

UNCOVERING THE ECONOMIC COSTS OF CLIMATE CHANGE



**Senate Budget Committee Staff Report
December 2024**

Executive Summary

Over 19 Committee hearings during the 118th Congress, the Senate Budget Committee heard from a range of experts about the looming economic, financial, and budgetary risks of climate change. Across multiple witnesses and topics, the message from economists, central bankers, actuaries, insurance industry analysts, scientists, health care providers, farmers, academics, state and local government leaders, national security experts, and even conservative political leaders was consistent: **climate change poses dangerous risks to the economy and the financial system**, and is already imposing substantial costs on American families and on the federal budget.

Economic damages from climate change are already occurring. As families, communities, local and state governments, and the federal budget all face this costly reality, it is no longer a question of whether, but of how bad. Damage from climate change does not discriminate by political party—costs are mounting in red, blue, and purple communities alike, and news reports day after day confirm the warnings of our hearings.¹

¹ See, e.g., Bloomberg, *Mississippi River dries up again at worst time for US farmers* (Oct. 28, 2024) (online at <https://subscriber.politicopro.com/article/eenews/2024/10/28/mississippi-river-dries-up-again-at-worst-time-for-us-farmers-00185519>); Andrew Freedman, *The era of "climateflation" is here, study shows*, Axios (Mar. 25, 2024) (online at <https://www.axios.com/2024/03/25/climate-change-inflation>); Noah Weiland, *Heat-Related E.R. Visits Rose in 2023, C.D.C. Study Finds*, New York Times (Apr. 18, 2024) (online at <https://www.nytimes.com/2024/04/18/us/politics/extreme-heat-hospital-visits-climate.html>); Giulia Carbonaro, *Florida Insurance Warning Issued as Fears Grow of Collapse*, Newsweek (Jul. 9, 2024) (online at <https://www.newsweek.com/florida-insurance-warning-issued-fears-grow-collapse-1922596>); Eliza Relman, *Montana's housing crisis is a warning for older homeowners across the country*, Business Insider (Jul. 10, 2024) (online at <https://www.businessinsider.com/home-prices-montana-retired-boomer-homeowners-losing-houses-insurance-taxes-2024-7>); Bloomberg, *Giant Hail Is the Weather Threat Keeping Insurers Up at Night* (May 20, 2024) (online at <https://www.bloomberg.com/graphics/2024-hail-storm-damage-insurance/>); Madison Iszler, *Texas Insurers hike rates as extreme storms like Beryl proliferate—and fatter profits are forecast*, San Antonio Express News (Jul. 15, 2024) (online at <https://www.expressnews.com/business/article/texas-insurance-rates-storms-increase-19569519.php>); Megan Fan Munce, *State Farm projects massive decline in policies in California as it faces financial instability*, San Francisco Chronicle (Sep 25, 2024) (online at <https://www.sfchronicle.com/california/article/state-farm-insurance-19792469.php>); John Cassidy, *The Home-Insurance Crisis That Won't End After Hurricane Season*, The New Yorker (Oct 14, 2024) (online at <https://www.newyorker.com/news/the-financial-page/the-home-insurance-crisis-that-wont-end-after-hurricane-season>); Patrick Cooley, *They Grow Your Berries and Peaches, but Often Lack One Item: Insurance*, New York Times (Mar. 27, 2024) (online at <https://www.nytimes.com/2024/03/27/business/economy/crop-insurance-climate-change.html>); Laura M., *Billions at stake for resort towns as US ski season shrinks*, TownLift (Apr. 2, 2024) (online at <https://townlift.com/2024/04/billions-at-stake-for-resort-towns-as-us-ski-seasons-shrink/>); Daniel

Witnesses repeatedly warned the Committee of systemic risks that threaten the entire economy. In particular, climate change is upending insurance markets, likely cascading into a crash in property values. The Committee heard testimony that more than \$1 trillion in coastal real estate could become uninsurable—and therefore unmortgageable. More frequent and severe wildfires signal a similar death spiral in the wildland-urban interface. Major insurers are raising rates and pulling out of states on the front lines of climate risk, resulting in substantial hardship for families. Since the Committee first held hearings on this topic, turmoil in insurance markets has only grown worse as availability declines and premiums increase. States such as Florida, Louisiana, and California—with high exposure to climate-related risks—are currently experiencing the worst of this insurability crisis, but it is spreading across much of the country.

Climate change also threatens global agriculture and supply chains, increasing prices for businesses and consumers. Supply chains support almost \$20 trillion each year in global trade and are foundational to the U.S. economy, yet few thought about them until the

Cusick, *Add sand, lose sand, repeat. The climate conundrum for beaches*, Politico Pro (Apr. 15, 2024) (online at <https://subscriber.politicopro.com/article/eenews/2024/04/15/add-sand-lose-sand-repeat-the-climate-conundrum-for-beaches-00146994>); The Economist, *Homeowners face a \$25trn bill from climate change* (Apr. 11, 2024) (online at <https://www.economist.com/briefing/2024/04/11/homeowners-face-a-25trn-bill-from-climate-change>); Adrien Bilal & Diego R. Känzig, *The Macroeconomic Impact of Climate Change: Global vs. Local Temperature*, National Bureau of Economic Research (Nov. 2024) (online at <https://www.nber.org/papers/w32450#:~:text=A%201%C2%B0C%20increase,our%20estimate%20is%20substantially%20larger>); Caroline Taylor, Tom R. Robinson, Stuart Dunning, J. Rachel Carr & Matthew Westoby, *Glacial lake outburst floods threaten millions globally*, Nature Communications (Feb. 7, 2023) (online at <https://www.nature.com/articles/s41467-023-36033-x>); Chris Mooney, John Muyskens, Kevin Crowe & Brianna Sacks, *The Drowning South: The new face of flooding*, Washington Post (Apr. 29, 2024) (online at https://www.washingtonpost.com/climate-environment/interactive/2024/flooding-sea-level-rise-gulf-coast/?utm_source=alert&utm_medium=email&utm_campaign=wp_news_alert_revere&location=alert); N BC New York, *It's so hot that an NYC bridge literally stopped working* (Jul. 8, 2024) (online at https://www.nbcnewyork.com/news/its-so-hot-that-a-nyc-bridge-literally-stopped-working/5576418/?utm_campaign=heatmap_am&utm_medium=email&hsenc=p2ANqtz-8ktjNC9oLaTj9fPCIuxeueFb8L4JJ2YjNje829E67ED8Q9oHIG7FI37CaBvkd-7OOIrLmR5xr0E-yPuFn8wW5L2jQVpQ&hsmi=314962517&utm_content=314962517&utm_source=hs_email); Raymond Zhong, *Thunderstorms, Wind and Climate Change: Here's What to Know*, New York Times (May 17, 2024) (online at <https://www.nytimes.com/2024/05/17/climate/thunderstorms-wind-climate-change.html>); Patrizia Mazzei, *'Insane' Heat Has Been Scorching Miami. It's Not Even June*, New York Times (May 21, 2024) (<https://www.nytimes.com/2024/05/21/us/miami-heat-summer-weather.html>); Associated Press, *Phoenix hits record October highs before warm season ends* (Oct. 22, 2024) (online at <https://subscriber.politicopro.com/article/eenews/2024/10/22/phoenix-hits-record-october-highs-before-warm-season-ends-00183633>); Climate Central, *Longer, More Intense Fire Weather Seasons* (May 15, 2024) (online at <https://www.climatecentral.org/climate-matters/longer-more-intense-fire-weather-seasons>).

COVID-19 pandemic laid bare their fragilities. Then, it quickly became clear how disruptions in supply chains cascade into increased prices for families. These days, climate change is periodically disrupting key transport routes such as the Mississippi River^{2, 3} and the Panama Canal, making clear that supply chain disruptions will be an ongoing source of climate-flation.⁴

Witnesses also testified about the havoc that climate change is wreaking on infrastructure. Climate-related extreme weather, wildfires, and sea level rise are already damaging our roads, bridges, railroads, ports, and water treatment systems. As climate change gets worse, the damages will mount, costing federal, state, and local governments increasingly large sums. But as local tax bases decline due to climate change and municipal bonds become a riskier investment, local governments will be even less able to raise money in the municipal bond market to pay for infrastructure.⁵

From rising temperatures to extreme weather events, climate change is altering natural landscapes and threatening a range of industries that depend on healthy and stable natural systems. Witnesses testified that climate-related droughts, rising temperatures, and severe weather events are harming crop yields and food production; and that climate change is damaging outdoor recreation and ocean-based economies. The results of these disruptions are lost jobs, damaged local economies, and higher prices for consumers in grocery aisles.

The Committee also heard about health care costs associated with climate change. Heatwaves and other climate-related extreme weather events result in worsening health

² Will Wade, *Drought Threatens to Snarl Mississippi River Traffic for a Third Year*, Bloomberg (March 21, 2024) (online at [Mississippi River Traffic Threatened by Climate-Driven Drought For a Third Year - Bloomberg](https://www.bloomberg.com/news/articles/2024-03-21/drought-threatens-to-snarl-mississippi-river-traffic-for-a-third-year)).

³ Michael Hirtzer and Brian K. Sullivan, *Mississippi River Dries Up Again at Worst Time for US Farmers*, Bloomberg (Oct. 25, 2024) (*Mississippi River Dries Up Again at Worst Time for US Farmers - Bloomberg*); Jim Salter, *The Mississippi River is running low again. It's a problem for farmers moving beans and grain*, AP News (Sept. 11, 2024) (online at <https://apnews.com/article/mississippi-river-low-water-level-7dc8782f47fb7f0b6cb4e51528c10f3c>).

⁴ Jonathan Yerushalmy, *Changing climate casts a shadow over the future of the Panama Canal – and global trade*, The Guardian, (Dec. 22, 2023) (online at <https://www.theguardian.com/environment/2023/dec/22/changing-climate-casts-a-shadow-over-the-future-of-the-panama-canal-and-global-trade>).

⁵ Leslie P. Norton, *Muni Bonds Face Climate Change. And Investors Are Ignoring the Risks*, Barron's (Sept. 20, 2019) (online at <https://www.barrons.com/articles/muni-bonds-face-climate-change-and-investors-are-ignoring-the-risks-51569010788>).

outcomes, especially for vulnerable populations,⁶ and raise health care costs for federal programs like Medicaid and Medicare.

Other witnesses testified that climate change is a catalyst of conflict and threatens U.S. military infrastructure and operational readiness—all at significant cost. Globally, climate change is destabilizing entire regions, stoking conflicts over increasingly scarce resources, driving impoverishment and migration, and creating new tensions in geopolitically sensitive areas. Climate change also means that maintaining defense infrastructure is becoming ever more costly.

Beyond the physical effects of climate change, the Committee explored the costs and risks of our current energy system and the danger of a disorderly transition to clean energy sources. U.S. reliance on fossil fuels expose the economy to volatile and manipulable global energy markets, which American drivers experienced firsthand after the Russian invasion of Ukraine and when the Organization of Petroleum Exporting Countries cartel cut production. Economic dependence on fossil fuel also leaves the U.S. vulnerable to a disorderly energy transition—a “carbon bubble”—where stranded fossil fuel assets upend state budgets that rely on fossil fuel revenues and roil capital markets, all with potential spillover effects into the broader economy.

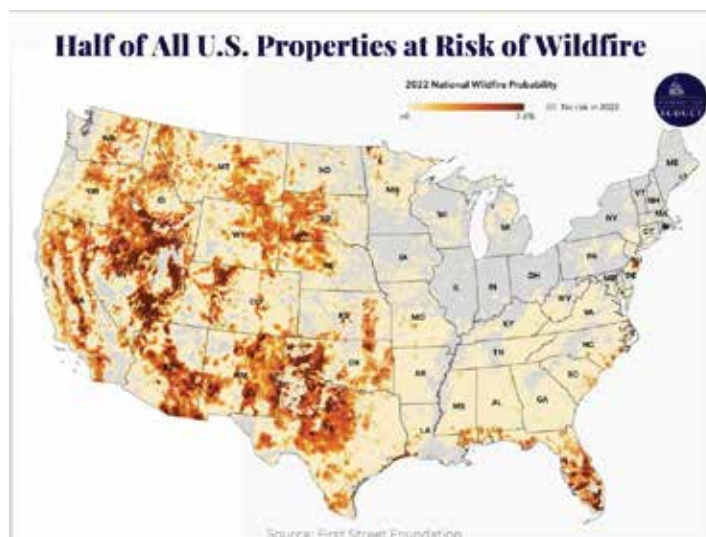
Together, these hearings demonstrated that enormous climate-related risks threaten the U.S. economy and that climate change is already raising costs for consumers. As the economic costs and damages associated with climate change continue to accelerate, Congress cannot say it was not warned.

⁶ Alejandra Borunda, *More than 200 million seniors face extreme heat risks in coming decades, study finds*, NPR (May 14, 2024) (online at <https://www.npr.org/2024/05/14/1251089159/more-than-200-million-seniors-face-extreme-heat-risks-in-coming-decades-study-fi>).

Chapter I: The Insurability Crisis

In March of 2023, the Committee began hearings on climate-related risks in coastal and wildfire-adjacent communities that are affecting insurance, mortgage, and real estate markets.

Mortgages are the means by which most Americans purchase a home, and insurance is a prerequisite to obtaining a mortgage. Every year, insurers sell over \$15 trillion in homeowners' multi-peril insurance coverage to almost 85 percent of all U.S. homeowners.⁷



More than 40 percent of the U.S. population and more than \$1 trillion of residential and commercial real estate is coastal.^{8, 9} Experts testified that climate-driven increases in sea levels, extreme precipitation events, hurricane intensity, and riverine flooding will significantly increase risks to residential properties in coastal communities over the next 30 years.¹⁰

⁷ Sangmin S. Oh, Ishita Sen & Ana-Maria Tenekedjieva, *Pricing of Climate Risk Insurance: Regulation and Cross-Subsidies* (Oct. 2022) (online at <https://www.federalreserve.gov/econres/feds/pricing-of-climate-risk-insurance-regulation-and-cross-subsidies.htm>).

⁸ Freddie Mac, *Sea Level Rise and Impact on Home Prices in Coastal Florida* (Mar. 16, 2022) (online at <https://www.freddiemac.com/research/insight/20220316-sea-level-rise-and-impact-home-prices-coastal-florida>).

⁹ USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II, Chapter 8: Coastal Effects (Nov. 23, 2018) (online at <https://nca2018.globalchange.gov/chapter/8/>).

¹⁰ Senate Committee on the Budget, *Rising Seas, Rising Costs: Climate Change and the Economic Risks to Coastal Communities*, 118th Cong. (Mar. 1, 2023) (online at <https://www.budget.senate.gov/hearings/rising-seas-rising-costs-climate-change-and-the-economic-risks-to-coastal-communities>).

Increased wildfire risk adds to the problem.¹¹ More than half of all U.S. properties face wildfire risk, a share that is increasing as climate change worsens.¹² Globally, the frequency and magnitude of extreme wildfires more than doubled over the past two decades.¹³

Expert witnesses who testified before the Committee painted a grim picture of how climate change will upend insurance, mortgage, and housing markets. Dr. Sean Beckett, the former chief economist for Freddie Mac, testified that with respect to potential losses: "It's extremely difficult to estimate nationally. I'm not sure I have enough zeros to do it."¹⁴

Insurance premiums will continue to increase in response to climate-related risks because, as Dave Burt of DeltaTerra Capital testified, "these issues are not well priced at all. So, the big mispricing exists both in flooding and in wildfire. The repricing seems to be underway."¹⁵

The data bear out that testimony. Nationally, the average homeowners' insurance premium increased 33



¹¹ Senate Committee on the Budget, *A Burning Issue: The Economic Costs of Wildfires*, 118th Cong. (Mar. 8, 2023) (online at <https://www.budget.senate.gov/hearings/a-burning-issue-the-economic-costs-of-wildfires>).

¹² Christopher Flavelle & Nadja Popovich, *Here Are the Wildfire Risks to Homes Across the Lower 48 States*, *The New York Times* (May 16, 2022) (online at <https://www.nytimes.com/interactive/2022/05/16/climate/wildfire-risk-map-properties.html>).

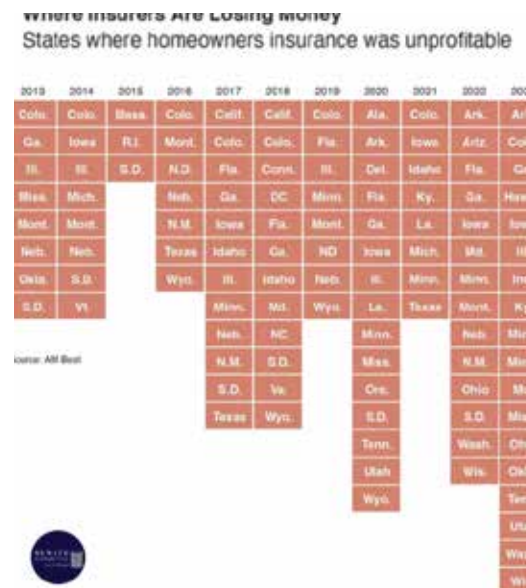
¹³ Calum X. Cunningham, Grant J. Williamson & David M. J. S. Bowman, *Increasing frequency and intensity of the most extreme wildfires on Earth* (June 24, 2024) (online at <https://www.nature.com/articles/s41559-024-02452-2>).

¹⁴ Senate Committee on the Budget, *Rising Seas, Rising Costs: Climate Change and the Economic Risks to Coastal Communities*, 118th Cong. (Mar. 1, 2023) (online at <https://www.budget.senate.gov/hearings/rising-seas-rising-costs-climate-change-and-the-economic-risks-to-coastal-communities>).

¹⁵ Senate Committee on the Budget, *A Burning Issue: The Economic Costs of Wildfires*, 118th Cong. (Mar. 8, 2023) (online at <https://www.budget.senate.gov/hearings/a-burning-issue-the-economic-costs-of-wildfires>).

percent between 2020 and 2023.¹⁶ In Florida, it more than doubled, with average premiums now costing more than \$6,000 per year.¹⁷ Annually, premiums in Miami-Dade County average nearly \$17,000,¹⁸ and in New Orleans, they are approaching \$10,000.¹⁹ Premiums have also climbed in wildfire-prone parts of California and the Mountain West.²⁰

When climate-driven losses become too hard to predict or too expensive to cover, insurance companies pull back. Since our hearings began in March of 2023, turbulence in insurance markets has accelerated. The effects are particularly pronounced in Florida, Louisiana, and California, which are highly exposed to climate-driven hurricane and wildfire risks. In Florida, between 2022 and 2023, more than a dozen insurance companies exited the residential property market due to unsustainable risk exposure from



¹⁶ New York Times, *Home Insurance Rates in America Are*

(online at <https://www.nytimes.com/interactive/2024/07/08/climate/home-insurance-climate-change.html>).

¹⁷ Office of Financial Research, *Wind, Fire, Water, Hail: What Is Going on In the Property Insurance Market and Why Does It Matter?* (Dec. 14, 2023) (online at <https://www.financialresearch.gov/the-ofr-blog/2023/12/14/property-insurance-market/#:~:text=It%20is%20said%20that%20Florida,from%20a%20catastrophe%20risk%20perspective.&text=According%20to%20the%20Insurance%20Information,average%20of%20%241%2C700%20per%20year>).

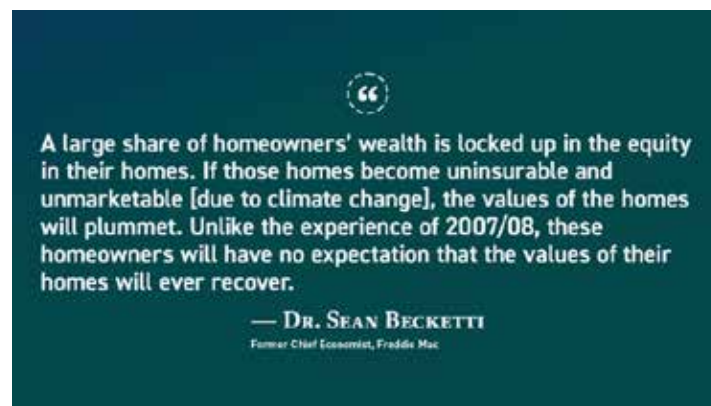
¹⁸ Senate Committee on the Budget, *Riskier Business: How Climate is Already Challenging Insurance Markets*, 118th Cong. (June 5, 2024) (online at <https://www.budget.senate.gov/hearings/riskier-business-how-climate-is-already-challenging-insurance-markets>).

¹⁹ Ibid.

²⁰ Office of Financial Research, *Wind, Fire, Water, Hail: What Is Going on In the Property Insurance Market and Why Does It Matter?* (Dec. 14, 2023) (online at <https://www.financialresearch.gov/the-ofr-blog/2023/12/14/property-insurance-market/#:~:text=It%20is%20said%20that%20Florida,from%20a%20catastrophe%20risk%20perspective.&text=According%20to%20the%20Insurance%20Information,average%20of%20%241%2C700%20per%20year>).

intensifying storms.²¹ In the past three years, 12 insurers left Louisiana, 11 declared insolvency, and 50 stopped writing new policies in certain parishes.²² Seven of California's top 12 homeowners insurance providers ceased writing new policies or exited the state, citing growing wildfire risks.²³

Climate risk and its effects on insurance availability and affordability "should be ringing alarm bells for housing markets all over the country" testified Dr. Benjamin Keys, a professor of Finance at the Wharton School of the University of Pennsylvania.²⁴ Dr. Beckett testified that declining insurability has broad economic consequences, stating, "A large share of homeowners' wealth is locked up in the equity in their homes. If those homes become uninsurable and unmarketable, the values of the homes will plummet. Unlike the experience of 2007/08, these homeowners will have no expectation that the values of their homes will ever recover."²⁵



In April of this year, the cover story in *The Economist* warned that climate change is affecting the world's largest asset class—residential real estate—and \$25 trillion in global real estate at risk. As Dr. Beckett foresaw as far back as 2016, "The economic

²¹ Axios, *Tampa-based Slide to obtain scores of Farmers Insurance policies*, (Oct. 17, 2023) (online at <https://www.axios.com/local/tampa-bay/2023/10/17/slide-farmers-insurance-policies>).

²² CRC Group, *Louisiana Assignment of Benefits Ban a Win for Insureds & Carriers* (no date) (online at <https://www.crcgroup.com/Tools-Intel/post/louisiana-assignment-of-benefits-ban-a-win-for-insureds-carriers>).

²³ KQED, *Insurance In California Is Changing. Here's How It May Affect You*, (Nov. 13, 2023) (online at <https://www.kqed.org/science/1985175/insurance-in-california-is-changing-heres-how-it-may-affect-you>).

²⁴ Senate Committee on the Budget, *Risky Business: How Climate Change is Changing Insurance Markets*, 118th Cong. (Mar. 22, 2023) (online at <https://www.budget.senate.gov/hearings/risky-business-how-climate-change-is-changing-insurance-markets>).

²⁵ Ibid.

losses and social disruption may happen gradually, but they are likely to be greater in total than those experienced in the housing crisis and Great Recession.”²⁶

Deborah Wood, a retired Floridian, testified to the Committee that her homeowners’ premium had more than doubled—increasing to \$8,000—in recent years. Forced to sell her home due to this substantial new expense, she stated, “we have reluctantly made the decision that we will not be buying a home in Florida ... there’s no escaping the insurance problems.”²⁷

Soaring insurance premiums are a textbook example of climate-flation, and they present an affordability crisis for many American families. Federal Reserve Chairman Jerome Powell has noted that high insurance premiums are a driver of the overall inflation that has burdened American families. anHed highlighted the climate connection, testifying, “In the longer term, companies are withdrawing from writing insurance in some coastal areas. It’s a significant issue.”²⁸

The climate-driven insurance crisis also poses risks to the U.S. mortgage market, which is valued at more than \$12 trillion. Climate change poses risks to existing federally backed mortgages, which accounted for three-quarters of outstanding mortgage debt for single-family homes in 2020. Fannie Mae and Freddie Mac, alone, backed more than half of that debt. That is especially problematic because troubled markets, like those in Florida, are often thinly capitalized. As Dr. Ishita Sen, a professor at Harvard Business School, testified, “[m]any insurers would potentially be unable to pay massive claims, as we are already seeing in Florida, and state-level backstops through guaranty associations may be insufficient. Many mortgage borrowers would default, leaving the banks and especially Fannie Mae, Freddie Mac, and the FHA on the hook for enormous losses.” Even a delay in claims payments can induce homeowners to walk away from a mortgage. Dr. Sen concluded that “we need to harden our financial institutions, our

²⁶ Senate Committee on the Budget, *Risky Business: How Climate Change is Changing Insurance Markets*, 118th Cong. (Mar. 22, 2023) (online at <https://www.budget.senate.gov/hearings/risky-business-how-climate-change-is-changing-insurance-markets>).

²⁷ Senate Committee on the Budget, *Riskier Business: How Climate is Already Challenging Insurance Markets*, 118th Cong. (June 5, 2024) (online at <https://www.budget.senate.gov/imo/media/doc/msdeborahwoodsensatebudgetcommitteetestimony.pdf>).

²⁸ Senate Committee on the Budget Senate Banking, Housing, and Urban Affairs Committee, *The Semiannual Monetary Policy Report to the Congress*, 118th Cong. (March 7, 2024) (online at <https://www.c-span.org/video/?533955-1/federal-reserve-chair-testifies-monetary-policy-economy>).

banks, and our insurance companies in order to make them withstand really large climate shocks that are for sure coming their way.”²⁹

Soaring insurance premiums threaten affordable housing, too. Nonprofit affordable housing organizations see skyrocketing insurance rates squeezing their already financially sensitive customer pool. Some planned affordable housing developments have been paused, and others are now being offered to market-rate customers. For example, the Community Opportunity Alliance warned that rising insurance premiums “could threaten to end affordable housing development as we know it.”³⁰

Unfortunately, many Republican witnesses did not take the warnings seriously. One even ludicrously suggested that the response to rising sea levels should be to “move New York, move Miami, move Southern Florida, move Boston.”³¹ Others went off on unrelated climate-denial tangents.

Chapter II: Risks and Opportunities for the Broader Economy



SOURCE: Gerri Ward, Principal Consultant at Oxygen Consulting

In February 2023, the Senate Budget Committee held its first hearing on climate-related fiscal, financial, and economic risks. Among the physical risks witnesses highlighted were the destruction of life, property, goods, or infrastructure from rising seas or from increasingly severe and more frequent storms, floods, droughts, wildfires, or heatwaves.³² Witnesses also highlighted

transition risks—the “carbon bubble”—that could arise from the disorderly transition to

²⁹ Senate Committee on the Budget, *Riskier Business: How Climate is Already Challenging Insurance Markets*, 118th Cong. (June 5, 2024) (online at <https://www.budget.senate.gov/imo/media/doc/drishitasensenatebudgetcommitteetestimony.pdf>).

³⁰ The New York Times, *Soaring Insurance Costs Could ‘End’ Affordable Housing, Developers Warn*, (Aug. 25, 2024) (online at <https://www.nytimes.com/2024/08/25/business/home-insurance-costs-affordable-housing.html>).

³¹ Senate Committee on the Budget, *Riskier Business: How Climate is Already Challenging Insurance Markets*, 118th Cong. (June 5, 2024) (online at <https://www.budget.senate.gov/hearings/riskier-business-how-climate-is-already-challenging-insurance-markets>).

³² Senate Committee on the Budget, *Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global Economy*, 118th Cong. (Feb. 15, 2023) (online at <https://www.budget.senate.gov/hearings/climate-related-economic-risks-and-their-costs-to-the-federal-budget-and-the-global-economy>).

a low-carbon economy. Such a transition would devalue carbon-intensive industries and assets.³³ Together, these climate risks could destabilize the entire U.S. economy. As Chairman Sheldon Whitehouse explained, “\$10 trillion of our federal debt can be ascribed to exogenous shocks to our economy [and] the biggest exogenous shock on the horizon out there is climate upheaval.”³⁴

Dr. Mark Carney, the former governor of the Banks of Canada and of England, testified that per capita GDP could decline 10-20 percent globally if climate change is not addressed. Dr. Carney’s estimate is likely conservative because it omits the cost of damage to biodiversity and human health, as well as hard-to-estimate effects of disrupted supply chains, degraded monetary and financial stability, and heightened national security risk.^{35, 36} His testimony was confirmed by recent research from the Potsdam Institute for Climate Impact Research, which estimated economic losses would reach 19 percent of global GDP (or \$38 trillion annually) by 2050.³⁷ Dr. Bob Litterman, the former head of risk management at Goldman Sachs, observed that U.S. losses from billion-dollar extreme weather events are “clearly growing rapidly over time,” totaling \$165 billion in 2022 alone.^{38, 39}

Dr. Litterman explained that although certain individual risks from climate change, on their own, could be managed, “the systemic nature of climate risk” is different.⁴⁰ The hazards of climate change have the potential to cascade out and “affect every aspect of

³³ Ibid.

³⁴ Senate Committee on the Budget, *Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global Economy*, 118th Cong. (Feb. 15, 2023) (Opening Statement of Chairman Sheldon Whitehouse) (online at <https://www.budget.senate.gov/download/chairman-whitehouses-opening-statement>).

³⁵ Senate Committee on the Budget, *Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global Economy*, 118th Cong. (Feb. 15, 2023) (Testimony of Dr. Mark Carney) (online at <https://www.budget.senate.gov/download/testimony-Carney>).

³⁶ Marshall Burke, W. Matthew Davis & Noah S. Diffenbaugh, *Large potential reduction in economic damages under UN mitigation targets* (May 23, 2018) (online at <https://www.nature.com/articles/s41586-018-0071-9>).

³⁷ Maximilian Kotz, Anders Levermann & Leonie Wenz, *The economic commitment of climate change* (April 17, 2024) (online at <https://www.nature.com/articles/s41586-024-07219-0>).

³⁸ Senate Committee on the Budget, *Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global Economy*, 118th Cong. (Feb. 15, 2023) (Testimony of Dr. Robert B. Litterman) (online at <https://www.budget.senate.gov/download/testimony-Litterman>).

³⁹ Adam B. Smith, *2022 U.S. billion-dollar weather and climate disasters in historical context*, National Oceanic and Atmospheric Administration (Jan. 10, 2023) (online at <https://www.climate.gov/news-features/blogs/beyond-data/2022-us-billion-dollar-weather-and-climate-disasters-historical>).

⁴⁰ Senate Committee on the Budget, *Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global Economy*, 118th Cong. (Feb. 15, 2023) (Testimony of Dr. Robert B. Litterman) (online at <https://www.budget.senate.gov/download/testimony-Litterman>).

the economy, including government budgets.”⁴¹ Minority and majority witnesses agreed that climate change would have economic and budgetary costs and should be addressed,⁴² and they agreed that a border-adjustable price on carbon would mitigate U.S. and global greenhouse gas emissions while creating substantial revenues that could help stabilize the country’s fiscal position.⁴³

In addition to avoiding risk, leadership on climate presents economic opportunities: Dr. Carney testified that the energy transition is “one of the greatest commercial opportunities of our time” and “carbon efficiency and climate resilience are becoming increasingly important determinants of company and national competitiveness.”⁴⁴ Management consulting firm Deloitte estimated that seizing this market opportunity could boost the global economy by \$43 trillion over the next half century.⁴⁵ As Chairman Whitehouse explained, the decision to embrace or delay the transition has economic consequences, and “the differential between being responsible and reckless about climate could sum to more than \$220 trillion between now and 2070.”⁴⁶

⁴¹ Senate Committee on the Budget, *Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global Economy*, 118th Cong. (Feb. 15, 2023) (online at <https://www.budget.senate.gov/hearings/climate-related-economic-risks-and-their-costs-to-the-federal-budget-and-the-global-economy>).

⁴² Ibid.

⁴³ Ibid.

⁴⁴ Senate Committee on the Budget, *Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global Economy*, 118th Cong. (Feb. 15, 2023) (Testimony of Dr. Mark Carney) (online at <https://www.budget.senate.gov/download/testimony-Carney>).

⁴⁵ Deloitte, *The Turning Point: A Global Summary* (June 20, 2022) (online at <https://www.deloitte.com/global/en/issues/climate/global-turning-point.html>).

⁴⁶ Senate Committee on the Budget, *Climate-Related Economic Risks and Their Costs to the Federal Budget and the Global Economy*, 118th Cong. (Feb. 15, 2023) (Opening Statement of Chairman Sheldon Whitehouse) (online at <https://www.budget.senate.gov/download/chairman-whitehouses-opening-statement>).

Chapter III: Supply Chain Disruptions

The global economy could not prosper without robust supply chains, which support almost \$20 trillion each year in global trade.^{47, 48} Nevertheless, global supply chains face dangers from climate change risks that could cost companies \$120 billion by 2026.^{49, 50} Undoubtedly, companies would pass these costs on to consumers in yet another example of climate-flation.

For example, climate-induced constraints on fertilizer shipments in the Mississippi basin resulted in an estimated loss of \$18.1 billion to U.S. GDP, at least 51,000 job-years, and a 0.25 percentage point increase in inflation.⁵¹ These estimates would be considerably higher if effects on grain shipments were also taken into account.⁵²

Climate-related disruptions in supply chains can compound other disruptions.⁵³ For example, Hurricane Irma displaced 6 million people from their homes^{54, 55} and crashed the local economy, while also creating unexpected demand for food, fuel, shelter, and medical care in new locations that caused local businesses and organizations to

⁴⁷ 80% of trade takes place in 'value chains' linked to transnational corporations, UNCTAD report says, UN Trade and Development (Feb. 27, 2013) (online at <https://unctad.org/press-material/80-trade-takes-place-value-chains-linked-transnational-corporations-unctad-report>).

⁴⁸ Senate Committee on the Budget, *Bottlenecks and Backlogs: How Climate Change Threatens Supply Chains*, 118th Cong. (Oct. 25, 2023) (Opening Statement of Chairman Sheldon Whitehouse) (online at <https://www.budget.senate.gov/imo/media/doc/102523chairmanwhitehouseopeningstatement.pdf>).

⁴⁹ Ibid.

⁵⁰ *Environmental supply chain risks to cost companies \$120 billion by 2026*, CDP (Feb. 9, 2021) (online at <https://www.cdp.net/en/articles/supply-chain/environmental-supply-chain-risks-to-cost-companies-120-billion-by-2026>).

⁵¹ Senate Committee on the Budget, *Bottlenecks and Backlogs: How Climate Change Threatens Supply Chains*, 118th Cong. (Oct. 25, 2023) (Testimony of Dr. Adam Rose) (online at https://www.budget.senate.gov/imo/media/doc/102523_drrosetestimony.pdf).

⁵² Ibid.

⁵³ Ibid.

⁵⁴ *Hurricane Irma Local Report/Summary*, National Oceanic and Atmospheric Administration (Sep. 10, 2017) (online at <https://www.weather.gov/mfl/hurricaneirma>).

⁵⁵ Senate Committee on the Budget, *Bottlenecks and Backlogs: How Climate Change Threatens Supply Chains*, 118th Cong. (Oct. 25, 2023) (Testimony of Ms. Kathy Fulton) (online at https://www.budget.senate.gov/imo/media/doc/102523_msfuldontestimony.pdf).

scramble to meet the new needs.⁵⁶ Superstorm Sandy caused the New York Stock Exchange to close for two days in 2012, which is the kind of information disruption that can paralyze the movement of goods.⁵⁷

Since the Committee held its original hearing, a severe drought in Central America limited traffic in the Panama Canal,⁵⁸ and renewed

drought in the Midwest again limited barge traffic on the Mississippi River.⁵⁹



Chapter IV: Public Infrastructure and Municipal Bonds

“Infrastructure is the foundation for our economy: drinking water and sewage systems, roads, bridges, railways, irrigation, flood levees, waterways, power plants, dams and transmission lines all enable our society to run,” said Chairman Whitehouse in his opening statement in the Senate Budget hearing on July 21, 2023.⁶⁰

Increased temperatures, rising seas, and extreme weather do damage to the nation's infrastructure, the costs of which will be borne by federal, state, and local governments, and ultimately by taxpayers. There was consensus that climate hazards create a growing risk of infrastructure failures. The Honorable Jon Bel Edwards, the former Governor of Louisiana, put it this way: “We have experienced significant devastation in our recent history from both acute shocks like hurricanes and flooding, and chronic stressors like

⁵⁶ Ibid.

⁵⁷ Ibid.

⁵⁸ Sarah Ruiz & Christina Shintani, *Drought in Panama is disrupting global shipping. These 7 graphics show how*, Woodwell Climate Research Center (Feb. 20, 2024) (online at <https://www.woodwellclimate.org/drought-panama-canal-7-graphics/>).

⁵⁹ Kristoffer Tighe, *Another Midwest drought is causing transportation headaches on the Mississippi River*, Mississippi Today (Sep. 16, 2024) (online at <https://mississippitoday.org/2024/09/16/another-midwest-drought-is-causing-transportation-headaches-on-the-mississippi-river/>).

⁶⁰ Senate Budget Committee, *Beyond the Breaking Point: The Fiscal Consequences of Climate Change on Infrastructure*, 118th Cong. (July 26, 2023) (online at <https://www.budget.senate.gov/hearings/beyond-the-breaking-point-the-fiscal-consequences-of-climate-change-on-infrastructure>).

sea level rise, subsidence, coastal land loss, habitat degradation, and extreme heat.”⁶¹ In particular, according to Dr. Susan Tierney, a Senior Advisor at Analysis Group, the nation’s energy infrastructure “is already being adversely impacted by the changing climate and related extreme weather events. Extreme cold and hot weather, droughts, flooding, wildfires, hurricanes, tornadoes, derechos, and other events are leading to power outages and fuel shortages.”⁶²

In a pernicious feedback loop, each of these hazards—whether the more gradual shifts in “normal” weather or sudden catastrophes—magnifies our vulnerability to other climate hazards and creates economic perils. Dr. Jesse Keenan, a professor at Tulane University, testified that “a failure to recognize and account for

these [climate-related] costs will not only undermine the reliability of our infrastructure, it will also undermine our global economic competitiveness.”⁶³ Robust, well-maintained infrastructure is paramount to a functioning economy, so failure to meet these new climate risks economic growth.^{64, 65}



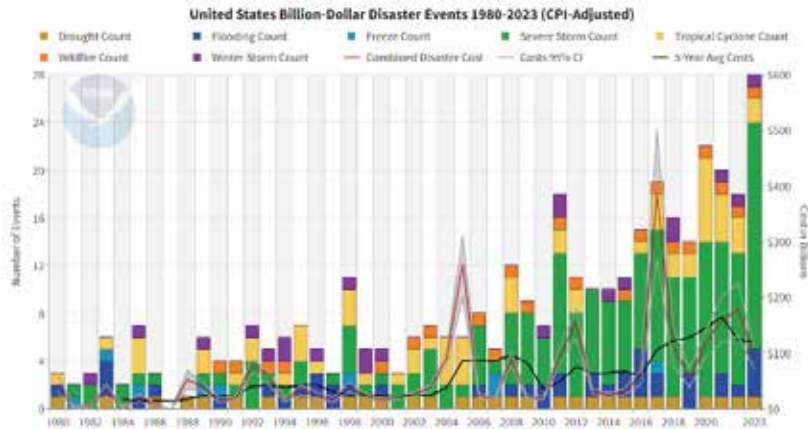
⁶¹ Senate Budget Committee, *Beyond the Breaking Point: The Fiscal Consequences of Climate Change on Infrastructure*, 118th Cong. (July 26, 2023) (online at <https://www.budget.senate.gov/imo/media/doc/Hon.%20John%20Bel%20Edwards%20-%20Testimony%20-%20Senate%20Budget%20Committee.pdf>).

⁶² Senate Budget Committee, *Beyond the Breaking Point: The Fiscal Consequences of Climate Change on Infrastructure*, 118th Cong. (July 26, 2023) (online at <https://www.budget.senate.gov/imo/media/doc/Hon.%20Susan%20F.%20Tierney%20-%20Testimony%20-%20Senate%20Budget%20Committee.pdf>).

⁶³ Senate Budget Committee, *Beyond the Breaking Point: The Fiscal Consequences of Climate Change on Infrastructure*, 118th Cong. (July 26, 2023) (online at <https://www.budget.senate.gov/imo/media/doc/Dr.%20Jesse%20M.%20Keenan%20-%20Testimony%20-%20Senate%20Budget%20Committee.pdf>).

⁶⁴ The New York Times, *Rising Frustration in Houston After Millions Lost Power in Storm* (July 10, 2024) (online at <https://www.nytimes.com/2024/07/10/us/hurricane-beryl-texas-grid.html>).

⁶⁵ Yale Climate Connections, *How much will climate change drag down the economy?* (July 1, 2023) (online at <https://yaleclimateconnections.org/2024/07/how-much-will-climate-change-drag-down-the-economy/>).



After disasters, the news moves on, but costs and impacts can persist for decades. In 2023, there were 28 climate-related disaster events⁶⁶ in the U.S. that had losses exceeding \$1 billion, and these major disasters leave economic scarring well after a disaster declaration is lifted. For

example, the billed surcharge for post-Hurricane Katrina electric utility reconstruction persisted *13 years* after the storm's 2005 landfall.⁶⁷ Economists have found that major hurricanes reduce local governments' revenues by 7.2 percent⁶⁸ for a decade, leading to a 13 percent decline in public works expenditures. Wildfires increase a municipality's risk of a budget deficit by 25 percent.⁶⁹ As a result, the places most in need of renewed investment in infrastructure are often least able to afford it, putting more pressure on the federal government to bear the costs of rebuilding.^{70, 71}

Public infrastructure such as roads, schools, airports, and water treatment are the basic building blocks of our nation's economy. Much of this infrastructure funding comes via the \$4-trillion municipal bond market, which is supported by state and municipal tax bases across the country. Should sea level rise or wildfires trigger a population exodus or a decline in a town's property values, its tax base will shrink, making it harder for that government to borrow, and the creditworthiness of local governments could be

⁶⁶ NOAA, Assessing the U.S. Climate in 2023 (online at [https://www.ncei.noaa.gov/news/national-climate-202312#:~:text=The%20costliest%20events%20in%202023,a%20cost%20of%20\\$246.0%20billion.](https://www.ncei.noaa.gov/news/national-climate-202312#:~:text=The%20costliest%20events%20in%202023,a%20cost%20of%20$246.0%20billion.))

(Accessed December 6, 2024).

⁶⁷ Senate Budget Committee, *Beyond the Breaking Point: The Fiscal Consequences of Climate Change on Infrastructure*, 118th Cong. (July 26, 2023) (online at <https://www.budget.senate.gov/imo/media/doc/Dr.%20Jesse%20M.%20Keenan%20-%20Testimony%20-%20Senate%20Budget%20Committee.pdf>).

⁶⁸ National Bureau of Economic Research, *Local Public Finance Dynamics and Hurricane Shocks* (online at <https://www.nber.org/papers/w28050>) (Accessed December 6, 2024).

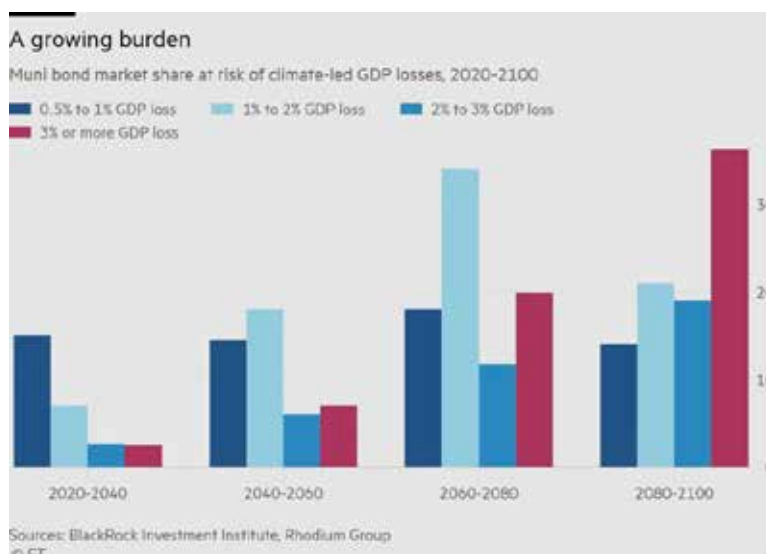
⁶⁹ Yanjun Liao and Carolyn Kousky, *The Fiscal Impacts of Wildfires on California Municipalities* (Sept. 24, 2021). (online at <https://ssrn.com/abstract=3612311>).

⁷⁰ Kotz, M., Levermann, A. & Wenz, L. *The economic commitment of climate change*. *Nature* 628, 551–557 (2024) (online at <https://doi.org/10.1038/s41586-024-07219-0>).

⁷¹ Axios, *Climate change may cost \$38 trillion a year by 2049, study says* (Apr. 18, 2024) (online at <https://www.axios.com/2024/04/18/climate-change-damages-38-trillion>).

imperiled.⁷² Five years after the Camp Fire, only a third of the population has returned to Paradise, California.⁷³ A similar hollowing out hit small towns in North Carolina in the wake of Hurricane Matthew.⁷⁴ Moody's warns that the "growing effects of climate change" will be a "growing negative credit factor for [state and local] issuers."⁷⁵

This creates a vicious cycle: as climate change drives the need for infrastructure and disaster recovery investments, climate risks to insurance, mortgage, and property markets erode the tax base and borrowing capacity of local governments. Without the ability to fully finance infrastructure and disaster recovery projects, these costs will increasingly fall to the federal government.



Climate risks have not been priced into the municipal bond market, so issuers are not incentivized to mitigate the mounting risks and investors are flying blind. "State and local governments' easily quantified climate risks are not clear to investors who deliver capital and to the federal government who provides the critical subsidy. Ratings agencies, while investing considerable resources

on ESG practices and climate data, have not communicated climate risk as clearly, nimbly, and concisely as needed. The new era will require new practices to better inform investors of climate risks and steps taken by issuers to mitigate those risks," explained

⁷² Dee Gill, *Is the \$1 Trillion Coastal Housing Market a Future Financial Crisis?*, UCLA Anderson Review (March 31, 2021) (online at <https://anderson-review.ucla.edu/is-the-1-trillion-coastal-housing-market-a-future-financial-crisis/>).

⁷³ Kirk Siegler, *A California town wiped off the map by wildfire is still recovering 5 years on*, NPR (Nov. 8, 2023) (online at <https://www.npr.org/2023/11/08/1209471739/a-california-town-wiped-off-the-map-by-wildfire-is-still-recovering-five-years-o>).

⁷⁴ Christopher Flavelle, *Climate Change Is Bankrupting America's Small Towns*, *The New York Times* (Sept. 15, 2021) (online at <https://www.nytimes.com/2021/09/02/climate/climate-towns-bankruptcy.html>).

⁷⁵ Moody's, *Climate change is forecast to heighten US exposure to economic loss placing short- and long-term credit pressure on US states and local governments*, (Nov. 28, 2017) (online at https://www.moody's.com/research/Moodys-Climate-change-is-forecast-to-heighten-US-exposure-to--PR_376056).

Thomas G. Doe, President and Founder of Municipal Market Analytics.⁷⁶ FEMA and HUD disaster funding has helped dampen the negative effects of climate-related disasters on municipal bond markets—a drag on the federal budget that will continue to increase as climate change worsens.⁷⁷

As private insurers exit high climate-risk areas, Dr. Chris Hartshorn, an expert on climate risks metrics, explained that “the diminishing of this historically critical pillar of past disaster recovery will only heighten the post-disaster financial pressure on the municipal (and federal) system.”⁷⁸ As climate change worsens, the share of the municipal bond market at risk from climate-related losses will increase.⁷⁹

Chapter V: Climate Risks to the Agriculture Sector

Climate change is changing the global agricultural landscape. Farmers, who have always had to navigate unpredictable weather, are seeing far more frequent and extreme weather variability. Agricultural yields are expected to decline due to climate-related temperature increases, shifts in water availability, soil erosion, and an increase in disease and pest outbreaks. The *Fourth National Climate Assessment* predicted declines in crop yields and quality and in livestock health, which will threaten food security and price stability.⁸⁰ Major agricultural corporations like Cargill have warned that midwestern production of some commodities, like wheat and corn, could drop by 69 percent by the end of the century.⁸¹ Martin Larsen, a fifth-generation family farmer from Minnesota testified to his concern for the increased frequency and duration of extreme weather,

⁷⁶ Senate Committee on the Budget, *Investing in the Future: Safeguarding Municipal Bonds from Climate Risk*, 118th Cong. (Jan. 10, 2024) (Testimony of Thomas G. Doe) (online at <https://www.budget.senate.gov/download/mr-thomas-g-doe-testimony---senate-budget-committee>).

⁷⁷ Ibid.

⁷⁸ Senate Committee on the Budget, *Investing in the Future: Safeguarding Municipal Bonds from Climate Risk*, 118th Cong. (Jan. 10, 2024) (Testimony of Dr. Chris Hartshorn) (online at <https://www.budget.senate.gov/download/dr-chris-hartshorn-testimony---senate-budget-committee>).

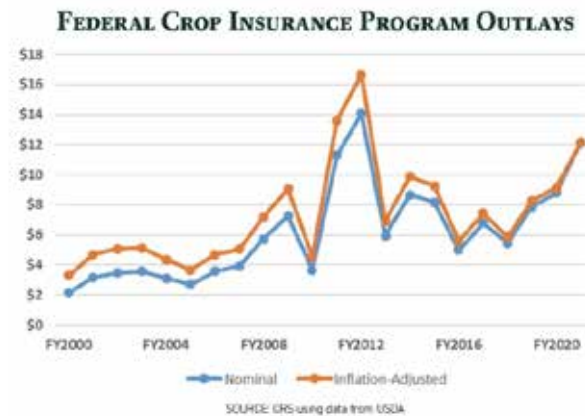
⁷⁹ Billy Nauman, *Municipal bond issuers face steeper borrowing costs from climate change*, *Financial Times* (Jan. 7, 2020) (online at <https://www.ft.com/content/6794c3d2-1d7d-11ea-9186-7348c2f183af>).

⁸⁰ U.S. Global Change Research Program, *Fourth National Climate Assessment*, Volume II: Impacts, Risks, and Adaptation in the United States, pp.16 (June 2019) (online at https://nca2018.globalchange.gov/downloads/NCA4_Report-in-Brief.pdf).

⁸¹ Jim Collins, *Heat in the Heartland: Climate Change and Economic Risk in the Midwest*, *Risky Business* (August 22, 2024) (online at <https://riskybusiness.org/report/heat-in-the-heartland-climate-change-and-economic-risk-in-the-midwest/>).

testified that his region has “broken weather records most years,” including floods, snowstorms, and heatwaves.⁸²

A number of federal programs protect and stabilize the agricultural sector during climate-related extreme weather. As these events increase in frequency, so will the federal government’s financial exposure.⁸³ The largest such program is the Federal Crop Insurance Program (FCIP), which offers farmers insurance coverage against adverse production or market conditions. A former USDA risk management official testified that there is a “consensus...that climate change has already impacted crop insurance costs, and will continue to impact them.”⁸⁴ This year, USDA is on track to pay more than \$630 million to farmers affected by hurricanes and tropical storms, compared to a previous high of \$266 million in 2022.⁸⁵ FCIP outlays have been increasing since 2000, as the figure above shows.⁸⁶



Consumers see the impacts of climate change in their grocery bills. Since the Committee’s hearing, climate-related severe weather phenomena drove up prices for

⁸² Senate Committee on the Budget, *Cultivating Stewardship: Examining the Changing Agricultural Landscape*, 118th Cong. (June 7, 2023) (Testimony of Martin Larsen) (online at <https://www.budget.senate.gov/imo/media/doc/Mr.%20Martin%20Larsen%20-%20Testimony%20-%20Senate%20Budget%20Committee.pdf>).

⁸³ U.S. Government Accountability Office, *Climate Change: Options to Enhance the Resilience of Agricultural Producers and Reduce Federal Fiscal Exposure*, (January 2023) (online at <https://www.gao.gov/assets/gao-23-104557.pdf>).

⁸⁴ Senate Committee on the Budget, *Cultivating Stewardship: Examining the Changing Agricultural Landscape*, 118th Cong. (June 7, 2023) (Testimony of Brandon Willis) (online at <https://www.budget.senate.gov/imo/media/doc/Mr.%20Brandon%20Willis%20-%20Testimony%20-%20Senate%20Budget%20Committee1.pdf>).

⁸⁵ U.S. Department of Agriculture, *USDA Makes Indemnity Payments to Producers Impacted by Hurricane Helene*, (Oct. 15, 2024) (online at <https://www.usda.gov/media/press-releases/2024/10/15/usda-makes-indemnity-payments-producers-impacted-hurricane-helene>).

⁸⁶ Congressional Research Service, *Farm Bill Primer: Federal Crop Insurance Program*, pp. 1 (August 26, 2024) (online at <https://crsreports.congress.gov/product/pdf/IF/IF12201>).

olive oil⁸⁷, rice⁸⁸, orange juice⁸⁹, sugar⁹⁰, and chocolate.⁹¹ When crop yields decrease, prices will rise; more climate-flation.

Chapter VI: Droughts, Oceans, and Outdoor Recreation

Climate change exacerbates the severity of droughts, increases demand for fresh water, and undermines water infrastructure and natural reservoirs.⁹² Communities across the country—but especially those in the more arid West—rely on lakes, rivers, reservoirs, dams, groundwater, and snowpack to store water for use through summer dry periods and during droughts. With rising temperatures, snowpack across the American West is down almost 25 percent since 1995.⁹³ This has profound effects not just on water availability throughout the West, but also on power generation: Glen Canyon Dam's electric power generating infrastructure was damaged by low water levels in 2023.⁹⁴ In 2021 and 2022 alone, a historic drought cost the Californian economy more than \$2 billion in lost agricultural production and nearly 20,000 jobs.⁹⁵ Precipitation is expected to further decline due to climate change in major agricultural regions, including

⁸⁷ Mary Whitfill Roeloffs, "Olive Oil Prices Jump 50%—And Climate Change Might Be Why," *Forbes*, (Sept. 20, 2023) (online at <https://www.forbes.com/sites/maryroeloffs/2023/09/20/olive-oil-prices-jump-50-and-climate-changemight-be-why>).

⁸⁸ Somini Sengupta, *Rice Gets Reimagined, From the Mississippi to the Mekong*, *The New York Times* (May 20, 2023) (online at <https://www.nytimes.com/interactive/2023/05/20/climate/rice-farming-climate-change.html>).

⁸⁹ Patrick Greenfield, *Orange juice prices to surge as US crops ravaged by disease and climate*, *The Guardian* (August 11, 2023) (online at <https://www.theguardian.com/environment/2023/aug/11/ravaged-orange-crop-in-florida-raises-fears-of-surge-in-us-juice-prices-aoe>).

⁹⁰ Oliver Milman, *Cookies and Candy are the Latest Victim of Climate Crisis as Sugar Prices Surge*, *The Guardian*, (January 5, 2024) (online at <https://www.theguardian.com/environment/2024/jan/05/climate-crisis-drought-sugarcost-impact>).

⁹¹ Mumbi Gitau, *Cocoa's Record Price Surge Comes With a Climate Warning*, *Bloomberg*, (Feb. 13, 2024) (online at <https://www.bloomberg.com/news/newsletters/2024-02-13/valentine-s-day-chocolate-comes-with-a-climatewarning-as-cocoa-surges>).

⁹² Senate Committee on the Budget, *Droughts, Dollars, and Decisions: Water Scarcity in a Changing Climate*, 118th Cong. (May 22, 2024) (online at <https://www.budget.senate.gov/hearings/droughts-dollars-and-decisions-water-scarcity-in-a-changing-climate>).

⁹³ U.S. Department of Agriculture, Natural Resources Conservation Service, *Snow telemetry (SNOTEL) and snow course data and products*, (Retrieved January 2, 2024 (online at www.drought.gov/data-maps-tools/nrcs-snotel-and-snow-course-data).

⁹⁴ Jennifer Yachnin, *Reclamation slows flows through Glen Canyon Dam to address*, *E&E NEWS*, (April 8, 2024) (online at <https://subscriber.politicopro.com/article/eenews/2024/04/08/reclamation-slows-flows-through-glen-canyon-dam-to-address-damage-00151133>).

⁹⁵ Josué Medellín-Azuara et. al., *Economic Impacts of the 2020-22 Drought on California Agriculture*, *The California Department of Food and Agriculture*, pp. 21 (November 22, 2022) (online at https://wsm.ucmerced.edu/wp-content/uploads/2023/01/Economic_Impact_CA_Drought_V02-1.pdf).

California. California alone grows 25 percent of U.S. vegetables and 75 percent of U.S. fruits and nuts.⁹⁶ Kevin Richards, Oregon Farmer and Managing Partner of RB Ag, testified that the math is easy: “less water means fewer crops and fewer jobs for farm workers and agriculture businesses.”⁹⁷

Drought drove Lake Oroville, the California’s State Water Project’s primary storage reservoir, so low that Adel Hagekhalil, General Manager and Chief Executive Office of The Metropolitan Water District of Southern California in December 2021 “would only receive enough water to meet human health safety needs.”^{98, 99} In New Mexico, in the spring of 2022, “during some of the worst drought conditions in recent history, [...] instead of snow on the mountains above Santa Fe, ... smoke clouds billowed from the worst fire in the State’s history” and “major reservoirs hit record low levels,” Tanya Trujillo, Water Policy Advisor and New Mexico Deputy State Engineer, shared.¹⁰⁰

The Committee also considered the economic threats of carbon pollution to our oceans.¹⁰¹ Oceans absorb a quarter of all carbon dioxide emissions and have absorbed more than 90 percent of the excess heat generated by these emissions.¹⁰² This means that our oceans absorb about 14 zettajoules of excess heat, or the equivalent of seven Hiroshima bombs detonating every second of every day, per year.¹⁰³ By way of scale, the entire output of energy by human beings on Planet Earth amounts to half a

⁹⁶ California Department of Food and Agriculture, *California Agricultural Production Statistics*, (September 5, 2024) (online at <https://www.cdfa.ca.gov/Statistics/>).

⁹⁷ Senate Committee on the Budget, *Droughts, Dollars, and Decisions: Water Scarcity in a Changing Climate*, 118th Cong. (May 22, 2024) (Testimony of Kevin Richards) (online at https://www.budget.senate.gov/imo/media/doc/richards_testimony.pdf).

⁹⁸ Hannah Gutierrez, *Lake Oroville recovers after the drought as water levels soar over 200 feet*, KRCR, (Oct. 4, 2023) (online at <https://krcrtv.com/news/local/lake-oroville-sees-remarkable-recovery-after-2021-drought-with-water-levels-soaring-over-200-feet>).

⁹⁹ Senate Committee on the Budget, *Droughts, Dollars, and Decisions: Water Scarcity in a Changing Climate*, 118th Cong. (May 22, 2024) (Testimony of Adel Hagekhalil) (online at https://www.budget.senate.gov/imo/media/doc/hagekhalil_testimony.pdf),

¹⁰⁰ Senate Committee on the Budget, *Droughts, Dollars, and Decisions: Water Scarcity in a Changing Climate*, 118th Cong. (May 22, 2024) (Testimony of Tanya Trujillo) (online at https://www.budget.senate.gov/imo/media/doc/trujillo_testimony.pdf).

¹⁰¹ Senate Committee on the Budget, *Warming Seas, Cooling Economy: How the Climate Crisis Threatens Ocean Industries*, 118th Cong. (Jan. 24, 2024) (online at <https://www.budget.senate.gov/hearings/warming-seas-cooling-economy-how-the-climate-crisis-threatens-ocean-industries>).

¹⁰² Senate Budget Committee, *Warming Seas, Cooling Economy: How the Climate Crisis Threatens Ocean Industries*, 118th Cong. (Jan. 24, 2024) (online at <https://www.budget.senate.gov/hearings/warming-seas-cooling-economy-how-the-climate-crisis-threatens-ocean-industries>).

¹⁰³ Sheree Curry, *New Research: Earth is Hotter Than Ever Recorded*, University of St. Thomas, (January 11, 2022) (online at <https://news.stthomas.edu/earth-is-hotter-than-ever-and-humans-are-to-blame/>).

zettajoule. Reflect on that a moment: for the fossil-fuel component of that half zettajoule of global energy, we pay the price of thirty times that amount of heat energy annually entering and disrupting our oceans. Heating and acidifying at this scale are not without consequences, testified Dr. Andrea Dutton, Helen Jupnik Endowed Research Professor in the Department of Geoscience at the University of Wisconsin-Madison: “climate impacts on the oceans have major repercussions for marine life” and major impact on weather patterns, including by overheated seas fueling more intense hurricanes, feeding back into the insurance crisis.¹⁰⁴

Forty percent of Americans live along the coast, and marine industries are a major driver of economic activity that employ nearly 2.3 million people.^{105, 106} In 2021, the American blue economy grew faster than the overall economy, contributing \$432.4 billion to U.S. GDP.¹⁰⁷ Professor Rashid Sumaila, University Killam Professor and Canada Research Chair in Interdisciplinary Ocean and Fisheries Economics, said “the U.S. has a lot to lose as climate change continues to grow. Consumers [and] businesses will face financial losses if they want to consume and provide the same quality and quantity of fish as climate change escalates.”¹⁰⁸ A fishing guide and lodge owner, Kyle Schaefer, testified that his businesses succeed “only because of thriving, healthy ecosystems and relatively predictable climate patterns,” but that, “unfortunately, in large part due to climate change, our oceans are now desperately lacking stability, balance, and abundance that we rely on.”¹⁰⁹

¹⁰⁴ Senate Budget Committee, *Warming Seas, Cooling Economy: How the Climate Crisis Threatens Ocean Industries*, 118th Cong. (Jan. 24, 2024) (online at <https://www.budget.senate.gov/hearings/warming-seas-cooling-economy-how-the-climate-crisis-threatens-ocean-industries>).

¹⁰⁵ National Oceanic and Atmospheric Administration, U.S. Department of Commerce, *New Blue Economy*, (June 20, 2023) (online at <https://www.noaa.gov/blue-economy>).

¹⁰⁶ Office for Coastal Management, NOAA, *Marine Economy*, (December 5, 2024) (online at <https://coast.noaa.gov/states/fast-facts/marine-economy.html>).

¹⁰⁷ Bureau of Economic Analysis, U.S. Department of Commerce, *Marine Economy Satellite Account, 2021* (June 8, 2023) (online at <https://www.bea.gov/sites/default/files/2023-06/mesa0623.pdf>).

¹⁰⁸ Senate Budget Committee, *Warming Seas, Cooling Economy: How the Climate Crisis Threatens Ocean Industries*, 118th Cong. (Jan. 24, 2024) (Testimony of Rashid Sumaila) (online at <https://www.budget.senate.gov/hearings/warming-seas-cooling-economy-how-the-climate-crisis-threatens-ocean-industries>).

¹⁰⁹ Senate Budget Committee, *Warming Seas, Cooling Economy: How the Climate Crisis Threatens Ocean Industries*, 118th Cong. (Jan. 24, 2024) (online at <https://www.budget.senate.gov/hearings/warming-seas-cooling-economy-how-the-climate-crisis-threatens-ocean-industries>).

Inundation danger for coastal economies and ocean industries will get worse, absent substantially reducing carbon pollution. “Coastal communities are already struggling to keep up with sea-level rise; yet future rates of sea-level rise will outpace those of the present” testified Dr. Dutton.¹¹⁰ This danger is worsened by potential tipping points that could drive increases in sea-level rise beyond existing central-case linear estimates.¹¹¹



Adaptation alone will not spare us from the worst consequences of climate change. We are already “reaching the limits of threshold of survival of some ... species like corals that cannot just swim away and find ... cooler water.”¹¹²

Across the country, communities rely on outdoor recreation to attract residents and visitors, create jobs, and spur economic development.¹¹³ In 2023, outdoor recreation generated \$1.2 trillion in economic output, accounted for 5 million jobs, and made-up 2.3 percent of U.S. GDP.¹¹⁴ Theresa McKenney, from New Hampshire-based outdoor company NEMO Equipment, Inc., testified that the “impacts of 2023’s volatile weather” were felt “with overstock issues and order cancellations from retailers in New England and beyond.”¹¹⁵ In 2022, torrential rains flooded Yellowstone National Park at the

¹¹⁰ Senate Budget Committee, *Warming Seas, Cooling Economy: How the Climate Crisis Threatens Ocean Industries*, 118th Cong. (Jan. 24, 2024) (Testimony of Andrea Dutton) (online at <https://www.budget.senate.gov/imo/media/doc/drandreaduttontestimonysenatebudgetcommittee.pdf>).

¹¹¹ Senate Budget Committee, *Warming Seas, Cooling Economy: How the Climate Crisis Threatens Ocean Industries*, 118th Cong. (Jan. 24, 2024) (online at <https://www.budget.senate.gov/hearings/warming-seas-cooling-economy-how-the-climate-crisis-threatens-ocean-industries>).

¹¹² Ibid.

¹¹³ Senate Budget Committee, *Recreation at Risk: The Nature of Climate Costs*, 118th Cong. (Mar. 20, 2024) (online at <https://www.budget.senate.gov/hearings/recreation-at-risk-the-nature-of-climate-costs>).

¹¹⁴ U.S. Bureau of Economic Analysis, Outdoor Recreation Satellite Account, U.S. and States, 2023 (November 20, 2024) (online at <https://www.bea.gov/news/2024/outdoor-recreation-satellite-account-us-and-states-2023>).

¹¹⁵ Senate Budget Committee, *Recreation at Risk: The Nature of Climate Costs*, 118th Cong. (March 20, 2024) (Testimony of Theresa McKenney) (online at <https://www.budget.senate.gov/imo/media/doc/mstheresamckenneytestimonysenatebudgetcommittee.pdf>).

height of the tourist season, depriving the local economy of the seasonal boom that carries them through the year.¹¹⁶ Hilary Hutcheson, a full-time fishing guide, outfitter, and shop owner near Glacier National Park, shared that in Montana, the unofficial fly-fishing capital of the country—with an estimated \$900 million a year in economic activity from fishing—"a recent report underscores the economic jeopardy posed by climate change, predicting the potential loss of 8,800 outdoor recreation jobs and a staggering \$263 million in labor earnings in Montana alone."^{117, 118} U.S. Olympic skier Gus Schumacher shared that throughout the ski country, "climate change has dramatically altered the conditions for winter sports" and "this unpredictability not only affects recreational opportunities, but also jeopardizes the economic viability of communities reliant on winter tourism."¹¹⁹ In Wisconsin, snowfall was so scarce that the Small Business Administration extended disaster coverage to affected businesses.¹²⁰

Chapter VII: Public Health Costs

Climate change affects the health of all Americans. In 2021, more than 200 medical journals published a joint editorial that called climate change the "greatest threat" to global public health.¹²¹ Health care costs related to the combustion of fossil fuels are estimated to total nearly \$820 billion in the U.S. annually—and this harm will only worsen if we do not eliminate carbon pollution.¹²²

¹¹⁶ National Park Service, Yellowstone: Flood Recovery & Operations (online at <https://www.nps.gov/yell/planyourvisit/flood-recovery.htm#:~:text=In%20June%202022%2C%20unprecedented%20amounts,and%20other%20critical%20park%20infrastructure>).

¹¹⁷ Montana Fish, Wildlife & Parks, *Fisheries Division*, (online at <https://fwp.mt.gov/binaries/content/assets/fwp/aboutfwp/legislature/fisheries-division-overview.pdf>).

¹¹⁸ Senate Budget Committee, *Recreation at Risk: The Nature of Climate Costs*, 118th Cong. (Mar. 20, 2024) (Testimony of Hilary Hutcheson) (online at <https://www.budget.senate.gov/imo/media/doc/mshilaryhutchesontestimonysenatebudgetcommittee.pdf>).

¹¹⁹ Senate Budget Committee, *Recreation at Risk: The Nature of Climate Costs*, 118th Cong. (Mar. 20, 2024) (Testimony of Gus Schumacher) (online at <https://www.budget.senate.gov/imo/media/doc/mrgusschumachertestimonysenatebudgetcommittee.pdf>).

¹²⁰ Ashley Kaster, *Federal loans available for Wisconsin businesses hit by unseasonable lack of winter snow*, Fox11News (February 20, 2024) (online at <https://fox11online.com/news/local/federal-loans-available-for-wisconsin-businesses-hit-by-unseasonal-lack-of-winter-snow-sba-small-cross-country-skiing-snowmobiling-ice-fishing-snowshoeing-tourism>).

¹²¹ Lukoye Atwoli et. al., *Call for Emergency Action to Limit Global Temperatures Increases, Restore Biodiversity, and Protect Health*, The New England Journal of Medicine (Sept. 5, 2021) (online at https://www.nejm.org/doi/full/10.1056/NEJMe2113200?query=featured_home).

¹²² Donald De Alwis and Dr. Vijay S. Limaye, *The Costs of Inaction: The Economic Burden of Fossil Fuels and Climate Change on Health in the United States*, Natural Resources Defense Council, (May 20, 2021) (online at <https://www.nrdc.org/sites/default/files/costs-inaction-burden-health-report.pdf>).

Climate change also increases health care costs through increasingly frequent and severe extreme weather events. Hurricane Sandy caused nearly 4,700 emergency room visits, over 6,600 hospital admissions, and 273 deaths and resulted in an estimated \$3.3 billion in health costs.¹²³ As Dr. Katelyn Moretti, an emergency physician, testified, “the effects of man-made climate change are so widespread and varied, that it makes recognizing and tallying” the total costs difficult, so the climate-related “economic impacts of poor health outcomes are severely underestimated.”^{124, 125} Dr. Moretti further shared that the health harms are not borne equally: “it is the socially and economically vulnerable, the disabled children and the elderly who will bear the brunt of climate change impacts.”¹²⁶

Extreme heat also raises health care costs. Maryland Delegate Stephanie Smith testified that “As climate change delivers more extreme heat days ... [it] can mean more emergency medical calls for chronic conditions,” and as the “heat index approaches 103 degrees, emergency calls for congestive heart failure can double.”¹²⁷ Large cities already suffer from a heat island effect, which is exacerbated by higher temperatures due to climate change.

Higher climate-related health costs will also increase federal health spending, particularly via Medicaid and Medicare. Medicare serves over 80 million of the most vulnerable individuals in the country, and Medicaid covers almost 40 percent of the

¹²³ Ibid.

¹²⁴ Senate Committee on the Budget, *Under the Weather: Diagnosing the Health Costs of Climate Changes*, 118th Cong. (April 26, 2023) (online at <https://www.budget.senate.gov/hearings/under-the-weather-diagnosing-the-health-costs-of-climate-change>).

¹²⁵ Alejandra Borunda, *The human cost of climate-related disasters is acutely undercounted, new study says*, NPR (February 29, 2024) (online at <https://www.npr.org/2024/02/29/1234671424/the-human-cost-of-climate-related-disasters-isacutely-undercounted-new-study-sa>).

¹²⁶ Senate Committee on the Budget, *Under the Weather: Diagnosing the Health Costs of Climate Changes*, 118th Cong. (April 26, 2023) (Testimony of Dr. Katelyn Moretti) (online at <https://www.budget.senate.gov/hearings/under-the-weather-diagnosing-the-health-costs-of-climate-change>).

¹²⁷ Senate Committee on the Budget, *Under the Weather: Diagnosing the Health Costs of Climate Changes*, 118th Cong. (April 26, 2023) (Testimony of Stephanie Smith) (online at <https://www.budget.senate.gov/hearings/under-the-weather-diagnosing-the-health-costs-of-climate-change>).

children in the U.S.¹²⁸ In 2021, Medicare and Medicaid made up almost 40 percent of all U.S. health care spending and almost 20 percent of all federal spending.¹²⁹

The process of extracting fossil fuels poses dire health risks for nearby communities—particularly for children—and in 2020, 18 million U.S. residents lived within a mile of an oil and gas well.¹³⁰ As Dr. Nicole Deziel, a Yale professor of epidemiology, testified, these include “increased adverse pregnancy outcomes, childhood cancer incidence, hospitalizations, asthma exacerbations, and mental health issues,” along with “health problems to newborn babies, such as birth defects, preterm birth, and low birthweight.”¹³¹ Pregnant mothers living within a kilometer of oil and gas extraction sites see increased risk of adverse birth outcomes, including low birth weight, preterm birth, and congenital anomalies.^{132, 133} Children growing up with a fracking well within two kilometers of their residence are two to three times as likely to develop childhood leukemia.¹³⁴ In the three months following the drilling of a fracking well, there is a 25 percent increase in the odds of being hospitalized for asthma.¹³⁵

¹²⁸ Christopher P. Chen & Joshua M. Liao, *The Role of Medicaid in Addressing Climate Change and Climate-Related Inequity*, Health Affairs, (March 10, 2023) (online at <https://www.healthaffairs.org/content/forefront/role-medicare-addressing-climate-change-and-climate-related-inequity#:~:text=Medicaid%20is%20uniquely%20positioned%20to,already%20face%20climate-related%20inequities>).

¹²⁹ Council of Economic Advisers, Executive Office of the President, *Economic Report of the President*, (March 2023), pp. 291 (online at <https://www.whitehouse.gov/wp-content/uploads/2023/03/ERP-2023.pdf>).

¹³⁰ Eliza D. Czolowski, Renee L. Santoro, Tanja Srebotnjak & Seth B.C. Shonkoff, *Toward Consistent Methodology to Quantify Populations in Proximity to Oil and Gas Development: A National Spatial Analysis and Review* (Aug. 23, 2017) (online at <https://ehp.niehs.nih.gov/doi/10.1289/ehp1535>).

¹³¹ Senate Committee on the Budget, *Left Holding the Bag: The Cost of Oil Dependence in a Low-Carbon World*, 118th Cong. (May 3, 2023) (Testimony of Dr. Nicole Deziel) (online at <https://www.budget.senate.gov/download/testimony-deziel->).

¹³² California Oil & Gas Public Health Rulemaking Scientific Advisory Panel, *Public Health Dimensions of Upstream Oil and Gas Development in California: Scientific Analysis and Synthesis to Inform Science-Policy Decision Making* (July 24, 2024) (online at <https://www.conservation.ca.gov/calgem/Pages/Public-Health.aspx>).

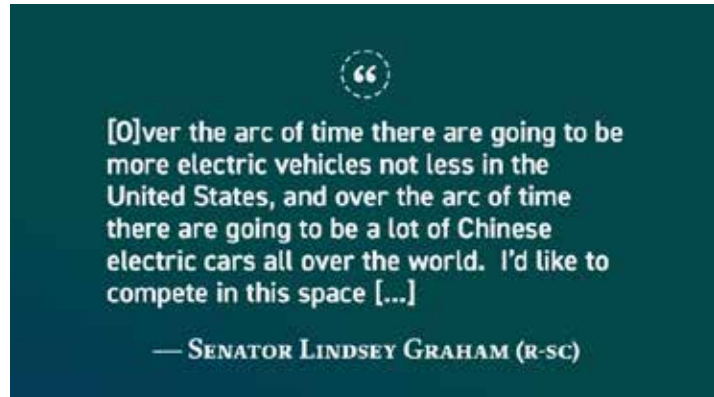
¹³³ Nicole C. Deziel, *Invited Perspective: Oil and Gas Development and Adverse Birth Outcomes: What More Do We Need to Know?* (July 21, 2021) (online at <https://ehp.niehs.nih.gov/doi/full/10.1289/EHP9715>).

¹³⁴ Cassandra J. Clark, Nicholas P. Johnson, Mario Soriano Jr, Joshua L. Warren, Keli M. Sorrentino, Nina S. Kadan-Lottick, James E. Saiers, Xiaomei Ma & Nicole C. Deziel, *Unconventional Oil and Gas Development Exposure and Risk of Childhood Acute Lymphoblastic Leukemia: A Case–Control Study in Pennsylvania, 2009–2017* (Aug. 17, 2022) (online at <https://ehp.niehs.nih.gov/doi/10.1289/EHP11092>).

¹³⁵ Mary D. Willis, Todd A. Jusko, Jill S. Halterman & Elaine L. Hill, *Unconventional natural gas development and pediatric asthma hospitalizations in Pennsylvania* (Oct. 2018) (online at <https://www.sciencedirect.com/science/article/abs/pii/S001393511830183X>).

Chapter VIII: Industrial Competitiveness and National Security

The committee's bipartisan hearing, "*Charging Ahead: The Future of Electric Vehicles*," co-chaired by Chairman Whitehouse and Senator Lindsey Graham (R-SC), highlighted that the U.S. has a stark choice: as the rest of the world electrifies transportation and transitions to a low carbon economy, the U.S. must either compete or fall behind, losing American industrial competitiveness.¹³⁶ As Senator Graham explained, "over the arc of time there are going to be more electric vehicles not less in the United States, and over the arc of time there are going to be a lot of Chinese electric cars all over the world. I'd like to compete in this space ... Consumers, particularly younger people, are into this, and the world is into this ... the march toward electric vehicles is inevitable."¹³⁷



The hearing spotlighted China's dominance of the supply chains for critical minerals. As Maureen Hinman, the Co-Founder and Executive Chair of Silverado Policy Accelerator, summarized: "the Chinese Communist Party's (CCP) approach dwarfs' other nations efforts not just in strategy, but critically in scope, scale, and consistency across the entirety of the supply chain. Put simply, China unfairly and illegally subsidizes more programs, for more critical nodes, over a longer period, and with more dollars. The CCP's stated goal is to establish global monopoly power in all critical industries and they are well on their way to achieving this end in the EV battery market. The International Energy Agency anticipates that China's battery manufacturing capacity will account for 77 percent of world demand by 2030."¹³⁸

There was broad agreement by members of the Committee that federal policies that support American innovation in the automotive space are essential. An auto industry representative put it this way: "I do not state this lightly – the future of this highly

¹³⁶ Senate Budget Committee, *Charging Ahead: The Future of Electric Vehicles*, 118th Cong. (July 31, 2023) (online at <https://www.budget.senate.gov/hearings/charging-ahead-the-future-of-electric-vehicles>).

¹³⁷ Ibid.

¹³⁸ Senate Budget Committee, *Charging Ahead: The Future of Electric Vehicles*, 118th Cong. (July 31, 2024) (online at <https://www.budget.senate.gov/imo/media/doc/msmaureenhinmantestimonysenatebudgetcommittee.pdf>).

competitive, capital-intensive industry hangs in the balance. The next decade will define which nations shape the future of automotive innovation and manufacturing. If U.S. policymakers do not support the development, commercialization, and acceptance of electrified vehicles, our nation risks becoming more dependent on foreign sources for raw materials and critical minerals in a future defined by our competitors.”¹³⁹

Just as American failure to compete adequately in low-carbon technologies poses a risk to our industrial competitiveness, climate change poses threats to our national security. The Committee’s hearing featured analysis that climate-induced rising tides and storms will cost federal defense facilities \$387 billion in the coming decades, disrupting military capability, training and operations, and medical care for veterans.^{140, 141}

During the 2018 fiscal year, the Department of Defense disclosed that over two thirds of 79 priority military installations reviewed were affected by climate events, and none were immune.^{142, 143} Naval installations in the Hampton Roads area, where storm surges frequently sever access to facilities and delay ship repairs, are particularly vulnerable.¹⁴⁴ Senator Mark Warner explained those naval facilities would need an additional \$500 to raise seawalls and prevent flooding. In Guam, U.S. facilities suffered damages costing

¹³⁹ Senate Budget Committee, *Charging Ahead: The Future of Electric Vehicles*, 118th Cong. (July 31, 2024) (online at <https://www.budget.senate.gov/imo/media/doc/mrdavidschwiertertestimonysenatebudgetcommittee.pdf>).

¹⁴⁰ Senate Committee on the Budget, *Budgeting for the Storm: Climate Change and the Costs to National Security*, 118th Cong. (May 15, 2024) (Opening Statement of Chairman Sheldon Whitehouse) (online at <https://www.budget.senate.gov/imo/media/doc/051524chairmanwhitehouseopeningstatement.pdf>).

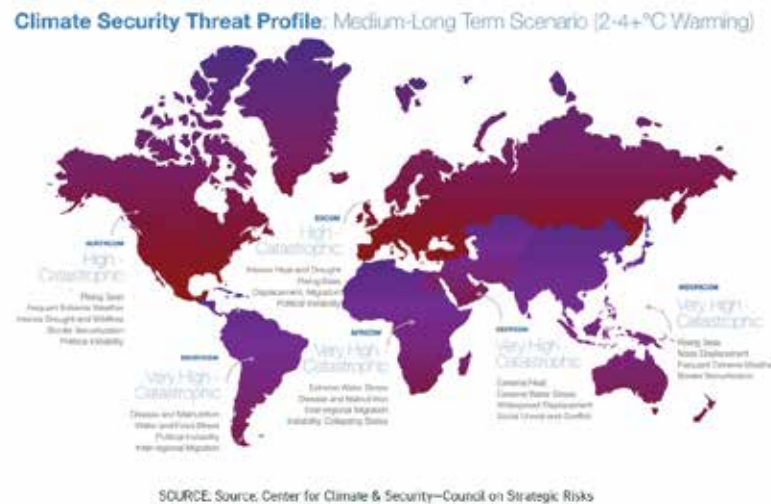
¹⁴¹ Stephen Lee, Paul Murphy, Atthar Mirza, & Jon Meltzer, *Rising Seas Imperil US Sites, Military Bases Worth \$387 Billion*, Bloomberg Law (Sep. 21, 2023) (online at <https://news.bloomberglaw.com/environment-and-energy/rising-seas-imperil-us-sites-military-bases-worth-387-billion>).

¹⁴² U.S. Department of Defense, *Report on Effects of a Changing Climate to the Department of Defense* (Jan. 2019) (online at <https://media.defense.gov/2019/jan/29/2002084200/-1/-1/1/climate-change-report-2019.pdf>).

¹⁴³ Senate Committee on the Budget, *Budgeting for the Storm: Climate Change and the Costs to National Security*, 118th Cong. (May 15, 2024) (Testimony of Mr. Rick Dwyer) (online at <https://www.budget.senate.gov/imo/media/doc/mrrickdwyertestimonysenatebudgetcommittee.pdf>).

¹⁴⁴ *Ibid.*

\$10 billion from typhoon Mawar.^{145, 146} Costs will continue to increase as sea levels rise and climate-related severe weather events become even more damaging.



Climate change will also worsen the geopolitical risks that require military aid or intervention, such as the climate change-driven migration of up to 200 million people worldwide.^{147, 148} In Africa, food shortages are fueling insurgent movements, and increasingly severe droughts in Central America are driving more migration to the U.S. border.^{149, 150} A former Assistant Secretary of the Navy for Energy, Installations, and Environment summarized, “our national security is comprised of three big pillars: our

¹⁴⁵ Senate Committee on the Budget, *Budgeting for the Storm: Climate Change and the Costs to National Security*, 118th Cong. (May 15, 2024) (Opening Statement of Chairman Sheldon Whitehouse) (online at <https://www.budget.senate.gov/imo/media/doc/051524chairmanwhitehouseopeningstatement.pdf>).

¹⁴⁶ David Roza, *Air Force Needs \$10 Billion to Repair Guam After 2023 Typhoon*, Air and Space Forces Magazine (May 7, 2024) (online at <https://www.airandspaceforces.com/air-force-guam-mawar-recovery-cost/>).

¹⁴⁷ Senate Committee on the Budget, *Budgeting for the Storm: Climate Change and the Costs to National Security*, 118th Cong. (May 15, 2024) (Opening Statement of Chairman Sheldon Whitehouse) (online at <https://www.budget.senate.gov/imo/media/doc/051524chairmanwhitehouseopeningstatement.pdf>).

¹⁴⁸ International Organization for Migration, *A Complex Nexus* (2024) (online at <https://www.iom.int/complex-nexus#:~:text=Future%20forecasts%20vary%20from%2025,estimate%20of%20international%20migrants%20worldwide>).

¹⁴⁹ Senate Committee on the Budget, *Budgeting for the Storm: Climate Change and the Costs to National Security*, 118th Cong. (May 15, 2024) (Testimony of Ms. Erin Sikorsky) (online at <https://www.budget.senate.gov/imo/media/doc/mserinsikorskytestimonysenatebudgetcommittee.pdf>).

¹⁵⁰ Andrew Linke, Stephanie Leutert, Joshua Busby, Maria Duque, Matthew Shawcroft, & Simon Brewer, *Dry growing seasons predicted Central American migration to the US from 2012 to 2018*, Nature Scientific Reports (Oct. 27, 2023) (online at <https://www.nature.com/articles/s41598-023-43668-9.pdf>).

energy security, our economic security, and our environmental security. They directly lead to our quality of life, our safety, and our health.”¹⁵¹

Chapter IX: The Carbon Bubble

In addition to the physical risks and costs driven by climate change, there are transition risks associated with dependence on fossil fuels. As other major economies transition to clean energy, the U.S. has doubled down on fossil fuel production. The U.S. has become the world’s largest producer of oil since 2018 and its largest producer of natural gas since 2011,¹⁵² and the fossil fuel industry presses to continue expanding U.S. oil and gas production.¹⁵³

However, the economic viability of the U.S. oil and gas industry in a decarbonizing world is tenuous. The danger is that the cartel-propped fossil fuel market collapses when low-cost producing countries decide to sell what they can, while they can before clean energy leads to a decline in demand for fossil fuels. As global demand for oil and gas declines, the International Energy Agency predicts that the lowest cost producers, like Saudi Arabia, may rush for the exits and begin dumping their oil and gas. This would drive prices down, beyond the point of profitability for more costly fossil fuel producers, like the U.S.¹⁵⁴

Economists predict this could be a systemic risk, with consequences cascading well beyond the fossil fuel industry into national and global economies. Local governments face particular risk. From 2015 through 2020, oil, coal, and gas generated an average of \$138 billion in revenue annually for localities, states, tribes, and the federal government.¹⁵⁵ In some regions of the U.S., fossil fuel revenues make up more than 10 percent of state and local budgets; in Wyoming, they comprise 59 percent.¹⁵⁶ As Daniel

¹⁵¹ Senate Committee on the Budget, *Budgeting for the Storm: Climate Change and the Costs to National Security*, 118th Cong. (May 15, 2024) (online at <https://www.budget.senate.gov/hearings/budgeting-for-the-storm-climate-change-and-the-costs-to-national-security>).

¹⁵² Bill Brown & Ari Kahan, *The U.S. leads global petroleum and natural gas production with record growth in 2018*, Energy Information Administration (Aug. 20, 2019) (online at <https://www.eia.gov/todayinenergy/detail.php?id=40973>).

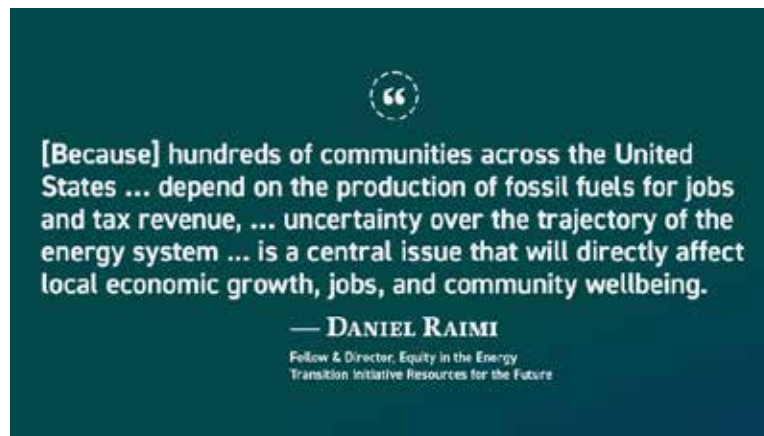
¹⁵³ Energy Information Administration, *Short-Term Energy Outlook* (Nov. 2024) (online at <https://www.eia.gov/outlooks/steo/archives/nov24.pdf>).

¹⁵⁴ International Energy Agency, *Net Zero by 2050: A Roadmap for the Global Energy Sector* (May 2021) (online at <https://www.iea.org/reports/net-zero-by-2050>).

¹⁵⁵ Daniel Raimi, Emily Grubert, Jake Higdon, Gilbert Metcalf, Sophie Pesek & Devyani Singh, *The Fiscal Implications of the US Transition away from Fossil Fuels*, Resources for the Future (Jan. 2022) (online at https://media.rff.org/documents/WP_22-3_-_Fiscal_Implications.pdf).

¹⁵⁶ Ibid.

Raimi, from Resources for the Future, explained, because “hundreds of communities across the United States ... depend on the production of fossil fuels for jobs and tax revenue, ... uncertainty over the trajectory of the energy system ... is a central issue that will directly affect local economic growth, jobs, and community wellbeing.”¹⁵⁷ And there are big unknowns, as Claudio Galimberti, North America Research Director of energy market analysis firm Rystad Energy, observed: “the outlook for US oil & gas could be dramatically different post-2030 depending on the pace of technological development and uptake.”¹⁵⁸



U.S. companies and investment funds, as the largest investors in foreign fossil fuels assets, stand to lose value as global demand for oil and gas shrinks. Particularly concerning is that this repricing could happen suddenly.¹⁵⁹ The decarbonization of the European Union and East Asia could wipe out \$1.4 trillion of value from fossil fuel assets—\$397 billion of which sits on the balance sheets of U.S. companies and investment funds.¹⁶⁰ Dr. Gregor Semieniuk, an assistant research professor of economics at the University of Massachusetts Amherst, concluded that “energy security in the short and long-run must consider a robust diversification away from relying

¹⁵⁷ Senate Committee on the Budget, *Left Holding the Bag: The Cost of Oil Dependence in a Low-Carbon World*, 118th Cong. (Mar. 29, 2023) (Testimony of Daniel Raimi) (online at <https://www.budget.senate.gov/download/testimony-raimi>).

¹⁵⁸ Senate Committee on the Budget, *Left Holding the Bag: The Cost of Oil Dependence in a Low-Carbon World*, 118th Cong. (Mar. 29, 2023) (Testimony of Claudio Galimberti) (online at <https://www.budget.senate.gov/imo/media/doc/Mr.%20Claudio%20Galimberti%20-%20Testimony%20-%20Senate%20Budget%20Committee14.pdf>).

¹⁵⁹ Gregor Semieniuk, Philip B. Holden, Jean-Francois Mercure, Pablo Salas, Hector Pollitt, Katharine Jobson, Pim Vercoulen, Unnada Chewprecha, Neil R. Edwards & Jorge E. Viñuales, *Stranded fossil-fuel assets translate to major losses for investors in advanced economies* (May 26, 2022) (online at <https://www.nature.com/articles/s41558-022-01356-y>).

¹⁶⁰ Ibid.

mainly on fossil fuels whose prices will only become more volatile in a declining global market.”¹⁶¹

Many economists contend that the present profitability of fossil fuels is, itself, a market failure. That is because the price of a barrel of oil does not include the costs of associated negative externalities: the damages to property, industries, markets, supply chains, infrastructure, and public health. These unpriced negative externalities are considered by most economists to be an indirect subsidy. The International Monetary Fund estimates implicit and explicit fossil fuel subsidies total \$760 billion annually in the U.S. alone and \$7 trillion globally.¹⁶² The economic artificiality of this vast subsidy creates added risk to the carbon bubble. Dr. Ted Gayer, an economist and the President of the Niskanen Center, shared that one corrective for the free-to-pollute business model, aligned with market principles, is to implement “a carbon tax that encourages consumers and producers to reduce emissions through market incentives.”¹⁶³ A timely carbon price would help lead to an orderly transition to a low-carbon economy and minimize the risks from stranded assets and the carbon bubble.

Chapter X: Not All Conservatives Oppose Climate Action

While most Republican witnesses at this series of hearings either downplayed or outright denied the economic risks and costs associated with climate change, and some even denied climate change itself, many conservative leaders understand what is at stake. The Committee spotlighted conservative support for climate action, contrasted with present partisan gridlock on climate in the United States. As Chairman Whitehouse emphasized, these witnesses proved that “there is nothing inherently conservative about ignoring climate change.”¹⁶⁴

¹⁶¹ Senate Committee on the Budget, *Left Holding the Bag: The Cost of Oil Dependence in a Low-Carbon World*, 118th Cong. (Mar. 29, 2023) (Testimony of Dr. Gregor Semieniuk) (online at <https://www.budget.senate.gov/download/testimony-semieniuk>).

¹⁶² Ibid.

¹⁶³ Senate Committee on the Budget, *Left Holding the Bag: The Cost of Oil Dependence in a Low-Carbon World*, 118th Cong. (May 3, 2023) (Testimony of Dr. Ted Gayer) (online at <https://www.budget.senate.gov/download/gayer-testimony->).

¹⁶⁴ Senate Committee on the Budget, *Lessons Learned: Leadership Perspectives and Experience on the National Costs of Climate Change*, 118th Cong. (May 10, 2023) (Opening Statement of Chairman Sheldon Whitehouse) (online at <https://www.budget.senate.gov/imo/media/doc/5.10.23%20opening%20remarks%20SW.pdf>).

In Australia, like the U.S., climate change is causing substantial economic disruptions. The Honorable Malcolm Turnbull, the former conservative Prime Minister of Australia, testified that natural disasters cost Australia \$38 billion a year—a cost that is projected to increase.^{165, 166}



The Honorable Malcolm Turnbull, former conservative Prime Minister of Australia, and Dr. Bill Frist, former Senate Majority Leader, testify at a Senate Budget Committee hearing. (May 10, 2023)

Like the U.S., Australia is experiencing large agricultural losses from climate change, and from 2001 to 2020, changes in seasonal conditions reduced average farm income by 23 percent.¹⁶⁷ Mr. Turnbull warned that climate change is damaging sensitive ocean ecosystems like the Great Barrier Reef because “the fundamental challenge [for the Reef] is the one of temperature.”¹⁶⁸

Chairman Whitehouse recalled domestic bipartisan achievements such as the Clean Air Act, the Clean Water Act, the creation of the Environmental Protection Agency (EPA), and joint work on the Montreal Protocol that phased out ozone-killing chlorofluorocarbons (CFCs).¹⁶⁹ “If we are unable to come together at home to address a fundamentally non-ideological issue [...], then our democracy is not functioning as it

¹⁶⁵ Senate Committee on the Budget, *Lessons Learned: Leadership Perspectives and Experience on the National Costs of Climate Change*, 118th Cong. (May 10, 2023) (Testimony of the Honorable Malcolm Turnbull) (online at <https://www.budget.senate.gov/imo/media/doc/Hon.%20Malcolm%20Turnbull%20-%20Testimony%20-%20Senate%20Budget%20Committee.pdf>).

¹⁶⁶ Special report: Update to the economic costs of natural disasters in Australia, Deloitte (2021) (online at <https://australianbusinessroundtable.com.au/assets/documents/Special%20report:%20Update%20to%20the%20economic%20costs%20of%20natural%20disasters%20in%20Australia/Special%20report%20Update%20to%20the%20economic%20costs%20of%20natural%20disasters%20in%20Australia.pdf>).

¹⁶⁷ Neal Hughes & Peter Gooday, *Climate change impacts and adaptation on Australian farms*, Australian Bureau of Agricultural and Resource Economics (May 20, 2022) (online at <https://www.agriculture.gov.au/abares/products/insights/climate-change-impacts-and-adaptation#recent-changes-in-seasonal-conditions-have-affected-the-profitability-of-australian-farms>).

¹⁶⁸ Senate Committee on the Budget, *Lessons Learned: Leadership Perspectives and Experience on the National Costs of Climate Change*, 118th Cong. (May 10, 2023) (online at <https://www.budget.senate.gov/hearings/lessons-learned-leadership-perspectives-and-experience-on-the-national-costs-of-climate-change>).

¹⁶⁹ Senate Committee on the Budget, *Lessons Learned: Leadership Perspectives and Experience on the National Costs of Climate Change*, 118th Cong. (May 10, 2023) (Opening Statement of Chairman Sheldon Whitehouse) (online at <https://www.budget.senate.gov/imo/media/doc/5.10.23%20opening%20remarks%20SW.pdf>).

should,” said Chairman Whitehouse as he called for the nation to return to bipartisan work on climate.¹⁷⁰

Former Republican Senate Majority Leader (and medical doctor) Bill Frist highlighted the links between climate change and health issues: heat stroke and heart, lung, and renal disease from extreme heatwaves; foodborne illnesses due to worsened runoff from intense precipitation; and vector-borne diseases such as the Zika and Chikungunya viruses which are found to spread more easily with increased temperatures.^{171, 172} Dr. Frist warned federal healthcare costs will escalate with climate change.¹⁷³ He called for a price on carbon emissions paired with a carbon border adjustment to “capture the market base, the flexibility, the dynamism of the private sector” to reduce dangerous greenhouse gas emissions.¹⁷⁴

Conclusion

Throughout the 118th Congress, the Senate Budget Committee systematically laid out the looming costs and risks associated with climate change. These risks and costs hit the federal budget, state and local governments, businesses, and families via scarcer and more expensive insurance policies, teetering property values, higher grocery prices, higher federal spending on health care, disaster relief, and crop insurance. The economic consequences of climate change will only worsen until we transition to a zero-carbon economy.

The Committee’s work presents Congress a stark choice: reduce emissions, blunt the costs associated with climate change, and reap the economic benefits of the transition to clean energy; or continue at the fossil fuel industry’s behest to do nothing, and put

¹⁷⁰ Ibid.

¹⁷¹ Méryl Delrieu, Jean-Philippe Martinet, Olivia O’Connor, Elvina Viennet, Christophe Menkes, Valérie Burtet-Sarramegna, Francesca D. Frentiu, & Myrielle Dupont-Rouzeyrol, *Temperature and transmission of chikungunya, dengue, and Zika viruses: A systematic review of experimental studies on Aedes aegypti and Aedes albopictus*, Current Research in Parasitology & Vector-Borne Diseases, Vol. 4 (Aug. 24, 2023) (online at <https://doi.org/10.1016/j.crpvbd.2023.100139>).

¹⁷² Senate Committee on the Budget, Lessons Learned: *Leadership Perspectives and Experience on the National Costs of Climate Change*, 118th Cong. (May 10, 2023) (Testimony of the Honorable Bill Frist, M.D.) (online at <https://www.budget.senate.gov/imo/media/doc/Hon.%20Bill%20Frist,%20M.D.%20-%20Testimony%20-%20Senate%20Budget%20Committee.pdf>).

¹⁷³ Ibid.

¹⁷⁴ Senate Committee on the Budget, Lessons Learned: *Leadership Perspectives and Experience on the National Costs of Climate Change*, 118th Cong. (May 10, 2023) (online at <https://www.budget.senate.gov/hearings/lessons-learned-leadership-perspectives-and-experience-on-the-national-costs-of-climate-change>).

our nation's economy at grave risk. Americans will be watching the choices that Congress makes, and no member of Congress can now say he or she wasn't warned.

UNCOVERING THE ECONOMIC COSTS OF CLIMATE CHANGE



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December 2024**