to date. Our grandchildren face grave danger.

Global sea level rise in this century, for example, is estimated to be between 2 and up to 10 feet, depending primarily on how quickly we reduce our emissions.

Before I go any further, I'd like to tell you a little bit about my background as much of my work is highly relevant to today's subject. I am an economist by training and have spent my career managing financial risks. I worked at Goldman Sachs for 23 years. I was a partner and head of the firm Wide Risk Department.

I now sit on several boards for groups that study and propose responses to climate risks, including the Climate Leadership Council and the Niskanen Center. No doubt, the reason I am here today is because in 2020 I chaired the CFTC Climate-Related Market Risk Subcommittee, which published a unanimous and widely cited report, *Managing Climate Risk in the U.S. Financial System*. We had environmental organizations, such as the Nature Conservancy and the Environmental Defense Fund, but also Agri business companies like Cargill and Bunge. Oil and gas companies like Conoco Phillips and BP, and banks like Morgan Stanley, J.P. Morgan Chase, and Citi.

There was no collection of wide-eyed environmental activists nor were politics involved. This was a rigorous report with dozens of recommendations from hard-headed experts and we came to the unanimous conclusion that climate change poses significant risks to the American economy that must be addressed urgently.

In the Agricultural sector, for example, we found that climate change is likely to significantly reduce crop yields, decrease labor productivity, degrade soil and water quality, increase the range and virulence of pests and disrupt supply chains. Climate change will also impose large costs on companies and governments.

One example, the CFTC Report, highlighted with the case of Pacific Gas and Electric in California which entered bankruptcy because of \$30 billion in liabilities associated with its infrastructure, sparking record wildfires. Extreme weather impacts are already here and are growing rapidly, including heatwaves, floods, hurricanes, drought, and wildfires.

Meanwhile, the effects of climate change loom every larger in the future. Losses from billion-dollar extreme weather events totaled \$165 billion last year. And while it varies from year to year, the costs from climate change are clearly growing rapidly. Extreme weather events are becoming more common as the atmosphere warms. Terms such as the 100-Year Flood are used to describe the magnitude of an event that has happened historically on average once every hundred years. That happens to be an important frequency.

We build infrastructure to withstand events that happen on a regular basis and so the damage created by weather that happens regularly is small. But when a 100-year event occurs, the magnitude is so large that we're not prepared and it typically leads to complete destruction of property. The problem is that while such a

term continues to describe the magnitude of extreme weather events the frequency of occurrence today tends to be much higher.

Declining real estate values driven by climate-related impacts or the expectation of such impacts in the future could substantially depress regional economic activity in exposed areas. Climate change will also likely inflict large costs on human health and its impacts will fall hardest on those with fewer resources, increasing inequity.

There are also a number of risks related to crossing a tipping point. A tipping point is a nonlinearity in the response of a system and there are a number of warning potential tipping points in the climatic system. More worrying still, recent scientific research suggests that we may cross several of these tipping points with even only at 1.5 degree of warming it may cross several additional ones with 2 degrees of warming.

While the subject of this hearing is the economic risks and costs associated with climate change, I would be remiss if I did not mention one last thing. All of the research and analysis on this subject agrees that the sooner we act to reduce emissions the lower will be the expected costs and risks we incur.

In addition, a rapid transition to a low-carbon economy will, by removing policy uncertainty, likely actually result in substantial investment and increased economic growth.

I have lots of ideas on this subject, but the bottom line is that with global average temperatures already having risen over 1 degree C and with potentially catastrophic tipping points on the horizon, risk management demands an immediate response leading to globally harmonized incentives to reduce emissions.

There are immediate steps that this Congress can take to move this process forward and I would welcome the opportunity to discuss the policies you might pursue to help the risk to the economy and ensure that prices reflect the actual costs associated with production of goods, including the damages created by carbon emissions. Thank you.

Chairman WHITEHOUSE. We look forward to taking you up on that offer, Dr. Litterman and turn to Dr. Holtz-Eakin.

**STATEMENT OF DR. DOUGLAS HOLTZ-EAKIN, PRESIDENT,
AMERICAN ACTION FORUM⁵**

Dr. HOLTZ-EAKEN. Chairman Whitehouse, Ranking Member Grassley, and members of the Committee, thank you for the privilege of being here today. Let me make three points quickly and then I look forward to the chance to answer your questions.

The first point is that climate change will have real impacts on the U.S. economy and these will worsen the federal budget outlook. Unquestionably, there will be additional outlays from the national flood insurance programs and other disaster crop risks kinds of programs and mandatory outlays. The Congress will probably chose to make some discretionary outlays in the future in response to the needs for mitigation and/or adaptation and these will worsen the budget picture, but the biggest impact is going to be lower revenue from an economy that grows more slowly over the long term and

⁵Prepared statement of Dr. Holtz-Eakin appears in the appendix on page 51.

that the loss of some capital assets, diminished labor productivity, diminished productivity in agricultural lands will cumulatively reduce inflows to the federal budget.

The Congressional Budget Office recently took a look at this issue and concluded that the center point of set of estimates for the impact would be about a percentage point lower in GDP by 2051. And I would just point out that while that's a significant impact it's tantamount to under a tenth of a percentage point slower growth each and every year.

In contrast, and this point number two, the federal budget presents an immediate and much larger economic threat. We already have debt to GDP in the range of 100 percent and there's a large literature that stems from the work of Ken Rogoff and Carmen Reinhart indicates that countries in that range experience slower growth on the order of a percentage point per year because of their debt burdens. And the U.S. not only has entered that range it has a budget outlook which is unsustainable.

The CBO will put out a revised Economic and Budget Outlook this afternoon at 2 o'clock. It will doubtlessly look like the one they put out last year that shows spending expending revenues as far as the eye can see, driven by very rapid growth in the outlays in Medicare at 7 percent a year, Social Security at 6 percent a year, faster than any revenue source could possibly grow and as a result it will show debt relative to GDP rising as far as the eye can see. The interest costs of carrying that debt rising as far as can see and that is a mechanism which is a guarantee for slower growth in the future.

The point of the borrowing is not just the debt. The point is that that brings resources from the private sector into the government sector. And for every dollar you take from private investment and put into the best of federal infrastructure investments, you lose about 50 percent of the rate of return, so you're losing on every one of those borrowing activities, diminishing the productivity in the economy, lowering the standard of living for future workers in the next generations.

We really don't spend a lot of money on investments in this program and more than likely we're going to take that money from a private investment and put it into a consumption expenditure. That's the point of Social Security and Medicare is to raise the standard of living in retirement for seniors. There's no rate of return to consumption investment, so the federal budget is the biggest headwind to economic growth because it is stacked against investing in the future and needs to be brought into some sort sustainable alignment in order to stop these headwinds to growth.

The other point that's going on in the federal budget is that the mandatory expenditures are crowding out discretionary spending. Discretionary spending is where we do national security, basic research, infrastructure, education, all the places where you can invest in the future of the country and those opportunities are getting squeezed out by the growth of these mandatory programs.

So, point number three, not only would getting the budget on a sustainable trajectory improve the economic outlook, it would free up the budget resources through investments, especially invest-

ments in the climate mitigation and adaptation that are so important to this Committee and to this hearing.

And so, I can't think of a single bigger accomplishment than for this Committee and the U.S. Congress to finally come to grips with the federal budget outlook and its unsustainability. It lies at the crossroads of all the threats to our future and needs to be addressed as quickly as possible.

I thank you for the chance to be here today. I look forward to your questions.

Chairman WHITEHOUSE. Thank you, Dr. Holtz-Eakin. I'll lead and then Senator Romney is next in line.

Dr. Carney, you've held two of the most significant and powerful positions global in the banking sector. Climate change was not customarily a part of the banking sector's interest. Why is it that you took such an interest in addressing climate change?

Dr. CARNEY. Thank you, Chair. It goes back, in part, to your opening comments, some of the points you made in your opening comments, which is that under-investing in resilience upfront leads to much greater costs down the road. And it was particular when I became Governor at the Bank of England and it's not commonly known, but one of the responsibilities of the Bank of England is to oversee the insurance industry and it's the fourth largest insurance industry in the world. It includes one of the largest, if not the largest, re-insurance market, the famous Lords of London, and so therefore that's a property in casualty and re-insurance industry that's directly affected by climate change.

And one of the lessons that the brokers and the risk managers in Lord of London had determined was that the tail risk of the past were becoming the central scenario of the future. I'll refer to Dr. Litterman's comments about one in a hundred risk events becoming that much more frequent. So, of course they're adjusting pricing. They're adjusting coverage which has real implications for economies and it's apparent to us, as risk managers, that this will affect the economy more broadly and the financial system potentially more broadly if there is not adequate information to assess the potential degree of those risks. And if risk managers don't at least have the opportunity to determine whether or not they will take steps—

Chairman WHITEHOUSE. Dr. Carney, you were in charge of the Bank of Canada after the 2008 financial crisis. Can you compare what you foresee with respect to climate with what you experienced in the 2008 mortgage crisis?

Dr. CARNEY. Well, there's two things that I would say. The first is that one of the experiences of that crisis, and many of the members, of course, lived through it and helped managed through it, is what's called a Minsky moment, a realization that basic assumptions were no longer true. For example, that health prices would never fall in the United States, that capital was money good, that assets off balance sheets would stay off balance sheets, all of those proved false and lead to the collapse or virtual collapse of the core, much of the core of the financial system with huge economic costs that ultimately have added to the debt burden of the United States, amongst other countries.

Now, in Canada, we were more fortunate for a variety of reasons, but one of the reasons was we had put more resilience into our financial institutions upfront.

Chairman WHITEHOUSE. I'm not getting into Canada specifically. I'm looking between what you project potentially happening with the climate crisis. What's the scale comparison, in your mind, between what we experienced with the 2008 financial crisis and what climate portends for our systems?

Dr. CARNEY. Okay, so I'll just lead from that point. The first point is what we want to avoid is a rapid and sudden adjustment to the climate crisis, both adaptation, the impact of fiscal damage or belated investments to address the issue. The orders of magnitude are potentially similar in those cases if we delay adjustment.

If we adjust upfront, actually, I'm of the view that we can actually grow economies through the investments which would improve competitiveness. But if we delay it until it's evident, and this is the tragedy of the horizon supremely evident to everybody, then the orders of magnitude approaches the financial crisis.

Chairman WHITEHOUSE. And just to be clear, your testimony is that climate change could reduce the level of global GDP per capita by 10 to 20 percent and in that calculation you leave out critical economic channels that have not been modeled, including disrupted supply chains, challenges to monetary and financial stability that increasing climate change will present, and potential economic impact of rising risks to national security; is that a fair summary?

Dr. CARNEY. That is a fair summary. And one of the lessons of large shocks is they get amplified as they come through the financial sector. Yes.

Chairman WHITEHOUSE. Dr. Litterman, the papers we have in front of us are littered with the "systemic risk." It seems like a mild little term. Could you give us a sense of what its impact is?

Dr. LITTERMAN. The system risk that's incorporated in climate change comes from the uncertainty about how the economy is going to be responding to the various different hazards that are increasing. So, we have whole areas of the country that may be impacted by extreme weather, Florida, for instance, that could lead to significant financial stress in terms of the ability to raise funds for capital. So, you can have significant systemic impacts on the economy. It's ones of those things we just don't know.

Chairman WHITEHOUSE. You said cascade through the economy.

Dr. LITTERMAN. Excuse me?

Chairman WHITEHOUSE. Systemic meaning it cascades through the economy and the sectors.

Dr. LITTERMAN. Exactly. It will affect every aspect of the economy, including government budgets.

Chairman WHITEHOUSE. And last question, you said you were hard-headed about your report. Explain?

Dr. LITTERMAN. Yes, this is a report that was created by a bunch of scientists, academics, business people, investor, and we came to unanimous agreement. It wasn't about, I don't know, gut feeling. It was about facts. And the problem is we don't know what the future is going to bring, so we have to be prepared. It's very simple.

Chairman WHITEHOUSE. Good word to end on. I think my clock started a little bit late, so if the Ranking Member would like to go a little bit beyond that would be—all's fair. And I turn to Senator Grassley, Senator Padilla next, Senator Romney next, unless Senator Marshall returns.

Senator GRASSLEY. Dr. Holtz-Eakin, our rising deficits are cast by a lot of people as long-term challenge, "long-term challenge." Something we will have to deal with in the future, but not immediate problem today. Is that really the case or are we already living with the consequences of reckless spending and borrowing?

Dr. HOLTZ-EAKIN. Well, I certainly believe the impacts are immediate and shouldn't be put off. Most people characterize the threat as something that looks like, you know, a Greece, Portugal sovereign meltdown that would happen somewhere in the future if we just did nothing, but the reality is that the mechanism I described in my opening remarks, the diminished productivity, the headwinds to raising the standard of living are going on in small amounts every single year.

It might be too tiny to notice in the moment, but cumulatively there are an enormous impact on our progress and so I think it's something that needs to be rectified immediately, both in and of itself, but also because it would allow the Congress more flexibility in pursuing other policy objectives.

Senator GRASSLEY. Also to you, in last week's State of the Union address, the President once again tried to portray himself as deficit reducer. He pointed to last year's \$1.4 trillion deficit, which was lower than the 2002 deficits due to cessation by bipartisan pandemic relief. So, to you how would you rate the President's budgetary performance so far?

Dr. HOLTZ-EAKIN. I think the Administration has done nothing to improve the budgetary outlook. Certainly, if you look back at 2021, the American Rescue Plan was an enormous policy error. Something I said at the time, so it's not 20/20 hindsight. It was a two trillion dollar stimulus in an economy that was growing at 6 percent. I was too big, was unnecessary, was poorly designed, lead to a lot of inflation, and this has been followed by several proposals called Build Back Better, but did not add up in any meaningful way and would have added to the core structural deficit in the United States.

He's taken administrative actions for hundreds of billions of dollars in student loan relief that are difficult for me to defend, so I don't see any activities being taken by the Administration that are recognizing the problems that federal budget faces and we need some leadership on that front.

Senator GRASSLEY. Dr. Carney, in last week's State of the Union address, President Biden admitted that the U.S. will need oil and gas "for a while." Your firm, Brookfield Asset Management, has invested in oil and gas infrastructure around the world. Do you believe that the U.S. Government should mandate private institutions divest from their fossil fuel interests, and if so, what immediate impact would this have on the average American?

Dr. CARNEY. The first thing, I agree with the President and the timeline in continued need for fossil fuel. Secondly, I'll just note Brookfield is one of the largest investors in renewables and opera-

tors of renewables in the world. Thirdly, no, I don't believe and I've never advocated mandatory divestment of fossil fuels assets. In fact, to address the climate challenge what is necessary to get capital financing to where the emissions are and ensure that businesses can invest to get those emissions down and that's been a consistent position I've had for more than a decade.

Senator GRASSLEY. Yes. I don't have a question, but you said—even though I have 1 and 12 seconds left, I'd like to just make a statement, but it's kind of a question for information from Dr. Litterman and Dr. Carney and it deals with the ESG movements within finance, within banking. And I know you don't have to invest where you don't want to invest, but as a family farmer in Iowa and my son, Robin, runs the family farm, but we're corn/soybean farmers.

So, let's just assume that the FDIC or some other regulator or bank say to the community bank in Parkersburg, Iowa that you've got to make sure that you know what the carbon footprint is of the farmer and in 60 years of arming I don't know where to start to answer that question. And then I think—so what is obligation that banker is under an obligation to get that information from me, but if the farmer can't give the information how does it get out? So this is what I'm thinking as a historic farming. When I started farming in 1960, we'd make 10 trips across the field and produce maybe 60 bushel of corn to the acre.

Today with minimum tillage or no tillage, we make about three or four trips across and we produce—in Iowa, I think the average farmer produced 204 bushels of corn to acre. So, you can see that farmers are already producing unit of food with a lot less units of energy than they used to and do we get any credit for that? I mean we've already been helping the global warming issue with more efficient farming and all that. But that banker in Parkersburg can say to Chuck Grassley you tell us what your carbon footprint is.

Dr. LITTERMAN. Senator, it's not an issue of reporting what your carbon footprint is. We don't have to be aware of what the carbon flux out of the atmosphere into the ground is and there's tremendous opportunity for farmers to actually address this problem, to sequester carbon into their soil so they can change the way they farm. But we do have to address the problem. We have to measure the carbon. We have to understand the science. There's a tremendous opportunity in farming, in ranching, and in timberlands to address this problem and I hope we do.

Senator GRASSLEY. Well, what'd you think we been doing? We have been using midland tillage for 25 years, no till for probably about that long.

Dr. LITTERMAN. Well, sadly, the farmers have not been compensated for the things that they have done to sequester carbon into the soil. They are compensated for being more efficient, but we haven't recognized carbon. Carbon movement into and out of the atmosphere is something that we need to be aware of. We need to measure it and we need to create incentives. We all understand this. We need to create incentives to reduce emissions. Let's just do it.

Chairman WHITEHOUSE. The Growing Climate Solutions Act is an example to help farmers do that, which passed with big bipar-

tisan numbers. Senator Padilla, and then I had the order wrong. Next is Senator Marshall.

STATEMENT OF SENATOR PADILLA

Senator PADILLA. Thank you, Mr. Chairman. Communities of Color, Indigenous Communities, Low-Income Communities, and Immigrant Communities are more likely to be located in climate-risk prone areas and areas with degraded infrastructure, making them even more vulnerable to the impacts of climate change.

It was one of the many reasons I was proud to support the Inflation Reduction Act and the bipartisan infrastructure law last Congress which are making critical investments to combat the climate crisis. And notably, these laws direct resources towards many of the underserved and frontline communities that I just referenced, which far too often bear the brunt of the crisis and other natural disasters.

First question is for Dr. Carney. Can you talk about how the climate crisis disproportionately impacts these already marginalized communities and the importance of equity in our financial response and investments?

Dr. CARNEY. Thank you, Senator, for the question. Yes, it is an unfortunate reality that climate change has these impacts, in part, through—well, through the direct areas in which many disadvantaged communities live, proximity, for example, to our coasts and of course this Committee will know that 40 percent of Americans are living within $\frac{1}{8}$ of a mile of coasts and coasts which potentially are subject to, on some estimates, half a trillion of property damage over the balance of this century.

Secondly, to the extent to which more extreme weather conditions leads to great volatility in food prices, energy costs, that will also be a direct impact to these disadvantaged groups. And then, thirdly, one of the issues that we all are going to be facing around the world, but certainly in America as well, businesses and families feasibility to get insurance coverage. As these impacts become more prominent, the ability to afford it, if it is available, and of course, so for families, and I'll finish with this, that are already vulnerable to not have the protection the insurance industry can provide because of just the risk, the greater risks that have become central scenarios, if you will, that adds to the vulnerability.

Senator PADILLA. Thank you, Dr. Carney. Appreciate you raising the issue of insurance coverage. We're working with the White House on an initiative in that regard, so I look forward to following up with you. But on the same broad theme, for far too long it's the disadvantaged communities that I'm talking about that have also been underserved or face barriers when it comes to accessing financial services.

Unfortunately, as Dr. Litterman wrote in his testimony, certain sectors of our economy are more susceptible to the sub-systemic risks of climate change. This includes community and regional financial institutions, given they typically serve geographically concentrated areas and can suffer potentially significant losses due to natural disasters and extreme weather events.

So, given that these institutions serve a vital function in providing financial access to low-income individuals and marginalized

communities, the risk is even more concerning. Dr. Litterman, can you discuss the risk of these climate-fueled sub-systemic shocks to local and regional economies and describe how they could disproportionately impact these communities?

Dr. LITTERMAN. Sure. Well, wealthy communities will be able to build their infrastructure, harden their infrastructure and be prepared. I live in California and we see smoke more often now. Well, if I put a HEPA filter in and I can filter my air I'm better off, but not everyone can afford that.

People who can't afford to address some of these risks that are coming, whether it's drought, smoke, heatwaves, and so on, if they can't air condition their homes, they're going to be suffering. And we see that around the world when exposed people are impacted by these hazards it's the poor that suffer the most. So, it's absolutely just one more example of where we have inequity and we're not paying attention to it.

Senator PADILLA. Thank you very much. Thank you, Mr. Chair.

Chairman WHITEHOUSE. Senator Marshall, followed by Senator Van Hollen, and then Senator Romney.

STATEMENT OF SENATOR MARSHALL

Senator MARSHALL. Well, thank you, Mr. Chairman. And I'm honored to be here on the Budget Committee with you. I just want to commit to you and my friends across the aisle is that I'm as committed as anybody is to leaving this world cleaner, healthier, and safer than we found it. That as a fifth-generation farm kid that means that my family has been stewarding the land for five generations. That the soil at our farm is in better shape today than it was five generations ago.

But we've done things like no-till farming like Senator Grassley mentioned since 1991. That we planted 20,000 trees. That we have fenced off creeks, we call them creeks in Rhode Island, Chairman, but whatever it is, creeks back home that flow into wildlife refuges. We've created wetland habitat.

Precision agriculture is exploding in Kansas, that we're growing more with less, that we're reusing water, that we're taking the fat from the packing plants and turning into renewable diesel. My point is that American innovation is working and that's why the carbon footprint of American is 14 percent less today than it was a decade ago.

So, my first question is for Dr. Holtz-Eakin. And I want to say thank you for your Daily Dish newsletter, which I still read daily and appreciate your thoughts on the economy. You kind of mentioned this in your testimony. As we try to solve the problem here, which we all believe that the environment is a challenge for us right now, do you think that American innovation will have a bigger impact going forward or do you think that a federal government heavy hand approach will have better results. And my question is, is the cure worse than the disease that the federal government keeps prescribing all these expensive propositions, is the cure worse than the disease?

Dr. HOLTZ-EAKIN. Thank you for the questions and the compliments. I'm not sure that the latter is deserved, but thank you.

There's a real issue in having the climate strategy and the economic growth strategy work hand-in-hand. And one of the points I tried to make in my opening remarks is that at the moment the federal budget is an enormous headwind to economic growth and if we have a climate strategy that exacerbates the budget problems it is going to make even worse the challenges on raising the standard of living for future generations. And so, I worry a lot about that.

I also worry about the fact that we are not guaranteed to get anything out of something like the Inflation Reduction Act because it has no sort of global coordination and this is ultimately a global problem. And so, when I think about climate, I come to the conclusion that the global challenge will not be solved without great U.S. leadership. I simply do not believe it is possible for the U.S. to be a laggard in this regard and have there be any real progress.

It will not be the case that we can make great progress and then provide that leadership if we are crippled by the budget outlook that we have. And if we don't undertake a strategy that features innovation—and I have for a long time been an advocate of using carbon pricing, carbon taxes, in particular. Well-designed carbon taxes are huge incentives for efficiencies, innovation that are completely decentralized.

On the ground people decide how they want to respond to price incentives. That's what made the U.S. economy the single greatest economy in the history of the world, using the same techniques to address this problem would be exactly the right way to go. And so, I think the strategy that the Administration has adopted is not the best strategy. I think it will yield little, quite frankly, in time and benefits.

Senator MARSHALL. Thank you. My next question is for Dr. Carney. Two questions, Dr. Carney, as you make your assessment of climate, you talk a lot about carbon footprints. How do you assess the cradle to grave impacts of what you're looking at? How do you calculate the cost of implementing your policies? And I'm going to give you a "for instance."

So, like Iowa, Kansas, over 50 percent of our electricity is generated from wind. Unfortunately, wind energy is seven times more per kilowatt to produce than from natural gas. Solar is probably 70 times per kilowatt more than from natural gas. And then when we transport that electricity, transporting electricity is 10 times more expensive than transporting natural gas. So, we're exporting a lot of that wind generator electricity and the cost of generating it and transporting is—you know, do the math, 70, 100 times more expensive.

So, my question, going back to you, Dr. Carney, is how do you address the entire cradle to grave impact of your policies, not just the carbon footprint and how do you calculate the cost of implementing your plans?

Dr. CARNEY. Thank you. Chair just cut me off when I used up too much time. Very quickly, I might refrain cradle to grave, Senator, as well wheeled. So, the all-in cost of delivered energy. I would point out that the levelized cost of wind and solar, new wind and solar is now comparable, if not through, in many jurisdictions. It is less expensive than natural gas is the first point.

The second point, and of course, subject to fewer price fluctuations in local and world markets. And then a quick point, if I may, just to pick up on the fiscal point, I'll just read into the record that one of the most effective mechanisms, and the Chair referenced this at the start, is credible climate policy that would include regulation. And when you combine that with the financial sector and businesses having the right information, you get the investment in technologies that are efficient today, cost effective, and in the types of innovations that will be necessary tomorrow. And I'll just refer to a detailed analysis that Secretary Yellen and I did prior to her—

Senator MARSHALL. Well, we'll have to agree to disagree on your cost analysis of wind and solar power. I wish. I could only wish that they were efficient. Thank you so much. I yield back.

Dr. CARNEY. One of the largest investors in energy, so that's what we based it off.

Chairman WHITEHOUSE. Senator Van Hollen.

STATEMENT OF SENATOR VAN HOLLEN

Senator VAN HOLLEN. Thank you, Mr. Chairman. Thank all of you for your testimony today.

Dr. Holtz-Eakin, I agree with your comments on carbon pricing. Many of us pushed for that for many years with appropriate safeguards like border adjustments to protect U.S. domestic industry. This is not a puritan statement. It's a statement of fact. We weren't able to get any support here in Congress from the other side of the aisle on that and that's why I strongly support the approach that we took in the Inflation Reduction Act because we have to do something and I think if you look at it we will achieve significant reductions in greenhouse gas emissions, not as much as I would like, and that brings me to a couple of points.

Number one, first of all, I think there are huge economic opportunities and job opportunities in going forward with the clean energy transition. In my state of Maryland, we have two offshore wind facilities that are being built, 10,000 good paying jobs projected from those two facilities.

We also know that the cost of doing nothing is huge and that's part of the purpose of this, today's hearing. And those costs are being borne as we speak in terms of taxpayer dollars for more climate resilience at the local level, at the state level, at the federal level and the cost that insurers or individual citizens are paying through insurance and through non-insurance and just the impact on them and their property and their lives.

Mr. Litterman, you testified, and I'm quoting here that "insurance markets are critical to diversify these risks and to create appropriate incentives for individuals, companies, and communities to prepare for extreme weather by building harden infrastructure in buildings." You go onto say "but the insurance markets are not working properly because historical loss experience is no longer relevant for predicting future losses."

I noted that in Florida and Louisiana and California, at least one of those three states if not all of them you're seeing just last year a number of insurance companies go insolvent because they just couldn't pay the bill for extreme weather events. Can you expand

on the comment you made about us being unprepared when it comes to insurance to capture this risk.

Dr. LITTERMAN. Sure. Insurance companies base their pricing on historical experience. That historical experience is no longer relevant. We are in a new weather environment now and so we see these tail events happening much more frequently than they have historically. We have to base insurance on what's actually going to happen or insurance companies are going to pull back. Look at California and wildfires. The probability of getting wildfires is now much higher than it was historically. Everyone knows that, including insurance companies. And so, if you want to buy insurance, insurance companies they're going to raise the premium, but the insurance regulators won't allow them to raise the premium because based on what they say. Show me the data. Well, the data is changing every day. These things are becoming more and more likely and so the insurance markets are not working. Reinsurers understand this. They see the risks and they say we won't underwrite these losses because we see them coming and so these markets are just not working.

And then you get Florida, the federal government says we'll provide the flood insurance. California says taxpayers will underwrite the costs of fire insurance. This leads to incorrect incentives. What people should be doing is recognizing that we need hardened infrastructure. We shouldn't be living in risky places and we certainly don't want the federal government to be subsidizing people to live in areas where it's more expensive. That's just going to increase the total cost in the long run.

So, we have to face the reality. I love what Professor Holtz-Eakin said. We need to put a price on it. We need to create incentives. People respond to incentives. That's all there is to it. And so, we get the right incentives, we'll get the right behaviors. If we have the wrong incentives, and the insurance industry right now we have the wrong incentives, and so we get the wrong behavior.

Senator VAN HOLLEN. Can you speak a little more to the secondary market of insurers? Because as you said they get it, right? Costs are going up as I look at these facts in Florida after six insurance companies went insolvent in 2022 alone, you now see premiums averaging more than \$4,200 per year, almost three times the national average.

So, as you say, at the end of the day, you're going to pick up the tab, right? I mean you're going to pick up the tab, either the taxpayer or you're going to have to pick up the tab through much higher home insurance rates and other insurance rates, which is why obviously the best course of action is to try to address the issue at its root and reduce the impact to climate change. But obviously, we're in this already so we have to provide the resilience.

I can tell you in my state of Maryland, just over the last four years if you look at it, in the last few years we've seen a dramatic increase in extreme weather events, costing the State of Maryland billions and billions of dollars. So, we're going to pay one way or another if we don't figure out how to address this. And as I said, there's huge opportunities, economically and job-wise in addressing them. Thank you, Mr. Chairman.

Chairman WHITEHOUSE. Thank you Senator Van Hollen. Do you care to respond?

Dr. LITTERMAN. I would just say that we can do better.

There are models that we can run. We can get better estimates of what the risks are, whether it's flooding or heat or smoke and so on, and we should. So, basically what the insurance market is going to have to do is start relying on climate models to project into the future what these risks are.

Chairman WHITEHOUSE. Senator Romney. Thank you for your patience.

Senator ROMNEY. Pardon?

Chairman WHITEHOUSE. Thank you for your patience.

STATEMENT OF SENATOR ROMNEY

Senator ROMNEY. Thank you, Mr. Chairman. I have no question about the impact of climate change. It's going to be significant, devastating in some areas more than others. The question is whether we're doing things that will actually make a difference and will lead to a different result.

What I'm concerned about is that most of what we do here in the United States is—well, I'll call it virtual signaling. That term has been used recently. But we do a lot of things that make us feel good about ourselves, but will have almost impact on global emissions. If we want to do something serious about global emissions, we need to put a price on carbon.

And our Democrat friends had the chance to do that during reconciliation. They didn't. And so, we can talk about all these other things we're doing and getting more batteries for cars and so forth, but the reason these things don't make a big difference is because the U.S. is not the big contributor to emissions in the world. China is and Brazil and India and Indonesia and all of the growth is going to come from them.

China's emissions are greater than the U.S., the EU, and Japan combined. So, when we do things here that are very expensive and disruptive to our economy, they don't change what's happening globally. We have to do things that have global impacts. So, research and technology and a price on carbon are the things that would make a difference.

So, it's frustrating to talk about this as a huge challenge to our budget and to our economy when it's out of control, unless we deal with them the way I've just described. And yet, there is something that is in our control that both parties are saying we won't touch that. And what is in our control is the level of debt we have. I just heard Professor Holtz-Eakin just indicate that the impact on the economy of the amount of debt we're adding up is 10 times the impact of climate change, 10 times. And yet, we're not willing to look at our entitlement programs to see if we can balance them somehow.

I'm not talking about cutting them or taxing them. I just saying let's at least come together and work on it. But the parties are afraid to even come together and have a discussion about how could we balance these things. It strikes me as one of the most outrageous things my generation has done to the coming generations is to say we're going to spend on this money on ourselves. We're

not going to tax ourselves to compensate for all that we're giving to ourselves. We're going to take all this money and then we're going to pass onto you for all of your lives slower growth so a more challenged economy and higher interest payments. It's unbelievable. It's almost immoral.

So, I look at this challenge, Professor Holtz-Eakin, am I reading this right that the challenge of the debt and our unwillingness to balance what we spend with what we tax that that unwillingness is having a huge impact on economic growth over the future and on the lives of our grandchildren and theirs?

Dr. HOLTZ-EAKIN. I think it's well said. I'd just amended it in two ways. I would take out almost in front of immoral and I would say that it's a disservice to the beneficiaries in Social Security and Medicare to pretend that somehow they can survive in their current form. They cannot. Trust funds will exhaust in under a decade, Social Security trust fund in a decade.

It is an enormous irony that something like the Social Security program, which was meant to eliminate income uncertainty in retirement and in old age is now the greatest source of income uncertainty in retirement and old age because we have no idea what that program will look like as the years roll forward.

So, I personally I'm enormously disappointed at a public debate that suggest we can't touch Social Security and Medicaid. They are the only things we should touch. They are the most important things to touch and I would encourage this Committee to put that on their list.

Senator ROMNEY. Thank you. Dr. Litterman, I described what I thought were the major levers that would have an impact on emissions and climate and that came from a model that was presented by a professor at MIT. They built this huge model there that shows all the things you could do and the impact they have. What was shocking was almost everything we talk about or we are excited about has no real impact globally, except a price on carbon and of course investments in new technology and innovation.

Some of that is on the table, but the price on carbon never have; am I wrong on that or is that a fair assessment?

Dr. LITTERMAN. No, you're absolutely right. In fact, I would go further because when we talk about the budget deficit, as Professor Holtz-Eakin knows, a carbon tax is a great way to raise revenues. Polluters pay and that reduces the deficit, so of course that's the right way to do it.

And another thing I would say is that you're absolutely right about the global perspective. This is not a U.S. problem. This is a global problem and the U.S. has to join the global community in creating harmonized incentives to reduce emissions globally. And right now those incentives vary across the board. The U.S. is kind of in the middle with very little incentives, but you know what our strongest incentive to reduce emissions comes from a gasoline tax. If I drive an electric vehicle, I don't pay it, but that's not a strong incentive, okay?

In Europe, the incentives to reduce emissions are over a hundred dollars a ton. In many Middle East countries, Russia, Venezuela, there are strong subsidies to increase pollution because they have fixed prices on fossil fuels, which are below the market. So, we've

got to move diplomatically, and I would say what we have to do in the U.S. is provide our State Department with the tools that they can go and negotiate globally to get these harmonized incentives to reduce emissions.

Senator ROMNEY. Thank you. Mr. Chairman.

Chairman WHITEHOUSE. Thanks Senator Romney. Senator Kaine.

STATEMENT OF SENATOR KAINE

Senator KAINE. Thank you, Mr. Chairman and thanks for kicking off our 118th Congress meetings of the Budget Committee with this important topic and thank you to the witnesses.

So, I represent Virginia and it's a coastal state. Our shoreline stretches more than 5,000 miles if you include all the snaking waterways around the Chesapeake Bay and the Atlantic. And it's home to assets like the world's largest Navy base, one of the largest cargo ports in the United States, tourism destinations like Virginia Beach and historic Jamestown, as well as commercial and residential districts, the second largest metropolitan area in Virginia is the Hampton Road area. It's about 1.7 million people.

Hampton Roads is listed behind New Orleans as the most vulnerable community in the country to sea level rise and this is not the only part of Virginia that's affected by climate change. We see intense rainstorms and flooding in the Appalachian region of Virginia that cause much more severe damage than they have in the past. Even though the annual rainfall hasn't changed much, it tends to come in much more violent episodes than it has in the past because of climate change, so obviously very interested in this topic.

One of the things that I've been troubled by, and I want to pick up a little bit, Senator Romney was talking about debt and spending and wanting to spend the right way, not the wrong way. One of the things I've been troubled by 10 years here in the Senate is it seems like we are willing to spend a lot of money on climate change, but only in this sense, we spend in response to emergencies.

So, we'll do a superstorm Sandy emergency relief package in the aftermath of some significant climate event and you can pretty much count on bipartisanship. We'll try to find ways to help our communities out when they've been hurt or we'll rewrite the Federal Flood Insurance Program to provide more and more financial support for those whose residences and businesses are getting more severe flood damage than they have in the past.

So, we'll come to respond on the backend, but what has been harder to do is find smart resilience funding or even, more importantly, smart prevention funding. I do think, as Senator Romney said, we are on the prevention side, some of the research investments either in the Chips and Research bill and in the Infrastructure bill or maybe frontloading some of these expenses in the prevention side.

But if either of you would just have thoughts about in spending and investing how should we be balancing between prevention, resilience, and response and is there a way we should adjust that dial to make it more likely effective?

Dr. LITTERMAN. Well, I think the most important thing we can do is create the incentive now to prevent this problem from getting bigger and bigger into the future, so that's what we have to do immediately. The costs themselves are primarily in the future and so, among other things, we have to be prepared.

I think in terms of what we really need to do to address this problem, as one of the senators mentioned, we have to create the innovation to create the new types of energy—the energy, the infrastructure, the housing, and so on that will be resilient to the future that's coming. And in order to do that, in order to generate the innovation and the capital and so on, what we need is to create the expectation among investors that there will be incentives that will pay—you know, if you have a low carbon approach that it'll be more profitable.

Senator KAINE. Can I just say what about innovation and then I did want to have the Professor respond as well. One the things I like as sort of a little virtuous competition in the innovation space. I know some of what we did in the IRA has made European nations kind of mad, like what you're trying to do things that will make it harder for industries. But then they've decided, well, maybe we'd better up or investments as well and that kind of virtuous competition it can lead to some tough words between otherwise allied nations, but it may not be bad in terms of the overall goal. Dr. Holtz-Eakin, I know you wanted to say something.

Dr. HOLTZ-EAKIN. Just briefly, I mean if you take the flood insurance program as an example, for long periods we didn't update the web maps and delivery didn't update the flood maps, so that's a terrible idea. You have to know the risks you face and then once you have those risks they have to be priced effectively. And that means in some cases premiums that are much higher than have been historically. That becomes uncomfortable. Let's be honest about that. But it provides exactly the right innovation and other incentives.

Don't build a house where it doesn't belong, right, then, you will not have to pay out of the flood program when it gets hit. New businesses to places are more secure for the future. All of that is the best kind of signal to send and it comes from really doing mundane structural things in a lot of federal programs, but we're not doing that.

Senator KAINE. Thank you, Mr. Chair.

Chairman WHITEHOUSE. Thank you very much, Senator Kaine. Senator Graham, followed by Senator Kennedy and then Senator Braun, unless we have Democrats that are mediating. Go ahead, Senator Graham.

STATEMENT OF SENATOR GRAHAM

Senator GRAHAM. Thanks, Mr. Chairman. This is a hearing worth having, for sure. So, we all sort of agree on the problem. Climate change is real. It's affecting quality life on the planet over time. We all agree with that. What to do about it is problematic, but let's talk about pricing carbon. Your price on carbon what would that translate to, Doug, in terms of increasing gas prices?

Dr. HOLTZ-EAKIN. I don't have a specific price for carbon that I would translate into gas prices, but the literature says very clearly that the right way to do this is to have—

Senator GRAHAM. No, I got it. I got it.

Dr. HOLTZ-EAKIN. Let me finish. Let me finish. It's a revenue neutral carbon tax so that you use the revenues to get rid of other taxes that people who make gasoline will have to pay. So, the net impact on the pump prices is not always from that. Again, something is going down, not just up.

Senator GRAHAM. So, revenue neutral gas tax. You take the money you collect from gas taxes and you offset obligations in other areas, right?

Dr. HOLTZ-EAKIN. Revenue neutral carbon tax economy-wide so that you can use the revenues to diminish taxes on capital and labor. Those are corporate income taxes, income taxes, payroll taxes.

Senator GRAHAM. Now, I'm making \$20 an hour in South Carolina. How do I get my money back for an increase gas tax?

Dr. HOLTZ-EAKIN. Payroll tax reduction.

Senator GRAHAM. Okay. And how does that affect Social Security?

Dr. HOLTZ-EAKIN. Sadly, in reality, it doesn't affect Social Security very much because it's already not going to have enough money, so you better figure that out.

Senator GRAHAM. Okay. What would you do?

Dr. HOLTZ-EAKIN. Well, Senator, I really like Senator Wyden's plan that didn't get into the Build Back Better, but he suggested that we have a low carbon tax to begin with, exclude gasoline, and then allow the incentive to rise quickly and so, there are various ways to address this. I would say that the gasoline is very inelastic and so you really don't impact very much the amount of pollution by putting on a gasoline tax. I think there's much better ways to address it.

Senator GRAHAM. How would it affect utility bills, this approach?

Dr. HOLTZ-EAKIN. How would—

Senator GRAHAM. Yes. I mean somebody's got to pay. Carbon's generated through transportation and production of energy itself.

Dr. HOLTZ-EAKIN. Well, Senator, I'm not an expert on utility, but I believe that utilities around the country have very different carbon footprints. So, in an area where you have clean electricity it wouldn't be much of an impact.

Senator GRAHAM. I'm generally supportive, but the problem with this is we talk in circles. I'm asking you if we go down this road how much will your utility bill go up, how much gas prices will go up, we need to actually talk more honestly about that. How about something maybe we can agree on, that if we don't get China and India and other big emitters to do better it doesn't really matter a whole lot what we do here; do you agree with that, Doug?

Dr. HOLTZ-EAKIN. I do agree with that.

Senator GRAHAM. Does everybody on the panel agree with that? Is one way to do that a border adjusted carbon fee?

Dr. HOLTZ-EAKIN. Certainly, if we had a global regime with people already doing something, right, then we should have a border adjustment.

Senator GRAHAM. Mr. Litterman.

Dr. LITTERMAN. Absolutely. Absolutely. I think it's a great way to go and I think it's something that both parties can agree on, so let's move forward.

Senator GRAHAM. So, if you're looking to make big polluters like China and India to change their behavior, we do all the things here at home may drive up prices. When they send products into the country, they're going to pay a pollution fee, for lack of a better term. You agree with that?

Dr. LITTERMAN. Oh, yeah, absolutely. We need to measure the incentives globally to reduce the emissions, we need to harmonize them, and we need to get them to the appropriate level, so let's work together to do that.

Senator GRAHAM. If we do electrification of the vehicle fleet along the lines that car companies are talking about by 2035, 2040, how much demand in power production will that create in America?

Dr. LITTERMAN. I don't know, Senator.

Senator GRAHAM. Do you know, Doug?

Dr. HOLTZ-EAKIN. I don't know the number off the top of my head. I'd be happy to get it to you. But in my written testimony—

Senator GRAHAM. Like a lot.

Dr. HOLTZ-EAKIN. But in my written testimony.

Senator GRAHAM. It's like a lot.

Dr. HOLTZ-EAKIN. It's like a lot.

Senator GRAHAM. It's like a lot. Where does that "a lot" come from? Can you do it without natural gas?

Dr. HOLTZ-EAKIN. I don't think so.

Senator GRAHAM. Can you do it without natural gas, Mr. Litterman?

Dr. LITTERMAN. Oh, yeah, absolutely.

Senator GRAHAM. Okay.

Dr. LITTERMAN. What you need to do is you need to create the right incentives and let the market work.

Senator GRAHAM. Time out. How much increase in demand for power or power will come from electrifying the vehicle fleet? How much, 100 percent, 50 percent, 10 percent, 200 percent? Do you have a clue?

Dr. LITTERMAN. How much of the electricity demand will be increased by electrifying—

Senator GRAHAM. To cars or plugging into something.

Dr. LITTERMAN. Yes, I don't know.

Senator GRAHAM. How can you say if you don't know there's no need for gas? This is the problem. Thanks.

Dr. LITTERMAN. Who said there was no need for gas, Senator?

Chairman WHITEHOUSE. Senator Kennedy is up next, followed by Senator Braun. And for the record, for people who came late, we actually have a third witness, who happens to not be visible because he's with us electronically, but it's Mark Carney, who was the former Chief of the Bank of Canada and the Bank of England.

STATEMENT OF SENATOR KENNEDY

Senator KENNEDY. Thank you, Mr. Chairman. Dr. Litterman, how long have you been studying climate change and possible solutions?

Dr. LITTERMAN. Studying? Well, I was the head of Risk Management at Goldman Sachs. I didn't worry too much about climate change at that.

Senator KENNEDY. Tell me the number of years, if you would, Doc?

Dr. LITTERMAN. How many years?

Senator KENNEDY. Yes.

Dr. LITTERMAN. Let's say 15.

Senator KENNEDY. And how about you, Dr. Holtz-Eakin?

Dr. HOLTZ-EAKIN. About 25.

Senator KENNEDY. Okay. Dr. Litterman, how much will it cost to make the United States of America carbon neutral by 2050?

Dr. LITTERMAN. I don't know, sir.

Senator KENNEDY. So, you're advocating we do these things, but you don't know the ultimate cost?

Dr. LITTERMAN. Yes, absolutely. I certainly don't know the ultimate cost and it's very uncertain. It depends on innovations. It depends on—

Senator KENNEDY. I understand. I'm just trying to lay a foundation here to understand your expert testimony. Dr. Holtz-Eakin, do you know how much it will cost to make the United States of America carbon neutral by 2050?

Dr. HOLTZ-EAKIN. Depends how you do it. If we do all on the federal budget—

Senator KENNEDY. Public and private dollars.

Dr. HOLTZ-EAKIN. Sorry?

Senator KENNEDY. Public and private dollars. It's ultimately private dollars anyway.

Dr. HOLTZ-EAKIN. Yes, I agree.

Senator KENNEDY. So, how much?

Dr. HOLTZ-EAKIN. You're going to look at \$50 trillion.

Senator KENNEDY. \$50 trillion.

Dr. HOLTZ-EAKIN. Yes.

Senator KENNEDY. Okay. Thank you. If we make the United States of America carbon neutral by 2050 by spending \$50 trillion, what you're advocating I gather? No? Okay, then strike that last part. I'm wrong. You're not advocating. You're advocating something.

Dr. HOLTZ-EAKIN. If you're going to do something, do something smart. That's what I advocated.

Senator KENNEDY. Okay. If we spend \$50 trillion to make the United States of America carbon neutral by 2050, how much will that lower world temperatures?

Dr. HOLTZ-EAKIN. I can't speculate what China and India and the rest of the world has done.

Senator KENNEDY. Okay. Have you heard anybody from the Biden Administration say how much it would lower world temperatures?

Dr. HOLTZ-EAKIN. No.

Senator KENNEDY. Does anybody know how much it would lower world temperatures? No?

Dr. HOLTZ-EAKIN. No one can know for sure.

Senator KENNEDY. Dr. Litterman.

Dr. LITTERMAN. Yes.

Senator KENNEDY. If we spend \$50 trillion or however much it takes to make the United States carbon neutral by 2050, how much will it lower world temperatures?

Dr. LITTERMAN. Senator, that depends on the rest of the world. We have to work with the rest of the world. We're in this together.

Senator KENNEDY. Well, what if—

Dr. LITTERMAN. We can't build a wall around the United States and say—

Senator KENNEDY. What if we spend \$50 trillion, Europe cooperates, most western democracies cooperate, but India and China don't, how much will our \$50 trillion lower world temperature?

Dr. LITTERMAN. We're in this together. We have to get the world to work together.

Senator KENNEDY. I get that.

Dr. LITTERMAN. Okay.

Senator KENNEDY. How much would it lower world temperatures?

Dr. LITTERMAN. If China and India do not help?

Senator KENNEDY. Yes.

Dr. LITTERMAN. I don't know.

Senator KENNEDY. Okay. Dr. Litterman, do you believe, based on your observations—you seem to be a very intelligent, well-informed man. Based on your observation of Mr. Xi Jinping that Mr. Xi Jinping will ever do anything that is inconsistent with China's best interests in the name of global climate change?

Dr. LITTERMAN. I understand that China has a federal carbon tax.

Senator KENNEDY. Yes, but face with a policy, okay, where China does something that's not in its best interest, but it does it because it's in the global best interest, do you think President Xi would do that?

Dr. LITTERMAN. I think that President Xi understands that we have to work together to address this global problem. Yes, I do, and it will be in the best interest of China to work with the United States to address this problem.

Senator KENNEDY. So, you think the answer is yes?

Dr. LITTERMAN. I think the answer is it's in China's best interest to work with the rest of the world to address this problem, as it is in the United States best interest to work with the rest of the world to address this problem.

Senator KENNEDY. Do you believe—

Dr. LITTERMAN. We need harmonized incentives to reduce the issue.

Senator KENNEDY. Do you believe in the Tooth Fairy?

Dr. LITTERMAN. No, sir.

Senator KENNEDY. Do you believe in the Easter Bunny?

Dr. LITTERMAN. No, sir.

Senator KENNEDY. Do you believe that Jimmy Hoffa died of natural causes?

Dr. LITTERMAN. No, sir.
 Senator KENNEDY. Okay. Thank you, Mr. Chairman.
 Chairman WHITEHOUSE. Senator Braun.

STATEMENT OF SENATOR BRAUN

Senator BRAUN. Thank you, Mr. Chairman. I've been four years on the Budget Committee each year and the last two years prior to this we did 16 hearings and we didn't do one hearing on the mechanics of actually doing a budget. This is the Budget Committee and we haven't put one together fully budgeted and appropriate on time in 25 years.

I've got four kids that now run my business, three of my four kids, and I was on a school board 10 years, state legislator for three years. No other place works like that and has a business plan that works into the future. I also come to the Senate and believe, as Republicans and conservatives, that if we don't weigh in on big issues of the day shame on us. Then we're going to be at the expense of whatever the other idea is.

Started the Climate Caucus back six months after I got here. Got six other Republicans to join and we've been an engaging caucus, a real caucus that's met over time. So, the issues are there, but I think until we—unless we want to change the name of this Committee to the General Issues of Concern Committee, we owe it to the American public that we're not going to base it upon doing no budgeting, no appropriating, doing it behind closed doors, and dropping 4100 page bills in our lap that none of us can read through and then having the gall to borrow the money from our kids and our grandkids. That is shameful.

We should be fleshing out the climate issues probably in EPW. I've been the loudest senator on the Republic side that says we have a broken healthcare system. Fixed it in my own business 15 years ago, made it consumer driven, but skin in the game from my own employees to be real healthcare consumers, cut costs by 50 percent, have not had premium increases in 15 years. That sounds like it'd be unbelievable, but it's true. When you do things that make sense and that are sustainable. You know I've got healthier employees for that now.

So, healthcare, it's breaking the bank in terms of mentioned earlier Medicare until you reform the healthcare industry and embrace competition, transparency, don't get hospitals all the rules and regs they need to become an unregulated utility like a monopoly in the sense of how they work, probably going to see costs going up.

So, I'm not going to weigh in on the climate issue, other than we've doing it. The experts there, the leaders and captains of industry I think are accepting it as an issue. It's going to be solved in that area through technology, not here. And it does beg the question when China's building a coal-fired plant weekly how does that hold thing fit into the equation?

So, I want to cite a few more statistics and then I'm going to ask Mr. Carney, who is out there in the cyber world and Dr. Holtz-Eakin, what you think about the trajectory we're on. The only budget out there that anybody's had the nerve to be I did it last year, privilege motion. We should discharge a budget resolution by

April 1st. There'll be some of us that do that again, but just cutting to what we do do, which is no budgeting, no appropriating, and then whether you believe in reforming things on a climate basis and healthcare. What about the idea that we're adding trillions to our national debt, 18 trillion when I got here, now 31 trillion. Start back in 2000 when we put a couple wars on the credit card. That took us from 5 trillion in debt to 10 trillion.

Next Administration said, well, we're not going to be outdone, added another 6 trillion. I get here it's 18 trillion. It's been off the rails ever since. Let's start with Mr. Carney. You come from the banking industry. I debated Bernie Sanders for 25 minutes on the Senate floor about the modern monetary theory. Can we keep borrowing and borrowing without having the consequences of crowding out all the issues that are going to come into play, is that a viable long-term business plan? And I'd like Dr. Holtz-Eakin to weigh in as well.

Dr. CARNEY. Thank you, Senator. I'll make a couple quick comments. The first is that crowding out is an issue. I think Professor Holtz-Eakin has made this point in this forum and other fora. And secondly, it is a relevant issue for climate change because of the cost of adaptation, resilience, and delayed action is going to lead to much greater crowding out and bigger economic impacts as well. So, the fiscal situation you described, and I won't comment on obviously on U.S. situation, but this underscores the importance of revenue neutral use of regulation and effective policies that other senators have been referencing.

Last point I'll make before handing it over to the other witness is I would just refer, given the earlier discussion, to the carbon tax in Canada, which is revenue neutral, is returned to Canadians and insures about 70 percent of Canadian households. I'm going to net ahead.

Senator BRAUN. What about the modern monetary theory, climate aside?

Dr. LITTELMAN. I don't want to—

Senator BRAUN. I figured you may not weigh in on that. Go ahead.

Dr. LITTELMAN. No, that's a theory to which I do not subscribe.

Senator BRAUN. Well, I can tell you it's a bad theory. Anywhere else you borrow from future generations it does not work out. Dr. Holtz-Eakin.

Dr. HOLTZ-EAKIN. Well, one, the federal budget is on an unsustainable structure and its getting worse. Two, it is imposing costs on the economy today and will increasingly impose those costs. The carving out is real. And three, there is nothing about modern monetary theory that coincides with the real-world experience. It's just incorrect.

Senator BRAUN. Yes. And thank you for that. And I think we should try to discharge a budget resolution by April 15th, if not, I will take one to the floor again because it's our responsibility to our kids and grandkids not to run this place like we currently run it.

Chairman WHITEHOUSE. Senator Lee.

STATEMENT OF SENATOR LEE

Senator LEE. Thank you, Mr. Chairman. I want to take a brief moment to say that I appreciate the opportunity to serve on the Budget Committee as a new member and especially to do so at a time when the state of our federal budget is in such profound disrepair, perhaps more so than at any other time in our nation's history.

Fifteen years ago, our public debt measured as a percentage of the American economy, was at just 35 percent. Today it stands at 100 percent and according to fairly rosy projections within the next few decades it'll get up to 200 percent. And whether it's decades or just a few years away, we will reach a point where our interest on the national debt becomes the largest line item we have, bigger than Social Security or Medicare or Defense.

This fiscally irresponsible path that our federal budget is on is something that increases significantly the odds of a debt crisis and the associated economic pain that will inevitably be borne by the American public, if and when that crisis arrives in its full force.

Just last year the Congressional Budget Office noted that the very tangible consequences of our federal debt needed to be kept in mind or the high and rising federal debt that CBO projects over the next three decades would have serious consequences for the economy and federal budgeting, including the crowding out of private investment, higher interest costs, and increased risk of a fiscal crisis.

So, let's not fool ourselves. And most importantly, let's not fool those we represent, the American people. Blooming deficits and surging debt have been driven by and will continue to be driven by runaway profligate spending by the federal government, not because of any effects of climate change. That is a different thing. That's not what has caused our ballooning debt and deficit.

There has become an all too prevalent quality in American political discourse and specifically among many in the United States Senate and on the left who seek to climate alarmism to justify a widespread federal government takeover of our economy and a radical, unrealistic and damaging transition of our energy sector with all of its abruptness and all of its disregarding of things that have worked and helped elevate people out of poverty. And yes, even helped, in many instances, clean up the environment.

Dating back to at least the 1970s, a group of left-wing academics and media allies began making apocalyptic claims about climate change, stipulating that climate-related apocalyptic events would wipe out hundreds of millions if not billions of the Earth's human inhabitants over the next few decades. What's more concerning than the kooky theories of Paul Ehrlich or Thomas Malthus that a growing number of Democratic members of Congress, bureaucrats, and private sector business people are now making similarly outlandish and inflammatory alarmist claims about a looming climate apocalypse or at least throw support behind green new deal style legislative proposals and regulatory mandates.

Not only is this supremely misguided and shortsighted, but it's not remotely necessary. It certainly isn't desirable. The reality is that U.S. energy-related carbon emissions have been steadily declining over the last 15 years without any green new deal styled

takeover of the federal budget and the American economy. And the same time China's carbon emissions have nearly doubled over that same time period.

Democrats in Congress and in the Biden Administration need to work with Republicans to promote American energy independence rather than promoting less efficient forms of energy, especially at a time of significant energy inflation. And it's been financially debilitating to low- and middle-income American households. And those energy costs translate also to higher food costs and higher costs for everything we buy and everything we do.

These costs don't fall on the wealthy like they fall on the poor and middle class. But brazen regulatory overreach currently being carried out by unelected and unaccountable bureaucrats must come to an end as those decisions of making law are expressly reserved for Congress under Article I, Sections 1 and 7 of the U.S. Constitution.

Lastly, it's my hope that this Committee will spend more of its time and effort this Congress deliberating ways to reduce our budget deficits so that we can stabilize our debt while putting our budget on a pathway to balance. Thank you, Mr. Chairman.

Chairman WHITEHOUSE. Thank you, Senator Lee. To be clear, the reason we're having this hearing and the reason that we're going to continue to have hearings on this subject is that \$10 trillion of our federal debt can be ascribed to exogenous shocks to our economy with which we had to cope. It wasn't cheap, but we had to do it.

The biggest exogenous shock on the horizon out there is climate upheaval. That's not just me. That's bankers, corporate CEOs, scientists, economists, people who will look at this problem all around the world. And it matters because we have the chance to head it off now if we take appropriate steps, many of which, as we've heard in this hearing, have support on both sides of the aisle.

I'll also add that I mentioned at the beginning of the hearing the prospect of healthcare reforms that can lower costs. Accountable care organizations were a perfect example of that and I look forward to working with members on both sides of the aisle and with CBO to drill into the cost bases for that and try to figure out we can do to do more of what looks like already trillions of dollars in healthcare savings that are projected from these changes.

But I'll close with a round of questioning. I didn't have the chance to ask Dr. Holtz-Eakin questions, so I'm going to yield myself a second round. And let me ask you, Dr. Holtz-Eakin, in preparing your testimony today did you familiarize yourself with the Bank of International Settlements so-called Green Swan Report, which warns of, and I quote, "catastrophic and irreversible impacts from climate so large that"—and quoted them again—"it would make quantifying financial damages impossible?"

Dr. HOLTZ-EAKIN. No, I did not read that report.

Chairman WHITEHOUSE. Did you familiarize yourself with the report put out in April of 2019 by dozens of central banks that says, "Estimates of losses are large and range up to \$20 trillion when looking at the economy more broadly."

Dr. HOLTZ-EAKIN. I don't know that report.

Chairman WHITEHOUSE. Did you familiarize yourself with the Deloitte Global Turning Point Report, which concluded that in 2070 alone global GDP could be 7.6 percent lower compared to a baseline that does not account for climate change.

Dr. HOLTZ-EAKIN. I read that report—scanned that report when it first came out.

Chairman WHITEHOUSE. Did you familiarize yourself with the report from economists largely centralized in Cambridge, but from around the world that said that the effect on the U.S. economy would be more than \$3 trillion in losses and GDP could shrink by more than 5 percent due to the collapse of stranded assets?

Dr. HOLTZ-EAKIN. I scanned that one as well when it came out.

Chairman WHITEHOUSE. Did you familiarize yourself with the report from Freddie Mac, the American mortgage giant that said, and I'm quoting here, that the economic losses and social disruption related to coastal property losses "are likely to be greater in total than those experienced in the housing crisis and the Great Recession."

Dr. HOLTZ-EAKIN. No.

Chairman WHITEHOUSE. I gather you did familiarize yourself with the CSTC Report that Litterman wrote. Correct?

Dr. HOLTZ-EAKIN. When it was released. Yes.

Chairman WHITEHOUSE. And when it was released, its opening sentence was "Climate change poses a major risk to the stability of the U.S. financial system and to its ability to sustain the American economy," is that correct?

Dr. HOLTZ-EAKIN. Yes.

Chairman WHITEHOUSE. And the second paragraph after its header says, "Risks include disorderly price adjustments in various assets classes with possible spillovers into different parts of the financial system as well as potential disruption of the proper functioning of financial markets." Not a good outcome, right?

Dr. HOLTZ-EAKIN. Not desirable.

Chairman WHITEHOUSE. Not desirable indeed. And then it also said, "A central finding of this report is that climate change could pose systemic risks to the U.S. financial system across multiple sectors, geographies, and assets in the United States, sometimes simultaneously, and within a relatively short timeframe." Do you recall it saying that?

Dr. HOLTZ-EAKIN. Not specifically, but I believe that.

Chairman WHITEHOUSE. And you wrote a little report on it in September of 2020 which noted that climate induced risks will cause dramatic financial fluctuations and the stability of the system will be at risk. And then on the backside of your one-pager, you said that the potential risks to financial markets posed by climate change represent a pervasive policy challenge. Have I quoted you correctly?

Dr. HOLTZ-EAKIN. Yes.

Chairman WHITEHOUSE. Thank you. Closing words to Dr. Litterman.

Dr. LITTERMAN. Yes. I would just say I am surprised, pleasantly surprised by the amount of agreement by certainly the witnesses here and the senators as well, and so I hope we can move forward. That's all.

Chairman WHITEHOUSE. Yes. I hope so too when I think that there are things that we can do. I think the key points coming out of this are that we've got to move forward globally. We can't pretend that we can build a fence around the United States, soft climate here and not be affected by what's going on in China and India and other places, Russia.

That we do have the tools to effect the behavior of China and India and other countries through carbon border tariffs, that they're already underway in the European Union. And that if we can pull together and be sensible about this we can take advantage of—I forget whether it was you, Dr. Litterman or Dr. Carney, who said negative risks, opportunities. That there is a huge upside to getting this right.

I'll close with the Deloitte number, which was that if we don't get this right it's \$180 trillion in costs to the global economy. If we do get it right, it's \$40 trillion in added value. The upside, the negative risks, the opportunities. Let's go for that.

I want to thank the witnesses for appearing in the Committee today. Their full statements will be included in the record of our proceedings. As information for all senators, questions for the record, are due by noon tomorrow with signed hard copies delivered to the Committee Clerk in Dirksen 624. Emailed copies are also fine. We will ask the witnesses to respond to those questions within seven days of receipt of them.

And with no further business before the Committee, the hearing is adjourned.

[Whereupon, at 11:43 a.m., Wednesday, February 15, 2023, the hearing was adjourned.]

**Opening Statement of Chairman Sheldon Whitehouse
Senate Committee on the Budget
"Climate-Related Economic Risks and Their Costs to the Federal Budget and
the Global Economy"
February 15, 2023**

Ranking Member Grassley, colleagues, particularly our new members, let me welcome you to what I hope will be a busy, revived, impactful and lively Budget Committee. I want this to be your surprise favorite committee. We have important work to do on bipartisan health care reforms, on reforming this Committee's process to fit the basic arithmetic of the budget, and on issues important to each of you as members.

We'll begin with a series of hearings on the looming costs and economic risks of climate upheaval. Almost exactly five years ago, I sent around this binder to all of my Senate colleagues, in which I compiled some of the most compelling warnings about the economic risks associated with climate change. Last week, I sent your staffs an updated version of this binder. Here it is. As you can see, the warnings keep piling up. Have fun with the light reading.

These warnings come from central bankers, economists, asset managers, insurance companies, investment banks, credit rating agencies, and leading management consultants — folks with a lot of credibility when it comes to economics, finance, corporate risk, and their effect on government spending and revenues. These will be our witnesses — economists, scientists, business leaders, and other financial and risk experts, many of whose work is included in this binder.

I've said that science provides the headlights for society; that it's scientists who illuminate the way for us to navigate into the future. Think of the economists and scientists we'll hear from as the headlights for the United States Congress as this committee helps navigate our long-term budget and fiscal priorities.

Look at our national debt. One thing that stands out is how much of it was incurred as a result of exogenous shocks to the economy. Consider the 2008 financial crisis, which blew up the financial security of families and businesses across the country, and reduced government revenues for a decade. Two years after the recession, CBO found that projected revenues fell by \$4.4 trillion and projected spending rose by \$800 billion to spur the recovery.

Consider the pandemic. The Committee for a Responsible Federal Budget estimates that the federal response to the pandemic, which brought Covid under control, protected families, and jump-started our economic recovery, will add \$5.5 trillion to our deficits. That doesn't factor in lost revenue, or lost economic activity, so the total economic cost is much higher.

We came through both, but together those two exogenous shocks contributed \$10 trillion to the federal debt — more than 40% of the total; proof of how catastrophic events can and do affect the federal budget and the economy. And how life has a way of upsetting best-laid plans—and 10-year budget baselines.

Headlights, and better attention to what they illuminated, could have helped. Plenty of financial experts saw the 2008 mortgage mess coming. Plenty of epidemiologists warned that the country was woefully unprepared for a pandemic.

Now we have all these warnings. Warnings of crashes in coastal property values as rising seas and more powerful storms hit the 30-year mortgage horizon. Warnings of insurance collapse from more frequent, intense and unpredictable wildfires. A dangerous interplay between the insurance and mortgage markets hitting real estate markets across the country. Inflation from decreased agricultural yields. Massive infrastructure demand. Trouble in municipal bond markets. Stranded assets, and a “carbon bubble.” The most dangerous risks are called “systemic,” meaning that they will cascade out into the broader economy, as the mortgage problem did in 2008. And it’s big: Deloitte predicts the differential between being responsible and reckless about climate could sum to more than 220 trillion dollars between now and 2070.

Some of these warned-of risks are already upon us. Already, climate-related natural disasters increase federal spending on disaster assistance, flood insurance, crop insurance, and other programs we fund. But this is just the beginning. It will certainly get worse — much worse, particularly if warming exceeds 1.5 degrees. We are on a bad trajectory. It’s time for us all to wake up and face the problem, before coastal cities flood with water or Southwest cities can’t get water. I hope we can fend that off, with action, if we snap into focus on the danger.

We are all familiar with the “tragedy of the commons.” In 2015, our opening witness Dr. Carney gave a speech entitled “the tragedy of the horizon,” because some the gravest dangers of climate change, which we could head off today, come to pass years or decades out. Rhode Island’s coastline will be gone, reshaped into an archipelago by 2100, you say? Who cares, that’s an eternity!

Well, almost exactly a year ago, I became a grandfather for the first time. Baby Vera, God willing, will be alive in 2100. When I look at her, I am looking at that future. Walk by any elementary school. The faces you see on the playground, God willing, will be alive in 2100. How will those little ones remember our Less-than-Greatest Generation? We owe it to kids on playgrounds all across America to pay attention, to get this right.

By the end of this series of hearings, if we hear these expert witnesses, if we treat their testimony as our headlights, then our path will be clear. Thank you, and let’s get to work.

Prepared Statement by U.S. Senator Chuck Grassley (R-Iowa)
Ranking Member, Senate Budget Committee
Hearing on Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global
Economy
Wednesday, February 15, 2023
[VIDEO](#)

Mr. Chairman, I'm pleased to be here with you for our inaugural hearing as Chair and Ranking Member of the Budget Committee. Despite our political differences, I know we can find common areas of agreement to work on together.

One area of agreement must be that our budget and appropriations process is broken. This sentiment isn't new, nor is it particularly partisan. No person could look at last year's process and say things are working.

For the fiscal year 2023 cycle, Congress didn't adopt a budget resolution. The Senate Appropriations Committee didn't markup a single bill. And, not one of the 12 individual appropriations bills was debated on the Senate floor. Instead, we were presented with a \$1.7 trillion omnibus just days before Christmas.

Things need to change.

I applaud Senators Murray and Collins for publicly announcing their commitment to regular order— including debating appropriations bills on the Senate floor. We need to do our part to make that happen.

We should also agree that our nation's fiscal outlook is dire.

The Congressional Budget Office will release updated budget projections this afternoon. Every indication is that their new projections will be as bad as – or worse than - last summer's projections.

What did they tell us last summer?

Within 10 years, public debt as a share of our economy will exceed World War II record highs. However, unlike after World War II – when spending and debt subsided – our public debt is projected to climb ever higher.

Our public debt will reach 110 percent of our economy in 2032 and grow to 185 percent by 2052.

Trillion dollar annual deficits will be replaced by \$2 trillion deficits within a few years.

Simply servicing the debt will lead to record-breaking annual costs of more than \$1 trillion within ten years.

Mr. Chairman, your immediate predecessor refused to bring in CBO to discuss the overall budget outlook. This was a mistake. I urge you to hold a hearing with CBO on the latest outlook. Nobody benefits from us burying our heads in the sand.

I acknowledge that a changing climate is a historical and scientific fact. I also recognize that most scientists agree manmade emissions contribute to climate change. Throughout my career, I have advocated for renewable and alternative energy solutions.

This being said, even if the entire U.S. stopped emitting greenhouse gases tomorrow, projected temperatures would only be 0.3 degrees Fahrenheit lower come 2100.

Even in this unrealistic scenario, the U.S. would still need major polluters, like China and India, to pull their weight.

As we look to address climate and energy issues, the nation must also address its fiscal health.

There's plenty of blame to go around for how we got into our current situation. For decades, Congress turned a blind eye as our nation walked toward a fiscal cliff. But, Democrats turned that walk into a sprint.

In March of 2021, Democrats took advantage of an emergency situation to pass a \$2 trillion partisan spending bill—even as our economy showed strong signs of recovery.

Then, as inflation soared to 40-year highs, they doubled down; spending trillions more on their liberal wish list. They pushed through omnibus appropriations bills with "take it or leave it" mantras for two years—each time growing the size of government. When not using fast-tracked procedures or a government shutdown as leverage, the Administration drove up deficits through unilateral actions like student loan giveaways that could cost taxpayers \$1 trillion.

Congress needs a fiscal reality check. This reality check should start with this Committee getting back to performing its core functions. This includes holding hearings on federal fiscal matters; examining programs and authorizations that have been on autopilot for decades; and performing robust oversight of agency spending—no government entity should be exempt.

Finally, I welcome the opportunity to work with you on budget process reform. Mr. Chairman, you are a well-established leader on the issue. I appreciate your stated interest in working with me on this issue starting from where you left off with Senator Enzi in 2019. It was a bipartisan process then and I think we can build to get it over the finish line this Congress.

Needless to say, we have our work cut out for us to get our fiscal house in order. To paraphrase former Fed Chairman Paul Volcker, cutting spending may be painful, but the pain for all of us will be much greater if it isn't accomplished.

I look forward to the witnesses' testimonies and a discussion of the challenges and risks facing our nation.



Prepared Testimony of Mark Carney
Former Governor, Bank of England; Former Governor, Bank of Canada
Former Chair, G20 Financial Stability Board
United Nations Special Envoy for Climate Action and Finance
Co-Chair, Glasgow Financial Alliance for Net Zero
Chair of Brookfield Asset Management

Hearing on "Climate-Related Economic Risks and Their Costs to the Federal Budget
and the Global Economy"
United States Senate Committee on the Budget

February 15, 2023

Chairman Whitehouse, Ranking Member Grassley, and Members of the Committee: Thank you for inviting me to address the risks and economic costs of climate change.

During my terms as Governor of the Bank of England and Chair of the G20's Financial Stability Board, I chaired expert committees with responsibility for understanding and addressing the principal risks to financial stability. About a decade ago, these bodies became increasingly concerned about the rising economic and financial risks from climate change, and the fact that the financial system lacked the information, tools, and markets to manage them. For example, although the Bank of England oversees the world's largest international financial center, including the world's fourth largest insurance sector and the largest reinsurance market, Lloyds of London, we realized that the system did not have access to clear, consistent, and decision-useful information on climate risks.

Recognizing this was a global challenge, in 2015, the G20 Presidency tasked the Financial Stability Board with assessing the financial stability risks from climate change. Over the following years, a wide range of regulatory authorities and private financial institutions have worked to develop the fundamental building blocks the financial system needs to begin to manage climate-related risks on behalf of their depositors, pensioners, clients and shareholders. This is leading to better climate-related financial disclosure, stress tests and transition planning. Many leading financial institutions are improving their climate risk management and channeling capital to make companies more competitive through investments to reduce their emissions.

However, while the pace of change has picked up, it is not yet commensurate with the scale of the challenge in America or globally. Due to the undiversifiable nature of climate risks, governments will bear many of the costs of extreme weather and adaptation. Moreover, the longer adjustment is delayed, the greater the impact of climate change on financial stability, inflation, jobs and growth. Conversely, transitioning to a low-carbon economy will reduce the impact of climate change, create the jobs of the future, and promote a resilient financial system.

Physical impacts of climate change are rising

Globally, each of the last four decades has been warmer than the decade that preceded it.¹ The past eight years were the warmest on record, with each of those years exceeding 1 degree Celsius of warming—or about 1.8 degrees Fahrenheit—over pre-industrial levels.² The average sea level has risen faster since 1900 than over any preceding century in at least 3000 years.³ Extreme heatwaves have become more frequent and more intense since the 1950s, as have heavy precipitation events and major storms.

Data collected by the U.S. Environmental Protection Agency, the National Oceanic and Atmospheric Administration (NOAA), and NASA, among others, provide a snapshot of how climate change is already impacting the United States. To summarize:

- Since the 1970s, unusually hot summer days have become five times more common on average across the U.S., and unusually hot summer nights have become almost ten times more common.⁴
- Since the 1960s, heatwaves in the U.S. have become more common, more intense, and longer lasting. The average annual frequency of heatwaves in the U.S. has tripled since the 1960s, with each heatwave lasting an average of 30% longer.⁵
- While the incidence of drought varies across the country, the western U.S. is experiencing a mega-drought that has persisted for over two decades, making it the most intense in at least 1200 years.⁶ In May 2022, almost three quarters (72%) of the land in western states was classified as under either severe, exceptional, or extreme drought conditions.⁷

¹ IPCC, Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf

² World Meteorological Organization, "Past eight years confirmed to be the eight warmest on record," 12 January 2023. <https://public.wmo.int/en/media/press-release/past-eight-years-confirmed-be-eight-warmest-record>

³ IPCC, Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis*.

⁴ U.S. Environmental Protection Agency, Climate Change Indicators: High and Low Temperatures.

<https://www.epa.gov/climate-indicators/climate-change-indicators-high-and-low-temperatures>

⁵ U.S. Environmental Protection Agency, Climate Change Indicators: Heat Waves, 2022.

<https://www.epa.gov/climate-indicators/climate-change-indicators-heat-waves>

⁶ A. Park Williams et al. "Rapid intensification of the emerging southwestern North American megadrought in 2020–2021," *Nature Climate Change* 12, March 2022. https://www.nature.com/articles/s41558-022-01290-z.epdf?sharing_token=uEvEu-o1TVRtz4qqcSFxhtRgN0AjWl9jnR3ZoTv0OkweMbawmVFM1UCLmLxuyBpGkIFJa1_BxzJ7UFQSQZ6HoKWVpxr-PXXpBdXS0aLJYrb-T2bjp5Y_Cku7vSenHbIt81qi9olu_1s3zBCVWxhOj7h1yPvukczp8OW-fMlnax-64I97Ydyz8yOYptdpaLuUfk5JMXGjlcK0IPR_bAbZezMr6HR87nF1y-C5ApXrPDDheDZbRuS7KnTcwWcPIrnf0J4AhCj_Wfnjfu1EOv7CpjtzkM_mV8MDsJdSgKcZ_ooLr6EFhE-v6Qhk1ivl&tracking_referrer=www.npr.org

⁷ NOAA National Centers for Environmental Information, "Annual 2022 Drought Report," 12 January 2023. <https://www.ncei.noaa.gov/access/monitoring/monthly-report/drought/202213>

- Median sea levels along the U.S. coast have increased by about 9 inches since the early 20th century, increasing the frequency of high-tide flooding for U.S. coastal communities by five to ten times since the 1950s.⁸
- The intensity of hurricanes and tropical storms affecting the east coast of the U.S. has risen significantly over the past twenty years, making the period since 1995 the longest stretch on record of above-average hurricane seasons in terms of NOAA's Accumulated Cyclone Energy Index.⁹
- Across the western United States, there has been "a profound increase in forest fire activity" in recent decades, driven by persistent drought and temperature increases in these regions.¹⁰ The Congressional Budget Office analyzed trends in wildfires and found that on average, 8 million acres burned in wildfires annually between 2017 and 2021, more than double the average thirty years ago.¹¹

Climate Change is having increasing impact on Americans

- **Weather-related damages:** Adjusted for inflation, the number of billion-dollar disasters has risen six-fold from an average of three per year during the first half of the 1980s to an average of 18 per year over the past five years. The average annual inflation-adjusted costs of these disasters have risen seven-fold from \$18 billion to \$120 billion.¹² I know from my time as an insurance supervisor that, globally, these increases in insured losses are even higher, and that uninsured losses continue to set new records.
- **Sea-level rise and property destruction:** At least \$1.4 trillion worth of American homes and businesses sit within one-eighth of a mile of the coasts, and shoreline counties have almost 50 million housing units, housing over 40% of the U.S. population.¹³ As noted, increased flooding and coastal erosion are already causing significant damage, with an estimated \$15.8 billion of eastern seaboard property value eroded between 2005 and 2017,¹⁴ and it is estimated that, absent massive spending on adaptation, over \$500 billion

⁸ U.S. Global Change Research Program, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*, 2018. <https://nca2018.globalchange.gov/chapter/1/>

⁹ U.S. Environmental Protection Agency, Climate Change Indicators: Tropical Cyclone Activity, 2022. <https://www.epa.gov/climate-indicators/climate-change-indicators-tropical-cyclone-activity>. Alan Buis, "How Climate Change May Be Impacting Storms over Earth's Tropical Oceans," NASA Jet Propulsion Laboratory, March 2020. <https://climate.nasa.gov/ask-nasa-climate/2956/how-climate-change-may-be-impacting-storms-over-earths-tropical-oceans/>

¹⁰ U.S. Global Change Research Program, Droughts, floods, and wildfires. In: *Climate Science Special Report: Fourth National Climate Assessment, Volume I*, 2017. <https://science2017.globalchange.gov/chapter/8/#section-3>

¹¹ Congressional Budget Office, Wildfires, June 2022. <https://www.cbo.gov/publication/58212>

¹² In 2022, there were 18 separate billion-dollar weather and climate disaster events—11 severe storms, three tropical cyclones, flooding in Kentucky and Missouri, the late December winter storm, and the heatwave and drought in the west and Midwest, including the western wildfires—with costs estimated at \$165 billion, making it the third costliest year in terms of extreme weather damages. 2022 was the eighth consecutive year with 10 or more billion-dollar disaster events. NOAA, Billion Dollar Weather and Climate Disasters, 2023. <https://www.ncei.noaa.gov/access/billions/time-series>

¹³ U.S. Global Change Research Program, Coastal Effects. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*, <https://nca2018.globalchange.gov/chapter/8/>

¹⁴ First Street Foundation, "Rising Seas Erode \$15.8 Billion in Home Value from Maine to Mississippi," February 2019. <https://assets.firststreet.org/2019/02/9d9d5c3f7295fd97d60332bb14c042-firststreet-floodiq-mid-atlantic-release.pdf>

worth of real estate in the U.S. could be below sea level by 2100 under a higher warming scenario.¹⁵

- **Increased homeowner insurance costs:** Increases in weather-related disasters have led to insurance becoming less available and more expensive for American families. For example, the National Flood Insurance Program has been the insurer of last resort for most Americans living in flood zones since 1968. Since the 2005 hurricane season, the NFIP has been unable to cover its payouts with premiums.¹⁶ Federal flood premiums are expected to increase significantly as the program adjusts its risk ratings. More broadly, with property losses from natural disasters increasing, policy premiums are expected to increase significantly for American families, with one reinsurer estimating that climate-related risks will result in a 22% increase in global property insurance premiums over the next 20 years.¹⁷
- **Agricultural output:** As anyone who grew up in a farming area—as I did—knows, extreme weather has an acute impact on agricultural production. The increased frequency of drought, heatwaves, freezes, and flooding is likely to significantly impair agricultural production, reducing incomes for American farmers and raising food costs for American families.¹⁸
 - For example, a NASA study projects that, absent action, corn yields globally will begin declining over the next twenty years.¹⁹ Variability of yields will also increase. So while studies project that every Iowa county will experience production declines of 10% or more by 2050, declines will reach 25% in some counties by 2030 and over 40% in 2050.²⁰ This is because, while growing-degree days are expected to increase by a modest amount, killing-degree days will increase by significantly more—an expected 57% by 2030 and 94% by 2050.
 - Warming is already estimated to have contributed \$27 billion, or almost 20%, of national crop insurance losses between 1991 and 2017.²¹

¹⁵ U.S. Global Change Research Program, Coastal Effects. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*, <https://nca2018.globalchange.gov/chapter/8/>

¹⁶ Renee Cho, "With Climate Impacts Growing, Insurance Companies Face Big Challenges," Columbia Climate School State of the Planet, November 2022. <https://news.climate.columbia.edu/2022/11/03/with-climate-impacts-growing-insurance-companies-face-big-challenges/#~:text=Raising%20premium%20rates&text=The%20property%20losses%20from%20natural,increase%205,3%20percent%20per%20year.>

¹⁷ SwissRe, Global property & casualty insurance premiums expected to more than double to USD 4.3 trillion by 2040, Swiss Re Institute forecasts, September 2021. <https://www.swissre.com/press-release/Global-property-casualty-insurance-premiums-expected-to-more-than-double-to-USD-4-3-trillion-by-2040-Swiss-Re-Institute-forecasts/66c9cf70-d69f-4e5e-8d87-1b389dbf9491>

¹⁸ U.S. Global Change Research Program, Agriculture and Rural Communities. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*. <https://nca2018.globalchange.gov/chapter/10/>

¹⁹ Ellen Gray, "Global Climate Change Impact on Crops Expected Within 10 Years, NASA Study Finds," Nov 2021. <https://climate.nasa.gov/news/3124/global-climate-change-impact-on-crops-expected-within-10-years-nasa-study-finds/>

²⁰ EDF, *How Climate Change Will Impact U.S. Corn, Soybean and Wheat Yields: A county-level analysis of climate burdens and adaptation needs in the Midwest*, 2022. <https://www.edf.org/sites/default/files/2022-10/climate-impacts-midwest-crop-yields.pdf>

²¹ Noah S Diffenbaugh et al, "Historical warming has increased U.S. crop insurance losses," *Environmental Research Letters*, 16: 8, 2021. <https://iopscience.iop.org/article/10.1088/1748-9326/ac1223>

- **Supply chain disruptions:** The increased frequency and intensity of flooding and disasters can disrupt or damage critical infrastructure, and in turn supply chains, hurting American businesses and raising costs for American families. For example, the Texas deep freeze in February 2021²² caused the worst involuntary blackout in U.S. history, closing three major semiconductor plants, which in turn slowed the production of new cars in the U.S.²³ In the same vein, in December 2021, an extreme typhoon damaged a large Malaysian port, shutting off semiconductor shipments from Taiwan, leading to semiconductor shortages that caused U.S. car manufacturers to suspend operations.²⁴

Physical impacts will worsen over time

These trends are expected to worsen. As the U.S. Global Change Research Program concluded in its most recent National Climate Assessment, “the severity of these projected impacts, and the risks they present to society, is greater under futures with higher greenhouse gas emissions.”²⁵ There is ample scientific evidence that with each additional fraction of a degree of warming, extreme weather becomes more frequent and more intense.²⁶ In the U.S., this means more frequent and more intense hurricanes; more frequent and deeper coastal flooding; hotter, more frequent, and longer-lasting heat waves; longer-lasting and more frequent droughts, and more of the wildfires that accompany them.²⁷

There are thresholds beyond which warming—and therefore extreme weather—is likely to accelerate rapidly due to unlocking feedback loops, such as the thawing of Arctic permafrost, which would lead to rapid release into the atmosphere of carbon that’s currently frozen.²⁸ There may also be certain warming thresholds beyond which catastrophic physical impacts are locked in irreversibly—so called “tipping points.” These include the collapse of the Greenland or Antarctic ice sheets, or the significant dieback of the Amazon rainforest, which could alter the earth’s water cycle.²⁹

Scientific modeling has assessed the likeliest temperature and broader climate outcomes under different collective country policy responses. If governments cut emissions in line with their current, stated climate policies, the world will be on track for warming of 2.4 degrees Celsius (or

²² Judah Cohen et al, “Linking Arctic variability and change with extreme winter weather in the United States,” *Science* 373: 6559, September 2021. <https://www.science.org/doi/10.1126/science.aba9167>

²³ Jacques Leslie, “How Climate Change Is Disrupting the Global Supply Chain,” *Yale Environment* 360, March 2022. <https://e360.yale.edu/features/how-climate-change-is-disrupting-the-global-supply-chain#:~:text=Scientists%20say%20that%20such%20climate,and%20perhaps%20more%20%E2%80%94%20by%202100.>

²⁴ Leslie, “How Climate Change Is Disrupting the Global Supply Chain.”

²⁵ U.S. Global Change Research Program, Overview. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, Volume II, 2018. <https://nca2018.globalchange.gov/chapter/1/>

²⁶ IPCC, Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis*

²⁷ U.S. Global Change Research Program, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, Volume II, 2018. <https://nca2018.globalchange.gov/>

²⁸ IPCC, Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis*.

²⁹ IPCC, Impacts of 1.5°C global warming on natural and human systems, in *Special Report: Global Warming of 1.5°C*. 2018. <https://www.ipcc.ch/sr15/chapter/chapter-3/>

4.3 degrees Fahrenheit) over pre-industrial levels by 2100.³⁰ If all governments were to achieve their net-zero objectives on the timelines they have outlined, warming would be limited to 1.8 degrees.³¹ Even in this optimistic scenario, there would be a substantial increase in extreme weather and economic costs facing America and the world, but we would be less likely to hit irreversible tipping points or activate critical feedback loops.³²

Potential impacts on GDP and beyond

The insured and uninsured losses noted above measure the value destruction of the stock of assets. GDP is a measure of the flow of income. At the global level, estimates suggest that, over the balance of this century, climate change could reduce the level of global GDP per capita by 10-20% without efforts to limit warming, the equivalent of a decade of no economic growth.³³ Similar estimates have been found for the United States.³⁴

While GDP represents a single year's worth of value added in the economy, estimates of the impact of the economic impacts of climate change project that what is lost is likely to stay lost, making climate change the curse that keeps on taking. In other words, these are level effects on GDP that are not recovered, unlike for nearly all other shocks to the economy.

As economically significant as these estimates are, it is instructive to examine what is not included in them, both 'assets' outside the market economy—such as biodiversity and human health—as well as critical economic channels that have not been modelled, including disrupted supply chains, the very real challenges to monetary and financial stability that increasing climate change will present, and the potential economic impact of rising risks to national security.

Increased temperatures, increased frequency and severity of extreme weather events, and greater sea level rise can all negatively influence human health, including through heat-related illnesses like cardiovascular complications; easier spread of vector-borne pathogens like West Nile virus; and increased transmission of water-borne illness like diarrheal disease.³⁵ For example, hot days affect human health through several channels, with the most extreme effects—including increased mortality—felt by vulnerable populations such as the elderly and pregnant women. Comparing higher and lower warming scenarios, an EPA analysis found that under a lower-warming scenario, expected additional deaths from extreme heat in 2090 could be cut by half, saving over 4,500 lives and \$80 billion in damages per year compared to a higher-warming scenario.³⁶

³⁰ Climate Action Tracker, *Warming Projections Global Update*, November 2022.

https://climateactiontracker.org/documents/1094/CAT_2022-11-10_GlobalUpdate_COP27.pdf

³¹ Climate Action Tracker, *Warming Projections Global Update*, November 2022

³² IPCC, *Avoiding Regional Tipping Points by Achieving More Ambitious Global Temperature Goals*, in *Special Report: Global Warming of 1.5 °C*, 2018. <https://www.ipcc.ch/sr15/chapter/chapter-3/>

³³ Mark Carney, 2022 Volcker Lecture at National Association of Business Economists Conference, March 2022.

³⁴ Candace Vahlsing and Danny Yagan, "Quantifying Risks to the Federal Budget from Climate Change," April 2022. <https://www.whitehouse.gov/omb/briefing-room/2022/04/04/quantifying-risks-to-the-federal-budget-from-climate-change/>

³⁵ U.S. Global Change Research Program, *Human Health*. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*. <https://nca2018.globalchange.gov/chapter/14/>

³⁶ U.S. Environmental Protection Agency, "Multi-Model Framework for Quantitative Sectoral Impacts Analysis," May 2017. https://cfpub.epa.gov/si/si_public_record_Report.cfm?Lab=OAP&dirEntryId=335095

Over time, the extreme impacts of climate change are set to make large areas of the world, currently home to large populations, uninhabitable. With livelihoods and lives of over a billion people directly affected by the spread of lethal climatic conditions, there are very real prospects for significant increases in involuntary migration and conflict over increasingly scarce resources and arable land.³⁷

Government budgets will need to adjust to climate impacts

As temperatures increase and extreme weather events worsen, the costs to governments—local, state, and federal—will increase further.³⁸ Ultimately, governments bear costs that private households, businesses, and markets are unable to shoulder. That is most evident for natural disasters, with local, state, and federal governments being forced to devote an increasing share of their budgets for meeting emergency needs, financing disaster recovery, and building resilience to future disasters.

Adapting and building resilience to the changing climate can help minimize some of the worst impacts, but it will be costly. Adaptation will require a wide range of investments in infrastructure and technology to withstand higher temperatures, higher sea levels, more flooding, more droughts, and worse storms. For example, ports will need to be protected against sea level rise and increased storm surge, with total potential costs for these improvements at over \$200 billion through 2100, or \$100 million per year for the port of Los Angeles.³⁹

Addressing climate change creates major economic opportunities

To conclude, the costs to property, agriculture, and livelihoods are already high and are expected to grow materially. The potential hit to GDP growth from unmitigated climate change is expected to be significant. And many of the most severe impacts—to human health, to livelihoods, and our natural heritage—are not included in these calculations.

But there is one final risk from climate change—a negative risk—better known as an opportunity. Increasing recognition of the risks of climate change is now galvanizing global efforts to address the issue. In recent years, the number of countries committed to achieving net zero has risen from less than one third of global emissions to over 90%.⁴⁰ In response, many companies are developing net-zero transition strategies, and private financial institutions managing balance sheets representing almost 40% of private financial assets are doing the same. With climate policies, such as the U.S. Inflation Reduction Act and RePowerEU, becoming increasingly impactful, and with capital widely available to finance investments for

³⁷ IPCC, Summary for Policymakers, 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. 2022. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

³⁸ Candace Vahlsing and Danny Yagan, "Quantifying Risks to the Federal Budget from Climate Change," April 2022. <https://www.whitehouse.gov/omb/briefing-room/2022/04/04/quantifying-risks-to-the-federal-budget-from-climate-change/>

³⁹ George Van Houtven et al, "Act Now or Pay Later: the Costs of Climate Inaction for Ports and Shipping," March 2022. <https://edf.org/sites/default/files/press-releases/RTI-EDF%20Act%20Now%20or%20Pay%20Later%20Climate%20Impact%20Shipping.pdf>

⁴⁰ Climate Action Tracker, 2023. <https://climateactiontracker.org/global/cat-net-zero-target-evaluations/>

emissions reductions, both carbon efficiency and climate resilience are becoming increasingly important determinants of company and national competitiveness.

Last year, over \$1 trillion was invested in the energy transition, representing over 1% of global GDP. These investments are expected to rise significantly in the coming years⁴¹, contributing to more jobs and higher incomes. For example, the IEA estimates that multiplier effects from the clean energy investment boom will lead to 4% higher GDP by the end of this decade.⁴²

In short, while ignoring climate change will lead to significant costs, climate solutions are becoming one of the greatest commercial opportunities of our time. In seizing them, as in so many other respects, the United States remains the indispensable nation.

Thank you again for the invitation to testify. I would be pleased to answer your questions.

⁴¹ BloombergNEF, "Global Low-Carbon Energy Technology Investment Surges Past \$1 Trillion for the First Time," January 2023. <https://about.bnef.com/blog/global-low-carbon-energy-technology-investment-surges-past-1-trillion-for-the-first-time/#:~:text=London%2C%20January%2026%2C%202023%20%E2%80%93,new%20report%20from%20research%20firm>

⁴² International Energy Agency, Net Zero by 2050 A Roadmap for the Global Energy Sector, 2021. https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf

STATEMENT OF ROBERT B. LITTERMAN, PHD
CHAIR, CFTC CLIMATE-RELATED MARKET RISK SUBCOMMITTEE CONCERNING
"Climate-Related Economic Risks and Their Costs to the Federal Budget
and the Global Economy"
DELIVERED TO
UNITED STATES SENATE COMMITTEE ON THE BUDGET
FEBRUARY 15, 2023

Chairman Whitehouse, Ranking Member Grassley, and members of the Committee: Thank you for inviting me to address the economic risks associated with climate change, and the tremendous costs they may impose on Americans, American businesses, and the federal, state, and local governments.

This summer I visited Greenland with a diverse group of individuals interested in studying the melting of its icesheet. We spoke with scientists, policy experts, entrepreneurs, and local people who are predominantly Inuit. The icebergs calving from the glaciers are impressive and beautiful, but they represent the very beginning of what, sadly, will be an inevitable acceleration of sea level rise the extent of which, however, is both highly uncertain and depends critically on the actions that we take today.

Our grandchildren will likely be alive in 2100, but sadly they are underrepresented among today's electorate. In their lifetime global sea level rise is estimated to be between two feet and ten feet, depending primarily on how quickly we reduce our emissions. That sea level rise will impose huge costs on our society and government. Indeed, in 2016, Freddie Mac estimated that the economic losses from sea level rise are "likely to be greater in total than those experienced in the housing crisis and Great Recession." And that was in 2016. Projections for sea level rise have only gotten more dire since then, as scientists have learned more about the vulnerabilities of the Greenland ice sheet and several massive West Antarctic glaciers.

Before I go any further, I'd like to tell you a bit about my background, as much of my work is highly relevant to today's subject. My name is Bob Litterman. I am an economist by training and have spent my career managing financial risk. I worked at Goldman Sachs for 26 years. I was a partner and head of our firmwide risk department. I am now the chair of the risk committee at Kepos Capital, and I sit on several boards for groups that study and propose responses to climate risk, including the Climate Leadership Council, which I co-chair with Kathryn Murdoch; the Niskanen Center, which I chair, the Woodwell Climate Research Center, the University Corporate for Atmospheric Research, and the World Wildlife Fund.

In 2020, I chaired the CFTC climate-related Market Risk Subcommittee which published a unanimous and widely cited report, "Managing Climate Risk in the U.S. Financial System." It is important to note that the Subcommittee included experts from a variety of backgrounds, including agribusiness companies like Cargill and Bunge, oil and gas companies like

ConocoPhillips and BP, banks like JPMorgan Chase and Citi, and environmental organizations like The Nature Conservancy. This was no collection of wild-eyed environmental activists. This was the collective work of people with a variety of perspectives and backgrounds. Nonetheless, we came to the unambiguous conclusion that climate change poses several important risks to the American economy. As we wrote in the report:

“Climate change is expected to affect multiple sectors, geographies, and assets in the United States, sometimes simultaneously and within a relatively short timeframe. [...] Transition and physical risks—as well as climate and non-climate-related risks—could interact with each other, amplifying shocks and stresses. This raises the prospect of spillovers that could disrupt multiple parts of the financial system simultaneously. [...] A sudden revision of market perceptions about climate risk could lead to a disorderly repricing of assets, which could in turn have cascading effects on portfolios and balance sheets and therefore systemic implications for financial stability.”

The physical risks of climate change are those that stem from the disruptions it causes via rising seas, more severe storms and floods, more frequent droughts, more intense heatwaves, and more destructive wildfires. Property is destroyed. Supply chains are disrupted. Crops wither. Labor productivity declines.

The transition risks of climate change are those that stem from changes in policy, technology, and/or consumer preferences. As lower carbon technologies become cheaper, demand for fossil fuels will decline. As more and more consumers demand sustainable products, demand for fossil fuels will decline. And as governments around the world take steps to decarbonize their economies, demand for fossil fuels will decline.

This process can lead to stranded assets in carbon intensive sectors. If investors have not managed this risk, it may cascade through the economy. Central banks have estimated the losses in the energy sector at up to \$4 trillion in the energy sector, and up to \$20 trillion in the broader economy.

Some might be tempted to say, well why not simply stop trying to decarbonize if the risk of stranded assets is so large. Well first of all, the losses from the physical risks of climate change are likely to be far larger. And second, even if U.S. policymakers made no effort to reduce emissions, Europe and China and other nations will. And consumers the world over will continue to demand lower carbon products. The U.S. represents a little over four percent of the global population. We are less than a quarter of GDP. If much of the rest of the world transitions, it won't matter what U.S. policymakers do or don't do. The demand for carbon-intensive products will crater, and with it the value of carbon-intensive assets.

In our report, we extensively examined the literature around the economic costs and risks associated with climate change. We found that by the end of the century, every degree the planet warms will shave around 1.2 percentage points off of GDP. Scientists currently estimate that we are on track for somewhere between 2.2 and 3.4 degrees of warming by 2100, which would result in GDP losses of somewhere between 2.6 and 4 percent. That's more than our recent annual growth rate, implying the possibility of long-term negative growth as climate change worsens.

In the agricultural sector, we found that climate change is likely to significantly reduce crop yields, decrease labor productivity, degrade soil and water quality, increase the range and virulence of pests, and disrupt supply chains.

Climate change will also impose large costs on companies and governments by degrading infrastructure. One example the CFTC report highlighted was the case of Pacific Gas and Electric in California, which entered bankruptcy because of \$30 billion in liability associated with its infrastructure sparking record wildfires. Meanwhile, the effects of climate change loom even larger in the future. Losses from billion-dollar extreme weather events totaled \$165 billion last year and while it varies from year to year, it is clearly growing rapidly over time.

Extreme weather events are becoming more common as the atmosphere warms. Terms such as the 100-year flood are used to describe the magnitude of an event that has happened historically on average once every 100 years. That happens to be an important frequency. We build infrastructure to withstand events that happen on a regular basis, and so the damage created by weather that happens every so often is small, but when the magnitude is a 100-year event, it typically leads to complete destruction of property.

The problem is that today such a term continues to describe the magnitude of extreme weather events, but the frequency of their occurrence today tends to be much higher. 100-year floods may happen every 5 or 10 years today because of the changing climate.

Insurance markets are critical to diversify these risks and to create appropriate incentives for individuals, companies, and communities to prepare for extreme weather by building hardened infrastructure and buildings, or to move to locations with less exposure to climate-related risks. But insurance markets are not working properly because historical loss experience is no longer relevant for predicting future losses.

Different regions will be affected by different hazards and abilities to adapt and mitigate damages. Declining real estate values — driven by climate-related impacts or the perception of such impacts in the future — could substantially depress regional economic activity. Some populations and local communities within the United States may ultimately be required to relocate, with potentially significant economic losses for households and investors.

What's more, we found that a decline in real estate values can have larger implications for the U.S. economy and financial sector. For most U.S. households, housing constitutes the largest share of household wealth, and substantial evidence suggests that household spending varies with housing wealth. In addition, because most residential real estate is purchased with a mortgage, declines in mortgage values could affect financial market participants, including banks that hold these mortgages on their balance sheets, investors in mortgage-backed securities, and government-sponsored enterprises (GSEs), primarily Fannie Mae and Freddie Mac, which guarantee the default risk of the mortgages they securitize. Emerging evidence suggests that lenders are passing along riskier mortgages to the GSEs, in part, to remove risk from their own books. The federal guarantee of the GSEs suggests that U.S. taxpayers may ultimately be on the hook for prepayment and default risks associated with the impacts of physical risks on collateral values.

Climate change will also likely inflict large costs on human health, and by extension, significantly reduce labor productivity in certain sectors. Estimates of the annual monetized damages from premature deaths due to extreme heat in 2090 range from \$60 to \$140 billion. Lost labor hours could reach six percent in parts of Florida and Texas.

There are also a number of risks related to crossing a tipping point. A tipping point is a nonlinearity in the response of a system. There are a number of worrying potential tipping points in the climactic system. For example, the warming of permafrost may melt frozen landscapes allowing significant additional quantities of greenhouse gases to enter the atmosphere and accelerate the warming. More worrying still, recent scientific research suggests that we may cross several of these tipping points with even only 1.5 degrees of warming, and may cross several additional ones with 2 degrees of warming.

While the subject of this hearing is the economic risks and costs associated with climate change, I would be remiss if I did not mention one last thing. All of the research and analysis on this subject agrees that the sooner we act to reduce emissions, the fewer costs and risks we incur. In addition, it appears that transitioning to a low carbon economy will actually result in substantial economic growth.

I have lots of ideas on this subject, but the bottom line is that with global average temperatures already having risen over 1 degree C, and with potentially catastrophic tipping points on the horizon, risk management demands an immediate ambitious response, including globally harmonized incentives to reduce carbon emissions. There are steps that this Congress can take to move this process forward and I would welcome the opportunity to discuss the policies you might pursue to help de-risk the economy and ensure that prices reflect the costs associated with production of goods.

Thank you kindly for the invitation to testify today. I hope that this testimony has helped shed some light on the under-appreciated fact that climate change is not just an environmental problem, it is an economic and financial one as well. Because of the nature of climate risks, time is not on our side. There are real costs to waiting. While many of the individual risks from climate change can be managed well by companies, individuals, and governments, the systemic nature of climate risk means we should be doing much more to price it and reduce greenhouse gas emissions.

I and my colleagues at the Climate Leadership Council, the Niskanen Center, and others stand ready to help you deliberate on these policies and do what is best for Americans and the future. Thank you for your attention and I look forward to answering any inquiries you may have.

Appendix:

[CFTC Report of the Climate-Related Market Risk Subcommittee.](#)

[“Managing Climate Risk in the U.S. Financial System”](#)

Climate-related Economic Risks
and Their Costs to the Federal Budget and the Global Economy

Testimony to the U.S. Senate, Committee on the Budget

Douglas Holtz-Eakin
President, American Action Forum'

February 15, 2023

'The views expressed here are my own and do not represent the position of the American Action Forum. I thank Gordon Gray, Sarah Hale, and Angela Kuck for their assistance. Chairman Whitehouse, Ranking Member Grassley, and members of the Committee, thank you for the privilege of appearing today. In this short testimony, I want to make three key points:

- Climate change will increase future budget deficits, largely through reduced economic growth and tax revenues;

- The existing (baseline) budget outlook is profoundly anti-growth and represents a larger economic risk than climate change; and
- Addressing the budget outlook will make more manageable budgeting mitigation and adaptation policies that will feature large, up-front federal outlays.

Let me discuss each in turn.

Budget Impacts of Climate Change

Climate change will likely produce higher average temperatures, rising sea levels, and increasing extreme weather events. There will be some dramatic changes in particular regions and industries, and these will be reflected in dramatic changes in the financial structures backing those real economic activities.¹

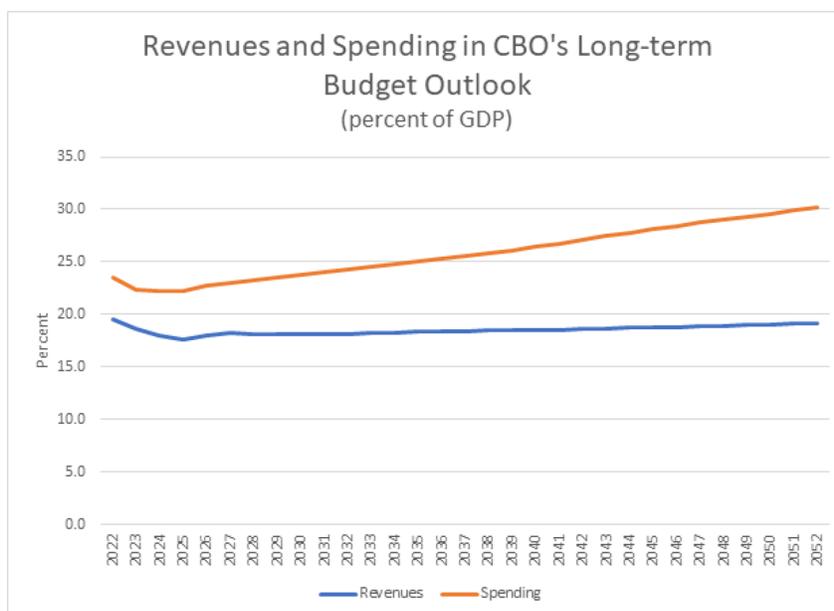
But from an aggregate macroeconomic and federal budgetary perspective, the impact of climate change will be to damage and reduce the value of agricultural land, infrastructure, and capital assets, as well as reduce the ability to supply labor. This will show up as lower measured economic activity and reduced collections of income taxes, payroll taxes, excise taxes, and other revenues. There will be impacts on the spending side of the budget, as well from the additional stresses climate change places on mandatory programs (e.g., the National Flood Insurance Program), and as Congress chooses to allocate additional discretionary resources.

In its recent survey, the Congressional Budget Office (CBO) concluded: “Drawing on studies that examine the historical relationship between regional output and regional temperature and precipitation, along with projections of future conditions, CBO has projected that, on net, climate change will lower the level of real (inflation-adjusted) gross domestic product (GDP) in 2051 by 1 percent from what it would have been if climatic conditions from 2021 to 2051 were the same as they were at the end of the 20th century. That figure is a central projection in a wide range of possible outcomes and does not reflect every channel by which climate change can affect GDP.”

To put this in perspective, a 1 percentage point decline in real GDP in 2051 is the equivalent of an annual growth rate in GDP that is lower by 0.034 percentage points. From a macro, aggregate perspective, the economic consequences of climate change over the next 30 years do not appear daunting.

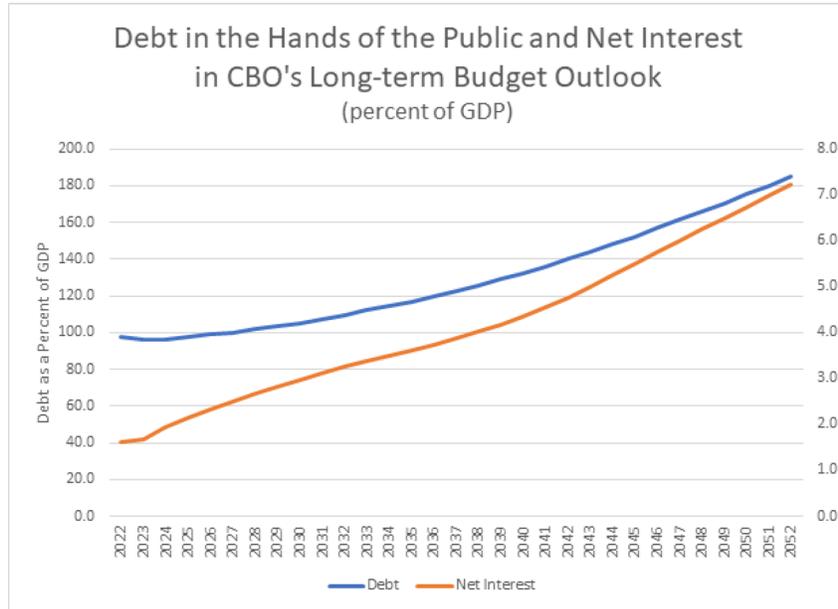
The Economic Risks of the Budget Outlook

The same cannot be said for the economic consequences of the federal budget outlook. The chart (below) replicates the spending and revenues (as a percent of GDP) contained in the CBO's most recent *Long-Term Budget Outlook*. The key feature is that spending rises much faster than revenues, leading to rising deficits.



This manifests as rising debt in the hands of the public (graph below, left scale) and rising net interest costs (right scale) as time passes. Clearly, debt rising toward 200 percent of GDP, and net interest rising toward 8 percent of GDP, is ultimately unsustainable. Eventually the inability of the federal government to exercise effective governance over its borrowing needs will shake faith of capital markets and a sovereign debt crisis will ensue.

While mechanically correct, this scenario is not the most likely or most threatening. The economic damage of fiscal irresponsibility is likely large and much more immediate. A relatively large literature stemming from the research of Carmen Reinhart and Kenneth Rogoff indicates that when gross government debt (as a percent of GDP) gets large enough (in their work, exceeds 90 percent) median growth is roughly 1 percentage point lower annually than for comparable countries with lower debt burdens.² With its large federal gross debt, the United States is likely already paying a growth penalty and, even if not fully 1 percentage point annually, this dwarfs the economic threat posed by climate change.



The Mechanisms of Slower Growth

What channels produce slower growth? The key insight is that debt is issued to allow the federal government to attract capital away from the private sector. In its recent review of the impact of infrastructure spending on the economy, CBO noted that an additional dollar's worth of private fixed capital increases real potential GDP by 9.8 cents (net of depreciation), while for public capital the net effect is an increase of 9.2 cents. So, if the debt shifts spending from private to public capital, the overall effect is a loss in productivity and growth.

But that is the best-case scenario. The vast majority of deficit-financed spending is for programs (e.g., Social Security and Medicare) that subsidize consumption and not public investment. In this case, the productivity effect is zero and the loss is the full 9.8 cents per dollar of borrowing.

Of note, the same losses in productivity would occur if the dollars were shifted from private investment to the federal budget using tax policy. Hence, any strategy for reducing deficits and debt that relies significantly on tax increases will do little to improve economic performance.

For this reason, the essence of a better strategy to address the fiscal future is to pair entitlement reform with tax reform, thereby controlling the underlying source of debt explosion and supporting the most rapid pace of economic growth possible.

Addressing the Outlook Makes Budgeting Climate Change Policies More Manageable

The key aspect of federal policies to mitigate greenhouse gas emissions or adapt to climate change is that they require large, up-front federal spending (or tax credits or regulation). Especially given the abject nature of the federal fiscal outlook, the outlays needed for pathways to net-zero emissions in the next 10–15 years are impossibly expensive.

For example, the American Action Forum published research on how much it would cost to get to 100 percent renewable power over 10 years. That study found that merely installing the required renewable capacity — in the form of solar, wind, hydroelectric, and storage — would cost \$5.7 trillion.³ The assumptions under which these costs were calculated were very optimistic and other studies have found a need for investment of a comparable magnitude. It is not obvious how much of this investment would be on the federal budget, but the existing budgetary woes would hamstring any serious effort at mitigating and adapting to climate change.

This is one example of a more general problem. Given that mandatory spending constitutes 70 percent of the federal budget, there is no room for significant additional discretionary outlays — precisely the type of spending where the federal government can finance infrastructure, education, national security, and other investments in the nation's future.

Thank you and I look forward to your questions.

Questions for the Record
from Senator Murray
for Dr. Mark Carney
“Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global
Economy”
February 15, 2023
Senate Budget Committee

From Senator Murray: *Notwithstanding the merits of an economy-wide price on carbon, what are the ways the United States should respond to the world’s largest trading bloc, the European Union, implementing its tariff regime for a carbon border adjustment? Washington state is one of the most trade dependent states in the nation, and there’s bipartisan agreement that we need to ensure our businesses continue to have access to mature and expanding foreign markets.*

As noted in a Group of 30 [study](#) which I co-authored, a carbon price is one example of credible and predictable public policy that can smooth and pull forward the transition to a net-zero economy.¹ Measures to price carbon emissions can provide important incentives to drive emissions reductions using a market-based approach. I continue to believe that some form of carbon pricing would be a worthwhile tool for the United States to consider. That said, U.S. policy to incentivize the low-carbon transition—namely through the IRA—could provide an alternative policy approach to carbon pricing and is already driving emissions reductions.

Trade policy should reflect the principle that countries should not be trade-advantaged by doing less to reduce emissions. Following this principle, carbon border adjustments should be designed to reflect either the relative carbon emissions reduction efforts between countries or the relative carbon intensity of goods being traded, regardless of national policies. If the former, a carbon border adjustment should recognize equivalence between explicit carbon prices and “shadow prices of carbon” that reflect regulation, subsidies, and other policy support for emissions reductions. There may be issues with methodologies for determining equivalence as they are being developed, as well as applicability under WTO rules, but the U.S. should continue to engage in and support efforts underway (e.g. through the G7) to recognize and determine the equivalency between carbon pricing and non-pricing measures.

¹ Group of 30, [Mainstreaming the Transition to a Net-Zero Economy](#), October 2020.

Questions for the Record
from Senator Ron Wyden
for Dr. Mark Carney

“Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global
Economy”

February 15, 2023
Senate Budget Committee

From Senator Wyden: *Last year, Congress passed, and the President signed, the largest climate tax law in the history of the world. Over two-thirds of the climate investments in the Inflation Reduction Act were climate tax provisions that my colleagues and I on the Finance Committee developed with a focus on building domestic supply chains.*

Mr. Carney, in your testimony, you mention that with the IRA and RePowerEU, “both carbon efficiency and climate resilience are becoming increasingly important determinants of company and national competitiveness.” What are some of the opportunities for growth as the world transitions to a new clean economy and what impact do national investments like the IRA have in catalyzing change across industries?

Achieving an orderly transition to net zero will require significant investment across the economy, which can help drive job creation and economic growth. Although estimates vary, based on different potential pathways to net zero, across all major scenarios energy sector investment must grow significantly over the coming decades—with most of that growth in the renewable power generation and infrastructure needed for the energy transition—as must investment in the major sectors that use energy.² For example, the International Energy Agency’s Net-Zero Energy scenario implies annual global renewables investment of \$1.3 billion by 2030, which is slightly more than the highest-ever annual investment in fossil fuel supply.³ As I noted in my testimony, this investment is likely to have GDP multipliers greater than 1 (meaning that investment spurs additional economic growth) and, importantly, multipliers that are about double those of fossil fuel investment.⁴ So, public investment and incentives to spur private investment in the energy transition are likely to support robust economic growth. This is also supported by the projected and realized employment benefits of the IRA, with over 100,000 new clean energy jobs announced in just the first six months after the law passed.⁵

² BloombergNEF, “[Counting Cash in Paris Aligned Pathways](#)”, May 2022

³ IEA, [Net Zero by 2050 - A Roadmap for the Global Energy Sector](#), October 2021

⁴ Nicoletta Batini et al, “[Building Back Better: How Big are Green Spending Multipliers?](#)”, IMF Working Paper, 2021.

⁵ Rachel Frazin, “[100K clean energy jobs announced since climate bill became law: analysis](#).” *The Hill*, February 2023. For estimates, see, e.g.: Robert Pollin et al, “[Job Creation Estimates Through Proposed](#)

Incentives and public investment are necessary in the energy transition both because of the time frame in which science requires emissions to fall (which is more rapid than markets would facilitate on their own), and because of the challenges of matching energy supply and demand during the transition. The IRA helps pull forward investment in the transition, and equally importantly provides incentives for investment across renewable energy supply growth, energy infrastructure improvements, and accelerating the adoption of technologies on the demand side, such as electric vehicles (EV). These demand-side incentives will help make clean energy and the technologies that run on it more cost-competitive for American households and businesses, including through incentives for industrial emissions reductions. Every major emitting company across the economy will chart its own course to emissions reductions over time, and the IRA helps incentivize a wide range of investments that, combined, reflect the economic change necessary over the coming decades.

There can be significant additional economic advantages associated with innovation and leadership in emerging industries. To support growth in the supply of clean energy technologies, the IRA provides incentives for domestic manufacturing of these technologies, including both more established technologies and those that have yet to see adoption at scale, which will incentivize manufacturers to locate production facilities in the United States. In addition to boosting American manufacturing and jobs, these incentives also help diversify and localize the supply chains for key technologies, helping to mitigate current concentration risks. For example, the IRA is projected to support the growth and relative competitiveness of the domestic EV and battery storage supply chains, with \$28 billion in investment already committed as of December 2022, including the shifting of planned manufacturing plants from other countries to the United States.⁶ Incentives will likely make U.S.-produced solar and wind modules among the cheapest in the world, and will help U.S.-produced green hydrogen, a relatively new technology, to be among the most cost-competitive in the world.⁷

[Inflation Reduction Act](#)", University of Massachusetts Amherst Political Economy Research Institute, August 2022. Ashna Aggarwal et al, "[The Economic Tides Just Turned for States](#)," RMI, February 2023.

⁶ Yayoi Sekine, "[Top 10 Energy Storage Trends in 2023](#)", January 2023, BloombergNEF.

⁷ Credit Suisse, "[US Inflation Reduction Act: A catalyst for climate action](#)," November 2022.

Questions for the Record
From Ranking Member Charles Grassley
For Dr. Robert Litterman
Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global
Economy
February 15, 2023
Senate Budget Committee

Question #1: During the hearing, I expressed my concern that federally imposed environment, social, and governance (ESG) efforts, such as the Biden Administration’s proposed Securities and Exchange Commission climate disclosure rule, would force banks to compel farmers to disclose their respective carbon footprints. Even the most experienced farmers would not know how to begin to do so. You responded, “It’s not an issue of reporting what your carbon footprint is. We all have to be aware of what the carbon flux out of the atmosphere into the ground is.” Moments later, you stated, “We have to measure the carbon.” So, how do you expect to calculate agricultural greenhouse gas emissions and where do farmers fall into your ideal federal emissions reporting scenario? Would farmers and ranchers be expected to track individual livestock emissions and each gallon of diesel or gasoline they use?

Answer: I agree with you that individual farmers, particularly small farmers, should not have the burden of ESG reporting pushed down on them, and, let me assure you I do not expect the forthcoming SEC guidance to require carbon emissions disclosures by farmers. And if there ever becomes an exposure reporting requirement, there will no doubt be an income threshold below which it will be exempted.

Of course, some large agribusinesses with material climate-related risk exposures may already be calculating emissions and the technologies for doing so will no doubt become more accurate and inexpensive over time.

As the climate changes, farmers, ranchers, and foresters are concerned about the increasing threat of physical hazards, such as drought, flooding, and wildfires. As such, many have been early adopters of innovative sustainable land management practices that simultaneously protect against physical hazards and help mitigate climate change. We should encourage such positive actions.

The next Farm Bill will provide an opportunity to further develop natural climate solutions. Woodwell Climate Research Center, on whose board I sit, has [many suggestions for climate-smart agriculture](#).

I also pass on for your consideration [the following priorities for the next Farm Bill](#) suggested by the Woodwell Center.

1. **Ensure Carbon Markets are Credible**

Carbon markets can provide financial benefits to producers while supplying

environmental benefits to all Americans, such as increasing biodiversity and reducing greenhouse gas (GHG) emissions.

2. **Utilize the Conservation and Forestry Titles for Climate Solutions**

The Conservation and Forestry titles of the Farm Bill should encourage natural climate solutions.

3. **Reduce Wildfire Risk**

Fuel reduction by thinning can reduce the risk of wildfire ignition.

4. **Increase Eligibility and Usage of Crop Insurance**

While the majority of U.S. cropland is insured, only about 19% of farms hold crop insurance.

5. **Increase Research Capacity**

Funding should increase for USDA's climate hubs and land-grant universities, which can study regional variability for land management practices.

Woodwell Center also notes that, "The Growing Climate Solutions Act (GSCA) is an excellent start for creating carbon markets for farms across the country. The GSCA was included in the 2023 omnibus spending package and the concepts there can be carried forward in the next Farm Bill."

Question #2: Thanks to technology and innovation in farming, agricultural greenhouse gas emissions per unit of food, fiber, or energy produced have declined by approximately 24% since 1990. If government is going to impose costly new mandates, rules, and regulations on American farmers to reduce greenhouse emissions then they should be fairly compensated. Assuming you have a way to measure the relative carbon emissions or sequestration from different farming practices, how do you give credit to a farmer changing to a practice that results in less carbon emitted or more sequestered while being fair to farmers that were already using that practice before you started measuring?

Answer: You are correct to raise the concern that farmers which have been practicing climate-smart agriculture this whole time shouldn't miss out. According to a study by the Soil Health Institute, which conducted an analysis of 100 regenerative farmers, more than 85% were already more profitable than traditional farms, even excluding any government incentives. Nonetheless, I strongly agree that farmers should be rewarded for pulling carbon dioxide out of the atmosphere and I support policies that are designed to achieve that goal. Many agencies, private sector initiatives, and farmers using innovative technologies, are already implementing strong GHG monitoring programs. Some guidelines for what this might look like in the future are provided in this [workshop report](#).

Questions for the Record
From Senator Patty Murray
For Dr. Robert Litterman
Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global
Economy
February 15, 2023
Senate Budget Committee

Question #1: Notwithstanding the merits of an economy-wide price on carbon, what are the ways the United States should respond to the world's largest trading bloc, the European Union, implementing its tariff regime for a carbon border adjustment? Washington state is one of the most trade dependent states in the nation, and there's bipartisan agreement that we need to ensure our businesses continue to have access to mature and expanding foreign markets.

Answer: There are enormous opportunities for the U.S. and EU to cooperate on climate and trade policies like a border carbon adjustment (BCA) or carbon border adjustment mechanism (CBAM) to the benefit of the economies of both jurisdictions and the global climate. Analysis from the Climate Leadership Council has shown that both the U.S. and EU have more carbon efficient economies relative to the world average.¹ Across industrial sectors, both the U.S. and EU emit less carbon per dollar of value than other major economies. A trade partnership by the U.S. and EU establishing common border carbon adjustments, assessing a fee based on the carbon intensity of imports, would see more efficient businesses in both jurisdictions gain a competitive advantage over higher emitting foreign competitors, and an incentive to lower emissions for businesses exporting to either jurisdiction. The single best way the U.S. can move forward towards this end is by Congress passing an economy wide carbon price with a border adjustment. Short of that, Congress could explore passing a new law establishing carbon fees on imports and directing the executive branch to negotiate trade agreements with other countries to form a climate alliance or carbon club. It is worth noting that in November 2021, the Biden Administration announced a negotiation with the E.U. to establish a new trade arrangement based in part on the carbon intensity of traded steel and aluminum². That negotiation is scheduled to be complete by October 2023. Ultimately, international cooperation on border adjustments as described above can result in more global demand for U.S. goods made with less carbon emissions—from Washington State and elsewhere in our country—while establishing incentives for lower global emissions.

¹ Catrina Rorke and Greg Bertelsen, [America's Carbon Advantage](#), Climate Leadership Council, September 2020.

² <https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/31/fact-sheet-the-united-states-and-european-union-to-negotiate-worlds-first-carbon-based-sectoral-arrangement-on-steel-and-aluminum-trade/>

Questions for the Record
From Senator Ron Wyden
For Dr. Robert Litterman
Hearing on “Climate-Related Economic Risks and Their Costs to the Federal Budget and the
Global Economy”
February 15, 2023
Senate Budget Committee

Question #1: Extreme weather events have become ever more frequent as a result of climate change. Oregon, like other Western states, has been hit hard with historic heat waves, droughts, and wildfires devastating homes and businesses.

Mr. Litterman, in your testimony you describe that climate-related impacts can have an impact on the U.S. real estate and housing markets. How do extreme weather events and other climate risks impact the housing market, and current and would-be homeowners, in a state like Oregon? Is there a need for additional support for affordable housing to recover from such events?

Answer: You raise two very important concerns, about the impact of climate change on real estate values, and the need to prepare for recovery from extreme-weather events.

The academic literature on climate-related impacts on financial markets was recently reviewed [here](#), with the focus on real estate is in Section 3.2. The central finding is that expectations of increasing climate-related extreme-weather impacts do reduce real estate valuations. This academic literature is rapidly expanding. A recent study published in Nature Climate Change, “[Unpriced climate risk and the potential consequences of overvaluation in the US housing markets](#),” for example, estimates that houses in areas that are vulnerable to flooding are overvalued by \$121-\$237 billion. According to the research, several factors exacerbate the mispricing of real estate. These include federal flood maps that do not reflect the changing climate, government subsidies in flood-prone areas, and buyers who are unaware of the dangers.

With respect to your second question about the need for additional support, I hesitate to express an opinion on the readiness of local, state, and federal authorities to respond to climate-related extreme weather events in Oregon. But what is true everywhere is that communities which are prepared ahead of time will suffer less damage from increasing climate-related events. Historical frequencies of extreme weather events are no long representative of what can be expected. Thus, there is a critical need for model-based advanced warning of the changing weather hazards. It is also important that insurance markets accurately reflect these changing risk profiles, and thus provide appropriate incentives for existing homeowners to prepare for the changing weather, and for new construction to be located in secure locations.

Question for the Record
from Senator Murray
for Dr. Holtz- Eakin
“Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global
Economy”
February 15, 2023
Senate Budget Committee

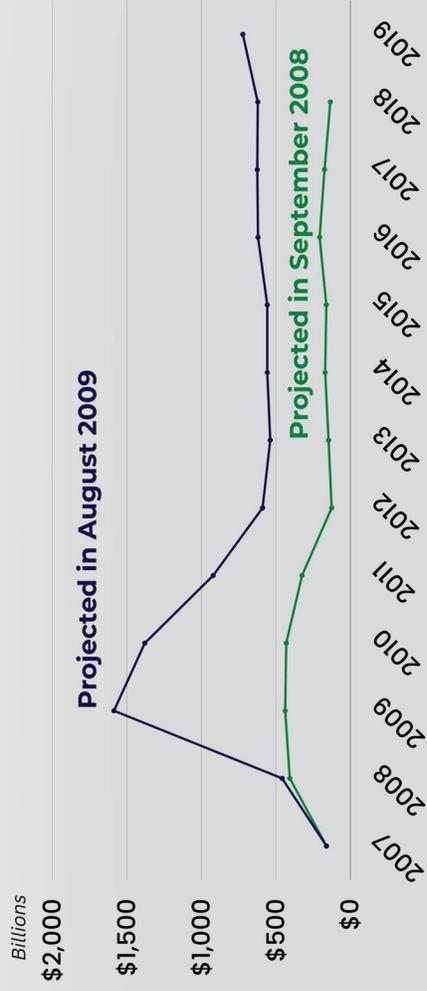
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Answer:

Aspects of the EU’s CBAM are likely not WTO compliant (see Tori Smith’s [paper](#)) and the US should be an active participant in ensuring any CBAMs (at home or abroad) are applied in accordance with international agreements. Step one would be to enter into consultations with the EU to resolve the suspected problems. If that is unsuccessful, the WTO’s dispute settlement system has processes for resolving disputes in mediation or through formally filing dispute cases. These actions could be taken alone by the US or with a collection of impacted member countries. The US position in these cases would be strengthened if it allowed new judges to be appointed to the appellate body.

Deficits Tripled as a Result of 2008 Shock

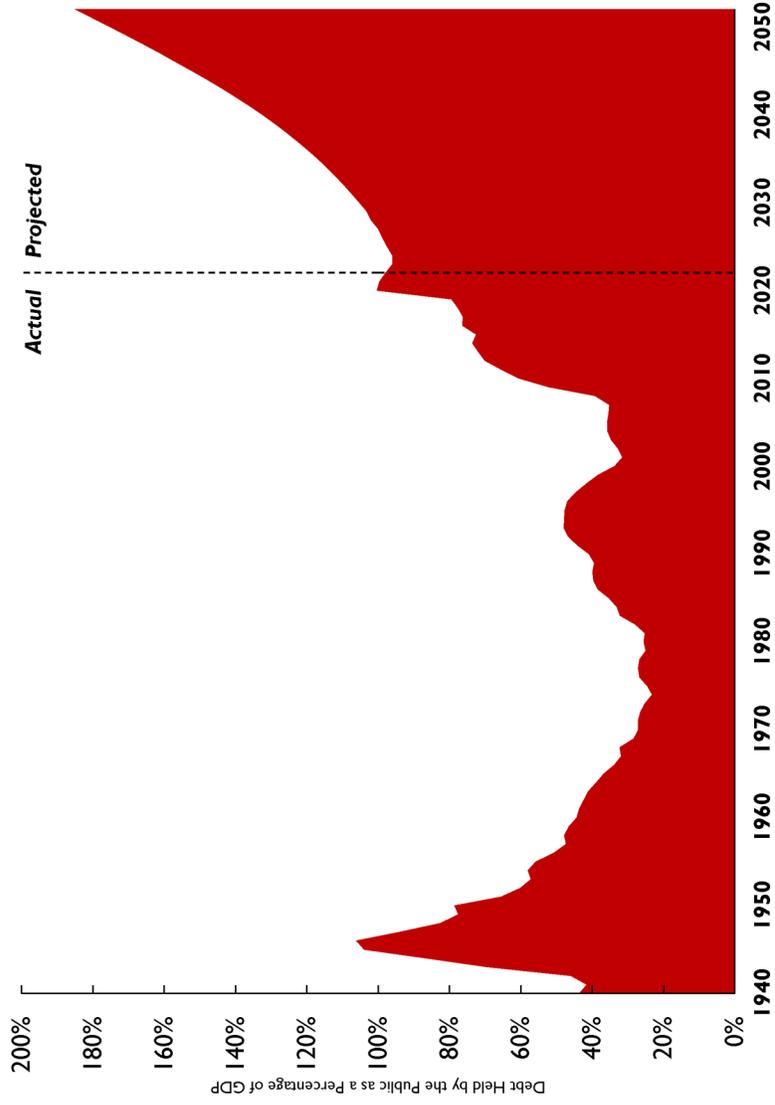


Source: Congressional Budget Office, "Budget and Economic Outlook"

FY 2023's Road to the Omnibus

President's Budget Submitted On Time?	No	
Budget Resolution?	No	65
Bills Considered by Senate Appropriations Committee?	0	
Continuing Resolutions Required?	3	
Omnibus Cost?	\$1.7 Trillion	

CBO Shows Debt on an Unustainable Path



Source: CBO's 2022 Long-Term Budget Outlook