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# 21ST CENTURY COMMUNITIES: CLIMATE CHANGE, RESILIENCE, AND REINSURANCE

## HEARING

BEFORE THE

## COMMITTEE ON BANKING, HOUSING, AND URBAN AFFAIRS UNITED STATES SENATE

ONE HUNDRED SEVENTEENTH CONGRESS

FIRST SESSION

ON

EXAMINING THE WAYS CLIMATE CHANGE PUTS THE AMERICAN ECONOMY AND AMERICAN COMMUNITIES AT RISK

JULY 20, 2021

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# C O N T E N T S

**TUESDAY, JULY 20, 2021**



**WITNESSES**



ADDITIONAL MATERIAL SUPPLIED FOR THE RECORD

# 21ST CENTURY COMMUNITIES: CLIMATE CHANGE, RESILIENCE, AND REINSURANCE

**TUESDAY, JULY 20, 2021**

U.S. SENATE,
COMMITTEE ON BANKING, HOUSING, AND URBAN AFFAIRS,
*Washington, DC.*

The Committee met at 10:02 a.m., via Webex and in room 538, Dirksen Senate Office Building, Hon. Sherrod Brown, Chairman of the Committee, presiding.

## OPENING STATEMENT OF CHAIRMAN SHERROD BROWN

Chairman BROWN. The Senate Banking, Housing, and Urban Affairs Committee will come to order. This hearing is in the hybrid format. Our Members are in person but we will have witnesses testifying both in person—two of them are here—and by video—three of them are elsewhere.

For those joining remotely, a few reminders. Once you start speaking there will be a slight delay before you are displayed on the screen. To minimize background noise please click the Mute button until it is your turn to speak or ask questions. You should all have one box on your screens labeled "Clock" that will show how much time is remaining. For those of you joining virtually you will hear a bell ring when you have 30 seconds remaining and then again when your time has expired.

If there is a technology issue we will move to the next witness until we can resolve it.

As we are, the Members and two of the witnesses, here in person, our speaking order will be as is traditional, that is by seniority of the Members here when the gavel came down at 10 o'clock, then by seniority of Members arriving later, alternating between Democrats and Republicans.

This morning the Banking and Housing Committee again looks at the ways climate change puts the American economy and American communities at risk. Earlier, we examined the ways big banks' focus on short-term profit, while ignoring long-term climate risk, puts homes and businesses and the overall health of the American economy at risk.

In April, we looked at all the opportunities for American workers and the benefits to the entire economy from investment in new, 21st century energy.

Today's hearing will look at what cities and towns and businesses of all sizes can do to protect our infrastructure, including homes and transit systems, that are at risk from climate change.

This Committee must do all we can to help our communities protect themselves and reduce the risk to taxpayers from climate disasters.

We will hear from witnesses about cost-effective measures to ensure the infrastructure we rely on—from bridges to major highways, from water treatment plants to neighborhoods and office buildings—to ensure they can withstand more frequent extreme weather events.

Pretty much every month we see another climate change-fueled catastrophe, from the wildfires ravaging the western United States to the increasingly common coastal and river flooding.

Historic heat melts streetcar cables in Portland, Oregon. Another polar vortex hits a woefully unprepared Texas and disables natural gas lines and the electrical grid. Last month, tropical storms that would have been unprecedented not too long ago devastated roads, and flooded homes through Ranking Member Toomey's Delaware and Chester Counties in the southeast part of his State.

Last year, remnants of Tropical Storm Isaias hit the same area outside Philadelphia, floating large shipping containers and crashing them into a local bridge, flooding roads and homes, and shutting down service on SEPTA, one of America's great and largest transit systems.

My State of Ohio is not immune. Recent landslides in Cincinnati closed heavily traveled highways and cut the value of some Ohioans' homes in half. The disaster resulted from the combination of the clay in that part of the country, and rainfall that has been more than 16 percent heavier than historical averages.

Water levels and temperatures in Lake Erie are higher than they have ever been, and are on a steady two-decade rise. This affects power plant operation, contributes to flooding of homes, businesses, and farmland, and feeds harmful algae blooms, jeopardizing the water supply for more than a million people.

All of these disasters affect the economy. They mean supply chain interruptions and power outages and damage to buildings and raw materials and transportation networks. It is just common sense—when disaster strikes the infrastructure our economy relies on, our economy gets interrupted, over and over and over again.

It is the American people who pay. They pay in higher utility bills and higher prices, more tax dollars shelled out to afford repairs, and lost jobs and homes and opportunity.

Our competitors around the world are taking this seriously. China plans to invest more than $2.5 trillion in more resilient, integrated transportation, energy, and information technology infrastructure by 2025, including 16 new Ultra High Voltage transmission routes to connect renewable generation in the countryside to the booming demand in its cities. That is all on top of their Government-funded clean energy R&D, where they invest more than the U.S., Japan, and India combined.

Every time business grinds to a halt because an American factory was not built to withstand extreme heat, or because a road is blocked by landslides, or because a power grid is shut down, that is another opportunity for China and other foreign competitors to get ahead.

Investment we can make now to shore up our infrastructure will both create jobs at home—jobs that cannot be outsourced—and make our industries more competitive. And all the investments we make today will save taxpayers money in the future. It is a lot cheaper to build a stronger bridge now than to repair it every other year.

This Committee oversees the stability of the economy, the homes Americans live in, and the transit systems that get people to work. It is our job to look at the risks that infrastructure faces, both the source of that risk, and the steps we must take to plan for it and prevent it. As we look at record high temperatures around the world, we should be worried that our grandchildren may look back at these days as "the good old days."

We cannot continue on this path. Now is the time to tackle this problem, to protect our vital infrastructure and American competitiveness.

I hope my colleagues will listen to today's testimony with the understanding that the health of our economy and the lives of our fellow Americans may very well depend on it.

Ranking Member Toomey.

**OPENING STATEMENT OF SENATOR PATRICK J. TOOMEY**

Senator TOOMEY. Thank you, Mr. Chairman. Today, the Committee will discuss climate-related risks, including the ways in which the insurance and reinsurance industries are evolving and adapting in response. This hearing is meant to be about reinsurance, though apparently we will also hear proposals for massive new Federal infrastructure spending based in part on misleading claims regarding climate-related risks. To the extent that policy proposals are based on misrepresentations or misunderstandings of the actual science, they could lead to very bad results.

Now at the outset, let me acknowledge that global warming is real. However, we must also recognize at least three important points. First, there is actual significant debate within the scientific community about global warming's impact on man and the economy. Second, direct economic damages associated with extreme weather events have actually decreased both globally and in the United States when measured against GDP. And third, insurance and reinsurance companies, whose very existence depends upon the presence of uncertain risks, have always adjusted to changing risks, and climate-related risks are no exception

In March, all 12 Republicans on this Committee sent a letter to Fed Chairman Jay Powell expressing concern that financial regulators were seeking to impose costly new rules based on highly uncertain climate models. Unfortunately, proposals to assess climate-related risks to financial institutions are too often based on outdated scenarios and unrealistic assumptions.

Even the Financial Stability Board acknowledges the massive uncertainty. They just issued a report earlier this month stating that, and I quote, "financial institutions' exposures to climate-related risks are generally subject to greater uncertainty than those relating to other financial risks," end quote. The report notes that this uncertainty derives from the difficulty in modeling such risks and a lack of reliable historical data.

Despite substantial modeling and data limitations, President Biden recently issued an unjustified Executive order directing financial regulators to consider integrating climate-related risks into supervision and regulation.

But good policy rests on a foundation of good science. As one recent publication in the leading science journal *Nature* stated, calls to integrate climate science into risk disclosure and economic decisionmaking, quote, "has leap-frogged the current capabilities of climate science and climate models by at least a decade," end quote.

Despite the great deal of uncertainty regarding climate-related risks, many in the media and politics assert that the frequency and severity of extreme weather events are increasing as a result of climate change. This assertion misrepresents the data, including assessments by the IPCC, the organization widely considered to be the world's leading climate authority.

The reality is that leading climate scientists do not agree on whether or not, or to what extent, climate change is causing an increase in the frequency or severity of weather events. There can be no debate, however, that economic damage from such events is shrinking as a portion of our economy, as one of today's witnesses, Dr. Roger Pielke, will explain in greater detail. And that decrease in economic damage is occurring is despite the tremendous amount of development in exposed areas.

Further, the overwhelming reason for increased disaster losses, in absolute terms, is that locations exposed to loss have grown in wealth and population, not that global warming has increased the frequency or severity of extreme weather events.

Behind the drive to impose climate-related regulations on financial institutions is a fatal conceit of progressivism, and that is that bureaucrats know the risks to business better than the businesses itself. But as we will hear from one of today's witnesses, insurance industry expert Jerry Theodorou, it actually has occurred to financial institutions that potential climate-related risks might affect their operations, and they have been responding accordingly.

Perhaps no industry has done more to adapt and evolve than insurance and reinsurance. Among other things, large property/casualty insurance companies covering about 70 percent of the U.S. market have been reporting climate risks for over 10 years. They have modified their underwriting practices and they have diversified their investment portfolios.

In addition, insurance policies and products are generally short term and are repriced annually or withdrawn as conditions change. Nevertheless, property/casualty insurance is readily available across the United States. Increased risk is not itself a prohibitive problem for insurance or reinsurance because their business models depend upon accurately pricing risk, at whatever level it occurs.

Regulators must avoid the temptation to think that they are smarter than the market. Assessing and pricing risk is the core competency of insurance companies, and they will apply hundreds of years of experience as risks evolve.

And when was the last time any major insurer or financial institution failed as a result of extreme weather, or any time an insurance company failed to pay a policy claim because of extreme weather?

Finally, I would like to note that States, not the Federal Government, have been the primary regulators of insurance for the past 150 years. Congress explicitly endorsed this State-based regulatory approach with the McCarran-Ferguson Act.

State-based regulation has worked and it has worked well for both the insurance industry and, of course, more importantly, for the consumers it serves. It would be profoundly misguided for the Biden administration to throw the State-based insurance regulatory regime out in pursuit of its climate agenda.

Let me conclude where I began: global warming is real, and it likely will present new risks. However, we simply have too little understanding of the near-term effects climate change will have on any particular place to justify imposing huge new regulatory costs on the consumers who would ultimately have to pay for them.

Thank you, Mr. Chairman.

Chairman BROWN. Thank you, Senator Toomey.

We will hear from five witnesses today. I will introduce the five and then we will begin the testimony. Dr. Abdollah Shafieezadeh, the Lichtenstein Endowed Professor of Civil, Environmental, and Geodetic Engineering, Director of the Risk Assessment and Management of Structural Infrastructure Systems, the RAMSIS Lab at The Ohio State University. He joins us remotely from Columbus. He is an Associate Professor in the Department of Civil, Environmental, Geodetic Engineering at The Ohio State University. His scholarship focuses on improving the resilience of a built environment against natural and manmade hazards. He is the Director, as I said, of OSU's RAMSIS Lab.

Dr. Rachel Cleetus is Policy Director, Union of Concerned Scientists. She joins us today on video. She leads the climate and energy program at UCS, where she designs equitable policies to address climate change. She has more than two decades of experience in climate and clean energy policy, power sector, decarbonization, the risks and costs of climate impact, and improving climate resilience. She is author or co-author of a number of publications on topics such as climate impacts on coastal communities, especially.

Mr. Frank Nutter is President of Reinsurance Association of America. He joins us in person. He is an expert on insurance and reinsurance. He currently advises OECD on financial management of large-scale disasters in the RAND Center on Catastrophic Risk Management. He is a member of the advisory board of the Carl Lender III Center for Insurance and Risk Management at his alma mater, the University of Cincinnati. He has been adjunct faculty at the Harvard School of Public Health.

Dr. Roger Pielke is Professor of Environmental Studies, University of Colorado. He is our third remote witness. Dr. Pielke is an academic and author focusing on the intersection of science and public policy at the University of Colorado. Before joining the faculty, he studied extreme weather and climate at the National Center for Atmospheric Research.

And our fifth witness, who is also joining us, is Mr. Jerry Theodorou. He is Director of Finance Insurance and Trade Program at the R Street Institute. Prior to his current job, Mr. Theodorou did insurance research for Conning, a global investment manage-

ment forum. Before that, he worked in global underwriting and strategy for the American International Group.

Dr. Shafieezadeh, you have 5 minutes, if you would begin your testimony. Thank you so much for joining us from my State capital.

**STATEMENT OF ABDOLLAH SHAFIEEZADEH, LICHTENSTEIN ENDOWED PROFESSOR OF CIVIL, ENVIRONMENTAL, AND GEODETIC ENGINEERING AND DIRECTOR OF THE RISK ASSESSMENT AND MANAGEMENT OF STRUCTURAL AND INFRASTRUCTURE SYSTEMS LAB, THE OHIO STATE UNIVERSITY**

Mr. SHAFIEEZADEH. Thank you, Chairman Brown, Ranking Member Toomey, and Members of the Committee on Banking, Housing, and Urban Affairs. My name is Abdollah Shafieezadeh. I am an associate professor of Civil, Environmental, and Geodetic Engineering, at The Ohio State University. I am also the Director of Risk Assessment and Management for the Structural Infrastructure Systems at OSU. It is my great honor to be here today to share my insights on challenges and solutions for the resilience of our infrastructure and communities.

We have a large set of infrastructure systems in the country. They are critical to the daily life of Americans, the long-term economic prosperity of the Nation, and the national security. The current state of our critical infrastructure is not good. According to a recent nationwide assessment, America's infrastructure scores a C-minus. These systems that expanded significant shortly after World War II have been challenged by a large set of factors, such as aging and deterioration, natural hazards, and cyber and physical attacks.

As an example, parts of the power grid were built about a century ago, but a major expansion of the grid happened in 1950s and 1960s, with components and systems that had the design lifetime of about 50 years. In many cities there are considerable portions of underground wastewater collection pipelines that are a century old.

Resilience concerns are further compounded by climate and other extremes. Since 1980, the country has witnessed 298 weather and climate disasters with a loss from each of them exceeding $1 billion. We call such events as billion-dollar disasters. The total cost of these events has exceeded $1.97 trillion. The observed trends in these losses are even more concerning. The number of billion-dollar weather and climate disasters has increased from 2.9 events per year in the 1980s to 12.3 events per year in 2010s.

Meanwhile, climate change is anticipated to increase risks to the built environment. As an example, projections indicate that an increase of only 14 inches in relative sea level along the coast of the U.S. may increase the annual frequency of damaging floods by 25 times. In addition, modern design codes for structures were developed in the late 1990s and early 2000s. Many of our structures, however, were built long before and based on codes that are no longer considered adequate.

Investment gap in the Nation's critical infrastructure is estimated at $2.59 trillion for this decade. The investment needs to be even larger if our infrastructure is to be prepared for future stresses and demands beyond this decade.

Attending to risks to our infrastructure in a cost-effective manner requires a national strategic vision that includes long-term planning with the flexibility included to adapt to uncertain conditions of the future. Mitigation of hazard risks to buildings and other infrastructure are among the most effective ways. However, infrastructure stakeholders may not be able to afford the upfront costs of resilience projects. Therefore, resiliency strategies will need to be incentivized through measures such as reduced insurance rates and premiums, Federal, State, or local grants, and improved resilience-based codes.

Infrastructure decisions, we also need to consider the eventual impacts and benefits for different populations, especially vulnerable populations, as hazard exposure and disruption impacts are not uniformly distributed. We also need to equip the various stakeholders with the knowledge and tools to be able to navigate the risks with limited available resources. Toward this goal, we should increase investment in basic and applied research to address knowledge and technology gaps and community resilience.

Thank you for your attention, and I would be happy to answer your questions.

Chairman BROWN. Thank you very much Dr. Shafieezadeh. Next is Dr. Cleetus. We recognize you for 5 minutes.

Thank you for joining us.

**STATEMENT OF RACHEL CLEETUS, POLICY DIRECTOR, UNION OF CONCERNED SCIENTISTS**

Ms. CLEETUS. Hello, and thank you, Chairman Brown, Ranking Member Toomey, and Members of the Committee, and thank you for providing the opportunity for me to testify remotely. My name is Rachel Cleetus and I am the policy director for the climate and energy program at the Union of Concerned Scientists.

The science on climate change and the real-world evidence of worsening climate impacts are abundantly clear and sobering. I welcome the opportunity here today to talk about solutions solutions that are well within our grasp and can help safeguard people, critical ecosystems, our economy, and our future well-being. We cannot delay action any longer.

This is not about some distant future. As we look around our country we see communities faced with intense drought, wave upon wave of extreme heat, a fiery start to what is likely to be a terrible wildfire season, an early start to an above-average hurricane season that is projected. Meanwhile, accelerating sea level rise and ocean acidification are slow-moving disasters poised to unleash profound consequences. Underlying this all, the relentless rise in global average temperatures, fueled by heat-trapping emissions.

Climate impacts are being felt by people all over our country, and communities of color and low-income communities bear a disproportionate toll. Many of these same communities also bear an outsized burden of the pollution from our dependence on fossil fuels. In addition, the COVID–19 pandemic and the economic crisis are far from over, both of which also have an equitable impact.

Extreme heat is one of the most harmful and deadly hazards we have faced. UCS research shows that without global action to reduce emissions, the number of days per year when the heat index

exceeds 100 degrees Fahrenheit will more than double from historical levels, and increase fourfold by midcentury, and increase fourfold by late century.

We also found that, on average, by midcentury, U.S. military installations will experience nearly five times as many days with a heat index above 100 Fahrenheit as they have experienced historically.

Our research also shows that under a high sea level rise scenario, by 2045, about 325,000 coastal properties, worth $136 billion, will be at risk from chronic flooding. All along our coasts, Florida, New Jersey, New York, California, Louisiana, and South Carolina are among the most exposed.

Military installations too, along the East and Gulf Coasts face risks of more frequent and extensive tidal flooding, land loss, and extensive storm surge. We analyzed 18 installations and found that by 2050, without action, most will see more than ten times the number of floods they see today, and four installations—Naval Air Station Key West, Joint Base Langley-Eustis, Dam Neck Annex, and Parris Island—are at risk of losing between 75 and 95 percent of their land by the end of the century.

Infrastructure disruptions due to climate impacts are very costly. We have seen, again and again, roads, bridges, our power infrastructure damaged or disrupted by extreme heat, floods, storms, wildfires. We must invest in upgrading and modernizing our infrastructure to ensure that it will be resilient in the face of worsening climate impacts. The past is simply not a good predictor of the future anymore.

Communities must also be better prepared and protected. We need to ramp up funding for predisaster mitigation measures. Increased access to grants, loans, affordable insurance, public health protections for communities, workers, first responders grappling with extreme heat, smoke from wildfires, floods, and other harms is also vital.

The Federal Government must lead on providing the research, data, and tools to help the public understand these risks, and we need coordination from the Federal to the State, Tribal, local sectors as well as the private sector.

Climate change is a systemic and growing risk to our economy and yet it is not being priced adequately into the market today. A combination of short-sightedness, maladaptive policies, the outsized power of fossil fuel companies, and business-as-usual inertia is getting in the way. We need monetary, transparent, and uniform disclosure of climate risks in the marketplace. We must harness the power of the market.

However, these approaches will not be enough on their own. We do need additional policies to foster equitable outcomes. We must ensure that 40 percent of Federal investments directly benefit marginalized and underserved communities. We cannot replicate or reinforce past harms. For example, our Nation's shameful history of mortgage redlining has led to lasting injustices and inequities, particularly for African-American households.

Finally, it is important to note that there are limits to adaptation. We also have to make deep cuts in our emissions. We must get firmly on the path to at least 50 percent reduction, 50 to 52

percent reductions below 2005 levels by 2030. We have to clean up our borrower transportation sectors. We have to work across the economy.

This is an opportunity to build a clean energy and climate-resilient economy that works for all, investing in domestic manufacturing, investing in a just transition for coal communities. We must meet this moment with a robust scale of investments to promote resilient, low-carbon infrastructure, good-paying jobs, environmental and economic justice, and we look to Congress to take these urgent actions.

Thank you again for the opportunity to testify and for your work to advance climate action and protect our Nation.

Chairman BROWN. Thank you, Ms. Cleetus, or Dr. Cleetus. Mr. Nutter, you are recognized for 5 minutes.

Thank you for joining us in person.

**STATEMENT OF FRANK NUTTER, PRESIDENT, REINSURANCE ASSOCIATION OF AMERICA**

Mr. NUTTER. Chairman Brown, Ranking Member Toomey, and other distinguished Members of the Committee, thank you for the opportunity to testify, and we appreciate the interest of this Congress and this Committee in improving the resilience of communities across the United States.

Climate change clearly is impacting the incidence and damage caused by climate and extreme weather. Congress can help improve resilience in the face of these risks to save lives and better protect our homes, businesses, communities, taxpayers, financial sector, and the economy.

The RAA and its member companies have recognized the value of the science of climate change since the 1990s and adopted a formal policy in 2008. Our climate change policy has driven the RAA to engage with a range of public and private sector communities to advocate for scientific and data-driven research and analytics, the development of new financial products, and public policy that seeks to mitigate climate and natural disaster risk and its impact.

The RAA has supposed coalitions that advocate for improved community resilience such as BuildStrong and SmarterSafe and the recently released Insurers' Principles for Climate Change Adaptation. We also supported initiatives such as the National Flood Insurance Program's Risk Transfer Program with reinsurers, which helped pay for Hurricane Harvey losses. Congressional enactment of the Disaster Recovery Reform Act of 2018, which increased predisaster mitigation funds, and Federal lending institutions' regulators issuance of private flood rule to increase consumer flood insurance options.

These are positive steps toward helping Americans and their communities increase resilience, but more must be done, especially given the increasing number of disasters and losses, including at least one billion-dollar disaster affecting each State since 1980.

In the context of the infrastructure legislation being developed by this Congress, the RAA developed and is advocating for a proposal to address the impact of climate change through data-driven analysis, established community disaster resilience zones, or CDRZs, as we refer to them, and direct public and incentivize private sector

investment to help improve infrastructure resilience, including affordable housing for CDRZ communities that are most in need and most at risk from natural disasters.

Specifically, the proposal would codify, enhance, and utilize FEMA's National Risk Index for Natural Hazards, to find the intersection of risk, vulnerability, and low community resilience scores as the basis to identify and establish these zones that reflect diversity among the States by geography and type of peril.

With our proposal, Congress can coalesce a variety of new funding mechanisms that focus Federal, State, local, charitable, and private sector investments in resilience projects in these zones, including taxable direct pay bonds, like Recovery Zone Economic Development Bonds, one of the three types of Build America Bonds created as part of the 2008–2009 financial crisis economic recovery; tax-exempt private activity bonds, subject to a separate volume cap like the Recovery Zone Facility Bonds, also in the 2009 recovery legislation. And for communities that are unable to access the debt markets because they do not have a tax base to support additional borrowing or have reached their debt limits, our proposal includes Federal tax credits for charitable contributions by individuals and businesses and transferrable tax credits, similar to low-income housing tax credit, to encourage investors to help fund resilience improvements in these zones.

Aligned with the CDRZ, the RAA supports the provisions in House Financial Services Chairwoman Waters' Housing is Infrastructure bill that would authorizing funding for affordable housing, climate, and natural disaster resilience. We are advocating for Congress and the Administration to enact disaster mitigation tax credits for homeowners and businesses; exempt homeowners from Federal taxation of State mitigation grants; improve research on building code standards and FEMA's new mitigation program, often referred to as BRIC; encourage nature-based solutions; include forward-looking climate and natural risk and analysis in Federal programs, initiatives, and regulation; enlist the insurance industry's risk assessment and financing capability related to climate and natural disasters; and reauthorize the National Flood Insurance Program for the long term and enact, part of the NFIP reforms, to increase public and private flood insurance options for consumers and align Federal agency private flood policies.

There are a variety of ways Congress can address and increase resources to mitigate the impacts of climate and natural disasters on our communities, especially for homeowners, businesses, and our most vulnerable communities. The RAA looks forward to working with this Committee and others on our most recent proposal.

Thank you for the opportunity to testify.

Chairman BROWN. Thank you, Mr. Nutter. Dr. Pielke from Boulder—I believe he is calling in from Boulder.

**STATEMENT OF ROGER PIELKE, JR., PROFESSOR, ENVIRONMENTAL STUDIES, UNIVERSITY OF COLORADO**

Mr. PIELKE. Yes. Chairman Brown, Ranking Member Toomey, and the entire Committee, thank you for the opportunity to share my perspectives today remotely.

I am a professor at the University of Colorado Boulder that has studied the use of science and policy for more than 25 years, including a long-term focus on climate. Unfortunately, key scientific guidance on climate that informs policy, including central bank climate stress testing and U.S. Government estimates of the social cost of carbon, has departed from basic standards of scientific integrity. A main reason for this departure is that climate science has increasingly been enlisted in support of policy advocacy rather than to inform policy debates and decisions.

Today I have five points to make. First, I emphasize that human-caused climate change is real, it poses significant risks, and policy responses in mitigation and adaptation are necessary and make good sense.

Second, the reality and importance of climate change does not excuse failures to provide up-to-date and accurate scientific advice to policymakers. In 1990, the U.S. Congress established the interagency Global Change Research Program to provide usable information on which to base policy decisions related to global change, the key product being the U.S. National Climate Assessment, produced every 4 years. In practice, however, the National Climate Assessment has been politicized in varying degrees by both Democratic and Republican administrations. It has been used less as a mechanism of science advice than as a tool for promoting the climate policy agenda of the President.

Third, shortfalls in scientific integrity matter, because right now policymakers are being badly misled in a number of crucial areas. Here I will briefly cite just two examples.

One, climate scenarios that underlie much of research on climate, its impact, and policy responses are badly outdated and no longer offer insight to plausible futures. It is analogous to focus our Nation's current foreign policy on the Soviet Union. Once that made sense, but today it would just be out of date. The out-of-date climate scenarios are not off by just a little. For instance, they assume the dramatic expansion of coal energy to a level six times that of today, such that it becomes our primary energy source, and we decide to use coal to fuel our cars. No one believes this is plausible, yet there it is, at the center of our most widely used climate scenarios.

Second, economic losses associated with extreme events are routinely attributed to changes in climate while changes in society and its exposure and vulnerability, which also profoundly influence future risks, are largely de-emphasized. Every day, somewhere on Planet Earth, extreme weather events are happening. With 21st century communication technology and platforms, we are all able to witness disasters in ways that in earlier times just were not possible.

But the visceral appreciation of extremes and their impacts is no substitute for data and evidence. These data and evidence indicate that since at least 1990, when data first became reliable, economic damages associated with extreme weather have, in fact, decreased when measured in the context of global GDP. This pattern has occurred in countries of all income levels. It is good news, and we want it to continue.

In contrast, the National Oceanic and Atmospheric Administration, one of the Nation's leading science agencies with a strong staff and an important mission, routinely promotes a billion-dollar disaster list of events since 1980, to suggest that disasters and their costs are increasing dramatically due to climate change. What the dataset really indicates is growing wealth in locations exposed to loss. We should always use climate data to document climate trends, not economic data. Every time you see economic advantage invoked as evidence of human-caused climate change you should think instead about the state of scientific integrity in climate.

Fourth, shortfalls in robust science advice on climate are more than just an academic issue. They also show up in important policy context. Here I will just cite two, which are discussed in more detail, with data, in my written testimony.

Proposals for climate stress testing in the global and national financial systems are grounded in the use of outdated scenarios. These scenarios include those of the Network for Greening the Financial System and the International Monetary Fund. If the baseline scenarios used to project policy futures are out of date, so too will be any guidance that results from their use.

The estimated social cost of carbon, of the Biden, Trump, and Obama administrations, each has similarly relied on outdated scenarios with roots decades ago. Again, following guidance from impossible futures is not a good recipe for useful science advice. Worse, it can mislead. These are problems that require immediate fixing.

Fifth and finally, climate change is too important to allow shortfalls of scientific integrity and science advice to persist. Congress should enhance its oversight of the U.S. Global Change Research Program and the National Climate Assessment to ensure that the scientific advice that it receives is up to date and accurate. Mechanisms are in place. They need to be matched by a bipartisan commitment securing robust science advice.

The bottom line. At present there are troubling signs that Congress and the Federal agencies are not receiving the high-quality advice necessary to inform decisionmaking on climate mitigation and adaptation policies.

Thank you very much.

Chairman BROWN. Thank you, Dr. Pielke. Mr. Theodorou, you are recognized for 5 minutes, in the room. Thank you.

**STATEMENT OF JERRY THEODOROU, DIRECTOR, FINANCE, INSURANCE, AND TRADE, R STREET INSTITUTE**

Mr. THEODOROU. Thank you, Chairman Brown, Ranking Member Toomey, distinguished Members of the Committee, for the opportunity to offer testimony on climate change, resilience, and reinsurance. These issues impact multiple public policy areas. They need to be understood to inform prudent responses to protect our economy.

The three topics of climate change, resilience, and reinsurance are interrelated. We are witness to the effects of changing climate, in higher temperatures, melting ice caps, rising sea levels, more frequent and more catastrophic weather events.

These trends call for resilience. Resilience is the ability to bounce back and to absorb shocks. Reinsurance is a financial shock absorber. It allows insurers and the people in the communities they protect and serve to bounce back, to recover. For example, a small insurance company in the northern panhandle of West Virginia, Municipal Mutual, paid $3.8 million in 334 claims from a wind event in March of last year. This was over 12 percent of its equity base.

But reinsurance allowed it to recover $3 million of the $3.8 million, so the net loss was a bearable $800,000. Reinsurance protected the company and its policyholders. Without reinsurance, hundreds of insurance companies, millions of policyholders would be exposed to the crippling financial loss on top of catastrophic physical loss.

The climate catastrophe event of the day is the complex of wildfires in a dozen Western States. Losses from wildfires are covered by standard homeowners, business owners, and commercial property policies. Wildfire is fire, the central peril covered by personal and commercial insurance. To be sure, the oldest continuously operating insurance company in the U.S., founded in 1752 by Ben Franklin, is the Philadelphia Contributionship for the insurance of homes from loss by fire.

With the exception of flood, largely covered by FEMA's national flood insurance program, risks from climate, fire, hail, drought, and wind are covered by existing insurance policies. This is what the insurance industry does. It matches its capital to these kinds of risks.

Collectively, the U.S. insurance industry and the global reinsurance industry are adequately capitalized to withstand the financial impact of today's climate-related risk. In the year when the most insured U.S. losses ever, 2005, when we had Hurricanes Katrina, Rita, and Wilma, there was $110 billion of insured losses. The U.S. property and casualty industry has $2.4 trillion of total assets. The global reinsurance industry, an additional $650 billion. This means that it would take a year with three times the losses of 2005 to dent the industry's capital by 10 percent.

Reinsurance is critical for the insurance industry to play its role, as we saw in West Virginia. In addition to the capital base of the insurance and reinsurance industries providing coverage for climate risks, alternative capital sources are also taking on climate risk. This is coming from pension funds, sovereign wealth funds, university endowments, foundations, and family offices that seek to take on catastrophe risk because it is uncorrelated with equity and debt market risk. This is a really new phenomenon, and it is growing. Alternative capital provided about 4 percent of reinsurance industry capital in 2006. Now it is 15 percent, about $100 billion.

Transferring climate risk onto the balance sheets of insurers and reinsurers and to alternative capital investors may be a source of comfort but it is not enough, because it kicks the can of climate risk down the road. Claims from losses will be paid, but premiums may rise as risks increase.

The traditional reinsurance industry, supplemented by alternative capital, plays, and will continue to play, an important role in providing resilience through its role as a shock absorber, taking

on climate risk, but it is only part of the long-term response. Public policy must also encourage and incentivize risk mitigation—incentives for sound construction, restrictions on building in catastrophe-prone areas, physical defenses and barriers, and working with authorities to introduce and to enforce codes and standards.

In closing, thank for the privilege of testifying today, and for your interest in exploring how the reinsurance market and private capital solutions provide resilience to our economy in the face of growing climate risk taking a toll on our homes, our businesses, our health.

Thank you. I look forward to your questions.

Chairman BROWN. Thank you, Mr. Theodorou.

Mr. Nutter, even when some of my colleagues acknowledge climate change is real, too many of them downplay the economic risks—do not worry about it now, or they say the market will take care of it. No one has ever labeled your industry alarmist. Your members look at risk. They suggest financial decisions clients can make to weather them.

So explain if you would, Mr. Nutter, to the Committee why we should take climate change seriously as a financial risk, and what steps Congress should take to protect ourselves, our families, our country?

Mr. NUTTER. Thank you, Mr. Chairman. Indeed, our sector, the insurance, and particularly the reinsurance sector, is very committed to providing financial relief for events related to climate and extreme weather.

The industry does see climate change through the prism of extreme weather events. It is very dependent upon sound science. It is very dependent upon Government research related to science. The funding of NOAA, NASA, the National Science Foundation is a critical part of how we look at that.

Our sector does engage both in the discussion about climate change and climate science, and many of the major companies have a very deep reservoir of people who are trained in the natural sciences to help them advise about the impacts of climate change as well as the analysis.

What we have proposed, Mr. Chairman, is a proposal designed really to look at the infrastructure package that is being considered by this Congress, to see if there is a way to improve the investment, not just by the public sector but by the private sector. So the proposal that we had, the Community Disaster Resilience Zone proposal, is designed to bring more private sector investment into predisaster mitigation and improve social vulnerability as well as the resilience of the communities in our country.

Chairman BROWN. Thank you, Mr. Nutter.

Dr. Cleetus, the *New York Times* reported a few weeks ago about the mayor of Des Moines and city leaders trying to increase the tree canopy in that city, particularly in low-income neighborhoods. We know that a good tree canopy keeps homes cooler in the summer, improves air quality. And even in cities with fairly abundant tree canopy—Des Moines,

Washington, DC, Cincinnati in my State—the relative lack of trees in lower-income, predominantly Black and Brown neighborhoods is startling. It often mirrors, as you suggest in your opening

testimony, the redlining that happened in those communities throughout the 20th century.

I know you have researched this. You have talked about increased premature mortality due to extreme temperatures and poor air quality. Talk about what a robust tree-planning program might mean for the lives of residents in those communities.

Ms. CLEETUS. Thank you, Chairman Brown. As you point out, many of our urban areas in the country are experiencing heat wave after heat wave, and what we are seeing is a disproportionate impact in low-income communities and communities of color, because of an exacerbated urban heat island effect. We have historically underinvested in these communities, including the lack of green space and tree canopy, but also the kind of asphalt and concrete infrastructure that traps heat and then releases it at night, so it just keeps those places hotter and hotter.

This is very harmful to health, especially for the elderly, for very young kids, for those whose health is compromised. It is also very harmful for outdoor workers, like policy, like construction workers, et cetera.

So we have an opportunity now to make the kinds of investments in urban areas as well as rural areas that can help mitigate some of these extreme heat impacts, including investments in the kind of infrastructure that will reduce these kind of harmful heat impacts, but also changing workplace requirements so that outdoor workers are protected, the have public health protections that allow them to be spared some of these extreme impacts. It is also very important for agricultural sector workers who are exposed to these impacts.

We know that in cities like Baltimore this does follow the tragic history of mortgage redlining in our country. Those long-term effects, we can see this in cities around the country. These neighborhoods need investments. They need 40 percent of Federal investments directed to these kinds of marginalized and underserved communities.

Chairman BROWN. Thank you. Dr. Shafieezadeh, you argue for the cost-effectiveness of investing to improve infrastructure resilience now. Dr. Cleetus, there is a phrase you use to describe why Congress has not gotten serious. It goes into the underinvest and pay more later, the business-as-usual inertia, you call it. We see the problem around.

So I would like to ask the two of you, and Mr. Nutter, to weigh in on really the central question, I think, in the remaining seconds. What are the costs of doing nothing?

So, Dr. Shafieezadeh, you would answer that briefly, and then two of the other witnesses. What is the cost of doing nothing?

Mr. SHAFIEEZADEH. So Senator, thank you for the question. Currently, even if we set aside the climate change impacts, we have a huge backlog of deferred maintenance that is impacting many of our infrastructure, so addressing those needs are in the order of $2.5 trillion for the coming decade. And a sign that it is needed to take care of these immediate needs as soon as possible is that the previous estimate, which was 4 years ago, was around $2.1 trillion. So in a matter of 4 years the needs have increased, estimates of needs has increased by $0.5 trillion, because the issues that we

have currently are becoming more and more severe, and if we do not take action this will lead to major problems with higher cost to address those.

And when systems are experiencing these types of issues, their capacity to meet the challenges of the future, like climate extremes and weather extremes, is going to reduce further and further, and the systems are going to be more vulnerable to future hazards.

Chairman BROWN. Dr. Cleetus, briefly, if you would. The same question. What is the cost of doing nothing? And then Mr. Nutter.

Ms. CLEETUS. The cost is incalculable, and it is not just economic costs. We are talking about leaving our children and grandchildren with a planet that is gravely more unsafe if we fail to curtail our emissions sharply. And what I want to point out is the benefits of action are tremendous. We can build this clean energy climate-resilient economy. We can make it a fair economy that works for everyone. So let us embrace that opportunity. The costs of inaction outweigh, by far, the costs of embracing this vision.

Chairman BROWN. Mr. Nutter.

Mr. NUTTER. The people in our communities, and our communities are reliant on both public insurance programs and private insurance coverage. If, in fact, we do little to mitigate, premitigate if you will, the exposure of these people and communities to climate and extreme weather risks, we will eventually develop uninsurable communities, and our people will be reliant upon disaster assistance from the Federal Government, which has largely been proven to be inadequate to help people fully recover.

Chairman BROWN. Thank you, Mr. Nutter. Senator Toomey is recognized.

Senator TOOMEY. Thank you, Mr. Chairman. Dr. Pielke, I want to start with you. It seems that nearly every day there is a new press report warning that weather events are more extreme and more frequent, and that they are a result of global warming, and that the attendant costs are skyrocketing. Your testimony suggests that this conclusion, the conclusion that climate change is the sole or primary cause of severe weather events, misrepresents the underlying data and evidence.

So could you describe to us what the actual data tells us about the frequency and severity of extreme weather events in the United States over, say, the past 100 years?

Mr. PIELKE. Yeah, thank you. And talking about extreme weather is a little bit like talking about disease. We would not lump together cancer with obesity, with COVID. We break down disease into its constituent parts. And it is the same with extreme weather. Extreme weather is not a particularly useful category. And if we look at the United States over the long term, both the U.S. National Climate Assessment, in its Volume 1, and the IPCC, have done a nice job of summarizing the trends and the physical science metrics.

And they are nuanced. So heat waves have increased in the United States, without a doubt, since the 1960s, but they have not since the 1930s. Drought, overall, in the United States, is down over the last century, but it is up in the Southwest. Hurricanes, to many people's surprise, hurricane landfall in the United States, both overall hurricanes and major hurricanes, have not increased

over the last century. Flooding, similarly. There is no trend up or down in flooding, though if you pick a region I can find you an up or a down trend. Extreme precipitation, which is not the same thing as flooding, has increased, again, in some regions but not in other.

So the relationship of the physical climate system and trends and extremes, and the damage that we witness is pretty complicated, but when we take a step back and take a look at what is driving the absolute cost of disasters, it is more property, more wealth in exposed locations, that happen to be vulnerable.

So yes, we want to take actions to reduce our exposure and vulnerability, and we have to realize that it is not all driven by patterns of climate, whether it is variability or change.

Senator TOOMEY. Right. You know, when you think about, I suppose, the many hundreds of thousands of miles of rivers around the world—and maybe it is millions—probably millions of miles of coastline, innumerable distinct geographies, different climates, different microclimates, from a purely statistical point of view, should not we expect a 1,000-year weather event to be occurring somewhere in the world on a fairly frequent basis, just statistically speaking?

Mr. PIELKE. This is where it gets very important to follow the science that the IPCC has recommended to us, and it involves two steps. One is the detection of changes over long terms, 30 to 50 years or longer, and once a trend is detected to attribute the trend to reasons. Something like flooding, as you say, is very complicated, because we pave the land surface, with agriculture we channelize rivers. And so identifying changes to one specific cause can be complicated.

But again, the IPCC has concluded that overall, for reasons of incomplete data but also lack of a strong signal, flooding overall, globally, has not increased on climate time scales.

Senator TOOMEY. So let me follow up then with a question, also for Dr. Pielke. The Federal Reserve recently joined the Network for Greening the Financial System. That is a coalition of central banks whose stated aim is to, and I quote, "mobilize mainstream finance to support the transition toward a sustainable economy," end quote. In other words, I think their mission is to allocate credit based on their perception of climate risks.

But this network recently released climate scenarios designed to stress-test financial institutions, and as you point out, the scenarios they are use are predicated on several very dubious assumptions. For instance, is it not true that the Network for Greening the Financial System assumes a level of greenhouse gas emission that significantly outpaces current trends?

Mr. PIELKE. Yes. Climate stress-testing is a good idea. We want to make sure that our institutions are robust in an uncertain future. The NGFS, to their credit, was one of the first organizations to recognize that the scenarios of the IPCC are dated and unrealistic. So they came up with their own custom scenario, and it turns out that was too extreme and unrealistic. So just last month they released a Version 2.0, which again is too extreme.

So stress-testing for risk makes good sense, but those risk estimates have to be grounded in empirical science that is defensible.

Senator TOOMEY. Great. And a quick question for Mr. Theodorou. Contrary to the concern that insurers or reinsurers will be wiped out by huge losses associated with disaster costs, is it not the case that short-term policies which are repriced annually tend to be less susceptible to that kind of risk than even, say, banks or other kinds of financial institutions that take long-term exposure?

Mr. THEODOROU. Yes, thank you for your question, Senator. That is true. Most insurance policies are annual policies that gives the insurer the opportunity to change terms and conditions to respond, sometimes favorably. Unrelated to today's discussion, worker's compensation policy that has less payroll than was anticipated at the beginning of the year, as happened last year, results in returned premiums, more premiums back in the pockets of the policyholders.

So there is a resilience there, and the insurance and reinsurance industries, although they have been buffeted by large disasters, have always recovered. This is the business that they are in, going back to the San Francisco fire early in the last century, to 2005, the catastrophes of 2017.

So there is resilience in the insurance and reinsurance industry. This is not a unique event, the likes of which we have never seen, that would lead one to conclude that the sky is falling, that reinsurers will pack up and go home. Certainly not. This is the business that they are in, and it is their job to find ways to deal with it, to manage risk, assume risk, and mitigate it.

Senator TOOMEY. Thank you. Thank you, Mr. Chairman..

Chairman BROWN. Thank you. Senator Tester of Montana is recognized.

Senator TESTER. Yeah, thank you, Mr. Chairman and Ranking Member Toomey, for having this hearing. I want to thank everybody who has testified today. This is an interesting concept that I have not heard until today, that the cost of climate incidents is less today when compared to GDP.

In my real life I am a farmer, and so I just want to point out a couple of things. Number one, if I address climate from where I am sitting right now, this is a pretty nice room, pretty comfortable. Outside it is hot, it is humid, and it is a different world. That is Washington, DC.

On my farm we can talk about ice cap melting and rising sea levels, but the truth of the matter is I am in north-central Montana. The ice cap is several thousand miles away, and the ocean is probably 800, 900 miles away. So I go off of that by what people tell me, because I have not seen it.

But where I live right now, in the month of June, for example, we had 6 days that were above the temperature of 100 degrees. Incidentally, my grandparents homesteaded this place. We have owned it for over 100 years. We have forest fires right now, I think you could say throughout the West, that are record. In Montana, if you take a look at where the fires are burning in our State, it is all over the damn State, except in the east, where there is grass, and that will probably be burning later, except we are in the middle of a drought, so the grass resource is not probably big enough to burn.

We have a situation where my parents never, ever had crop insurance, never had a hailstorm in the 35 years they farmed, from

1943 to 1978. My wife and I have been on the farm, this is our 44th harvest, and it ain't going to be much of a harvest, because, quite frankly, between the drought and the hailstorm that came through a week ago, day before yesterday, there is not much left. OK?

But there is crop insurance, something my folks never had to have, that almost every farmer has now, that, by the way, is highly subsidized by the Federal Government. So you add on flood but also include crop into that on subsidized insurance. And we also have hail insurance that some have. And I will tell you that I am not concerned about the hail insurance company, because, quite frankly, they have it pegged out. And next year I guarantee you that because of the hailstorm that went through, our premiums will go up, because that is what hail insurance companies do, and that is what they should do. That is what insurance companies do, and that is what they should do.

So I am not as concerned about the insurance industry, because they will manage the risk. I am concerned about what I have seen over the last 43 years on our farm, and the last 100 years overall. Let me give you an example. In 2000, when we had another extreme drought, my mom was still alive, a child of the 1930s, and said, "We got more moisture in the 1930s" that we are getting at that moment in time, and now we have had another series of droughts.

So I would just say this, and I have got a question in all this, by the way. I would just say that we can say that this does not have physical impacts, but I am going to tell you what it does have—food impacts. If we do not address this, there are going to be a lot of hungry people around here 100 years from now. In fact, there are going to be a lot less people on this Earth 100 years from now. I really believe that.

And I will also tell you that I still think it is physically prudent, even though big houses are built in the middle of forests, which do not make a lot of sense to me, and built in the middle of floodplains, which do not make a lot of sense to me, but they have been doing that since I have been around, the 64 years I have been here.

I want Dr. Cleetus to answer this question. On the claim that the cost of incidences is less today, of climate events, than it was in years past, compared to the GDP, could you respond to that, if that is something that you see as the same way, number one. And number two, if that means that climate change is less of a situation that we should be dealing with, or just let it go?

Ms. CLEETUS. Thank you, Senator Tester, especially for your personal testimony for what the people of Montana are bearing right now. I am finding myself deeply disturbed by the cherry-picking of data and the misrepresentation of climate signs that I have heard here today. I would prefer to look to all major scientific organizations and institutions here in the U.S.—the National Academies of Science—these are the institutions of integrity that we should look to for independent science to help guide our policymaking. And every one of them is telling us that climate change is here, and its effects are going to get profoundly worse if we fail to curtail our heat-trapping emissions sharply.

So please, please, let us not waste time debating the science. Let us take action now. People around the country depend on it. And I am not talking about people in boardrooms, fields, folks with multibillion-dollar paychecks. I am talking about ordinary people, the working people, who are finding their livelihoods wiped out, who are faced with terrible disasters, still trying to get back on their feet from the last one before the next one hits. Those are the people that we need to be protecting and looking out for, now and in the future. And I thank you for your calling attention to that today.

Senator TESTER. Thank you. I yield.

Chairman BROWN. Thank you, Senator Tester. Senator Cortez Masto from Nevada.

Senator CORTEZ MASTO. Thank you. Thank you, Chairman and Ranking Member Toomey, for this important conversation. I have to agree with my colleague from Montana. Something is happening there, and we cannot discount it as some sort of natural event that occurs and has occurred in the past.

I will tell you this. I am from Nevada. We have wildfires now all the time. They are no longer seasonal wildfires. They happen. I was just home in Nevada. I was traveling through northern Nevada, where it is very, very dry. A thunderstorm came. Lightning hit. As soon as we drove up to where the lighting was, the Prison Hill Fire was happening, because of that lightning. I mean, it is immediate and it is something we cannot ignore.

So, Dr. Cleetus, let me ask you this. I am introducing my wildfire bill, the Western Wildfire Support Act. One provision of this bill would provide assistance to at-risk communities to establish wildfire protection plans, to address local hazard and wildfire fuels reduction, and to assist homeowners with the disposal of brush in order to help communities, homeowners, and building owners in adapting homes property to decrease the harmful impacts from wildfire.

So, Dr. Cleetus, can you talk about the importance of preparing communities and individual properties to mitigate against wildfire impacts, and how such assistance may financially help property owners impacted by the wildfires?

Ms. CLEETUS. Thank you, Senator Cortez Masto. I cannot agree more. We have to stop reacting to these as one-off disasters that we cannot predict. Now that we are seeing these long, hotter, drier conditions that are fueling these terrible wildfire seasons, we have to act in advance. And we know that climate change is contributing, of course, but also our history of mismanagement of our forests and fuels, the places in which development is happening, putting more people and property in harm's way are all contributing to worsening these disasters.

So taking steps ahead of time, as you are proposing, are very, very important to protect communities so that they are not just left picking up the pieces after the disaster. We have to make sure that we are reducing these risks.

Emergency responders on the front lines of this, wildfire firefighters, are just being pushed to the max by these seasons again and again. It is taking a terrible toll, both mental and physical. We

cannot just continue business as usual, continue doing what we have done in the past. We have to do better.

Senator CORTEZ MASTO. Thank you. And then, Dr. Shafieezadeh, Nevada has 27 federally recognized Tribes, with numerous reservations in our State. When we discuss resilience we need to ensure our Tribal communities are part of that conversation.

In your opinion, do you believe our Tribes have the resources available to cope with the impacts of climate change?

Mr. SHAFIEEZADEH. Thank you for the question, Senator, and usually socioeconomically vulnerable communities are not equipped to deal with disasters and preparing for disasters. Many studies have shown that when we look at the treatments of risk which is hazard, the impacts on the built environment, and the consequences of those failures for society, there are disparities at every elements of risk. And even some of the measures that we see and have been studied to show that they have very high benefit-to-cost ratios, those communities are not usually able to afford those measures. So there needs to be some assistance, in various forms, that could be made available to them, to be able to adopt those measures.

Senator CORTEZ MASTO. Thank you. Mr. Nutter, in your opinion, what types of investments should we target to our Tribal areas to promote resilience?

Mr. NUTTER. Senator, thank you for the opportunity to respond. Also to your comment about the introduction of your legislation, which we look forward to working you. In our testimony, we highlighted a proposal that we have developed that, in fact, would use the National Risk Index, which does look at social vulnerability, the nature of the communities, the community resilience, if you will, and it has a proposal that would allow more private sector investment in addition to public sector investment. Each of the Members of the Committee have in front of them a screen shot, if you will, of our effort to try and take the National Risk Index and look at community vulnerability on a variety of factors, including agriculture. I am sorry that Senator Tester is not here. I wanted to highlight that. And it would bring, in fact, more predisaster mitigation funding into communities, based on what the community believes is appropriate to help with its resilience. It also includes tax credits for individuals and tax credits for these communities that would be transferrable and tradeable.

Senator CORTEZ MASTO. Thank you. Thank you, Mr. Chairman.

Chairman BROWN. Thank you, Senator Cortez Masto. Senator Ossoff from Georgia is recognized.

Senator OSSOFF. Thank you, Mr. Chairman. Thank you for holding this hearing. Thank you to our panelists, both in person and those joining remotely.

Dr. Shafieezadeh, I would like to address a couple of questions to you, if you please. First of all, just to set the table here, the National Oceanic and Atmospheric Administration, or NOAA, states that warmer oceans may result in stronger, wetter tropical storms and hurricanes, increased storm surge, and other events that threaten coastal settlements.

The U.N. Intergovernmental Panel on Climate Change, or IPCC, states that sea level rise will likely result in more damaging coast-

al storm surge and flooding. And the Department of Defense cites climate change as a national security threat to its installations, including the Naval Submarine Base at Kings Bay, Georgia, which may suffer from increased flooding, damage from storm surge, and threats to naval operations there.

Dr. Shafieezadeh, if these projections from NOAA, the IPCC, and the Department of Defense are correct, can you please speak to the climate risks faced by Georgia's coastal cities such as Savannah, Brunswick, and Georgia's barrier island chain, including Tybee, St. Simons, St. Catherines, St. Marys, Sapelo, and Cumberland Islands?

Mr. SHAFIEEZADEH. Thank you, Senator, for the question. There are overwhelming concerns in the community, in the research community, academic community, that there is upward trend in many hazards by climate. And we are not only are concerned about single events, single hazard types becoming more frequent or intense but we are also concerned about combination of the events, extreme events, becoming more likely. And that, coupled with aging and deterioration of the infrastructure, cyber and physical attacks, and changes in the service demands across the Nation may put some conditions for our infrastructure that are not designed for. That is the major problem.

Some, as were mentioned earlier, there are some parts of the Nation that may see decrease in some of the hazards, but there are some, a lot of parts of the country we are seeing increases in the stresses, and those are the parts that are very concerning, because the infrastructures are not designed for those type of increases.

So in many coastal regions we have the issues of flooding and sea level rise. Even small amount of sea level rise will substantially increase the frequency of damaging floods to these events, and when such hazard happens then we have significant stress on various infrastructures—housing, transportation, our power grid. And the other challenge there is that with sea level rise the exposure increases. Not only we are concerned about the frequency but also the exposure, meaning that many of our flooding events are going to go further inland, impacting areas that are not currently at high exposure to flooding events.

So these compounding effects are something that we need to be very serious about in how we think about the future and preparing for the future hazards.

Senator OSSOFF. Well, thank you, Dr. Shafieezadeh. And considering these potential impacts on Savannah, Georgia, on our naval facility at Kings Bay, on our barrier island chain—Cumberland Island, Sapelo Island, Tybee Island—it is vital, in my view, and I know I have discussed this with the Chairman as well, that this upcoming infrastructure bill includes significant investments in coastal resilience, to help communities in coastal Georgia, and coastal communities across the country, prepare for increased flooding, worse tropical storms, increased storm surge events.

Can you speak to the kind of infrastructure that will help communities like Savannah, Georgia, adapt to what is coming?

Mr. SHAFIEEZADEH. So that is a great question. We have a whole host of solutions, at least from the engineering and science community, and then I would suggest that for every specific location we

need to do a deeper study on the hazards that these areas are facing, what sorts of solutions need to be taken now. And one point I would like to make is that the risks you are facing are dynamic, not static, so we need to have strategies that are adaptive in time, meaning that some of the actions we need to take now, but we need to also have a plan for sustained funding so that as we hear more from the science community and climatologists about the trends of the future climate, we are able to make decision on the go and improve the state of infrastructure further.

The type of solutions that might be available now for coastal communities can range from nature-based systems to flood walls and levels to improving the stormwater collection systems, to elevating homes or buying out some of the houses in the floodplains. And the good news is that the benefit-to-cost ratio for many of these measures are very high, and it is highly justified to take those actions.

Senator OSSOFF. Thank you, Dr. Shafieezadeh, and with the Chairman's permission just one final question for you, Dr. Cleetus, please. The impacts of climate change and these events will not be uniformly distributed. Low-income communities, vulnerable communities, communities in the floodplain, communities who already live in under-resourced neighborhoods, dilapidated housing, will be more severely impacted. I am thinking, for example, of the Geechee communities along Georgia's coastline, descendants of West African slaves, brought to Georgia and other parts of the Southeast to work in coastal plantations, who still endure a high level of poverty. These communities are going to be hit the hardest.

What can we do to ensure that our investments in coastal resilience help and protect those who are most vulnerable, Dr. Cleetus?

Ms. CLEETUS. Thank you, Dr. Ossoff. I think you raise a very, very important point, and what is most important is that we understand that we need to engage with these communities directly. They need to be at the table as solutions are being developed that will benefit them, because they have very good ideas of what can work and what cannot.

As you pointed out, there are places like St. Simons and Tybee Island where we have thousands of homes that are at risk from chronic inundation. We have places like Brunswick where nearly one-half of the residents are African American, nearly one-third live below the national poverty line. It is projected to have more than 800 homes at risk of chronic flooding, which would put 20 percent of this property tax base at risk.

So we have to make sure that we are deliberately allocating funding programs and policies to these communities, reducing the barriers to access. Many of these communities are underinsured. They are not able to navigate the bureaucratic red tape to get assistance. Recent research has shown that FEMA funding is disproportionally inequitable along racial and income lines. This is very, very troubling. We need to be tracking this data to make sure that the people who need access to these resources are first in line.

Senator OSSOFF. Thank you, Dr. Cleetus. Thank you, Mr. Chairman.

Chairman BROWN. Thank you, Senator Ossoff. Senator Van Hollen from Maryland is recognized.

Senator VAN HOLLEN. Thank you, Mr. Chairman and Ranking Member Toomey. I thank all of our witnesses today.

There was a March survey, March of this year, by the National Association of Insurance Commissioners. In that survey, more than a quarter of consumers said that they had trouble getting homeowner's insurance or renewing their policies due to natural disasters in their area. Over 25 percent of homeowners said that insurance premiums had risen for the same reason, and nearly three-quarters of consumers said that most significant threats facing their homes today were weather related, not surprising when we see that in 2020, the United States experienced a record-breaking 22 incidents of over $1 billion in damage due to extreme weather disasters.

I want to second the comments made by my colleague, Senator Ossoff, about the importance of the infrastructure modernization plan that Congress is considering to include investments in resilience to protect our communities.

Mr. Nutter, what can the insurance industry do to help promote mitigation and resilience measures in response to the impact of climate-related risks?

Mr. NUTTER. Yes, Senator, thank you for the question. In our prepared statement and brief testimony we highlighted a new proposal that we have made about directing more public as well as private sector investment in communities that are socially vulnerable as well as have resilience issues and that are affected by natural disasters.

The proposal takes FEMA's National Risk Index, which is 18 perils, is across the country, and it would facilitate the issuance by local communities of both taxable and nontaxable bonds and provide tax credits associated with what the communities believe are improvements in resilience for those communities. Each of the Members of the Committee have before them a brief screen shot of a data analytics program that we have done showing how you can take this information, vulnerable communities, and direct investments, if you will, to deal with those communities.

So our newest proposal is that, Senator. We have supported a host of tax credits as well, for both businesses and individuals, that would help encourage disaster mitigation, predisaster mitigation investments.

Senator VAN HOLLEN. Thank you. Thank you for that proposal. I will take a look at it.

Another question related to the rising risks and costs of climate change, which is that those risks outpace insurance supply. Is there a way of transferring that risk more broadly so that catastrophic risk is not concentrated in a small number of insurers and that more balance sheet is freed up so that insurers can continue to offer coverage to as many households and businesses as possible? Do products like cat bonds have a useful role to play here?

Mr. NUTTER. Senator, thank you for that comment, and absolutely, the reinsurance sector has, as part of its strategic business model, the use of reinsurance as well as catastrophe bonds, that you referenced, as a way to tap into capital markets to supplement the traditional reinsurance indemnity process. That is almost $100 billion of capacity that is in place now with catastrophe bonds used

by the National Flood Insurance Program and by a number of insurance companies. We do think that those are ways to transfer risk and to spread it, if you will, into the capital markets and not just on the Government's balance sheet.

We also see creative proposals being made about parametric insurance, which is insurance that may be for communities or individuals that would provide financial recovery funds independent of the actual loss that an individual may have, but where the trigger is based upon the event, if you will—the wildfire, the flood, that sort of thing.

Senator VAN HOLLEN. I thank you. I do not know if any of the other witnesses want to comment on that. That was my final question.

Mr. THEODOROU. Thank you, Senator. I would like to comment. Indeed, there is diversification that is done by insurers so that they do not exceed their capacity in a particular area, just like decades ago there were pins on a map, and if there were too many houses in one particular area they would stop writing there. What is the maximum possible loss? They calculated that. And indeed, they do spread the risk. I mentioned a small West Virginia mutual insurance company that has less than $20 million in premium and that got a big return from the reinsurance recoverable. That company had over 10 reinsurers. So even reinsurers are not overloaded with risk in a particular area.

Since 1992, in Hurricane Andrew, the modeling industry, risk modeling, was born and has developed so that insurers can manage their accumulations and spread it, and it is a large market. There are hundreds of reinsurers, a couple thousand insurers, so that no one company has got too much of a concentration in one particular part of a State.

Senator VAN HOLLEN. Thank you.

Chairman BROWN. Thank you, Senator Van Hollen. Senator Menendez of New Jersey is recognized.

Senator MENENDEZ. Thank you, Mr. Chairman. Flooding is one of the most expensive and most frequent natural disasters in the United States. As we look to invest in our Nation's infrastructure for the 21st century, we need to ensure that our investments are protected from the challenges that lie ahead.

In New Jersey, we are leveraging Federal resources from Community Development Block Grants to build state-of-the-art resilient infrastructure like Hoboken's Rebuild by Design project, a $230 million mitigation initiative which I helped secure funding for, and will help alleviate repetitive flooding and protect against damage from storm surges.

Dr. Shafieezadeh, as Congress looks to enact historic infrastructure legislation, should we not be investing in more flood-resilient projects to programs like CDBG–DR, to ensure that our investments in infrastructure last for years to come?

Mr. SHAFIEEZADEH. Thank you very much for the great question. I believe that the project in New Jersey is a very good model because it took a multihazard view to the issue and had a long-term view, and it took a look at a whole host of solutions, both hard solutions to nature-based solutions to improving the capacities of the city itself.

And related to flooding issues, we currently have a lot of problems from flooding to our infrastructure. Around 57 percent of 1,948 bridge collapses that were recorded in the U.S. have been related to hydrology problems where flooding and scouring are the major drivers there.

So they have been putting a lot of pressure on our infrastructure, and we anticipate that these stressors are going to continue to increase. Under very mild climate projections it is estimated that 66,000 of our bridges are going to be vulnerable to increased peak flow rates, and addressing the vulnerable bridges would cost somewhere between $140 to over $200 billion. And that is just one liability due to increased peak flow. And that also applies to many other built environment that they have, for example, the power grid, telecommunication, and hospitals in coastal areas.

But the good news is that the benefit-to-cost ratio of taking actions is very high. Studies have shown that retrofitting existing buildings with some common retrofit measures, in coastal areas has a benefit-to-cost ratio of 4-to-1. And applying these measures to buildings where benefit-to-cost ratio would cost somewhere around $500 billion, but the estimated benefits is over $2.2 trillion.

Senator MENENDEZ. Very good. So I would say the answer to my question is yes, based on what you said, right? Investing in flood resilience projects makes a lot of sense.

Mr. SHAFIEEZADEH. Yes.

Senator MENENDEZ. OK. Let me turn to Dr. Cleetus. In 2012, Superstorm Sandy devastated New Jersey's coastline in the greatest natural disaster in our State's history. It caused billions of dollars in damage, it took lives, including some sustained damage to home values. Sea levels continue to rise at alarming rates, exacerbating the potential damage from major storms like Sandy as well as more common rainfall events.

As climate hazards continue to grow, this inevitably endangers the cornerstone of wealth building for so many American families, which is their home value. If, due to climate change, these homes become uninsurable and unmarketable, the value of these homes and the wealth of homeowners is at risk.

So Dr. Cleetus, without bold action to mitigate the effects of climate change, do you expect coastal homes and homes facing other climate risks to lose value relative to the balances of home owners' mortgages, causing those mortgages to become financially under water?

Ms. CLEETUS. There is no question that we have billions of dollars of real estate along our coastlines, including in New Jersey, that are at risk of chronic inundation well within the lifetime of the 30-year mortgage issued today. And we have seen the leading edge of some of these challenges already in many coastal communities, including places like Ocean City and Cape May, Monmouth Beach, in New Jersey, Atlantic City.

But right now the market is not pricing this risk adequately, and my sincere worry and concern is that when the market moves, the adjustment can be very harsh and abrupt, and it will really hurt fixed-income and low-income folks for whom their home is their single biggest asset. I urge policymakers to get out ahead of this

problem, make the kinds of investments that will make communities' homeowners more climate resilient.

And it is not just about individuals homes and homeowners. This is the property tax base of these communities. This is linked to our mortgage market. This is linked to many of our retirement portfolios that include real estate. The reverberations are wide for our economy. We do not know what can trigger this. It can be an extreme weather event, change in insurance rates, policies. But the physical risk is real.

Our climate projections show that the physical risk is increasing due to accelerating climate change. So let us implement the policies ahead of time that will safeguard communities and their financial well-being.

Senator MENENDEZ. Thank you. Mr. Chairman, would you indulge me one other question?

Chairman BROWN. Of course.

Senator MENENDEZ. Thank you. Mr. Nutter, as we continue to pursue major infrastructure legislation, including investments to mitigate the impacts of climate change, we need to ensure that this funding finds its way to where it is most needed, like those communities facing outsized climate risk as well as those that have historically been underserved, from our low-income urban communities to our rural communities and environmental justice communities.

How can a data-driven approach guide our policy decisions here in Washington to ensure that our Federal investments have the maximum impact while reaching the communities that are most in need?

Mr. NUTTER. Senator Menendez, thank you for your question and your comment. We have promoted the idea that in this infrastructure package Congress should include a proposal to identify communities at risk and that are socially vulnerable by using the National Risk Index, which is a FEMA-prepared product that provides a number of factors related to community vulnerability and social vulnerability, and allow the local communities, consistent with your point earlier, to make decisions about what kind of investments would be appropriate in those communities to make them more resilient and protect the communities and the homeowners that are there, by using federally taxable as well as tax-exempt obligations and tax credits that would draw both public sector investment but also private sector investment.

We look forward to working with you and your staff to include it in an infrastructure package. We think it does a lot to help draw additional resources to protect these communities and protect the homes and the homeowners that are there.

Senator MENENDEZ. Thank you, Mr. Chairman. This hearing is, for coastal States like my own, although not only coastal States, but for coastal States like my own this hearing is incredibly important to understand some of the challenges we have and some of the policy opportunities I hope we can pursue. Thank you.

Chairman BROWN. Thank you, Senator Menendez, for your always thoughtful comments.

Thanks to our witnesses for joining us today, the three remote and the two here. For Senators who wish to submit questions for

the record, these questions are due 1 week from today, Tuesday, July 27th. To our witnesses, per our Committee rules, we ask that you respond to any questions within 45 days from the day you have received them.

Thank you again. With that the hearing is adjourned. Thank you so much.

[Whereupon, at 11:29 a.m., the hearing was adjourned.]

[Prepared statements, responses to written questions, and additional material supplied for the record follow:]

## PREPARED STATEMENT OF CHAIRMAN SHERROD BROWN

This morning the Banking and Housing Committee again looks at the ways climate change puts the American economy and American communities at risk.

Earlier, we examined the ways big banks' focus on short-term profit, while ignoring long-term climate risk, puts our homes and businesses and the overall health of the American economy at risk.

In April, we looked at all the opportunities for American workers and the benefits to the entire economy from investment in new, 21st century energy.

Today's hearing will look at what cities and towns and businesses of all sizes can do to protect our infrastructure, including homes and transit systems, that are at risk from climate change.

This Committee must do all we can to help our communities protect themselves and reduce the risk to taxpayers from climate disasters.

We'll hear from our witnesses about cost-effective measures to ensure the infrastructure we rely on—from bridges to major highways, from water treatment plants to neighborhoods and office buildings—can withstand more frequent extreme weather events.

Pretty much every month we see new climate change-fueled catastrophes, from the wildfires ravaging the Western United States to the increasingly common coastal and river flooding.

Historic heat melts streetcar cables in Portland, Oregon. Another polar vortex hits an unprepared Texas and disables natural gas lines and the electrical grid.

Last month, tropical storms that would have been unprecedented not too long ago devastated roads, and flooded homes throughout Delaware and Chester Counties in the southeast part of Ranking Member Toomey's home State of Pennsylvania.

Last year, remnants of Tropical Storm Isaias hit the same area outside Philadelphia, floating large shipping containers and crashing them into a local bridge, flooding roads and homes, and shutting down service on SEPTA, one of America's largest transit systems.

My State of Ohio is not immune.

Recent landslides in Cincinnati closed heavily traveled highways and cut the value of some Ohioans' homes in half. The disaster resulted from the combination of the clay in that part of the country, and rainfall that's been more than 16 percent heavier than historical averages during this century.

Water levels and temperatures in Lake Erie are higher than they have ever been, and are on a steady two-decade rise.

This affects power plant operation, contributes to flooding of homes, businesses, and farmland, and feeds harmful algae blooms, jeopardizing the water supply for 11 million people.

All of these disasters affect the economy. They mean supply chain interruptions and power outages and damage to buildings and raw materials and transportation networks.

It's just common sense—when disaster strikes the infrastructure our economy relies on, our economy gets interrupted—over and over again.

And it's the American people who pay for it. They pay in higher utility bills and higher prices, more tax dollars shelled out to afford repairs, and lost jobs and homes and opportunity.

Our competitors around the world are taking this seriously. China plans to invest more than $2.5 trillion in more resilient, integrated transportation, energy, and information technology infrastructure by 2025, including 16 new Ultra High Voltage transmission routes to connect renewable generation in the countryside to the booming demand in its cities.

That's all on top of their Government-funded clean energy research and development, where they invest more than the U.S., Japan, and India combined.

Every time business grinds to a halt because an American factory wasn't built to withstand extreme heat, or because a road is blocked by landslides, or because a power grid is shut down—that's another opportunity for China and other foreign competitors to get ahead.

Investment we make now to shore up our infrastructure will both create jobs at home—jobs that can't be sent overseas—and make our industries more competitive.

And all the investments we make today will save taxpayers money in the future. It's a lot cheaper to build a stronger bridge now than to repair it every other year.

This Committee oversees the stability of the economy, the homes Americans live in, and the transit systems that get people to work and school and doctors appointments.

It's our job to look at the risks that infrastructure faces—both the source of that risk, and the steps we must take to plan for it and prevent it.

As we look at record high temperatures around the world, we should be worried that our grandchildren may look back at these times as "the good old days."

We cannot continue on this path. Now is the time to tackle this problem, to protect our vital infrastructure and American competitiveness.

I hope my colleagues will listen to today's testimony with the understanding that the health of our economy and the lives of our fellow Americans may depend on it.

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**PREPARED STATEMENT OF SENATOR PATRICK J. TOOMEY**

Thank you, Mr. Chairman.

Today, the Committee will discuss climate-related risks and the ways in which the insurance and reinsurance industries are evolving and adapting in response. This hearing is meant to be about reinsurance, though apparently we will also hear proposals for massive new Federal infrastructure spending based in part on misleading claims regarding climate-related risks. To the extent that policy proposals are based on misrepresentations of science, they could lead to very bad results.

At the outset, let me acknowledge that global warming is real. However, we must also recognize three important points. First, there is actual significant debate within the scientific community about global warming's impact on man and the economy. Second, direct economic damages associated with extreme weather events have actually decreased both globally and in the United States when measured against GDP. Third, insurance and reinsurance companies, whose existence depends upon the presence of uncertain risks, have always adjusted to changing risk, and climate-related risks are no exception.

In March, all 12 Republicans on this Committee sent a letter to Fed Chairman Jay Powell expressing concern that financial regulators were seeking to impose costly new rules based on highly uncertain climate models. Unfortunately, proposals to assess climate-related risks to financial institutions are too often based on outdated scenarios and unrealistic assumptions.

Even the Financial Stability Board acknowledges the massive uncertainty. They just issued a report stating that "financial institutions' exposures to climate-related risks are generally subject to greater uncertainty than those relating to other financial risks." The report notes that this uncertainty derives from the difficulty in modeling such risks and a lack of reliable historical data.

Despite substantial modeling and data limitations, President Biden recently issued an unjustified executive order directing financial regulators to consider integrating climate-related risks into supervision and regulation. But good policy rests on a foundation of good science. As one recent publication in the leading science journal *Nature* stated, calls to integrate climate science into risk disclosure and economic decision-making "has leap-frogged the current capabilities of climate science and climate models by at least a decade."

Despite the great deal of uncertainty regarding climate-related risks, many in the media and politics assert that the frequency and severity of extreme weather events are increasing as a result of climate change. This assertion grossly misrepresents the data, including assessments by the IPCC, the organization widely considered to be the world's leading climate authority.

The reality is that leading climate scientists do not agree on whether or not—or to what extent—climate change is causing an increase in the frequency or severity of weather events. There can be no debate, however, that economic damage from such events is shrinking as a portion of our economy, as one of today's witnesses, Dr. Roger Pielke, will explain in greater detail. And that decrease is despite the tremendous amount of development in exposed areas.

Further, the overwhelming reason for increased disaster losses is that locations exposed to loss have grown in wealth and population—not that global warming has increased the frequency or severity of extreme weather events.

Behind the drive to impose climate-related regulations on financial institutions is a fatal conceit of progressivism: Bureaucrats know the risks to business better than the business itself. But as we will hear from one of today's witnesses, insurance industry expert Jerry Theodorou, it has actually occurred to financial institutions that potential climate-related risks might affect their operations, and they are responding accordingly.

Perhaps no industry has done more to adapt and evolve than insurance and reinsurance. Among other things, large property/casualty insurance companies covering approximately 70 percent of the U.S. market have been reporting climate risk for over 10 years. They've modified their underwriting practices and they've diversified their investment portfolios.

In addition, insurance policies and products are generally short term and are rericed annually or withdrawn as conditions change. Nevertheless, property/casualty insurance is readily available across the United States. Increased risk is not a prohibitive problem for insurance or reinsurance because their business models depend upon accurately pricing risk—at whatever level.

Regulators must avoid the temptation to think they're smarter than the market. Assessing and pricing risk is the core competency of insurance companies, and they will apply hundreds of years of experience as risks evolve.

When was the last time any major insurer or financial institution failed as a result of extreme weather? Or the last time an insurance company failed to pay a policyholder claim because of extreme weather?

Finally, I'd like to note that States, not the Federal Government, have been the primary regulators of insurance for the past 150 years. Congress explicitly endorsed this State-based regulatory approach with the McCarran–Ferguson Act.

State-based regulation has worked and it has worked well for both the insurance industry and more importantly for the consumers it serves. It would be profoundly misguided for the Biden administration to throw the State-based insurance regulatory regime out in pursuit of its climate agenda.

Let me conclude where I began: global warming is real, and it likely will present new risks. However, we simply have too little understanding of the near-term effects climate change will have on any particular place to justify imposing huge new regulatory costs on the consumers who would ultimately pay for them.

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## PREPARED STATEMENT OF ABDOLLAH SHAFIEEZADEH

LICHTENSTEIN ENDOWED PROFESSOR OF CIVIL, ENVIRONMENTAL, AND GEODETIC ENGINEERING AND DIRECTOR OF THE RISK ASSESSMENT AND MANAGEMENT OF STRUCTURAL AND INFRASTRUCTURE SYSTEMS LAB, THE OHIO STATE UNIVERSITY

JULY 20, 2021

Chairman Brown, Ranking Member Toomey, and Members of the Committee on Banking, Housing, and Urban Affairs, my name is Abdollah Shafieezadeh. I am the Lichtenstein Associate Professor of Civil, Environmental and Geodetic Engineering at The Ohio State University (OSU). I am also the director of Risk Assessment and Management of Structural and Infrastructure Systems lab at OSU. It is my great honor to share with the Committee my insights on the state of the Nation's critical infrastructure, current and future risks, especially those that are imparted by climate and weather hazards, and some of the ways we can pursue to improve the resilience of our infrastructure and communities.

### The Significance of the Nation's Infrastructure

The daily life of Americans, the long-term economic prosperity of the Nation and the national security of the United States depend on the continued functioning of a large set of infrastructure systems in the country. These systems that form the backbone of our society are complex in terms of their scale, and system operations and interdependencies under normal conditions and when challenged by the stresses of the environment. Attending these risks in a cost-effective manner requires a strategic vision that includes long-term planning with a flexibility included to adapt to uncertain conditions of the future.

The physical and operational scales of our infrastructure are significantly large. As an example, the power grid in the U.S., is widely considered the most complex engineered system in the world. It includes over 8,000 power plants, 600,000 miles of high and extra high voltage transmission lines and millions of miles of distribution lines.[1] At every instant in time, this system balances electricity supply and demand, and delivers power from distant generation units to energy consumers through a web of transmission and distribution networks. We have over 4 million miles of public roadways and over 600,000 bridges across the United States. Together, they facilitated 3.2 trillion vehicle miles traveled in 2019.[2] More than 16,000 wastewater treatment plants in the country and a web of tens to tens of thousands of miles of pipelines under small communities to large cities collect and process over 60 billion gallons of wastewater every day.[2] Similarly, we have other vast inter-

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[1] U.S. DOE, "Dynamic Line Rating Report to Congress", June 2019, *https://www.energy.gov/sites/default/files/2021/03/f83/DLR%20Report%20-%20June%202019%20final%20-%20FOR%20PUBLIC%20USE.pdf*.

[2] American Society of Civil Engineers, "2021 Report Card for America's Infrastructure" (Reston, VA), accessed July 14, 2021, *https://infrastructurereportcard.org/wp-content/uploads/2020/12/National-IRC-2021-report.pdf*.

connected and interdependent systems of telecommunication, water, dam, and levees, health care and emergency services, among many others, that provide immediate and long-term critical services to the society.[3]

**Challenges Facing Our Critical Infrastructure**

The current state of our critical infrastructure, however, is not good, and for many systems, the state is far from good. According to a nationwide assessment of the state of our critical infrastructure across the Nation by the American Society of Civil Engineers (ASCE), which I am a member of, America's infrastructure scores C-.[2 4] A grade of C means that the infrastructure state is mediocre and requires attention, and a grade of D means that the infrastructure is poor and at risk.[2]

Our infrastructure, for a long time, has been a source of pride for the Nation. The vast power grid, highway systems, water and wastewater networks, among our other infrastructure systems have changed the way of life, created jobs and provided many opportunities for growth for rural and urban communities. These systems that expanded to a significant degree shortly after World War II, have been challenged by a large set of factors including, among others, aging and deterioration; natural hazards, primarily climate and weather extremes; cyber and physical attacks; and shifting, and in some parts, increasing demands for infrastructure services, partly, because of increasing urbanization. The infrastructure needs have been increasing with systems and components reaching or passing their intended design lifetime, as this transition increases the rate of failure, and subsequently, the required replacement or costly maintenance and rehabilitation actions.[5] While local, State, and Federal Governments and public and private sectors have been investing in infrastructure, the needs have consistently exceeded investments, leading to a growing gap in infrastructure investments.[2]

The Nation's infrastructure was built long ago. As an example, parts of the power grid were built about a century ago, but a major expansion of the grid happened in 1950s and 1960s, with components and systems that had the design lifetime of about 50 years. Inspection of facilities built in 1960s and earlier have shown significant deterioration.[6] The traffic volume on bridges and roadways has increased by 18 percent from 2000 to 2019.[2] The increasing service demands along with aging have resulted in accelerated deterioration, which among other factors, have left 43 percent of our public roadways in poor or mediocre conditions and 7.5 percent of bridges (over 46,000 bridges) in the Nation in poor conditions.[2] In many cities, there are considerable portions of underground wastewater collection pipelines that are a century old. Infiltration, exfiltration and leakage are becoming more frequent, as these systems are aging and as traffic loads on our roadways are increasing, posing risks to public health and safety.[7 8]

Resilience concerns of our increasingly deteriorating—yet increasingly vital—critical infrastructure are further compounded by climate and weather extremes. The built environment in the U.S. is exposed to a broad range of climate and weather hazards. Since 1980, the country has sustained 298 billion-dollar weather and climate disasters[9 10] with the total cost of these events exceeding $1.975 trillion. The observed trends in these losses are concerning. The number of billion-dollar weather and climate disasters has increased from 2.9 events per year in 1980s to 12.3 events per year in 2010s. In the same period, the average annual loss by such events has

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[3] DHS, "Critical Infrastructure Sectors CISA", accessed July 13, 2021, *https://www.cisa.gov/critical-infrastructure-sectors.*

[4] The scoring is based on regular assessment of the state of the infrastructure and considers multiple factors including capacity, condition, funding, future need, operation and maintenance, public safety, resilience, and innovation. See ASCE Infrastructure Report Card 2021 for more details.

[5] Yousef Mohammadi Darestani, et al., "Life Cycle Resilience Quantification and Enhancement of Power Distribution Systems: A Risk-Based Approach", Structural Safety 90 (2021): 102075.

[6] PJM Regional Transmission Operator (RTO), "2019 Regional Transmission Expansion Plan (RTEP)", 2020, *https://www.pjm.com/library/reports-notices/rtep-documents.aspx.*

[7] Soroush Zamanian, Jieun Hur, and Abdollah Shafieezadeh, "Significant Variables for Leakage and Collapse of Buried Concrete Sewer Pipes: A Global Sensitivity Analysis via Bayesian Additive Regression Trees and Sobol'indices", Structure and Infrastructure Engineering, 2020, 1–13.

[8] Soroush Zamanian, Mehrzad Rahimi, and Abdollah Shafieezadeh, "Resilience of Sewer Networks to Extreme Weather Hazards: Past Experiences and an Assessment Framework", in *Pipelines 2020* (American Society of Civil Engineers Reston, VA, 2020), 50–59.

[9] A billion-dollar disaster refers to an event with the total incurred loss across all impacted areas exceeding $1 billion.

[10] NOAA National Centers for Environmental Information (NCEI), "U.S. Billion-Dollar Weather and Climate Disasters", 2021, DOI: 10.25921/stkw-7w73, *https://www.ncdc.noaa.gov/billions/*.

increased by a factor of 4.6 to $84.5 billion. In 2020, the number of billion-dollar disasters reached 22 incurring $98.9 billion in losses. Impacts of climate and weather extremes on our infrastructure have been significant. Historical data indicate that extreme weather events are the leading cause of power grid outages.[11] In the period of 1980 to 2012, the Nation observed an alarming tenfold increase in the number of outages.[12] The compounding effects of aging and deterioration and stresses from extreme events can substantially increase grid failures.[13] [14] The number of major power outages has remained high since 2012.[15] [16] Power outages inflicted an annual average loss on the U.S. economy of between $40 and $55 billion.[17] The lasting outages have also had detrimental impacts on public health especially for vulnerable populations.[18] [19] Similarly, the impacts of climate and weather extremes on the transportation infrastructure have been significant. Over 57 percent of 1948 recorded bridge collapses in the U.S. until 2014 have been linked to hydraulic causes, e.g., flooding.[20]

We are in a highly uncertain and increasingly volatile environment because of the changes in climate patterns, especially climate and weather extremes. We are not only concerned about single hazard types becoming more extreme, we are also concerned about the increasing likelihood of compound weather and climate events,[21] where combinations of multiple climate drivers or hazards can lead to significant losses.[22] Climate change is anticipated to impact many hazards to the built environment. Projections indicate that the relative sea level along the coasts of the U.S. may rise by over 14 inches by 2080 under a low global mean sea level rise scenario.[23] This scenario is very likely to be exceeded under various climate change projections. This small rise in relative sea level will increase the annual frequency of damaging flood events by 25 times,[23] which will have devastating impacts on buildings, energy, and transportation infrastructure and other critical built and natural systems in coastal regions, and will extend the reach of coastal flooding to areas further inland. While there are differences in the projected impacts, studies generally indicate that stresses to the built environment in the United States will increase, and in some parts of the country the increase will be substantial.[24]

Infrastructure design codes and standards have traditionally relied on statistical analysis of historical data to determine design loads for the intended service life of the systems. This approach would work well if the environment remains stationary meaning that there are no long-term temporal trends in loads. However, we are currently at a stage where we are observing trends that are changing loads. In addition, modern design codes for structures with new design philosophies and procedures were developed in late 1990s and early 2000s based on the lessons learned

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[11] Executive Office of the President., "Economic Benefits of Increasing Electric Grid Resilience to Weather Outages" (IEEE USA Books and eBooks, p. 29., 2013).

[12] Alyson Kenward and Urooj Raja, "Blackout: Extreme Weather, Climate Change and Power Outages", *Climate Central* 10 (2014): 1–23.

[13] Abdollah Shafieezadeh, et al., "Age-Dependent Fragility Models of Utility Wood Poles in Power Distribution Networks Against Extreme Wind Hazards", *IEEE Transactions on Power Delivery* 29, no. 1 (2013): 131-139.

[14] Yousef Mohammadi Darestani and Abdollah Shafieezadeh, "Multi-Dimensional Wind Fragility Functions for Wood Utility Poles", *Engineering Structures* 183 (2019): 937–948.

[15] Sayanti Mukherjee, Roshanak Nateghi, and Makarand Hastak, "A Multi-Hazard Approach To Assess Severe Weather-Induced Major Power Outage Risks in the U.S.", *Reliability Engineering & System Safety* 175 (2018): 283–305.

[16] Stephen A. Shield, et al., "Major Impacts of Weather Events on the Electrical Power Delivery System in the United States", *Energy* 218 (2021): 119434.

[17] Richard J. Campbell and Sean Lowry, "Weather-Related Power Outages and Electric System Resiliency" (Congressional Research Service, Library of Congress Washington, DC, 2012).

[18] Joan A. Casey, et al., "Trends from 2008–2018 in Electricity-Dependent Durable Medical Equipment Rentals and Sociodemographic Disparities", *Epidemiology* (Cambridge, Mass.) 32, no. 3 (2021): 327.

[19] Wangjian Zhang, et al., "Power Outage: An Ignored Risk Factor for COPD Exacerbations", *Chest* 158, no. 6 (2020): 2346-2357.

[20] Madeleine M. Flint, et al., "Historical Analysis of Hydraulic Bridge Collapses in the Continental United States", *Journal of Infrastructure Systems* 23, no. 3 (2017): 04017005.

[21] Omid Mazdiyasni and Amir AghaKouchak, "Substantial Increase in Concurrent Droughts and Heatwaves in the United States", Proceedings of the National Academy of Sciences 112, no. 37 (2015): 11484–89.

[22] Jakob Zscheischler, et al., "A Typology of Compound Weather and Climate Events", *Nature Reviews Earth & Environment* 1, no. 7 (2020): 333–347.

[23] William Sweet, et al., "Global and Regional Sea Level Rise Scenarios for the United States", 2017.

[24] Donald J. Wuebbles, et al., "Climate Science Special Report: Fourth National Climate Assessment (NCA4), Volume I", 2017.

from past failures and research on the performance of structures.[25] Many structures in the Nation's built environment, however, were designed and constructed long before modern standards and based on codes that are no longer considered adequate. In addition, changes in the characteristics of the environment over time, e.g., land use and its impacts, can result in conditions that significantly differ from those assumed during the design of infrastructure, therefore, posing risks that were not accounted for in the design process.

**Projected Costs for Improving the Resilience of Critical Infrastructure**

Proactive management of risks is substantially more effective than reactive strategies; however, insufficient resources have prevented infrastructure owners and operators from applying proactive measures in many cases. Instead actions are taken when failures occur or when the state of the infrastructure reaches a critical condition. The American Society of Civil Engineers has estimated that the investment gap in the Nation's critical infrastructure has grown from $2.06 trillion for the period of 2016–2025[26] to $2.59 trillion for 2020–2029[2] period. More detailed assessments of investment gaps by infrastructure type are available in ASCE's Report Card for America's Infrastructure.[2] These estimates of investments are primarily to address current and immediate future needs and to comply with current regulations. The investment needs will grow, if these systems are to be prepared for the anticipated stresses and expected service demands of the future. As an example, depending on the emissions scenario, 66,000 to 117,000 of the Nation's bridges are estimated to be vulnerable to increased peak flow risks because of climate change.[27] The total cost for adapting to these increased risks alone ranges from $140 to $250 billion.[28]

**Solutions to Infrastructure Challenges**

The Nation's infrastructure plays a critical role for many activities of the society, in supporting the economy and serving the public safety and national security. As elaborated earlier, these systems, however, face a wide spectrum of near-term and long-term challenges in an environment that is highly uncertain and increasingly volatile. In order to prepare our infrastructure for such environments, I recommend the following solutions.

*Strategic Investments in Our Infrastructure*

We are in an environment where risks to our infrastructure are not static but dynamic, the needs are evolving, and the environment is uncertain. In response, we need a long-term national vision for the resilience of our infrastructure with sustained investment plans for adaptive, robust strategies. Mitigation of hazard risks to buildings and other infrastructure systems are among the most effective ways to reduce losses and enhance the resilience of the built environment. Cost-benefit studies of such investments have shown high benefit to cost ratios in the order of 11 to 1 for adopting the latest building codes, 4 to 1 for above-code design of buildings, and 4 to 1 for applying common and practical retrofit measures to our existing building stock.[28] Every dollar spent on resilience investments for businesses has reduced business interruption losses under major hazards by over $4.5. Retrofitting bridges and hardening the power grid are shown to yield significant benefits over the life of these systems.[29] [30] [31] To maximize gains, the mitigation investments must consider strategies that improve infrastructure resilience against multihazard

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[25] Jim Rossberg and Roberto T. Leon, "Evolution of Codes in the USA", ASCE. *https://www.Nehrp.Gov/Pdf/UJNR-2013-Rossberg-Manuscript.pdf (Sept. 29, 2019), 2013.*

[26] American Society of Civil Engineers, "2017 Report Card for America's Infrastructure" (Reston, VA), accessed July 14, 2021, *https://2017.infrastructurereportcard.org/wp-content/uploads/2019/02/Full-2017-Report-Card-FINAL.pdf.*

[27] Len Wright, et al., "Estimated Effects of Climate Change on Flood Vulnerability of U.S. Bridges," *Mitigation and Adaptation Strategies for Global Change* 17, no. 8 (2012): 939-955.

[28] Multi-Hazard Mitigation Council, "Natural Hazard Mitigation Saves: 2019 Report" (Washington, DC: National Institute of Building Sciences, 2019), *https://www.nibs.org/files/pdfs/NIBS-MMC-MitigationSaves-2019.pdf.*

[29] Ehsan Fereshtehnejad and Abdollah Shafieezadeh, "A Multi-Type Multi-Occurrence Hazard Lifecycle Cost Analysis Framework for Infrastructure Management Decision Making", *Engineering Structures* 167 (2018): 504–517.

[30] Nariman L. Dehghani, Ashkan B. Jeddi, and Abdollah Shafieezadeh, "Intelligent Hurricane Resilience Enhancement of Power Distribution Systems via Deep Reinforcement Learning", *Applied Energy* 285 (2021): 116355.

[31] Nariman L. Dehghani, Chi Zhang, and Abdollah Shafieezadeh, "Evolutionary Optimization for Resilience-Based Planning for Power Distribution Networks", in *Nature-Inspired Computing Paradigms in Systems* (Elsevier, 2021), 47–61.

[32] Jieun Hur and Abdollah Shafieezadeh, "Multi-Hazard Probabilistic Risk Analysis of Off-Site Overhead Transmission Systems", in *SMiRT-25* (Charlotte, NC: IASMiRT, 2019).

risks.[30] [32] Moreover, early application of climate adaptation measures to deficient infrastructure can substantially reduce adaptation costs.[28] A critical point to note here is that infrastructure stakeholders including owners, operators, and users may not be able to afford the upfront costs of resilience projects, even for cases where the benefit to cost ratio is high. Therefore, resilience strategies may need to be incentivized through measures such as reduced insurance rates and premiums; Federal, State, or local grants for resilience strategies; tax incentives; mortgages and loans for mitigation plans; and improved resilience-based codes. [33]

As resources are limited, the short- and long-term infrastructure needs must be characterized and prioritized.[34] [35] We must develop and apply tools for life-cycle cost and life-cycle performance (e.g., life-cycle resilience [36]) analysis to evaluate infrastructure projects. Future projects should have funding plans that cover maintenance, operation, and end of service life costs, in addition to the initial costs of projects. Reliable characterization and prioritization of needs require extensive data from the built environment. Facilitating the application of sensing technologies at large scales to various elements of our existing and new infrastructure along with broadband communication and technologies such as digital twin to collect, transfer, process, and learn from the data can enable highly effective proactive risk management for our infrastructure systems.

*Integration of Equity Considerations in Risk Distribution Into Infrastructure Decisions*

Apart from technical challenges, we face very important questions at the interface of science and policy about the distribution of risks. Socioeconomically vulnerable communities are taking a higher share of infrastructure disruption risks relative to the rest of the population. This disparity manifests in both hazard exposure and impacts of disruptions. In all stages of resilience response including predisaster mitigation projects as well as infrastructure and community recovery, we should consider the eventual impacts and benefits for different populations in the society, especially the vulnerable populations, to ensure that the risks are equitably shared.

*Support Research and Development for Resilient Infrastructure and Communities*

Infrastructure resilience is a highly complex problem with significant knowledge gaps in many areas including, among others, (i) evolving characteristics of hazards, (ii) physical and operational performance of the built environment during and in the aftermath of extreme, uncertain conditions of natural hazards, (iii) interactions of built, natural, and human systems over time and space, and (iv) innovative technologies and strategies that enable robust, adaptive, and cost-effective pathways to infrastructure resilience in the evolving uncertain hazard environment. We must increase investment in basic and applied research to address these gaps in science and technology. Moreover, critical infrastructure resilience research is often hampered by limited access to reliable integrated and spatially explicit data related to infrastructure and hazard impacts. Policies are needed to require critical infrastructure owners and operators to collect and make the data available. This step, in addition to benefiting research to understand and enhance resilience, will lend to a transparent environment where infrastructure stakeholders can learn about the performance of service providers and make informed decisions for risk management.

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[33] Multi-Hazard Mitigation Council, "Developing Pre-Disaster Resilience Based on Public and Private Incentivization" (Washington, DC: National Institute of Building Sciences, 2015), *https://www.nibs.org/files/pdfs/NIBS-MMC-ResilienceIncentivesWP-2015.pdf*.

[34] Ehsan Fereshtehnejad, Abdollah Shafieezadeh, and Jieun Hur, "Optimal Budget Allocation for Bridge Portfolios With Element-Level Inspection Data: A Constrained Integer Linear Programming Formulation", *Structure and Infrastructure Engineering*, 2021, 1–15.

[35] Ehsan Fereshtehnejad, et al., "Ohio Bridge Condition Index: Multilevel Cost-Based Performance Index for Bridge Systems", *Transportation Research Record* 2612, no. 1 (2017): 152–160.

[36] Nariman L. Dehghani, Yousef Mohammadi Darestani, and Abdollah Shafieezadeh, "Optimal Life-Cycle Resilience Enhancement of Aging Power Distribution Systems: A MINLP-Based Preventive Maintenance Planning", *IEEE Access*, 2020.

# PREPARED STATEMENT OF RACHEL CLEETUS

POLICY DIRECTOR, UNION OF CONCERNED SCIENTISTS

JULY 20, 2021

**Testimony of Dr. Rachel Cleetus,**
**Policy Director, Climate and Energy Program, Union of Concerned Scientists**

***"21st Century Communities: Climate Change, Resilience, and Reinsurance"***

**Hearing before the Senate Committee on Banking, Housing and Urban Affairs**

**July 20, 2021**

Hello and thank you, Chairman Brown, Ranking Member Toomey, and Members of the Committee, for providing me the opportunity to testify remotely today. My name is Rachel Cleetus, and I am the policy director and lead economist for the climate and energy program at the Union of Concerned Scientists.

The science on climate change and the real-world evidence of worsening climate impacts are clear. I welcome the opportunity here today to talk about solutions—solutions that can help safeguard people, critical ecosystems, our economy, and our future wellbeing. We cannot delay any longer.

Summer has just begun here in the US, and we are faced with intense drought, wave upon wave of extreme heat, a fiery start to what is likely to be a terrible wildfire season, an early start to a hurricane season that is projected to be above normal, and flash flooding in the Midwest.[1] The Bootleg fire in Oregon, now the largest wildfire burning in the nation, has burned over 300,000 acres thus far.[2] Last week's catastrophic flooding in Germany and Belgium, with a death toll of over 180 people, was precipitated by record-breaking rainfall and has been called a once-in-a-thousand-year event. These disasters bear the clear fingerprints of climate change. For example, scientists have confirmed that the incredible, anomalous recent heatwave in the Pacific Northwest would have been virtually impossible without climate change.[3] We are now living in a climate-altered world, with the dice loaded and the odds greatly increased for many types of extreme weather. Meanwhile, accelerating sea level rise and ocean acidification are slow-moving disasters, poised to unleash profound consequences.

Underlying all this, data from NOAA and NASA show that we are continuing to see a relentless rising trend in global average temperatures, with 2020 ranking as the warmest or second warmest year on record (tied with 2016 or just behind it).[4] The summer of 2020 was the warmest on record for the Northern Hemisphere.[5] The seven warmest years in the 1880–2020 record have all occurred since 2014. The 10 warmest years have occurred since 2005. 2020 is the 44th consecutive year (since 1977) above the 20th century average, meaning that no one under the age of 44 has ever experienced a cooler-than-average year. The global average temperature has risen over 2 degrees Fahrenheit (1.2C) since the Industrial Revolution began in the late 1800s.

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[1] https://blog.ucsusa.org/pablo-ortiz/can-the-us-survive-californias-drought/; https://blog.ucsusa.org/kristy-dahl/is-another-brutal-heat-and-wildfire-season-in-store-for-us-west-heres-what-we-know/; https://blog.ucsusa.org/adrienne-hollis/the-2021-hurricane-season-begins-six-major-risks-were-watching/

[2] https://inciweb.nwcg.gov/incident/article/7609/61204/

[3] https://www.worldweatherattribution.org/western-north-american-extreme-heat-virtually-impossible-without-human-caused-climate-change/

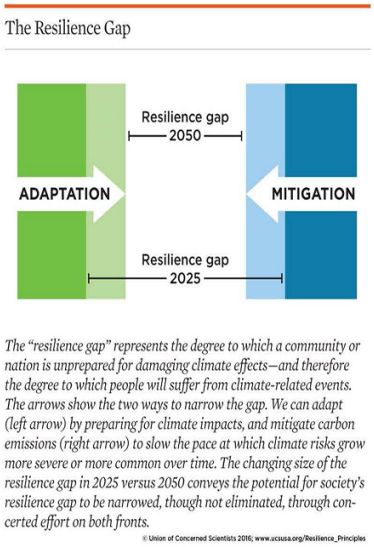
[4] 2020 is tied with 2016 as the warmest year, according to NASA: https://www.giss.nasa.gov/research/news/20210114/, and is the second warmest, behind 2016 by a slight margin, according to NOAA: https://www.ncdc.noaa.gov/sotc/global/202013

[5] https://www.noaa.gov/news/northern-hemisphere-just-had-its-hottest-summer-on-record

In addition, the COVID-19 pandemic and the economic crisis it unleashed are far from over. All of this means that many communities, businesses and frontline emergency responders around the country are being forced to cope with a complex set of compounding risks.

We must take robust action on two fronts: sharply curtail the heat-trapping emissions that are fueling climate change; and invest in making our communities and infrastructure more resilient to the impacts of climate change. We cannot treat these disasters as one-off events but must respond proactively to the sobering trends the science indicates we are facing. Adaptation is costly, and there are limits to how much climate change we can adapt to, so emissions reductions in line with the goals of the Paris Agreement are critical. Our goal must be to limit the resilience gap for communities, through a combination of adaptation and mitigation measures (see figure 1).

**Figure 1: Closing the Resilience Gap**




*The "resilience gap" represents the degree to which a community or nation is unprepared for damaging climate effects—and therefore the degree to which people will suffer from climate-related events. The arrows show the two ways to narrow the gap. We can adapt (left arrow) by preparing for climate impacts, and mitigate carbon emissions (right arrow) to slow the pace at which climate risks grow more severe or more common over time. The changing size of the resilience gap in 2025 versus 2050 conveys the potential for society's resilience gap to be narrowed, though not eliminated, through concerted effort on both fronts.*



There is no time to waste to act. Bold, just, and equitable climate action is the surest path to limiting the worst impacts of climate change, protecting communities, and unlocking the tremendous opportunities of an economy powered by clean energy.

## I. The Science is clear

The US Fourth National Climate Assessment (NCA) —a quadrennial report mandated by Congress since 1990—was released in November 2018.[6] Drafted by thirteen federal agencies and drawing on the best available science, the report emphasized that climate change is not about some distant future; communities around our nation are already coping with record-breaking heat, flooding, wildfires and accelerating sea level rise. The report's stark conclusion is that these climate-related impacts will only get worse and their costs will mount dramatically if carbon emissions continue unabated.

Growing scientific evidence shows a trend of hurricanes intensifying faster, and becoming wetter, slower and more destructive—which is linked to climate change.[7,8,9,10] In the early 1980s, hurricanes had a roughly 1-in-100 chance of undergoing rapid intensification. Those odds increased to 1-in-20 by 2005.[11] In 2020, there were a record-breaking 30 tropical storms in the Atlantic, of which 12 made landfall in and seven were billion dollar plus disasters.[12] The 2020 hurricane season saw 10 storms that intensified rapidly, a trend that scientists link to climate change.[13]

Hotter, drier conditions in the western US are driving longer and more intense wildfire seasons.[14,15] Recent studies have attributed over half of the observed trends in the dryness of wildfire fuels and forest fire areas directly to climate factors.[16] A history of mismanagement of forests and wildfires, along with growing development in wildfire prone areas, is also raising risks to people, property and ecosystems.

In 2020, the nation experienced nearly 59,000 wildfires which burned approximately 10.12 million acres, the second highest total area affected in single year, just behind 2015.[17] About 40 percent of the burned area was in California alone.[18] Five of California's six largest fires on record occurred in 2020.[19] Engulfing approximately 1 million acres, the 2020 August Complex fire became California's largest ever wildfire, doubling the previous record. In Alaska, where temperatures are increasing twice as fast as the

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[6] US Global Change Research Program (USGCRP). 2018. Fourth national climate assessment: Impacts, risks, and adaptation in the United States, volume 2. Washington, DC. Online at https:// nca2018.globalchange.gov.
See also: US Global Change Research Program (USGCRP). 2017. Fourth national climate assessment: Climate Science Special Report, volume 1. Washington, DC. Online at https://science2017.globalchange.gov/

[7] Holland, G., Bruyère, C.L. Recent intense hurricane response to global climate change. *Clim Dyn* **42,** 617–627 (2014). https://doi.org/10.1007/s00382-013-1713-0

[8] Patricola, C.M., Wehner, M.F. Anthropogenic influences on major tropical cyclone events. *Nature* **563,** 339–346 (2018). https://doi.org/10.1038/s41586-018-0673-2

[9] Hall, T.M., Kossin, J.P. Hurricane stalling along the North American coast and implications for rainfall. *npj Clim Atmos Sci* **2,** 17 (2019). https://doi.org/10.1038/s41612-019-0074-8

[10] Aslak Grinsted, Peter Ditlevsen, Jens Hesselbjerg Christensen. Normalized US hurricane damage estimates using area of total destruction, 1900–2018.Proceedings of the National Academy of Sciences Nov 2019, 116 (48) 23942-23946; DOI: 10.1073/pnas.1912277116.

[11] https://journals.ametsoc.org/jcli/article/31/20/8281/92614/Projected-Response-of-Tropical-Cyclone-Intensity

[12] https://www.climate.gov/news-features/blogs/beyond-data/2020-us-billion-dollar-weather-and-climate-disasters-historical

[13] https://blog.ucsusa.org/astrid-caldas/rapid-intensification-unprecedented-number-of-storms-make-2020-a-record-hurricane-season/

[14] https://www.ucsusa.org/resources/climate-change-and-wildfires

[15] UCS Infographic: Wildfires and Climate Change. https://www.ucsusa.org/resources/infographic-wildfires-and-climate-change

[16] http://www.pnas.org/content/113/42/11770.short

[17] Data from the NIFC: https://www.nifc.gov/fire-information/statistics/wildfires. NICC data show that 2020 had the second highest annual total of area burned. https://fas.org/sgp/crs/misc/IF10244.pdf

[18] https://fas.org/sgp/crs/misc/IF10244.pdf

[19] https://www.fire.ca.gov/media/4jandlhh/top20_acres.pdf

rest of the country, wildfires have been increasing in frequency and size.[20] While Alaska's boreal forests evolved with fire, current fire regimes surpass those of the previous 3,000 years.[21] Four of the 10 largest fire years on record have occurred in the past 15 years, with each burning over 2 million acres. Fire patterns and behavior are also changing in the southeastern United States, where drought, pathogens, and insect infestations are changing ecosystems and raising fire risks.[22]

Communities are experiencing compound risks from the overlap of the COVID-19 pandemic, the economic crisis it triggered, and ongoing climate and extreme-weather related disasters.[23,24] Unfortunately, the future is likely to bring more of these types of situations. The current crises also are laying bare all the fundamental inequities in our society, including racism, the wealth and income gap, unaffordable healthcare, and economic disparities faced by rural communities. Recent studies and CDC data show that COVID-19 is inflicting a disproportionately deadly toll on African Americans, Latinos and Indigenous communities, for example.[25,26] We also know that climate change and the economic crisis are exacerbating these inequities.[27,28]

In 2020, the nation experienced a record-breaking 22 extreme weather and climate related disasters that each cost at least one billion dollars (see Figure 2).[29] This was the sixth year in a row where 10 or more billion dollar-plus extreme events occurred. As of July 9, the nation has already experienced eight such disasters in 2021.[30] Hurricanes Harvey, Irma, Maria and Sandy, all of which occurred in the last decade, are four of the five costliest billion-dollar disasters. The last four years have also brought three of the most destructive and costly wildfire seasons, with California suffering the most harm. These disasters are not just costly in economic terms, they take a profound toll on people, including causing death, injury and other lasting harms. The intense heatwave in the Pacific Northwest last month is estimated to have caused over 100 deaths, leading local officials in Oregon to call it a "mass casualty event."

These types of physical risks of climate change pose challenges for many facets and sectors of the economy, including infrastructure, agriculture, fisheries, insurance, real estate and tourism. The impact on the health, safety and productivity of workers, especially those who work outdoors, is also significant.

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[20] https://science2017.globalchange.gov/chapter/11/

[21] https://www.pnas.org/content/110/32/13055

[22] https://www.ucsusa.org/resources/climate-change-and-wildfires

[23] Phillips, C.A., Caldas, A., Cleetus, R. *et al.* Compound climate risks in the COVID-19 pandemic. *Nat. Clim. Chang.* **10,** 586–588 (2020). https://doi.org/10.1038/s41558-020-0804-2

[24] Sen Pei, Kristina A. Dahl, Teresa K. Yamana, Rachel Licker, Jeffrey Shaman. Compound risks of hurricane evacuation amid the COVID-19 pandemic in the United States.
medRxiv 2020.08.07.20170555; doi: https://doi.org/10.1101/2020.08.07.20170555

[25] Yancy CW. COVID-19 and African Americans. *JAMA.* 2020;323(19):1891–1892. doi:10.1001/jama.2020.6548. https://jamanetwork.com/journals/jama/fullarticle/2764789

[26] https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html

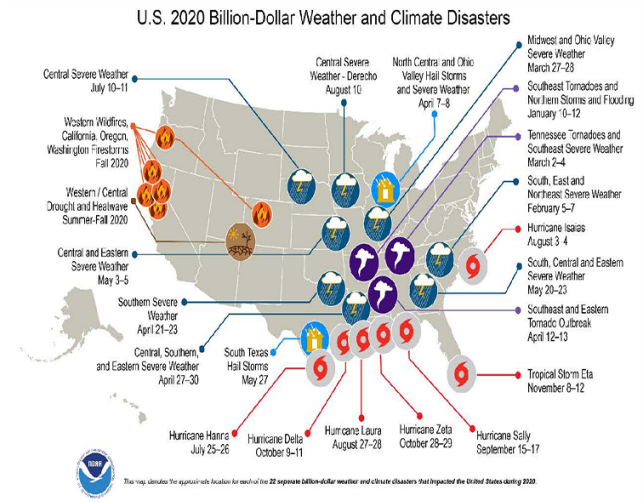
[27] https://blog.ucsusa.org/adrienne-hollis/african-americans-are-disproportionately-exposed-to-extreme-heat

[28] https://blog.ucsusa.org/rachel-cleetus/economic-recovery-depends-on-controlling-the-covid-19

[29] NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2021). https://www.ncdc.noaa.gov/billions/, DOI: 10.25921/stkw-7w73

[30] https://www.ncdc.noaa.gov/billions/

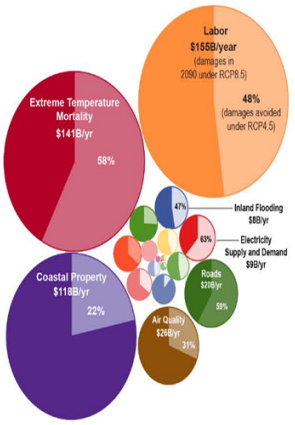
**Figure 2: U.S. 2020 Billion-Dollar Weather and Climate Disasters**




## II. Climate change is a challenge to our economy and prosperity

According to the Fourth NCA, under high emissions scenarios with little or no adaptation, annual losses in some sectors are projected to exceed $100 billion by the end of the century and surpass the gross domestic product of many states. Some of the most consequential impacts the report highlights include premature mortality due to extreme temperatures and poor air quality, loss in labor productivity with rising temperatures and loss in the value of coastal property due to accelerating sea level rise. Critical infrastructure—including roads and bridges, water and stormwater, and power—is also at risk. However, making swift and deep cuts in global emissions can help limit climate change and significantly curtail the magnitude of these impacts (see figure 3).

**Figure 3: Projected U.S. damages and potential for risk reduction by sector**




| Annual Economic Damages in 2090 | | |
|---|---|---|
| Sector | Annual damages under RCP8.5 | Damages avoided under RCP4.5 |
| Labor | $155B | 48% |
| Extreme Temperature Mortality◊ | $141B | 58% |
| Coastal Property◊ | $118B | 22% |
| Air Quality | $26B | 31% |
| Roads◊ | $20B | 59% |
| Electricity Supply and Demand | $9B | 63% |
| Inland Flooding | $8B | 47% |
| Urban Drainage | $6B | 26% |
| Rail◊ | $6B | 36% |
| Water Quality | $5B | 35% |
| Coral Reefs | $4B | 12% |
| West Nile Virus | $3B | 47% |
| Freshwater Fish | $3B | 44% |
| Winter Recreation | $2B | 107% |
| Bridges | $1B | 48% |
| Munic. and Industrial Water Supply | $316M | 33% |
| Harmful Algal Blooms | $199M | 45% |
| Alaska Infrastructure◊ | $174M | 53% |
| Shellfish* | $23M | 57% |
| Agriculture* | $12M | 11% |
| Aeroallergens* | $1M | 57% |
| Wildfire | −$106M | −134% |

*Source: Fourth National Climate Assessment,[31] adapted from EPA 2017*[32]

The total area of each circle represents the projected annual economic damages (in 2015 dollars) under a higher scenario of climate change (RCP8.5) in 2090 relative to a no-change scenario. The decrease in damages under a lower scenario (RCP4.5) compared to RCP8.5 is shown in the lighter-shaded area of each circle. Adaptation was shown to reduce overall damages in sectors marked by the diamond symbol. Asterisks denote sectors with annual damages that may not be visible at the given scale.

The Global Risks Report 2021, part of the World Economic Forum's Global Risk Initiative, identified 'extreme weather' and 'climate action failure' as the top two risks by likelihood that the world faces in the next ten years.[33] Climate action failure ranks second, just behind infectious diseases, as the top risk by impact.

Last year, the Commodity Futures Trading Commission (CFTC), released a report titled "*Managing Climate Risk in the Financial System.*"[34] The first-of-its-kind CFTC report sends another clear signal that

[31] Fourth National Climate Assessment, Chapter 29: Reducing risks through emissions mitigation. https://nca2018.globalchange.gov/chapter/29/

[32] EPA. 2017. Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment. U.S. Environmental Protection Agency, Washington, D.C. https://cfpub.epa.gov/si/si_public_record_Report.cfm?Lab=OAP&dirEntryId=335095

[33] http://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2021.pdf

[34] See https://www.cftc.gov/PressRoom/PressReleases/8234-20

climate change poses a significant risk to our economy and financial system. If left unaddressed, these risks—which include flooding exacerbated by sea level rise and heavy rainfall, extreme heat, and worsening wildfires—will escalate untenably and harm our prosperity and well-being today and into the future. Markets for agricultural commodities, real estate, insurance and mortgages are among those highly exposed to these risks, as are the supply chains of many companies. Liability risks for fossil fuel companies, whose products are the main drivers of climate change, are mounting as cities, counties and states file lawsuits against these companies, including ExxonMobil and Chevron, to recover the costs of climate damages and fraud.

Major banks including JP Morgan, Goldman Sachs, Bank of America and Citigroup have all made recent regulatory filings noting that climate change poses a material risk to their businesses. JP Morgan's 2020 annual report to the SEC[35] states that "*Climate change manifesting as physical or transition risks could have a material adverse impact on JPMorgan Chase's business operations, clients and customers*" And "*…climate-related physical risks and transition risks could have a financial impact on JPMorgan Chase both directly on its business and operations and as a result of material adverse impacts to its clients and customers, including: declines in asset values; reduced availability of insurance; significant interruptions to business operations, and negative consequences to business models, and the need to make changes in response to those consequences.*"

A recent report from McKinsey & Company notes that the physical risks of climate change are increasing, spatial in how they manifest, non-stationary, nonlinear, systemic and regressive.[36] The report notes that climate impacts are already evident around us and that climate change is already having measurable socioeconomic impacts. The range of impacts going forward could include impacts on livability and workability, food systems, physical assets, infrastructure services and natural capital.

In December 2019 the Federal Reserve Bank of San Francisco hosted its first-ever conference on the 'Economics of Climate Change.' Reporting on the meeting, a bulletin from the Bank[37] says:

- Climate change will have sweeping effects on our economy and financial system (Network for Greening the Financial System 2018, hereafter NGFS; USGCRP 2018). Climate-related shifts in the physical environment can slow economic growth, increase volatility, and depreciate the value of business and household assets and property. Avoiding further climate change will involve a substantial transformation of the economy. Consequently, climate change appears increasingly relevant to central bankers and financial supervisors for achieving their macroeconomic, inflation, and financial stability mandates (NGFS 2018, Rudebusch 2019).
- Climate change has long-term macroeconomic implications for worker productivity and the composition and profitability of business investment. Solomon Hsiang (U.C. Berkeley) presented research on how warmer temperatures make exposed workers less productive. This is particularly important for outdoor workers, as in agriculture and construction. Over time, the higher temperatures may result in significant losses for the overall economy and notable shifts in the occupations workers choose.
- There are wide differences in how climate change affects various areas of the world. Moreover, regional disparities in resources, policies, and technology only exacerbate these differences. Still,

[35] https://jpmorganchaseco.gcs-web.com/node/366736/html
[36] https://www.mckinsey.com/business-functions/sustainability/our-insights/climate-risk-and-response-physical-hazards-and-socioeconomic-impacts
[37] https://www.frbsf.org/economic-research/publications/economic-letter/2019/december/economics-climate-change-first-fed-conference/

changes in one region of the world can have consequences elsewhere, including people migrating to avoid adverse climate developments and extreme natural events disrupting international trade.

- As economies adapt to climate change and gradually switch from carbon-based, so-called brown, energy to greener energy alternatives, the value of assets associated with brown technologies will decline and, in the extreme, assets may become "stranded."

The Government Accountability Office's (GAO's) High Risk report series have repeatedly flagged climate change as a key area of fiscal exposure for the federal government, including in its 2019 report.[38] It calls for limiting this exposure by better managing climate risks, including through proactive steps to reduce risks ahead of disasters as part of a comprehensive resilience investment strategy.

Zillow and Freddie Mac, two influential entities in the real estate sector, have both released reports in the last few years examining the impact of future sea level rise on coastal real estate.[39,40] Freddie Mac finds that sea level rise could "destroy billions of dollars in property and displace millions of people," with the resulting social and economic impacts "greater in total than those experienced in the housing crisis and Great Recession." The credit rating agencies Moody's and Standard & Poor's have begun to evaluate and communicate how to account for climate risks in their credit ratings.

The impact on the insurance market is serving as an early warning sign of the systemic and growing risks of climate change. The federally backed National Flood Insurance Program (NFIP), vital to millions of homeowners, is struggling with growing debt triggered by extreme flooding disasters and has been repeatedly cited by the Government Accountability Office (GAO) as a growing source of risk to the federal government.[41,42] The federal crop insurance program, also affected by floods and droughts, has been similarly cited by the GAO. Worsening wildfire seasons in the western U.S. are causing private insurance companies to raise insurance rates and/or drop policyholders, in some cases triggering temporary stop-gap actions by state regulators to help protect consumers. Major reinsurers like Munich Re, Swiss Re and Zurich Re, have repeatedly highlighted the growing risks of climate change globally—with the U.S. ranking high in terms of the dollar value of losses.

Unfortunately, instead of taking into account the latest scientific projections and incorporating the risks into market decisions in a proactive way, the financial system is still largely operating in a reactive, one-off way when disasters strike. A combination of short-sightedness, maladaptive policies and business-as-usual inertia is getting in the way of the transformative resilience we need to build. Many US businesses do increasingly understand that climate change is an economic threat and that there are significant economic opportunities in the transition to a low-carbon economy. And most forward-thinking companies recognize that addressing climate change will require robust federal action.

[38] https://www.gao.gov/assets/700/697245.pdf

[39] https://www.zillow.com/research/climate-change-underwater-homes-12890/ and https://www.zillow.com/research/climate-change-underwater-homes-2-16928/

[40] http://www.freddiemac.com/research/insight/20160426_lifes_a_beach.page

[41] https://www.gao.gov/highrisk/limiting-federal-governments-fiscal-exposure-better-managing-climate-change-risks

[42] https://www.gao.gov/highrisk/national-flood-insurance-program

## III. UCS Research on some major threats posed by climate change

**Extreme Heat**

Extreme heat is one of the most harmful and deadly hazards we face. A 2019 analysis from UCS provides a detailed view of how extreme heat events caused by dangerous combinations of temperature and humidity are likely to become more frequent and widespread in the United States over this century as a result of climate change (see Table 1 and figure 4). Without global action to reduce heat-trapping emissions, the number of days per year when the heat index—or "feels like" temperature—exceeds 100 degrees Fahrenheit would more than double from historical levels to an average of 36 across the country by midcentury and increase four-fold to an average of 54 by late century. The number of days per year when the heat index exceeds 105 degrees Fahrenheit would quadruple from historical levels (1970-2000) such that more than 150 of our larger cities across the country (cities with a population greater than 50,000) would experience an average of 30 or more days per year with a heat index above 105. That is compared to 3 such cities today.

By the end of the century, with no action to reduce global emissions, about 120 million people across the US—more than one-third of today's population—would experience the equivalent of a week or more of conditions so hot they exceed the upper limit of the National Weather Service's current heat index scale and a heat index would be incalculable. Such "off-the-charts" conditions could pose unprecedented health risks. Among those most vulnerable to the impacts of extreme heat include the elderly, the very young, outdoor workers, those with pre-existing health conditions, low or fixed-income households that may not have access to air conditioning or may not be able to afford paying higher electric bills to run it, people living in urban areas where the heat island effect can exacerbate extreme heat, the homeless, and incarcerated people.

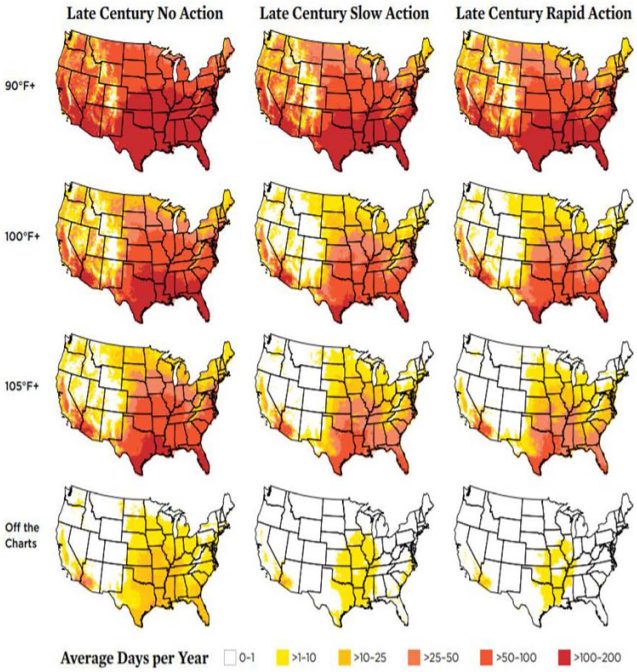
**Table 1: Extreme heat will become more severe and frequent in every region of the country**

| Time Period | Scenario | Heat Index Threshold | Mid-west | North-east | N. Plains | North-west | South-east | S. Plains | South-west | US |
|---|---|---|---|---|---|---|---|---|---|---|
| Historical | - | 90°F | 25 | 13 | 13 | 6 | 69 | 71 | 37 | 41 |
| Midcentury | No Action | 90°F | 62 | 40 | 36 | 20 | 113 | 109 | 60 | 69 |
| Midcentury | Slow Action | 90°F | 54 | 32 | 31 | 16 | 105 | 102 | 54 | 63 |
| Late Century | No Action | 90°F | 90 | 70 | 57 | 37 | 140 | 134 | 84 | 93 |
| Late Century | Slow Action | 90°F | 63 | 39 | 37 | 21 | 113 | 109 | 60 | 70 |
| -[9] | Rapid Action | 90°F | 56 | 34 | 32 | 17 | 107 | 104 | 56 | 65 |
| Historical | - | 100°F | 6 | 3 | 3 | 1 | 15 | 21 | 23 | 14 |
| Midcentury | No Action | 100°F | 30 | 14 | 12 | 4 | 65 | 61 | 24 | 36 |
| Midcentury | Slow Action | 100°F | 22 | 10 | 8 | 3 | 51 | 51 | 22 | 30 |
| Late Century | No Action | 100°F | 53 | 32 | 24 | 11 | 96 | 88 | 35 | 54 |
| Late Century | Slow Action | 100°F | 27 | 12 | 10 | 4 | 60 | 57 | 24 | 34 |
| - | Rapid Action | 100°F | 22 | 10 | 8 | 3 | 52 | 52 | 22 | 31 |
| Historical | | 105°F | 3 | 2 | 2 | 0 | 4 | 7 | 13 | 5 |
| Midcentury | No Action | 105°F | 17 | 8 | 6 | 2 | 40 | 39 | 17 | 24 |
| Midcentury | Slow Action | 105°F | 12 | 5 | 4 | 1 | 27 | 30 | 17 | 18 |
| Late Century | No Action | 105°F | 38 | 20 | 14 | 5 | 73 | 66 | 22 | 40 |
| Late Century | Slow Action | 105°F | 15 | 7 | 5 | 2 | 34 | 35 | 17 | 22 |
| - | Rapid Action | 105°F | 12 | 5 | 4 | 1 | 27 | 30 | 18 | 19 |
| Historical | - | Off the Charts | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| Midcentury | No Action | Off the Charts | 2 | 1 | 1 | 1 | 3 | 3 | 8 | 3 |
| Midcentury | Slow Action | Off the Charts | 2 | 1 | 1 | 0 | 2 | 2 | 6 | 2 |
| Late Century | No Action | Off the Charts | 7 | 3 | 3 | 2 | 12 | 12 | 10 | 9 |
| Late Century | Slow Action | Off the Charts | 2 | 1 | 1 | 1 | 2 | 3 | 7 | 3 |
| - | Rapid Action | Off the Charts | 2 | 1 | 1 | 0 | 2 | 2 | 7 | 2 |

*As heat-trapping emissions rise, each region of the country is projected to experience an increase in the average number of days per year with heat above the thresholds analyzed in this study.*

The report also shows how actions taken, or not taken, within the next few years to reduce global emissions will help determine how hot and humid our future becomes. If the goal of the Paris Agreement is met and future global average warming is limited to 2 degrees Celsius, by late century the United States would see half the number of days per year, on average, with a heat index above 105 degrees Fahrenheit, and almost 115 million fewer people would experience the equivalent of a week or more of "off-the-charts" heat days. The longer the U.S. and other countries wait to drastically reduce emissions, the less feasible it will be to realize the "rapid action scenario" analyzed.

Figure 4: Frequency of extreme heat depends on the choices we make



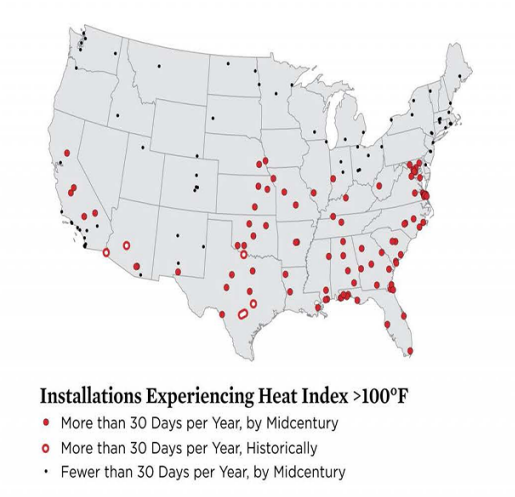

*The emissions choices we make in the coming decades will profoundly shape the frequency and severity of extreme heat later this century. With no action to reduce global emissions, the contiguous United States would face an average of twice as many days with a heat index above 105°F in late century as it would with rapid action.*

UCS also used its data and methodology for extreme heat projections to analyze how the frequency of days with dangerous heat at sizable Air Force, Army, Marine Corps, and Navy installations in the contiguous US is projected to change in the coming decades (See figure 5).[43] Our results show that with no action to reduce global heat-trapping emissions, on average, by midcentury US installations would experience nearly five times as many days with a heat index above 100°F as they have historically. These results imply that living, working, and training at US military bases is poised to become increasingly risky for servicepeople and their families over the course of the next few decades and in every branch of the armed forces.

[43] https://blog.ucsusa.org/kristy-dahl/military-extreme-heat

We found that by midcentury, with no action to reduce global emissions, sizable military installations in the US would, on average, experience an additional 33 days per year with a heat index above 100°F. For some bases, however, the increase is much larger. Fort Sill in Oklahoma, for instance, is projected to experience an additional 53 days per year of dangerous heat by midcentury. Fort Campbell in Kentucky would experience an additional 51 days per year with a heat index above 100°F. And in cases like Luke Air Force Base in Arizona, the heat would be much more extreme: an additional 17 days per year with a heat index above a scorching 120°F.

**Figure 5: Projections of extreme heat at US military installations by mid-century**




*Historically, only nine major military installations in the US have experienced 30 or more days per year with a heat index above 100°F. By midcentury, with no action to reduce emissions, 100 installations would experience such conditions.*

**Sea Level Rise:**

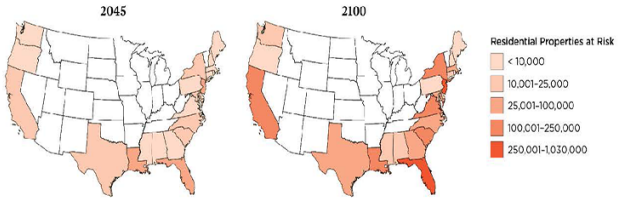
UCS research on the impacts of sea level rise to coastal communities shows that long before rising seas permanently submerge properties, millions of Americans living in coastal communities will face more frequent and disruptive high-tide flooding. By the end of the century, under a high sea level rise scenario,[44] approximately 2.5 million US coastal homes and commercial properties currently worth more

[44] The high scenario, which is drawn from the 2014 National Climate Assessment, assumes rapid ice sheet loss and projects a global average sea level rise of 6.6 feet (2.0 m) above 1992 levels by the end of this century. This scenario is considered most applicable in situations with a low tolerance for risk. This makes it most suitable for estimating the scale of risk to residential properties, which typically represent a homeowner's greatest single

than $1 trillion would be at risk from chronic flooding—a threshold we defined as flooding that occurs 26 times per year or more.[45] By 2045, within the lifetime of a typical mortgage issued today, about 325,000 coastal properties worth $136 billion will be at risk of chronic flooding (see figures 6 and 7). The properties at risk by 2045 currently house 550,000 people and contribute nearly $1.5 billion toward today's property tax base. Those numbers jump to about 4.7 million people and $12 billion by 2100 (see fig 8).

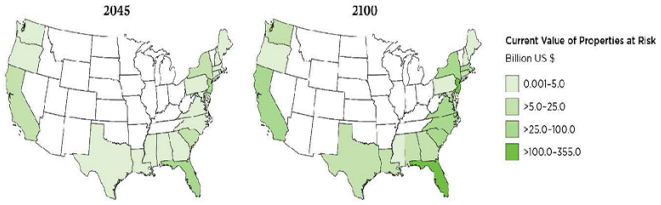
Every coastal state faces this risk to some extent, with Florida, New Jersey, New York, California, Louisiana and South Carolina among the most exposed.[46] Louisiana, North Carolina, New Jersey, and Maryland also have significant numbers of highly exposed communities with above-average rates of poverty, creating hotspots of heightened risk. Many experts in risk assessment, credit rating, real estate markets, insurance markets, affordable housing and flood policy recognize that the risk of sea level rise to coastal real estate is significant and growing— and yet, for the most part, financial markets do not currently account for these risks.

**Figure 6: Homes at risk of chronic inundation**




Credit: Union of Concerned Scientists. Data provided by third parties through the Zillow Transaction and Assessment Dataset (ZTRAX).

**Figure 7: Value of homes at risk from chronic inundation**



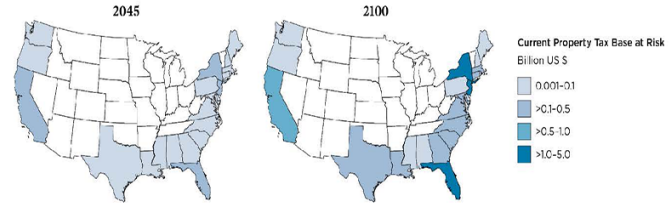

Credit: Union of Concerned Scientists. Data provided by third parties through the Zillow Transaction and Assessment Dataset (ZTRAX).

asset. For more on our data and methodology, please see:
https://www.ucsusa.org/sites/default/files/attach/2018/06/underwater-analysis-full-report.pdf and
https://www.ucsusa.org/sites/default/files/attach/2018/06/underwater-analysis-technical-backgrounder.pdf

[45] https://www.ucsusa.org/resources/underwater

[46] For information by congressional district, please see this online searchable map:
https://ucsusa.maps.arcgis.com/apps/MapJournal/index.html?appid=b53e9dd7a85a44488466e1a38de87601

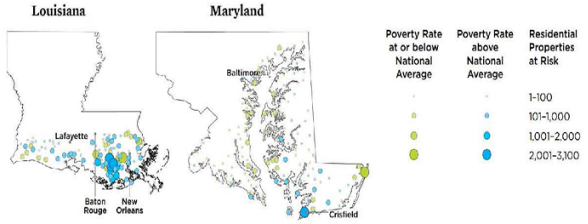
**Figure 8: Property tax base at risk from chronic inundation**




Credit: Union of Concerned Scientists. Data provided by third parties through the Zillow Transaction and Assessment Dataset (ZTRAX).

The declining value of coastal homes will be damaging, even devastating, to individual homeowners, especially for low- and fixed-income homeowners for whom this is likely to be their single biggest asset. It will also have more widespread consequences, including for affected communities, lenders, investors, and taxpayers. Communities with fewer resources to start with, or that are otherwise disadvantaged, will likely be most heavily affected by chronic flooding and its accompanying financial losses (see Figure 9).

**Figure 9: Communities with high poverty rates at risk of chronic inundation in Louisiana and Maryland**




UCS also developed an interactive mapping tool that allows one to explore the risk sea level rise poses to homes at the congressional district level and provides district-specific fact sheets about those risks.[47] What our maps show is that rising seas will begin to reshape many coastal communities in the coming decades, in some cases quite drastically. Communities need policymakers to advocate for the research, funding, and policies needed to help them cope with sea level rise and coastal flooding head-on—in some cases including help with relocation to safer ground. Research from NASA scientists shows that, unfortunately, high-tide flooding is poised to significantly worsen in the 2030s when the impacts of accelerating sea level rise collide with a tide-amplifying cycle of the moon's orbit.[48]

Our research also points to the choices we face: If the global community adheres to the primary goal of the Paris Agreement of capping warming below 2°C, and with limited loss of land-based ice, by the end

[47] Interactive map, data and fact sheets for all coastal Congressional districts in the lower 48 states available here: https://ucsusa.maps.arcgis.com/apps/MapJournal/index.html?appid=b53e9dd7a85a44488466e1a38de87601

[48] https://www.nasa.gov/feature/jpl/study-projects-a-surge-in-coastal-flooding-starting-in-2030s; https://www.nature.com/articles/s41558-021-01077-8

of the century the United States could avoid losing residential properties that are currently valued at $780 billion, contribute $10 billion annually in property tax revenue, and house 4.1 million people.

Real estate in the western U.S. is also increasingly at risk from longer, more intense wildfire seasons. Research from CoreLogic has found that nearly 2 million homes in the United States—worth nearly $640 billion in total—have an elevated risk of wildfire damage.[49]

The potential loss in value of homes that may be exposed to these kinds of risks is firstly of great harm and consequence to homeowners, It is also a risk for the local property tax base. It's a risk for anyone with a retirement portfolio that includes real estate. It's a risk to the federal government if federally backed mortgages or federally backed flood insurance is implicated. And thus it is a risk to the taxpayer at large.

**Threat to rail infrastructure:**
We also used our sea level rise data and methodology to assess the risks of chronic flooding to Amtrak's Northeast corridor route between Boston and Washington, one of the most heavily travelled rail routes in our nation. Our maps were used in a Bloomberg story on this subject, *Rising Waters Are Drowning Amtrak's Northeast Corridor*.[50] Many parts of the Northeast Corridor rail route are at risk of chronic flooding starting by 2060, including sections near Wilmington, Delaware, and throughout Connecticut, New Jersey, and New York (see figure 7). Current preparation efforts fall far short of these realities.

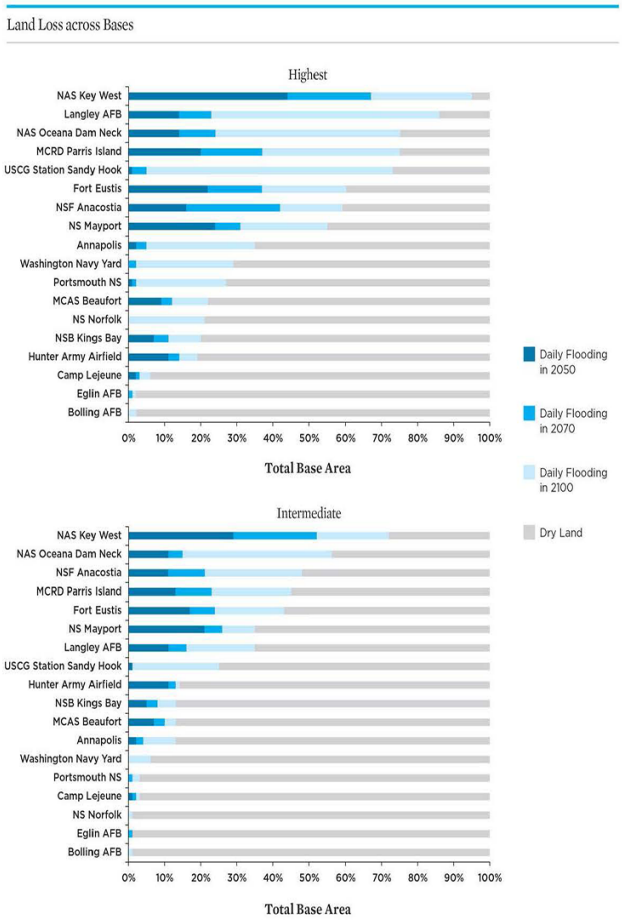
**Threat to U.S. military bases:**

UCS has also analyzed the exposure of 18 military installations along the East and Gulf coasts to more frequent and extensive tidal flooding, land loss as some areas flood with daily high tides, and deeper and more extensive storm surge inundation.[51] In the absence of preventive measures, these sites, including bases in Virginia, Georgia and Florida face major risks:

- By 2050, most of the installations we analyzed will see more than 10 times the number of floods they experience today.
- By 2070, half of the sites could experience 520 or more flood events annually—the equivalent of more than one flood daily.
- By 2100, eight bases are at risk of losing 25 percent to 50 percent or more of their land to rising seas.
- Four installations—Naval Air Station Key West, Joint Base Langley-Eustis, Dam Neck Annex, and Parris Island—are at risk of losing between 75 and 95 percent of their land by the end of this century (see figure 10).

[49] https://www.corelogic.com/press-releases/insights/wildfires-threaten-the-west-nearly-2-million-homes-at-elevated-risk-of-wildfire-damage-according-to-corelogic/
[50] https://www.bloomberg.com/graphics/2018-amtrak-sea-level/
[51] https://www.ucsusa.org/global-warming/science-and-impacts/impacts/sea-level-rise-flooding-us-military-bases

**Figure 10: US military bases exposed to chronic inundation and land loss**




*As high tide reaches farther inland, significant land loss is possible, in both the intermediate and highest scenarios, at many of the installations analyzed. Dark blue represents the percentage of total base area that floods with daily high tides in 2050; such land is conservatively considered a loss in this analysis. Medium blue represents the additional area that is inundated with high tide by 2070; light blue represents additional area inundated by 2100. Gray represents the percentage of the total base area that remains above the high tide line at the end of the century. Affected land can include developed and undeveloped areas and even wetlands that reside above the current high tide mark. This analysis finds that installations projected to see major land loss will also see substantial loss of currently developed and utilized areas.*

## IV. Infrastructure at risk from climate change

Infrastructure disruptions due to climate impacts—such as roads, bridges, rail lines, air travel and power infrastructure disrupted or damaged by extreme heat, floods, storms and wildfires, or barge traffic on major waterways affected by drought—are also very costly, and these costs are mounting.[52] The electricity system, for example, underpins multiple critical services as well as basic fundamentals of daily living, and has repeatedly faltered and failed in the face of worsening climate impacts. Such impacts include heatwaves, which put enormous pressure on the power grid, decreasing the efficiency and availability of some electricity resources at the same time as demand for cooling increases electricity use; drought, which threatens hydropower supplies as well thermogenerators that rely on water for cooling;[53] wildfires, which can be both sparked by and cause the destruction of electricity infrastructure; and worsening floods and severe storms, which expose critical grid infrastructure to inundation.[54] Resulting power outages can trigger cascading effects, such as business interruptions, loss of critical services like healthcare, and shutdown of other infrastructure that depends on electricity such as water treatment systems and gas pumps. During power outages, major oil refineries, petrochemical plants and other industrial facilities have also released enormous amounts of toxic pollution, with disproportionate impacts on Black and Latino communities.[55] A recent study showed that the incidence of major grid failures is on the rise and could pose serious health risks if they occur during heatwaves.[56] If power losses occur during heatwaves (as has happened during the summer wildfire season and summer hurricane season) or during extreme cold snaps (as the one that hit Texas earlier this year), they can be extremely costly and life-threatening.[57] The Government Accountability Office (GAO) has released recent reports citing the need for more investments in grid resilience, including more assertive actions from DOE and FERC.[58]

## V. Addressing Climate Inequities and Injustices

Climate impacts are being felt by communities in all regions of the country—and communities of color and low-income communities bear a disproportionate toll of these harmful impacts. Many of these same communities also bear an outsize burden of the pollution from our dependence on fossil fuels.

For example, the legacy of the racist practice of mortgage redlining persists to this day, including in the racial divide in generational wealth that it has perpetrated. We can also see this harmful legacy in terms of the long-standing lack of investment in beneficial infrastructure and amenities in formerly redlined neighborhoods, which has further limited economic opportunities for residents. As climate change

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[52] https://www.mckinsey.com/business-functions/sustainability/our-insights/climate-risk-and-response-physical-hazards-and-socioeconomic-impacts; https://www.mckinsey.com/business-functions/sustainability/our-insights/will-infrastructure-bend-or-break-under-climate-stress; https://www.sciencedirect.com/science/article/pii/S0020768316300634

[53] https://www.eenews.net/energywire/2021/06/28/stories/1063735943

[54] https://blog.ucsusa.org/jamesine-rogers-gibson/as-the-san-joaquin-valley-grows-hotter-questions-arise-about-future-power-grid-reliability/; https://www.ucsusa.org/resources/lights-out; https://blog.ucsusa.org/julie-mcnamara/california-wildfires-power-outages-and-climate-ambition/; https://blog.ucsusa.org/julie-mcnamara/hurricane-irma-power-outage/

[55] https://www.edf.org/media/millions-pounds-air-pollution-released-because-grid-failure-freeze-texas

[56] According to the study, *"Major electrical grid failure or "blackout" events in the United States, those with a duration of at least 1 h and impacting 50,000 or more utility customers, increased by more than 60% over the most recent 5 year reporting period."* https://pubmed.ncbi.nlm.nih.gov/33930272/

[57] https://blog.ucsusa.org/astrid-caldas/the-polar-vortex-has-killed-24-in-texas-so-far-whos-to-blame/; https://blog.ucsusa.org/julie-mcnamara/texas-power-outages-wake-up-call/

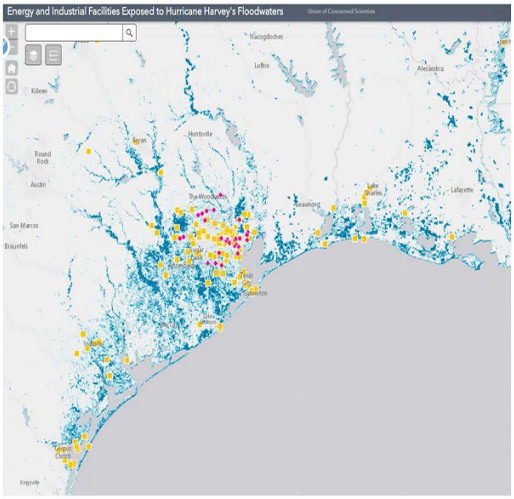
[58] https://www.gao.gov/assets/gao-21-346.pdf; https://www.gao.gov/assets/gao-21-274.pdf

worsens extreme heat, research also shows that residents in urban communities that were formerly redlined face hotter temperatures on average than non-redlined neighborhoods.[59] This is due to a variety of factors connected with discrimination, including lack of tree canopy, and the siting of highways, industrial facilities and other asphalt and concrete-heavy infrastructure in these neighborhoods. A recent study showed that in Baltimore, the urban heat island effect is more pronounced for people who are poor, face health burdens and are experiencing higher rates of unemployment and violent crime.[60] Another recent study measuring the intensity of urban heat islands found New Orleans, Newark, N.J., New York City, Houston, and San Francisco among the cities with the most intense urban heat islands.[61] As sea level rise worsens flood risks, coastal low-income communities and communities of color are also at increasing risk of declining property values, displacement and climate gentrification.

Climate change adds an additional layer of risk for communities already exposed to challenges like toxic pollution. For example, Hurricane Harvey's unprecedented levels of rainfall—which scientists have linked to warmer air and oceans caused by climate change[62]—exacted a huge toll on the residents of Texas and Louisiana. In the wake of this storm, UCS analysis showed that more than 650 energy and industrial facilities may have been exposed to Hurricane Harvey's floodwaters.[63]

[59] https://www.mdpi.com/2225-1154/8/1/12/htm
[60] https://cnsmaryland.org/interactives/summer-2019/code-red/neighborhood-heat-inequality.html
[61] https://medialibrary.climatecentral.org/resources/urban-heat-islands
[62] Risser, M.D. and M. F. Wehner. 2017. Attributable Human-Induced Changes in the Likelihood and Magnitude of the Observed Extreme Precipitation during Hurricane Harvey. Geophysical Research Letters. Volume 44, Issue24 28 December 2017 Pages 12,457-12,464. https://doi.org/10.1002/2017GL075888
Trenberth, K. E., Cheng, L., Jacobs, P., Zhang, Y., & Fasullo, J. (2018). Hurricane Harvey links to ocean heat content and climate change adaptation. Earth's Future, 6. https://doi.org/10.1029/ 2018EF000825
[63] https://blog.ucsusa.org/kristy-dahl/flooded-by-hurricane-harvey-new-map-shows-energy-industrial-and-superfund-sites

Figure 11: Chemical facilities potentially exposed to flooding from Hurricane Harvey




*Hurricane Harvey may have exposed to flooding more than 160 of EPA's Toxic Release Inventory sites, 7 Superfund sites, and 30 facilities registered with EPA's Risk Management Program.*

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The Gulf Coast is home to a vast chemical industry. The EPA's Toxic Release Inventory (TRI) program lists over 4,500 facilities in Texas and Louisiana alone that are required to report chemical releases to the environment. Before the storm hit, many facilities shut down preemptively, releasing toxic chemicals in the process. In the wake of the storm, explosions at Arkema's Crosby facility highlighted the risks that flooding and power failures pose to the region's chemical facilities and, by extension, the health of the surrounding population.[64] In the Houston area, low-income communities and communities of color are disproportionately exposed to toxic chemicals.[65] Our analysis shows that over 160 TRI facilities, at least seven Superfund sites, and over 30 facilities registered with EPA's Risk Management Program were potentially exposed to floodwaters. The number of flooded Superfund sites may be even higher than the map shows, as indicated by reports from the EPA and other sources.[66] Though most of the impacts from

[64] https://blog.ucsusa.org/gretchen-goldman/as-arkema-plant-burns-six-things-we-know-about-petrochemical-risks-in-the-wake-of-harvey/
[65] https://www.ucsusa.org/resources/double-jeopardy-houston
[66] https://apnews.com/article/floods-health-hurricane-harvey-toxic-sites-houston-27796dd13b9549b0ac76aded58a15122

this exposure remain unknown, the risks include compromised facilities and the release of toxins into the air and receding floodwaters.[67]

Studies find that White Americans and those with more wealth often receive more federal dollars after a disaster than do minorities and those with less wealth[31] and that disaster relief in the U.S. worsens the growing gap between White and Black wealth.[32] Recent investigative reports from NPR and the Washington Post highlight very troubling and longstanding racial inequities in access to Federal Emergency Management Agency (FEMA) funding.[35] A major challenge identified is that, because of our nation's history of racism and Jim Crow laws, many Black households do not have clear titles or deeds to their homes and this often disqualifies them from disaster aid. A similar pattern occurred in Puerto Rico after Hurricane Maria, because many families lacked formal deeds or titles.[36]

Federal agencies including FEMA should gather and track data and create tools to monitor the distributional aspects of their programs and policies, specifically assessing any racial and socioeconomic disparities. FEMA must allow homeowners to provide alternative means to prove ownership so they can access federal aid, otherwise existing patterns of structural racism are reinforced, and communities of color suffer disproportionately. Low-income households and renters are also at a greater disadvantage in accessing funding from FEMA's Individual Assistance program. For example, FEMA data post-Hurricane Harvey shows that homeowner applicants making less than $30K a year accounted for 48 per cent of denials of Individual Assistance even though they were just 28% of applicants.[37] These kinds of issues must be addressed head-on and quickly. FEMA should undertake a thorough analysis of its programs by race and income and make the information and data publicly available so that communities and other stakeholders can access it and the agency can be held accountable.

For some less well-resourced communities, the bureaucratic and technical hurdles to accessing post-disaster funding from FEMA and the Department of Housing and Urban Development (HUD) can be a major barrier. Federal agencies must invest in providing technical assistance and capacity building for disadvantaged and underserved communities, including communities of color, Tribal communities and low-income communities. Meaningful and inclusive stakeholder engagement is vital and must occur on an ongoing basis, not just post-disaster.

## VI Addressing climate change in a bold, just and equitable way

The choices we make now will have profound consequences for generations to come. Addressing the risks of climate changes will take a robust and coordinated approach from the national to the international level, and from the national to the local level. The US has a major role to play, together with the global community, to help limit the global average temperature increase to well below 2°C above pre-industrial levels. And Congress has a unique and powerful opportunity right now to put the US firmly on a path to cutting its emissions at least 50-52 percent below 2005 levels by 2030. Bold, just, and equitable climate action is the surest path to limiting the worst impacts of climate change, protecting communities, and unlocking the tremendous opportunities of an economy powered by clean energy.

But we have no time to waste. Legislation enacted this year—either as part of a bipartisan infrastructure deal or through a bold investment package that passes through a budget reconciliation process—must include a significant down payment on climate action that guarantees robust reductions in heat-trapping emissions and investments in making our communities and infrastructure more climate resilient. A

[67] https://www.washingtonpost.com/news/energy-environment/wp/2017/08/29/houstons-flood-threatens-to-turn-polluted-superfund-sites-into-a-toxic-gumbo/

legislative package that advances the priorities in the American Jobs Plan in a just and equitable way are the kinds of solutions we need and that are supported by both the science and the American public.

We have to go big—for good paying jobs, environmental and economic justice, the climate, and our future. That means a robust scale of investments in climate-related priorities. And it means we must invest in a domestic manufacturing base and supply chains—especially in the clean energy and transportation sectors—that can help create millions of good paying jobs for workers in our country. It also means ensuring that at least 40 percent of the benefits of these investments must flow directly to communities that have been historically marginalized and underserved, as called for in the Justice40 Initiative. President Biden's Executive Order (EO) 14008 on Tackling the Climate Crisis at Home and Abroad notified federal agencies to better address the needs of low-income, communities of color, and historically disadvantaged communities to ensure an equitable economic future.[33] The EO established the White House Environmental Justice Advisory Council (WHEJAC) which recently released a report with a set of recommendations on how Federal climate and energy investments could be aligned to meet the Justice40 goal to target 40 percent of these benefits towards disadvantaged communities.[34]

We need federal policies and investments that help with critical climate priorities, including:

1. **Cleaning up the power sector**. Swiftly cleaning up the power sector is critical to achieving our carbon emissions reduction targets. A rapid shift toward clean energy is already underway but without robust policies it is not happening fast enough, and 60 percent of the nation's electricity mix still comes from fossil fuels. Congress must act to hasten the transition and secure a clean, affordable, low-carbon, and resilient power supply for people across this nation—all while ensuring that the transition is considerate of the workers and communities adversely impacted by the shift away from fossil fuels. That means Congress should:

- ***Implement robust power sector targets***: Set and enforce targets that achieve power sector emissions reductions of 80 percent below 2005 levels by 2030 and 100 percent reductions soon thereafter, designed and funded in such a way as to drive renewables online while minimizing ratepayer impacts.[68]
- ***Fully fund clean energy tax incentives:*** Provide 10-year clean energy tax incentives with full refundability or a direct pay option for new clean energy generation, energy storage capacity, and transmission buildout, with support for robust labor standards.
- ***Bolster transmission development and grid modernization:*** Facilitate transmission expansion and adapt and increase funding for grid modernization programs to enable the rapid integration of high levels of renewable resources while improving the efficiency, reliability, and resiliency of our nation's electricity system.
- ***Facilitate the replacement of polluting resources with clean alternatives:*** Prioritize the rapid replacement of heavily polluting fossil fuel-fired resources with clean electricity alternatives, including through the accelerated retirement of the remaining coal fleet, the targeted use of clean energy sources to replace dirty "peaker" plants in overburdened communities, and strong support for community-owned clean energy resources.
- ***Support a fair transition for fossil fuel workers and communities:*** Coal workers and communities are already being hurt by the market-driven shift away from coal. As the nation accelerates its transition to clean energy, we cannot leave these workers and communities behind. First and foremost, a fair transition must include five years of income support (to include wage replacement, health care coverage, and continued employer retirement contributions), along with flexible education benefits.[69] UCS recently released a report with the Utility Workers Union of

[68] https://blog.ucsusa.org/julie-mcnamara/congress-must-advance-bold-power-sector-targets/
[69] https://blog.ucsusa.org/jeremy-richardson/how-to-support-our-energy-veterans/

America that estimates the costs of these supports.[70] It must also include robust support for communities facing the loss of tax revenue and to help them diversify their economies, and a coordinated effort by the federal government to address the complex set of problems facing coal workers and communities.

- ***Round out the changes with attention to energy end uses:*** As Congress acts on cleaning up our electricity supply, it must also act to improve the efficiency of our energy *use*, by setting strong energy efficiency standards, boosting electrification of energy end uses, and ramping up funding for the Low Income Home Energy Assistance Program (LIHEAP) and DOE's Weatherization Assistance Program (WAP) given the urgent importance of weatherizing buildings to save energy and lower bills while protecting people's health and safety in the face of rapidly escalating climate impacts.

2. **Electrifying our transportation sector.** Transportation is the nation's largest source of carbon emissions. Each new car purchased generally stays on the road for 15 years, so accelerating electric vehicle (EV) adoption today is critical to reaching our climate goals tomorrow. Zero-emission trucks and buses will also significantly reduce dangerous air pollution along trucking corridors and transit routes. To enable this transformation, Congress must:

- ***Help transit agencies and school districts buy electric buses:*** Electric transit and school buses are more expensive than their diesel-fueled counterparts but will eliminate the dangerous air pollution from burning diesel along these routes and for the drivers and passengers. Electric buses are made in the US and are already starting to be deployed in communities across the country. Significant investment in these buses will allow more places across the country to deliver on cleaner air for their residents in the near term.
- ***Incentivize EV purchases:*** Consumers who purchase an electric vehicle are eligible for a $7,500 tax credit to offset the higher upfront cost, but each manufacturer is currently limited in how many credits their customers can take. To accelerate the deployment of EVs, UCS supports extending the credit to make it available for all EV purchases, making it refundable or a point-of-sale rebate, and also incentivizing making these vehicles in the US by employees protected by sound labor standards.[71] We also support an incentive for low- and moderate-income people for the purchase of used EVs.
- ***Electrify medium- and heavy-duty vehicles, including at ports:*** Trucks ranging from delivery vans to tractor trailers can and are being electrified, but there are no federal financial incentives for fleet owners to offset the increased upfront cost of EVs.[72] Additionally, ports are hubs of transportation activity that are fueled by diesel and plagued by the pollution that comes from that. Communities along highway corridors and around ports are disproportionately impacted by dangerous pollution from diesel emissions and frequently, these are communities of color or low-income communities.[73] Robust funding to transition these heavier vehicles to non-polluting electric trucks will help communities most directly affected by diesel pollution.
- ***Deploy charging infrastructure:*** We need charging infrastructure both for passenger cars and trucks and for larger trucks and buses. Ensuring that charging is available along highways, in rural communities, and urban communities, particularly in underserved areas, is critical to successful EV deployment.[74] Investment in charging infrastructure for truck and bus fleets will also be needed to ensure that EVs work in these applications.

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[70] https://www.ucsusa.org/resources/support-coal-workers

[71] https://www.ucsusa.org/sites/default/files/2021-03/amping-up-ev-incentives.pdf

[72] https://www.ucsusa.org/resources/ready-work

[73] https://blog.ucsusa.org/dave-reichmuth/air-pollution-from-cars-trucks-and-buses-in-the-u-s-everyone-is-exposed-but-the-burdens-are-not-equally-shared/

[74] https://blog.ucsusa.org/samantha-houston/federal-policy-for-charging-access-a-tale-of-two-ev-drivers/

- ***Invest in domestic manufacturing of EVs:*** The auto sector is at the heart of America's manufacturing industry and needs to invest heavily in making EVs and their components in the US to retain our leadership in this sector. The government should fund programs to help companies retool factories and build up electric motor and battery supply chains. Including strong labor standards will secure good-paying jobs to communities across the nation.

3. **Helping to prepare and protect communities dealing with climate change.** No matter how quickly we fix our power sector, transportation sector, and other areas of our economy, people's lives are being upended by climate change already, and vulnerable communities need smart policies from the federal government to ensure they can prepare and adapt. To truly meet the climate crisis, Congress must invest in:

- ***Funding for communities to prepare for and recover from disasters:*** Robust funding for programs like FEMA's Building Resilient Infrastructure Communities program (BRIC), which helps support states, Tribes, and municipalities to proactively invest in projects to reduce their risks ahead of disasters, and HUD's Community Development Block Grant-Disaster Recovery program which can help communities invest in a climate-resilient recovery.
- ***Establishing the Civilian Climate Corps:*** One of the best new ideas in the American Jobs Plan would help people and the planet, creating jobs that make our nation more resilient to climate impacts. Making sure it's robustly funded is important to ensuring its success.
- ***Financing solutions through a Green Bank:*** Congress should establish a national resilient infrastructure bank similar to that proposed in H.R. 806, the Clean Energy and Sustainability Accelerator Act. A Green Bank would finance clean energy and climate resilient infrastructure projects, with dedicated investments to benefit underserved and historically marginalized communities.
- ***Investing in public health protections*** for communities and workers coping with extreme heat, wildfires, flooding, intensifying storms, and other harmful climate impacts.
- ***Expanding access to affordable high-quality insurance for climate-related disasters.*** Too many households and communities are not insured, or not adequately insured, against climate-related disasters. Making affordable insurance more widely available can help people get back on their feet quicker. Affordability provisions should include grants, low interest loans and other incentives to help homeowners and communities invest in risk mitigation measures.

4. **Building a resilient and equitable food and farm system.** An often-overlooked sector of our economy, agriculture generates its own carbon emissions yet also presents a major opportunity to help solve the climate crisis while simultaneously building a food and farm system that is sustainable and equitable. Congress must:

- ***Expand and strengthen existing working lands conservation programs to better address climate and equity goals.*** Agricultural soil carbon is a critically important tool in battling the climate crisis. There are more than 897 million acres of US farmland, each acre an opportunity to create a more resilient, sustainable food system, *if* we make the right investments. USDA working lands programs—in particular, the Conservation Stewardship Program (CSP) and the Environmental Quality Incentives Program (EQIP)—are immensely popular among farmers and ranchers and frequently oversubscribed. Because CSP and EQIP are familiar to farmers and ranchers and already encourage the adoption of many practices that can help farmers mitigate and adapt to climate change, small adjustments and strategic funding investments in these existing programs offer the best and most immediately actionable opportunities for the USDA to equitably tackle the climate crisis.
- ***Reprioritize USDA's Research, Education, and Economics mission area to incorporate and invest in more climate research.*** There is an urgent need to increase public funding for agricultural and food research and to reprioritize USDA research investments to increasingly address climate change mitigation and adaptation, especially through interdisciplinary and

systems approaches and agroecological theories and concepts. Congress should expand and enhance existing grant programs—including the Agriculture and Food Research Initiative, the Sustainable Agriculture Research and Education program, and the Organic Transitions Program—as well as other research-focused efforts including the USDA Climate Hubs, the Long-Term Agroecosystem Network, and the National Agroforestry Center.

- ***Strengthen support for historically marginalized communities in agriculture.*** Longstanding structural and institutional racism has excluded Black, Indigenous, and People of Color (BIPOC) from access to land, financial resources, information, political standing, and educational and professional trajectories, which limits their ability to shape the food system. This, in turn, impacts the ability of BIPOC farmers to adapt to the climate crisis. Congress should follow BIPOC-led legislation, such as the Justice for Black Farmers Act (S. 300), and should also work to ensure that USDA technical assistance directly supports BIPOC farmers and that USDA allocates resources to conduct targeted outreach to BIPOC and other socially disadvantaged producers.

## VII Financial Sector Solutions

In terms of the financial sector, Congress, financial regulators and the federal government will each need to play their part. UCS strongly supports mandatory disclosure rules for climate risk to avoid untenable growth of climate and ESG risk within our markets that harms investors, spurs the improper allocation of capital, and may increase the cost of capital for U.S. companies. Mandatory disclosures should address companies' stewardship of a just and equitable transition to a low-carbon economy; human capital management; impacts on and strategies related to racial, economic, environmental, and climate justice; accounting of country-by-country tax payments; and disclosure of political activity including direct and indirect spending on elections and lobbying.

We are encouraged to see growing support from several quarters for taking steps to evaluate climate risks and create a framework for risk disclosure.

- The Commodity Futures Trading Commission (CFTC) issued a first-ever report last year, *Managing Climate Risk in the U.S. Financial System*, and in March this year established an interdivisional Climate Risk Unit (CRU) to assess the risks to US financial stability posed by climate change.[75]
- The Federal Housing Finance Agency (FHFA) recently held a public listening session and issued a Request for Information on current and future climate and natural disaster risk to the housing finance system and to the regulated entities: Fannie Mae and Freddie Mac and the Federal Home Loan Banks.[76]
- The Securities and Exchange Commission recently requested public input on climate change risk disclosure.[77]
- The U.S. Department of the Treasury recently announced a Coordinated Climate Policy Strategy with a New Treasury Climate Hub and a Climate Counselor.
- The Federal Reserve recently issued a note outlining an approach to evaluating the financial risks of climate change and potential avenues to include it in the Federal Reserve's financial stability monitoring framework.[78]

[75] https://www.cftc.gov/PressRoom/PressReleases/8234-20
https://www.cftc.gov/PressRoom/PressReleases/8368-21
[76] https://www.fhfa.gov/Media/PublicAffairs/Documents/Climate-and-Natural-Disaster-RFI.pdf
[77] https://www.sec.gov/news/public-statement/lee-climate-change-disclosures
[78] https://www.federalreserve.gov/econres/notes/feds-notes/climate-change-and-financial-stability-20210319.htm

- President Biden recently issued an Executive Order on Climate-Related Financial Risks and calling for a report outlining a comprehensive whole-of-government Climate-Related Financial Risk Strategy.[79]
- Legislation has been put forward in Congress to help advance climate risk disclosure, including the *Climate Risk Disclosure Act of 2021* and the *Climate Change Financial Risk Act of 2021*. At the international level, important initiatives are underway, including through The Taskforce on Climate-Related Financial Disclosures and The Network for Greening the Financial System. The U.S. Federal Reserve is a member of the latter and Treasury Secretary Janet Yellen has indicated an interest in also having the U.S. Treasury participate and promote these priorities.[80]

UCS has submitted comments to the Securities and Exchange Commission, the Commodity Futures Trading Commission[81] and the Federal Housing Finance Agency[82] to highlight each body's role in ensuring these outcomes. We have also endorsed Congressional action, including organizing a letter of support for the Climate Risk Disclosure Act of 2021 (introduced by Rep. Sean Casten, D-IL) signed by 82 environmental and social justice groups, faith-based and public interest organizations and socially responsible investors.[83] Given the existential threat posed by climate change, concurrent and complementary administrative, regulatory, and legislative actions to strengthen disclosures are urgently needed.

In addition to the physical risks of climate change, the financial sector and individual companies also face risks because the current fossil fuel-dominated economy is simply incompatible with our climate goals. We must cut carbon emissions swiftly and deeply—and that means fossil fuel companies and their investors will have to change their business model or risk major losses. Delaying this inevitable transition will only increase the exposure of these companies. Transitioning away from fossil fuels quickly will require proactive policies and investments, including investments in ensuring that workers and communities who depend on fossil fuels are not left behind.[84]

***Mandatory Risk Disclosure Will Help Correct Market Failures***

Climate change is a systemic and growing risk to our economy, yet it is not priced into most market decisions today because of multiple market failures including a lack of information and a mismatch in time horizons for assessing risks considered material. This has the potential to increasingly creating an unstable financial system with broader implications for the economy and the public The financial system requires transparent, uniform disclosure of climate risks, based on the best available science, to evaluate which companies are best prepared to weather the physical and transition risks of climate change. Yet many companies don't mention—or even downplay—the effects of climate change in their publicly available information, misleading investors into overconfidence about long-term returns, and propping up the oil and gas industries, which operate as though the status quo is sustainable when they are fully aware they should be moving toward a clean-energy business model. The lack of standardization of data for

[79] https://www.whitehouse.gov/briefing-room/presidential-actions/2021/05/20/executive-order-on-climate-related-financial-risk/

[80] https://home.treasury.gov/news/press-releases/jv0269

[81] Pinko, N., R. Cleetus, and K. Mulvey. 2020. Union of Concerned Scientists Submission to the Climate-Related Market Risk Subcommittee Under the Market Risk Advisory Committee of the CFTC. Online at https://comments.cftc.gov/PublicComments/ViewComment.aspx?id=62482&SearchText=.

[82] Cleetus, R. and S. Udvardy. 2021. Union of Concerned Scientists Response to the FHFA RFI on Climate Risk. Online at https://www.fhfa.gov/AboutUs/Contact/Pages/input-submission-detail.aspx?RFIId=1426.

[83] Letter in support of the Climate Risk Disclosure Act. 2021. Online at https://casten.house.gov/sites/casten.house.gov/files/Climate%20Risk%20Disclosure%20Act%20Support%20051121.pdf.

[84] https://www.ucsusa.org/resources/support-coal-workers

climate risk disclosure creates additional hurdles, even for companies that are seeking to be more transparent about climate risks but may find that regulators or investors may not be able to easily understand or compare such data within or across industries.

Despite efforts by some lawmakers, the White House, and domestic financial bodies, US public companies—particularly those in the fossil fuel industry—currently lack sufficient incentives to disclose accurate, standardized, and comparable metrics regarding their climate risks. The statement "what is measured is managed" applies here, as the lack of consistent, accurate, and comparable measurement of climate-related financial metrics suggests a lack of management of climate-related financial risks.

Furthermore, accurate disclosure of climate risks is also important to create a fuller accounting of the benefits of low and zero-carbon sources of energy relative to the costs of fossil fuels, helping to accelerate their deployment to meet global goals of achieving net zero emissions by 2050.

**Lack of Disclosure Disproportionately Harms Working People and Communities of Color**

Climate change is not just an environmental crisis, but one of social justice, wealth distribution, equity and human rights. Climate change is already imposing a harsh toll on these communities and our current disaster aid policies exacerbate these problems.[85] [86]Much more is at stake than simply the fiscal well-being of US businesses. The public relies on these companies to grow and manage our savings, investments, pension funds, future energy choices, and other long-term portfolios. Currently, some large companies and investors are able to use proprietary datasets to help reduce their exposure to climate risks but the lack of widely available, standardized, comparable data means that the broader public is largely unaware and unprepared for the financial consequences of these risks. As we saw during the economic crisis generated by COVID-19, economic insecurity has a disproportionate, much harsher impact on low-income communities and communities of color.[87] Many of these communities have also been excluded from building generational wealth due to racist policies like mortgage redlining and lack of access to credit. Alongside climate risk disclosure, we must also invest in a comprehensive suite of policies to avoid harms like climate gentrification that reinforce existing disparities.

Realigning market incentives to reflect the latest science is necessary but not sufficient; we also need a transformative climate resilience strategy that addresses underlying systemic challenges like structural racism and socioeconomic inequities so as to better protect all communities as we grapple with the near and long-term threats of climate change.

**Standardized Requirements Are Necessary for Climate Accountability**

Burning fossil fuels for electricity, heat, and transportation is the largest source of global warming emissions. Scientists can now quantify the global warming emissions, global average temperature increase, sea level rise, and ocean acidification attributable to the product-related emissions of particular fossil fuel companies.[88] Due to the impact of burning its oil, gas, and coal products—and also to its past

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[85] A recent investigative report from NPR using Federal Emergency Management Agency data shows that with more funding going to richer communities than poorer ones https://www.npr.org/2019/03/05/688786177/how-federal-disaster-money-favors-the-rich

[86] https://journals.sagepub.com/doi/full/10.1177/2378023118816795

[87] https://www.lancetcountdownus.org/2020-lancet-countdown-u-s-brief/

[88] Licker, R., B. Ekwurzel, S. C. Doney, S. R. Cooley, I. D. Lima, R. Heede, and P. C. Frumhoff. 2019. Attributing ocean acidification to major carbon producers. Environmental Research Letters 14 124060. https://iopscience.iop.org/article/10.1088/1748-9326/ab5abc. Ekwurzel, B., J. Boneham, M. W. Dalton, R. Heede, R. J. Mera, M. R. Allen, and P. C. Frumhoff. 2017. The rise in global atmospheric CO2, surface temperature, and sea level from emissions traced to major carbon producers. Climatic Change 144(4): 579–590. https://doi.org/10.1007/s10584-017-1978-0.

and ongoing campaigns to deceive the public and policymakers about climate science and solutions[89]—the fossil fuel industry bears an outsize responsibility for climate change.[90]

The fossil fuel industry faces a unique mix of climate-related financial risks, such as potential regulations to reduce emissions, market competition from renewable energy technologies, climate damages lawsuits, and reputational damage for knowingly deceiving[91] the public and shareholders[92] about the climate risks of its products.[93] The industry is also particularly vulnerable to physical damages to infrastructure and disruption of operations due to acute climate impacts.[94]

In recent years, several shareholder proposals calling for publicly listed oil and gas companies to disclose how they are managing the risks and opportunities of climate change and the energy transition have won majority support. In response to investor pressure, companies such as ExxonMobil and Chevron now publish annual climate risk reports. But the woeful inadequacy of these voluntary (and unaudited) climate risk disclosures has contributed to shareholder rebellions by asset owners and managers dissatisfied with how both companies are aligning their business models and policy advocacy with the goals of the Paris Agreement. If climate risk reporting is to have any value to investors, it must be connected to companies' financial reports and subject to an auditor's review. In addition, it is vital that banks that are funding fossil fuel investments also be required to be more transparent about their lending policies and practices for fossil fuel clients, including client banks with significant oil and gas exposures.[95]

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[89] Mulvey, K., and S. Shulman. 2015. The climate deception dossiers: Internal fossil fuel industry memos reveal decades of corporate misinformation. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/global-warming/fight-misinformation/climate-deception-dossiers-fossil-fuel-industry-memos.

[90] Shue, H. 2017. Responsible for what? Carbon producer CO2 contributions and the energy transition. Climatic Change 144(4): 591–596. https://link.springer.com/article/10.1007/s10584-017-2042-9. Frumhoff, P., R. Heede, and N. Oreskes. 2015. The climate responsibilities of industrial carbon producers. Climatic Change 132:157. https://link.springer.com/article/10.1007/s10584-015-1472-5.

[91] Brief of Amici Curiae Robert Brulle, Center for Climate Integrity, Justin Farrell, Benjamin Franta, Stephan Lewandowsky, Naomi Oreskes, Geoffrey Supran, and the Union of Concerned Scientists in Support of Plaintiff-Appellee and Affirmance, State of Rhode Island v. Shell Oil, LLC, Case No. 19-1818. 2020. Online at http://climatecasechart.com/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2020/20200102_docket-19-1818_amicus-brief-3.pdf.

[92] Commonwealth of Massachusetts v. ExxonMobil Corporation, No. 19-3333, Mass Super. Ct. Online at https://www.mass.gov/doc/october-24-2019-massachusetts-complaint-exxon/download.

[93] Pinko, N., K. Mulvey, B. Ekwurzel, and P. Frumhoff. 2018. *The 2018 Climate Accountability Scorecard: Insufficient Progress from Major Fossil Fuel Companies.* Cambridge, MA: Union of Concerned Scientists. Online at https://www.ucsusa.org/resources/climate-accountability-scorecard-0#ucs-report-downloads.

[94] Carlson, C., G. Goldman, and K. Dahl. 2015. *Stormy Seas, Rising Risks: What Investors Should Know About Climate Change Impacts at Oil Refineries.* Cambridge, MA: Union of Concerned Scientists. Online at https://www.ucsusa.org/resources/stormy-seas-rising-risks#ucs-report-downloads.

[95] See letter to JP Morgan to request information from JPMorgan Chase & Co. (JPMC) regarding its lending policies for oil and gas clients, including client banks with significant oil and gas exposures. https://oversight.house.gov/sites/democrats.oversight.house.gov/files/2021-06-21.Khanna%20KP%20to%20Dimon-JPMC%20re%20Oil%20and%20Gas%20Lending.pdf

VIII Overall Recommendations for the Federal Government's Response to Growing Climate Risks

- **The federal government must play a lead role in researching and communicating a full range of climate risks to the public and incorporating those risks into its own policies and actions.**[96] Federal investments are needed to ensure that robust datasets, modeling and weather prediction initiatives are widely and freely accessible.[97] The private sector is increasingly developing sophisticated proprietary tools to assess climate risks and sharing that information with their clients, however the general public does not yet have a clear appreciation of these risks. Over time, those with resources and information will be better able to insulate themselves from housing market risks, reinforcing existing inequities. The federal government must play a lead role in sharing information with the public and private sector actors at the federal, state and local level.
- **Mandating climate risk disclosure in the marketplace is vital to help individuals and businesses understand the risks to their investments and drive more resilient outcomes, however this must be done in a transparent and careful way.**[98] Financial regulators and market actors must live up to their responsibilities to the public. For example, the FHFA should require more transparent reporting and disclosure of the risks that climate change poses to the mortgage portfolios of the regulated entities today and how those risks will change over time. Better data and tools for assessing and managing market related climate risks are also needed. Without this, business-as-usual decisions are increasing the exposure to risks, putting more people and property in harms' way and creating a greater potential for mortgage defaults that can have cascading effects. The disclosure of risks itself can trigger sharp—and potentially inequitable—market shifts in highly exposed places, even precipitating a crash in values in some markets. Unlike past housing market crashes, values may not recover in places where the data show the risk is extreme. Thus, it is vital to have other support programs in place *ahead of time*, communicate and engage with community stakeholders, and to consider ways to phase in some changes.
- **The federal government must work together with state and local authorities and the private sector to provide options, and significantly ramped up and well-resourced programs, for risk-mitigation measures for people with homes at risk from climate-related disasters.** This could range from home buyout programs, programs to expand investments in floodproofing of homes, expanded access to affordable insurance and enforcement of insurance purchase requirements in the most at-risk places.
- **Limiting new development in flood and fire-prone areas is also key to reducing the exposure to these risks over time.** The federal government should work with state and local entities, and community stakeholders, to consider how to limit development in high-risk areas, while ensuring that communities have access to affordable housing options in safer areas. The Groundwork's Climate Safe Neighborhoods project found that historical segregation redlining practices correlated with more vulnerability to extreme heat and flood in these neighborhoods.[99]

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[96] See H.R.4823 - FEMA Climate Change Preparedness Act, https://www.congress.gov/bill/116th-congress/house-bill/4823

[97] *See* S.4462 - A bill to establish a national integrated flood information system within the National Oceanic and Atmospheric Administration, and for other purposes *and* H.R.2462 - Flood Mapping Modernization and Homeowner Empowerment Pilot Program Act of 2019

[98] *See* H.R.3623 - Climate Risk Disclosure Act of 2019 and S.2075 - Climate Risk Disclosure Act of 2019.

[99] *See* Mapping Project Explores Links Between Historic Redlining And Future Climate, Vulnerability. https://www.wbur.org/earthwhile/2021/03/05/haverill-merrimack-climate-redlining-maps. *Also see* The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas, https://www.mdpi.com/2225-1154/8/1/12/htm

Additionally, while GSE's provide the benefit of facilitating access to homeownership, they may also encourage lenders to distribute their climate risk and encourage households to locate in flood risk areas while not also accounting for climate change projections over the 30-year fixed rate mortgage.[100]

- **Ensuring that past harms are not replicated.** Our nation's shameful history of mortgage redlining has led to lasting injustices and inequities in housing and wealth, particularly for African American households.[101] The unfortunate reality is that a type of "modern day" redlining exists when it comes to the success rate of people of color securing loans for purchasing homes.[102] Congress and the administration must ensure that they do not to replicate those harmful patterns—directly or indirectly—for example, by pulling back investments or federally-backed mortgages in underserved communities.
- **Market-based approaches alone will not be sufficient** to address the growing risks of climate change—and are particularly unlikely to foster equitable and resilient outcomes without additional policies. UCS has developed a framework and a set of principles for science-based equitable adaptation that could be instructive in this context.[103] We also recommend the establishment of a federally financed and administered frontline equity redistribution and investment fund to help provide financial resources to those homeowners willing to relocate from areas that are highly exposed to climate risks.[104]

In closing, thank you for this opportunity to testify today and for your efforts to help advance the commonsense climate solutions we so urgently need. Our economic prosperity and the well-being of communities around the nation depends on these kinds of vital efforts.

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[100] *See* Amine Ouazad & Matthew E. Kahn, 2019. "Mortgage Finance and Climate Change: Securitization Dynamics in the Aftermath of Natural Disasters," NBER Working Papers 26322, National Bureau of Economic Research, Inc.

[101] *See* January 26, 2021 White House Memorandum on Redressing Our Nation's and the Federal Government's History of Discriminatory Housing Practices and Policieshttps://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/26/memorandum-on-redressing-our-nations-and-the-federal-governments-history-of-discriminatory-housing-practices-and-policies/.

[102] *See* Modern-day redlining: How banks block people of color from homeownership. https://www.chicagotribune.com/business/ct-biz-modern-day-redlining-20180215-story.html

[103] https://www.ucsusa.org/sites/default/files/attach/2016/06/climate-resilience-framework-and-principles.pdf

[104] https://www.zillow.com/research/climate-change-underwater-homes-12890/ and https://www.zillow.com/research/climate-change-underwater-homes-2-16928/

**PREPARED STATEMENT OF FRANK NUTTER**

PRESIDENT, REINSURANCE ASSOCIATION OF AMERICA

JULY 20, 2021

RAA

REINSURANCE ASSOCIATION OF AMERICA

STATEMENT

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**TESTIMONY OF**
**FRANKLIN W. NUTTER**
**PRESIDENT**
**REINSURANCE ASSOCIATION OF AMERICA**

**BEFORE THE**
**UNITED STATES SENATE**
**COMMITTEE ON**
**BANKING, HOUSING, AND**
**URBAN AFFAIRS**

**DURING THE HEARING ON**
**"21ST CENTURY COMMUNITIES: CLIMATE CHANGE, RESILIENCE, AND REINSURANCE"**

**JULY 20, 2021**

Chairman Brown, Ranking Member Toomey, and members of the Committee on Banking, Housing, and Urban Affairs (Committee), thank you for the opportunity to testify during today's hearing entitled, "21st Century Communities: Climate Change, Resilience, and Reinsurance," and thank you for your interest in the U.S. property casualty (re)insurance industry.

I am Frank Nutter, President of the Reinsurance Association of America (RAA). The RAA is the leading trade association of property and casualty reinsurers doing business in the United States. RAA membership is diverse, including reinsurance underwriters and intermediaries licensed in the U.S. and those that conduct business on a cross border basis. The RAA represents its members before state, federal and international bodies.

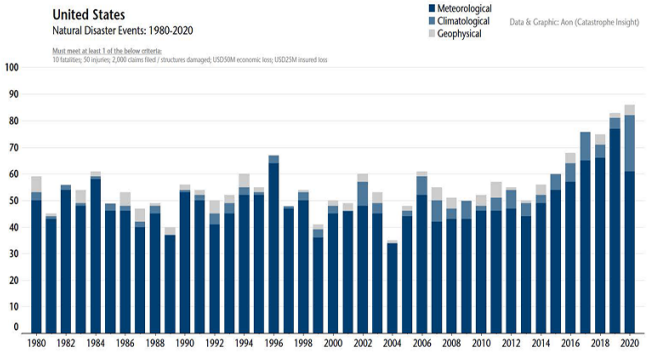
The RAA encourages the Committee, Congress, and Administration to improve America's community resilience in the face of climate and natural disaster risks, including the risk of flooding. The RAA specifically recommends that infrastructure and other legislation establish Community Disaster Resilience Zones (CDRZ). Our proposal would direct public and incentivize private sector investment to help improve infrastructure resilience, including affordable housing resilience, for communities that are the most in need and most at risk from natural disasters. Our CDRZ proposal is described in detail below. The RAA also supports a long-term reauthorization of the National Flood Insurance Program (NFIP) and flood insurance reforms.

**Climate Change and Natural Disaster Risks**

The RAA's longstanding policy recognizes climate change and the impacts of climate change, and the RAA is committed to working with policymakers, regulators, and the scientific, academic, and business communities to assist in promoting awareness and understanding, as well as addressing the risks associated with climate change. A copy of the RAA's climate change policy can be found on our website and in Appendix A of this statement.[1] At the federal, state, and local levels, it is especially critical that the private sector address significant natural disaster risks associated with floods, wildfire, earthquake, or other devastating natural disaster events. Urgently addressing these risks is particularly important as the frequency, severity, and costs of many natural disasters continue to increase due to climate change.

The U.S. Department of Commerce National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information reported that, "The U.S. has sustained 298 weather and climate disasters since 1980 where overall damages/costs reached or exceeded $1 billion (including CPI adjustment to 2021). The total cost of these 298 events exceeds $1.975 trillion."[2] According to NOAA, "Each state has been affected by at least $1 billion-dollar disaster since 1980."[3] Tables 1-4, by Aon's Catastrophe Insight division, demonstrate the increase in the number of natural disaster events and overall and insured losses in the U.S. and globally from 1980 to 2020. In 1980, the U.S. had 59 natural loss events that resulted in $57 billion in overall losses, including $5 billion in insured losses, compared to 203 natural loss events globally that resulted in $180 billion in losses, including $7 billion in insured losses.[4] Fast forward to 2020, and the U.S. had 86 natural loss events that resulted in $129 billion in overall losses, including $81 billion in insured losses, compared to 352 natural loss events globally that resulted in $289 billion in losses, including $105 billion in insured losses.[5]

**Table 1.**




[1] https://www.reinsurance.org/Advocacy/RAA_Policy_Statements/
[2] https://www.ncdc.noaa.gov/billions/
[3] https://www.climate.gov/news-features/blogs/beyond-data/2010-2019-landmark-decade-us-billion-dollar-weather-and-climate
[4] Catastrophe Insight division, Aon plc, July 2021
[5] Catastrophe Insight division, Aon plc, July 2021

Table 2.

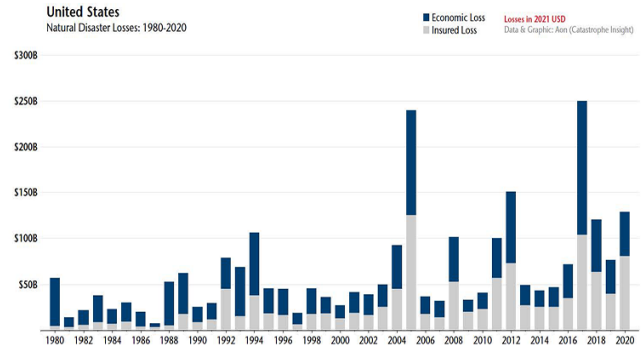



Table 3.

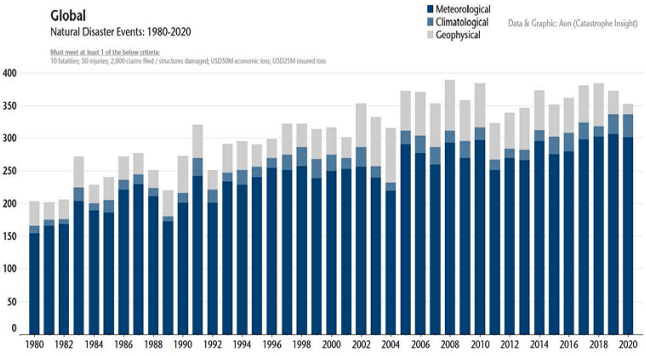
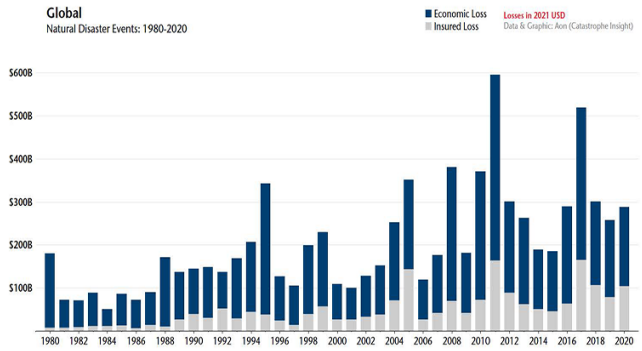



Table 4.



Insurance is a critical component for economic and social recovery from the effects of extreme weather and climate driven events. In the financial services sector, property casualty insurers and reinsurers are the most exposed to natural disasters, especially those impacted by climate and weather. The industry would be at great financial risk if it did not understand global and regional climate impacts, variability and developing scientific assessment of a changing climate. Integrating this information into the insurance sector is an essential function. Insurance pricing also is a mechanism for conveying the consequences of decisions about where and how we build and where people choose to live.

Our industry is science based. Blending the actuarial sciences with the natural sciences is critical to providing the public with the financial resources needed to recover from natural catastrophic events. As the scientific community's knowledge of climate change continues to develop, it is important for (re)insurers to incorporate that information into the exposure and risk assessment process and that it be conveyed to stakeholders, policyholders, the public and public officials that can or should address adaptation and mitigation alternatives. Developing an understanding about climate and its impact on various risks – for example, wildfires, droughts, heat waves, the frequency and intensity of tropical hurricanes, thunderstorms, and convective events, rising sea levels and storm surge, more extreme precipitation events and flooding – is critical to our role in translating the interdependencies of weather, climate risk assessment and pricing.

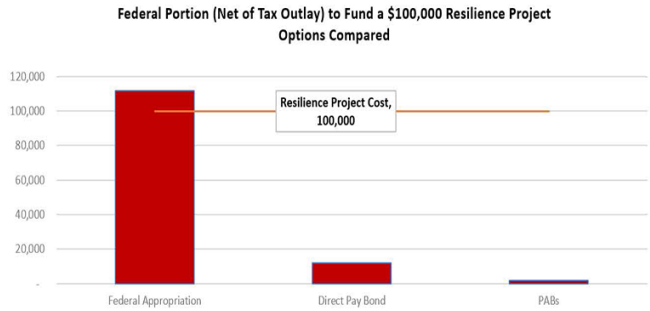
Climate-related and natural disaster risk exposure is broad-ranging. These risks are widespread, geographically diverse, and include a range of natural disaster perils impacting homeowners and renters, property owners, servicers, mortgage investors, taxpayers, and communities. It is important to ensure that these risk exposures are addressed and mitigated. Natural hazard mitigation includes physical enhancements and insurance to better protect residential properties and other infrastructure against damage caused by natural disasters. For government programs, government-sponsored enterprises, private sector financial institutions, and taxpayers, financial mitigation also is important to protect against any mortgage credit default risk associated with natural disaster risk.

The RAA believes a variety of solutions should be used to improve community resilience to the benefit of all those in the value chain of climate and natural disaster risk exposure. The RAA also believes that it is important to address geographic, natural disaster peril, and socioeconomic diversity. Some traditional solutions, like property insurance protections for homeowners certainly can and should be utilized, but new analytical capabilities that increasingly and intelligently can help reduce risk and direct resources to achieving that goal also should be pursued.

**Investing in Resilience for America's Communities is Critical, Logical, and Smart**

Dedicated federal appropriations in the form of grants are one option but limited, and for the federal government, the costliest mechanism to pay for resilience projects. Table 5 provides an example of the cost to federal taxpayers to fund a $100,000 resilience project using federal appropriations versus direct pay bonds and private activity bonds. For fiscal year 2020, FEMA made $700 million available for hazard mitigation grant programs but received over 1,200 applications requesting an estimated $4 billion.[6] There is demand, but traditional appropriation funding is inadequate.

**Table 5.**




Source: RAA, July 2021

In December 2019, the National Institute of Building Sciences issued its U.S. Department of Housing and Urban Development-funded "Natural Hazard Mitigation Saves" report.[7] The report describes that federal disaster mitigation has saved $6 for every $1 invested since 1995. Other mitigation-related activities, such as updating building codes to ensure resilient structures, and investments can save between $4 and $11 for every $1 spent. Investing in mitigation can reduce the impact of future disasters on lives, property, and the economy. Congress and the Administration can increase these investments by directing both public and incentivizing private sector resources to support infrastructure resilience projects.

Reducing the impact of climate and natural disaster risk in the first place, followed by other protections like traditional insurance and risk transfer – particularly to benefit vulnerable homeowners and renters in rural and urban areas – should be a top public and private-sector priority for climate and natural disaster resilience and risk management.

[6] https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/fy2020-subapplication-status#2020-chart

[7] https://www.nibs.org/projects/natural-hazard-mitigation-saves-2019-report

As a member of the BuildStrong Coalition, the RAA supports the Coalition's work to further the achievements of the bipartisan "Disaster Recovery Reform Act of 2018," which significantly increased America's investment in pre-disaster mitigation to help communities protect against disaster risk. The RAA specifically supports the Coalition's objectives, including to:

- Increase disaster mitigation funding for FEMA's Building Resilient Infrastructure and Communities (BRIC) program;
- Provide incentives for state and local communities to strengthen and enforce building codes;
- Invest in risk-reducing enhancements to improve the resilience of lifeline infrastructure;
- Create incentives and investments that help to improve resilience;
- Encourage the use of American-made products for resilience projects; and
- For state, local, and tribal governments, provide resources and eliminate barriers to enhance resiliency and protect against all hazards.[8]

The RAA also is a member of the SmarterSafer Coalition and supports the Coalition's recently released priorities for Congress in relation to infrastructure legislation:

- Enhance infrastructure-related research, including that which pertains to climate risk, and match new findings from new research with advanced pre-disaster mitigation plans and investment in pre-disaster mitigation.
- Invest in natural and climate resilience infrastructure projects.
- Improve infrastructure resilience in America's floodplains, as envisioned in the "Flood Risk Management Act" (S. 1688), the "Flood Resiliency and Taxpayer Savings Act" (H.R. 481) and the "Built for Future Disasters Act of 2021" (H.R. 2632); and consider and address the racial inequities inherent in federal disaster assistance and hazard mitigation assistance programs that reflect and perpetuate discriminatory practices and historic redlining.
- Facilitate and strengthen public-private partnerships, such as transferring risk to private financing, insurance, and reinsurance to shift some of the financial burdens associated with climate change from the government's balance sheet to willing private sector participants to improve the implementation of federal programs.

[8] https://buildstrongamerica.com/about-us/; https://homeland.house.gov/imo/media/doc/2021-06-08-EPRR-HRG-Testimony-Williams.pdf

- Direct federal funds to outcome-driven projects that strengthen communities and reduce long-term risk, such as requiring stronger minimum design standards and incorporate forecasts of future conditions for federal infrastructure investments, as envisioned in the "Build to Last Act" (S.1282/H.R.2760).[9]

The RAA endorsed the "Insurers' Principles of Climate Change Adaptation" recently released by the Insurance Institute for Business & Home Safety (IBHS), which "outline the steps policymakers – in collaboration with the insurance industry and other private sector stakeholders – should take to improve the resilience of American homes, businesses, and communities." Details about the Principles can be found online, but an overview is as follows:

- Principle 1: Climate Change Adaptation is Necessary;
- Principle 2: Building Codes and Land Use Support Tomorrow's Resilience;
- Principle 3: Prioritize Funding for Increasing Resilience of Existing Structures;
- Principle 4: Make Resilience Available for All;
- Principle 5: Leverage Climate Data and Analytics to Support Climate Change Adaptation; and
- Principle 6: Enhance Resilience for Public Infrastructure and Facilities. [10]

The RAA also supports legislation to use the tax code to provide homeowners and business with incentives to improve building resilience and better protect against the natural disaster risks they face, including:

- The "Disaster Tax Relief Act of 2021" (H.R.3954) provisions that, like federal disaster mitigation grants, would exempt from federal taxation state disaster mitigation grants that help people protect their homes against windstorms, earthquakes, or wildfires;[11] and
- The "Strengthening Homes and Eliminating Liabilities Through Encouraging Readiness (SHELTER) Act (S.1805/H.R.3925) to provide individuals and businesses a disaster mitigation tax credit, specifically 25% of qualifying mitigation expenses of up to $5,000.[12]

FEMA's BRIC program, the U.S. Department of Housing and Urban Development programs, the U.S. Department of the Treasury's Capital Magnet Fund, and other federal programs should direct funding resources toward achieving housing climate and natural disaster resilience for "extremely low- and very low-income households" that face significant natural disaster risk and particularly

[9] https://www.smartersafer.org/about-us/; https://www.smartersafer.org/2021/07/15/smartersafer-infrastructure-priorities-letter/
[10] https://adaptingtoclimate.com/
[11] https://mikethompson.house.gov/newsroom/press-releases/thompson-announces-introduction-of-disaster-tax-relief-act-of-2021
[12] https://www.cassidy.senate.gov/newsroom/press-releases/cassidy-bennet-introduce-new-tax-credit-for-working-families-small-businesses-preparing-for-natural-disasters-; https://crist.house.gov/news/documentsingle.aspx?DocumentID=2386

that expose taxpayer-backed federal housing programs to climate and natural disaster risks.[13] In general, the RAA also recommends that the Financial Stability Oversight Council (FSOC) and all of its members prioritize climate and natural disaster resilience efforts for federally funded and federally-backed residential properties in communities that are the most in need and most at risk from significant natural disaster(s).

**The RAA's Community Disaster Resilience Zones Proposal**

Low-income and minority neighborhoods are disproportionately impacted by natural disasters.[14] This fact should be a priority consideration for policymakers and the private sector as we work to understand and address the climate and natural disaster-related risks facing communities across America. The RAA has developed an innovative approach to addressing climate and natural disaster resilience, specifically to improve infrastructure resilience in the face of natural disasters and address socio-economic disparities. The RAA urges Congress and the Administration to include our proposal as part of infrastructure or other legislation that may become law during the 117th Congress.

In general, the RAA's proposal would create a federal structure that directs public and incentivizes private-sector funding for resilience projects to communities most in need and most at risk from significant natural disaster(s). More specifically, it would:

1) Address the impact of climate change through data-driven analysis;

2) Establish Community Disaster Resilience Zones (CDRZ) for communities most in need and most at risk from significant natural disaster(s); and

3) Direct and incentivize public and private-sector investment in the CDRZ to improve infrastructure resilience.

Under the proposal, CDRZ communities would be provided a menu of funding and financing options to pay for resilience projects to better protect them against significant natural disaster risk(s). Climate and natural disaster resilience projects could include:

- Nature-based solutions designed to increase climate and natural disaster resilience, such as the creation of open space, the restoration of wetlands, coastal barriers, beaches, and natural protections;

- Retrofit existing facilities to increase climate and natural disaster resilience, including the construction of emergency storm shelters, safe rooms, upgraded roofs, and other risk-reducing and community-resilience enhancing actions;

- Construction of new facilities with design and construction features that provide climate and natural disaster resilience;

[13] https://www.hudexchange.info/programs/htf/; https://www.cdfifund.gov/programs-training/programs/cmf
[14] https://www.americanprogress.org/wp-content/uploads/2013/08/LowIncomeResilience-2.pdf

- Retrofit, construction, or other updates to lifeline infrastructure, including water, electric, and communications infrastructure, that increase the infrastructure's climate and natural disaster resilience; and

- Programs that provide funding to property owners to retrofit existing structures, including single-family homes, multifamily homes, and commercial buildings, with design and construction features that provide climate and natural disaster resilience.

The RAA's legislative proposal has a few core components to help achieve these objectives:

I. Codify, enhance, and utilize FEMA's National Risk Index for Natural Hazards (NRI) data to find the intersection of risk, vulnerability, and low community resilience scores, as the basis to identify and establish the CDRZ that reflect diversity among the states by geography and type of peril, such as fire storm/wildfire, tornado, hurricane, flooding, ice storms, earthquake, wind, hail, and drought.

II. Within CDRZ, coalesce a variety of funding mechanisms, providing a menu of financing enhancements and tax incentives that can focus federal, state, local, charitable, and private-sector investment in resilience projects. To help fund resilience projects in CDRZ the proposal would establish:

    - CDRZ **taxable direct pay bonds**, like Recovery Zone Economic Development Bonds, which were one of three types of Build America Bonds that Congress created in 2009 as part of financial crisis economic recovery legislation (these bonds are federally subsidized bonds issued by state and local governments for local projects that support community resilience);

    - CDRZ **tax-exempt facility private activity bonds** subject to a separate volume cap, like Recovery Zone Facility Bonds (also in the 2009 recovery legislation), and provide for life and property/casualty insurers' exclusion from proration for investments in these CDRZ bonds (the proceeds from these federally tax-exempt bonds would be utilized by private or quasi-governmental entities to fund resilience projects that benefit a public purpose);

    - Federal **transferrable tax credits for individuals** for resilience improvements to housing in CDRZ;

    - Federal **tax credits for charitable contributions** for resilience projects in CDRZ; and

    - Federal tax credits for community-level projects in CDRZ that are tradeable, transferrable, and do not expire, and allow proceeds from the sale of certified tax credits to be used to, for example, meet matching requirements for federally funded resilience projects.

    Limited federal funds can leverage non-federal funding if Congress establishes a variety of options to pay for resilience projects. Some CDRZ communities – with good credit issuer

ratings and a tax base that can support resilience projects – will be eligible to use taxable direct pay bonds and private activity bonds. CDRZ communities – that are unable to access the debt markets because they do not have a tax base that can support additional borrowing or have reached their debt limits will need Congress to provide options like transferrable tax credits, similar to the Low-Income Housing Tax Credit, and charitable tax credits, versus deductions, to incentivize and direct the business and philanthropic communities to invest and donate funds to pay for resilience projects.

CDRZ resilience project bonds and tax credits are likely to be very attractive to corporations, especially given the increasing corporate focus on investing and charitable contributions to achieve objectives related to Environmental, Social, and Governance (ESG) factors. The insurance industry (property casualty, life, and health) is one of the largest holders of bonds in the U.S. The $1.2 trillion of $4.4 trillion in U.S. Treasury, corporate, and municipal bonds held by the insurance industry will mature and need to be reinvested over the next 5 years. Federal bond and tax incentives could encourage investments toward CDRZ resilience projects.

III. Set aside and unlock federal program funding to invest in resilience projects in CDRZ. This could include waiving, reducing, or allowing other forms of financing, such as the proceeds from the sale of tax credits mentioned above and in-kind and charitable donations, to qualify for matching funds for resilience projects in CDRZ. Allowing a variety of resources to contribute to and invest in resilience projects in CDRZ, as they relate to federal program matching fund requirements, could significantly unlock resources for CDRZ resilience projects. For example, with more flexibility to meet matching fund requirements, CDRZ resilience projects could more likely benefit from FEMA's BRIC program funding and funding from other federal programs. FEMA, HUD, and other federal agencies also should provide resources, such as financial and technical assistance, to CDRZ communities to help facilitate resilience project planning.

The RAA developed a data analytics tool and the CDRZ legislative proposal that aligns with Congressional interests and President Biden's plan, Executive orders, announcement, and fiscal year 2022 budget proposal[15] to rebuild America's infrastructure, enable green initiatives and smart building to address the impact of climate change, create needed jobs, fuel economic recovery, support historically underserved communities where the need is often greatest, and provide sources of much-needed resilience project funding to states and localities.

The RAA's data analytics tool utilizes publicly available data to very clearly, by county, Congressional district, and census tract in each state, understand where natural perils, older housing stock, and disadvantaged populations converge. The data in the RAA's data analytics tool is from FEMA's NRI supplemented with data from the U.S. Census Bureau's American

[15] https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/; https://www.whitehouse.gov/briefing-room/presidential-actions/2021/05/20/executive-order-on-climate-related-financial-risk/; https://www.federalregister.gov/documents/2021/05/25/2021-11168/climate-related-financial-risk; https://www.whitehouse.gov/briefing-room/statements-releases/2021/05/24/fact-sheet-biden-administration-invests-1-billion-to-protect-communities-families-and-businesses-before-disaster-strikes/; https://www.whitehouse.gov/briefing-room/statements-releases/2021/05/26/fact-sheet-the-american-jobs-plan-will-produce-preserve-and-retrofit-more-than-2-million-affordable-housing-units-and-create-good-paying-jobs/; https://www.whitehouse.gov/wp-content/uploads/2021/05/budget_fy22.pdf

Community Survey (ACS). NRI includes data that identifies communities by census tract in each state and county that are the most at risk from 18 natural hazards, such as coastal and riverine flooding, earthquake, hail, hurricane, strong wind, tornado, and wildfire.[16] The NRI is different from other natural disaster risk scoring approaches because it scores census tract level loss exposure values (buildings, agricultural and population equivalence), social vulnerability, and community resilience across 18 natural hazard risks, to provide a more holistic view of risk.[17] The RAA urges policymakers to use the same information, particularly to understand the U.S. landscape and pinpoint and prioritize communities that are most in need and most at risk from significant natural disasters, diversified by state, Congressional district, and natural disaster peril.[18]

Appendix B of this statement includes examples from the RAA's data analytics tool, visualizing how FEMA's NRI and data from the Census Bureau's ACS can be used to understand vulnerability and risk for the state of Ohio, represented by Chairman Brown, and the state of Pennsylvania, represented by Ranking Member Toomey.

The RAA's proposal has been favorably mentioned during three Congressional hearings this year:

- March 18, 2021, House Transportation and Infrastructure Subcommittee on Economic Development, Public Buildings, and Emergency Management hearing on "Building Smarter: The Benefits of Investing in Resilience and Mitigation";[19]

- May 18, 2021, Senate Committee on Banking, Housing, and Urban Affairs hearing on, "Reauthorization of the National Flood Insurance Program, Part I";[20] and

- May 19, 2021, House Committee on Ways and Means hearing on "Leveraging the Tax Code for Infrastructure Investment".[21]

**Housing Resilience**

Given that most federal housing programs fall under the jurisdiction of this Committee, it has an important leadership role to play in prioritizing and directing federal program funding toward housing resilience, which is the third core component of the RAA's legislative proposal mentioned above. Housing, especially affordable housing, that can withstand the most significant disaster(s) that vulnerable communities across the country face is an investment in critical infrastructure. Witnesses from a variety of organizations have raised this point in testimony delivered during Congressional hearings, for example:

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[16] https://www.fema.gov/flood-maps/products-tools/national-risk-index
[17] https://www.fema.gov/flood-maps/products-tools/national-risk-index/overview
[18] https://hazards.geoplatform.gov/portal/apps/MapSeries/index.html?appid=ddf915a24fb24dc8863eed96bc3345f8; https://www.census.gov/programs-surveys/acs
[19] https://transportation.house.gov/committee-activity/hearings/building-smarter-the-benefits-of-investing-in-resilience-and-mitigation
[20] https://www.banking.senate.gov/hearings/05/11/2021/reauthorization-of-the-national-flood-insurance-program-part-i
[21] https://waysandmeans.house.gov/legislation/hearings/ways-and-means-committee-hearing-leveraging-tax-code-infrastructure-investment

- "We invest in disaster recovery and resilience work because people of modest means are most likely to be harmed by disasters and tend to be the slowest to recover. Through our Building Resilient Futures initiative, we are working to ensure that sustainable, resilient, affordable housing becomes the norm and that communities are equipped to withstand and recover from disasters. Despite growing interest and commitment, our housing, infrastructure, and regions are not mitigating or adapting at the necessary pace of change. It's time for America to invest in modern infrastructure that is built to last."[22]
  - Jacqueline Waggoner, Enterprise Community Partners, Inc., House Financial Services Committee hearing, April 14, 2021

- "America built the transatlantic railroad in six years but somehow we struggle to deliver long term housing assistance to our most vulnerable citizens whose lives have been upended by natural disasters."[23]
  - Reese C. May, SBP (The St. Bernard Project), House Transportation and Infrastructure Committee hearing, October 22, 2019

To that end, the RAA supports provisions in the "Housing is Infrastructure Act of 2021," which was introduced by House Financial Services Committee Chairwoman Maxine Waters on July 16, 2021, that: prioritize applications for the $75 billion authorized for public housing agencies located in areas that have a plan to increase "climate and natural disaster resilience and water and energy efficiency," authorize at least $19.1 billion for "climate and natural disaster resilience and water and energy efficiency" for ten federal affordable housing programs, and authorize at least $10.7 billion for affordable housing in areas of high and persistent poverty. The RAA also supports the bill's $11.9 billion authorization for the National Flood Insurance Program's (NFIP) Flood Mitigation Assistance Program.[24]

The RAA will continue to work with Chairwoman Waters on the "Housing is Infrastructure Act of 2021" and other legislation members of this Committee and the House Financial Services Committee may consider so that it can most impactfully help improve resilience in vulnerable communities that are most in need and most at risk from significant natural disaster(s).

**The Protection Gap, (Re)Insurance, and the NFIP**

***Natural Disaster Insurance Protection Gap***

Homeowners and renters, property owners, mortgage investors, taxpayers, and communities face risks due to climate change, natural disaster risks, and the lack of insurance coverage or underinsurance of such coverage. There is a serious and significant natural disaster insurance protection gap in the United States. The U.S. Department of the Treasury's Federal Insurance Office's Federal Advisory Committee on Insurance (FACI) has a subcommittee that is dedicated to addressing it. Several RAA members serve on both the FACI and the "Subcommittee on Addressing the Protection Gap through Public-Private Partnerships and Other Mechanisms."

[22] https://financialservices.house.gov/calendar/eventsingle.aspx?EventID=407532
[23] https://transportation.house.gov/committee-activity/hearings/an-assessment-of-federal-recovery-efforts-from-recent-disasters
[24] https://financialservices.house.gov/news/documentsingle.aspx?DocumentID=408154

During FACI's December 2019 meeting, the Subcommittee cited statistics to provide examples of the insurance protection gap in the U.S. and issued recommendations that FHFA should consider.[25] The National Association of Insurance Commissioners (NAIC) has published alarming statistics about the disaster insurance protection gap. For example, one NAIC statistic cited in the Subcommittee's presentation is that "Only 1% of properties outside of flood zones have flood insurance, yet half of U.S. floods occur in these areas." Various studies and reports, including a 2018 report by AIR Worldwide, have warned that the next big earthquake to impact California, likely by 2044, could result in $170 billion in total damage and almost half would be residential-related loss, $37 billion of which would be uninsured.[26] Given the likelihood of future, significant, and costly natural disasters throughout the U.S. and uninsured residential costs, it is important to have a coordinated effort focusing on closing the insurance protection gap.

Congress, the Administration, the NAIC, state and local officials, and the private sector, including reinsurers, should develop a comprehensive strategy to identify and address the natural disaster insurance protection gap in the U.S. and the risks it poses to homeowners and renters, property owners, individuals, businesses, and federal programs and taxpayers. It also is important to close the insurance protection gap. Congress and federal regulators should help initiate efforts to close the insurance protection gap via traditional insurance and risk transfer. Congress and federal regulators can further facilitate a private market for flood insurance, potentially providing consumers with more flood insurance options. One way to achieve this is for the Federal Housing Finance Agency (FHFA) and HUD's Federal Housing Administration (FHA) to align their regulations and/or guidance for private flood insurance with those issued in 2019 by federal lending regulators.[27] (In 2020, HUD issued a proposed regulation to align its regulations and guidance with that of the 2019 federal lending regulators[28]).

***Primary Insurance***

Traditional insurance solutions – such as primary property insurance protection, including earthquake, wind, fire, and flood insurance – are critical for people, property, jobs, businesses, and communities to be resilient in the aftermath of natural disasters. That is especially true since federal disaster assistance is provided only when there is a federally declared disaster and typically results in a fraction of what insurance assistance can provide. For example, according to FEMA, in 2019, the average, annual flood insurance premium was $700 (about $58 per month), and the average claim payout was $53,000.[29] Meanwhile, in 2019, federal disaster assistance was capped at $34,900 with an average annual payment of $6,246.[30] Ensuring that the protection gap is bridged, and property insurance adequately covers the climate and natural disaster risk(s) involved are of utmost importance. Risk transfer products that protect each stakeholder from climate and natural disaster risks can play an important role.

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[25] https://home.treasury.gov/system/files/311/December2019FACI_ProtectionGapPresentation.pdf; https://home.treasury.gov/system/files/311/December2019FACI_ProtectionGapProposedRecs.pdf

[26] https://www.air-worldwide.com/Publications/Infographics/Who-Will-Pay-for-the-Next-Great-California-Earthquake-/

[27] https://www.fdic.gov/news/financial-institution-letters/2019/fil19008.html

[28] https://www.federalregister.gov/documents/2020/11/23/2020-25105/acceptance-of-private-flood-insurance-for-fha-insured-mortgages; https://www.hud.gov/press/press_releases_media_advisories/HUD_No_20_191

[29] https://www.fema.gov/data-visualization/historical-flood-risk-and-costs

[30] https://www.federalregister.gov/documents/2018/10/22/2018-22884/notice-of-maximum-amount-of-assistance-under-the-individuals-and-households-program; FEMA communication with RAA, 4/16/2021

*Reinsurance and Risk Transfer*

**Reinsurance.** Reinsurance is essentially insurance for insurance companies, federal programs, and state insurance programs. It is a risk management tool for insurance companies and government programs to reduce the volatility in their portfolios and improve their financial performance and security.

Reinsurance also is the primary mechanism for spreading risk globally, thereby accessing a greater pool of capital to pay for inevitable catastrophic losses. Consistent with the intent of Congress, reinsurers believe the private sector can and should assume more federal government risk. Reinsurers are willing to offer reinsurance options to a wide variety of government programs to help manage their exposure to losses.

Reinsurance is extensively used by the private markets to diversify risk and protect against future losses. Reinsurance is purchased for essentially four reasons: (1) to limit liability on specific risks; (2) to stabilize loss experience; (3) to protect against catastrophes; and (4) to increase capacity. Depending on the purchaser's goals, different types of reinsurance contracts are available to bring about the desired result. For federal programs, purchasing reinsurance would mitigate the financial impact of any large-scale future losses and help to prevent any future funding lags as it is pre-arranged financing for losses. Reinsurance also allows federal programs to gain financial flexibility and not be forced to rely on emergency federal funding in the event of defaults that could put programs in jeopardy.

**Risk Transfer.** Risk transfer, including reinsurance, is a successful solution used by both the public and private sector including (re)insurers, financial institutions, and government programs. In addition to federal programs, which are described below, risk transfer also has been used by state programs, including the California Earthquake Authority, California Wildfire Fund, Florida Hurricane Catastrophe Fund, Florida Citizens Property Insurance Corporation. Government risk can and should be transferred voluntarily to the private market. The use of private capital will protect consumers, taxpayers, and communities, while spreading risk throughout the globe to insurers and other capital providers who are willing to assume such risk. Risk transfer will strengthen government programs by giving them the financial flexibility to ensure they continue to remain viable in the long term.

**Benefits of Risk Transfer.** Risk transfer can help both government agencies and private businesses analyze and manage risk by providing financing stability and reducing the impact of future losses. For a variety of federal programs and operations, the reinsurance market has the capacity and interest to assist the government to appropriately manage its risk. Opportunities exist for the federal government to benefit from the competitive market's risk management services and risk transfer capabilities to deleverage federal program balance sheets and simultaneously increase protections for U.S. taxpayers. Expanded utilization of (re)insurance would reduce systemic risk by further diversifying insurance and credit risks and by transferring more of the enormous exposure currently borne by taxpayers, such as the mortgage default risk to the government sponsored enterprises (GSEs) following a major U.S. earthquake. Reinsurers are poised to work with the Congress and the Administration to expand and maximize the federal government's utilization of the private market to the extent the industry can write credit risk.

As noted above, reinsurance is routinely utilized by insurers and government programs to provide a crucial safety net for low frequency, high severity natural and man-made events that result in extreme insured losses. Insurers rely on reinsurers to assume losses for a single event or, in many cases, for an accumulation of losses from hurricanes, earthquakes, winter storms, wildfires, or terrorist attacks. Some historic events illustrate this. Hurricanes Katrina, Rita and Wilma in 2005 caused over $92 billion in insured losses, and reinsurers bore around 28% of the losses from those events.[31] Reinsurers assumed 55% of $41 billion in insured losses from the terrorist events of September 11.[32] Superstorm Sandy caused $25 billion in insured losses with reinsurers taking 30% of those losses.[33] The pattern of risk transfer for catastrophe-exposed property insurance to the reinsurance market applies across the global insured landscape as well.

***Examples of Successful Federal Government Risk Transfer Programs***

Several federal government agencies already have risk transfer programs in place. These programs highlight the ways in which risk transfer can succeed for government agencies.

**NFIP.** The best example of an ongoing federal risk transfer program is the Federal Emergency Management Agency's (FEMA's) NFIP Reinsurance Program. The NFIP Reinsurance Program enables the NFIP to utilize the private market to help manage the financial burden of the NFIP's catastrophic flood risk by providing financial backing for the government's flood risk, protecting taxpayers, and helping the program to be more resilient and pay claims. In 2016, FEMA, launched its NFIP Reinsurance Program via a pilot and, in 2017, transferred $1.042 billion of the NFIP's financial risk to 25 reinsurers, offsetting some of NFIP's risk to the private sector in lieu of U.S. taxpayers. In the program's first year (2017), FEMA collected from the private reinsurance sector the full $1.042 billion to help pay the cost of NFIP losses and claims resulting from Hurricane Harvey. This 2017 coverage, which also improved NFIP's financial viability and protected taxpayers, cost $150 million, and the program successfully renewed the subsequent year. This example is a true testament of successful private public partnerships. Following the 2017 placement, the program was renewed and currently has reinsurance coverage through 2024. For FEMA's traditional reinsurance placements from 2017 through the first quarter of 2021 and capital market reinsurance placements from 2018 through the first quarter of 2021, FEMA has paid a total of $1.264 billion in premium to reinsurers and the capital markets, received $1.042 billion from reinsurers as previously mentioned, and through July 31, 2021, has up to $2.928 billion in reinsurance and capital markets placements available to collect after a qualifying loss event.[34] The initial 2017 purchase marked key first steps towards helping the NFIP achieve long term resilience and financial stability and was crucial in enabling the reinsurance program to be a long-term project. (Please see below for more detailed comments on the NFIP).

**EXIM.** The Export-Import Bank of the U.S. (EXIM) also executed a reinsurance pilot program. In 2016, EXIM solicited risk management analytical services regarding risk sharing structures to assess transferring some of the risks in EXIM's portfolio to the private market. In March 2018,

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[31] Holborn Corporation, "Holborn Perspectives, Looking Closer At... SuperStorm Sandy," December 12, 2012
[32] Holborn Corporation, "Holborn Perspectives, Looking Closer At... SuperStorm Sandy," December 12, 2012
[33] Holborn Corporation, "Holborn Perspectives, Looking Closer At... SuperStorm Sandy," December 12, 2012
[34] https://www.fema.gov/flood-insurance/work-with-nfip/reinsurance; https://www.fema.gov/flood-insurance/work-with-nfip/watermark-financial-statements?web=1&wdLOR=c92E70680-BBC6-4687-81BD-4579F7073DBD; https://www.fema.gov/flood-insurance/work-with-nfip/watermark-financial-statements/library?web=1&wdLOR=cE9491E0B-A8DC-424C-9843-C6CC3503BF36

EXIM announced its reinsurance pilot program, which provided for $1 billion in loss coverage for a significant portion of EXIM's existing portfolio of large commercial aircraft financing transactions. EXIM stated that it was the largest public-private risk-sharing arrangement for a U.S. government credit agency and minimized EXIM and U.S. taxpayers' liability for potential future losses without requiring additional funding. This purchase of reinsurance gives EXIM protection from future losses and financial flexibility for the future.[35] In 2021, EXIM announced an expansion of its risk-sharing program.[36]

**FHFA.** The Federal Housing Finance Agency (FHFA) also has a credit risk transfer program for the Government Sponsored Enterprises (GSEs), Fannie Mae and Freddie Mac, in support of the U.S. housing market. FHFA launched its credit risk transfer initiative in 2012 (when the GSEs were in their fourth year of conservatorship) to enlist the private sector to reduce taxpayer exposure to the GSEs' mortgage risk. In 2013, the GSEs initiated their pilot $77 million credit risk transfer transaction, and it has grown since then. Over 50 (re)insurers have participated in FHFA's credit risk transfer programs and assumed U.S. mortgage risk. From the program's 2013 inception through the second quarter of 2021, the GSEs have transferred roughly $140 billion of credit risk on unpaid balances of more than $4 trillion of single-family mortgages through the capital markets, reinsurance, and front-end reinsurance transactions.[37] The GSEs purchased insurance primarily from diversified reinsurers. These partially collateralized transactions spread across many different reinsurers reduce risk in a variety of ways. Since the FHFA announced in May 2020 its re-proposed, and now final, GSE capital rule that reduced by half the capital relief for credit risk transfer, Fannie Mae has not executed new credit risk transfers.[38]

***National Flood Insurance Program***

The RAA greatly appreciates the leadership of Members of Congress, specifically those who serve on the Senate Committee on Banking, Housing, and Urban Affairs and the House Committee on Financial Services, for starting a formal conversation on reauthorization of the NFIP. The RAA has urged Congress to reauthorize NFIP and to enact flood insurance and mitigation-related reforms. The RAA supports a long-term reauthorization of the NFIP and reforms that:

- Continue to strengthen NFIP's financial framework and resiliency so that it can pay claims, particularly after catastrophic events;
- Remove impediments to consumer choice and confirm consumer protections; and
- Modernize the statute to give FEMA additional tools to encourage additional private market participation, including capital, in NFIP to benefit consumers and taxpayers.

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[35] https://www.exim.gov/news/exim-bank-announces-landmark-risk-sharing-program-private-sector-reinsurers
[36] https://www.exim.gov/news/exim-increases-taxpayer-protections-announcement-new-broker-partnership-aon-reinsure-portfolio
[37] Aon plc, July 2021; https://clarity.freddiemac.com/; https://capitalmarkets.fanniemae.com/tools-applications/data-dynamics
[38] https://www.fhfa.gov/Media/PublicAffairs/Pages/FHFA-Releases-Re-Proposed-Capital-Rule-for-the-Enterprises.aspx; https://www.sec.gov/Archives/edgar/data/0000310522/000031052221000156/fnm-20201231.htm; https://www.sec.gov/Archives/edgar/data/0000310522/000031052221000192/fnm-20210331.htm

The RAA supports the SmarterSafer and BuildStrong coalitions' reform proposals. The RAA also supports the "State Flood Mitigation Revolving Fund Act" (S.2192/H.R.1610-116th) as described in the letter in Appendix C of this testimony.[39]

**Confirm Consumer Protections.** Flood insurance uncertainty for consumers, as it relates to continuous coverage and potential rate increases by the NFIP, are an impediment to consumers buying private flood insurance and limit consumers' choices. Insurance agents and brokers have stated that "…the risk of a substantial NFIP rate increase should the consumer later wish to return to the NFIP often makes insurance agents and brokers hesitant to recommend private flood insurance policies."[40] It is important that Congress and FEMA provide consumers with clarity about continuous coverage compliance so that current and future NFIP policyholders are confident that they have complied with the law's continuous coverage requirements by having an NFIP or private flood insurance policy. For example, if a consumer leaves the NFIP to secure a private flood policy with better coverage and a better price and later re-assumes an NFIP policy, so long as the consumer had continuous coverage, that NFIP policy should be at the same rate and terms as if the consumer had continuously maintained an NFIP policy.

The RAA supports legislation from the 116th Congress (H.R. 1666) introduced by Representatives Kathy Castor (D-FL) and Blaine Luetkemeyer (R-MO) to amend the National Flood Insurance Act of 1968 (NFIA) to "consider any period during which a property was continuously covered by private flood insurance to be a period of continuous coverage, including for the purposes of NFIP subsidies."[41] In two previous Congresses, similar legislation had broad bipartisan support. In 2016, by a vote of 419-0, the House passed a similar provision as part of H.R. 2901 and, in 2017, by a vote of 58-0, the House Financial Services Committee passed a similar provision as part of H.R. 1422.

**Support NFIP Reinsurance Program.** The RAA supports FEMA's NFIP Reinsurance Program and requests that it be preserved in NFIP reauthorization and reform legislation.[42] The RAA has long advocated for the NFIP to utilize the private market to help manage the financial burden of the NFIP's catastrophic flood risk by providing financial backing for the government's flood risk, protecting taxpayers, and helping the program to be more resilient and pay claims. In 2021, for the fifth consecutive year, FEMA has successfully administered its NFIP Reinsurance Program that transfers risk from the NFIP to the capital markets, specifically through reinsurance placements and a catastrophe bond issuance.

**Modernize 1968 NFIA Part A Authority.** When enacted in 1968, over 50 years ago, the National Flood Insurance Act (NFIA) incorporated two approaches to providing consumers with flood insurance, Part A and Part B. The NFIP operates under Part B with the federal government assuming the full underwriting risk subject to the risk transfer program mentioned above. Congress should modernize Part A of the NFIA and clarify that FEMA can use its authorities simultaneously with the Part B program. Re-purposing and modernizing the statutory language in Part A would give FEMA additional tools to partner with private insurers, facilitate the

[39] https://www.pewtrusts.org/-/media/assets/2019/03/state-flood-mitigation-revolving-fund-supporters-draft-3-11-2019.pdf
[40] https://financialservices.house.gov/uploadedfiles/hhrg-116-ba00-wstate-heidrickc-20190313.pdf
[41] https://www.congress.gov/bill/115th-congress/house-bill/1422?q=%7B%22search%22%3A%5B%22H.R.+1422%22%5D%7D&s=1&r=3
[42] https://www.fema.gov/flood-insurance/work-with-nfip/reinsurance

participation of private insurers in NFIP on a risk-sharing basis, further improve NFIP's viability, increase the NFIP's resources to pay claims, and increase flood insurance opportunities for consumers. Part A reforms also can lead to a stronger public-private partnership, give private insurers experience in underwriting flood risk, and help close the flood insurance coverage gap.

The Part A statutory language currently authorizes the FEMA Administrator to facilitate and assist the creation of a pool of insurers on a risk sharing basis with the federal government to provide flood insurance through their network of agents and policyholder relationships. Under the statute, the Administrator defines the qualifications of insurers for the pool and risk capital to be provided. The Administrator is authorized to enter into a contractual relationship with the pool defining the insured risk to be retained and the government's risk through its reinsurance of the pool. Pursuant to the statute, the financial arrangement recognizes that the NFIP provides subsidies to certain policyholders.

The RAA specifically recommends that NFIP reauthorization legislation include the amendment offered to the "National Flood Insurance Program Reauthorization Act of 2019" and withdrawn by Representative Blaine Luetkemeyer (R-MO) during the House Financial Services Committee's June 11-12, 2019, mark up.[43] The amendment language would: (1) Require FEMA to solicit ideas for risk-sharing demonstration programs; (2) Provide FEMA with authority, but not require it, to conduct risk-sharing demonstration programs; and (3) Make technical amendments to the NFIA Part A authority, which FEMA can use for risk-sharing demonstration programs.

The above-mentioned reforms can further facilitate the development of a private flood insurance market and improve the viability of NFIP. The reinsurance market is interested and has the capacity to underwrite flood insurance risk, including extreme flood risk, in both the public NFIP program, private market, and any future public-private flood insurance partnerships. Actions taken in recent years by some states, such as Florida, have demonstrated the interest and benefits of private insurers assuming a broad cross-section of risk, and the same would result from the above flood insurance reforms. Reinsurers stand ready to partner with both the private- and public-sectors as the flood market transitions.

**Conclusion**

The RAA looks forward to continuing to work with Chairman Brown, Ranking Member Toomey, and other members of the Committee on legislation to improve America's housing and community resilience in the face of climate and natural disaster risks by prioritizing and directing public and private sector resources to communities that are the most in need and most at risk from natural disaster(s), closing the insurance protection gap, and enacting a long-term reauthorization of the NFIP and flood insurance reforms that facilitate the development of a private flood insurance market. Thank you for your consideration of our views and recommendations in this testimony. The RAA and its members welcome the opportunity to meet with you about our views and recommendations, work with you to develop CDRZ legislation, or answer any questions you may have.

[43] https://financialservices.house.gov/calendar/eventsingle.aspx?EventID=407747; https://financialservices.house.gov/calendar/eventsingle.aspx?EventID=403829

## APPENDIX A

## RAA CLIMATE CHANGE POLICY

The world's climate is changing. An increase in the severity and frequency of extreme weather is impacting daily life for the global community. Mounting evidence from the scientific community makes it increasingly clear that climate change is having a significant effect on the world's social and economic risks and that it will continue to do so. The scientific evidence also strongly indicates that human behavior is having an impact on the climate, primarily through carbon emissions.

With a fundamental role in assisting individuals and businesses manage risk, it is prudent for the insurance industry to acknowledge the changing climate as well as the risks it poses to all areas of its business. Furthermore, policymaking and corporate strategies must also reflect measures for the mitigation of, and adaption to, climate change.

The RAA is committed to working with policymakers, regulators, and the scientific, academic and business communities to assist in promoting awareness and understanding of the risks associated with climate change.

Specifically, the RAA will take the following actions:

- In the scientific arena, promote research on climate change, including improvements in the capability to assess climate change and extreme weather events. We acknowledge the importance of enhanced national and regional forecasting. Additionally, recognizing our primary reliance on the scientific community for fundamental insights about climate change, the RAA and individual member companies will provide to the public, insurers and to policymakers our understanding of the likely impact of climate change, particularly the impact of extreme weather events on insurers and policyholders.

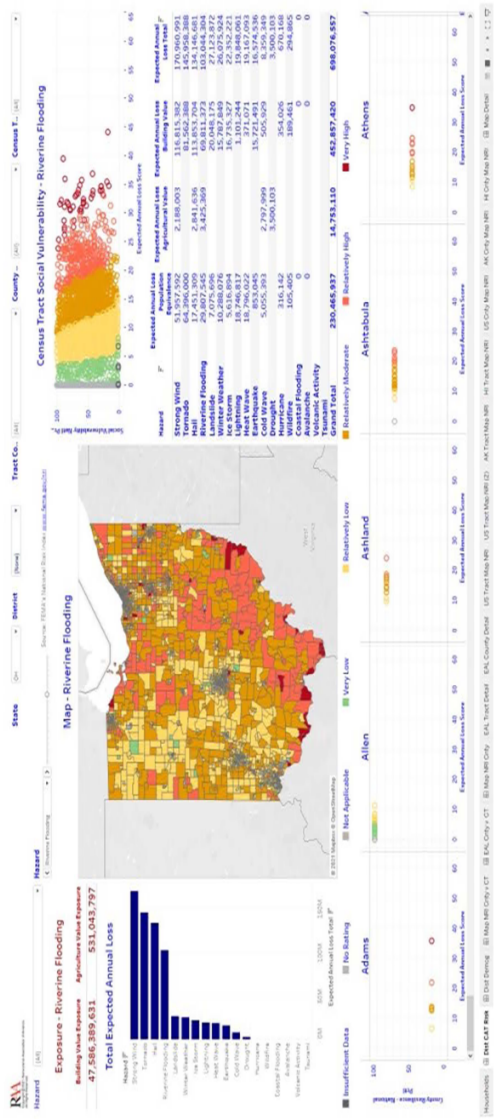
- Support climate change awareness for insurers and policyholders. Additionally, the RAA will work with regulators and industry to develop appropriate risk disclosure responsibilities of insurers.

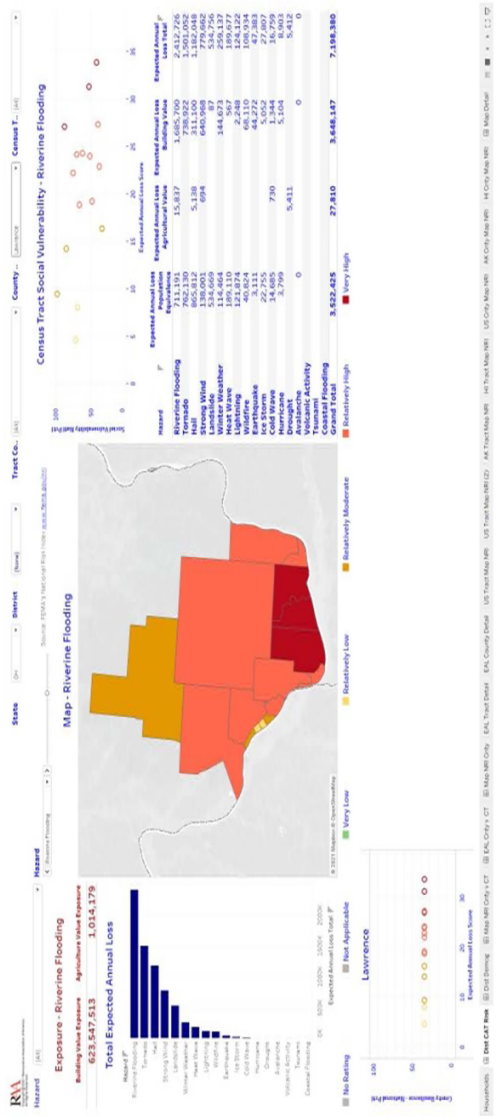
- Support the efforts of RAA members and other private market participants to develop and offer financial products and services using risk-based pricing to assist in managing the financial risk associated with climate change and catastrophic risk. The RAA acknowledges the need to improve the evaluation of future risks associated with climate change as a part of the reinsurance risk assessment and capital management processes.

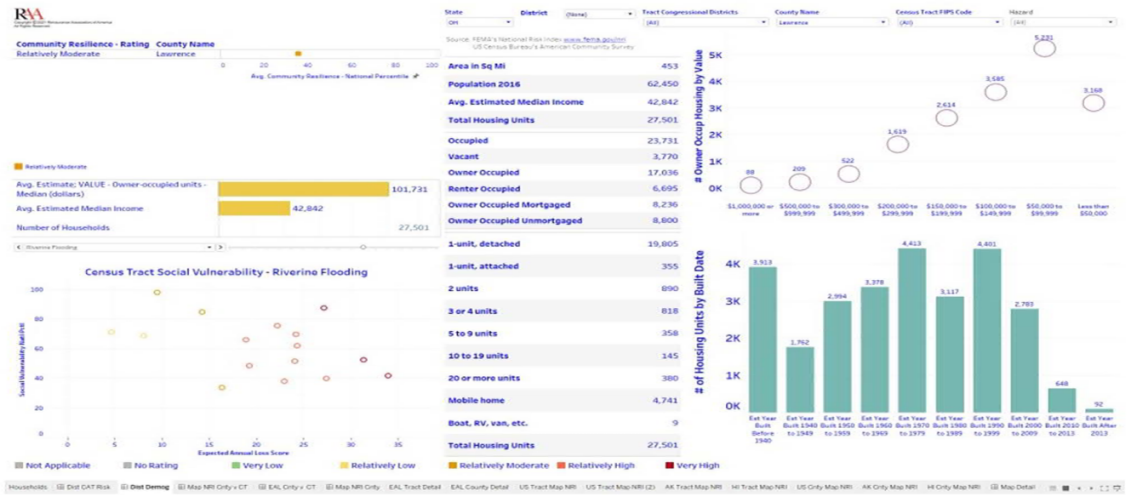
- At the state and national levels, the RAA will work with policymakers to support legislation to mitigate greenhouse gases and take steps to adapt to climate change through improved preventive measures and public initiatives to address the reduction of risks associated with climate change. These measures include natural hazard mitigation through better land use planning, improved building codes, the use of structurally sound, environmentally friendly building materials, alternative energy sources and other appropriate means.

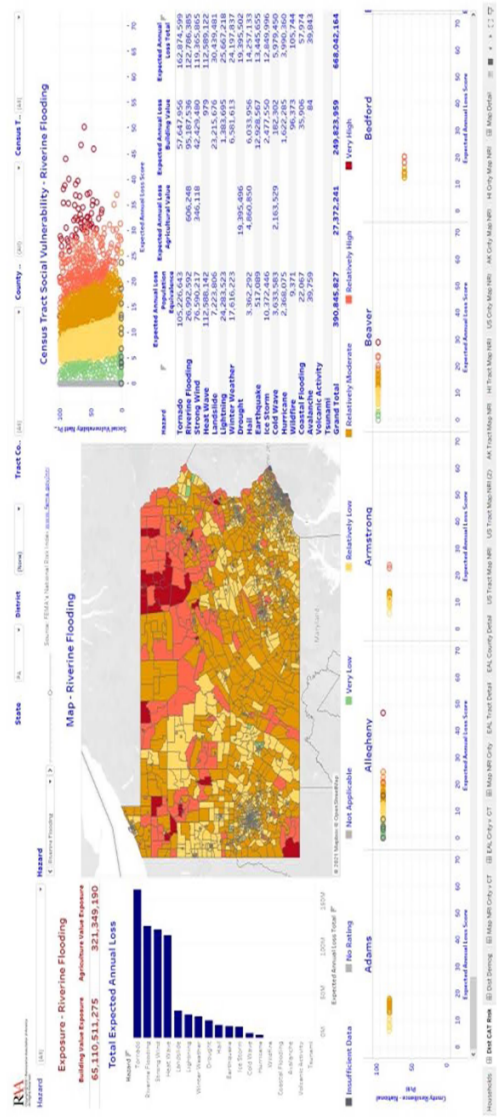
The RAA will also encourage each of its members to assess the impact of their business operations to analyze their contribution to climate change and to evaluate emissions reductions measures and improve their use of every efficient technologies.

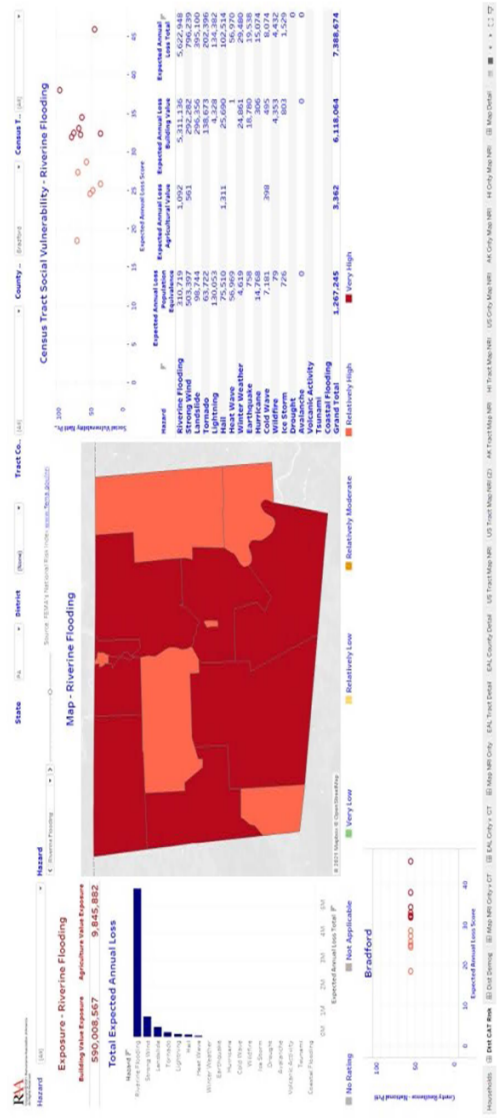
**APPENDIX B**

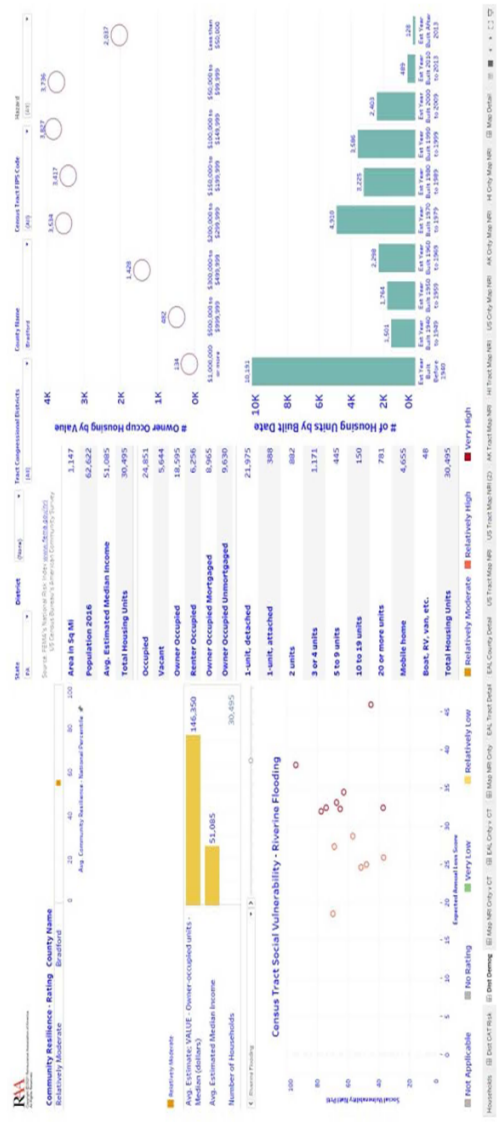

Map - Riverine Flooding
Exposure - Riverine Flooding
Total Expected Annual Loss
Census Tract Social Vulnerability - Riverine Flooding
Adams
Allen
Ashland
Ashtabula
Athens


Map - Riverine Flooding
Census Tract Social Vulnerability - Riverine Flooding
Exposure - Riverine Flooding
Total Expected Annual Loss
Lawrence
Very Low
Relatively Low
Relatively Moderate
Relatively High
Very High
Not Applicable
No Rating


Community Resilience - Rating
Relatively Moderate
County Name
Lawrence
Avg. Community Resilience - National Percentile
Relatively Moderate
Avg. Estimate; VALUE - Owner-occupied units - Median (dollars)
101,731
Avg. Estimated Median Income
42,842
Number of Households
27,501
Census Tract Social Vulnerability - Riverine Flooding
Social Vulnerability Rank Pct
Expected Annual Loss Score
Not Applicable
No Rating
Very Low
Relatively Low
Relatively Moderate
Relatively High
Very High
Area in Sq Mi 453
Population 2016 62,450
Avg. Estimated Median Income 42,842
Total Housing Units 27,501
Occupied 23,731
Vacant 3,770
Owner Occupied 17,036
Renter Occupied 6,695
Owner Occupied Mortgaged 8,236
Owner Occupied Unmortgaged 8,800
1-unit, detached 19,805
1-unit, attached 355
2 units 890
3 or 4 units 818
5 to 9 units 358
10 to 19 units 145
20 or more units 380
Mobile home 4,741
Boat, RV, van, etc. 9
Total Housing Units 27,501
# Owner Occup Housing by Value
# of Housing Units by Built Date


Map - Riverine Flooding
Exposure - Riverine Flooding
Building Value Exposure
65,110,511,275
Agriculture Value Exposure
321,349,190
Total Expected Annual Loss
Census Tract Social Vulnerability - Riverine Flooding
Allegheny
Armstrong
Beaver
Bedford
Adams
Insufficient Data
No Rating
Very Low
Relatively Low
Not Applicable
Relatively Moderate
Relatively High
Very High


Exposure - Riverine Flooding
Map - Riverine Flooding
Census Tract Social Vulnerability - Riverine Flooding
Total Expected Annual Loss
Bradford
Very Low
Relatively Low
Relatively Moderate
Relatively High
Very High
No Rating
Not Applicable


Community Resilience - Rating
Relatively Moderate
County Name
Bradford
Avg. Community Resilience - National Percentile
Census Tract Social Vulnerability - Riverine Flooding
Social Vulnerability Ranking
Riverine Flooding Annual Loss Score
Not Applicable
No Rating
Very Low
Relatively Low
Relatively Moderate
Relatively High
Very High
# Owner Occup Housing by Value
# of Housing Units by Built Date
Census Tract FIPS Code
Hazard
Households
Dot Ctrl Risk
Dot Owning
Maj NRI Only + CT
EAL Only + CT
Maj NRI Only
EAL Tract Detail
US Tract Detail
US Tract Maj NRI
US Tract Maj NRI (2)
AK Tract Maj NRI
HI Tract Maj NRI
US Only Maj NRI
AK Only Maj NRI
HI Only Maj NRI
Maj Detail

## APPENDIX C

### NATIONAL SUPPORT FOR THE STATE FLOOD MITIGATION REVOLVING FUND:

*as of March 8, 2019*

Alliance for National and Community Resilience
American Conservation Coalition
American Farmland Trust
American Flood Coalition
American Institute of Architects
American Planning Association
American Public Works Association
American Rivers
American Society of Civil Engineers
American Society of Landscape Architects
Association of State Floodplain Managers
Consumer Mortgage Coalition
Ecological Restoration Business Association
Enterprise Community Partners
Environmental and Energy Study Institute
Insurance Institute for Business & Home Safety
International Code Council
National Association of Mutual Insurance Companies
National Ground Water Association
National Hazard Mitigation Association
National Institute of Building Sciences
Natural Resources Defense Council
Pinchot Institute
Property Casualty Insurance Association of America
Reinsurance Association of America
Smart Home America
Southern Environmental Law Center
St. Bernard Project
The Main Street Alliance
The Nature Conservancy
The Pew Charitable Trusts
Union of Concerned Scientists
U.S. Resiliency Council

### THE PROBLEM

Flooding is the costliest and most common natural disaster in the U.S., claiming lives, damaging households and businesses, and straining government agencies that provide flood response and relief. Since 2000, flood-related disasters have cost over $750 billion. The federal government and states need to pursue more investment before disasters strike to help protect our communities and lower the cost burden on American taxpayers in future floods.

### THE VALUE OF FLOOD MITIGATION

According to a 2018 report by the National Institute of Building Sciences, for every dollar spent on hazard mitigation, the nation saves $6. In the case of riverine flood, projects involving acquisition or demolition of flood-prone buildings save $7 for every dollar invested. The benefits come largely from avoided property damage, casualties associated with storms, and savings when businesses and communities quickly return to normal following a flood event.

Despite these findings, the federal approach to flood disasters continues to focus on response and recovery while underinvesting in preparation. In too many instances, infrastructure or homes are rebuilt as they were, only to flood again. Investments in pre-disaster mitigation have historically failed to meet demand, perpetuating this cycle of loss and repair. Although the federal government spent $277.6 billion from 2005 to 2014 on overall disaster assistance, the Federal Emergency Management Agency (FEMA) has spent just $600 million on its Pre-Disaster Mitigation grant program over the same time period.

**NEEDED: A NEW FEDERAL-STATE PARTNERSHIP**

The federal government can break the cycle of paying to repeatedly rebuild by increasing investments *before* disasters strike. FEMA and other federal agencies, however, cannot solve this problem alone. Localities and states are key decision-makers for policies that affect flood risk, with clear authorities to guide new development away from hazardous areas and enforce building standards that will protect lives and property.

A cost-sharing partnership, capitalized, in part, with federal monies administered by states, and tailored to unique local needs, could provide a long-term, self-sustaining source of financing for a wide range of projects. Since its inception in 1987, for example, the Clean Water State Revolving Fund has leveraged $41 billion in federal investments and 7.6 billion in corresponding state contributions for $118 billion in high priority water quality projects. The revolving loan fund model, also used successfully for drinking water treatment facilities, energy efficiency projects, and economic development, could address the nation's flood preparation needs as well.

**THE SOLUTION**

Legislation introduced in Congress for a State Flood Mitigation Revolving Fund program would create a new partnership with states to provide low-interest loans for projects that save lives and dollars.

With federal backing and local engagement, this legislation would allow each state to select and implement the types of mitigation projects best suited to the unique flood hazards it faces. Projects supported by the individual state revolving funds could include elevations and flood proofing of public buildings, businesses, and residences; improvements to stormwater management; assistance to local residents who wish to move out of harm's way; or converting frequently flooded areas into open space amenities.

With billions of dollars and countless lives at risk, and following yet another year of record-breaking storms and floods, now is the time for Congress to act.

**MORE SUPPORT FOR THE STATE FLOOD MITIGATION REVOLVING FUND:**

**AZ**
Nogales-Santa Cruz County Chamber of Commerce
Sedona Chamber of Commerce & Tourism Bureau

**CA**
American Planning Association – California Chapter
American Planning Association San Diego Chapter
California Coastkeepers Alliance
California Nevada Cement Association
City of Roseville
City of Santa Maria
Costa Mesa Chamber of Commerce
Friends of the LA River
Greater Irvine Chamber of Commerce
Greater Los Angeles African American Chamber of Commerce
Huntington Beach Chamber of Commerce
Klamath Riverkeeper
Los Angeles Area Chamber of Commerce
Los Angeles Waterkeeper
North Orange County Chamber of Commerce
Orange County Business Council
Redondo Beach Chamber of Commerce
San Francisco Chamber of Commerce
Santa Barbara Chamber of Commerce
Santa Cruz Area Chamber of Commerce
Sequoia Riverlands Trust
Silicon Valley Leadership Group
Torrance Area Chamber of Commerce

**CO**
American Planning Association – Colorado Chapter
Colorado Municipal League
Estes Park Economic Development Council
Special Districts Association of Colorado
Urban Drainage and Flood Control District

**DE**
Delaware Nature Society

**FL**
Broward County
Florida Floodplain Managers Association

**GA**
Altamaha Riverkeeper
American Planning Association Georgia Chapter
Center for a Sustainable Coast
Coosa River Basin Initiative
EarthShare Georgia
Georgia Association of Floodplain Management
Humane Society for Greater Savannah
LifeLine Animal Project
St. Marys Riverkeeper
Trees Atlanta

**IA**
Food Bank of Iowa
Iowa Floodplain and Stormwater Management Association
Iowa Ground Water Association
Iowa State Association of Counties
Quad Cities Waterkeeper

**ID**
Association of Idaho Cities
American Planning Association – Idaho Chapter

**IL**
Association of Illinois Soil and Water Conservation Districts
Illinois Groundwater Association

**IN**
Indiana Dunes Tourism

**MN**
Association of Minnesota Emergency Managers
Conservation Minnesota
Minnesota Association of Floodplain Managers
Minnesota Coalition for the Homeless
Minnesota Section of the American Society of Civil Engineers

**MO**
Great Rivers Greenway
Great Rivers Habitat Alliance
Missouri Confluence Waterkeeper

**MS**
Tishomingo County Tourism Council

**NC**
MountainTrue
North Carolina Association of Floodplain Managers
North Carolina Coastal Federation
North Carolina Conservation Network
North Carolina Housing Coalition

**NJ**
Environment New Jersey
New Jersey Future
Pinelands Preservation Alliance
South Jersey Land & Water Trust
The Conservancy of New Jersey

**NY**
Cayuga County Chamber of Commerce
Cayuga County Economic Development Agency
Center for NYC Neighborhoods
Gowanus Canal Conservancy
Greater Rochester Chamber of Commerce
Hudson River Sloop Clearwater, Inc.
Neighborhood Preservation Coalition of New York State
New York Riverkeeper
New York State Rural Housing Coalition
Niagara USA Chamber of Commerce
Orleans County Chamber of Commerce
Orleans Economic Development Agency
Regional Plan Association
Resilient Red Hook
The Bronx River Alliance

**OH**
Brecksville Chamber of Commerce
Chamber of Commerce in Broadview Heights
Green Area Chamber of Commerce
Tallmadge Chamber of Commerce

**PA**
10,000 Friends of Pennsylvania
Central PA Alliance for Response
Humane PA
PennFuture
Pennsylvania Association of State Floodplain Managers
Schuylkill Headwaters Association, Inc.

**SC**
Coastal Conservation League
Municipal Association of South Carolina
South Carolina Association of Counties
South Carolina Insurance Association
The Nature Conservancy of South Carolina

**TN**
Greater Nashville Regional Council
Greenspaces Chattanooga
Nashville Civic Design Center
North Chickamauga Creek Conservancy
Tennessee Association of Floodplain Managers
Tennessee Development District Association
Tennessee Renewable Energy and Economic Development Council
Tennessee Small Business Alliance
The Housing Fund
Upper Cumberland Development District
Vanderbilt Engineering Center for Transportation and Operational Resiliency
Walk Bike Nashville

**TX**
Bay Area Houston Economic Partnership
Concerned Citizens of Texas
Cypress Creek Flood Prevention
Houston Northwest Chamber of Commerce
Lake Travis Fire Rescue
Resource Environmental Solutions, LLC
West Houston Association
West Isle Property Owners Association

**UT**
St. George Chamber of Commerce

**WI**
American Planning Association – Wisconsin Chapter
Bad River Band of Lake Superior Chippewa
Bay-Lake Regional Planning Commission
Eau Claire Area School District
Gathering Waters: Wisconsin's Alliance for Land Trusts
League of Wisconsin Municipalities
Milwaukee Riverkeeper
St. Croix River Association
Superior Rivers Watershed Association
The Association of Wisconsin Regional Planning Commissions
The Wisconsin Land and Water Conservation Association
Wisconsin Counties Association
Wisconsin EMS Association

# PREPARED STATEMENT OF ROGER PIELKE, JR.

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JULY 20, 2021



STATEMENT OF
DR. ROGER PIELKE JR.
to the COMMITTEE ON BANKING, HOUSING, AND URBAN AFFAIRS
of the UNITED STATES SENATE

HEARING on
21st Century Communities: Climate Change, Resilience, and Reinsurance
Dirksen Senate Office Building 538
20 July 2021

My testimony focuses on the importance of securing robust scientific advice on climate change. Unfortunately, key scientific guidance on climate that informs policy– including central bank stress testing and U.S. government estimates of the social cost of carbon – has departed from basic standards of scientific integrity. A main reason for this departure is that climate science has increasingly been enlisted in support of policy advocacy rather than to inform policy debates and decisions. My biography is included at the end of this statement. My testimony today represents my individual views not those of any organization.

**Five Take-Home Points**

1. At the outset, I emphasize explicitly and unequivocally that human-caused climate change is real, that it poses significant risks to society and the environment, and that various policy responses in the form of mitigation and adaptation are necessary and make good sense.
2. However, the reality and importance of climate change does not provide a rationale or excuse for the evasion or avoidance of meeting basic standards of research integrity in the provision of scientific advice to policy makers.
3. Currently, policy makers are being badly misled in a number of crucial areas related to climate science, impacts and economics. Specifically:
    - The climate scenarios that underlie much of climate research are badly outdated and no longer offer insight to plausible futures;
    - Economic losses associated with extreme events are routinely attributed to changes in climate, while changes in society and its exposure and vulnerability – which also influence future risks -- are largely ignored;
    - Trends in the incidence of extreme weather events in the United States and around the world are far more nuanced than discussions found in the media and in politics.
4. Shortfalls in robust science advice on climate are more than just an academic issue – they also show up in important policy contexts, such as:
    - Proposals for "climate stress testing" in the global and national financial systems;
    - The estimated "social cost of carbon" of the Biden, Trump and Obama administrations;
    - Proposed Congressional legislation to address financial system risks related to climate change.
5. Climate change is too important to allow shortfalls of scientific integrity in science advice to persist. Congress should enhance its oversight of the U.S. Global Change Research Program and its National Climate Assessment to ensure that the scientific advice that it receives is up-to-date and accurate.

The remainder of my written testimony elaborates and substantiates these five take-home points.

**Elaboration of the Five Take-Home Points**

1. *At the outset, I emphasize explicitly and unequivocally that human-caused climate change is real, that it poses significant risks to society and the environment, and that various policy responses in the form of mitigation and adaptation are necessary and make good sense.*

The Intergovernmental Panel on Climate Change has for more than 30 years through its Working Group 1 provided routine assessments of the physical science aspects of climate change.[1] The IPCC WG1 is scheduled to release its 6th assessment report on 9 August 2021. These assessments have documented changes in climate that have been detected and attributed to human causes, notably the emission of carbon dioxide and other greenhouse gases.

My views on the importance of climate policy have been consistent for almost three decades. For instance, in 2006 I testified before the House of Representatives on the conclusions of the IPCC: "on this basis alone I am personally convinced that it makes sense to take action to limit greenhouse gas emissions. Of course, the answer to what action is not at all straightforward. It involves questions of on what time scales, at what cost, with what consequences, with what foregone opportunities, and what mix of adaptation and mitigation."[2] Such complexities are why the provision of expert advice to Congress and the federal agencies is so important.

For more insight on my views on the science and policy of climate, please see my book **The Climate Fix** (2010). Nothing in the testimony that follows should be interpreted as downplaying the importance of climate change or policy responses to it. In fact, the issue is so crucial that we should expect the absolute highest standards of scientific integrity in the information being provided to policy makers.

2. *However, the reality and importance of climate change does not provide a rationale or excuse for the evasion or avoidance of meeting basic standards of research integrity in the provision of scientific advice to policy makers.*

"Scientific integrity," as I use the phrase here, is defined by several leading scholars to consist "of proper reasoning processes and handling of evidence essential to doing science" and "a respect for the underlying empirical basis of science."[3] It is uncontroversial that we want good science to inform policy.

The U.S. Congress has established countless mechanisms for the provision of science advice to government across many areas of policy making – such as in the more than 1,000 FACA (Federal Advisory Committee Act) committees that provide guidance on topics as varied as vaccine approval and the regulation of pollutants.[4]

[1] https://www.ipcc.ch/
[2] https://www.govinfo.gov/content/pkg/CHRG-109hhrg29932/html/CHRG-109hhrg29932.htm
[3] Douglas, H. E., & Bour, E. (2014). Scientific integrity in a politicized world. In *Logic, Methodology, and Philosophy of Science: Proceedings of the Fourteenth International Congress* (pp. 253-268).
[4] https://www.facadatabase.gov/FACA/FACAPublicPage

In 1990, the U.S. Congress established an advisory mechanism for climate science in the form of a national climate assessment.[5] That legislation required the national climate assessment to be produced every four years by the interagency U.S. Global Change Research Program and, among other tasks, is to document "the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity" in order to provide "usable information on which to base policy decisions relating to global change."[6]

In practice, however, the U.S. National Climate Assessment (NCA) has been politicized in varying degrees by both Democratic and Republic administrations. It has been used less as a mechanism of science advice to Congress and the President (as mandated in law) but as a tool for promoting the climate policy agenda of the administration. This continues today. The main reason for the politicization of the NCA is that it is housed in the Executive Office of the President (under the Office of Science and Technology Policy) and is ultimately led by political appointees – which is not an ideal structure for effective science advice.[7]

Thus, due to the politicization of the NCA, the ability of the U.S. government's primary science advisory body on climate to ensure scientific integrity, and to correct course when things get off track, is limited. I say more on how to address these shortfalls under #5 below.

3. *Currently, policy makers are being badly misled in a number of crucial areas related to climate science, impacts and economics. For instance:*

    - *The climate scenarios that underlie much of climate research are badly outdated and no longer offer insight to plausible futures;*

A large proportion of research on climate science, impacts and economics depends upon scenarios of the long-term future to produce projections of future changes in climate, their impacts on society and the environment and the consequences of alternative possible policy actions.[8] However, the scenarios that are currently prioritized in climate research and in policy analyses are badly outdated, and for a range of reasons have not been updated.[9]

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[5] https://www.govinfo.gov/content/pkg/STATUTE-104/pdf/STATUTE-104-Pg3096.pdf

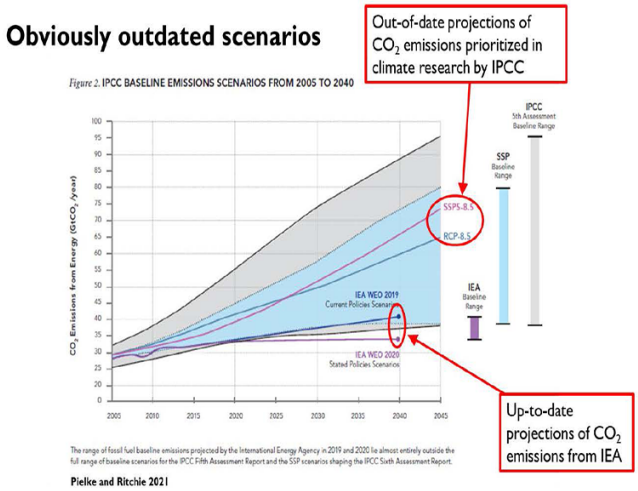
[6] Pielke, R. A. (1995). Usable information for policy: an appraisal of the US Global Change Research Program. *Policy Sciences*, *28*(1), 39-77.

[7] For more details see: https://rogerpielkejr.substack.com/p/fixing-the-us-national-climate-assessment

[8] Brian C. O'Neill, Timothy R. Carter, Kristie Ebi, Paula A. Harrison, Eric Kemp-Benedict, Kasper Kok, Elmar Kriegler, Benjamin L. Preston, Keywan Riahi, Jana Sillmann, Bas J. van Ruijven, Detlef van Vuuren, David Carlisle, Celia Conde, Jan Fuglestvedt, Carole Green, Tomoko Hasegawa, Julia Leininger, Seth Monteith, and Ramon Pichs-Madruga, "Achievements and needs for the climate change scenario framework," *Nature Climate Change* 10 (2020): 1074–1084.

[9] R. Pielke Jr. and J. Ritchie, 2021. How Climate Scenarios Lost Touch With Reality, *Issues in Science and Technology*, Summer. And for a deeper, more technical analysis see: Pielke Jr, R., & Ritchie, J. (2021). Distorting the view of our climate future: The misuse and abuse of climate pathways and scenarios. *Energy Research & Social Science*, *72*, 101890.

The figure below shows clearly that carbon dioxide emissions in the real world are already at a level far less that those projected in the highest priority climate scenarios (which are typically used to represent a "business as usual" or reference case projection of the future).




- *Economic losses associated with extreme events are routinely attributed to changes in climate, while changes in society and its exposure and vulnerability – which also influence future risks -- are largely ignored;*

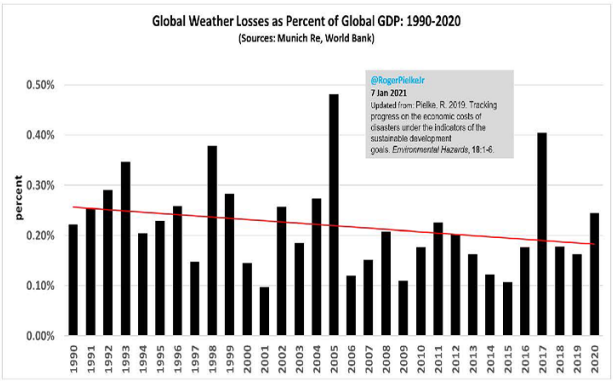
Every day, somewhere on planet earth extreme weather events are happening. With 21st century communication technology and platforms we are all able to witness disasters in ways that in earlier times just wasn't possible. But the visceral appreciation of extremes and their impacts is no substitute for data and evidence.

Data and evidence indicate that since at least 1990 (about when global data on disaster losses is judged to become reliable) the economic damages associated with extreme weather have in fact *decreased* when measured in the context of global GDP. This is shown clearly in the graph on the next page, based on data from the global reinsurance company Munich Re and global GDP from the World Bank.[10] The trend of decreasing impacts of weather as a proportion of GDP holds for countries at all income levels.[11] This data should not be confused with data on the frequency or

[10] Pielke, R. (2019). Tracking progress on the economic costs of disasters under the indicators of the sustainable development goals. *Environmental Hazards*, *18*(1), 1-6.
[11] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(19)32596-6/fulltext

intensity of weather events – weather and climate data will always better serve for that purpose.

What the evidence shows is that the world has become *less vulnerable* to the direct economic impacts of weather and climate extremes as the global economy has grown.[12] This is in fact very good news, but there is no guarantee that it will continue, unless we pay greater attention in policy making to societal exposures and vulnerabilities to climate variability and change.




Regrettably, one of the U.S. governments most important science agencies has for years been contributing to the spread of misinformation on the economic costs of disasters. The National Oceanic and Atmospheric Administration (NOAA)[13] maintains a dataset of "billion dollar disasters" since 1980 that provides simple count of the number of disasters each year that exceed $1 billion in losses.[14] The U.S. government uses this simple metric as an indicator of climate change.[15]

What the dataset actually shows is a combination of poor methodology and the consequences of a growing society, with more people and property in locations exposed to loss from extreme weather. It is not an indicator of climate change. Climate data, not economic data, should be used for that purpose.

Consider just one example that illustrates the flawed methodology: Hurricane Kate made landfall near Mexico Beach, Florida, in 1985 and caused about $600 million in damages in current

[12] Formetta, G., & Feyen, L. (2019). Empirical evidence of declining global vulnerability to climate-related hazards. *Global Environmental Change*, *57*, 101920.
[13] I worked for 16 years in a NOAA cooperative institute and have great respect for its scientists. NOAA's longstanding promotion of the "billion dollar disaster" tabulation is in my view an aberration from what is typically one of the nation's most rigorous science agencies.
[14] https://www.ncdc.noaa.gov/billions/
[15] https://www.globalchange.gov/browse/indicators/billion-dollar-disasters

dollars—not enough to make NOAA's list for that year. But estimates that I developed with colleagues, published in the journal *Nature Sustainability* in 2018,[16] show that if we take into account the 50% increase in the region's population over almost four decades, and the parallel rise in the value of homes, their contents and other built infrastructure, that exact same storm today would cause damages amounting to some $2 billion. Yet, Hurricane Kate doesn't appear in the NOAA tabulation.

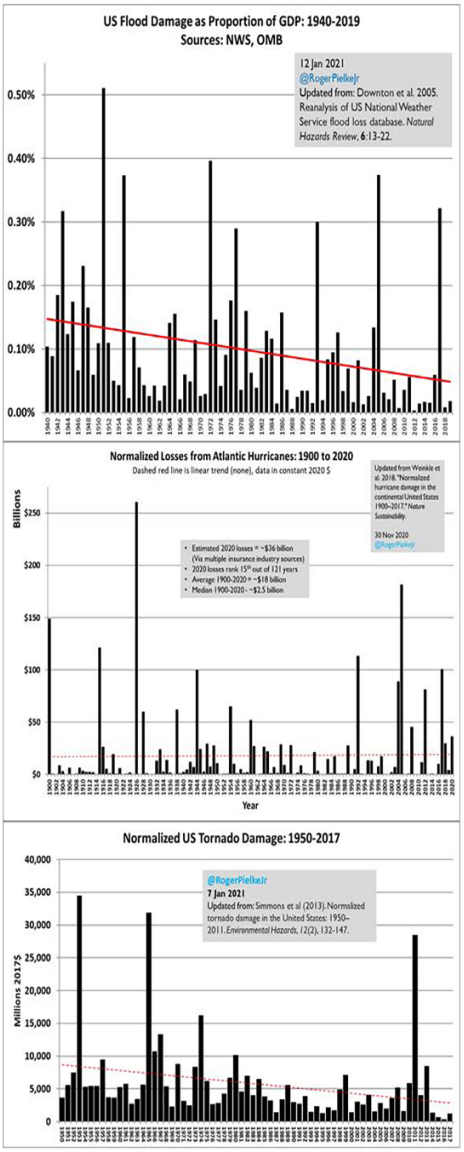
The "billion dollar disaster" list is routinely used in policy settings to suggest that disasters costs are increasing dramatically due to climate change, but what the dataset really indicates is growing wealth in locations exposed to loss. Every time you see this dataset invoked as evidence of human-caused climate change you should think instead about the state of scientific integrity in U.S. federal science agencies.

A more accurate and scientifically robust picture of the economic losses associated with extreme weather in the United States is available. For instance, based on work I've conducted with a number of colleagues, the three panels on the following page show the economic impacts of floods, hurricanes and tornadoes, considering growth in wealth and exposure. The picture that emerges is very different than that conveyed by the misleading NOAA dataset.

The three-panels show:

> **Top**: U.S. flood damage as a proportion of U.S. GDP from 1940 to 2019 (updated from Downton et al. 2005). The data show a sharp decline in the toll of flood damage as a proportion of the U.S. economy. This trend can be attributed to a combination of factors, including policy, development and climate.
>
> **Middle**: U.S. hurricane damage normalized to 2020 values, based on population, wealth and inflation (updated from Weinkle et al. 2018). The data show no trend and are consistent with trends in landfalling hurricanes.
>
> **Bottom**: U.S. tornado damage normalized to 2017 values, based on population, building stock and wealth, and inflation (updated from Simmons et al. 2012). The data show a downward trend which can be attributed to a number of factors, including a decrease in the incidence of strong tornadoes.

[16] Weinkle, J., Landsea, C., Collins, D., Musulin, R., Crompton, R. P., Klotzbach, P. J., & Pielke, R. (2018). Normalized hurricane damage in the continental United States 1900–2017. *Nature Sustainability*, *1*(12), 808-813.


US Flood Damage as Proportion of GDP: 1940-2019
Sources: NWS, OMB
12 Jan 2021
@RogerPielkeJr
Updated from: Downton et al. 2005. Reanalysis of US National Weather Service flood loss database. Natural Hazards Review, 6:13-22.
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
Normalized Losses from Atlantic Hurricanes: 1900 to 2020
Dashed red line is linear trend (none), data in constant 2020 $
Updated from Weinkle et al. 2018 "Normalized hurricane damage in the continental United States 1900–2017" Nature Sustainability.
30 Nov 2020
@RogerPielkeJr
Estimated 2020 losses = ~$36 billion (Via multiple insurance industry sources)
2020 losses rank 15th out of 121 years
Average 1900-2020 = ~$18 billion
Median 1900-2020 = ~$2.5 billion
Billions
$250
$200
$150
$100
$50
$0
Year
Normalized US Tornado Damage: 1950-2017
@RogerPielkeJr
7 Jan 2021
Updated from: Simmons et al (2013). Normalized tornado damage in the United States: 1950–2011. Environmental Hazards, 12(2), 132-147.
Millions 2017$
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0

- *Trends in the incidence of extreme weather events in the United States and around the world are far more nuanced than discussions found in the media and in politics.*

Detecting changes in the frequency, intensity and other dimensions of extreme events beyond observed natural variability on climate time scales (that is, according to the IPCC, of >30 to 50 years) is scientifically challenging. Evidence for detection of change is often subject to competing expert perspectives on data, methods and conclusions as in many cases the signals of change are small in the context of observed variability. Detection and attribution of trends is also difficult because extreme events – by definition – are rare.

Such competing views are normal and indicate healthy scientific activity in the context of a complex field. Leading assessments accurately reflect the complexities and nuance associated with identifying changes in the behavior of extreme events. However, virtually all of this nuance is lost in public and policy debate, as extreme events have become enlisted as symbols in the public debate over climate change and are used to represent the need for changes in energy policy. In addition to oversimplifying the science on extremes, the loss of nuance also has the unfortunate consequence of pushing aside the reality that the most effective policy responses to extreme events in the context of climate variability and change will be adaptive and highly local in order to reduce societal exposure and vulnerabilities.

As just one example of important nuance that is overlooked -- the most recent U.S. National Climate Assessment did not show trend data on the incidence of landfalling hurricanes in the United States. Landfalling hurricanes cause considerable damage and are always at the center of discussion of climate change. Thus, the failure to show trends in hurricane incidence is a major oversight for a U.S.-focused climate science assessment.

That data is shown on the following page. Neither hurricane nor major hurricane landfalls have increased in the United States over the past century – contrary to much conventional wisdom represented in the media and in political debates. Nor have tropical cyclone landfalls of hurricane-strength increased globally since at least 1970.[17] The case for action on energy policy is strong with or without evidence of more hurricanes hitting the US (or around the world), and policy makers should know these trends. It is remarkable that they were not included in the US NCA.

The role of climate change in observed and projected hurricane behavior is the subject of ongoing research and according to recent assessments of the World Meteorological Organization there is not presently a scientific consensus that a signal of climate change has been detected or attributed to human causes in observed activity with high levels of certainty.[18] As two NOAA scientists

[17] Weinkle, J., et al. (2012). Historical global tropical cyclone landfalls. *Journal of Climate*, *25*(13), 4729-4735.

[18] The four recent WMO assessments are:

Knutson, T., Camargo, S. J., Chan, J. C., Emanuel, K., Ho, C. H., Kossin, J., Mohapatra, M., Satoh, M., Sugi, M., Walsh, K., & Wu, L. (2019). Tropical cyclones and climate change Assessment: Part I: Detection and attribution. Bulletin of the American Meteorological Society, 100(10), 1987–2007.

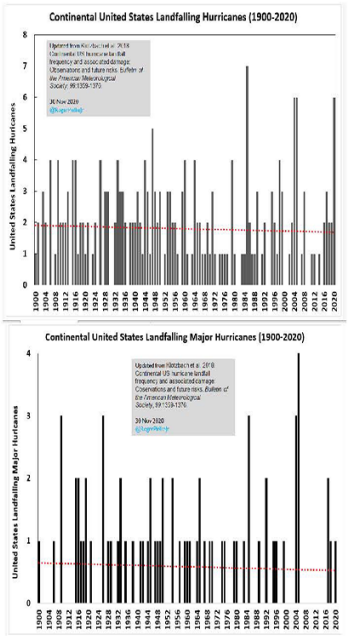
Knutson, T., Camargo, S. J., Chan, J. C., Emanuel, K., Ho, C. H., Kossin, J., Mohapatra, M. & Wu, L. (2020). Tropical cyclones and climate change assessment: Part II: Projected response to anthropogenic warming. *Bulletin of the American Meteorological Society*, *101*(3), E303-E322.

Lee, T. C., Knutson, T. R., Nakaegawa, T., Ying, M., & Cha, E. J. (2020). Third assessment on impacts of climate change on tropical cyclones in the Typhoon Committee region – part I: Observed changes,

observed last week: "Various scientists within NOAA have differing opinions about global warming's impact on hurricanes and there is no official NOAA policy on the topic. Varying ideas on an issue often mean that it is a science in progress with no definitive answers."[19]

The IPCC and the World Meteorological Organization have each produced recent assessments of the state of scientific understandings of hurricanes (tropical cyclones) and together do an admirable job overall in identifying what is known, what is not yet known and areas of uncertainty and fundamental ignorance.

If you happen to among those who believe incorrectly that U.S. hurricanes or major hurricanes have increased since 1900 (when data is reliable) or global tropical cyclone landfalls (since 1970 when data is reliable), you should think about the integrity of science advice being provided to policy makers on climate.




detection and attribution. Tropical Cyclone Research and Review, 9(1), 1–22.
Cha, E. J., Knutson, T. R., Lee, T. C., Ying, M., & Nakaegawa, T. (2020). Third assessment on impacts of climate change on tropical cyclones in the Typhoon Committee Region–Part II: Future projections. *Tropical Cyclone Research and Review*, *9*(2), 75-86.

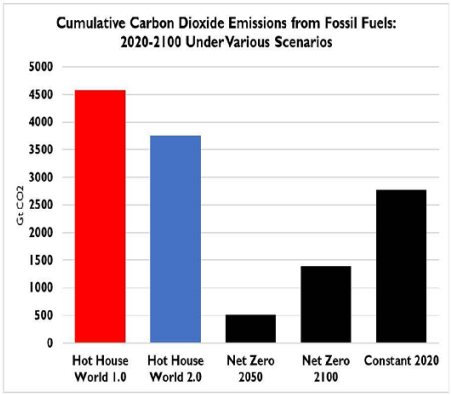
[19] https://noaanhc.wordpress.com/2021/06/30/was-2020-a-record-breaking-hurricane-season-yes-but/

4. *Shortfalls in robust science advice on climate are more than just an academic issue – they also show up in important policy contexts, such as:*

    - *Proposals for "climate stress testing" in the global and national financial systems;*

The Network for Greening the Financial System (NGFS) is voluntary consortium comprised of more than 60 central banks representing almost 50% of the global economy.[20] The NGFS provides climate scenarios for use by governments and businesses to "stress test" their activities in the context of projected climate change and proposed climate policies. To their credit the NGFS is one of the few institutions that that has recognized that the most commonly used climate scenarios (of the IPCC) "were designed about 10 years ago and do not match well with recent emissions trends."[21] The NGFS has thus taken it upon itself to create new scenarios for climate stress testing.

However, despite the recognition that the IPCC scenarios are outdated, the reference scenario created by the NGFS (called "Hot House World") – both its first iteration and then an update released last month[22] -- are also well out of date when compared to recent emissions trends and projections. This can easily be seen in the graph below which compares cumulative carbon dioxide emissions 2020 to 2100 for the two NGFS "Hot House World" scenarios (red and blue) with those that assume constant 2020 emissions to 2100, and then two that assume the world moves toward net-zero carbon dioxide in 2050 and 2100 (in black).




The scenarios underlying climate stress testing assume continued growth in emissions to at least 2090, to a level about ~50% greater than those of today. Whether or not such an assumption is plausible has not been explored, but if such aggressive growth in emissions is implausible (and our

[20] https://www.ngfs.net/sites/default/files/medias/documents/synthese_ngfs-2019_-_17042019_0.pdf
[21] https://www.ngfs.net/sites/default/files/ngfs_climate_scenario_technical_documentation_final.pdf
[22] https://www.ngfs.net/en/communique-de-presse/ngfs-publishes-second-vintage-climate-scenarios-forward-looking-climate-risks-assessment

work suggests that it is implausible), then the "stress tests" conducted under the scenario will have no real-world meaning and instead will just be academic exercises.

- *The estimated "social cost of carbon" of the Biden, Trump and Obama administrations;*

In 2008, a federal court ruled that the U.S. Department of Transportation was in error in conducting a benefit-cost analysis when it assigned a value of zero to the economic consequences of carbon dioxide emissions, concluding, "while the record shows that there is a range of values, the value of carbon emissions reduction is certainly not zero."[23] This judgment meant that the government would need to develop a defensible estimate of economic consequences of carbon dioxide emissions.[24] Subsequently, in 2009 the Obama administration established an "interagency working group" (IWG) to develop estimates of the "social cost of carbon" (SCC), "to ensure that agencies were using the best available science and to promote consistency in the values used across agencies."[25]

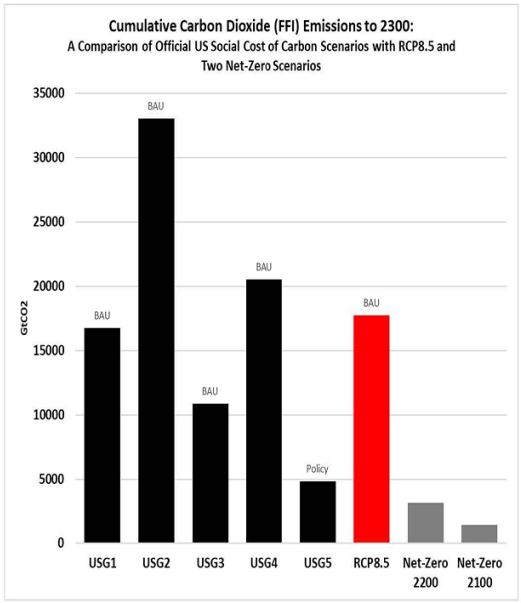
Soon after, in 2010 the IWG estimated the SCC at $26 (in 2007$ for 2020) per ton of carbon dioxide, and following several updates, in 2016 set the value at $42 (in 2007$ for 2020) per ton in 2016.[26] In March, 2017, the Trump administration disbanded the IWG and issued a new and much lower estimate for the SCC of $7 per ton (in 2018$ for 2020).[27] Recently, the Biden administration restored the final estimate of the Obama administration (now $51 per ton in inflation-adjusted 2020$ for 2020), as an "interim step" to issuing updated estimates sometime in the next year.[28]

In order to estimate future damages resulting from the emissions of carbon dioxide into the atmosphere, plausible estimates of how that future might unfold are necessary. The IWG based its original 2010 SCC on eight different scenarios of the climate future, developed decades ago.[29] Four of the scenarios were to represent different visions of how the future might unfold in the absence of climate policies (called "business as usual") and four others were combined into a single scenario to reflect a future with climate policy. These five scenarios looked out to 2100, so the IWG extended them to 2300 using a range of assumptions. Each of the five scenarios is weighted equally in estimating the SCC.

These scenarios are all badly outdated and have never been updated in the IWG methodology.[30] All of them, including the policy scenario, envisage enormous emissions of carbon dioxide from the burning of fossil fuels to 2300. None of these futures are remotely plausible. This can be seen in the figure below, which shows the scenarios of the IWG (in black) compared to the implausible

[23] https://bit.ly/3wHyKK2
[24] https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A4/a-4.pdf
[25] https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf
[26] https://www.nap.edu/catalog/24651/valuing-climate-damages-updating-estimation-of-the-social-cost-of
[27] https://www.federalregister.gov/documents/2017/03/31/2017-06576/promoting-energy-independence-and-economic-growth and https://www.gao.gov/assets/710/707776.pdf
[28] https://www.whitehouse.gov/briefing-room/blog/2021/02/26/a-return-to-science-evidence-based-estimates-of-the-benefits-of-reducing-climate-pollution/
[29] https://doi.org/10.1016/j.eneco.2009.10.013
[30] https://www.nap.edu/catalog/24651/valuing-climate-damages-updating-estimation-of-the-social-cost-of

"business as usual" scenario of the IPCC Representative Concentration Pathways (in red), as well as two much more plausible scenarios that assume the world achieves net-zero carbon dioxide in 2100 and in 2200 (in grey).




One does not have to be a climate expert to observe that the scenarios underlying the "social cost of carbon" estimates of the Obama, Trump and (to date) Biden administration are far out of touch with any plausible projection of future emissions. There are many technical and political debates about the "social cost of carbon" – but none of these debates mean much so long as the entire effort is built upon a foundation of implausibility.

- *Proposed Congressional legislation to address financial system risks related to climate change.*

Recently introduced legislation risks exacerbating the issues of scientific integrity related to climate science discussed in this testimony. Two examples follow:

- H.R. 1549 introduced in early 2021 would create a new scientific advisory body called the "Climate Risk Advisory Committee" to advise the Financial Stability Oversight Council.[31] The proposed legislation establishes no connection of new advisory committee with

[31] https://financialservices.house.gov/uploadedfiles/bills-117pih-addressingclimatefinancialr.pdf

existing climate advisory bodies of the U.S. government, notably the U.S. Global Change Research Program and its National Climate Assessment. This new advisory body would set the stage for disparate, conflicting or unclear guidance being provided to policy makers across uncoordinated advisory mechanisms.

- H.R. 3571, also introduced in early 2021, would create yet another expert advisory body, the "Climate Risk Scenario Technical Development Group" under the Board of Governors of the Federal Reserve.[32] The proposed legislation exempts the advisory group from the Federal Advisory Committee Act and requires that it develop one business-as-usual scenario and two policy scenarios and update them every three years. Not only would this add further complexity and possible dissonance in expert advice to policy makers, but it also risks codifying in law the establishment of flawed scenarios (imagine if new scenarios were produced in December, 2019, on the eve of the pandemic – these would have been immediately out-of-date). Congress should not mandate the substance of scenarios or how often they shall be updated.

Policy making will be improved with mechanisms for the provision of expert advice on climate, including that related to financial risks. However, attention should first be paid to addressing documented shortfalls in advisory systems before proliferating new advisory committees.

5. *Climate change is too important to allow shortfalls of scientific integrity in science advice to persist. Congress should enhance its oversight of the U.S. Global Change Research Program and its National Climate Assessment to ensure that the scientific advice that it receives is up-to-date and accurate.*

In 1990, Congress established in legislation (P.L. 101-606) the U.S. Global Change Research Program to provide "usable information on which to base policy decisions relating to global change."[33] In the legislation Congress also mandated that the USGCRP produce a "national climate assessment" (NCA) not less frequently than every four years, to provide guidance to Congress and the president on

(1) integrates, evaluates, and interprets the findings of the Program and discusses the scientific uncertainties associated with such findings;
(2) analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and
(3) analyzes current trends in global change, both human-inducted and natural, and projects major trends for the subsequent 25 to 100 years.[34]

Crucially, the NCA does not exist to promote or to sell the policy agenda of the current administration — regardless of the merits of a particular administration's policy proposals. The NCA exists to produce a "scientific assessment" which can certainly including evaluation of policy

[32] https://financialservices.house.gov/uploadedfiles/bills-117357lihccfra.pdf
[33] Pielke, R. A. (1995). Usable information for policy: an appraisal of the US Global Change Research Program. *Policy Sciences*, *28*(1), 39-77.
[34] https://www.govinfo.gov/content/pkg/STATUTE-104/pdf/STATUTE-104-Pg3096.pdf

alternatives, but as a mechanism of expert advice, it does not exist to advance the political goals of the White House.

However, in every administration since the first NCA was produced under President Bill Clinton, the NCA has been overseen by the White House and, ultimately, political appointees. This has created what is apparently an irresistible temptation to manage the NCA in such a way as to promote the current administration's policy agenda. This dynamic of influencing the substance of the NCA for apparent political gain is predictably bipartisan. Ultimately, the politicization of the NCA means that neither Congress nor the president are receiving the quality of scientific advice on climate of the sort envisioned by Congress when it established the USGCRP in 1990.

To fix the NCA would not be difficult. Three actions are needed.

First, the assessment should be housed within and implemented entirely from a federal agency within the scope of the USGCRP. There should be no oversight or control exerted from the White House or its OSTP. It should be treated like other high-profile scientific advisory mechanisms that must operate in the context of highly politicized issues. We have good experience with meeting this challenge and, generally, with providing robust expert advice on contested subjects such as vaccine approval and pollution regulation.

Second, the report should be led and written by experts chosen by an empaneling team. This team should be selected by a bipartisan group, as is typically done for reports on highly politicized issues. For instance, the majority and minority members of the House Science Committee could each select (say) 3 members of this empaneling committee, with two co-chairs. The empaneling committee would then identify and justify its recommended selection of experts to lead the production of the report.

Third, before the writing starts, the assessment team should formally query decision makers — federal, state, local, in business and civil society — to identify what information they perceive to be most useful to their decisions related to climate mitigation and adaptation. Such information would also be useful to the Congress in its oversight of the USGCRP to help ensure that research priorities line up with the needs of decision makers.[35]

These three steps would ensure that there is no perception of White House influence on the report, that it is authored by experts assembled in a bipartisan manner and that the topics that the report focuses on have direct relevance to decision makers. The NCA is far too important to be politicized because politicization can compromise scientific integrity.

Mechanisms already exist for the Congress and federal agencies within the executive branch to receive higher quality expert advice on climate, including climate-related financial risks. However, for that potential to be realized requires that the Congress improve its oversight of the USGCRP and the NCA and establish the expectation that the requirements of P.L. 101-606 will be fulfilled. At present there are troubling signs that Congress and the federal agencies are not receiving the high-quality advice necessary to inform decision making on this important subject.

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[35] Sarewitz, D., & Pielke Jr, R. A. (2007). The neglected heart of science policy: reconciling supply of and demand for science. *environmental science & policy*, *10*(1), 5-16.

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Pielke Jr, R., & Ritchie, J. (2021). Distorting the view of our climate future: The misuse and abuse of climate pathways and scenarios. *Energy Research & Social Science*, *72*, 101890.

Pielke Jr, R., & Lane, N. (2020). Memo for President Biden: Five steps to getting more from science, *Nature*.

Pielke, R. (2021). Economic 'normalisation' of disaster losses 1998–2020: a literature review and assessment. *Environmental Hazards*, *20*(2), 93-111.

Pielke, R. (2018). **The rightful place of science: disasters and climate change**. CSPO:ASU.

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Simmons, K. M., Sutter, D., & Pielke, R. (2013). Normalized tornado damage in the United States: 1950–2011. *Environmental Hazards*, *12*(2), 132-147.

Weinkle, J., Landsea, C., Collins, D., Musulin, R., Crompton, R. P., Klotzbach, P. J., & Pielke, R. (2018). Normalized hurricane damage in the continental United States 1900–2017. *Nature Sustainability*, *1*(12), 808-813.

**Biography of Roger Pielke Jr.**

Roger Pielke, Jr. has been on the faculty of the University of Colorado Boulder since 2001, where he teaches and writes on a diverse range of policy and governance issues related to science, technology, innovation and sports. Roger is a professor in the Environmental Studies Program. Roger is currently leading the EScAPE project (Evaluation of Science Advice in a Pandemic Emergency) a 16-country evaluation of science advice in the COVID-19 pandemic, sponsored by the U.S. National Science Foundation.

Roger holds degrees in mathematics, public policy and political science, all from the University of Colorado. In 2012 Roger was awarded an honorary doctorate from Linköping University in Sweden and was also awarded the Public Service Award of the Geological Society of America. In 2006, Roger received the Eduard Brückner Prize in Munich, Germany for outstanding achievement in interdisciplinary climate research.

Roger has been a Distinguished Fellow of the Institute of Energy Economics, Japan since 2016. From 2019 he has served as a science and economics adviser to Environmental Progress. Roger was a Fellow of the Cooperative Institute for Research in Environmental Sciences from 2001 to 2016. He served as a Senior Fellow of The Breakthrough Institute from 2008 to 2018. In 2007 Roger served as a James Martin Fellow at Oxford University's Said Business School. Before joining the faculty of the University of Colorado, from 1993 to 2001 Roger was a Scientist at the National Center for Atmospheric Research.

At the University of Colorado, Roger founded and directed both the Center for Science and Technology Policy Research and the Sports Governance Center. He also created and led the university's Graduate Certificate Program in Science and Technology Policy, which saw its graduates move on to faculty positions, Congressional staff, presidential political appointees and in positions in business and civil society.

His books include **Hurricanes: Their Nature and Impacts on Society** (with R. Pielke Sr., 1997, John Wiley), **Prediction: Science, Decision Making and the Future of Nature** (with D. Sarewitz and R. Byerly, 2001, Island Press), **The Honest Broker: Making Sense of Science in Policy and Politics** published by Cambridge University Press (2007), **The Climate Fix: What Scientists and Politicians Won't Tell you About Global Warming** (2010, Basic Books). **Presidential Science Advisors: Reflections on Science, Policy and Politics** (with R. Klein, 2011, Springer), and **The Edge: The War Against Cheating and Corruption in the Cutthroat World of Elite Sports** (Roaring Forties Press, 2016). His most recent book is **The Rightful Place of Science: Disasters and Climate Change** (2nd edition, 2018, Consortium for Science, Policy & Outcomes).

## PREPARED STATEMENT OF JERRY THEODOROU

DIRECTOR, FINANCE, INSURANCE, AND TRADE, R STREET INSTITUTE

JULY 20, 2021

Chairman Brown and Ranking Member Toomey: Thank you for the opportunity to offer testimony on climate change, resilience and reinsurance. These issues impact multiple public policy areas. They need to be understood to inform the development of prudent responses to protect our economy from great harm today and in the future. I am the director of Finance, Insurance & Trade for the R Street Institute. R Street is a nonprofit, nonpartisan public policy research organization whose mission is to engage in policy research and outreach to promote free markets and limited, effective Government. The issues covered in today's hearing are of interest to R Street because, since its founding R Street has analyzed the role of reinsurance, and climate change and resilience are among the most consequential issues of the day.

The three topics of climate change, resilience and reinsurance are interrelated. The effects of climate change can be seen in the form of higher temperatures, melting ice caps, rising sea levels, and more frequent and severe catastrophic weather events, including tropical storms, hurricanes and convective storms.[1] These trends are a clarion call for resilience, which is the ability to bounce back and to absorb shocks. Reinsurance is a financial shock absorber. It allows insurance companies and the people and communities they serve to bounce back and to recover. For example, a small insurance company in the northern panhandle of West Virginia—Municipal Mutual Insurance Company of West Virginia—paid $3.8 million in 334 claims, equivalent to 12 percent of its equity, after a severe windstorm in March 2020. Reinsurance allowed it to recover $3 million of the $3.8 million, so the net loss was a more bearable $800,000.[2] Reinsurance protected the company and the policyholders. Without reinsurance hundreds of insurers across the country and millions of policyholders would be exposed to crippling financial loss on top of catastrophic physical loss.

My comments will focus on the response of the insurance and reinsurance market to risks from climate change. The climate catastrophe event of the day is the complex of wildfires in a dozen Western States. Wildfire is fire, which is the main peril covered by personal insurance and commercial insurance. In fact, the oldest continuously operating insurance company in the United States, the Philadelphia Contributionship, was founded in 1752 by Benjamin Franklin and his fellow firefighters to allow policyholders to share risk related to fire damage and loss.[3] Since Franklin's day the insurance industry has expanded its product offerings to cover the needs and the risks of a changing economy with automobile insurance, workers compensation insurance, liability insurance, and cyber insurance.

The risks associated with climate change—fire, flood, hail, drought, and wind—are covered by existing insurance products. This is what the insurance industry does. It matches its capital to risk. The one exception is flood insurance because flood risk is primarily covered by the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP). Unlike the insurance industry, which is well capitalized and financially sound, the NFIP operates uneconomically, having incurred $36 billion of debt since its founding.[4] The NFIP is undertaking reforms to be introduced this fall, but it will be many years before the NFIP can approach financial health. In other countries with elevated flood risk, such as Australia and Japan flood coverage is available in their insurance policies.[5] However, the market for private flood insurance in the United States is small because it is challenging for insurers to compete with artificially low and subsidized NFIP rates.

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[1] S&P Global and Intelligent Insurer, "Global Reinsurance Highlights 2020", *Newton Media Limited*, 2020. *https://www.spglobal.com/-assets/documents/ratings/research/global-reinsurance-highlights-2020.pdf.*

[2] "2020 Management Discussion and Analysis", *S&P Global*, 2020. *https://platform.marketintelligence.spglobal.com/web/client?auth=inherit#company/documents?id=13229.*

[3] "History", *The Philadelphia Contributionship*, last accessed June 17, 2021. *https://1752.com/blog/about-us/history.*

[4] Diane P. Horn, National Flood Insurance Program Borrowing Authority, Congressional Research Service, Oct. 2, 2020. *https://fas.org/sgp/crs/homesec/IN10784.pdf.*

[5] Nicole Pederson-McKinnon, "How To Tell If Your Insurer Covers You for Flood Damage", *The Sydney Morning Herald*, March 27, 2021. *https://www.smh.com.au/money/insurance/how-to-tell-if-your-insurer-covers-you-for-flood-damage-20210326-p57ee4.html*; Jiji, "Japan Nonlife Insurers To Raise Premiums 6–8 percent in Wake of Disasters", *The Japan Times*, July 8, 2020. *https://www.japantimes.co.jp/news/2020/07/08/business/japan-nonlife-insurers-raise-premiums-6-8-percent-wake-disasters.*

Collectively, the U.S. insurance industry and the global reinsurance industry are adequately capitalized to withstand the financial impact of today's climate-related catastrophe risk. In 2005—the year with the most insured U.S. losses—there was $110 billion of insured losses.[6] The U.S. property and casualty insurance industry has $2.4 trillion of total assets; the global reinsurance industry an additional $600 billion.[7] This means that it would take a year with three times the losses of 2005 to dent the industry's capital by 10 percent.

Reinsurance is critical for the insurance industry to play its role, as demonstrated in the previously mentioned example in West Virginia. The reinsurance industry is global, allowing insurers that buy reinsurance to spread their risk to multiple counterparties, each protecting its own balance sheet by taking a sliver of risk. Only three of the top 25 reinsurers in the world are U.S.-based. The remaining 22 are domiciled in reinsurance hubs in continental Europe, London, Bermuda, and increasingly, Asia.

In addition to the capital base of the insurance and reinsurance industry providing coverage for climate-related risks, there is also alternative capital taking on insurance climate risk.[8] This alternative capital comes from pension funds, hedge funds, sovereign wealth funds, university endowments, foundations and family offices that seek to take on catastrophe risk because it is uncorrelated with equity and debt market risk. This is a relatively new phenomenon, and it is growing. The volume of alternative capital in the reinsurance industry has grown from $17 billion in 2006, when it accounted for 4.4 percent of global reinsurer capital, to $94 billion in 2020, when it accounted for $14.5 percent of global reinsurer capital.[9]

U.S. pension funds have over $32 trillion in assets.[10] To give an example of pension funds taking on catastrophe risk, the Arkansas Teacher Retirement System, a $20 billion fund, invests $330 million, equivalent to 1.7 percent of its total assets, in catastrophe bonds.[11] To the extent the large pool of private capital gets more comfortable with insurance catastrophe risk as a diversifying asset class, there would be less need for taxpayer-funded disaster recovery expenditure.

Transferring climate risk onto the balance sheets of insurers and reinsurers and into the investment portfolios of third-party investors may be a source of comfort, but it is not enough because it kicks the can of climate risk down the road. Claims from losses will be paid, but premiums will rise as the risk increases. The traditional reinsurance industry, supplemented by alternative capital, plays and will continue to play an important role in providing resilience through its role as a shock absorber, taking on climate risk, but it is only part of the long-term response. Public policy must also encourage and incentivize risk mitigation-incentives for sound construction, restrictions on building in catastrophe-prone areas, defenses and barriers, and working with authorities to establish and enforce codes and standards.

In closing, thank you for the privilege of testifying today, and for your interest in exploring how the reinsurance market and private capital solutions provide resilience to our economy in the face of growing climate risk taking a toll on our homes, businesses and health.

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[6] "Facts + Statistics: U.S. Catastrophes", Insurance Information Institute, last accessed July 17, 2021. *https://www.iii.org/fact-statistic/facts-statistics-us-catastrophes#Loss%20Events%20in%20the%20U.S.201980-2018.*

[7] S&P Global and Intelligent Insurer. *https://www.spglobal.com/-assets/documents/ratings/research/global-reinsurance-highlights-2020.pdf.*

[8] Steve Evans, "World Bank Climate Plan Highlights Cat Bonds & Risk Transfer", Artemis, June 24, 2021. *https://www.artemis.bm/news/world-bank-climate-change-plan-highlights-cat-bonds-risk-transfer.*

[9] "Aon's Reinsurance Aggregate: Results for the Year to December 31, 2020", *Aon Empower Results*, 2021. *http://thoughtleadership.aon.com/Documents/ARA-FY-20210415.pdf.*

[10] F. Norrestad, "Total Assets of Pension Funds in the United States From 2009 to 2019", Statista, Dec. 7, 2020. *https://www.statista.com/statistics/421729/pension-funds-assets-usa.*

[11] Steve Evans, "Pension Funds Investing in Insurance-Linked Securities (ILS)", *Artemis*, last accessed July 17, 2021. *https://www.artemis.bm/pension-funds-investing-in-insurance-linked-securities-ils*; Michael R. Wickline, "Teacher Fund Ends Quarter $783M Higher", *Northwest Arkansas Democrat Gazette*, June 8, 2021. *https://www.nwaonline.com/news/2021/jun/08/teacher-fund-ends-quarter-783m-higher.*

## RESPONSES TO WRITTEN QUESTIONS OF CHAIRMAN BROWN FROM ABDOLLAH SHAFIEEZADEH

**Q.1.** *Value of Infrastructure at Risk*—Dr. Shafieezadeh, would you be able to share with the Committee current reliable data pinpointing the value of U.S. infrastructure at risk from climate change?

**A.1.** One of the areas of need for assessing risks and developing effective mitigation and adaptation strategies in response to the changing climate is the data of the built environment and its conditions. Climate change will impact many stressors to our infrastructures in different ways and to different degrees, with the impacts varying spatially over the United States and over time. Moreover, depending on the type and conditions of the infrastructure, the impacts may vary considerably. Moreover, failure of a component within an infrastructure can have cascading effects within the same system and across multiple infrastructure systems. The compounding effects of aging infrastructure and climate change effects can also increase system vulnerabilities. These factors lead to a highly complex problem that will need to be captured in the analyses in order to reliably analyze the infrastructure at risk. Extensive multidisciplinary research is needed to address these challenges, uncover yet-unknown effects of climate change on the built environment and develop innovative strategies for communities and the Nation in order to effectively prepare and respond to upcoming challenges.

Several studies, e.g.,[1] [2] [3] have investigated climate change impacts on the elements of the built environment in the United States. While these investigations provide valuable insights into the risks posed to the infrastructure, they have considered a subset of the key complexities of climate change impacts. Therefore, their risk estimates can be regarded as a lower bound for infrastructures at risk and the actual risks may be higher.

**Q.2.** In the absence of a nationwide accounting of all elements of critical infrastructure, can you share with the Committee whatever relevant sectoral assessments of which you are aware on the value of infrastructure at risk from climate change with respect to——

Electricity generation, transmission, and distribution infrastructure?

**A.2.** The power grid is a vast infrastructure system. It includes over 8,000 power plants, 600,000 miles of high and extra high voltage transmission lines and millions of miles of distribution lines.[4] The depreciated value of the U.S. power grid is estimated to range between $1.5 and $2 trillion and replacing this system to cost near-

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[1] James E. Neumann, et al., "Climate Change Risks to U.S. Infrastructure: Impacts on Roads, Bridges, Coastal Development, and Urban Drainage", *Climatic Change*, 131.1 (2015), 97–109.

[2] April M. Melvin, et al., "Climate Change Damages to Alaska Public Infrastructure and the Economics of Proactive Adaptation", Proceedings of the National Academy of Sciences, 114.2 (2017), E122-31.

[3] Charles Fant, et al., "Climate Change Impacts and Costs to U.S. Electricity Transmission and Distribution Infrastructure", *Energy*, 195 (2020), 116899.

[4] U.S. DOE, "Dynamic Line Rating Report to Congress", June 2019 (*https://www.energy.gov/sites/default/files/2021/03/f83/DLR%20Report%20-%20June%202019%20final%20-%20FOR%20PUBLIC%20USE.pdf*) [accessed 13 July 2021].

ly $5 trillion.[5] Climate change may impact many elements of this vast system. Heatwaves, droughts, rain, lightning, wildfires, sea level rise, storm surge, floods, high winds, freezing temperatures, and ice and snow storms are among the key stressors for the power grid that are impacted by climate change. A recent study[3] that analyzed the impacts of a subset of these stressors on the grid estimated the discounted total costs incurred by climate change impacts to range from $120 to $380 billion through 2099 (based on $ 2017) considering different general circulation models (GCMs), emission scenarios, and adaptation strategies. The study also found that proactive adaptation strategies can reduce costs by as much as 50 percent compared to no adaptation for a given emissions scenario. Not considered in the study are the compounding effects of stressors, cascading effects of failures, and some key elements of the power grid including generation plants, and the impacts of climate change on the production of electricity beyond immediate infrastructure impacts (e.g., high environment temperatures may lead to the shutdown of power plants as the available water cannot be used for cooling the plants). These factors can substantially increase the estimates of the impacts of climate change on the power grid.

**Q.3.** Ports or inland waterway infrastructure?

**A.3.** Seaports are one of the pivotal nodes in transportation networks and serve as critical gateways for national and international trade. Past experiences have shown that any disruption in the activities of port infrastructure may lead to significant losses from secondary economic effects in addition to direct losses associated with physical port damage.[6] These systems are disproportionately vulnerable to climate change effects due to their high exposure to stressors that are affected by climate change. Sea level rise and increasing frequency and intensity of extreme wind, storm surge and wave events, precipitation, droughts, heatwaves, and riverine floods are among significant evolving stresses for seaports. Projections indicate that the relative sea level along the coasts of the U.S. may rise by over 14 inches by 2080 under a low global mean sea level rise scenario.[7] This scenario is very likely to be exceeded under various climate change projections. This rise in relative sea level is expected to increase the annual frequency of damaging flood events by 25 times,[7] which will have devastating impacts on coastal infrastructure including seaports. To the best of my knowledge, no nationwide estimates of value of seaports at risk of climate change are currently available.

**Q.4.** Flood control infrastructure adjacent to our Nation's major rivers?

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[5] Joshua D. Rhodes, "The Old, Dirty, Creaky U.S. Electric Grid Would Cost $5 Trillion To Replace. Where Should Infrastructure Spending Go?", *The Conversation* (*http://theconversation.com/the-old-dirty-creaky-us-electric-grid-would-cost-5-trillion-to-replace-where-should-infrastructure-spending-go-68290*) [accessed 12 September 2021].

[6] Abdollah Shafieezadeh and Lindsay Ivey Burden, "Scenario-Based Resilience Assessment Framework for Critical Infrastructure Systems: Case Study for Seismic Resilience of Seaports", *Reliability Engineering & System Safety*, 132 (2014), 207–219.

[7] William Sweet, et al., "Global and Regional Sea Level Rise Scenarios for the United States", 2017.

**A.4.** Levees and other flood control infrastructures are vital for mitigating risks of coastal and riverine flooding for large populations in vulnerable regions. Indeed, levees protect millions of people and $2.3 trillion of property.[8] The total length of levees in the U.S. is estimated at 40,000 miles with 30,000 miles included in the National Levee Database maintained by the U.S. Army Corps of Engineers (USACE) and about 10,000 miles of levees outside of this portfolio with limited information available.[9] The costs of maintaining and improving the moderate to high-risk levees in the USACE portfolio is estimated at $21 billion.[10]

Climate change poses additional direct and significant risks to our flood control infrastructure requiring adaptation strategies to address the evolving threats. The high significance of risks stems from the anticipated high impacts of climate change on sea level rise as well as increasing intense precipitation in many parts of the U.S. However, to the best of my knowledge, no estimates of the value of flood control infrastructure at risk due to climate change are currently available.

**Q.5.** Any significant portion of the Interstate Highway system, or any other federally or State-funded highway that has been determined to be nationally or regionally economically significant?

**A.5.** There are over 4 million miles of public roadways and over 600,000 bridges across the United States.[11] Together, they facilitated 3.2 trillion vehicle miles traveled in 2019. The needs to address current risks to the transportation infrastructure are significant. Based on the National Bridge Inventory (NBI) database of the U.S. Department of Transportation (DOT), about 36 percent of bridges (220,000 bridges) need repair and about 8 percent of bridges (79,500) need replacement. Among bridges in need of repair are over 17,000 Interstate Highway bridges. The bridge investment backlog representing all bridge improvements needed to meet the current conditions and operational performance of the highway system (i.e., excluding expansion needs as well as mitigation and adaptation needs in response to climate change) is estimated at $125 billion (based on $ 2014).[12]

Climate change poses additional risks to the existing portfolio of transportation infrastructure. Depending on the emissions scenario, it is estimated that 66,000 to 117,000 of the Nation's bridges will be vulnerable to the impacts of climate change when only increases in the peak flow are considered.[13] The total cost of adapting to these risks ranges from $140 to $250 billion.[13] These estimates, however, do not account for the impacts of increases induced by cli-

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[8] American Society of Civil Engineers, "2021 Report Card for America's Infrastructure" (Reston, VA) (*https://infrastructurereportcard.org/wp-content/uploads/2020/12/National-IRC-2021-report.pdf*) [accessed 14 July 2021].

[9] U.S. Army Corps of Engineers, "U.S. Army Corps of Engineers Levee Portfolio Report: A Summary of Risks and Benefits Associated With the USACE Levee Portfolio", March 2018 (*https://www.mvk.usace.army.mil/Portals/58/docs/LSAC/USACE-Levee-Safety-Report2018.pdf*).

[10] Congressional Research Service, "Levee Safety and Risk: Status and Considerations", 7 December 2017.

[11] American Society of Civil Engineers.

[12] U.S. Department of Transportation, "Status of the Nation's Highways, Bridges, and Transit: Report to Congress" (Washington, DC, 21 November 2019) (*https://www.fhwa.dot.gov/policy/23cpr/chap7.cfm*).

[13] Len Wright, et al., "Estimated Effects of Climate Change on Flood Vulnerability of U.S. Bridges", *Mitigation and Adaptation Strategies for Global Change*, 17.8 (2012), 939–955.

mate change in stressors other than peak flow, the amplifying effects of bridge deterioration for the impacts of climate and weather stressors, and the cascading effects of bridge failures for transportation systems.

**Q.6.** Please share with the Committee any analyses assessing the effect on the U.S. economy from the loss of all or significant component parts of the infrastructure elements in the previous question?

**A.6.** As indicated in response to the previous questions, climate change impacts on the built environment is expected to be significant. Assessing the collective impacts of climate change on critical infrastructures and the U.S. economy is very challenging and requires further studies. In the meantime, past hazard incidents and their impacts can provide valuable insights into current trends of risks by climate and weather extremes and the evolving characteristics of these risks. Since 1980, the country has experienced 298 weather and climate disasters with the total loss of each event exceeding $1 billion.[14] The collective loss of these events has exceeded $1.975 trillion. The observed trends in these losses are very concerning. The number of billion-dollar weather and climate disasters has increased from 2.9 events per year in 1980s to 12.3 events per year in 2010s. In the same period, the average annual loss by such events has increased by a factor of 4.6 to $84.5 billion. In 2020, the number of billion-dollar disasters reached 22 incurring $98.9 billion in losses.[14] These trends are anticipated to continue, thus indicating a dire situation for our built environment and communities in many parts of the United States.

**Q.7.** *Compounding Risks*—This Committee is concerned about any threat to the economy. Climate change creates a significant range of challenges for the economy, but the situation is particularly daunting when those potential impacts are compounded by the challenges of an aging infrastructure, long-term underinvestment in maintenance and upkeep of that infrastructure, and cyberbased threats from increasingly sophisticated actors.

What recommendations would you make to the Committee and Congress, generally, to address compounding risks?

**A.7.** Climate change, aging and their compounding effects create an environment where the consequent impacts on the infrastructure are expected to be significant. At the same time, uncertainties in the specific manifestations of vulnerabilities are high and evolving. To address these pressing challenges, first and foremost, we need a long-term, national, strategic plan for our critical infrastructure to support adaptive risk management strategies as new threats are uncovered, projections of risks are updated and new infrastructure technologies emerge.

Even in the absence of climate change impacts, there are significant gaps in knowledge and practice vis-a-vis the performance of new and aging built environment under extreme stresses of natural hazards and the most effective ways to mitigate the risks. Climate change imposes additional significant complexities that the engineering and science community has only recently begun to analyze.

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[14] NOAA National Centers for Environmental Information (NCEI), "U.S. Billion-Dollar Weather and Climate Disasters", 2021, DOI: 10.25921/stkw-7w73 (*https://www.ncdc.noaa.gov/billions/*) [accessed 13 July 2021].

While Federal entities such as National Science Foundation, Department of Energy, National Oceanic and Atmospheric Administration, and Department of Defense have recently initiated programs in support of research and development (R&D) for issues concerning climate change, support for such programs especially in areas related to the nexus of infrastructure and climate change should increase to address the significant knowledge gaps. Furthermore, impacts of climate change on critical infrastructures and the subsequent socioeconomic consequences will vary across the United States. To investigate specific challenges posed by climate change and aging infrastructure to regional built environment and support the decision needs of regional economies and communities, regional research hubs fostering collaborations between universities, national labs, the private sector and communities can be established, which can also serve as a platform for the much needed workforce development.

In managing risks of climate change, currently there are a set of solutions available for each infrastructure. The particular designs of the strategies depend on the characteristics and conditions of the infrastructure and the projected risks of climate and weather extremes, among other factors. Although such solutions are known to be effective, infrastructure stakeholders including owners, operators, and users may not be able to afford the upfront costs of these projects. Therefore, resilience strategies may need to be incentivized through measures such as reduced insurance rates and premiums; Federal, State, or local grants for resilience strategies; tax incentives; mortgages and loans for mitigation plans; and improved resilience-based codes.[15] While there are known effective solutions, support must continue and increase for improving existing and developing disruptive technologies. New green technologies or those that address practical limitations of existing green technologies are important in adapting to climate change. As an example, the intermittency of renewable energy resources (e.g., wind and solar power) can be addressed by coupling these systems with emerging nuclear power technologies such as small modular reactors, microreactors, or fission batteries,[16] which are safe, carbon-free, and economically competitive means of energy production.

**Q.8.** As a faculty member at The Ohio State University and a resident of the Columbus area, are there threats to our State's infrastructure that are of particular concern to you, whether from likely impacts of climate change or other pervasive challenges?

**A.8.** Ohio is exposed to several climate and weather hazards. Since 2000, Ohio has experienced many billion-dollar disasters including 33 severe storms, 4 floods, 3 winter storms, 5 droughts, 3 tropical cyclones, and 1 freezing temperature event.[14] Climate change impacts on the built environment will be spatially and temporally stochastic, and each region in the country will face particular types and degrees of challenges. In Ohio, climate change is anticipated

[15] "Multi-Hazard Mitigation Council, Developing Pre-Disaster Resilience Based on Public and Private Incentivization" (Washington, DC: National Institute of Building Sciences, 2015) (*https://www.nibs.org/files/pdfs/NIBS-MMC-ResilienceIncentivesWP-2015.pdf*) [accessed 15 July 2021].

[16] Elmar Eidelpes, et al., "Fission Battery Initiative: Siting and Transportation Workshop Report" (Idaho National Lab, August 2021).

to increase the frequency and intensity of extreme precipitation and floods as well as the number of extremely hot days, which may pose risk to public health in urban areas and the agriculture sector in rural areas.[17] Climate change is also anticipated to increase the intensity of summer droughts in Ohio.[17]

Of particular concern in Ohio is the vulnerability of our levees and other flood protection systems such as dams. In spring 2019, severe flooding in the Midwest incurred over $20 billion in damages to public and private property and losses to the agriculture sector. During this event, over 700 miles of levees sustained damage and more than 80 levee systems in the USACE levee portfolio failed due to overtopping or breach.[18] Repairing damaged levees is estimated to cost approximately $1 billion.[18] Although this event did not particularly impact Ohio, the State is vulnerable to such events.

The increasing intensity and frequency of extremely hot days and humidity in Ohio will likely challenge the energy security of the State. Such environments on the one hand will increase the energy demand of households and industries, and on the other hand will challenge the ability of the grid to generate and transmit electricity. Analyzing climate change risks for Ohio must also account for the impacts of compound hazards such as flood, tornado, or downburst that can induce damage to the grid followed by extreme temperatures and humidity that put additional stresses on the system.

Increasing temperatures and precipitations, in addition to acting as shocks to the built environment in Ohio, may accelerate the deterioration of some of infrastructure components, thus further increasing the vulnerabilities of systems. In developing adaptation strategies, these gradual impacts of climate change must also be considered.

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## RESPONSES TO WRITTEN QUESTIONS OF CHAIRMAN BROWN FROM RACHEL CLEETUS

**Q.1.** Dr. Cleetus, if we are being honest about the goal of addressing climate change, and we want to ensure that our solutions lean into not only our energy use and emissions reductions, but also community resilience and environmental equity, what scale of resources do we need to dedicate to our collective response to the ongoing climate crisis?

**A.1.** Thank you for the question. Yes, the reality is we have to work on aggressively on both fronts: sharply cutting our heat-trapping emissions and investing in equitable climate resilience. Because we have delayed action on climate change for so long, we have locked in some pretty significant climate impacts in the decades ahead. Right now, we are dealing with climate-related extreme events—such as intensifying storms, floods, droughts, wildfires and heatwaves—as if they are one-off disasters instead of

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[17] NOAA National Centers for Environmental Information, State Climate Summaries: Ohio (Revised 2019), 2019 (*https://statesummaries.ncics.org/downloads/OH-screen-hi.pdf*) [accessed 12 September 2021].

[18] Federal Emergency Management Agency, Hazard Mitigation Assistance (*https://www.fema.gov/hazard-mitigation-assistance.*)

the worsening trend that the science shows. We are spending billions of dollars in postdisaster aid for communities and businesses ravaged by climate impacts. We would be much better off if we also invested upfront, prior to these disasters, to better protect people and our infrastructure. Investing upfront will help keep people safer and lessen rebuilding costs.

A study from the National Institute of Building Sciences shows how the benefits of preventive measures and investments far outweigh the costs for a range of climate-related risks (see Figure 1 below). [1]

**Figure 1: Benefit-cost ratios for mitigation measures to reduce risks**


We know we will have to invest in our response to the climate crisis in a sustained way for many decades to come and that inaction is the most harmful and costly path forward, as the latest IPCC report confirms. [2] This year Congress must pass a $3.5 trillion reconciliation bill with significant climate provisions, as a downpayment on climate action. We must invest here at home, and also contribute in a robust way to international climate finance to help developing countries also make a low carbon transition and invest in climate resilience. Along with other groups, UCS has sent a letter to Congress calling for at least $3.3 billion in climate finance to be appropriated this year and are calling on President Biden to commit to at least $12 billion a year by 2024. [3]

**Q.2.** This summer the Congress may consider Infrastructure in multiple pieces of legislation. You have undoubtedly seen media re-

[1] *https://www.nibs.org/projects/natural-hazard-mitigation-saves-2019-report*
[2] *https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/*
[3] *https://ucsusa.org/about/news/un-general-assembly-convening-critical-climate-action-robust-us-climate-finance-1*

ports talking about what the total cost of the bipartisan bill might be, and what a Budget Reconciliation bill might add to the total level of investment. What range of Federal investment must be considered in order to allocate the resources mentioned above, so that we don't miss a once-in-a-generation opportunity to create more resilient and equitable communities?

**A.2.** There is no question that the scale of funding for the reconciliation package must be on the order of at least $3.5 trillion, including significant investments in climate related priorities alongside other pressing social and economic needs. We need transformative climate action now, that will put us on a firm path to meeting the goal of cutting U.S. emissions 50–52 percent below 2005 levels by 2030 and ensure that our communities and infrastructure are climate resilient. This year alone, people in our Nation have been reeling from a series of unprecedented climate-related disasters, with a mounting human and economic toll. There is no time for delay and we cannot just take incremental steps that will leave us vastly underprepared.

We are encouraged to see the House committees pass a package that includes several important priorities, including:

- The Clean Energy Payment Plan (CEPP) and extending and expanding clean energy tax incentives over the next 10 years to help ensure that 80 percent of the electricity that's produced in the United States by 2030 comes from clean sources.
- Tax credits, grants, and rebates to support the transition to electric heavy-duty vehicles to reduce pollution in overburdened communities and the deployment of charging infrastructure to improve access to EV charging.
- An updated EV tax credit including equity provisions and strong domestic manufacturing and labor standards.
- A fee on methane emissions.
- Robust investments that directly benefit environmental justice communities, including environmental and climate justice block grants; funding to reduce greenhouse gases and local pollution; increased monitoring of toxic air pollution in frontline communities; solar projects that serve low-income households; and investments in healthy ports, affordable housing, climate resilience, and much more.
- Funding for an affordability program for the National Flood Insurance Program (NFIP).
- Funding for the Civilian Climate Corps.

These provisions must remain strong and robustly funded as the package moves toward final passage. We also urge greater attention to funding programs to benefit workers who may be dislocated by the transition from fossil fuels to clean energy.

I would like to share with you a few blogposts that my colleagues and I have written on these topics to provide more detail on the level of funding and the investments needed across the economy: *https://blog.ucsusa.org/rachel-cleetus/priorities-for-congress-climate-change/*; *https://blog.ucsusa.org/rachel-cleetus/we-have-an-infrastructure-bill-we-still-need-bold-climate-action-urgently/*; *https://blog.ucsusa.org/jonna-hamilton/zero-emission-transpor-*

*tation-must-be-included-in-congressional-priorities/*; *https://blog.ucsusa.org/john-rogers/the-cepp-clean-energy/*.

**Q.3.** With respect to Banking and Housing jurisdiction—the financial services sector, housing, transit—how would you recommend this Committee work to influence future legislation to achieve the goals I mentioned—environmental performance, resilience, and equity—what will do the most good for the most people? What policy proposals will best position us to avoid the most catastrophic climate scenarios, and importantly, help to close the resilience gap that you mentioned in your testimony?

**A.3.** The Senate Banking and Housing Committee has a vital role to play in helping to elevate and advance climate action. Three specific areas for action that should be prioritized:

- Legislation to ensure transparent, standardized climate risk disclosure in the marketplace, and specifically to help ensure fossil fuel companies are held accountable. Currently, climate risks are not being appropriately accounted for in the marketplace and that is leading to business-as-usual actions that increase climate risks and costs—with a disproportionate impact on low-income households and communities.
- Investments to help ensure that our Nation's housing and transit infrastructure is climate-resilient, low-carbon and energy efficient, safe, accessible, and affordable. Oversight of the FHFA and GSEs is also vital to help ensure the housing market is proactively taking into account climate risks, and ensuring equitable access to safe, affordable housing. Federal investments should be made in line with President Biden's Justice40 Initiative to help ensure that communities that have long been marginalized and disadvantaged benefit directly and equitably from these investments. Across the Nation, communities are being forced to contend with the compounding effects of climate-related disasters, longstanding social and economic inequities and structural racism. Climate solutions must be responsive to this and not reinforce existing injustices.
- Ensuring that the National Flood Insurance Program is updated to reflect the latest science, ensure affordability provisions, and encourage investments in flood mitigation measures at the individual and community level.

To close the resilience gap, we will need to work on both fronts, to cut heat-trapping emissions and build climate resilience, while prioritizing historically disadvantaged communities. I would like to offer one additional resource to help answer the question of what policies are most needed in the United States to help limit some of the worst impacts of climate change: *A Transformative Climate Action Framework: Putting People at the Center of Our Nation's Clean Energy Transition*.

## RESPONSES TO WRITTEN QUESTIONS OF SENATOR WARREN FROM RACHEL CLEETUS

**Q.1.** How does the United States compare to other Nations in its regulation of climate change-related financial risks, particularly with respect to the insurance industry?

**A.1.** The reality is the United States is currently falling well short on regulating climate change related financial risks, particularly behind the U.K. and European Union—and this is to our detriment since it potentially increases risks to our financial system and our markets, which ultimately affects the well-being and prosperity of all of us. Further, it is entrenching and elevating narrow profit interests of fossil fuel companies, instead of the broad interests of the public which is to move as quickly as possible to a clean energy economy. UCS strongly supports mandatory disclosure rules for climate risk to avoid untenable growth of climate and ESG risk within our markets that harms investors, spurs the improper allocation of capital, and may increase the cost of capital for U.S. companies. Mandatory disclosures should address companies' stewardship of a just and equitable transition to a low-carbon economy; human capital management; impacts on and strategies related to racial, economic, environmental, and climate justice; accounting of country-by-country tax payments; and disclosure of political activity including direct and indirect spending on elections and lobbying.

We have submitted comments to the Securities and Exchange Commission, the Commodity Futures Trading Commission[1] and the Federal Housing Finance Agency[2] to highlight each body's role in ensuring these outcomes. We have also endorsed Congressional action, including organizing a letter of support for the Climate Risk Disclosure Act of 2021 (introduced by Rep. Sean Casten, D-IL) signed by 82 environmental and social justice groups, faith-based and public interest organizations and socially responsible investors.[3]

**Q.2.** Congress created the Financial Stability Oversight Council (FSOC) to identify risks to financial stability and coordinate responses to these risks amongst regulators.

Is the existing macroprudential regulation of insurance companies sufficient to protect the financial system from distress if one of these companies were to fail due to climate risk?

**A.2.** In brief, no. Insurance companies are still largely operating in a backward-looking sense in evaluating risks but the reality is that climate change is a systemic risk that is worsening and accelerating. We are already seeing the challanges, as insurance companies struggle to adapt to catastrophic wildfire seasons, worsening flooding, and more. The past is no longer a good guide for the future and the FSOC should help identify and foster a forward-look-

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[1] Pinko, N., R. Cleetus, and K. Mulvey. 2020. Union of Concerned Scientists Submission to the Climate-Related Market Risk Subcommittee Under the Market Risk Advisory Committee of the CFTC. Online at *https://comments.cftc.gov/PublicComments/ViewComment.aspx?id=62482&SearchText=*.

[2] Cleetus, R. and S. Udvardy. 2021. Union of Concerned Scientists Response to the FHFA RFI on Climate Risk. Online at *https://www.fhfa.gov/AboutUs/Contact/Pages/input-submission-detail.aspx?RFIId=1426*.

[3] Letter in support of the Climate Risk Disclosure Act. 2021. Online at *https://casten.house.gov/sites/casten.house.gov/files/Climate%20Risk%20Disclosure%20Act%20Support%20051121.pdf*.

ing risk evaluation and management regime that takes into account the latest scientific projections of climate risks.

**Q.3.** How should FSOC evaluate the financial stability risks associated with the exposure of the insurance industry to climate change?

**A.3.** The FSOC should be guided by the latest science and also be very mindful of worsening and compounding climate risks—for example, extreme heat and extreme flooding colliding or the cascading risks when extreme events result in critical infrastructure failures that magnify impacts on insured assets. Spatially downscaled data is vital to help understand the geography of risk and how that intersects with socioeconomic and demographic factors that can result in disproportionate impacts for some. Too many communities are underinsured or do not have access to affordable insurance at all. With climate change, this gulf could worsen.

**Q.4.** Please describe how the various tools at FSOC's disposal can help mitigate these risks.

**A.4.** The FSCOC can play a vital role by:

- Assembling the data, tools, and platforms to help evaluate and communicate financial risks posed by climate change in a uniform and transparent way
- Coordinating across Federal Government agencies to ensure that climate risks are appropriately accounted for in their actions
- Providing nonbinding expert advice and recommendations to regulators
- Helping ensure than equity considerations are centered in how climate risk disclosure and actions to mitigate those risks are implemented

To fulfill these functions well, FSOC must also have the necessary staffing levels and resources.

I am grateful for the opportunity I had to testify before the Committee. Please do reach out if the Union of Concerned Scientists can be a resource on these topics or anything else in the future.

Thank you for your efforts to advance just and equitable climate action in this crucial moment.

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**RESPONSES TO WRITTEN QUESTIONS OF CHAIRMAN BROWN FROM FRANK NUTTER**

**Q.1.** Mr. Nutter, the impacts of climate change are clear: Power goes out; water supplies are cut; crops are threatened; smoke from wildfires keeps kids from playing outside and jeopardizes the health of our first responders; and people lose their homes and jobs, and sometimes, their lives.

Your industry is data-driven and also has significant skin in the game when it comes to paying for losses resulting from extreme weather disasters.

Does the data your member companies see and analyze demonstrate both that the number of natural disasters and the costs of losses are increasing?

**A.1.** Yes, the frequency, severity, and costs of many natural disasters continue to increase due to climate change. In my written testimony, please see pages 2 and 3, specifically tables one through four by Aon's Catastrophe Insight division, which demonstrate the increase in the number of natural disaster events and overall and insured losses in the U.S. and globally from 1980 to 2020.

**Q.2.** What would you suggest Congress do about it?

**A.2.** In addition to encouraging traditional solutions, like property insurance protections for homeowners, my written testimony highlights several bills and proposals. Pages 8 through 12 feature the RAA's legislative proposal to establish Community Disaster Resilience Zones (CDRZ) and direct public and incentivize private sector investment to help improve infrastructure resilience, including affordable housing resilience, for communities that are the most in need and most at risk from natural disasters. Reducing risk and improving resilience in communities can help reduce the loss of lives and property, natural disaster recovery costs, and the cost of insurance.

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**RESPONSES TO WRITTEN QUESTIONS OF SENATOR WARREN FROM FRANK NUTTER**

**Q.1.** Congress created the Financial Stability Oversight Council (FSOC) to identify risks to financial stability and coordinate responses to these risks amongst regulators. How can improved Federal and State coordination of regulation help mitigate climate-related risks?

**A.1.** Insurers and reinsurers are regulated by the States in the U.S. The FSOC includes three insurance members, including a State insurance commissioner, an independent member having insurance expertise, and the Treasury's Director of the Federal Insurance Office (FIO). President Biden issued Executive Order 14030, pursuant to which FSOC is required to conduct an analysis and issue a report on climate-related financial risk, and FIO also has climate-specific directives.

In 2011, for the FSOC, Federal Reserve, and others, the RAA prepared a substantial analysis about the systemic nature of property casualty reinsurance. The analysis demonstrated that rather than being a potential source of systemic risk, property casualty (re)insurance is a material mitigant of systemic risk in the financial markets and broader economy. Further to this point, in my written testimony, please see pages 2 through 4 and pages 14 and 15 for a more detailed discussion about climate change, natural disasters, reinsurance, and risk transfer. Expanded utilization of (re)insurance would reduce systemic risk, including climate-related risk. Pages 8 through 12 feature the RAA's legislative proposal to establish Community Disaster Resilience Zones (CDRZ) and direct public and incentivize private sector investment to help improve infrastructure resilience, including affordable housing resilience, for communities that are the most in need and most at risk from natural disasters. Reducing risk and improving resilience in communities can help reduce the loss of lives and property, natural disaster recovery costs, and the cost of insurance.

There also is strong coordination by "Team USA" between State regulators and the Federal Government (including the Treasury's Federal Insurance Office) in advocating U.S. positions at the International Association of Insurance Supervisors (IAIS) and other relevant international fora. Critically, this coordination helps to ensure that any international insurance standards that are developed and expected to be adopted in the U.S. are constructed in a manner that works for the current insurance regulatory structure. The RAA supports FIO's international work.

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**RESPONSES TO WRITTEN QUESTIONS OF SENATOR SINEMA FROM FRANK NUTTER**

**Q.1.** Can you share specific instances where Government can use or has used risk transfer to lower exposure to taxpayers and mitigate systemic risks, such as climate risk? What can Congress do to encourage diversification of systemic risk?

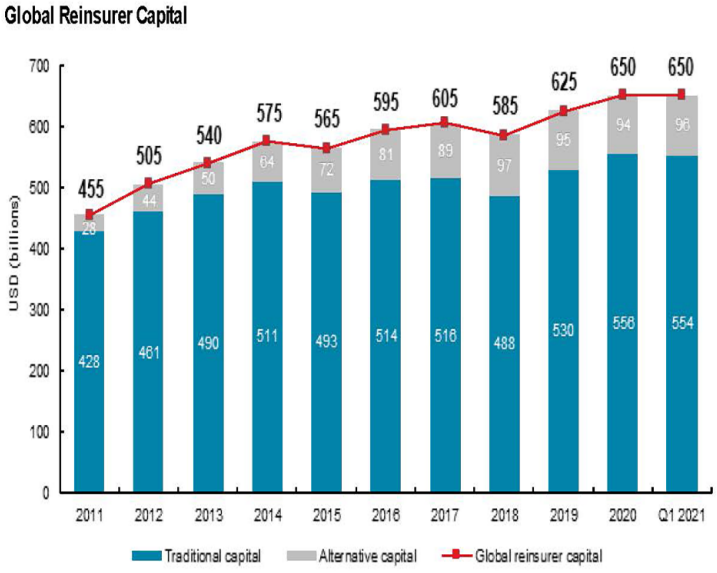
**A.1.** Examples of successful State and Federal risk transfers programs can be found on pages 14 through 15 of my written testimony. The best example of an ongoing Federal risk transfer program is the Federal Emergency Management Agency's National Flood Insurance Program Reinsurance Program. In the program's first year (2017), FEMA transferred $1.042 billion of NFIP's financial risk to 25 reinsurers, and FEMA collected the full amount to help pay the cost of NFIP losses and claims resulting from Hurricane Harvey. This 2017 coverage, which also improved NFIP's financial viability and protected taxpayers, cost $150 million, and the program successfully renewed the subsequent year and currently has reinsurance coverage through 2024. This example is a true testament of successful private–public partnerships.

Like NFIP, the Export-Import Bank of the United States and others, Congress can explicitly authorize and/or encourage Federal agencies with risk to diversify that risk by transferring it, as is cost-effective, to the private reinsurance sector and the capital markets. Government risk can and should be transferred voluntarily to the private market. The use of private capital will protect consumers, taxpayers, and communities, while spreading risk throughout the globe to insurers and other capital providers who are willing to assume such risk. Risk transfer will strengthen Government programs by giving them the financial flexibility to ensure they continue to remain viable in the long term.

**Q.2.** Do you believe that there is appetite among the insurance industry and in the insurance market to transfer publicly held risk to the private market? To what extent does that remain true if insurance markets harden further?

**A.2.** Risk transfer, including reinsurance, is a successful solution used by both the public and private sector including (re)insurers, financial institutions, and Government programs. Reinsurers believe the private sector can and should assume more Federal Government risk. Reinsurers are willing to offer reinsurance options to a wide variety of Government programs to help manage their exposure to losses. The graph, "Global Reinsurer Capital", below dem-

onstrates the previous decade of reinsurance industry capital growth despite extreme events.




Sources: Company financial statements / Aon Business Intelligence / Aon Securities Inc.

ADDITIONAL MATERIAL SUPPLIED FOR THE RECORD

## STATEMENT OF THE NATIONAL ASSOCIATION OF MUTUAL INSURANCE COMPANIES



The National Association of Mutual Insurance Companies (NAMIC) is pleased to provide comments to the United States Senate Committee on Banking on the topic of resilience and the critical role of the insurance industry in responding to disasters and working against the effects of growing climate risk. As the nation continues to be impacted by severe natural catastrophes on what seems like a daily basis, we thank Chairman Brown and Ranking Member Toomey for holding today's hearing on such an important topic.

NAMIC is the largest property/casualty insurance trade group with a diverse membership of more than 1,400 local, regional, and national member companies, including seven of the top 10 property/casualty insurers in the United States. NAMIC members lead the personal lines sector representing 66 percent of the homeowner's insurance market and 53 percent of the auto market. Through our advocacy programs we promote public policy solutions that benefit NAMIC member companies and the policyholders they serve and foster greater understanding and recognition of the unique alignment of interests between management and policyholders of mutual companies.

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### Unique Capability and Role of Insurance Industry in Managing Climate Risk

Despite an unprecedented level of natural disasters over the last decade, the U.S. property/casualty insurance industry always has been well positioned and fully capable to serve policyholders and play a critical role in the disaster mitigation and recovery process, standing shoulder-to-shoulder with the federal government and emergency responders to help victims recover and rebuild. With the U.S. expecting to face increasingly severe climate impacts in the years ahead, the property/casualty insurance industry looks forward to continuing fulfilling this critical role, but it is now more important than ever to consider the devastating impact of severe weather events. During this critical time, as the U.S. is affected by catastrophes in all corners of the nation, we must ensure we are doing all we can to protect communities across the nation ahead of the next disaster.

To put it simply, no industry has done more to advance real-world policies designed to combat climate risk than the property/casualty insurance industry, and insurers look forward to continuing to push for policies rooted in science to better protect homes and communities. NAMIC has been working to promote resiliency efforts in the U.S. for decades. In 2011, recognizing the growing number of severe climate events, NAMIC launched the BuildStrong Coalition, a group of insurers, architects, emergency managers, builders, contractors, fire fighters, and code officials all dedicated to building stronger in the face of the risks from a shifting climate. The Coalition launched one year after the industry funded construction of the Insurance Institute for Business and Home Safety Research Center, which conducts state-of-the-art research into the how-to of resilient construction. While few organizations in Washington were talking about the need to make communities more resilient, NAMIC and the BuildStrong Coalition for years were working to educate Congress about the lifesaving power of stronger building codes and mitigation and the need to create a national mitigation investment strategy. In 2018, the landmark Disaster Recovery Reform Act

(DRRA) was enacted into law. The DRRA is a transformational law that is making America's communities more resilient, including through the creation of a massive new pre-disaster mitigation fund, the Building Resilient Infrastructure and Communities (BRIC) Program. That program is already generating new resources for states and localities to implement and enforce resilient building codes.

## The Building Resilient Infrastructure and Communities Program

Pursuant to the DRRA, an amount equal to 6 percent of disaster relief spending can automatically be deposited into the BRIC Program, which will award grants on an annual basis to states and communities all over the country in order to undertake projects and perform other risk reducing activities that are designed to mitigate damage. Because of the way the BRIC Program is structured, where funds are prioritized for states and communities that have stronger resiliency standards in place, communities are incentivized to actively understand where they stand on a national basis in terms of resilience, and are empowered to plan tangible actions that would amplify their efforts to drive down the impacts of disaster hazards. The DRRA also ensures BRIC funds can be used ability for the enforcement of strong building codes and requires that construction performed using BRIC funds be built to modern codes.

The first application period ran from Sept. 30, 2020 to Jan. 31, 2021, and the application period for the next round of funding will open on Sept. 30, 2021. Demand for the first round of BRIC funding, in which BRIC is awarding $500 million to states and communities, was heavy. FEMA received nearly $5.5 billion in applications from 53 states and territories, with 8 states applying for projects totaling $200 million or more. On the heels of this high demand, President Biden announced on May 24 that the next round of funding for the BRIC Program in Fiscal Year 2021 will award $1 billion in funding. This represents the largest-ever funding level for risk-reducing mitigation measures before disasters in the U.S. In a sign of how much the pre-disaster landscape has changed, as recently as 2015 the federal government provided a total of only $30 million to states and communities for pre-disaster mitigation efforts.

## The Path Forward – New Policy and a Smart Regulatory Approach

Congress should continue to lead the way as we pursue the goal of enacting policies to provide incentives for ensuring our nation's communities – including underserved communities – are being fortified. As such, NAMIC recommends that members of the Senate Banking Committee work to include policies that incentivize and provide resources to facilitate smart, climate-conscious behaviors and mitigation in any infrastructure bill, as well those that remove the moral hazards and policy impediments inhibiting decisionmakers from creating resilient systems and communities. Specifically, we are asking for the inclusion of policies that make up the forthcoming Resilient Assistance for Mitigation for Environmentally Resilient Infrastructure and Constructions by Americans Act (Resilient AMERICA Act) being crafted by members of the House and Senate. Examples of such provisions are those that would:

- Increase state and local capacity for mitigation by significantly boosting BRIC funding levels

- Create new tools and incentives for the state and local adoption of modern building codes
- Harden the nation's communities and lifeline infrastructure, including electric and energy grids
- Ensure that a certain percentage of BRIC funds can be used towards building code enforcement
- Address aging structures by utilizing BRIC funds to incentivize individuals to undertake retrofits

NAMIC views the forthcoming legislation as an important next step to follow the DRRA during this critical time where the nation is experiencing more and more severe weather events. Further, looking ahead, with an increasing focus on climate-risk related policy from Congress as well as policymakers around the nation, it is important to point out that regulators and lawmakers should be mindful that as expectations increase for insurers to use "forward-looking" climate models and long-term scenarios to assess underwriting risks, these expectations far outstrip the current state of climate modelling science. As such, if translated into regulatory requirements, these expectations would require considerable work without leading to additional insights into risk. Further, as regulators press for disclosure of climate data, they need to be aware of existing data limitations and should be clear about why they are requesting data and how that data will be used, and should take iterative approach to climate focused regulation.

We thank you for holding today's hearing and look forward to working together in an effort to create a stronger, more resilient America.

**STATEMENT OF THE INSURANCE INSTITUTE FOR BUSINESS & HOME SAFETY**

Insurance Institute for Business & Home Safety®

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**Re: 21st Century Communities: Climate Change, Resilience and Reinsurance**

Chairman Brown and Ranking Member Toomey:

Thank you for the opportunity to submit this statement for the record of the July 20, 2021 hearing held by the Senate Committee on Banking, Housing, and Urban Affairs. My name is Roy Wright, and I am President & CEO of the Insurance Institute for Business & Home Safety (IBHS). IBHS is a 501(c)(3) organization, enabled by the property insurance industry's investment, to fund building safety research that leads to real-world solutions for home and business owners, helping to create more resilient communities.

Severe weather disrupts lives, displaces families, and drives financial loss. IBHS delivers top-tier science and translates it into action so we can prevent avoidable suffering, strengthen our homes and businesses, inform the insurance industry, and support thriving communities. The perils we study at IBHS are part of the natural world in which we live, but social and economic disasters occur when these perils meet human populations that live or work in harm's way. In order to break the cycle of destruction, it is essential to address all aspects of the building performance chain: where you build, how you design and construct, and how well you maintain and repair. As a building science institute, IBHS focuses on the ways that weather behaves, what makes homes and businesses vulnerable, and how our buildings can be more resilient. We exist to help ensure that the places where people live, learn, work, worship, and gather are safe, stable, and as strong as the best science can equip them to be.

In the context of climate change, the resilience of the built environment – housing, in particular – is more important than ever. Resilience keeps families and communities together and reduces the costs of severe weather for individuals, insurers, and the government. Identifying smart public policies that strengthen the resilience of every American home is not just a matter of equity and public health – although it is both – it is

a responsible investment of tax dollars. Improving resilience for American families reduces the costs of future natural disasters and the economic disruption associated with related dislocations.

Any discussion of resilience and climate change should be guided by the following lodestar: **federally funded building projects should be built to withstand knowable risks and last for at least a generation.** The federal taxpayer should not pay for the same building more than once. Indeed, failing to make resilience to severe weather and a changing climate a central component of any federal spending is a missed opportunity – one that results in avoidable suffering and higher disaster relief costs for generations to come.

### INSURERS' PRINCIPLES FOR CLIMATE CHANGE ADAPTATION

In June of this year, IBHS and a group of our members – including primary insurers, reinsurers, brokers, and catastrophe risk modelers – released the Insurers' Principles for Climate Change Adaptation (https://adaptatingtoclimate.com). The document highlights six principles that seek to inform public policy discussions regarding climate change adaptation and identifies illustrative actions the nation can take to improve the resilience of American homes, businesses, and communities:

1. Climate change adaptation is necessary.
2. Building codes and land use support tomorrow's resilience.
3. Prioritize funding for increasing resilience of existing structures
4. Make resilience available for all
5. Leverage climate data and analytics to support climate change adaptation
6. Enhance resilience for public infrastructure and facilities

This statement is focused primarily on the first four of these principles. Together, the Principles can identify a set of pathways to help make resilience more available for all Americans, regardless of their financial means. Strengthening our resilience to natural perils and climate change is among the most pressing challenges we face as a nation, but solutions are within our reach.

### CLIMATE CHANGE ADAPTATION IS NECESSARY

The last 18 months have taught us the fundamental importance of our homes. The dangers of COVID-19 led Americans from all fifty states to seek refuge in their homes, juggling remote work, child-rearing, and all the other necessities of life under a single roof. And yet, this period should also be remembered for the ways that Mother Nature

kicked down the front door of American homes – a time in which climate change affected families across the country. 2020 delivered the most active Atlantic hurricane season on record, with the most named storms in history; a wildfire season with a record-shattering 18 infernos of 100,000 acres or more across the West, and a Midwest derecho that was among the most costly thunder storms in national history. According to reporting from the NOAA's National Centers for Environmental Information, 2020 set a record of 22 billion-dollar weather and climate disasters in the United States. However, we must look at 2020 in the broader context: while natural perils last year were particularly bad, they were not anomalous. 2020 was the sixth consecutive year in which ten or more billion-dollar weather and climate disaster events have occurred in the United States. 2021 has offered little respite thus far, including a record cold wave affecting Texas in February and a record heat wave affecting the Pacific Northwest in July. Considering this trend, we must adapt by making our families, businesses, and communities more resilient to a changing climate and associated severe weather.

The core perils studied at the IBHS Research Center are wind, wind-driven rain, hail, and wildfire, are all relevant to today's hearing because they could become more frequent and destructive with a changing climate. The design of our Research Center—with 105 fans capable of generating wind speeds approximating the gusts of a Category 3 Hurricane—provides unique capabilities to replicate real world weather conditions that arise during high wind, convective storms, and wildfires. We have developed a unique capability to replicate the density, hardness, and kinetic energy of natural hailstones to assess the durability and damageability of asphalt shingles and other products. We also have made significant, long-term investments wildfire research. Wildfire is one of the most important perils we study at the IBHS Research Center. This is the only place beside real-world wildfire events that can expose full-size buildings and building components to realistic thermal exposure of flames and embers. Creating a realistic scenario to study building vulnerabilities to wildfire has made IBHS the epicenter of wildfire research over the past decade and has attracted other research organizations to collaborate with IBHS.

In addition to work at our facility, our scientists and partners have conducted post-disaster investigations to examine the real-world effects of different natural hazards. This field research deepens our understanding of the effect of hail, hurricanes, and wildfire on the built environment. IBHS' best-in-class science fills knowledge gaps to achieve significant social and economic benefits across all regions and demographics of America.

Due to the research conducted at IBHS, actions to strengthen the resilience of homes and businesses are not just knowable but known. Using this knowledge to strengthen

the resilience will reduce avoidable suffering, displacement, and economic disruption. Such investments are smart fiscal choices, returning an average of $6 for every $1 provided by a federal mitigation grant, a 500 percent return on investment. Given its important societal and economic benefits, adaptation is both a sound fiscal strategy and a good public policy.

**BUILDING CODES AND LAND USE SUPPORT TOMORROW'S RESILIENCE**

Strong, and strongly enforced, building codes are an important tool to improve resilience. Building codes are sets of regulations, standards, and guidelines adopted by states and local jurisdictions to promote the construction of safe and durable structures. Historically, codes focus on life safety, but through proper application, they also can reduce the disruption natural hazards have on our lives. The National Institute on Building Safety (NIBS) has concluded that each dollar spend on up-to-date building costs would result in $11 dollars of benefit, a 1000 percent return on investment. FEMA's 2020 "Building Codes Save" study found that existing codes will result in $132 billion in losses avoided between 2000 and 2040. If all new buildings in the United States were built to modern editions of model building codes, the losses avoided would be more than $600 billion. However, adoption and enforcement of building codes are not uniform across the country, or even within some of our most hazard-prone states. In fact, the FEMA study reported that 30 percent of new construction occurs in communities with either no codes at all, or codes that are more than twenty years outdated.

Similarly, decisions by local officials of where housing should be built can be as consequential to the resilience of that housing as how that housing is built. Any questions as to the impact of land use decisions on the consequences of climate change need look no farther than the American West. Between 1991 and 2010, the number of homes in the wildland-urban interface increased by 41 percent, contributing greatly to the significant increase in wildfire-related losses experienced in recent years.

Building codes and land use, though quintessential state and local issues, have national consequences each time the American taxpayer is asked to pick up the tab for a natural disaster. Congressional action – such as by providing FEMA and HUD with increased tools to incentivize and fund *new* state-level building code enactment, modernization, and enforcement – can encourage the adoption and enforcement of strong, state-wide building codes based on the most current model codes and land use decisions that incorporate resilience and climate change adaptation as meaningful considerations.


**PRIORITIZE FUNDING FOR INCREASING RESILIENCE OF EXISTING STRUCTURES**

While building codes and land use decisions are fundamental tools for shaping the resilience of tomorrow's homes, they do not strengthen resilience in older homes where Americans live today. We must find ways to encourage, incentivize, and assist American families to strengthen the resilience of their existing homes.

Social science suggests that effectively evaluating risk – particularly high impact, low likelihood risks like natural disasters – is challenging. When it comes to natural perils, people often feel more protected than they are and therefore fail to invest in resilience. In response, government should provide cost-effective support to encourage property owners to make investments that strengthen the resilience of existing homes and buildings before a natural disaster occurs. Such support could take the form of tax credits for resilient investments, or incentives in federal housing programs for homeowners that invest in resilience.

Natural disasters destroy lives and property, displace families, disrupt economies, and wreak havoc on communities. They also present an opportunity to strengthen homes and communities – if resilience is centric to disaster recovery programs and funding. Following a disaster, disaster assistance should be targeted to strengthen resilience – with funding requirements that mandate building back to, at a minimum, best-available building codes. Houses rebuilt to the same design level that failed to withstand past disasters will, most likely, fail to withstand future disasters. Post-disaster recovery funds that are not deliberately resilience-centric are a wasted opportunity to strengthen resilience.

Homeowners are not the only decision-makers who need to better account for the risk to and resilience of existing structures. Consistent with Principle 6 (Enhance resilience for public infrastructure and facilities), state, local, Tribal, and territorial entities (SLTTs) should do more to strengthen the physical resilience of public buildings like schools, town halls, and city-owned structures. These structures – if built to withstand natural disasters – can provide critical emergency shelters during severe weather and allow the continuity of government services after the weather passes. Moreover, SLTTs also should strengthen their financial resilience against the perils of climate change. This includes purchasing appropriate insurance solutions instead of expecting federal assistance to act as a replacement for private market insurance.

**MAKE RESILIENCE AVAILABLE FOR ALL**

Far from a luxury, residential and community resilience are basic needs – the absence of which is most keenly felt by those who lack the resources to invest in it themselves. According to sociological research, disabled, elderly, low income, and other vulnerable people are less likely to prepare for disasters, evacuate safely, avoid physical or psychological trauma, or recover quickly and fully. Low-income residents account for a meaningful percentage of the population in many coastal communities and other areas that face climate risk, often living in the most vulnerable types of housing. This reality places an even higher priority on resilience programs that prevent avoidable damage to the places these populations live.

Resilience should be a fundamental component of affordable housing programs. A key goal for affordable housing should be identifying the right set of factors that allow a home to be enduringly affordable. To achieve this goal, housing for low-income populations should be based on a three-prong foundation of affordability, resilience, and energy-efficiency. This approach reduces costs in the short term through reduced utility bills *and* avoids future loss, disruption, and displacement through resilient construction or retrofits. The convergence of affordability, resilience and energy-efficiency is already occurring in Louisiana, where an affordable housing project from the New Orleans Redevelopment Authority mandated that affordable housing be built to IBHS's FORTIFIED standard and the Energy Star Homes Version 3.0 standard. In this spirit, Congress should identify opportunities to embed resilience funding in all affordable housing legislation. One example of this kind of legislation is H.R. 4497, the *Housing Is Infrastructure Act of 2021*, which authorizes at least $19.1 billion for "climate and natural disaster resilience and water and energy efficiency" across ten different categories of affordable housing programs. Such legislation will both help the families living in affordable housing and save federal dollars in the long run.

More broadly, public sector, private sector, and philanthropic spending on resilience will be most effective if it targets the communities that contend with significant natural hazard risk and elevated socio-economic vulnerability. To date, we have lacked tools to systematically identify these communities on a national level. The Reinsurance Association of America (RAA) has developed a proposal that meets this need. Using data from sources like the Federal Emergency Management Agency's National Risk Index and the U.S. Census Bureau, the RAA proposal identifies Community Disaster Resilience Zones (CDRZs) – communities of heightened vulnerability and risk – and identifies incentives to direct private and public sector capital to increase resilience in those needy communities. In addition to being data-driven in a manner consistent with Principle 5 (Leverage climate data and analytics to support climate change adaptation),

the RAA approach represents a powerful framework to utilize public sector data and programs with private sector capital in a way that strengthens the resilience of our nation's most vulnerable communities. The CDRZ proposal is an innovative approach to a longstanding problem in the resilience and disaster recovery space: driving up financial capacity and technical capabilities for communities that otherwise lack both.

* * *

We thank the Committee for its recognition of the importance of resilience and climate change. Americans are not powerless against severe weather—it *is* possible to reduce the damage inflicted today and in the future.

Sincerely,

Roy E. Wright
President & CEO
Insurance Institute of Business & Home Safety

## STATEMENT OF THE SMARTERSAFER COALITION

SMARTERSAFER.ORG
Americans for Smart Natural Catastrophe Policy

July 20, 2021

The Honorable Sherrod Brown
Chairman
U.S. Senate Committee on Banking,
Housing, and Urban Affairs
503 Hart Senate Office Building
Washington, D.C. 20510

The Honorable Patrick Toomey
Ranking Member
U.S. Senate Committee on Banking,
Housing and Urban Affairs
455 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Brown and Ranking Member Toomey:

The SmarterSafer Coalition (SmarterSafer) is a diverse coalition of conservation and environmental groups, taxpayer-focused organizations, insurance and reinsurance interests, and housing advocates. We are pleased to have the opportunity to submit this letter for the record for the Senate Banking, Housing, and Urban Affairs Committee hearing entitled "21st Century Communities: Climate Change, Resilience, and Reinsurance." Members of our coalition look forward to a robust conversation and welcome the opportunity to hear from the informed panel of witnesses you have assembled, including Frank Nutter of the Reinsurance Association of America and Jerry Theodorou, both active SmarterSafer members. SmarterSafer applauds and encourages you and your colleagues to continue to address, through robust collaboration, fiscally sound and environmentally responsible policy solutions to building communities that are more resilient to natural catastrophes.

***Climate Research***

We encourage the Senate Banking Committee (the Committee) to enhance and strengthen the nation's capacity to conduct more climate-related research, especially as it pertains to future risk, ocean science, disaster-resilient construction and engineering, and nature-based mitigation solutions. It is essential that we close the gap between the research needed on climate impacts and the growing need to apply that knowledge to make the nation more prepared and resilient. More broadly, we believe the Senate should consider new investments in infrastructure design, siting, and engineering that will allow the nation to track, monitor, prepare, and respond to changing climate and its related disasters.

***Pre-Disaster Mitigation***

It is imperative that the new findings from climate research are matched with advanced pre-disaster mitigation plans. Outdated strategies have caused the federal government to spend billions of dollars reacting to disasters after they strike. Without change, this number is only expected to increase. Mitigation, however, is a short-term cost with long term gains as every $1 invested in mitigation is estimated to save $6 on post-disaster spending[1]. These investments are particularly appropriate as the country anticipates another year of devastating natural disasters. SmarterSafer supports the implementation of resilience programs at FEMA and HUD, including FEMA's Building Resilient Infrastructure and Communities program and HUD's Community

[1] https://www.fema.gov/sites/default/files/2020-07/fema_mitsaves-factsheet_2018.pdf

Development Block Grant program, to bolster community resilience by investing in pre-disaster mitigation, especially in natural infrastructure solutions.

***Natural Infrastructure***

Natural and nature-based solutions provide significant and measurable risk-reduction benefits to communities. NOAA estimates that U.S. coastal wetlands alone provide $23.2 billion in storm protection each year. During Hurricane Sandy, wetlands reduced damages by more than 22 percent in more than half of the areas directly affected by the storm. On inland waterways, researchers have found that wetlands provide $237 billion a year in benefits for flood mitigation and groundwater recharges[2]. Investment in natural restoration and resilience projects will provide important wildlife habitats, assist in creating outdoor recreational opportunities, and strengthen tourism activity. The restoration of wetlands, dunes, mangroves, and other living shorelines will reduce flood and erosion risks for coastal communities. Federal assistance in implementing regional ecological restoration plans and authorized projects will support large-scale restoration of natural systems that provide protections against sea level rise and disaster events. Such investments will also help confront the climate crisis by naturally sequestering more carbon and bolstering community resilience to wildfires, hurricanes, and flooding, while advancing environmental justice by removing pollution from our air, water, and soils. Greater emphasis needs to be placed on natural infrastructure and the surplus of benefits available when used in tandem with gray infrastructure. Additionally, SmarterSafer believes funding should also be allocated to accelerate flood mapping to inform strategic investments and development decisions. Support for programs that bolster resilience to wildfires, including programs at the U.S. Forest Service (which we recognize falls outside the jurisdiction of the Committee), including vegetation and watershed management, wildland fire preparedness, and wildlife and fisheries management, is essential to protecting Western communities and infrastructure.

***Investing in Climate Resilient Infrastructure***

As Congress continues to debate comprehensive infrastructure policy, SmarterSafer encourages the Committee to work with Senate colleagues to require government-funded agencies involved in floodplain construction to follow certain mitigation strategies to ensure that funds are used for projects that can withstand disasters. The Committee should also consider the racial inequities inherent in federal disaster assistance and hazard mitigation assistance programs that reflect and perpetuate discriminatory practices and historic redlining. Low-income and minority homeowners and communities, which have not traditionally received the same level of benefits from federal buyout programs as other segments of the population, should be given priority and additional assistance as a first step to address the history of placing low-income and minority housing in areas of higher risk. Further, there should be a focus on ensuring minority communities are not excluded from buyout programs and on raising awareness in these communities that these programs are available for them to use.

Lastly, it is not enough to build in environmentally sound areas, we must keep durability and longevity in mind. Federal funds, whether provided through disaster assistance, Community Development Block Grants, or other programs should be directed to outcome-driven projects that strengthen communities and reduce long-term risk. Enhanced minimum design standards that

[2] https://www.ducks.org/conservation/conserving-wetlands-waterfowl/the-many-benefits-of-wetlands-conservation

incorporate forecasts of future conditions are needed to create stronger communities that can withstand an uncertain future. High-quality information and data are necessary to guide these efforts. SmarterSafer supports bipartisan legislation such as the *Built to Last Act*, introduced in the 116th and 117th Congress by Sens. Tammy Baldwin (D-WI) and Marco Rubio (R-FL) which would ensure standards-developing organizations that issue building codes have access to forward-looking meteorological information, including data on wildfires and other environmental trends. It is only by following this path that the U.S. will continue to see tangible improvements in at-risk communities.

***Risk Transfer and Reinsurance***

It is important to realize that facilitating and strengthening public-private partnerships will give programs increased access to better technology and more capital to increase efficiency to better serve the individuals they intend to help. The private sector, particularly the insurance and reinsurance industries, is eager to take on additional risk associated with natural disasters. Certain federal programs and agencies, including the Federal Housing Finance Agency, the Export-Import Bank, and the Federal Emergency Management Agency, already employ risk transfer strategies, proving they can be successful. We believe more can be done in the climate space. Reinsurance is key to creating a sustainable future that will help drive down financial loss. By leveraging private financing, insurance, and reinsurance availability, policymakers can shift some of the financial burdens associated with climate change from the government's balance sheet to willing private sector participants to improve the implementation of the entire program.

Thoughtful spending can and should simultaneously create and protect economic growth, security for communities, and long-term savings for taxpayers. As the economy begins to recover and expand in the post-COVID-19 era, we hope that you will continue to focus your time and effort on these topics and appreciate your consideration of the aforementioned suggestions that promote fiscally and environmentally resilient communities. We also hope that, with your focus and efforts, we will continue to see considerable results. Our coalition stands ready to be a resource to you and your colleagues as you pursue these ideas.

Respectfully,

SmarterSafer Coalition

# STATEMENT OF THE AMERICAN PROPERTY CASUALTY INSURANCE ASSOCIATION

American Property Casualty Insurance Association
INSURING AMERICA apci.org

**Statement of the American Property Casualty Insurance Association**

**21st Century Communities: Climate Change, Resilience, and Reinsurance**

**Committee on Banking, Housing, and Urban Affairs**

**The United States Senate**

**July 20, 2021**

The American Property Casualty Insurance Association (APCIA) respectfully submits comments to the Senate Committee on Banking, Housing and Urban Affairs in conjunction with the Committee's hearing -- 21st Century Communities: Climate Change, Resilience, and Reinsurance. APCIA publicly and actively supports measures to address the impacts of climate change and extreme weather, including the incorporation of climate-related risk into federal strategic plans to ensure proper preparedness for future disasters.

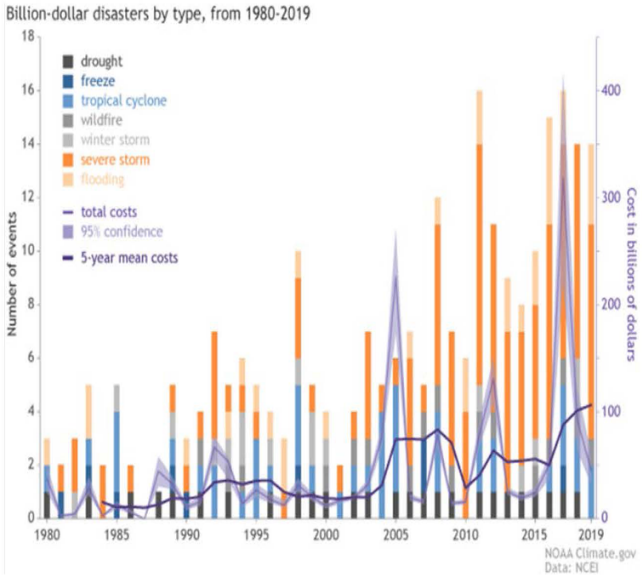
APCIA members represent the broadest cross-section of home, auto, and business insurers of any national insurance trade association. APCIA promotes and supports the health and viability of insurance markets for the benefit of consumers and insurers, protecting families, communities, and business in the U.S. and across the globe.

Every part of the United States is exposed to the threat of natural disasters whether in the form of hurricanes, floods, tornadoes, hailstorms, wildfires, drought, earthquakes, extreme cold, or blizzards. Improving the nation's resiliency is critically important to individuals, businesses, and communities impacted by catastrophes on an increasingly frequent basis. The increasing frequency and severity of weather-related events in the United States, and around the world, evidences an underlying cause on a global scale. A critical evaluation of climate-change related phenomenon and the resulting loss of life and property is extremely important and APCIA is encouraged that the Committee is meeting to address these matters.

Full consideration of climate-change as an underlying contributor to costly natural catastrophes is the primary step in examining the effect that these events have on federal expenditures, which in turn is an important component in moving the nation toward a more proactive approach to mitigation and preparedness. We appreciate the continued leadership of Congress on resiliency and mitigation related issues and support further engagement by this Committee.

**Climate Change is Creating a Rising Tide of Natural Disasters**

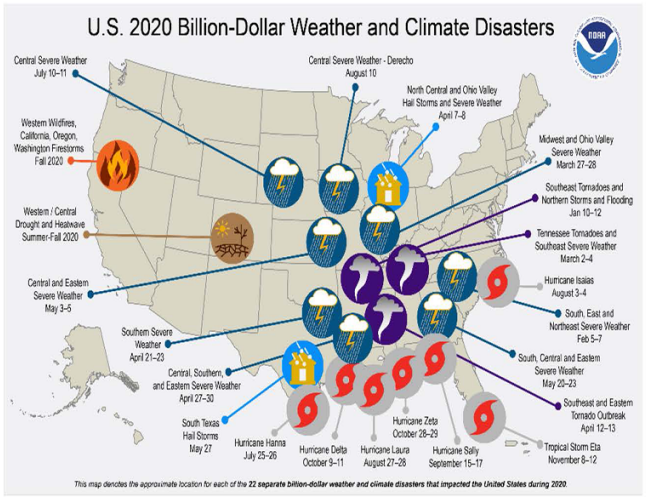
Records show the number and severity of natural catastrophes has been rising for decades around the world, and in the United States.[1] Floods, hurricanes, wildfires, and droughts, have all emerged as an ongoing hazard to economic growth and social progress. Population and housing growth in hazard-prone areas coupled with the effects of climate change are driving higher frequencies of weather-related catastrophes, leading to a perpetually higher than average number of billion-dollar loss events. The average number of billion-dollar catastrophic events per year (events where damages or costs exceed $1 billion) has more than doubled in the past 30 years, with mean average costs eclipsing the $100 Billion mark in 2019.[2]




[1] Munich Re, "Natural disaster risks: Losses are trending upwards," 2021. https://www.munichre.com/en/risks/natural-disasters-losses-are-trending-upwards.html#-1624621007

[2] National Oceanic and Atmospheric Administration (NOAA), "2020 U.S. billion-dollar weather and climate disasters in historical context", (2021) https://www.climate.gov/news-features/blogs/beyond-data/2020-us-billion-dollar-weather-and-climate-disasters-historical

Evidence suggests these trends may be accelerating, as 2020 resulted in 22 billion-dollar weather and climate events in the United States, shattering the previous annual record of 16 that occurred in 2011 and 2017, and the sixth consecutive year in which 10 or more billion-dollar weather and climate disaster events have impacted the United States.

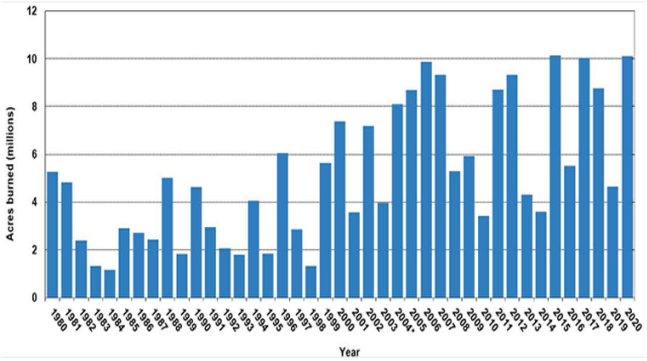



The total cost of hurricanes in the United States from 1980-2020 has been approximately $1.875 trillion[3] and the estimated cost of non-coastal flooding was approximately $200 billion from 1988-2017.[4] Despite the growing damage and costs, FEMA estimates that only about 3% of homeowners have flood insurance, leaving millions of Americans critically exposed to the rising danger brought about by climate change induced increases in precipitation and sea level rise.[5]

[3] Office of Coastal Management (NOAA), "Fast Facts: Hurricane Costs", (2021). https://coast.noaa.gov/states/fast-facts/hurricane-costs.html
[4] Scientific American, "Rising Costs of U.S. Flood Damage Linked to Climate Change", (2021). https://www.scientificamerican.com/article/rising-costs-of-u-s-flood-damage-linked-to-climate-change/
[5] Insurance Information Institute, "FEMA Publishes Flood Insurance Claim Records Going Back to 1978", (2019). https://www.iii.org/insuranceindustryblog/fema-publishes-flood-insurance-claim-records-going-back-to-1978/

The American west has also seen a dramatic increase in damage caused by wildfires. Since 2016 there have been on average 1,126 large or significant fires annually.[6] The national statistics for wildfire acreage burned has seen a similar trend to that of hurricanes, flooding, and windstorms, with noticeable increases in the last 10-15 years.[7]

**National Acres Burned from 1980-2020**




*2004 fires and acres do not include state lands for North Carolina.
Source: Insurance Information Institute, "Facts + Statistics: Wildfires", (2021)

While drought conditions routinely fluctuate throughout the United States, in the past 20 years, roughly 20 to 70 percent of the U.S. land area has experienced conditions that were at least abnormally dry.[8] Current climate projections show that the southwest region of the U.S. may experience chronic future precipitation deficits increasing dry conditions, which contribute to wildfires.[9]

Federal appropriations in response to natural disasters are now regularly eclipsing $10 billion annually (with supplemental spending included) and look to be growing.[10] These costs are not financially sustainable, and solutions need to be found to mitigate disaster losses and help consumers and communities become more resilient to changes in weather severity.

[6] Congressional Research Services, "Wildfire Statistics", (Updated July 15, 2021). https://fas.org/sgp/crs/misc/IF10244.pdf
[7] Insurance Information Institute, "Facts + Statistics: Wildfires", (2021). https://www.iii.org/fact-statistic/facts-statistics-wildfires
[8] Environmental Protection Agency, "Climate Change Indicators: Drought", (2021). https://www.epa.gov/climate-indicators/climate-change-indicators-drought
[9] National Integrated Drought Information System, "Historical Drought", (2021). https://www.drought.gov/what-is-drought/historical-drought
[10] Congressional Research Service, "The Disaster Relief Fund; Overview and Issues", (Updated Nov. 2021). https://fas.org/sgp/crs/homesec/R45484.pdf

**The Impact of Climate Change and Natural Catastrophes on Insurance**

The property casualty insurance industry has been engaged in natural catastrophe response through servicing policyholders, working with emergency response divisions in the states, and providing valuable resources needed in recovery and rebuilding.

The insurance industry in the United States is regulated at the state level, with each state having a Department of Insurance or equivalent division tasked with monitoring insurance rates, products offered to consumers, and the market generally. Localized regulation allows for tailored review of insurance products aligned with the unique risks found in each state. Insurance regulation at the national level does not generally come from the federal government, rather through coordination among State insurance commissioners. This cooperative model provides flexibility within the regulatory space to respond to the demands of the market and existing risks on an as needed basis.

Unfortunately, increased risk factors associated with climate change have led to a hardening of insurance markets as insurers and reinsurers respond to increasing costs. A Willis Towers Watson report found aggregate price changes reported by commercial property carriers throughout 2020 were at or above double digits, with the fourth quarter resulting in the highest one-quarter movement seen in their survey history. The rate of price increases in 2021 remains elevated versus historical norms.[11] Some western commercial insurance markets have seen consumers forced to seek coverage through the excess and surplus lines marketplace to find insurance coverage amidst growing wildfire risk.[12]

As severity of losses due to natural catastrophes rise, the property casualty insurance markets tend to follow in similar fashion. The increase in exposure is typically offset through premium increases or limitation of insurance products being offered. These responses to large, sudden losses allow for market adjustment to protect the long-term financial viability of the insurance market within a state or region.

Catastrophic events, however, have an oversized impact on insurance markets, and multiple events can threaten the stability and viability of the market at a fundamental level. The most notable example of this threat are the circumstances which followed Hurricane Andrew (1992) in Florida.[13] The significant property damage from the storm forced numerous insurers into insolvency and produced a mass exodus of insurance carriers from the Florida market. While such crisis levels have been rare, fears have begun to emerge that California with its ongoing wildfire losses and gulf states with continued hurricane damage are facing crisis level market deterioration.

The overall effect of insurance market deterioration will have broad economic impacts as insurance is a presumed bullwork of state and regional economies, with most economic actors relying on the protections offered by insurers. The need for a heathy and viable insurance market in the face of increasing climate related risk cannot be overstated. The primary economic consideration following any major catastrophe is the need to rebuild and the speed at which recovery can take place. Insurance is the most efficient and often the first and most significant contributor to rebuilding efforts at individual, business, and community levels. A healthy insurance market moves hand-in-hand with a healthy economy.

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[11] Willis Towers Watson, (June 2021) https://www.reinsurancene.ws/wtw-reports-uptick-in-commercial-insurance-rates-through-q1/
[12] Collins, Karen, APCIA Property Insurance: 2020 Year in Review, (2021) https://www.apci.org/attachment/static/4441/
[13] Insurance Information Institute; Hurricane Andrew and Insurance; The enduring Impact of an Historic Storm, (2012). https://www.iii.org/sites/default/files/paper_HurricaneAndrew_final.pdf

**Building a Resilient Future**

Making the United States more resilient to natural catastrophe events will take the combined efforts of government, communities, the private sector, and individual property owners. As the Committee examines the impact of climate change and resilience and the role of insurance, APCIA encourages continued Congressional support of federal mitigation and resiliency programs.

In addition to encouraging continued support for federal hazard mitigation programs passed by Congress in the Disaster Recovery and Reform Act (DRRA), an effective and balanced National Flood Insurance Program (NFIP), and further funding for FEMA's Building Resilient Infrastructure and Communities (BRIC) Program, APCIA wishes to offer the following broad-based suggestions to the committee:

- Incorporate climate risk models and climate resilience standards into all public infrastructure projects.
- Commit additional government funds for resilient infrastructure and retrofitting existing infrastructure in areas at risk.
- Encourage states, U.S. territories, communities, and tribes to adopt prudent, hazard-specific land use measures.
- Encourage states to adopt and enforce strong building codes and defensible space requirements for both new and existing property and construction to increase resilience to present and future risks.
- Support and utilize research and targeted incentives (such as tax credits, loans, or grants) to promote effective loss mitigation, to reduce current and future risk to people, property, natural features, ecosystems, and critical infrastructure.
- Share science-based information to better inform public policy and decision-making at all levels of government and commerce, including analyses of the benefits and costs of property mitigation measures.

We also ask that policymakers keep at the forefront of their minds the most vulnerable communities when deciding how best to allocate resources to improve the resiliency of American communities. With increasing frequency and severity of natural catastrophes come unequal impact. Lower-income and vulnerable communities are more vulnerable to direct harm and less able to recover and rebuild following natural disasters. Social vulnerability and equity should be included in evaluations of climate change and planning efforts to mitigate future harm.

Making America more resilient to natural catastrophe events will take the combined efforts of government-federal, state, and local, communities, the private sector and individual property owners. Property casualty insurers stand ready to assist the Committee in addressing the challenges of climate change, building a resilient future, and helping communities recover quickly after disaster strikes. APCIA thanks the Committee for holding this important hearing.

**Appendix:**
APCIA: 2020 Property Insurance the Year in Review

# Property Insurance

## 2020 The Year in Review

U.S. Property Insurance Market Continues to Harden,
Expected to Continue in 2021

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# Property Insurance – 2020 The Year in Review

U.S. Property Insurance Market Continues to Harden, Expected to Continue in 2021

**Key Points**

- Increased population in hazard-prone areas and climate change are driving record losses
- Near term trends will continue to add pressure to the existing hard market
- Mitigation will be a critical long-term strategy to reduce future losses

**Summary**

Property Insurance markets continue to harden following historically low interest rates, costly social inflation (including increased litigation), and severe weather events. These conditions have resulted in higher losses, led to increasing insurance rates, reduced capacity, and stricter underwriting in numerous states. Insurers are facing increasing pressure as a perfect storm pushing loss costs up continues to build.

*2020 Storms and Wildfires* – Another year of record-breaking weather-related catastrophes has added more pressure, and trends suggest the market will continue to face volatility. Population and housing growth in hazard-prone areas coupled with the effects of climate change are driving higher frequencies of weather-related catastrophes, leading to a perpetually higher than average number of billion-dollar loss events.

North America suffered the highest losses in 2020, with six of the ten costliest natural disasters having occurred in the United States. MunichRe noted overall U.S. losses and insured losses from natural disasters in 2020 were as follows:

U.S. Total: $95 billion, $67 billion in insured losses
- Hurricanes: $43 billion, $26 billion in insured losses
- Severe Storms: $40 billion, $30 billion in insured losses
- Wildfires: $16 billion, $11 billion in insured losses

*Looking Ahead* – Materials and labor costs are expected to remain elevated in 2021 after widespread losses in 2020, as well as rate increases for reinsurance. Interest rates will also remain steady at record low rates, continuing to depress investment returns.

*Mitigation* – The property insurance industry has focused on mitigation as a critical priority to reduce future losses. Recent studies released in 2020 highlight significant economic opportunities from increased building code standards and home hardening, to build communities more resilient to severe weather-related events such as wildfires, floods, and hurricanes. Regulators are also beginning to focus on financial mitigation, with new expectations being established to disclose financial risks from climate change.

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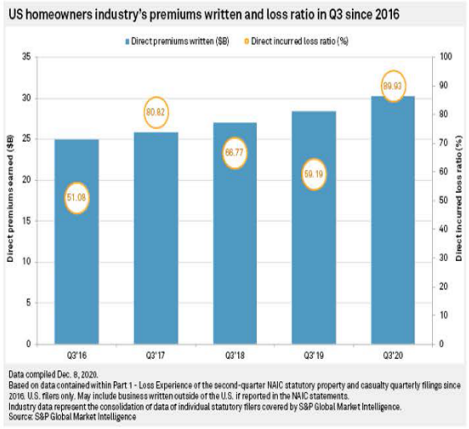
## U.S. P&C INSURANCE HEADWINDS

The compounded effects of COVID-19, natural catastrophes, and civil unrest have put pressure on the U.S. property casualty insurance industry. In the second quarter the combined ratio worsened to 100.6 percent, 5.7 points worse than the first quarter's 94.9 percent, pushing insurance underwriting into the red. The U.S. residential property insurance market appeared to escape significant direct impacts from COVID, however near-record third quarter catastrophe losses will certainly push underwriting results further into negative territory as the Q3 U.S. Homeowner loss ratio jumped to 89.9 percent.




A proposed corporate tax increase, if passed by the new congress[i], may compound the effects of record low interest rates which have continued to depress investment returns in 2020, stressing a greater need for underwriting discipline. Additional pressures weighing heavily on the property market include social inflation (particularly litigation), increased frequency of natural catastrophes, and upward pressure on reinsurance rates for many lines of business. While the industry remains positioned to meet its expected obligations, the unusual combination of losses and future uncertainty is weighing heavily on property lines.

## 2020 STORMS AND WILDFIRES

Between wildfires, hurricanes, and other severe storms, 2020 was the sixth consecutive year in which the U.S. has experienced 10 or more billion-dollar weather and climate-related disasters. According to NOAA, the yearly average is 6.6 events, though 2020 recorded 22 individual disasters[ii], each costing a billion dollars or more, shattering a previous record.[iii] This included 7 tropical cyclones, 13 severe storms, 1 drought and 1 wildfire.

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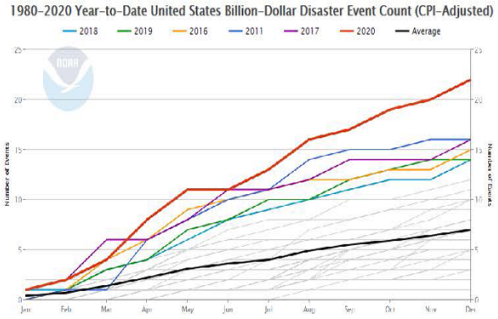
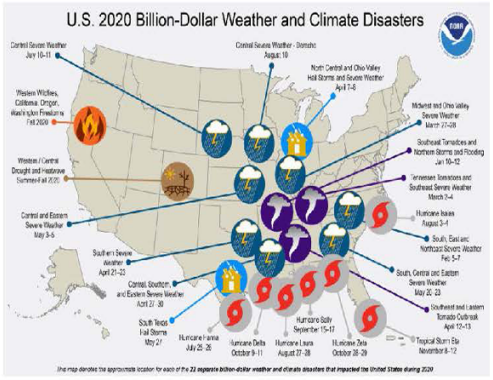



*Hurricanes*

In the southeast, the Florida market is reaching crisis levels as soaring litigation and numerous hurricanes continue to batter the state. Despite no major hurricane striking densely populated areas such as Miami or Tampa, a hyperactive Atlantic hurricane season in 2020 will not serve to reduce existing pressure in the Florida market. Highlights and new records from the 2020 season include:

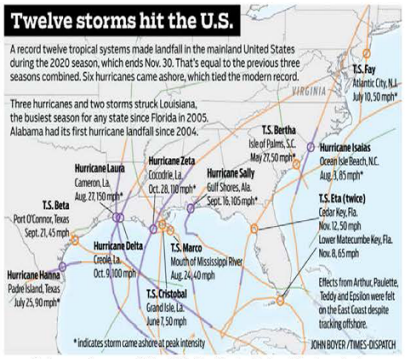
- 5th consecutive above-normal season and the second year ever to exhaust hurricane names in the alphabet, with meteorologists resorting to Greek letters.
- 30 named storms, a new record high overtaking the 28 named storms that occurred in 2005
- Record 12 named storms made U.S. landfall, overtaking the prior record of 9 set back in 1916.
- Of those making landfall, 9 struck the Gulf coast also shattering a previous record.

AccuWeather estimated the 2020 Atlantic hurricane season resulted in $60-65 billion in U.S. damages/economic losses[iv], with one analyst projecting losses could reach $100 billion, which would place 2020 in the top 5 costliest hurricane seasons on record.[v]

In mid-September Hurricane Sally created more flooding than wind damage, impacting Florida and Alabama in particular. AccuWeather estimates damages/economic losses range between $8 to $10 billion[vi]. According to AM Best[vii] more than two-thirds of the flood insurance in Alabama is in the federal program, though some insurers have significant exposure to private flood.

In Louisiana residents and business owners continue to cleanup following a record five hurricanes to hit the state in 2020, including Hurricanes Laura and Delta both striking the Lake Charles area only 6 weeks apart. With sustained winds of 150 mph, Hurricane Laura was the fifth strongest storm ever to make landfall in the U.S. and tied for the most powerful storm ever to hit the state, resulting in 42 deaths and over 400,000 structures damaged or destroyed. AccuWeather estimates Hurricane Laura resulted in $25-30 billion in damages/economic losses[viii] though noted, while Laura was a stronger storm that continued to intensify until it made landfall, damages were well below the $125 billion in losses sustained from Hurricane Katrina which struck densely populated New Orleans in 2005.

Texas narrowly avoided landfall from Hurricane Laura which tracked east of the state, though did sustain damage from Hurricane Hanna and Tropical Storm Beta, along with severe weather and hail earlier in the year.



Data source for maps: National Weather Service, National Hurricane Center

Following multiple above average hurricane seasons in recent years, pressure has continued to build in coastal property insurance markets, with growing concerns for state residual plans. Regional carriers in Florida had already begun to retreat prior to the start of hurricane season, following reduced levels of capital and steep rate increases from reinsurers, in some cases up to 30-35 percent, while double digit rate increases have become a trend throughout the year among many other private-market insurers. According to a recent Sun Sentinel article, Citizens, the state's residual pool, is no longer the "insurer of last resort, but the insurer of first resort" as the carrier struggles to increase rates, resulting in rates 10-40 percent below private-market insurers. Citizen's policy count has swelled 100,000 policies in 2020 to now 532,000, with heavy concentrations in south Florida[ix]. A recent Tampa Bay Times article highlighted a Florida State University study released in November which suggests "the insurance market stability may be wavering" and further indicated portfolios of many carriers in the state are heavily concentrated

in the Florida market, and "the lack of diversity of these insurers in combination with their significant market share could lead to serious market disruptions if a major loss were to occur. "[x]

The Texas Windstorm Insurance Association (TWIA) voted late in 2020 to file a +5 percent rate increase, well below the +26 percent indication compiled by Willis Towers Watson for residential coverage. TWIA has been slow to respond to rate need in recent years as opponents have indicated it would be unfair to coastal residents still recovering from the effects of Hurricane Harvey which devastated the state in 2017, with TWIA instead opting to pass on higher assessments to member companies.

*Severe Storms*

In the Midwest, the deadliest tornado outbreak since 2014 occurred in April as over 140 tornadoes touched down between Texas and Maryland. Tennessee was particularly impacted in 2020 as 35 tornadoes struck the state killing 28, including an EF-3 tornado that carved a path of destruction through densely populated Nashville in March, the 6th costliest tornado in U.S. history resulting in $1.4 billion in damage/economic losses.[xi]

In August multiple states suffered widespread devastation when a major derecho event (a 'land hurricane') unleashed 110-140 mph winds across eastern Nebraska, Iowa, Illinois, Wisconsin, and Indiana. Homes, businesses, and crops suffered $7.5 billion in damages, with the most severe impacts devastating Cedar Rapids, Iowa and surrounding areas. According to NOAA it was the costliest single-day thunderstorm event to strike the U.S. since 1980.[xii]



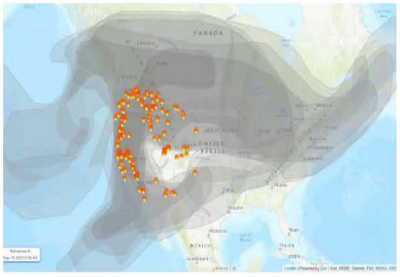
*Wildfires*

Further west, 2020 proved to be another record-breaking wildfire season as most western states experienced extreme fires leading to substantial human, property and economic losses. RMS estimates insured losses will fall between $7-13 billion from this year's wildfires[xiii]. Highlights and records from the 2020 season include:

- Most severe on record based on acreage with 10.3 million acres burned
- Colorado: three of its four largest wildfires on record, resulting in almost 1,000 structures lost
- Oregon and Washington: experienced double the 10-year average for acres burned, resulting in 6,000 structures lost
- California: five of the six largest fires on record, including 4.3 million acres burned shattering a recent high of 1.9 million acres in 2018, leading to 31 deaths and 10,000 structures lost

California also experienced the state's first ever 'Gigafire' where a single fire resulted in more than 1 million acres burned. Only three other Gigafire events have occurred in recent history, including two brush fires in Australia earlier this year that combined to burn 1.5 million acres, the 2004 Taylor Complex fire in Alaska which burned 1.3 million acres, and the 1998 Yellowstone fire in Montana and Idaho which burned 1.58 million acres.[xiv]

By mid-September drift smoke from wildfires had "covered almost the entirety of the Lower 48, even reaching D.C.", darkening skies to an ominous red and exposing millions to hazardous levels of air pollution.[xv] Losses due to smoke damage and evacuations were significant, contributing to approximately 20 percent of losses in California and Colorado, and 35 percent in Oregon and Washington.[xvi]



Smoke extent from fires in the Lower 48. Large wildfires are also shown. (AirNow)

Reminiscent of Florida's experience with hurricane related property damage in the 1990's, which following Hurricane Andrew in 1992 resulted in numerous insurers becoming insolvent and a mass exodus, the California residential property insurance market has deteriorated to crisis levels following multiple years of record-breaking wildfires, leading the California Department of Insurance (CDI) to issue mandatory non-renewal moratoriums in 2019 and 2020. The CDI acted as more insurance carriers looking to manage their risk exposure increasingly withdrew from high-risk areas of the state, issuing non-renewals and forcing homeowners to seek coverage in the state's residual market, the CA FAIR plan. In November, the CDI issued its latest order placing 2.4 million homeowners under moratorium (almost 20 percent of homeowners in the state) as more than 4 million acres burned, over 4% of the state's acres of land. The FAIR plan recently approved a +15 percent rate increase, with another +15 percent filed to try and keep up with the swell of policies, increased losses and exposures.

## GROWTH IN HIGH-RISK AREAS AND CLIMATE CHANGE

As records continue to break and losses accrue from weather-related disasters, insurers and other stakeholders across the industry are looking to understand the various factors contributing to increasing losses year after year. Two main themes have consistently emerged as leading contributors: population growth in hazard-prone areas such as the Gulf Coast and the Wildland Urban Interface (WUI), and escalating frequency and severity of weather-related disasters due to climate change. (Weather-related

disasters include floods, hurricanes, tropical storms, tornados, wildfires, droughts, winter storms, and extreme temperatures.}[xvii]

*The Wildland Urban Interface*

A recent CoreLogic year-end presentation on the 2020 wildfire season highlighted data from the U.S. Forest Service which indicated the WUI "grew rapidly from 1990 to 2010, with increases of 41 percent in homes and 33 percent in land, making it the fastest growing land use type in the lower 48 states.". The WUI is an area where population centers are built directly adjacent to or among wildlands. As open space that previously separated wildlands and communities continues to shrink, the wildfires that naturally burn in the wildlands will more often spread into populated areas.

This can be seen in a map comparing rural, mountain areas west of Boulder, Colorado in 1990 vs 2010. Extensive community development (shaded area) in and around Rocky Mountain National Park and the Arapahoe National Forest have put homes directly in the path of wildfires, as was the case with the Cameron Peak fire this year, which started in wildlands, but high winds carried embers and flames into residential areas destroying over 400 structures.


Source: CoreLogic / U.S. Forest Service

A similar story has repeatedly unfolded in California in recent years, as the high cost of living in coastal areas has resulted in extensive housing developments in lower cost areas of the state, including the WUI, putting thousands of homeowners at risk each year. Major wildfires in 2017 and 2018 were sparked by poorly maintained electrical equipment in rural areas during high wind events which carried embers miles ahead, quickly overrunning residential communities. In 2020 a widespread dry lightning event simultaneously sparked hundreds, if not thousands of wildfires in rural areas throughout northern California, and led to the evacuation of tens of thousands in nearby residential areas. When seasonal high winds picked up, fires not yet contained quickly accelerated and were pushed into residential communities, once again tragically resulting in signficant loss of life and property.

CoreLogic has noted they are observing more wind events occurring outside the normal windy season, including Santa Ana winds in southern California and Diablo winds in northern California. Extreme duration and wind intensity coupled with longer duration and larger areas of drought is translating to longer and more catastrophic fire seasons in western states. (Western states include: Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming)

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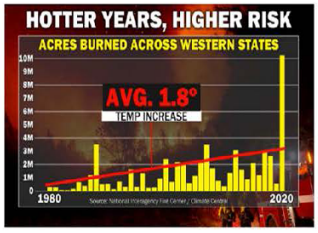
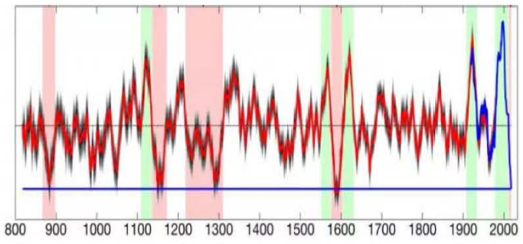



*Climate Change*

In early 2020 the Journal of Science released a study done by Columbia University suggesting the western U.S. is in the midst of a 'megadrought'. Included in their analysis was 1,200 years of soil moisture data and tree ring data, which helped identify periods of drought and periods of higher rainfall. Going back 1,200 years their findings indicate there have been 4 megadroughts, prior to the current megadrought which began as early as 2000.

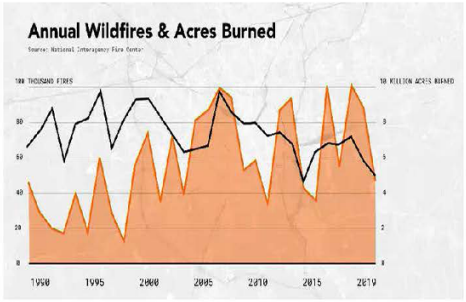



1,200 years of soil moisture data used in the study. The red fluctuating lines indicate tree ring data, while the blue are from modern records. Red-shaded areas indicate droughts, while green indicates higher rainfall. The bottom blue line represents the mean from 2000-2018.

A News Atlas article highlighted "the most interesting aspect of the study is the role that climate change is playing. The current drought seems to be affecting a wider area more consistently than the earlier events, which is a hallmark of climate change." It went on to note "climate change has created higher underlying temperatures".[xviii]

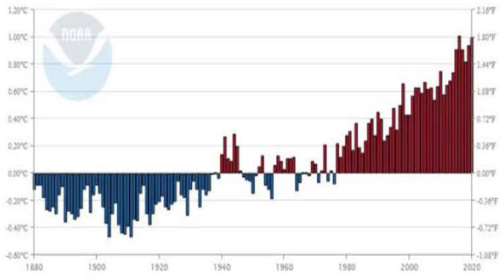
This is echoed by a Federal National Climate Assessment made in 2018, which indicated climate change has intensified the severe drought in California and is worsening drought in the Colorado River Basin. Part of the reason for this is that climate change makes such droughts hotter than they might've been just a few decades ago, which draws more moisture out of soils and vegetation, thereby worsening the drought in a positive feedback loop. The report stated "higher temperatures sharply increase the risk of megadroughts — dry periods lasting 10 years or more".[xix]

These impacts from drought and climate change are leading to fires burning hotter and an increasing number of acres burned each year in the west, in spite of fewer annual wildfires.[xx]




Data reflect wildland fires and acres burned nationwide, including wildland fires on federal and nonfederal lands

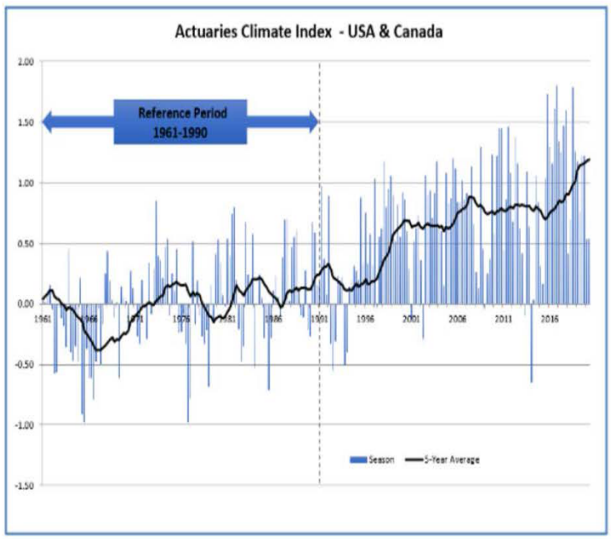
The U.N.'s World Meteorological Organization (WMO) released its State of the Global Climate 2020 report wherein it indicated "climate change continued its relentless march in 2020," with 2020 on track to be one of three warmest years globally on record. A climate scientist at UCLA indicated all of the lower 48 states had above-average temperatures this year and further suggested "there's a very good chance" 2020 may overtake 2016 to become the hottest year on record, which would be "absolutely stunning" considering the strong La Niña event currently in the Pacific Ocean.[xxi]




Global Land and Ocean January-through-November Temperature Anomalies

The U.N. report drew attention to the emergence of widespread and systemic ocean heat waves, noting 80 percent of the world's oceans experienced heat waves in 2020, with nearly 50 percent of those considered strong. Ocean heat waves form as they store over 90 percent of the excess heat that becomes trapped by increasing atmospheric greenhouse gases. This heat can linger in the oceans for generations, affecting marine ecosystems and impacting the climate. The U.N. report noted this to be the case in 2020, where North Atlantic temperatures remained above normal throughout the hurricane season and excess heat in the Western Caribbean fueled strong storms through the late fall, resulting in the record-breaking Atlantic hurricane season.[xxii] Climate models indicate rapid intensification of hurricanes will increase as average temperatures rise. NOAA defines rapid intensification as a gain of 35 mph or more in wind speed over 24 hours, as was seen with Hurricane Laura which quickly grew from Category 2 to Category 4 strength over several hours, just prior to making landfall in Louisiana.[xxiii]

These trends have also been reflected in the Actuaries Climate Index – USA & Canada, which includes a seasonal 5-year moving average, and "presents a composite measure of long-term changes across an array of observed weather extremes and sea levels in the two countries." Key findings note the index "has steadily climbed from its most recent low of 0.70 in 2015 to a new high of 1.19 for the moving average in spring 2020. The measurements of extreme climate conditions tracked by the index—high and low temperatures, heavy rain, drought, high wind, and sea level—continue to move away from zero, which was the baseline for the index reference period of 1961 to 1990." These observations underscore the increasing "frequency of extreme climate conditions over recent decades."[xxiv]




## LOOKING AHEAD

The increased frequency of severe storms in 2020 has had widespread and devastating impacts across the U.S., and when coupled with the effects of COVID have led to skyrocketing costs to rebuild homes and businesses. The National Association of Home Builders reported over the summer of 2020 lumber costs for building a single-family home increased by 70 percent, and commercial construction contractors identified wood/lumber to be the most reported material shortage, with increasing concerns on the fluctuating cost of steel.[xxv] "U.S. manufacturing output dropped by the most in just over 74 years in March as the novel coronavirus pandemic fractured supply chains".[xxvi] This impacted many "manufactured products that go into construction of a new building: Concrete, steel, doors, windows, roofing, siding, wallboard, lighting, heating systems, wire, plumbing fixtures, pipe, valves, cabinets, appliances, etc." In the spring the U.S. steel industry was noted to be "in the most severe

downturn since 2008, as steelmakers cut back production to match a sharp collapse in demand and shed workers. Capacity Utilization dropped from 82% to 56% in April." In mid-August CapU had only risen to 61%, well below 2019 capacity,[xxvii] and by year-end, U.S. factories remain 5% below pre-pandemic levels, with aluminum and steel production levels still down -8.1% and -18%, respectively.[xxviii]

CoreLogic estimated overall year-over-year construction costs through Q3 2020 have risen +4.1 percent for materials, heavily driven by lumber, and +3.0 percent for labor costs, noting a +4.6 percent in roofing costs, the highest increase.


This was a sharp reverse course from Q4 2019 year-over-year construction costs, when CoreLogic noted very moderate cost trends, including -0.6% materials and 0.7% labor for commercial, and 1.0% materials and 0.9% labor for residential markets. Steel, copper, and aluminum prices were also noted at the time to have bottomed out and stabilized at the end of 2019.[xxix]

As a result, and as noted earlier, residential and commercial catastrophe-prone markets continued to harden in 2020 as insurers and reinsurers respond to increasing costs. Willis Towers Watson (WTW) found aggregate price changes reported by commercial property carriers was near 10 percent for the second consecutive quarter (Q3'20 vs Q3'19).[xxx] In some commercial markets in the west, businesses have been forced to seek coverage through surplus lines as securing insurance coverage amidst growing wildfire risk has become more complex.[xxxi] The latest market update from USI Insurance Services suggests the commercial market is in the 'most challenging and sustained' hard market since the 1980s and will persist well into 2021[xxxii].

A recent Artemis report echoed this as analysts at Morgan Stanley indicate reinsurance pricing momentum is forecast to continue throughout the 2021 renewal seasons, with rises of 5 percent to 6 percent expected across the key upcoming January renewals.[xxxiii] A report by Howden Broking Group Ltd went further to state global property-catastrophe reinsurance rates on-line rose 6% at the Jan. 1 renewals, the "biggest year-over-year increase in over a decade". However, Howden specifically noted increases "were led by North American programs, where there were average rate-on-line increases of 8.5%." Rate increases reflected "record activity" in the 2020 North Atlantic hurricane season, "another year of devastating wildfires" on the U.S. Pacific Coast and the "unusually severe" derecho in the U.S. Midwest.[xxxiv] Willis Re noted catastrophe exposed loss hit accounts in the U.S saw the greatest increases, ranging from 10% to 25%, while catastrophe exposed loss free risks and non-catastrophe accounts with losses saw increases of 5% to 15% and 5% to 20%, respectively.[xxxv]

Lastly, investment income will offer minimal to no relief as returns are expected to remain depressed after the Federal Reserve left its benchmark interest rate at near-zero level in December, with the federal funds benchmark also expected to remain effectively at zero percent through 2023.[xxxvi]

**MITIGATION A CRITICAL PRIORITY**

With climate change impacts showing no signs of easing, the industry has placed a substantial focus on mitigating future loss costs to ensure the private insurance market remains well positioned to provide coverage. 2020 has underscored the need for public and private stakeholders across the industry to work together to make communities more resilient, to withstand increasingly frequent and severe catastrophic events. This should include better community planning, increased fuels management and higher building code standards in catastrophe-prone areas, as well as hardening existing homes including supporting programs that promote community-wide adoption of hazard-resistant building codes such as 'Community Rating Systems'.

In November, FEMA released a report titled, "Building Codes Save: A National Study". The study shows that modern building codes lead to major reductions in property losses from natural disasters and focused on three dominant natural hazards in the United States: floods, hurricane winds and earthquakes. The International Code Council shared the following of the study.

> FEMA reported that if all new construction adhered to modern building codes, the nation would save more $600 billion by 2060. Per the Agency's summary: "Adopting building codes is the single most effective thing we can do! One change in building codes can save lives and protect property for generations to come."

The main report includes state level loss avoidance data, with appendices providing loss avoidance data county by county. The ICC went on to highlight the following from the study:

- The International Residential Code (IRC) and International Building Code (IBC) provided more than $27 billion in cumulative mitigation benefits against flood, hurricane wind, and earthquake hazards from 2000 to 2016. These benefits could have been doubled if all post 2000 construction adhered to these codes.
- The IBC and IRC could help communities avoid $132 billion to $171 billion in cumulative losses through 2040.
- 65 percent of local governments across the U.S. have not adopted modern building codes and 30 percent of new construction is occurring in communities with no codes at all or codes that were not developed this century. To realize that $600 billion in savings, these communities would need to adopt and implement modern codes.

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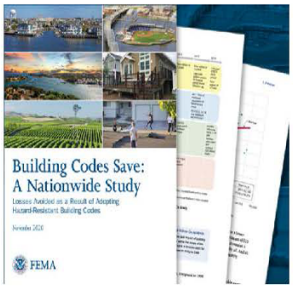


For more information, here is a link to FEMA's main page for the study and ICC's joint release with FLASH and the Insurance Institute of Building and Home Safety (IBHS).

2020 also saw the rollout of FEMA's Building Resilient Infrastructure and Communities (BRIC) program. The program began accepting grant applications to support state and local mitigation projects and provides consistent funding from the Federal Government for pre-disaster mitigation projects. The new funding regime reflects a growing commitment to long-term mitigation efforts and cost savings at the national level.

Combating climate change is also expected to be a top priority in the incoming administration and congress. Reports suggest a green infrastructure package may be submitted within Biden's first 100 days in office and may potentially include investments to help weatherize two million homes and retrofit buildings.[xxxvii]


IBHS also continued their scientific research in 2020, on behalf of the insurance industry to help policyholders and the public identify, reduce, and manage risk. IBHS released their 2020 Standards for FORTIFIED Home, which provides scientifically tested construction methods to strengthen a home

against hurricanes, high winds and hail. The latest standards and corresponding guide can be used by homeowners affected by 2020 hurricanes and severe storms, to rebuild a stronger, more resilient home. IBHS notes on their website the US Small Business Association (SBA) offers disaster assistance in the form of low-interest loans to homeowners, renters, and business owners in regions affected by declared disasters, to cover repairs and replacement of physical assets damaged in a declared disaster. Further, to protect against future storm damage, SBA will loan an additional 20% to property owners choosing to upgrade to the FORTIFIED standard, which often may require upgrades from common building codes.

Also, in partnership with RMS, NAIC and IBHS, The Center for Insurance Policy and Research (CIPR) released a white paper in November focused on increasing survivability in a wildfire, titled 'Application of Wildfire Mitigation to Insured Property Exposure'.[xxviii] This study explored the economic benefits of wildfire resilience strategies in nine communities in California, Colorado and Oregon, and included the following key findings:

- Historical wildfire claims data is not sufficient to promote risk reduction. Catastrophe models are a critically important tool for calculating the cost/benefit for wildfire risk reduction actions.
- Wildfire risk can be managed. Implementation of structural and vegetation modifications can reduce the risk from wildfires by up to 78 percent. Losses avoided can be even more significant (e.g., five times higher) when comparing a highly flammable structure to a well-built one.
- Twenty years of building science research from organizations like IBHS, National Institute of Standards and Technology (NIST), and others demonstrate that insurance companies could adopt risk reduction strategies instead of withdrawal strategies.

A growing body of evidence suggests mitigation provides a strong long-term solution to reduce future losses. However, in the near term as carriers seek to address current pressure on loss ratios through rate adjustments, insurers will continue to face regulatory challenges into 2021 as regulators respond to increasing concerns of insurance affordability and availability. In New York, the Superintendent of Financial Services, Linda Lacewell, recently outlined her department's expectations in a letter to all domestic and foreign insurers operating in the state. She stated insurance carriers should "start integrating the consideration of the financial risks from climate change into their governance frameworks, risk management processes and business strategies." This includes developing an approach to climate-related financial disclosures. Politico noted the move is the latest signal that regulators around the world are ramping up efforts to police financial firms for climate risks.[xxix] Lacewell wrote, "Mitigating the financial risks from climate change is a critical component of creating a stronger industry and a healthier and safer world for ourselves, our families, and future generations. There is no more time to wait."

In conclusion, 2020 proved to be another challenging year for property insurance carriers, and the outlook indicates these trends will continue in 2021. FEMA's study affirmed recent findings by the National Institute of Building Sciences that every $1 spent on natural hazard mitigation in new code construction can save $11 in disaster repair and recovery costs. As climate change will continue to present increasing threats to an already challenged property insurance market, building resilient communities to mitigate future losses must become a critical priority for the insurance industry and all other key stakeholders in 2021 and beyond.

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**STATEMENT OF THE SBP**

**Written statement for the record for the hearing titled**

## "21st Century Communities: Climate Change, Resilience, and Reinsurance"

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**United States Senate Committee on Banking, Housing, and Urban Affairs**
**July 20, 2021**

**Prepared by: Reese May, Chief Strategy and Innovation Officer, SBP**

SBP submits this testimony for the record and in support of Member and witness remarks. We thank the Committee for its leadership in discussing the pressing climate risk and adaptation issues facing American communities and we thank the witnesses for their expert opinions on what can be done to better prepare and protect American communities today and in the future.

Our organization, SBP, has rebuilt homes for nearly 4,000 low to moderate income disaster survivors dating back to Katrina. We know first-hand the value of resilience - especially when it is absent. After major disasters our country's most vulnerable homeowners-- often low to moderate income families in predominantly black and brown communities-- are the least able to rebuild their homes and lives. Low-income communities have some of the greatest risk exposure and, by definition, lack access to financial resources to insure and make homes more resilient against disaster perils. Before disasters, there are no available financing mechanisms to make resilient home upgrades or protect against perils. After disasters, residents are not well-positioned to navigate a complex and unpredictable pathway to FEMA and other aid, which routinely pales in comparison to enduring community needs, especially for low-income communities and communities of color.

In our view, the work of this Committee and today's witnesses is critically important to 1) correcting problematic patterns that have followed federal resilience and recovery investment in the past, and 2) ensuring forthcoming resilience investment reaches the communities where it is needed the most.

Problematic Past

A recent Rice University study highlights what SBP has witnessed in many recovering communities-- where federal recovery investment flows, white families increase their net worth

while Black and Brown families' net worth is reduced over the same period[1]. This disturbing fact was acknowledged in FEMA's 2020 National Advisory Committee report. Most upsetting of all is the direct connection between (rapidly increasing) risks and previously redlined communities. Black and Brown communities have often been forced into riskier and less desirable areas via racist housing development policies and practices[2]. These communities now face increasing risks and insurance costs through no fault of their own. We must address these issues head-on to ensure that insurance products (especially NFIP flood insurance policies) remain affordable for the most vulnerable.

SBP is highly supportive of the Reinsurance Association of America's proposed Community Disaster Resilience Zones (CDRZ) and the legislative proposals that accompany Mr. Nutter's testimony. Relying on Federal data - like the National Risk Index - to identify and direct resilience investment to areas of high and persistent poverty where both risk and social vulnerability are high. This approach will drive better protection and greater resilience for low-income communities in a data supported way that will simultaneously enhance state and local governments' ability to make clearer and more deliberate resilient and mitigation investments.

SBP is also supportive of a transferable resilience tax credit. The NIBS study has shown that proper mitigation investment can save up to $13 in loss/impact per $1 invested[3]. Recent legislation like the SHELTER act and other bills have introduced the notion of resilience tax credits. However, SHELTER and other tax credit proposals lack the component of transferability and thus deny the potential for such investment in communities where protection is needed the most. Without the ability to transfer the credit, the only citizens who can potentially benefit from the credit are those who have funds upfront to make the upgrades to their homes and have sufficient tax liability against which to use the credit. By introducing transferability, credits can be transferred to socially and financially aligned investors and vendors that work together to finance and conduct resilience upgrades in low-income areas where investment is needed most.

Again, we thank the committee for its leadership on these issues. We welcome any opportunity to work with Committee Members and staff to expound upon these and other critical disaster preparedness and recovery issues that pose significant challenges for American communities.

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