

**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.

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.nwccg.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>

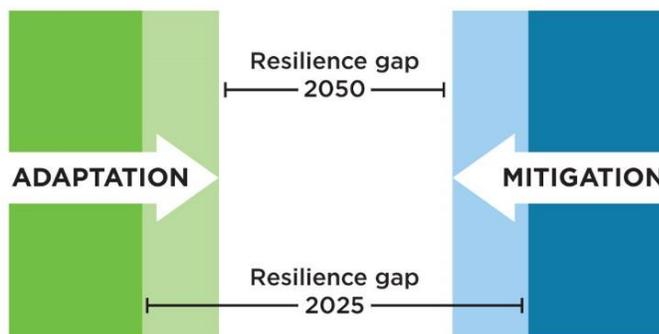
⁵ <https://www.noaa.gov/news/northern-hemisphere-just-had-its-hottest-summer-on-record>

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



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.

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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

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>. NIFC 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.

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>

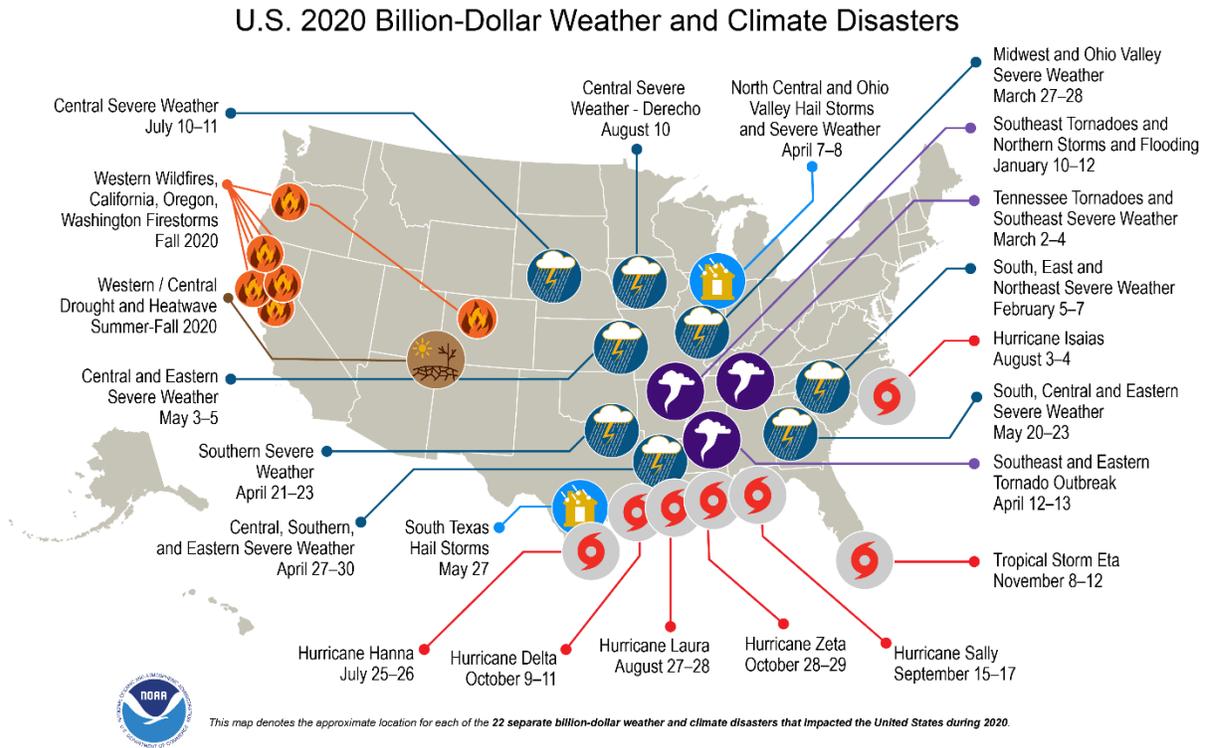
²⁷ <https://blog.ucsusa.org/adrienne-hollis/african-americans-are-disproportionately-exposed-to-extreme-heat>

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](https://doi.org/10.25921/stkw-7w73)

³⁰ <https://www.ncdc.noaa.gov/billions/>

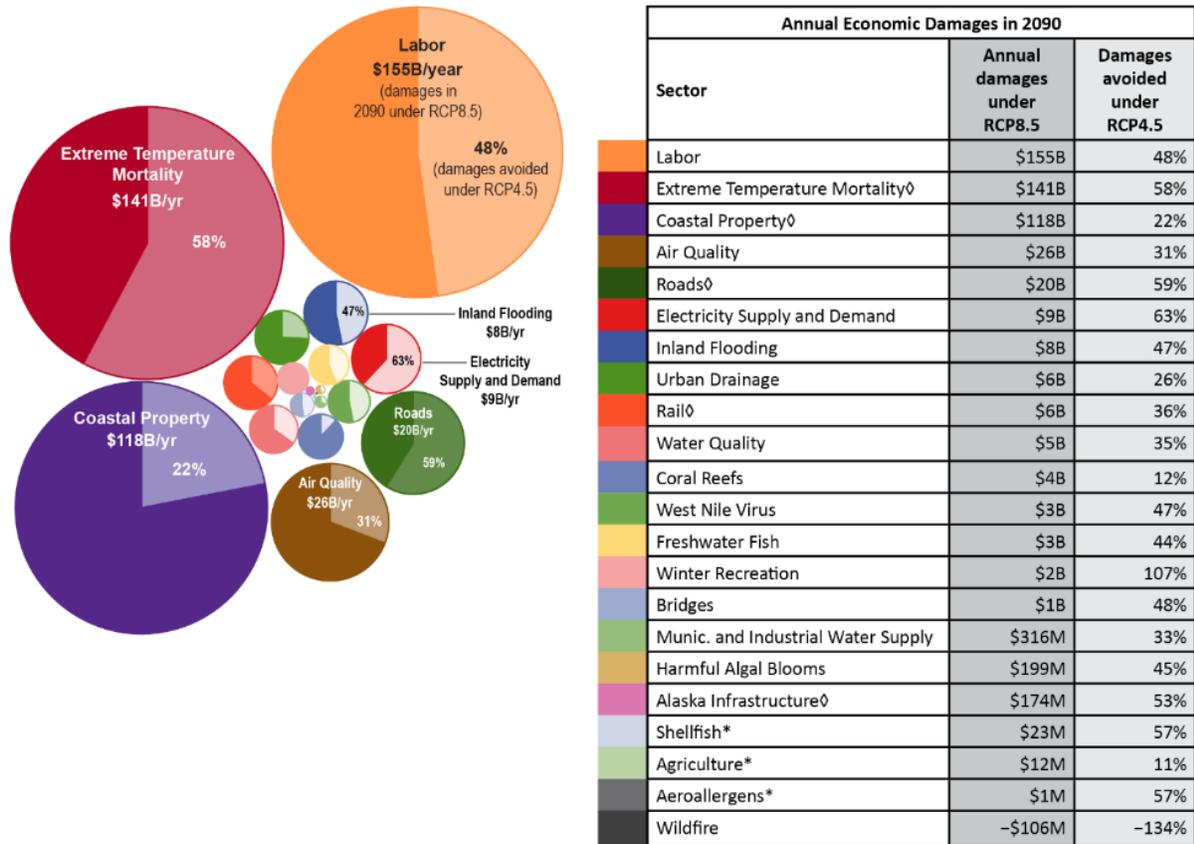
Figure 2: U.S. 2020 Billion-Dollar Weather and Climate Disasters



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



Source: Fourth National Climate Assessment,³¹ adapted from EPA 2017³²

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 SEC³⁵ 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 Bank³⁷ 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.

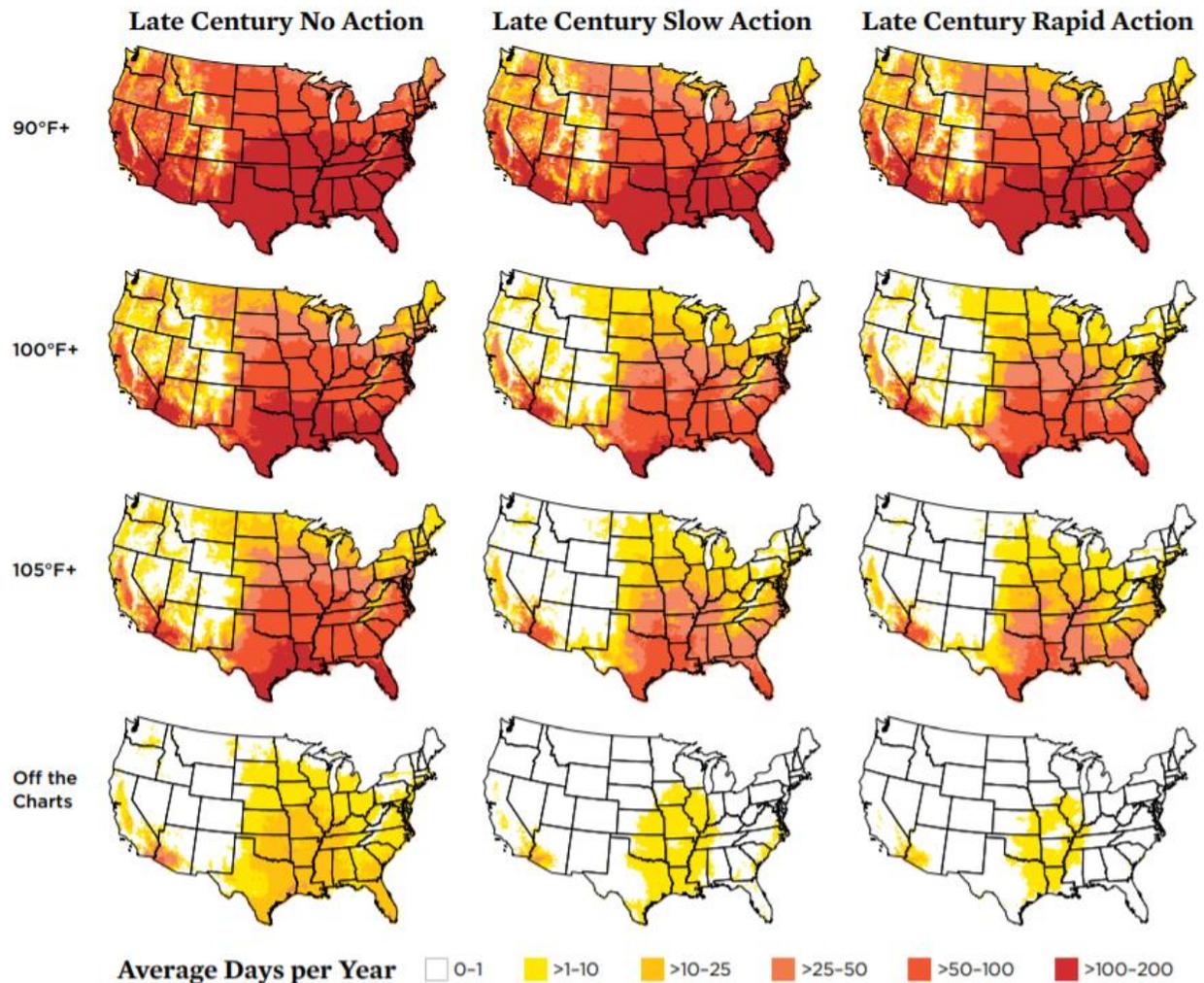
Table 1: Extreme heat will become more severe and frequent in every region of the country

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



Installations Experiencing Heat Index >100°F

- More than 30 Days per Year, by Midcentury
- ◉ More than 30 Days per Year, Historically
- Fewer than 30 Days per Year, by Midcentury

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:

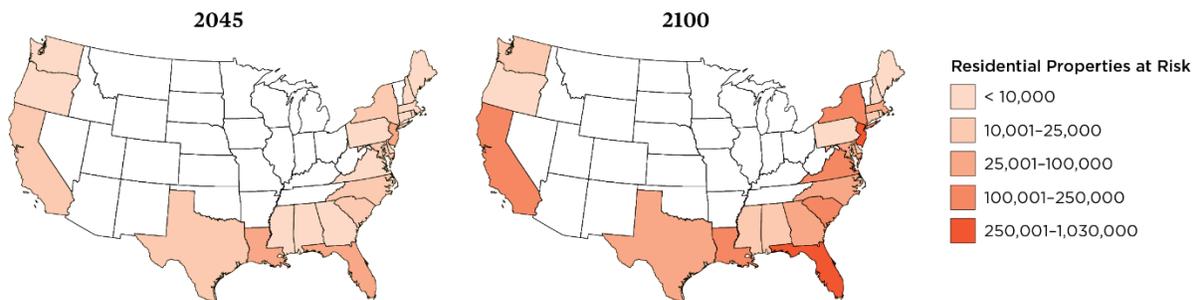
UCS research on the impacts of sea level rise to coastal communities shows that long before rising seas permanently submerge properties, millions of Americans living in coastal communities will face more frequent and disruptive high-tide flooding. By the end of the century, under a high sea level rise 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).

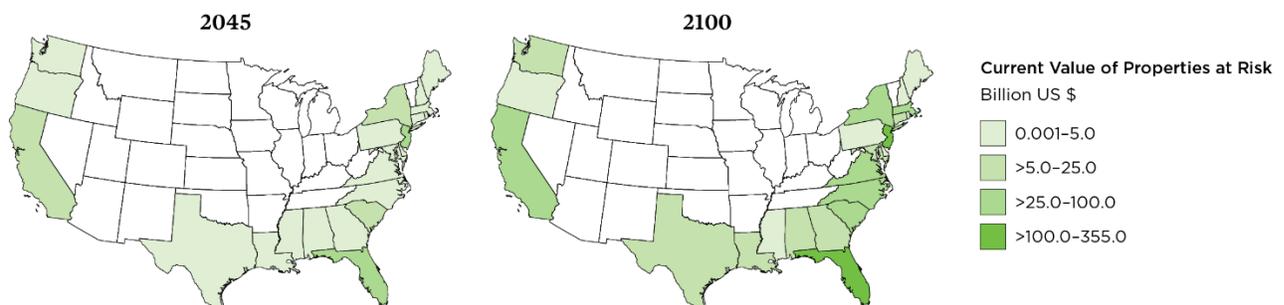
Every coastal state faces this risk to some extent, with Florida, New Jersey, New York, California, Louisiana and South Carolina among the most exposed.⁴⁶ Louisiana, North Carolina, New Jersey, and Maryland also have significant numbers of highly exposed communities with above-average rates of poverty, 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:

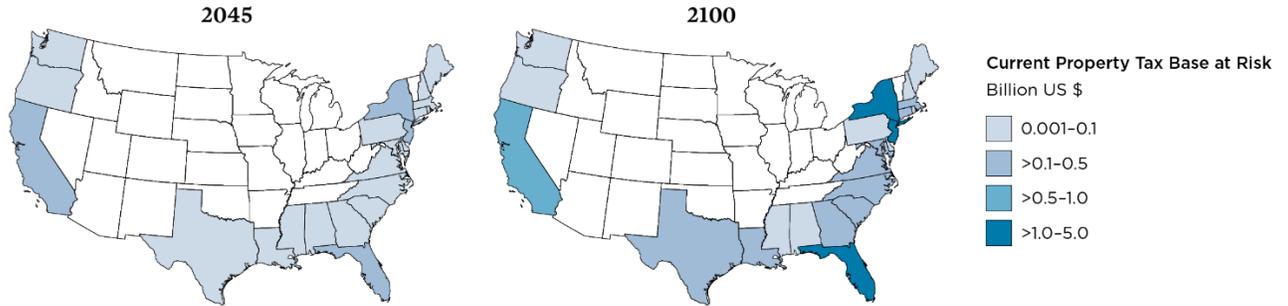
<https://www.ucsusa.org/sites/default/files/attach/2018/06/underwater-analysis-full-report.pdf> and
<https://www.ucsusa.org/sites/default/files/attach/2018/06/underwater-analysis-technical-background.pdf>

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>

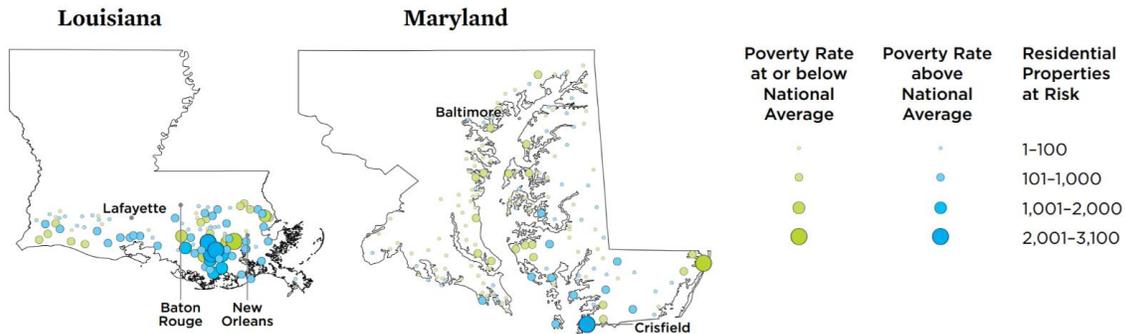
Figure 8: Property tax base at risk from chronic inundation



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).

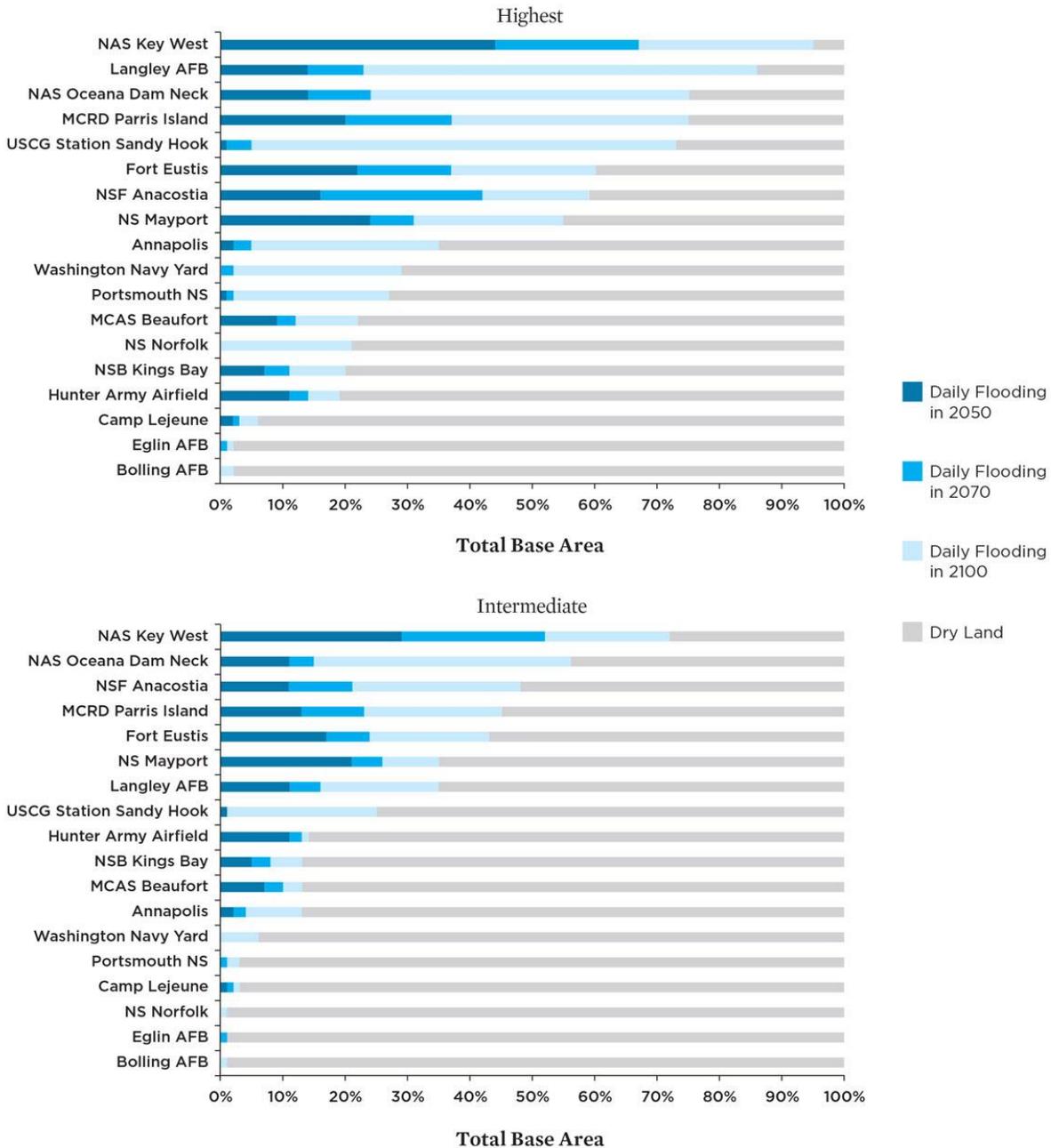
⁴⁹ <https://www.corelogic.com/press-releases/insights/wildfires-threaten-the-west-nearly-2-million-homes-at-elevated-risk-of-wildfire-damage-according-to-corelogic/>

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

Land Loss across Bases



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.

© Union of Concerned Scientists 2016; www.ucsusa.org/MilitarySeasRising

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

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 change⁶²—exact 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>

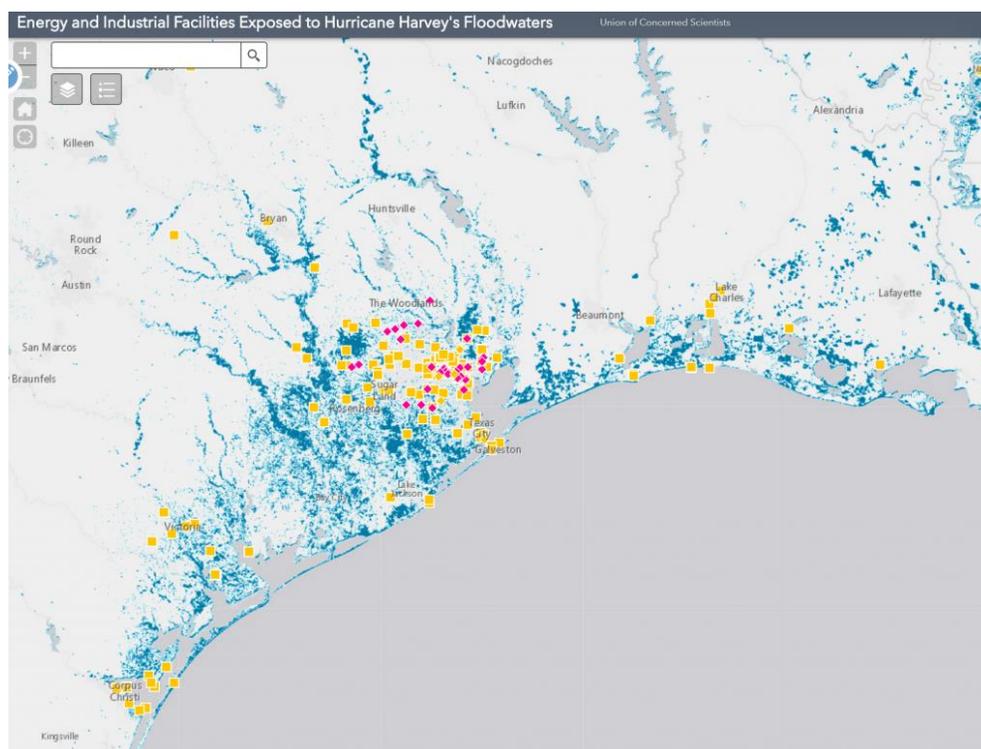
⁶¹ <https://medialibrary.climatecentral.org/resources/urban-heat-islands>

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, Issue 24](#) 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.

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 wealth³¹ 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.

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 Commission⁸¹ and the Federal Housing Finance Agency⁸² 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/jy0269>

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=.](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?RFID=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 ⁸⁶Much 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

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 solutions⁸⁹—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 deceiving⁹¹ the public and shareholders⁹² 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

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

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.

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 Policies <https://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/>