COSTS OF CLIMATE CHANGE

FINANCIAL AND ECONOMIC IMPACTS ON CALIFORNIA AND U.S. HOUSEHOLDS

NEXT 10

UC Berkeley
Center for Law, Energy & the Environment

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NEXT 10 is an independent nonpartisan organization that educates, engages and empowers Californians to improve the state's future.

Next 10 is focused on innovation and the intersection between the economy, the environment, and quality of life issues for all Californians. We provide critical data to help inform the state's efforts to grow the economy and reduce greenhouse gas emissions. Next 10 was founded in 2003 by businessman and philanthropist F. Noel Perry.

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"[Climate breakdown] is a recipe for permanent recession."
—Simon Stiell, Executive Secretary UN Framework Convention on Climate Change[1]

1 Fiona Harvey, "Tackling climate crisis will increase economic growth, OECD research finds," *The Guardian* (26 Mar. 2025), available at: https://www.theguardian.com/environment/2025/mar/26/tackling-climate-crisis-will-increase-economic-growth-oecd-research-finds

Executive Summary

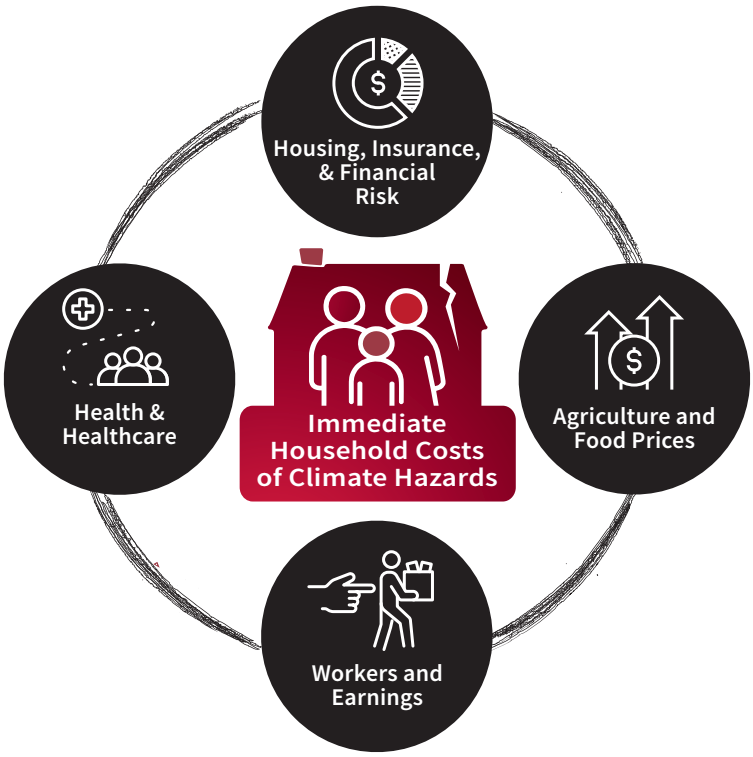
The costs of climate change are enormous and affect every sector of the economy. Disasters, including hurricanes, wildfires, and heat waves, are increasing in severity, causing costly damage to property, businesses, and health. Increasing temperatures, extreme events, and other climate-related disruptions affect energy consumption, health and lead to increased costs for households and businesses. These disruptions are also destabilizing insurance and financial markets.

The National Oceanic and Atmospheric Administration identified 27 individual climate disasters in which damages exceeded at least $1 billion in the United States in 2024.[2] Between 1980 and early 2025, climate-driven extreme events cost over $2.9 trillion nationwide. 40% of these costs have occurred in just three states (California, Texas, and Florida), and California incurred the 3rd most at 11.4%.[3] These events and associated costs are expected to continue to rise and individuals in their capacities as residents, taxpayers, ratepayers, and consumers bear the costs of climate change in a climate-impacted economy.

These large dollar amounts communicate the magnitude of the climate crisis, but they do not provide a clear picture into how climate change increases costs for individuals, businesses, or the public sector. The cost calculations of the impact of extreme events typically assess the direct costs of damages to infrastructure but often neglect the indirect and lasting effects of extreme events to individuals, businesses, and the public sector.[4]

As shown in Figure 1, climate change increases costs in a variety of ways - increasing costs to households and businesses, disrupting employment and wages, and increasing the costs of healthcare and insurance. Quantifying these disaggregated costs more clearly conveys the day-to-day economic impacts of climate change and makes it easier to identify possible solutions to mitigate these costs. This paper reviews available literature to provide a snapshot of the costs climate change poses for households, workers, businesses, public sector, and insurance – both nationally and in California.

Figure 1. Costs of climate change affect households, businesses, workers, and the public sector



Costs of Climate Change to California Households, Businesses, and Workers

California has unique vulnerabilities to climate because of its Mediterranean climate, the economic importance of climate-vulnerable industries including agriculture, tourism, and recreation, and the seasonal nature of its precipitation patterns that affect water supply. California is already experiencing severe impacts due to climate change – all of which are expected to increase in severity over the century.[5] Below are highlights of the costs of climate change to California households, businesses, workers, and the public sector.

2 Adam B. Smith, "2024: An active year of U.S billion-dollar weather and climate disasters, NOAA (January 10, 2025), available at https://www.climate.gov/news-features/blogs/beyond-data/2024-active-year-us-billion-dollar-weather-and-climate-disasters

3 *The 12th National Risk Assessment Property Prices in Peril,* First Street (February 2025), available at https://assets.riskfactor.com/media/The%2012th%20National%20Risk%20Assessment.pdf

4 Dylan E. McNamara and Andrew Keeler, "A coupled physical and economic model of the response of coastal real estate to climate risk", Nature Climate Change 3 (February 17, 2013), available at https://www.nature.com/articles/nclimate1826

5 Fourth CA Climate Assessment Statewide Summary Report

Climate Change and Household Expenses

Climate change increases a range of everyday household expenses through inflation, increased demand for services, and direct impacts on household products, including food. The average American born in 2024 can expect to pay $500,000 in climate costs[6] in their lifetime[7]—when including more uncertain climate factors, these estimates rise to $1 million.[8]

Inflation: Analysis shows that higher temperatures due to climate change increase the global rate of inflation in the economy by 0.32-1.18 percentage points per year.[9]

Electricity Costs:

- Increasing temperatures result in higher household energy costs due to increased use of air conditioning and other cooling technologies. A recent analysis of low-income residents in California found that for each additional day over 95°F, electricity costs increase by 1.6%.[10] Analysis of households who experienced damage from the 2023 flood in Planada, CA showed that nearly one fifth of those households fell behind on utility bills.[11]
- Wildfire mitigation costs are one of the two largest drivers of increasing electricity rates in California. Wildfire-related costs accounted for 7.1% to 12.8% of the average residential customer's bill in 2023.[12]

Insurance Premiums: Home insurance premiums rose over 23% between 2017 and 2022 as severe wildfire seasons incurred record-breaking infrastructure damages across the state.[13] Following the Los Angeles fires in 2025, State Farm (California's largest insurer) requested a 22% average rate increase for insurance policies across California.[14] Under that increase, State Farm policyholders would pay $841 more, on average, for home insurance in 2025 than they did in 2023.[15,16] Households in some communities will pay over $4,000 in premium increases.

Food Costs: Disruptions to supply chains, damage from storms, and other climate-related disruptions affect costs of food items. Some specific examples include:

- Orange juice concentrate prices in the U.S., the majority of which is produced in California and Florida, nearly doubled from 2020 to 2024 due to storm damage and other climate-related stresses.[17]
- Global losses in cacao production resulted in a 136% increase in the price of cocoa between 2022 and 2024.[18]

6 This estimate includes the increasing costs of climate change and expected decreases to income due to climate impacts.

7 ICF incorporated, ***Cost of Climate Chance to an American Born in 2024,*** ICF et al. (2024), available at: https://advocacy.consumerreports.org/wp-content/uploads/2024/04/ICF-CR-Cost-of-Climate-Change-Study.pdf

8 Id.

9 Maximilian Kotz, Friderike Kuik, Eliza Lis and Christiane Nickel, ***Global warming and heat extremes to enhance inflationary pressures***, Nature Communications Earth & Environment (2024), available at: https://www.nature.com/articles/s43247-023-01173-x

10 Alan Barreca et al., "High temperatures and electricity disconnections for low-income homes in California", Nature Energy 7 (October 20, 2022), available at https://www.nature.com/articles/s41560-022-01134-2

11 ***Disaster Response: The Planada Food, Federal Policy Gaps, and Unmet Community Needs,*** Community and Labor Center UC Merced (May 2023, available at https://clc.ucmerced.edu/sites/clc.ucmerced.edu/files/page/documents/disaster_response_0.pdf

12 California Public Utilities Commission. 2024. 2024 SENATE BILL 695 REPORT Report to the Governor and Legislature on Actions to Limit Utility Cost and Rate Increases Pursuant to Public Utilities Code Section 913.1. Available at: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2024/2024-sb-695-report.pdf

13 Judson Boomhower et al.,"How are Insurance Markets Adapting to Climate Change? Risk Classification and Pricing in the Market for Homeowners Insurance", National Bureau of Economic Research(2024), available at https://www.nber.org/system/files/working_papers/w32625/w32625.pdf

14 A 21.8% increase was approved by the California insurance commissioner in March 2025, pending a future hearing; Premiums on Fire: How State Farm's California rate hike forces the rising costs of climate disasters onto policyholders instead of the Big Oil companies fueling the crisis", Center for Climate Integrity(2025), available at https://climateintegrity.org/uploads/media/Premiums-On-Fire-2025.pdf

15 Premiums on Fire: How State Farm's California rate hike forces the rising costs of climate disasters onto policyholders instead of the Big Oil companies fueling the crisis", Center for Climate Integrity(2025), available at https://climateintegrity.org/uploads/media/Premiums-On-Fire-2025.pdf

16 State Farm requested a 22% average rate increase, but a judge ultimately approved for a 17% average rate increase.

17 Sasha Rogelberg , "Is breakfast endangered? Disease and extreme weather are jacking up coffee and orange juice prices—and consumers are getting squeezed", Fortune(2024), available at https://fortune.com/2024/06/11/orange-juice-coffee-prices-climate-change-agriculture-breakfast/

18 Id.

Disasters and Personal Expenses: Extreme events lead to increases in rent and other personal expenses. Analysis of households located within the perimeter of the 2020 Camp Fire showed higher rates of consumer credit card spending and, with that, higher delinquency rates, which were 45% above average in those households.[19]

Climate Change Impacts on Wages and Productivity

Climate-driven extreme events may create unsafe labor conditions due to wildfire smoke or extreme temperatures, leading to reduced productivity, hours and wages, furlough, or even job loss. In addition, they can result in time spent away from work due to adverse health impacts. California workers have already experienced the following:

Aggregate Lost Wages: The Moore Foundation estimated that wildfire results in approximately $60 billion in income loss, statewide, over the five year period from 2017 to 2021.[20]

Lost Wages and Extreme Events: The 2025 Los Angeles wildfires resulted in $297 million in lost wages for local employees and businesses.[21]

Reduced Employment: The 2021 drought led to a 2.9% decrease in total employment in the Central Valley, primarily in crop production. The 2022 drought decreased employment in the same region by 3.8%.[22]

Climate Change and Costs to Businesses

Climate change increases costs to businesses due to disruptions to supply chains, direct damage to products, and other costs. These increased costs are especially acute for the insurance industry. Impacts in California include the following:

Dairy Production: The California dairy industry lost $52 million in productivity due to the 2017 Central Valley Heat wave.[23]

Crop Productivity: The 2021 Desert Lands heat event resulted in $110 million in lost crop productivity.[24] The drought in that same year was estimated to cause $1.7 billion in revenue losses for farmers and upstream sectors providing agricultural goods and services in the state.[25]

Insurance: The 2020 wildfire season is estimated to have generated between $5 billion and $9 billion in insured losses, while the 2017 and 2018 wildfire seasons each produced over $10 billion in insured losses.[26]

19 Xudong An et al., "Extreme Wildfires, Distant Air Pollution, and Household Financial Health", SSRN (February 3, 2023), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4353113

20 James Paci et al., "The Economic, Fiscal, and Environmental Costs of Wildfires in California", Gordon and Betty Moore Foundation(2023), available at https://www.moore.org/docs/default-source/default-document-library/the-economic-fiscal-and-environmental-costs-of-wildfires-in-ca.pdf

21 Zhiyun Li and William Yu, *Economic Impact of the Los Angeles Wildfires,* UCLA Anderson School of Management (2025), available at: https://www.anderson.ucla.edu/about/centers/ucla-anderson-forecast/economic-impact-los-angeles-wildfires.

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

23 Rabab A. Charafeddine et al., Impacts of extreme heat to California's people, infrastructure and economy, California Department of Insurance (June 28, 2024), available at https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Impacts-of-extreme-heat-to-California-s-people-infrastructure-and-economy-by-California-Department-of-Insurance-June-2024.pdf

24 Rabab A. Charafeddine et al., Impacts of extreme heat to California's people, infrastructure and economy, California Department of Insurance (June 28, 2024), available at https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Impacts-of-extreme-heat-to-California-s-people-infrastructure-and-economy-by-California-Department-of-Insurance-June-2024.pdf

25 *Policy Brief: Drought and California's Agriculture,* Public Policy Institute of California, Supra. https://www.ppic.org/publication/policy-brief-drought-and-californias-agriculture/

26 *The True Costs of Wildfires,* Bay Area Council Economic Institute (November 2021), available at https://www.bayareaeconomy.org/report/the-true-cost-of-wildfires/

Climate Change and the Public Sector

Governments incur significant costs from climate change and climate-related disasters. These include damage to infrastructure, increased demand and/or stress on services, lost revenue from property taxes, and costs needed to prepare existing infrastructure for climate-related impacts. Climate risk can also lead to increased borrowing costs for local governments. A 1% increase in climate risk (measured through coastal cities' economic vulnerability to sea-level rise) has been associated with an increase of $1.7 million in issuance costs for average bonds.[27]

Infrastructure Damage: Extreme heat events result in damage to roads and railways. Recent heat events resulted in railway repairs and delays that cost between $3.8 million to $35 million per heat event.[28]

Revenue and GDP Loss: Los Angeles County incurred approximately $4.6 billion in direct GDP losses from the wildfires.[29]

Infrastructure Preparation: California jurisdictions have spent over $6 billion on solutions to sea-level rise, including $5 billion to reinforce San Francisco's seawall and $120 million to protect from sea-level rise in the San Elijo Lagoon in San Diego.[30]

The subsequent sections provide a more comprehensive review of the literature that captures the direct and indirect costs associated with climate change. The next section provides an overview of the most well-documented direct costs with a focus on infrastructure damages, rising utility expenses, and increased spending during climate disasters, followed by a section reviewing indirect costs. This report provides a snapshot of the nationwide costs and those specific to California and concludes with recommendations for future research.

Areas for Future Research

This literature review provides an initial review of available literature on the costs of climate change and provides a starting point for future research and analysis. The literature review reveals significant information gaps on how climate change affects the costs of food and basic household expenses, businesses, and workers.

Quantifying the costs of climate change is complex, but more complete information on the financial impacts of climate hazards is urgently needed. This research will be instrumental in conducting cost-benefit analyses of both mitigation and adaptation measures to address the impacts of climate-related extreme events.

27 Marcus Painter, "An inconvenient cost: The effects of climate change on municipal bonds", Journal of Financial Economics(2020), available at https://www.sciencedirect.com/science/article/pii/S0304405X19301631?casa_token=grhFhVOcaOcAAAAA:huoLoHsbQ-mO1P-pFLvV_TIZOGGjkH0lrZsluovxjs9aXWZhVRGi2qErQhgcv6zdaamMUE-tJtQ

28 Rabab A. Charafeddine et al., Impacts of extreme heat to California's people, infrastructure and economy, California Department of Insurance (June 28, 2024), available at https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Impacts-of-extreme-heat-to-California-s-people-infrastructure-and-economy-by-California-Department-of-Insurance-June-2024.pdf

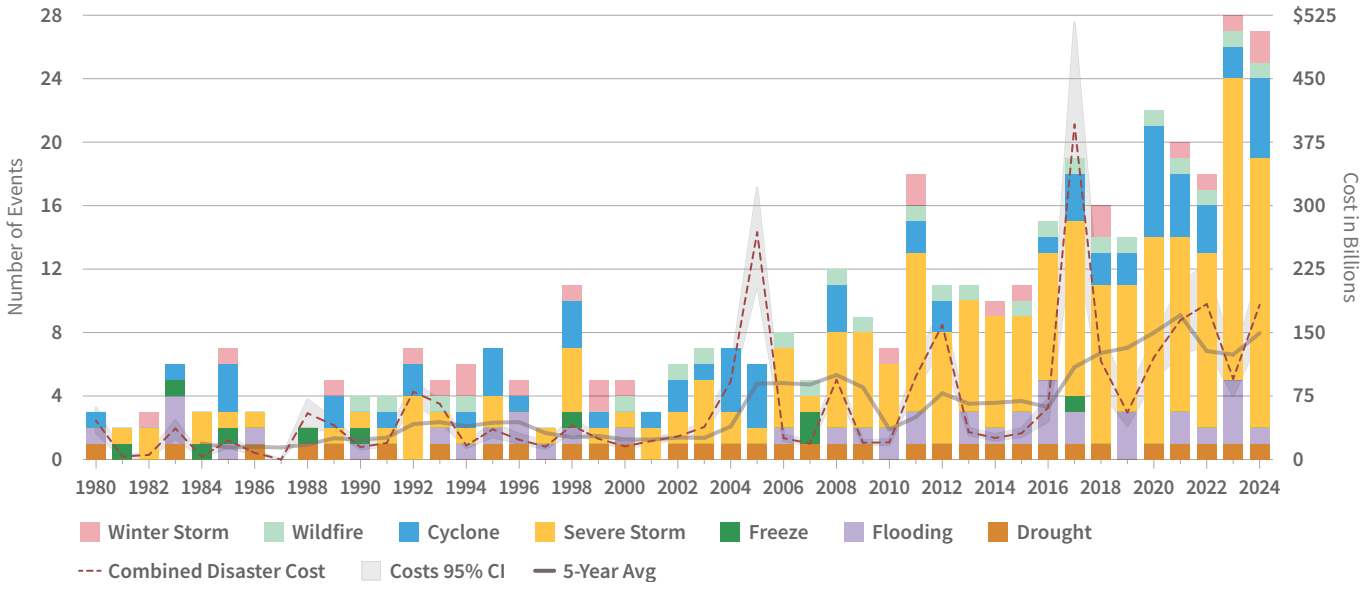
29 Zhiyun Li et al., Supra https://www.anderson.ucla.edu/about/centers/ucla-anderson-forecast/economic-impact-los-angeles-wildfires

30 "California's Sea Level Rise", Sea Level Rise, available at https://sealevelrise.org/states/california/

I. Introduction

California, like the rest of the world, is already experiencing the effects of climate change. The state is experiencing increasing average temperatures, rising sea levels, and an increase in the frequency and severity of extreme events.[31]

Figure 2. Billion-dollar disaster events in the U.S. between 1980-2024 (CPI-adjusted)[31]



Notes: The 5-year average cost does not start until 1984.

Some the changes happening in California include:

- Annual average temperature has increased 2.5° F since 1895 and the rate of warming has increased in the last three decades.
- The number of extreme heat events has increased dramatically since 1950.
- The area burned by wildfire annually has increased dramatically over the last several decades. More acres burned in 2020 than any year on record. The total acres burned in 2020 was more than double any other recorded year.

California produces a regular Climate Change Assessment that provides projections of future climate change under different future scenarios at a scale that is relevant for state and regional planning. The Fourth California Climate Change Assessment, published in 2018, shows that, even under the best-case scenario, California will experience warming of at least 5.5° F by 2100.[33] The Fourth California Climate Change Assessment also projects an increase in heavy precipitation events (i.e., atmospheric rivers), prolonged drought, and declining snowpack.[34]

Climate-Induced Extreme Events

The National Oceanic and Atmospheric Administration identified 27 individual climate disasters in which damages exceeded at least $1 billion in the United States in 2024.[35] The rate of these high-cost disasters is increasing across all categories, including wildfire, flooding, severe storms, drought, tropical cyclones, freezes, and winter storms. Climate-driven disasters in 2024 resulted in approximately $182.7 billion in damages in the U.S. – from 1980 to 2024, the combined cost of climate-driven extreme events was over $2.9 trillion.

Since 2020, damages for climate-driven extreme events have cost Americans hundreds of billions of dol-

31 Adam B. Smith et al., supra https://www.climate.gov/news-features/blogs/beyond-data/2024-active-year-us-billion-dollar-weather-and-climate-disasters

32 Office of Environmental Health Hazard Assessment, 2022. Indicators of Climate Change. https://oehha.ca.gov/sites/default/files/media/downloads/climate-change/document/2022caindicatorsreport.pdf

33 Bedsworth, Louise, Dan Cayan, Guido Franco, Leah Fisher, Sonya Ziaja. (California Governor's Ofce of Planning and Research, Scripps Institution of Oceanography, California Energy Commission, California Public Utilities Commission). 2018. Statewide Summary Report. California's Fourth Climate Change Assessment. Publication number: SUMCCCA4-2018-013

34 Id.

35 Adam B. Smith, "2024: An active year of U.S billion-dollar weather and climate disasters, NOAA (January 10, 2025), available at https://www.climate.gov/news-features/blogs/beyond-data/2024-active-year-us-billion-dollar-weather-and-climate-disasters

lars. The Federal Reserve found that 13% of Americans reported financial hardship specifically due to extreme events in 2022.[36] Texas, Florida, and California have incurred 40% of the nation's climate-driven disaster costs between 1980 and early 2025, at 15.6%, 14.4%, and 11.4%, respectively.[37] While the costs of extreme events are staggering, multiple estimates point to these numbers being underestimated because they do not account for indirect and downstream associated losses.[38]

The number, severity, and cost of climate-driven extreme events are all increasing.[39] Climate change is increasing the frequency and severity of extreme events resulting in greater damage to health, infrastructure, and well-being. According to the Fifth National Climate Assessment, each additional degree of climate warming incurs significant economic losses[40]—a global temperature increase of 2°F is expected to more than double the economic harm caused by 1°F of warming.[41] These increasing costs are amplified by higher rates of development in high-risk areas, increasing exposure to climate risks. For example, in the United States, the number of new houses in the wildland urban interface grew 41% between 1990 and 2010.[42]

Equity and Climate Risks

While these costs are rising for all households, all households are not experiencing them equally. A 2023 Department of the Treasury report shows significant overlap between U.S. counties with high exposure risk and those with high social vulnerability.[43] The report found that 53% of U.S. counties face especially high exposure to future climate-driven extreme events, including large areas of California vulnerable to wildfire, drought, and extreme heat.[44] Nearly one-fifth of U.S counties in this category also face elevated social vulnerability, defined as communities that are most vulnerable to the impacts of hazards and stressors due to demographic and socioeconomic factors, according to data from the Centers for Disease Control and Prevention's Social Vulnerability Index.[45]

Cost calculations of the impact of extreme events typically assess the direct costs of infrastructure damages, neglecting the indirect and lingering effects of extreme events as well as their distributional impacts.[46] Climate change and climate-induced extreme events result in high costs to households, businesses, and workers. They also lead to increased healthcare costs resulting from exposure to climate hazards.

36 Alicia Lloro et al., *Economic Well-Being of U.S Households in 2022*, Board of Governors of the Federal Reserve System (May 2023), available at https://www.federalreserve.gov/publications/files/2022-report-economic-well-being-us-households-202305.pdf

37 *The 12th National Risk Assessment Property Prices in Peril*, First Street (February 2025), available at https://assets.riskfactor.com/media/The%2012th%20National%20Risk%20Assessment.pdf

38 Smith, *Supra* https://www.ncei.noaa.gov/monitoring-content/billions/docs/smith-and-katz-2013.pdf, https://assets.riskfactor.com/media/The%2012th%20National%20Risk%20Assessment.pdf

39 *The Impact of Climate Chance on American Household Finances,* U.S Department of the Treasury (September 2023), available at https://home.treasury.gov/system/files/136/Climate_Change_Household_Finances.pdf, Smith, Supra https://www.ncei.noaa.gov/access/billions/

40 C.W. Avery et al., *Fifth National Climate Assessment Front Matter*, Global Change Research Program (2023), available at https://toolkit.climate.gov/sites/default/files/2025-07/NCA5_2023_FullReport.pdf

41 A.R. Crimmins et al., *Fifth National Climate Assessment*, Global Change Research Program (2023), available at https://toolkit.climate.gov/sites/default/files/2025-07/NCA5_2023_FullReport.pdf

42 Radeloff, VC, et al. 2018. Rapid growth of the US wildland-urban interface raises wildfire risk. Proceedings of the National Academy of Scientists. 115(13). https://www.pnas.org/doi/abs/10.1073/pnas.1718850115

43 U.S Department of the Treasury https://home.treasury.gov/system/files/136/Climate_Change_Household_Finances.pdf

44 USGCRP, U.S. Climate Thresholds – LOCA RCP 8.5 Early Century, 4th National Climate Assessment (2018), at https://resilience.climate.gov/maps/nationalclimate::u-s-climate-thresholds-loca-rcp-8-5-early-century/about. Detailed technical documentation is available at https://scenarios. globalchange.gov/loca-viewer/

45 CDC, CDC/ATSDR Social Vulnerability Index (CDC/ATSDR SVI), ATSDR's Geospatial Research, Analysis & Services Program (2022), at https://www.atsdr.cdc. gov/placeandhealth/svi/fact_sheet/pdf/GRASP-Social-Vulnerability-Index-v10262022.pdf.

46 Dylan E. McNamara and Andrew Keeler, "A coupled physical and economic model of the response of coastal real estate to climate risk", Nature Climate Change 3 (February 17, 2013), available at https://www.nature.com/articles/nclimate1826

The remainder of this paper reviews available literature on the costs of climate change to California, starting with the direct effects of extreme events and sea level rise, including specific costs to households. This is followed by a review of how climate change affects health and healthcare, including costs and access. The next section reviews disruptions to agriculture, including discussion of impacts on food prices. The final section provides a review of how climate change affects insurance, housing, and financial risk. The literature review concludes with a brief summary and next steps.

Figure 3a. Mapping climate hazards and social vulnerability across the U.S.[45]

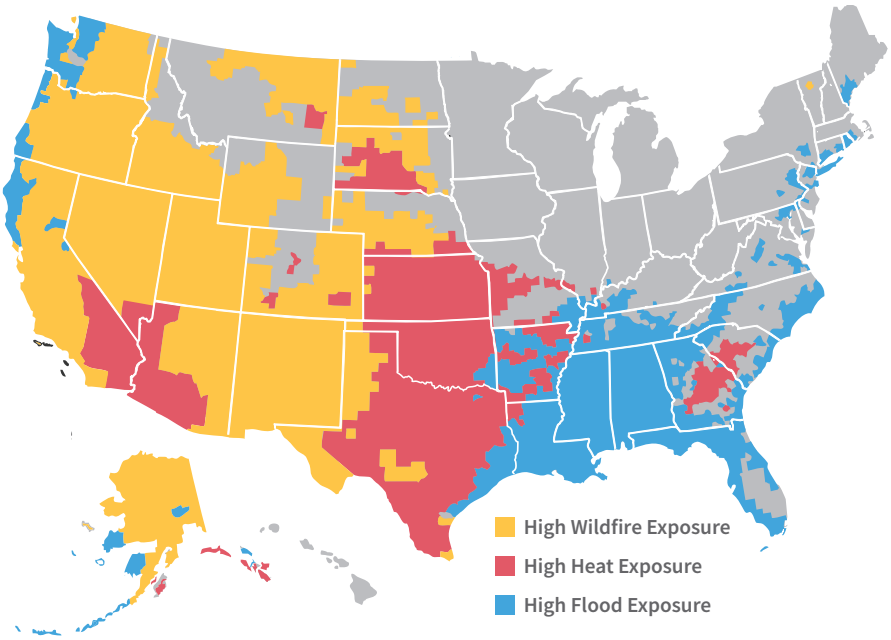
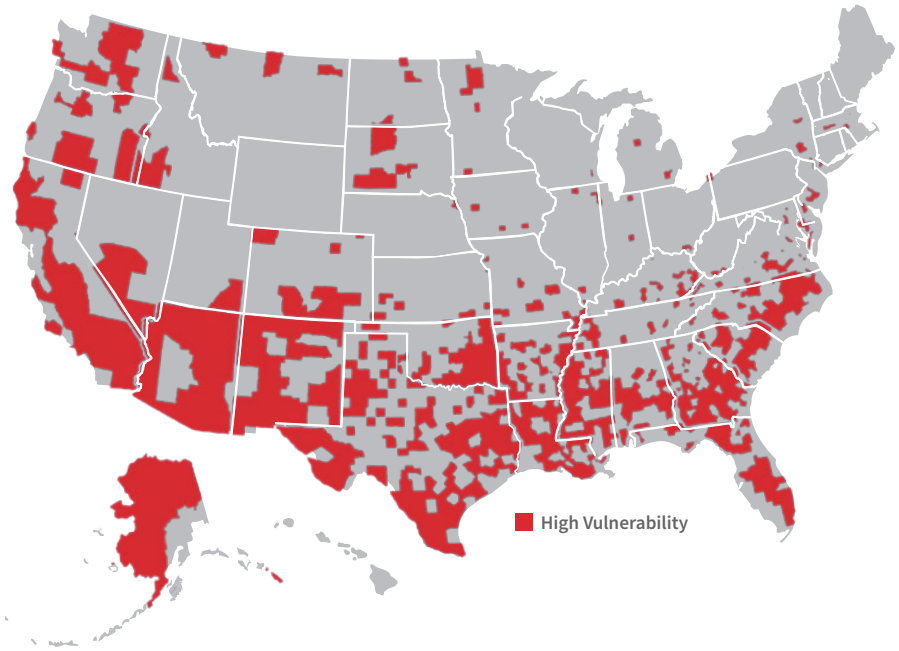
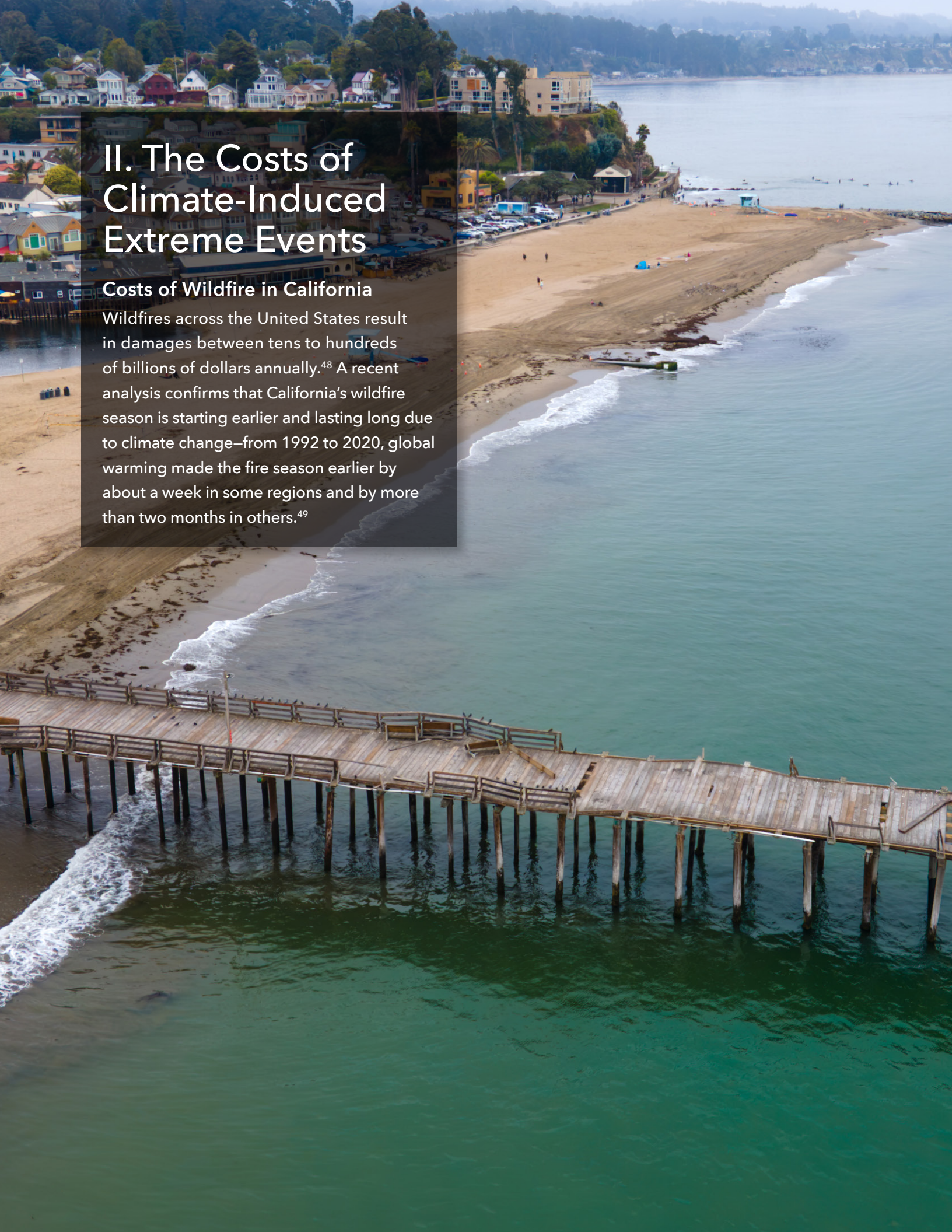


Figure 3b. Social vulnerability by county, top 25 percent[45]



47 https://home.treasury.gov/system/files/136/Climate_Change_Household_Finances.pdf



II. The Costs of Climate-Induced Extreme Events

Costs of Wildfire in California

Wildfires across the United States result in damages between tens to hundreds of billions of dollars annually.[48] A recent analysis confirms that California's wildfire season is starting earlier and lasting long due to climate change–from 1992 to 2020, global warming made the fire season earlier by about a week in some regions and by more than two months in others.[49]

This year, California has already experienced devastating losses from the Los Angeles wildfires in January, resulting in estimated wildfire-induced property and capital losses of $95 billion and $164 billion, respectively.[50] It is also estimated that Los Angeles County incurred approximately $4.6 billion in direct GDP losses from the wildfires.[51] These costs largely do not include the health, income, financial, and insurance impacts associated with wildfire damages, which will be addressed in later sections.

The rising costs of wildfire damages have been well-documented through multiple record-breaking fire seasons in California over the last decade. A report by the Moore Foundation calculated the average annual economic costs of wildfires in California between 2017 and 2021 to be over $117.4 billion.[52] The 2020 wildfire season is estimated to have generated between $5 billion and $9 billion in insured losses, while the 2017 and 2018 wildfire seasons each produced over $10 billion in insured losses.[53] The 2018 Camp Fire destroyed over 18,000 structures[54] and resulted in damages of $19 billion (inflation-adjusted).[55] These costs are primarily borne by California residents and households as a result of damages to personal property, increased utility bills, or contributing taxpayer dollars to public infrastructure recovery.

Wildfire Costs to Households and Businesses

Wildfire mitigation costs, which are expected to continue to grow, are one of the two largest drivers of increasing electricity rates in California. Between 2019 and the third quarter of 2023, the state and federal regulators authorized placing approximately $27 million of "wildfire-related" costs the rates of California's three investor-owned utilities.[56] Wildfire-related costs include wildfire mitigation (e.g., vegetation management) and insurance costs. Wildfire-related costs have become an increasing share of residential rates. In 2023, the wildfire-related portion of the average customer's bill for three investor-owned utilities ranged from 7.1% to 12.8% (Figure 5).

Climate-related extreme events such as catastrophic wildfires result in increased personal spending. An et al. (2025) documented higher rates of consumer credit card spending and credit card delinquency in households within the perimeter of the Camp Fire, with delinquency rates 45% above average within the burn area (Figure 4).[58] These higher rates were primarily associated with additional borrowing by renter households with lower credit scores, highlighting the financial vulnerability of lower-income households to climate shocks. The costs of wildfire smoke are also often experienced by populations far from the original source: smoke pollution from the 2023 Canadian wildfires adversely affected residents in

48 Christian Crowley et al., *Increasing damages from wildfires warrant investment in wildland fire management*, U.S. Department of the Interior, Office of Policy Analysis (2023), available at: https://www.doi.gov/sites/doi.gov/files/ppa-report-wildland-fire-econ-review-2023-05-25.pdf.

49 Madakumbura et al. 2025. Anthropogenic warming drives earlier wildfire season onset in California. *Science Advances 11(32).*

50 Zhiyun Li et al., "Economic Impact of the Los Angeles Wildfires", UCLA Anderson Forecast (March 32025), available at https://www.anderson.ucla.edu/about/centers/ucla-anderson-forecast/economic-impact-los-angeles-wildfires

51 Zhiyun Li et al., Supra https://www.anderson.ucla.edu/about/centers/ucla-anderson-forecast/economic-impact-los-angeles-wildfires

52 James Paci et al., *The Economic, Fiscal, and Envrionmental Costs of Wildfires in California*, Gordon and Betty Moore Foundation (June 27 2023), available at https://www.moore.org/docs/default-source/default-document-library/the-economic-fiscal-and-environmental-costs-of-wildfires-in-ca.pdf

53 *The True Costs of Wildfires*, Bay Area Council Economic Institute (November 2021), available at https://www.bayareaeconomy.org/report/the-true-cost-of-wildfires/

54 California Department of Forestry and Fire Protection (CAL FIRE), "Remembering the Camp Fire" (webpage), available at: https://www.fire.ca.gov/our-impact/remembering-the-camp-fire.

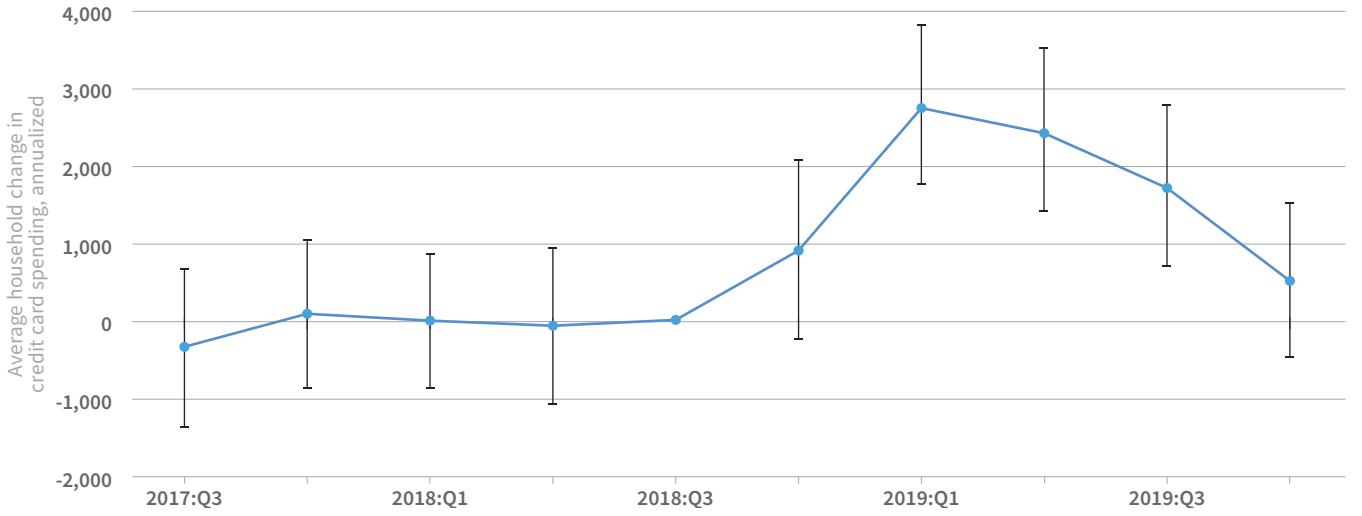
55 Emily Orzechowski et al., *Taming Wildfires in the Context of Climate Change*, OECD Environment Policy Paper No. 40, available at: https://www.oecd-ilibrary.org/deliver/ef69cc94-en.pdf?itemId=/content/paper/ef69cc94-en&mimeType=pdf.

56 California Public Utilities Commission. 2024. 2024 SENATE BILL 695 REPORT Report to the Governor and Legislature on Actions to Limit Utility Cost and Rate Increases Pursuant to Public Utilities Code Section 913.1. Available at: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2024/2024-sb-695-report.pdf

57 Xudong An et al., "Dirty air from wildfires casts a cloud over household finances", Federal Reserve Bank of Dallas (September 24, 2024), available at https://www.dallasfed.org/research/economics/2024/0924; Xudong An et al., Supra https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4353113.

58 California Public Utilities Commission. 2024. 2024 SENATE BILL 695 REPORT Report to the Governor and Legislature on Actions to Limit Utility Cost and Rate Increases Pursuant to Public Utilities Code Section 913.1. Available at: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2024/2024-sb-695-report.pdf"

Figure 4. Credit card spending increases in the Camp Fire burn area[59]



Notes: This figure shows the temporal pattern of the estimated Camp Fire effect on credi card spending and balance in a difference-in-differences framework. The graphic compares borrowers living in wildfire burn areas (the treatment group) with those that are five miles away from the fire perimeter (the control group), before and after the Camp Fire. Results are adjusted for fixed effects and additional time-varying control variables.
Sources: U.S. Department of Homeland Security National Incident Management System/Incident Command System; U.S. Forest Service Monitoring Trends in Burn Severity databases; Federal Reserve &-14M

New York, leading to an estimated additional $6 billion in household[59] credit card spending and $10 billion in household credit card debt for the affected households in New York.[60]

Wildfire also causes business disruptions, which affect workers and local tax revenue. An analysis by the Bay Area Council Economic Institute found a reduction in hotel tax receipts in Napa and Sonoma Counties in the fiscal year following the North Bay Fires. Travel and leisure account for 12% of employment in these two counties. Unemployment claims in the two counties more than tripled in 2017, the year of the fire, compared to the previous and following years.[62]

Figure 5. Wildfire-related portion of the average monthly bill for residential customers[63]

	Total Bill	Wildfire-Related Portion ($)	Wildfire-Related Portion (%)
PG&E	$190.94	$24.42	12.8%
SCE	$174.79	$17.73	10.1%
SDG&E	$182.82	$12.97	7.1%

Costs of Extreme Heat in California

Most of the financial costs of extreme heat are related to healthcare expenses, lost income, and lost agricultural productivity addressed in later sections. However, the immedi-

59 Xudong An et al., "Dirty air from wildfires casts a cloud over household finances", Federal Reserve Bank of Dallas (September 24, 2024), available at https://www.dallasfed.org/research/economics/2024/0924; Xudong An et al., Supra https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4353113.

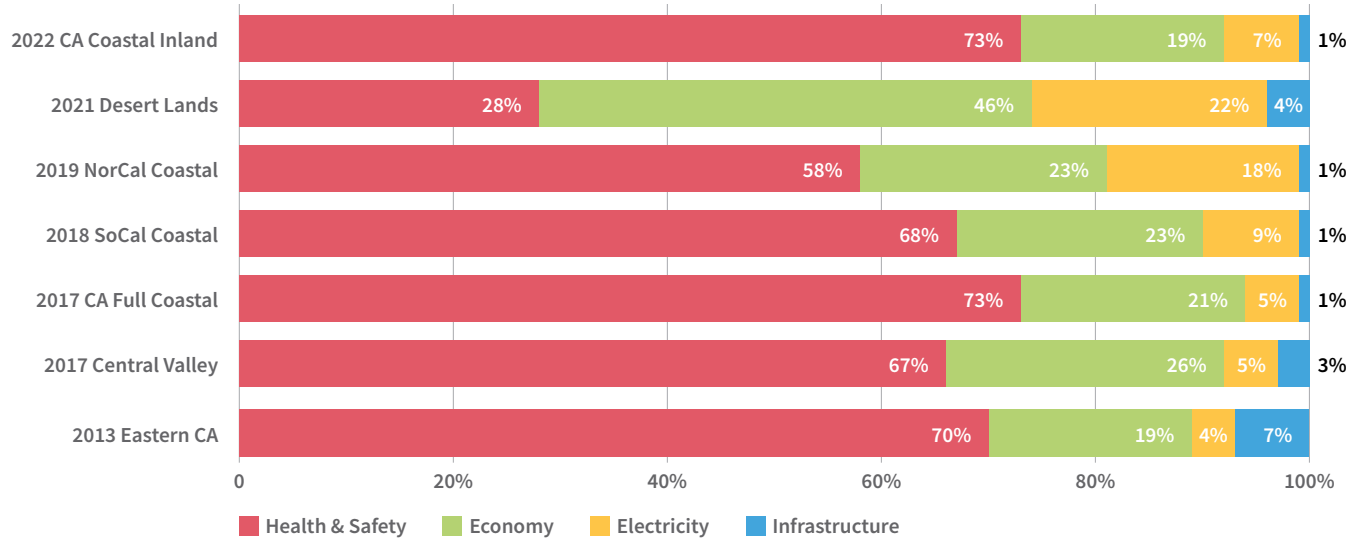
60 Xudong An et al., "Extreme Wildfires, Distant Air Pollution, and Household Financial Health", SSRN (February 3, 2023), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4353113

61 Rabab A. Charafeddine et al., Supra https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Impacts-of-extreme-heat-to-California-s-people-infrastructure-and-economy-by-California-Department-of-Insurance-June-2024.pdf

62 Bay Area Council Economic Institute. 2021. The True Costs of the Wildfires: Analyzing the Effect of Wildfires on the California Economy. Available at: https://www.bayareaeconomy.org/files/pdf/BACEI_WildfireImpacts_Nov2021.pdf

63 California Public Utilities Commission. 2024. 2024 SENATE BILL 695 REPORT Report to the Governor and Legislature on Actions to Limit Utility Cost and Rate Increases Pursuant to Public Utilities Code Section 913.1. Available at: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2024/2024-sb-695-report.pdf

Figure 6. Share of extreme heat costs by category: health and safety, economy, electricity, and infrastructure[64]



Note: Health & Safety - Healthcare expenses. Economy - Lost income or agricultural productivity. Electricity - Power outages. Infrastructure - Damage to roads and railways.

ate damages of heat waves are extensive—affecting health and safety, the economy, energy use, and infrastructure (Figure 6). The California Department of Insurance calculated the total economic impact of seven extreme heat events in California at $7.7 billion, impacting nearly the entire California population.[65] The 2017 Central Valley heat event resulted in dairy productivity losses of $52 million, while the 2021 Desert Lands event created $110 million in lost crop productivity. Reduced work time in heat-affected industries cost a total of $210 million during the 2022 CA Coastal Inland event.

These costs included damage to roads and railways, causing repairs and delays costing $3.8 million to $35 million per heat event.[66] Heat softens asphalt road surfaces, creating ruts that necessitate resurfacing and other repairs, as well as causing delays and damages to vehicles. Heat also expands rails, causing speed restrictions and subsequent train delays; in severe cases, high heat can deform rails and lead to derailment.

64 Rabab A. Charafeddine et al., Supra https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Impacts-of-extreme-heat-to-California-s-people-infrastructure-and-economy-by-California-Department-of-Insurance-June-2024.pdf

65 Rabab A. Charafeddine et al., Impacts of extreme heat to California's people, infrastructure and economy, California Department of Insurance (June 28, 2024), available at https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Impacts-of-extreme-heat-to-California-s-people-infrastructure-and-economy-by-California-Department-of-Insurance-June-2024.pdf

66 Id.

Figure 7. Summary of economic impacts of extreme heat events in California[67]

Heat Event	Dairy Productivity	Dairy Cow Mortality	Crop Productivity	Manufacturing Productivity	Reduced Work Time in Weather-Exposed Industries
1. 2022 CA Coastal Inland	$17,000,000	$330,000	$72,000,000	$310,000,000	$210,000,000
2. 2021 Desert Lands	$13,000,000	$280,000	$110,000,000	$2,600,000	$7,300,000
3. 2019 NorCal Coastal	$210,000	$4,100	$630,000	$74,000,000	$12,000,000
4. 2018 SoCal Coastal	$1,100,000	$61,000	$49,000,000	$84,000,000	$81,000,000
5. 2017 CA Full Coastal	$3,300,000	$1,100,000	$14,000,000	$230,000,000	$140,000,000
6. 2017 Central Valley	$52,000,000	$1,100,000	$58,000,000	$35,000,000	$59,000,000
7. 2013 Eastern CA	$2,500,000	$52,000	$17,000,000	$7,100,000	$18,000,000

Note: Total losses across economic impact categories for seven extreme heat events.

Costs of Extreme Heat to Households and Businesses

The Department of Insurance report data also includes the costs of heat-related power outages, with the 2022 California Coastal Inland event ranking the highest at $230 million (Figure 8). The costs associated with power outages primarily include the costs of business interruption, as well as other system disruptions such as transport and school closures. These costs have increased over time—the costs from the 2013 Eastern CA event were much lower at $9.6 million.[68]

As extreme heat events increase energy use for cooling, rising energy expenses have become a key immediate cost of heat events. Barreca et al. find that each additional day of temperatures reaching 95°F increases electricity costs by 1.6% in California, posing a significant affordability burden on lower-income households.[70] As the failure to pay energy bills can lead to household disconnection by utility providers, this study found that the risk of disconnection for households in California also increased by 1.2% with each additional day of temperatures reaching 95°F.[71]

Figure 8. Power outage costs of extreme heat in California (millions 2022 dollars)[69]

	Total Costs	Residential User Costs	Commercial & Industrial User Costs
1. 2022 CA Coastal Inland	$230	$2.2	$230
2. 2021 Desert Lands	$63	$0.84	$62
3. 2019 NorCal Coastal	$69	$0.81	$69
4. 2018 SoCal Coastal*	$83	$0.73	$82
5. 2017 CA Full Coastal*	$92	$0.93	$91
6. 2017 Central Valley*	$39	$0.40	$38
7. 2013 Eastern CA*	$9.6	$0.14	$9.5

Note: Totals may not sum due to rounding.

* County-level outage data not available for these events. Results are estimates based on person-days in the event and average costs from three events with outage data.

67 Rabab A. Charafeddine et al., Supra https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Impacts-of-extreme-heat-to-California-s-people-infrastructure-and-economy-by-California-Department-of-Insurance-June-2024.pdf

68 Id.

69 Id.

70 Alan Barreca et al., "High temperatures and electricity disconnections for low-income homes in California", Nature Energy 7 (October 20, 2022), available at https://www.nature.com/articles/s41560-022-01134-2

71 Id.; Disconnections seen in 71 to 75 days following the heat event.

Costs of Floods in California

Between 1996 and 2019, 99% of U.S. counties experienced a flooding event.[72] The U.S. Congress Joint Economic Committee estimated in 2024 that the total cost of flooding in the U.S. is between $179.8 and $496.0 billion annually (in 2023 dollars).[73] A series of atmospheric rivers in California in 2024 caused $4.5 billion in recorded damages.[74] Floods in 2023 also generated $5 billion to $7 billion in economic losses in California,[75] and over $900 billion worth of homes and other structures in California face some level of flooding risk.[76]

Costs of Floods to Households

The 2023 flood in Planada, a small town in Merced County, California, caused financial losses for over 700 households (80% of households in Planada).[77] A UC Merced Community and Labor Center analysis found that of households with losses from the flood, 19% had fallen behind on their utility bill payments and 4% had fallen behind on their rent or mortgage payments as a result of the flood, while 21% fell behind on both (Figure 9).

Figure 9. Households that fell behind on bills among house holds impacted by work or property loss during the 2023 flood in Planada, California[78]

	Percent	Estimate
Not Fallen Behind	57%	422
Fallen Behind on Both Rent/Mortgage or Utilities	21%	155
Fallen Behind on Utilities	19%	138
Fallen Behind on Rent/Mortgage	4%	26
Households w/ losses from Jan. 9 Flood	100%	741
Amount Fell Behind on Bills (mean)	$1,448	301

Source: UC Merced Community and Labor Center analysis of Planada Flood Community Needs Assessment Survey 2023

Costs of Sea-Level Rise in California

Global sea levels have risen between 21 and 24 centimeters (8.3-9.4 inches) on average since 1880,[79] and the expected direct cost of 67 cm (2.2 feet) of sea-level rise in the U.S. has been projected at $254.1 billion.[80] In California, the costs of just three sea-level rise projects is over $6 billion: the City of San Francisco is undergoing a $5 billion infrastructure improvement project to reinforce the city's seawall, and San Diego County has begun a $120 million project to increase resilience to sea-level rise in the San Elijo Lagoon, among others.[81]

72 "Historical Flood Risks and Costs", FEMA (2019), available at Historical Flood Risk and Costs | FEMA.gov, available at https://www.fema.gov/ca/about/reports-and-data/data-visualizations

73 "Flooding Costs the U.S Between $179.8 and $496.0 Billion Each Year," Joint Economic Committee (June 2024), available at https://www.jec.senate.gov/public/_cache/files/bc171a7e-2829-462d-8193-7b7c4d59a6e3/jec-report-on-economic-cost-of-flooding.pdf

74 https://www.ncei.noaa.gov/access/billions/state-summary/CA.

75 Jeffrey Mount et al., *Floods in California*, Public Policy Institute of California (February 2024), available at https://www.ppic.org/publication/floods-in-california/

76 Id.

77 *Disaster Response: The Planada Food, Federal Policy Gaps, and Unmet Community Needs*, Community and Labor Center UC Merced (May 2023, available at https://clc.ucmerced.edu/sites/clc.ucmerced.edu/files/page/documents/disaster_response_0.pdf

78 https://clc.ucmerced.edu/sites/clc.ucmerced.edu/files/page/documents/disaster_response_0.pdf

79 Rebecca Lindsey, "Climate Change: Global Sea Level", NOAA (August 22, 2023), available at https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level

80 Nisha Krishnan et al., "Climate change adaptation cost in the US: what do we know?", Climate Policy 14 (March 26, 2013), available at https://www.tandfonline.com/doi/full/10.1080/14693062.2013.777604

81 "California's Sea Level Rise", Sea Level Rise, available at https://sealevelrise.org/states/california/

By 2050, California properties worth $10 billion[82] and buildings worth $17.9 billion[83] are expected to be inundated due to sea-level rise.[84] Rising sea levels threaten an estimated $62 billion worth of coastal property in the San Francisco Bay region alone.[85] Protecting grey and green infrastructure in the Bay Area from sea-level rise and associated storm surges is expected to cost $110 billion by 2050,[86] and by 2100, estimates of sea-level rise damage in California could reach $150 billion in property value.[87] Ninety centimeters of sea-level rise by 2100 is projected to leave 4.2 million residents in the continental U.S. underwater, including many on the California coast.[88]

Costs of Drought in California

While many of the costs of drought involve income and agricultural losses addressed in more detail in later sections, this section provides a brief overview of droughts' immediate economic impacts in California. Drought accounted for 41% of all costs associated with extreme weather events in the U.S. over a 20-year span,[89] and the economic impact of the 2021 drought in California resulted in an estimated $1.7 billion in revenue losses alone.[90]

Costs of Drought to Households

As droughts reduce local water availability, water providers enact emergency mitigation measures, including curtailment or investment in additional water sources, raising costs passed down to residents through increased water rates.[91] A 2023 study that evaluated drought impact on households in Santa Cruz found that, in all scenarios modeled, droughts and resulting water provider investments disproportionately reduced water affordability for low-income households. Monthly bills consistently increased for low-income households by a range of $2 and $72, while bills decreased for high-income households in some cases.[92] Other research has also shown that low-income households disproportionately bore the impact of increased drought charges on the cost of basic water use in the three California cities (Benicia, Lake Elsinore, and Glendale (Figure 10) during a drought in the state in 2015.[93]

82 Jochen Hinkel et al., "Coastal flood damage and adaptation costs under 21st century sea-level rise", PNAS (2014), available at https://www.pnas.org/doi/full/10.1073/pnas.1222469111.

83 Letitia Grenier et al., *Sea Level Rise in California*, Public Policy Institute of California (February 2024), available at https://www.ppic.org/publication/sea-level-rise-in-california/#:~:text=Twenty%20inches%20of%20sea%20level,found%20at%20very%20low%20elevations.

84 Jochen Hinkel et al., "Coastal flood damage and adaptation costs under 21st century sea-level rise", PNAS (2014), available at https://www.pnas.org/doi/full/10.1073/pnas.1222469111.

85 Jamesine Rogers, James Barba, and Fiona Kinniburgh, From Boom to Bust? Climate Risk in the Golden State, Risky Business: The Economic Risks of Climate Change in the United States (April 2015), available at https://riskybusiness.org/report/from-boom-to-bust-climate-risk-in-the-golden-state/.

86 https://documents.coastal.ca.gov/reports/2023/7/W6e/W6e-7-2023-report.pdf

87 Gabriel Petek, *What Threat Does Sea Level Rise Pose to California*, Legislative Analysts Office (2020), available at https://lao.ca.gov/Publications/Report/4261.

88 https://www.nature.com/articles/nclimate2961

89 Cawdrey, Kathryn, 2023. "Warming Makes Droughts, Extreme Wet Events More Frequent, Intense" National Aeronautics and Space Administration. https://www.nasa.gov/centers-and-facilities/goddard/warming-makes-droughts-extreme-wet-events-more-frequent-intense/

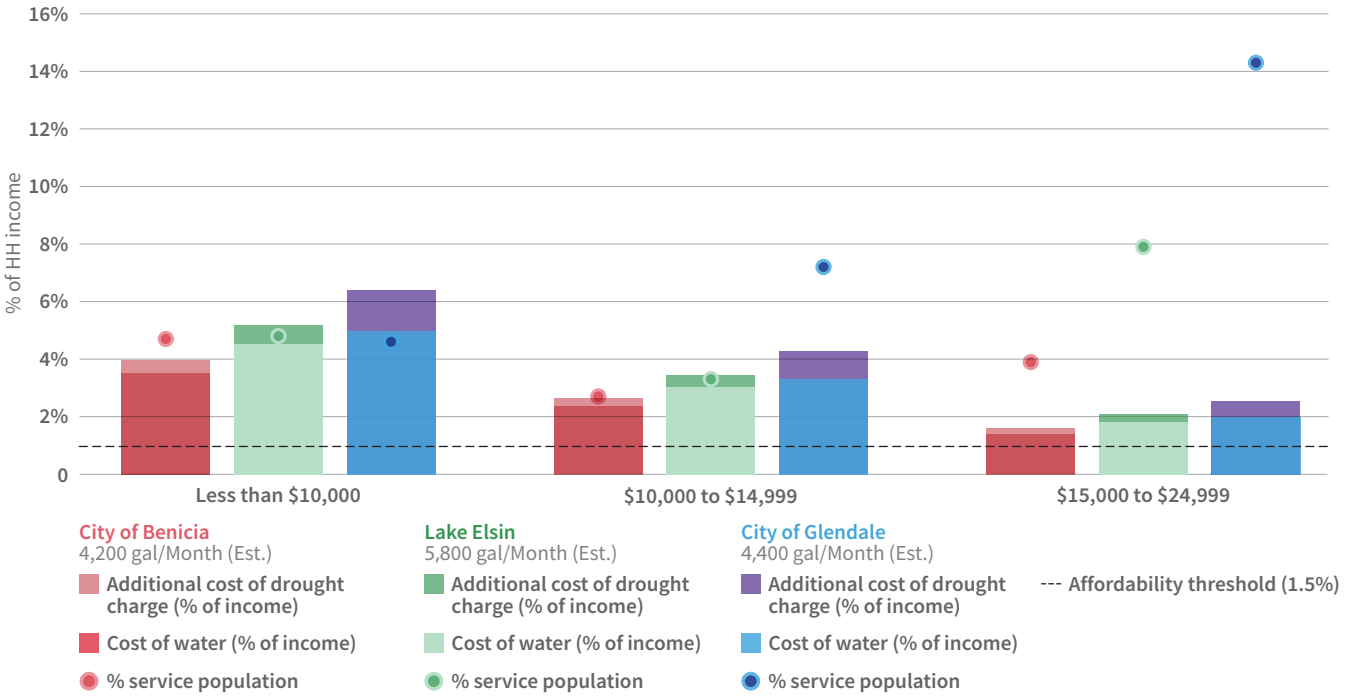
90 Alvar Escriva-Bou et al., *Policy Brief: Drought and California's Agriculture*, Public Policy Institute of California (April 2022), available at https://www.ppic.org/publication/policy-brief-drought-and-californias-agriculture/

91 Benjamin Rachunok et al., "Socio-hydrological drought impacts on urban water affordability", Nature Water 1 (January 19, 2023), available at https://www.nature.com/articles/s44221-022-00009-w

92 Id.

93 Laura Feinstein et al., Drought and Equity in California, Pacific Institute (January 2017), available at: https://ejcw.org/wp-content/uploads/2016/08/DroughtAndEquityInCA_Jan_2017.pdf

Figure 10. Cost of water use for low-income households with and without drought charges in 3 California cities[94]



Notes: Vertical bars show the cost of 55 GPCD of water as percentage of income for a mean-size household in the three lowest income brackets for three water utilities with and without drought charges. Colored circles show the percentage of houeholds in each income bracket. Blue dashed line shows the affordability threshold for drinking water of (1.5 percent of annual income).

Source: https://ejcw.org/wp-content/uploads/2016/08/DroughtAndEquityInCA_Jan_2017.pdf

Summary

Analyses calculating the costs of climate-driven extreme events often focus on the more easily quantifiable costs of infrastructure damage. Research has begun to calculate other direct costs of extreme events to California households, including rising utility bills and expenses during events such as wildfires, floods, sea-level rise, droughts, and extreme heat. While the overarching costs of climate-driven extreme events are staggering, they often include only the most visible expenses climate change poses to U.S. residents. Other costs of climate change due to extreme events, including more indirect and less-quantified costs such as healthcare expenses and rising inflation, are addressed in the following sections.

94 Laura Feinstein et al., Supra https://ejcw.org/wp-content/uploads/2016/08/DroughtAndEquityInCA_Jan_2017.pdf

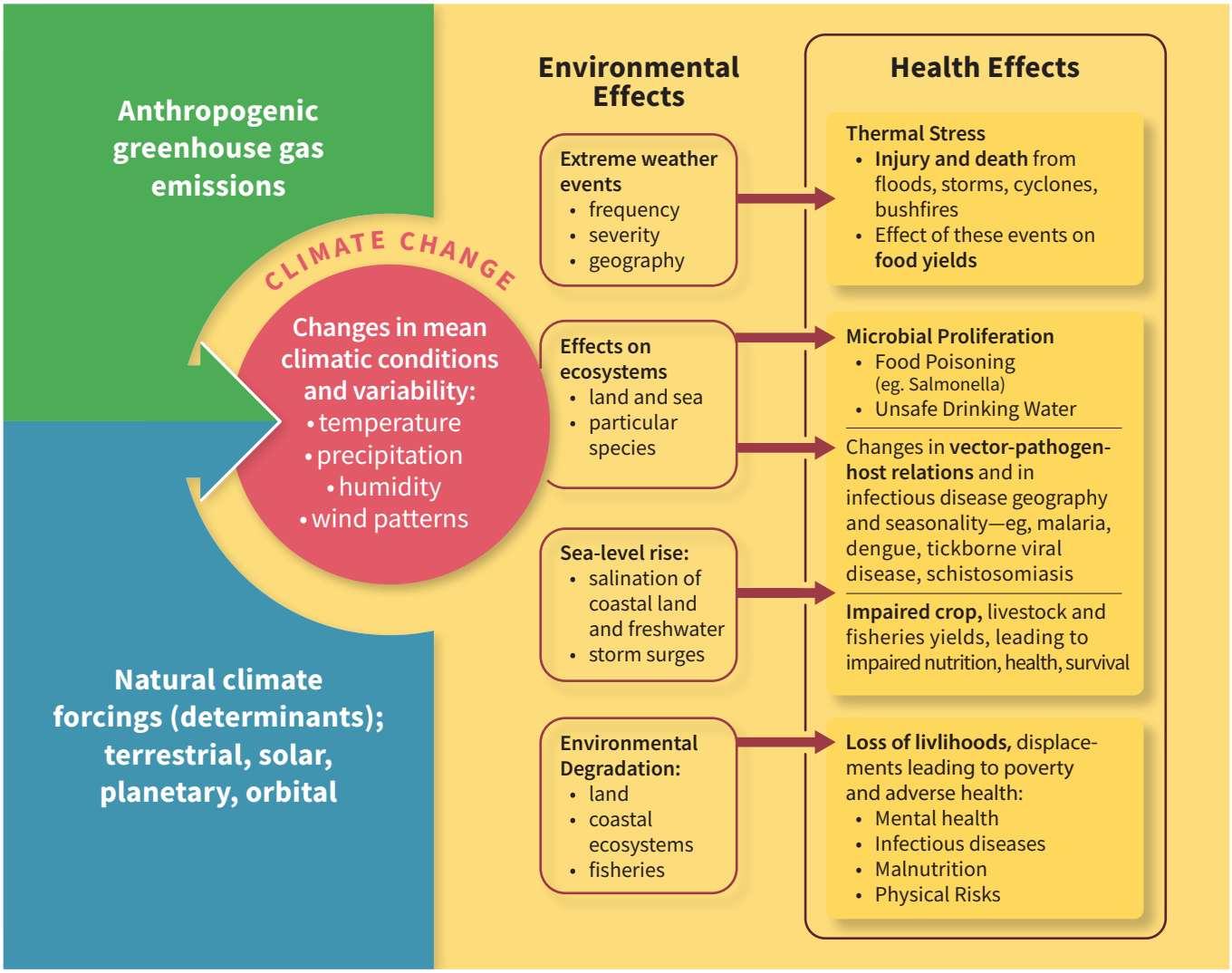
III. Costs of Climate Change to Health and Healthcare

The health impacts of climate-driven extreme events are both acute and cumulative due to increased incidence and vulnerability.[95] Climate-related health impacts directly translate to rising costs of medical care, hospitalization, and even mortality from extreme events and hazards, generating issues ranging from respiratory complications from wildfire smoke to rising incidence of food-borne illness. These costs are experienced population-wide but are most concentrated in disproportionately impacted communities.

"Climate change may be the greatest health threat of the twenty-first century, impacting lives both directly and indirectly, through undermining the environmental and social determinants of health.[96]"

–Campbell-Lendrum et al., Nature Medicine

Figure 11. Illustrating the health impacts of climate change[97]



This section provides an overview of the known health costs associated with climate-driven wildfire smoke and extreme heat events – both of which impact local air pollution – followed by an overview of the costs of reduced access to healthcare and associated equity impacts.

Health Costs Due to Wildfire Smoke

The total health cost of wildfire smoke in Southern California has been calculated at $84.42 per person per day of exposure.[98] This estimate was calculated using the willingness to pay to reduce one day's worth of wildfire smoke-induced symptoms during a wildfire in Los Angeles County in 2009. Between 2007 and 2018, over 99% of California residents lived in a county that

95 Kasia Dahlbeck, Scoping the Public Health Impacts of Wildfire, Berkeley Law Center for Law Energy and the Environment (May 2024), available at https://www.law.berkeley.edu/wp-content/uploads/2024/05/Scoping-the-Public-Health-Impacts-of-Wildfire.pdf

96 Diarmad Campbell-Lendrum et al., "Climate change and health: three grand challenges", Nature Medicine 29 (July 28, 2023), available at https://www.nature.com/articles/s41591-023-02438-w

97 Anthony J. McMichael et al., "Climate change and human health: present and future risks" The Lancet 367 (March 11, 2006), available at https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(06)68079-3/abstract?pubType=related

98 Leslie Richardson et al., "The hidden cost of wildfires: Economic valuation of health effects of wildfire smoke exposure in southern California", Journal of Forest Economics (2012), available at https://research.fs.usda.gov/treesearch/40381

experienced chronic wildfire-induced smoke pollution.[99] Wildfire smoke pollution in the San Francisco Bay Area alone resulted in an estimated $7.8 billion of health costs in 2018.[100] Beyond the direct costs of wildfire damages, the costs of smoke pollution are stark: national air quality damages from wildfire smoke were quantified at $201 billion in 2017.[101]

The high health costs of wildfire also result from smoke-associated mortality. Connolly et al. (2024) find that PM2.5 exposure from California wildfires from 2008 to 2018 caused up to 55,710 premature deaths, equating to economic costs of up to $456 billion using the U.S. EPA's value of a statistical life.[102] The highest-risk individuals for both health costs and wildfire-associated mortality include those with chronic health conditions, children, the elderly, pregnant people, those with disabilities, outdoor workers, firefighters, Indigenous populations, undocumented populations, incarcerated populations, and unhoused populations.[103]

Health Costs Due to Extreme Heat

Nationally, researchers have estimated that extreme heat resulted in approximately $1 billion in additional health care costs annually between 2016 and 2020.[104] Based on a Virginia study, these costs extrapolated nationally equate to nearly 235,000 additional emergency department visits and over 56,000 hospital admissions for heat-related illness every summer between 2016 and 2020. The health costs of extreme heat are expected to increase as the climate continues to warm. In California alone, researchers project that rising temperatures will result in an additional 7,700 deaths annually by the end of the century due to heat-related illness.[105]

Extreme heat, rising average temperatures, more frequent wildfires, which are all attributable to a warming climate, worsen local air quality and increase ozone and particulate pollution in areas already vulnerable to poor air quality.[106] Over 90% of California's population already resides in areas exceeding federal health-based standards set for ozone and PM2.5,[107] and over $70 billion in health-related costs in the state are a result of ozone and particulate matter pollution. Ozone levels in California are the highest in the San Joaquin Valley and the South Coast region. Maya et al. (2024) found that California residents with well-controlled asthma experienced a $601,250 cost increase (across 5,000 individuals) during a smoke event due to acute symptom exacerbation and increased associated medical costs compared to a scenario without wildfire smoke exposure.[108]

Costs of Limitations to Healthcare Access

Climate-driven extreme events also affect the quality and availability of healthcare. Healthcare providers and associated medical facilities may face reduced hours or closures during extreme events, and research has found that residents can experience challenges with accessing them even while open – climate-driven extreme weather or severe wildfire smoke may cause residents to shelter in place even if they need medical care. For example, Heft-Neal et al. (2023) find that emergency department visits for injuries and non-urgent symptoms declined significantly during days of extreme wildfire

99 Patricia Koman et al., "Using wildland fire smoke modeling data in gerontological health research (California, 2007-2018)," Science of the Total Environment (May 31, 2022), available at: https:// pubmed.ncbi.nlm.nih.gov/35660427/.

100 Jeff Bellisario et al., "The True Cost of Wildfires: Analyzing the Impact of Wildfires on the California Economy", Bay Area Council Economic Institute(2021), available at https://www.bayareaeconomy.org/files/pdf/BACEI_WildfireImpacts_Nov2021.pdf

101 Shaui Pan et al., "Quantifying the premature mortality and economic loss from wildfire-induced PM2.5 in the contiguous U.S.", Science of The Total Environment(2023), available at https://www.sciencedirect.com/science/article/abs/pii/S0048969723012305?casa_token=hkOczxIU_%208EAAAAA:HPpa5SRtWfU4_se4FCuhXEVq5YHINfawJeWZ3NXr9cM7P7naJBF69Xc1P7Nz%20K6oSZdiAW3JzoQ

102 Rachel Connolly et al., "Mortality attributable to PM2.5 from wildland fires in California from 2008 to 2018", National Library of Medicine(2024), available at https://pubmed.ncbi.nlm.nih.gov/38848356/

103 Kasia Dahlbeck, "Scoping the public health impacts of Wildfire", Berkeley Law(2024), available at https://www.law.berkeley.edu/wp-content/uploads/2024/05/Scoping-the-Public-Health-Impacts-of-Wildfire.pdf

104 Steven Woolf at al., "The Health Care Costs of Extreme Heat", CAP(2023), available at https://www.americanprogress.org/article/the-health-care-costs-of-extreme-heat/

105 From Boom To Bust Climate Risk In The Golden State , supra. https://riskybusiness.org/report/from-boom-to-bust-climate-risk-in-the-golden-state/

106 Id.

107 Id.

108 Id. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2024GH001037

smoke because of behavior shifts during severe smoke events.[109] For individuals who need access to routine medical care, climate-driven extreme events can also prevent regular medical appointments, causing chronic health conditions to worsen. As a result, more expensive treatment or increased time away from work can lead to additional financial strain.[110] These challenges in access are exacerbated by climate risks facing hospitals and other healthcare infrastructure – an estimated mean sea-level rise of 4.6 feet along the California coast would place 55 healthcare facilities at risk of inundation by the end of the century.[111]

Inequitable Impacts of Rising Health Costs

The health costs of climate-driven extreme events and hazards disproportionately burden already vulnerable populations. Over the last two decades, global heat-related mortality has increased by approximately 68% for individuals older than 65.[112] Households in rural and lower-income communities with already-limited access to healthcare may face reduced treatment of medical conditions or expensive care delays.[113] Households without health insurance face heightened risks due to climate change, including increased medical expenses and poorer health outcomes in the longer-term.[114] The impacts of extreme events and climate hazards place additional financial burden on individuals with pre-existing conditions.[115]

Rising health costs due to climate-driven extreme events are increasing and exacerbating an inequitable affordability burden on California households. While significantly less-quantified than the costs of infrastructure damage, the health costs of climate change are immense, especially in the U.S. context of already-limited access to affordable healthcare.

109 Sam Heft-Neal et al., "Emergency department visits respond nonlinearly to wildfire smoke", PNAS(2023), available at https://www.pnas.org/doi/10.1073/pnas.2302409120

110 "The Impact of Climate Change on American Household Finances", U.S. Department of the Treasury (2023), available at https://home.treasury.gov/system/files/136/Climate_Change_Household_Finances.pdf

111 From Boom To Bust Climate Risk In The Golden State , supra. https://riskybusiness.org/report/from-boom-to-bust-climate-risk-in-the-golden-state/

112 Romanello, M. et al. The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels. Lancet 400, 1619–1654 (2022).

113 The Impact of Climate Change on American Household Finances, supra. https://home.treasury.gov/system/files/136/Climate_Change_Household_Finances.pdf.

114 Id. https://home.treasury.gov/system/files/136/Climate_Change_Household_Finances.pdf

115 Sigal Maya et al., "The Impact of Wildfire Smoke on Asthma Control in California: A Microsimulation Approach", AGU(2024), available at https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2024GH001037

IV. Climate Costs to Workers and Earnings

In addition to increasing expenses, climate change negatively impacts household income, creating a dual strain on the cost of living.[116] Climate-driven extreme events may directly create unsafe labor conditions due to wildfire smoke or extreme temperatures, leading to reduced hours and wages, furlough, or even job loss, as well as time spent away from work due to adverse health impacts.

Indirect disruptions to household income include strain on businesses through infrastructure damage or supply chain disruption due to extreme events such as storms, flooding, or wildfire. As the frequency and severity of climate-driven extreme events increases, these disruptions will become increasingly cumulative: for instance, prolonged exposure to extreme heat impacts workers' health, lowering productivity and thus wages.[117] Jobs in certain high-risk sectors may become less available over time, leading to extended unemployment for impacted workers, compounding labor and financial stresses.

This section provides an overview of the heightened income losses and disruptions faced by workers in high-risk industries, followed by the projected labor risk due to climate change in the future.

Financial and Occupational Risks for Outdoor Workers

Workers in majority-outdoor occupations are particularly financially affected by the adverse consequences of climate-induced extreme events. High-risk occupations include emergency responders, construction workers, farmworkers, transportation workers, healthcare practitioners, and community and social service workers across sectors and geographies.[118]

The Centers for Disease Control and Prevention recommends that work hours be reduced when temperatures reach 100°F.[120] California has also passed legislation to better protect outdoor workers by establishing water minimums and ensuring access to shade when the temperature is above 80°F.[121] In practice, however, many workers across outdoor occupations lack protective standards that maintain pay during work disruptions due to hazardous conditions. As a result, an estimated 32 million outdoor workers in the U.S. face the decision of whether to risk their health by working in dangerous conditions or risk their income by staying home every year.[122] These health and financial risks are not equally distributed across the population: men make up approximately 83% of affected outdoor workers, and the outdoor workforce is disproportionately composed of Black and Latino populations.[123] Additional factors such as language barriers, gaps in

Figure 12. Occupations and jobs, grouped by climate-related health risks[119]

Occupational Category	Examples
Building & Grounds Cleaning| & Maintenance	Janitor, Pest Control Worker, Landscaper
Construction & Extraction	Carpenter, Roofer, Mining Machine Operator
Farming, Fishing, & Forestry	Farmworker, Forest Conservation Worker
Installation, Maintenance, & Repair	Mechanic, Electrical or Telecommunications Line Worker
Material Moving	Truck Driver, Railroad Worker
Protective Service	Police Officer, Fire Fighter
Transportation	Airfield Operations Specialist, Delivery Truck Driver

Note: Two-thirds or more of jobs in the seven occupational categories included in this analysis require outdoor work. These occupational categories include roughly 32 million US workers.

Source: https://www.ucs.org/resources/too-hot-to-work

116 The Impact of Climate Change on American Household Finances, supra. https://home.treasury.gov/system/files/136/Climate_Change_Household_Finances.pdf

117 Id.

118 https://www.allhomeca.org/california-jobs-first/ Regional Plan Part 1.

119 Id.; Original source: Ndugga, N., Pillai, D., & Artiga, S. (2023, June 26). Climate-Related Health Risks Among Workers: Who is at Increased Risk? KFF. https://www.kff.org/racial-equity-and-health-policy/issue-brief/climate-related-health-risks-among-workers-who-is-at-increased-risk/. Second table drawn from https://www.ucs.org/resources/too-hot-to-work report, with original source: BLS (US Bureau of Labor Statistics). No date. "Occupational Requirements Survey." https://www.bls .gov/ors.

120 Kristina Dahl et al., "Too Hot to Work Assessing the Threats Climate Change Poses to Outdoor Workers", Union of Concerned Scientists(2021), available at https://www.ucs.org/resources/too-hot-to-work#top

121 https://www.dir.ca.gov/title8/3395.html

122 Id. https://www.ucs.org/resources/too-hot-to-work#read-online-content

123 Id.

Figure 13. Estimation of statewide income losses from California wildfires (2017-2021)[124]

	2017	2018	2019	2020	2021	5-Year Average
Smoke Days	28.0	32.7	10.9	58.5	59.4	37.9
Percentage Reduction in Wage and Salary Income	-2.7%	-3.2%	-1.1%	-5.7%	-5.8%	-3.7%
Total Wages and Salary Income (statewide, mil $, 2022)						**$1,634,244**
Net reduction in wages and salary income (statewide, mil $, 2022)						**$60,119**

Source: Borgschulte, et al.; NOAA; California Dept. of Finance (2022).

health insurance, and concerns about immigration status may further exacerbate these impacts.

Earnings Losses from Wildfire

UCLA research estimates that wage losses from the 2025 Los Angeles wildfires totaled $297 million for local employees and businesses.[125] The Moore Foundation estimated about $60 billion in statewide income losses from California wildfires from 2017 to 2021 on average (Figure 13).[126]

These losses are primarily due to the health impacts of wildfire smoke exposure and associated wage losses for impacted workers. Borgschulte et al. (2022) estimate that for each 1 μg/m3 annual increase in PM2.5 from wildfire smoke, annual labor earnings decrease by $123 billion across the U.S. (in 2018 dollars).[127] These reductions are primarily seen across the utilities, crop production, manufacturing, healthcare, and transportation sectors due to decreased workforce participation. Lost earnings totaled $125 billion each year between 2017 and 2019. For counties whose populations have an above-median proportion of Black residents, earning reductions from smoke exposure are about 60% larger.[128]

Earnings Losses from Other Climate-Related Extreme Events

Extreme Heat: A California Department of Insurance report assessing seven recent extreme heat events in the state, as discussed in Figure 8, found labor productivity losses per heat event ranging from between $7.7 million (2021 Desert Lands heat event) to $210 million (2022 Coastal Inland heat event).[129] Those seven heat events resulted in labor productivity losses of $76 million per heat event on average. Zhang and Shindell (2021) also find that businesses in southern states from California to Florida are especially vulnerable to large economic losses due to extreme heat.[130] Between 2006 and 2016, extreme temperatures resulted in earnings losses of approximately $1.7 billion annually across the U.S.[131]

124 Id. https://www.moore.org/docs/default-source/default-document-library/the-economic-fiscal-and-environmental-costs-of-wildfires-in-ca.pdf

125 Zhiyun Li and William Yu, Economic Impact of the Los Angeles Wildfires, UCLA Anderson School of Management (2025), available at: https://www.anderson.ucla.edu/about/centers/ucla-anderson-forecast/economic-impact-los-angeles-wildfires.

126 James Paci et al., "The Economic, Fiscal, and Environmental Costs of Wildfires in California", Gordon and Betty Moore Foundation(2023), available at https://www.moore.org/docs/default-source/default-document-library/the-economic-fiscal-and-environmental-costs-of-wildfires-in-ca.pdf

127 Mark Borgschulte et al., "Wildfires reveal the large toll of air pollution on labor market outcomes", Stanford Institute for Economic Policy Research(2022), available at https://siepr.stanford.edu/publications/policy-brief/wildfires-reveal-large-toll-air-pollution-labor-market-outcomes

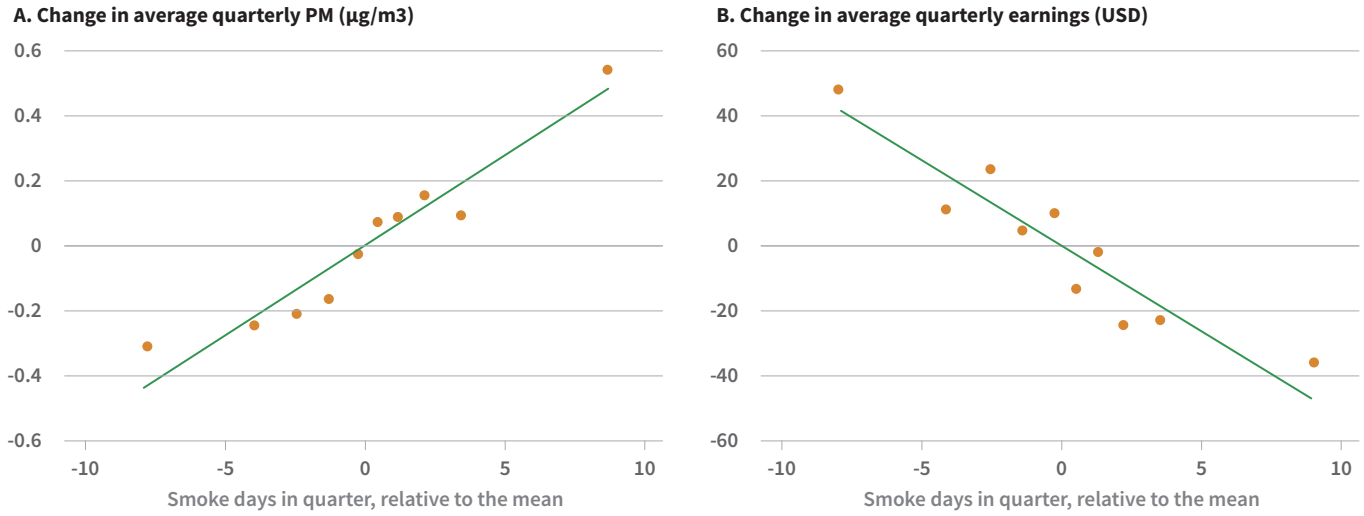
128 Id. https://siepr.stanford.edu/publications/policy-brief/wildfires-reveal-large-toll-air-pollution-labor-market-outcomes

129 Impacts of extreme heat to California's people, infrastructure and economy, California Department of Insurance, Supra. https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Impacts-of-extreme-heat-to-California-s-people-infrastructure-and-economy-by-California-Department-of-Insurance-June-2024.pdf

130 Yuqiang Zhang et al.,"Costs from labor losses due to extreme heat in the USA attributable to climate change", Springer Nature(2021), available at https://link.springer.com/article/10.1007/s10584-021-03014-2

131 Id.

Figure 14. Effect of wildfire smoke on earnings[132]



Note: The figure reports how the number of smoke days a country experiences in a quarter of the year relates to air quality, as captured by PM2.5 (Panel A) and earnings (Panel B). Outcome variables and the number of smoke days are demeaned by county-quarter and state-year categories. The points in each panel reflect the average outcome, by decile of smoke days.

Drought: A UC Merced-led report for the California Department of Food and Agriculture found that the 2021 California drought decreased total employment in the Central Valley by 2.9%–mostly in crop production.[133] The 2022 drought decreased agricultural employment in the Central Valley by 3.8%. Employment losses from these drought years translated to 4,856 lost agricultural jobs across the state in 2021 and 7,366 lost jobs in 2022.[134] The Public Policy Institute of California estimates that the 2021 drought resulted in a total of 14,600 jobs lost across all industries in California.[135]

Future Projected Income Losses and Disruptions

Research has projected that U.S. construction and extraction workers could lose about $1,900 per year in per capita wages due to adverse working conditions by mid-century under current rates of climate warming.[136] Labor productivity losses due to extreme heat in the U.S. are expected to cost half a trillion dollars annually by 2050, disproportionately affecting Black and Hispanic workers.[137] Around $39.3 to $55.4 billion of outdoor workers' annual earnings could be at risk by mid-century.[138] In California, labor productivity is most likely to decline in the San Joaquin Valley and Sacramento regions due to climate change.[139]

132 Id. Mark Borgschulte et al., "Wildfires reveal the large toll of air pollution on labor market outcomes," Stanford Institute for Economic Policy Research (December 2022), available at: https://siepr.stanford.edu/publications/policy-brief/wildfires-reveal-large-toll-air-pollution-labor-market-outcomes.

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

134 Id.

135 *Policy Brief: Drought and California's Agriculture*, Public Policy Institute of California, supra. https://www.ppic.org/publication/policy-brief-drought-and-californias-agriculture/

136 Too Hot to Work Assessing the Threats Climate Change Poses to Outdoor Workers, supra. https://www.ucs.org/resources/too-hot-to-work#read-online-content

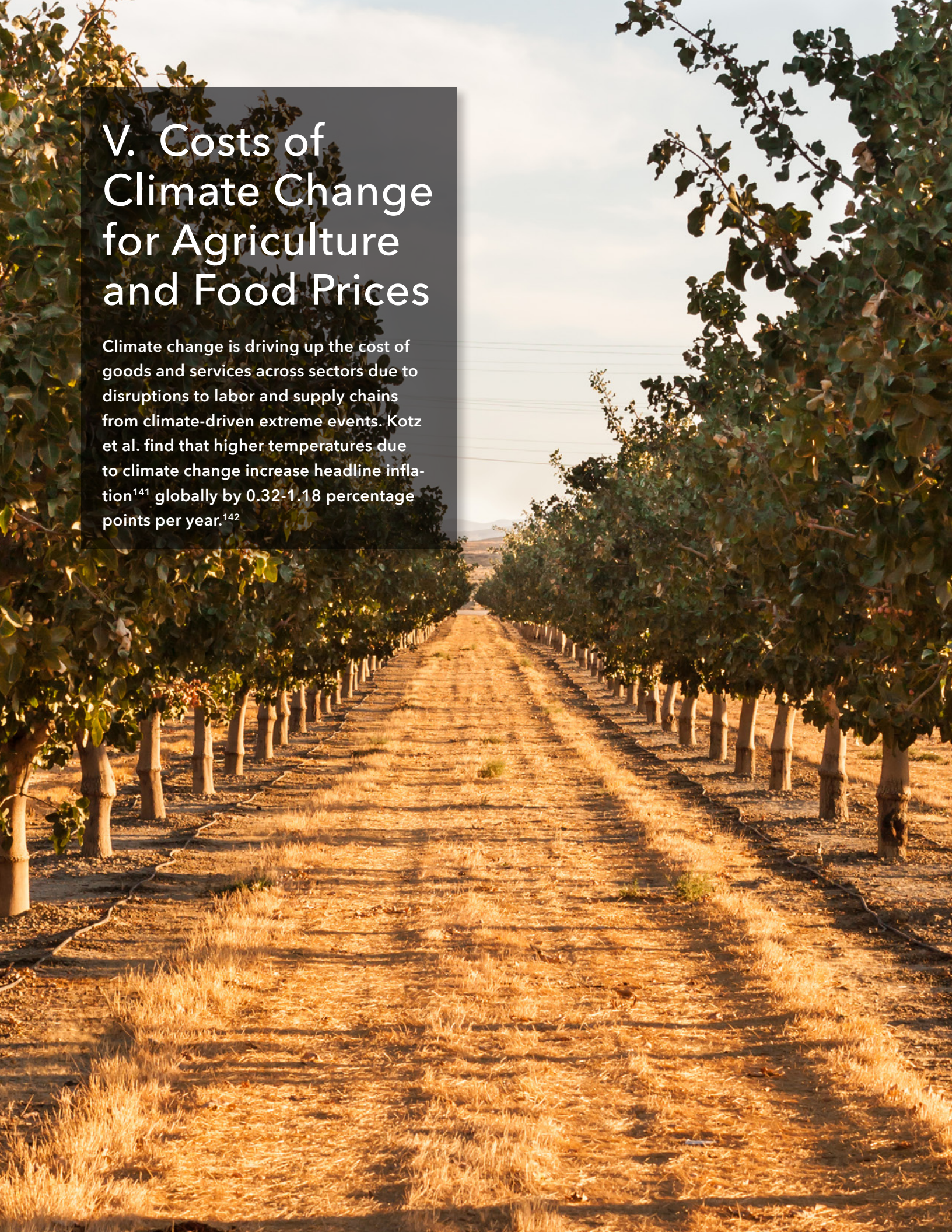
137 Adrienne Arsht, "Extreme Heat: The Economic and Social Consequences for the United States", Atlantic Council(2021), available at https://www.atlanticcouncil.org/wp-content/uploads/2021/08/Extreme-Heat-Report-2021.pdf

138 Too Hot to Work Assessing the Threats Climate Change Poses to Outdoor Workers, Supra. https://www.ucs.org/resources/too-hot-to-work#read-online-content

139 From Boom To Bust Climate Risk In The Golden State , supra. https://riskybusiness.org/report/from-boom-to-bust-climate-risk-in-the-golden-state/.

Climate-driven extreme events are expected to result in income losses not only for the current workforce, but for children and youth entering the workforce in the future. Extreme heat events associated with 2°C and 4°C of climate warming are expected to generate a 4% to 7% reduction in academic achievement per child in the U.S. due to the negative impacts of high temperatures on learning outcomes.[140] For every graduating class of students, the overall reduction in future income associated with these learning losses across the U.S. is estimated between $6.9 billion and $13.4 billion.

140 "Climate Change and Children's Health and Well-Being in the United States",U.S. Environmental Protection Agency(2023), available at https://www.epa.gov/cira/climate-change-and-childrens-health-report



V. Costs of Climate Change for Agriculture and Food Prices

Climate change is driving up the cost of goods and services across sectors due to disruptions to labor and supply chains from climate-driven extreme events. Kotz et al. find that higher temperatures due to climate change increase headline inflation[141] globally by 0.32-1.18 percentage points per year.[142]

These inflationary impacts are strongest on food prices, due to the negative impacts of high temperatures and extreme events on agricultural production. Climate-driven extreme events are projected to increase food prices specifically by 0.92-3.23 percentage points per year globally through 2035.[143]

Figure 15a. Crop revenue losses from the 2020-2022 California drought, 2021 compared to 2019[147]

Region	Alfalfa & Pasture	Corn	Other Field & Grain	Trees & Vine	Vegetable & other Fruit	Total
Central Valley	**57**	**97**	**409**	**408**	**210**	**1,182 (-4%)**
Sacramento	15	11	228	51	53	358 (-8%)
San Joaquin River	14	13	25	91	13	157 (-2%)
Tulare Lake	27	74	156	267	144	667 (-4%)
Northern Intermountain	13	-	9	-	6	28 (-7%)
Coastal	1	-	0	26	45	73 (-1%)
Colorado River	8	11	2	10	10	40 (-2%)
All Regions	**79**	**108**	**420**	**444**	**271**	**1,323 (-4%)**

Source: https://wsm.ucmerced.edu/wp-content/uploads/2023/01/Economic_Impact_CA_Drought_V02-1.pdf

Figure 15b. Crop revenue losses from the 2020-2022 California drought, 2022 compared to 2019[147]

Region	Alfalfa & Pasture	Corn	Other Field & Grain	Trees & Vine	Vegetable & other Fruit	Total
Central Valley	**48**	**101**	**660**	**423**	**232**	**1,464 (-5%)**
Sacramento	10	19	482	65	81	659 (-15%)
San Joaquin River	12	15	33	107	17	184 (-2%)
Tulare Lake	26	66	145	251	134	621 (-4%)
Northern Intermountain	18	-	8	-	8	34 (-9%)
Coastal	1	-	-	39	91	131 (-2%)
Colorado River	20	13	3	19	36	91 (-5%)
All Regions	**87**	**114**	**671**	**481**	**367**	**1,720 (-5%)**

Source: https://wsm.ucmerced.edu/wp-content/uploads/2023/01/Economic_Impact_CA_Drought_V02-1.pdf

Cost of Climate-Related Extreme Events on Agricultural Productivity

Ortiz-Bobea et al. (2021) find that climate change has decreased global agricultural productivity by 21% since 1960.[144] A 2024 analysis found that many of California's most valuable food products, including tree fruits, nuts, and livestock operations, face significant climate risks from increased heat, limited water availability, and increased disease incidence.[145] Global crop production is projected to decrease by 9% in the 2030s and by 23% in the 2050s, posing wide-ranging risks to the prices of both domestic and imported food products for U.S. households.[146] This section provides an overview of the impacts of climate-driven extreme events on agricultural productivity before highlighting two food products whose availability and prices are already disrupted by climate change.

141 Headline inflation refers to the total rate of inflation in the economy.

142 Maximilian Kotz, Friderike Kuik, Eliza Lis and Christiane Nickel, *Global warming and heat extremes to enhance inflationary pressures*, Nature Communications Earth & Environment (2024), available at: https://www.nature.com/articles/s43247-023-01173-x.

143 Id.

144 Ariel Ortiz-Bobea et al., "Anthropogenic climate change has slowed global agricultural productivity growth", nature climate change(2021), available at https://www.nature.com/articles/s41558-021-01000-1

145 From Boom To Bust Climate Risk In The Golden State , supra. https://riskybusiness.org/report/from-boom-to-bust-climate-risk-in-the-golden-state/.

146 Mekbib Haile et al., "Impact of Climate Change, Weather Extremes, and Price Risk on Global Food Supply", Springer Nature(2017), available at https://link.springer.com/article/10.1007/S41885-017-0005-2

147 Economic Impacts of the 2020-22 Drought on California Agriculture, supra. https://wsm.ucmerced.edu/wp-content/uploads/2023/01/Economic_Impact_CA_Drought_V02-1.pdf

Figure 16a. Economic impacts (losses) of the 2020-2022 drought on California agriculture, 2021[148]

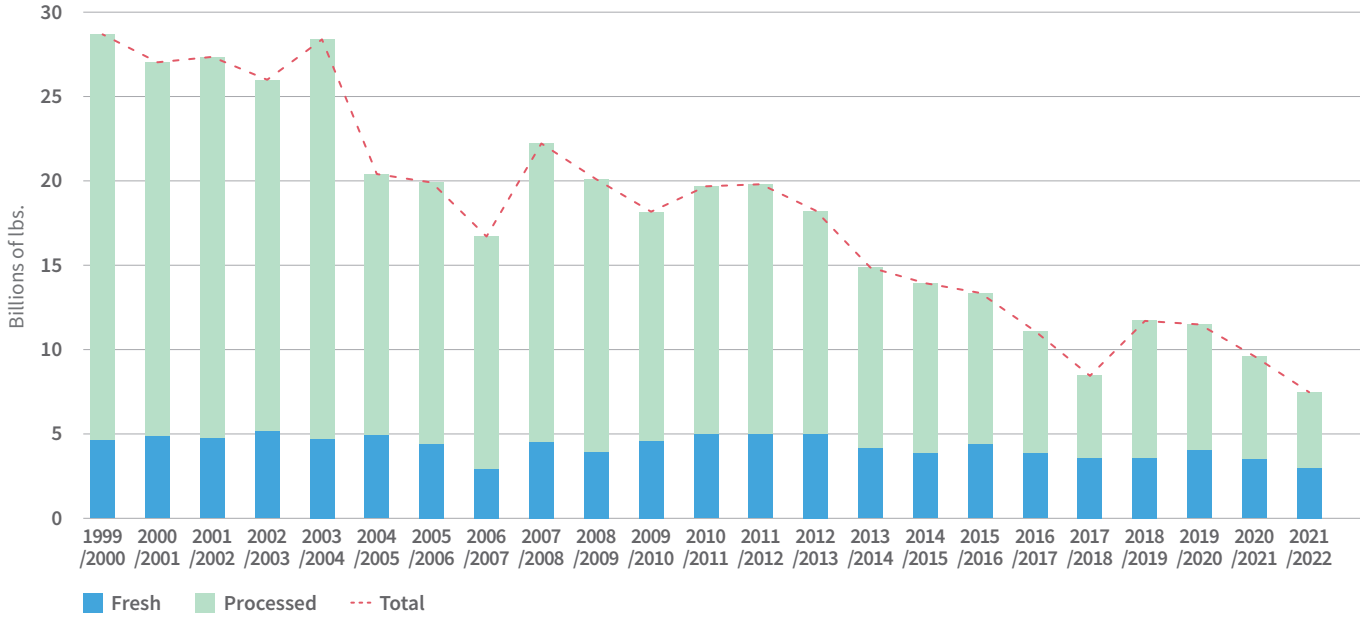
Summary of economic impacts of the 2021 drought in California agriculture and processing sector						
Impact (Losses)	**Sacramento Valley**	**San Joaquin Valley**	**Northern Intermountain**	**Coastal**	**Colorado River**	**State**
Crops						
Gross Revenues ($M)	358	824	28	73	40	1,323
Employment (Jobs)	2,312	6,555	194	567	254	9,882
Value Added ($M)	213	520	11	44	24	812
Pumping Costs ($M)	15	169	-	-	-	184
Processing						
Gross Revenues ($M)	1,172	1,237	-	-	-	2,409
Employment (Jobs)	2,499	2,357	-	-	-	4,856
Value Added ($M)	294	295	-	-	-	589
Total Direct Impacts						
Gross Revenues ($M)	1,545	2,229	29	73	40	3,915
Employment (Jobs)	4,810	8,912	194	567	254	14,738
Value Added ($M)	507	815	11	44	24	1,401

Figure 16b. Economic impacts (losses) of the 2020-2022 drought on California agriculture, 2022[148]

Summary of economic impacts of the 2022 drought in California agriculture and processing sector						
Impact (Losses)	**Sacramento Valley**	**San Joaquin Valley**	**Northern Intermountain**	**Coastal**	**Colorado River**	**State**
Crops						
Gross Revenues ($M)	659	805	33	131	91	1,720
Employment (Jobs)	3,698	6,478	263	1,019	591	12,049
Value Added ($M)	438	588	15	78	54	1,172
Pumping Costs ($M)	24	99	-	-	-	123
Processing						
Gross Revenues ($M)	2,223	1,244	-	-	-	3,467
Employment (Jobs)	4,794	2,572	-	-	-	7,366
Value Added ($M)	549	298	-	-	-	846
Total Direct Impacts						
Gross Revenues ($M)	2,906	2,148	33	131	91	5,309
Employment (Jobs)	8,492	9,049	263	1,019	591	19,414
Value Added ($M)	987	885	15	78	54	2,018

148 Id. https://wsm.ucmerced.edu/wp-content/uploads/2023/01/Economic_Impact_CA_Drought_V02-1.pdf

Figure 17. U.S. orange production from 2000-2022[149]



Agricultural production has already seen extensive losses due to climate-driven extreme events. The 2022 drought in California caused $1.7 billion in revenue losses for farmers and upstream sectors providing agricultural goods and services in the state.[150] These included millions of dollars in revenue losses from alfalfa and pasture crops, corn, other field and grain crops, trees and vine crops, vegetables, and fruit.

The economic impacts of these drought events were stark, including billions of dollars lost across crop production, groundwater pumping costs, and food processing sectors (Figure 16a&b).[151] The estimated total crop gross revenue losses due to droughts have been the most severe in the Central Valley.

In addition to the drought losses above, California growers have also faced extreme heat events concurrently with these drought years, namely the Desert Lands and California Coastal Inland heat events in 2021 and 2022.[152] The California Coastal Inland heat event alone caused $72 million in losses from decreased crop productivity, $17 million in losses from reduced dairy productivity, and $330,000 from dairy cow mortality.[153] Compounding climate-driven extreme events increase agricultural risks and contribute to upward pressure on food prices.

Food Product Disruption: Oranges

Citrus fruits like oranges comprise roughly 14% of fresh fruit produced for American consumption, as well as support the orange juice industry.[154] California and Florida make up the largest share of orange production in the U.S., at 79% and 17% of total citrus production,

149 The United States Orange Industry: Declining Production and Climbing Imports,supra. https://journals.flvc.org/edis/article/view/134806/141265

150 *Policy Brief: Drought and California's Agriculture,* Public Policy Institute of California, Supra. https://www.ppic.org/publication/policy-brief-drought-and-californias-agriculture/

151 Id.

152 Impacts of extreme heat to California's people, infrastructure and economy, California Department of Insurance, supra. https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Impacts-of-extreme-heat-to-California-s-people-infrastructure-and-economy-by-California-Department-of-Insurance-June-2024.pdf

153 Id.

154 Daniel Munch, "U.S. Citrus Production – An Uphill Battle to Survive", Farm Bureau(2023), available at https://www.fb.org/market-intel/u-s-citrus-production-an-uphill-battle-to-survive

respectively.[155] Due to surging temperature levels and tropical storms, Florida in particular has experienced drastic losses to the state's orange cultivation levels.[156]

Hurricane Ian, a major tropical storm that made landfall in Florida in 2022, destroyed roughly 152,000 hectares of citrus groves across the state, leading to over $247 million in citrus production losses.[157] Hammami et al. find that the production of oranges in the U.S. has slowly declined since the beginning of the 21st century (Figure 17).[158] Climate-driven extreme events, alongside higher temperature levels, have led to a 3% per year decrease in the acreage of orange trees across the U.S, causing recent harvests to be some of the lowest in over 90 years.[159] In the orange industry, the changing climate has had a clear impact on consumer prices: orange juice concentrate prices in the U.S. reached $4.28 per 16 ounces in 2024, according to data from the U.S. Department of Agriculture.[160] The same quantity was priced at $2.28 prior to 2020.

Food Product Disruption: Chocolate

As another staple of American food consumption, chocolate accounts for $21.4 billion in confectionery sales in the U.S.[161] The global market value of cacao is estimated at $98.3 billion, and demand for cacao has risen by an estimated 3% annually since 2008.[162] Cacao trees are primarily grown near the equator in nations such as Côte d'Ivoire, Ghana, Brazil, and Ecuador;[163] over 70% of the global cocoa supply is produced in West Africa.[164] From 2017 to 2021, the U.S. imported an average of $5.06 billion of cocoa and cocoa-based products per year.[165]

Cacao trees are significantly impacted by climate-driven extreme events, including water limitations, storms, and extreme heat. The 2015-2016 drought in Brazil resulted in an 89% decrease in cocoa yield among farms in Bahia, including high cacao tree mortality and increased tree infection rates.[166] A recent report found that from 2015 to 2024, climate change has resulted in 40 additional days per year with daily maximum temperatures over cacao's optimal range in Cameroon, Côte d'Ivoire, Nigeria, and Ghana.[167]

Losses in cacao production across the world have led to corresponding price surges for consumers: the price of cocoa grew approximately 136% globally between 2022 and 2024.[168]

155 "Citrus Fruits 2023 Summary", United States Department of Agriculture(2023),available at https://downloads.usda.library.cornell.edu/usda-esmis/files/j9602060k/4742bs21j/3n205h50s/cfrt0923.pdf

156 Skyler Simnitt, "Natural disasters, disease cut Florida orange production an estimated 92 percent since 2003/04", U.S. Department of Agriculture(2024), available at https://www.ers.usda.gov/data-products/charts-of-note/chart-detail?chartId=109051#:~:text=Since%202003%2F04%2C%20bearing%20acreage,harvest%20in%20nearly%2090%20years

157 Christa D. Court et al., "Estimated Agricultural Losses resulting from Hurricane Ian", University of Florida-Institute of Food and Agricultural Sciences(2023), available at https://fred.ifas.ufl.edu/media/fredifasufledu/economic-impact-analysis/reports/FRE-Final-Hurricane-Ian-Report.pdf

158 A. Malek Hammami et al., "The United States Orange Industry: Declining Production and Climbing Imports", University of Florida-Food and Resource Economics department(2024), available at https://journals.flvc.org/edis/article/view/134806/141265

159 Natural disasters, disease cut Florida orange production an estimated 92 percent since 2003/04", U.S. Department of Agriculture,supra. https://www.ers.usda.gov/data-products/charts-of-note/chart-detail?chartId=109051#:~:text=Since%202003%2F04%2C%20bearing%20acreage,harvest%20in%20nearly%2090%20years

160 Sasha Rogelberg , "Is breakfast endangered? Disease and extreme weather are jacking up coffee and orange juice prices—and consumers are getting squeezed", Fortune(2024), available at https://fortune.com/2024/06/11/orange-juice-coffee-prices-climate-change-agriculture-breakfast/

161 "Getting to Know Chocolate Consumers," NCA(2024), available at https://candyusa.com/my-nca/business-insights/getting-to-know-chocolate-consumers-2024/

162 Fiona Lahive et al., "The physiological responses of cacao to the environment and the implications for climate change resilience. A review," Springer Nature(2019), available at https://link.springer.com/article/10.1007/s13593-018-0552-0

163 "Growing Cocoa," ICCO, available at https://www.icco.org/growing-cocoa/

164 "Climate change is heating up West Africa's cocoa belt," Climate Central (2025), available at https://www.climatecentral.org/report/analysis-climate-and-cocoa-2025

165 Bart Kenner et al., "U.S. imports of cocoa and chocolate products valued at over $5 billion annually," U.S. Department of Agriculture(2022) available at https://www.ers.usda.gov/data-products/charts-of-note/chart-detail?chartId=103222

166 Lauranne Gateau-Ray et al., "Climate change could threaten cocoa production: Effects of 2015-16 El Niño-related drought on cocoa agroforests in Bahia, Brazil," PLOS(2018), available at https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0200454

167 Climate change is heating up West Africa's cocoa belt, supra. https://www.climatecentral.org/climate-matters/climate-and-cocoa-2025

168 Id.

VI. Housing, Insurance, & Financial Risk

The costs of infrastructure damage due to climate-driven extreme events, covered in Section II, also generate downstream financial impacts, especially in physical asset markets such as housing. Rental, insurance, and mortgage lending markets face significant additional risk due to climate change–generating exorbitant costs to households as well as broader economic risk.[169]

This section provides an overview of climate-driven costs on renters, followed by the significant costs in the insurance market and risks to mortgages and lending.

Increased Costs for Renters: According to the Brookings Institution, average property rent in the U.S. increases by over 4% following a disaster event (such as a severe wildfire or a hurricane), by another 6% following a second extreme event, and another 5% after a third event.[170] Each of these increases remains in effect for periods of 4-5 years. Renters typically have fewer resources to make improvements in their homes to protect against climate-driven extreme events before they occur, exacerbating financial risk.[171] Hamideh et al. also find that multifamily and duplex homes also recover more slowly after the incidence of climate-driven extreme events.[172]

Rising Insurance Costs and Risk

Homeowner's insurance is "a crucial backbone to communities facing climate risks."[173] However, average U.S. homeowner insurance premiums have increased over 33% from 2020 to 2023 in direct relation to local disaster risk.[174] Since 2018, skyrocketing financial risk for insurers associated with climate-induced extreme events has led to the nonrenewal of over 1.9 million home insurance policies across the U.S., leaving many homeowners without any form of insurance protection.[175] Some insurers have even partially exited states with extensive climate disaster costs, such as California and Florida.[176]

Insurance premium price adjustments and market exits have generated extensive economic losses, with devastating consequences for both household finances and home property values.[177] Rising insurance costs significantly increase the cost of homeownership; insurance premiums across the U.S. have increased by 74% since 2008, and house prices have increased by over 40%.[178]

Rising Insurance Premiums and Non-Renewals in California

In California, there is a strong correlation between total hectares of land burned during wildfires and increases in insurance prices. Home insurance premiums rose over 23% between 2017 and 2022 as severe wildfire seasons incurred record-breaking infrastructure damages across the state.[179] Following the Los Angeles fires in 2025, State Farm (California's largest insurer) requested a 22% average

169 Marco Migliorelli et al.,"The Impact of Climate Risks on the Insurance and Banking Industries", Springer Nature(2020), available at https://link.springer.com/chapter/10.1007/978-3-030-54530-7_2

170 Carlos Martín et al., *Disasters and the Rental Housing Community: Setting a Research and Policy Agenda*, Brookings Institution (2023), available at: https://www.brookings.edu/articles/disasters-and-the-rental-housing-community/.

171 The Impact of Climate Change on American Household Finances, supra. https://home.treasury.gov/system/files/136/Climate_Change_Household_Finances.pdf

172 Based on a case study of recovery following Hurricane Ike in Texas; Sara Hamideh et al., "Housing type matters for pace of recovery: Evidence from Hurricane Ike," International Journal of Disaster Risk Reduction (2021), available at https://www.sciencedirect.com/science/article/pii/S2212420921001151?via%3Dihub

173 U.S. Treasury (2022, Oct). Treasury's federal insurance office takes important step to assess climate-related financial risk–seeks comment on proposed data call. U.S. Treasury Press Releases.

174 Benjamin Keys et al., "Property Insurance and Disaster Risk: New Evidence from Mortgage Escrow Data", National Bureau of Economic Research, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4867443

175 Christopher Flavelle et al., "Insurers Are Deserting Homeowners as Climate Shocks Worsen", The New York Times (2024), available at https://www.nytimes.com/interactive/2024/12/18/climate/insurance-non-renewal-climate-crisis.html

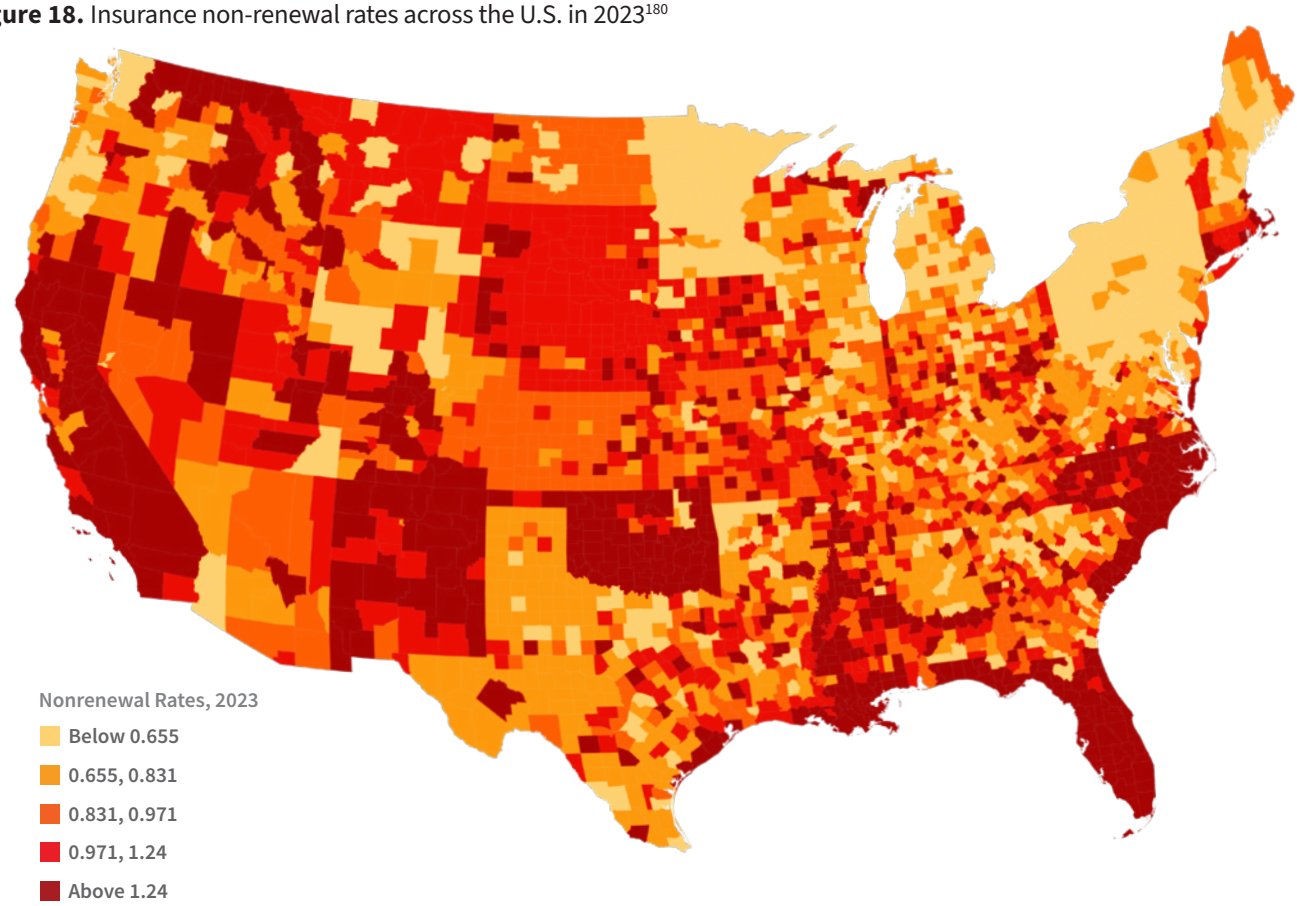
176 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4867443, https://www.nytimes.com/interactive/2024/12/18/climate/insurance-non-renewal-climate-crisis.html

177 "Next to Fall: The Climate-Driven Insurance Crisis is Here-and getting Worse", Senate Budget Committee(2024), available at https://www.budget.senate.gov/imo/media/doc/next_to_fall_the_climate-driven_insurance_crisis_is_here__and_getting_worse.pdf

178 These numbers include adjustments for inflation; Steve Koller, "The Insurance Crisis Continues to Weigh on Homeowners",Joint Center for Housing Studies of Harvard University(2024), available at https://www.jchs.harvard.edu/blog/insurance-crisis-continues-weigh-homeowners

179 Judson Boomhower et al.,"How are Insurance Markets Adapting to Climate Change? Risk Classification and Pricing in the Market for Homeowners Insurance", National Bureau of Economic Research(2024), available at https://www.nber.org/system/files/working_papers/w32625/w32625.pdf

Figure 18. Insurance non-renewal rates across the U.S. in 2023[180]



Source: U.S. Senate Budget Committee. Note: The state average is shown in counties with few policies reported.

rate increase for insurance policies across California.[181] Under that increase, State Farm policyholders would pay $841 more, on average, for home insurance in 2025 than they did in 2023.[182] Households in some communities would pay over $4,000 in premium increases. Ultimately, they were approved for a 17% average rate increase.

Further research points to insurers cancelling their customers' policies altogether due to wildfire risk. These percentages reached a record high of 7% in California compared to a historical 2 to 3% average annual cancellation rate.[183]

Even when insurance is available, many insurance policies are not sufficient to fully cover the cost of losses that may be incurred. This phenomenon is known as underinsurance; current estimates find that 60% of California homes are underinsured by about 30%.[184]

180 https://www.nytimes.com/interactive/2024/12/18/climate/insurance-non-renewal-climate-crisis.html; Original data source: U.S. Senate Budget Committee.

181 A 21.8% increase was approved by the California insurance commissioner in March 2025, pending a future hearing; Premiums on Fire: How State Farm's California rate hike forces the rising costs of climate disasters onto policyholders instead of the Big Oil companies fueling the crisis", Center for Climate Integrity(2025), available at https://climateintegrity.org/uploads/media/Premiums-On-Fire-2025.pdf

182 Id.

183 How are Insurance Markets Adapting to Climate Change? Risk Classification and Pricing in the Market for Homeowners Insurance,supra. https://www.nber.org/system/files/working_papers/w32625/w32625.pdf

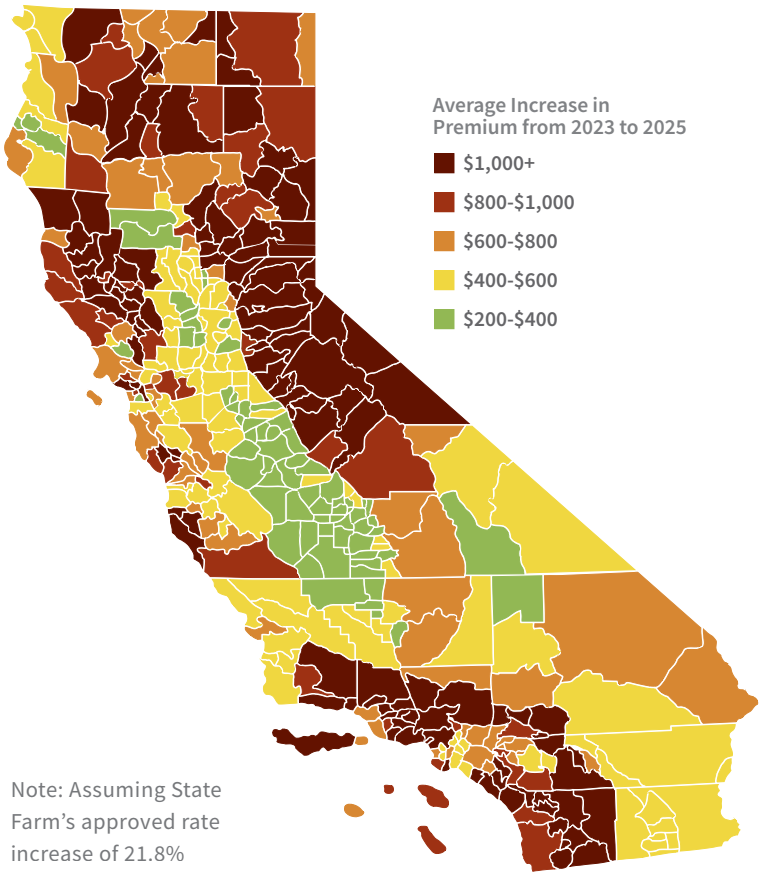
184 Kenneth Klein, "Truth and Consequences: What Catastrophe Teaches Us About Homeownership and Underinsurance" SSRN(2025), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5139315

Broader Mortgage and Lending Risks

Real estate and broader lending markets are deeply impacted by climate-driven extreme events. In many cases, homeowners' insurance is required to secure a mortgage. Aside from insurance coverage rates, mortgage rates are negatively impacted by climate-driven extreme events: mortgage loan officers approve fewer loan applications and reduce loan amounts during periods of abnormally high local temperatures due to climate concerns.[185] This effect is particularly strong in counties more exposed to risks of sea-level rise. Ouazad and Kahn (2020) find that after billion-dollar extreme weather events in the U.S. between 2004 and 2012, the issuance of both conforming and jumbo loans for mortgages decreased by 5%.[186] Major wildfires are also associated with a 2.2% drop in home prices in surrounding neighborhoods, closely associated with wildfire proximity, frequency, and scale.[187]

Broader lending markets also show evidence of strain due to the financial impacts of climate-induced extreme events. Counties more strongly affected by climate change spend more on underwriting fees when issuing long-term municipal bonds.[188] A 1% increase in climate risk (measured through coastal cities' economic vulnerability to sea-level rise) has been associated with an increase of $1.7 million in issuance costs for average bonds.[189] Financial markets are also increasingly pricing corporations' exposure to climate risks: firms' carbon `emissions and carbon intensity are positively associated with their corporate default risk.[191]

Figure 19. Map of the average premium increase for State Farm homeowner policyholders from 2023-2025[190]



Note: Assuming State Farm's approved rate increase of 21.8%

185 Tinghua Duan and Frank Weikai Li, *Climate change concerns and mortgage lending*, Journal of Empirical Finance (2024), available at: https://www.sciencedirect.com/science/article/pii/S0927539823001123.

186 Amine Ouazad et al., "Mortgage Finance in the Face of Rising Climate Risk", National Bureau of Economic Research(2020), available at https://www.nber.org/system/files/working_papers/w26322/revisions/w26322.rev1.pdf?ftag=msfd61514f

187 Hongwei Dong, "Climate change and real estate markets: An empirical study of the impacts of wildfires on home values in California", Landscape and Urban Planning(2024), available at https://www.sciencedirect.com/science/article/pii/S0169204624000616

188 Id. https://www.sciencedirect.com/science/article/pii/S0304405X19301631?casa_token=grhFhVOcaOcAAAAA:huoLoHsbQ-mO1PpFLvV_TIZOGGjkH0lrZsluovxjs9aXWZhVRGi2qErQhgcv6zdaamMUE-tJtQ

189 Id. https://www.sciencedirect.com/science/article/pii/S0304405X19301631?casa_token=grhFhVOcaOcAAAAA:huoLoHsbQ-mO1PpFLvV_TIZOGGjkH0lrZsluovxjs9aXWZhVRGi2qErQhgcv6zdaamMUE-tJtQ

190 Id. https://climateintegrity.org/projects/climate-costs-studies/premiums-on-fire

191 Giusy Capasso et al., "Climate Change and Credit Risk", Journal of Cleaner Production(2020), available at https://www.sciencedirect.com/science/article/pii/S0959652620316814?casa_token=So9FhIatT3gAAAAA:UtlYes0GYiotPXjSVozi_VpRhePpAfPq7qBrxGKGIuvxlloLwwVJPDkI2w2WMNOpE6Rhsq2Vw#sec6

The implications of these financial risks are stark. As temperatures rise and the severity of climate risks continues to increase, the rising uninsurability of physical assets may generate not only increasing expenses for households, but severe disruption to financial markets and the health of the economy.[192]

Figure 20. Top 20 communities with average insurance premium increases over $2,000 from 2023-2025[193]

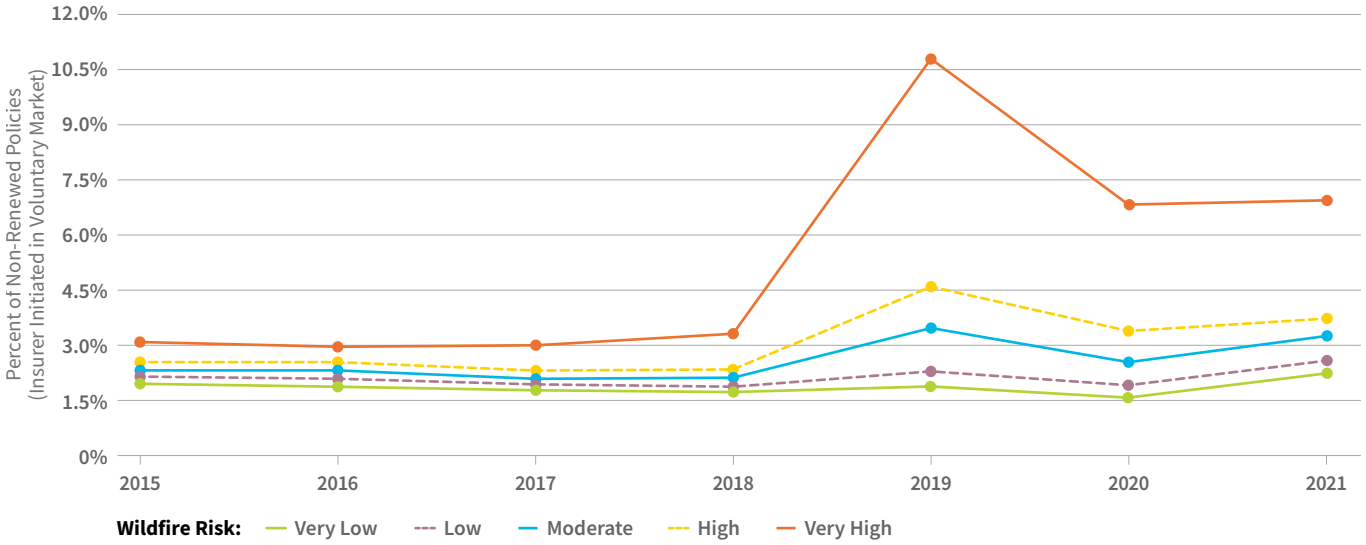
Rank	Community	County	Number of Policies Impacted in Community	Total Average Increase in Premium from 2023 to 2025
1	Laguna-Pine Valley CCD	San Diego County	468	$4,815.64
2	Agoura Hills-Malibu CCD	Los Angeles County	2,357	$4,380.48
3	Alpine CCD	San Diego County	387	$3,453.66
4	Coulterville CCD	Mariposa County	189	$3,438.49
5	Groveland CCD	Tuolumne County	211	$3,335.14
6	Jamul CCD	San Diego County	1,394	$3,255.52
7	Yuba Foothills CCD	Yuba County	122	$2,988.15
8	Angels City CCD	Calaveras County	1,146	$2,942.84
9	Lake Arrowhead CCD	San Bernardino County	2,996	$2,941.41
10	Triunfo Pass-Point Magu CCD	Ventura County	2,395	$2,789.92
11	Lower Lake CCD	Lake County	130	$2,674.54
12	Twain Harte-Tuolumn City CCD	Tuolumne County	2,285	$2,638.86
13	Los Padres CCD	Ventura County	1,237	$2,590.54
14	Ojai-Mira Monte CCD	Ventura County	755	$2,572.07
15	Palomar-Julian CCD	San Diego County	342	$2,492.82
16	Arnold-West Point CCD	Calaveras County	1,367	$2,460.32
17	North El Dorado CCD	El Dorado County	2,292	$2,350.95
18	Sutter Creek-Plymouth CCD	Amador County	510	$2,328.66
19	Cobb CCD	Lake County	321	$2,285.48
20	Foresthill-Back Country CCD	Placer County	647	$2,283.92

Source: https://climateintegrity.org/projects/climate-costs-studies/premiums-on-fire

192 Günther Thallinger, "Climate, Risk, Insurance: The Future of Capitalism", Linkedin(2025), available at https://www.linkedin.com/pulse/climate-risk-insurance-future-capitalism-g%C3%BCnther-thallinger-smw5f/

193 Id.https://climateintegrity.org/projects/climate-costs-studies/premiums-on-fire

Figure 21. Insurance non-renewals due to wildfire risk in California[194]

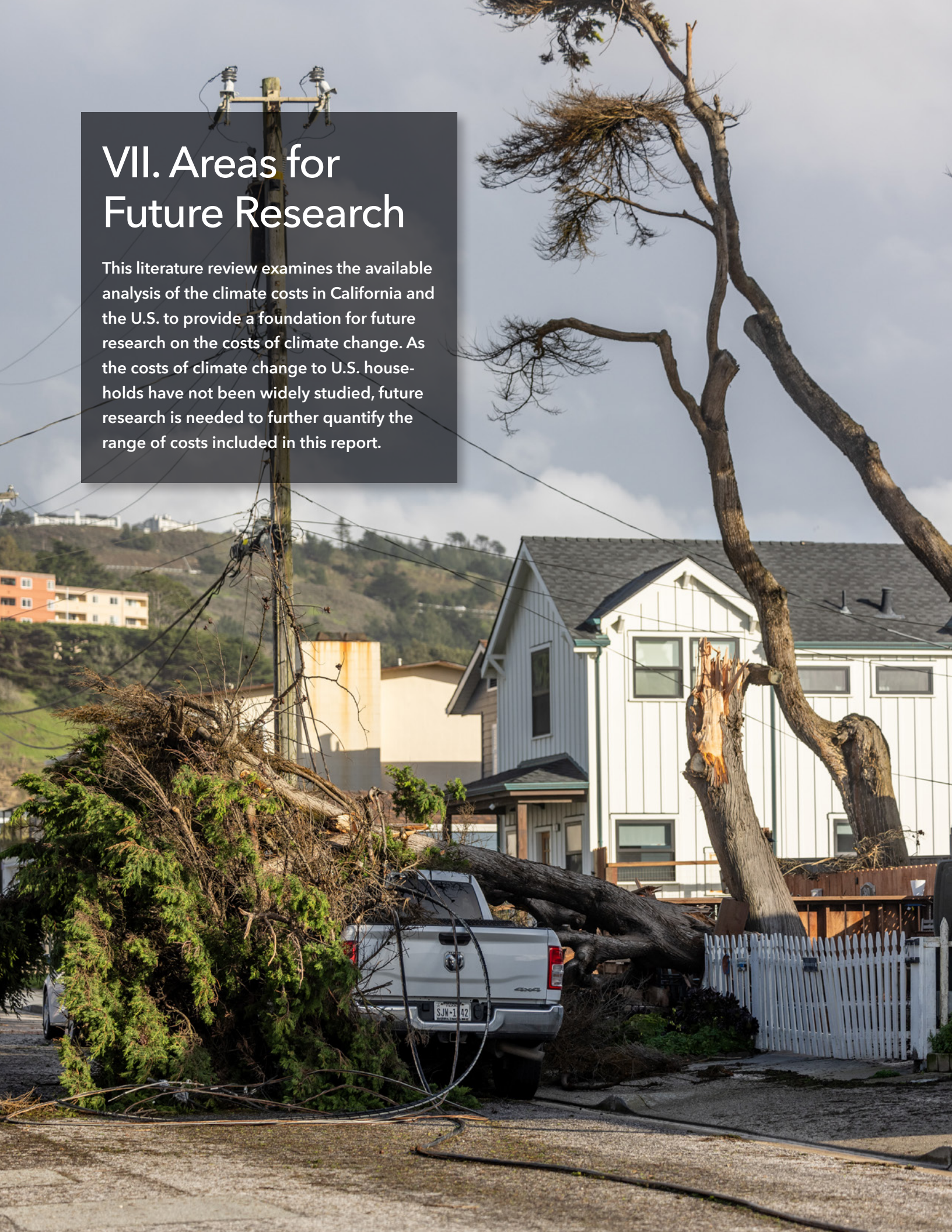


Source: California Department of Insurance https://www.insurance.ca.gov/01-consumers/200-wrr/upload/Residential-Insurance-Policy-Analysis-by-County-2015-to-2021-2.pdf Note: Percent of insurer-initiated non-renewals calculated as the number of insurer-onitiated non-renewed policies divided by the sum of renewed and non-renewed (both insurer-initiated and insured-initiated) policies. Private market only. Policies for renters and condominium unit owners are excluded.

194 Carolyn Kousky, "Is California becoming Uninsurable?",Environmental Defense Fund(2025), available at https://blogs.edf.org/markets/2025/01/17/is-california-becoming-uninsurable/

VII. Areas for Future Research

This literature review examines the available analysis of the climate costs in California and the U.S. to provide a foundation for future research on the costs of climate change. As the costs of climate change to U.S. households have not been widely studied, future research is needed to further quantify the range of costs included in this report.



This review also identifies several gaps in the This review also identifies several gaps in the information that should be addressed in future research. These include the following:

Costs of Climate Change on Households

- Quantifying household utility bill increases due to climate-related extreme events and increasing average temperatures
- Quantifying increased household spending during climate-related extreme events
- Quantifying the impacts of climate change on prices of basic food items and household goods

Rising health and healthcare costs

- Quantifying the health and healthcare costs of climate-related extreme events to U.S. households
- Quantifying the costs of climate-related limitations in healthcare access

Income impacts and disruptions

- Quantifying downstream income disruptions to households and businesses, including the income risks faced by lower-risk occupations
- Understanding long-term impacts of disruptions to work and income

Rising inflation and food prices

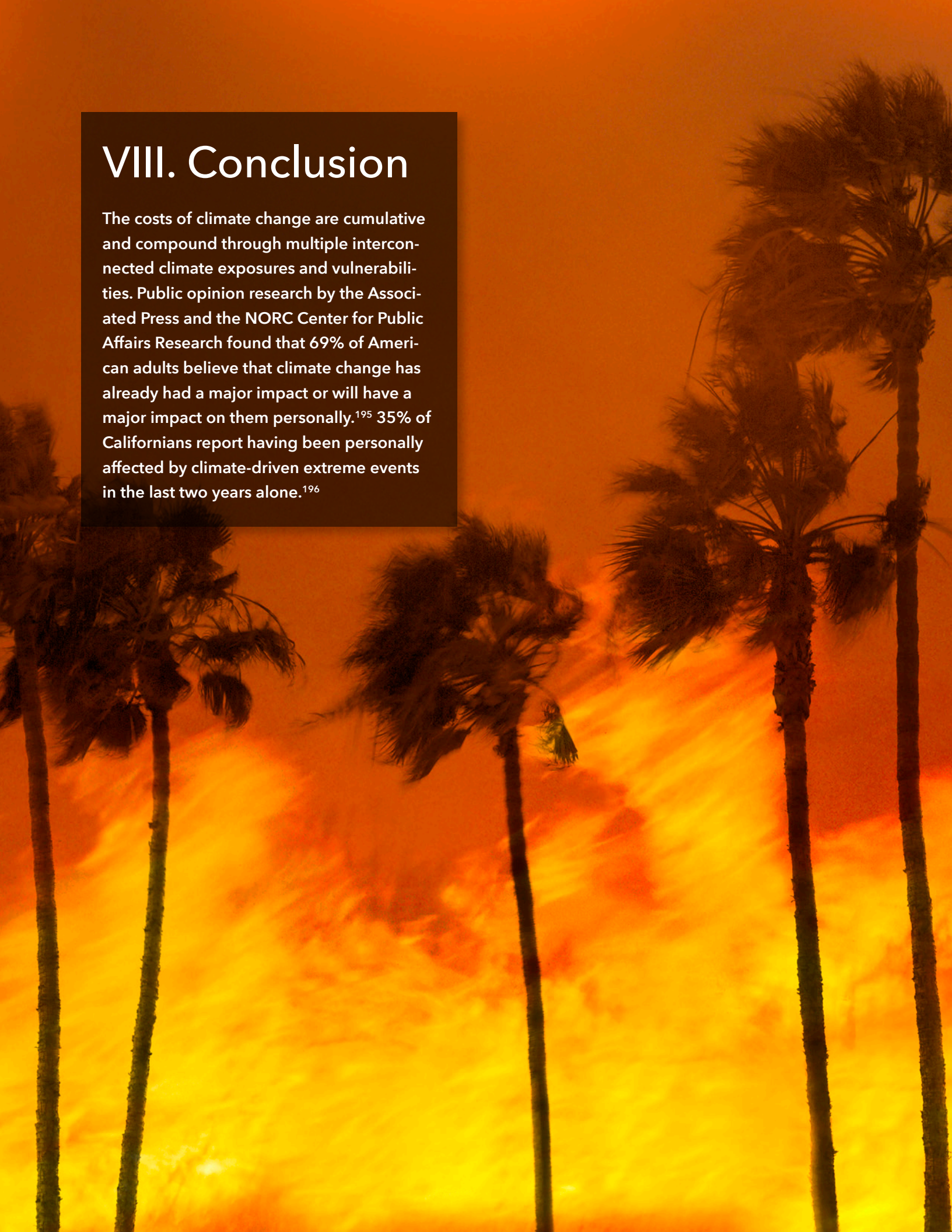
- Quantifying food product price increases to California residents across all food products

Housing, insurance, and financial risk

- Quantifying the financial impact of climate-related extreme events on California renters
- Quantifying downstream disruptions of climate change to mortgage and lending markets

Across all of these areas, further work is needed to better understand and quantify the distributional impacts for households facing higher existing social vulnerability. Further research is also needed to better quantify these impacts on other states beyond California.

While quantifying these –often indirect and downstream– costs of climate change is complex, data on the financial impacts of climate hazards is urgently needed to inform future calculations of the aggregate costs of climate change to California and U.S. residents. This research will be instrumental in conducting cost-benefit analyses of both mitigation and adaptation measures to address the impacts of climate-related extreme events.



VIII. Conclusion

The costs of climate change are cumulative and compound through multiple interconnected climate exposures and vulnerabilities. Public opinion research by the Associated Press and the NORC Center for Public Affairs Research found that 69% of American adults believe that climate change has already had a major impact or will have a major impact on them personally.[195] 35% of Californians report having been personally affected by climate-driven extreme events in the last two years alone.[196]

As climate change worsens, these numbers will only increase: every future increase of 1°C in mean global surface temperature is expected to decrease global GDP by 12%.[197] Far from being an abstract number, these losses will translate to direct impacts on lives and livelihoods in California and the U.S.

Rising household expenses due to infrastructure damage, rising utility costs, increased spending during climate-related extreme events, rising health and healthcare costs, rising inflation and food prices, rising rent costs, rising insurance premiums, and increased insurance and lending risk already incur significant financial losses for California and U.S. households. Climate-related extreme events are simultaneously generating labor losses and disruptions to expected income, limiting households' financial ability to absorb these shocks.

Future research is needed in quantifying every aspect of the costs of climate change, with emphasis on the indirect impacts of climate hazards and their distributional effects on low-income and underserved populations. Comprehensive policy action is essential to mitigate rising emissions and the widespread financial and economic costs of climate change to U.S. residents, households, and communities.

195 Half the public has been personally affected by extreme cold spells or heat waves within the past five years", AP-NORC Center for Public Affairs Research(2025), available at https://apnorc.org/projects/half-the-public-has-been-personally-affected-by-extreme-cold-spells-or-heat-waves-within-the-past-five-years/

196 https://www.ppic.org/publication/ppic-statewide-survey-californians-and-the-environment-july-2024/

197 Adrien Bilal & Diego R. Känzig, *The Macroeconomic Impact of Climate Change: Global vs. Local*, National Bureau of Economic Research (2024), available at Temperature"https://www.nber.org/papers/w32450?utm_campaign=ntwh&utm_medium=email&utm_source=ntwg5