NOVEMBER 2023

Natural Hazards and Federally Assisted Housing

A joint report by

The Public and Affordable Housing Research Corporation &
The National Low Income Housing Coalition

NATIONAL LOW INCOME HOUSING COALITION

PAHRC℠

Andrew Aurand, PhD., MSW
NLIHC, Senior Vice President for Research

Dan Emmanuel, MSW
NLIHC, Senior Research Analyst

Kelly McElwain, MPP
PAHRC, Manager, Research and Industry Intelligence

Cate Asp, MPP
PAHRC, Research Analyst

ABOUT NLIHC

The National Low Income Housing Coalition is dedicated to achieving racially and socially equitable public policy that ensures people with the lowest incomes have quality homes that are accessible and affordable in communities of their choice.

The National Low Income Housing Coalition
1000 Vermont Avenue, NW Suite 500
Washington, DC 20005
202-662-1530
www.nlihc.org

ABOUT PAHRC

The Public and Affordable Housing Research Corporation (PAHRC) is a non-profit research center dedicated to conducting research that promotes the national conversation about the importance of affordable housing. PAHRC spotlights the impact, outcomes, and value affordable housing brings to the families it serves and to the communities it supports, delivering data and tools that assist researchers, practitioners, and advocates to build an evidence-based case for why affordable housing matters.

Public and Affordable Housing Research Corporation
189 Commerce Court
PO Box 189 Cheshire, CT 06410
203-272-8220
www.pahrc.org

CONTENTS

EXECUTIVE SUMMARY

The U.S. faces an affordable housing crisis, with a shortage of 7.3 million affordable and available rental homes for the lowest-income renters (Aurand et al., 2023). As a result, nearly three-quarters of extremely low-income renters — those whose household incomes are below either the federal poverty guideline or 30% of their area median income (AMI) — are severely cost-burdened, spending more than half their income on housing. The federally assisted housing stock, accounting for approximately 10% of the nation's rental housing, is a limited but critical resource in the context of this crisis (Aurand et al., 2021a). At the same time, severe weather events are predicted to increase in frequency, posing a growing threat to federally assisted homes and their residents, who are often the least prepared to respond to and recover from disasters (Agha-Kouchak et al., 2020).

This report – the result of collaboration between the Public and Affordable Housing Research Corporation (PAHRC) and the National Low Income Housing Coalition (NLIHC) – analyzes the risks that natural hazards pose to federally assisted homes and their communities using the Federal Emergency Management Agency's (FEMA) National Risk Index (NRI). The NRI compares across locations the risk of harm from 18 different types of weather, geological, and climate events. Using measures available within this index and housing data from the National Housing Preservation Database (NHPD), we find that:

- Of the six most destructive hazards in terms of loss of property and life, heat waves are the most prevalent hazard threatening residents of federally assisted homes. Twenty-eight percent of federally assisted rental homes are in census tracts with the greatest risk of losses from extreme heat.
- Twenty-five percent of federally assisted rental homes are in census tracts with the greatest risk of losses from tornadoes, and 23% are in census tracts with the greatest risk of losses from riverine flooding.
- Considering the social vulnerability of residents and community resilience, in addition to the loss of property and life, 24% of federally assisted homes are in census tracts with the greatest risk of negative impacts from natural hazards nationwide. In eight states, more than half of federally assisted homes are in census tracts with the greatest risk of negative impacts.
- Federally assisted homes in rural areas are more vulnerable to the negative impacts of natural hazards compared to homes in urban areas. Thirty percent of federally assisted rental homes in rural areas were in census tracts with the greatest risk for negative impacts compared to 23% of federally assisted rental homes in urban areas.

Natural hazards pose a significant threat to federally assisted homes, while residents are especially susceptible to adverse impacts. State and local stakeholders should assess the vulnerability of the federally assisted homes in their communities. They should develop or improve strategies and resources for equitable planning, mitigation, and recovery. States and localities have a particularly important role in incorporating disaster mitigation into the construction and placement of new assisted housing. The federal "Reforming Disaster Recovery Act," meanwhile, would expedite and improve the recovery of federally assisted housing when it is lost to disasters. Given the acute heat risks faced by residents of federally assisted homes, the federal government should also consider revising utility allowance policies in housing programs to make more households eligible for assistance with air conditioning costs.

INTRODUCTION

The U.S. is experiencing more frequent and more intense weather and climate-related hazards like hurricanes, wildfires, and flooding (Smith, 2023). Climate-change experts expect this trend to continue in the coming years. While not all natural hazards result in disasters with costly or catastrophic outcomes, such hazards represent a risk and can result in negative impacts. The potential exposure of federally assisted homes to natural hazards, whether on a smaller scale or in the context of a larger disaster, is of interest given the inherent vulnerabilities and social value of this housing stock. Like other low-income households, residents of federally assisted rental homes, who often have extremely low incomes, are particularly vulnerable to negative impacts (Rummukainen, 2012).

Rental housing itself may be more vulnerable to negative impacts from natural hazards and disasters compared to other types of housing. Evidence suggests that rental housing can sustain greater damage and recover more slowly from disasters than owner-occupied housing (Hamideh et al., 2021; Peacock et al., 2014; Zhang & Peacock, 2009). Multifamily and duplex structures, building types commonly associated with rental housing, typically take longer to repair than single-family structures (Hamideh et al., 2021; Peacock et al., 2014). At the same time, renters and landlords might not have the same incentives as homeowners to make long-term mitigation investments (Collins, 2008). Moreover, while the dollar value of damage is associated with the amount of disaster assistance allocated to homeowners, it is not a predictor of the amount of assistance provided to renters (Drake et al., 2021). Rental housing has historically been less likely to benefit from recovery resources such as Community Development Block Grant-Disaster Recovery (CDBG-DR) funds than owner-occupied housing (Fair Share Housing Center, 2015; GAO, 2010; Spader & Turnham, 2014). The U.S. Government Accountability Office (2010), for example, found that following Hurricanes Katrina, Rita, and Wilma, 62% of damaged homeowner units were assisted, compared to just 18% of damaged rental units. In addition, Rice University's Kinder Institute for Urban Research (2017) found that renters received less aid than homeowners in response to Hurricane Harvey.

Lower-cost rental housing may face even greater challenges. Lower-cost rental housing is often characterized by lower physical quality and tends to be located in less desirable and more risk-prone areas, putting it at greater risk of damage and negative recovery outcomes (Lee & Van Zandt, 2019). These homes, including those that are federally assisted, also tend to be older, making them more susceptible to damage due to wear, a lack of upgraded building materials, and older systems than those found in newer properties (FEMA, 2020; Fothergill & Peek, 2004).

Owners of lower-cost market-rate rental housing and federally assisted rental properties may find it especially challenging to repair or rebuild their housing due to limited rental income to pay for repairs and meet newer mitigation standards (Aurand & Emmanuel, 2019). Owners of lower-cost rental housing in the private market may need to raise rents or sell to new owners with sufficient capital to financially cover disaster-related damages, jeopardizing affordability. In weaker markets where they cannot raise rents, private landlords can be hard-pressed to rehabilitate their housing at all. Owners of federally assisted rental

housing may face even greater challenges generating funds to repair or rebuild after a disaster, because rent increases are typically restricted. Owners of lower-cost market-rate and federally assisted rental housing likely require access to scarce subsidies to rehabilitate or rebuild their properties.

Residents of lower-cost rental housing in either the private or subsidized markets face significant risk of displacement. Low-income renters living in federally assisted homes may face even greater risks. Research from Hurricane Katrina suggests that subsidized renters are least likely to return to their pre-disaster homes compared to low-income homeowners or low-income market-rate renters (Fussell & Harris, 2014). Displacement makes it more difficult for survivors to participate in the disaster recovery process, potentially exacerbating inequitable disaster impacts (Hamideh & Rongerude, 2018; Rumbach & Makarewicz, 2016). Public housing residents displaced by Hurricane Ike in Galveston, Texas, for example, were largely unable to participate in local recovery planning meetings and, as a result, community opponents of public housing were mostly successful in preventing the recovery of the public housing stock (Hamideh & Rongerude, 2018).

People of color, people with disabilities, and seniors are overrepresented among federally assisted renters and considered socially vulnerable in the disaster research literature, meaning they are disproportionately likely to suffer adverse impacts from natural hazards, such as death, injury, property loss, or disruption of their livelihoods (Donner & Rodriguez, 2008; FEMA, 2023; Fothergill et al., 1999; Howell & Elliott, 2018; Brookings Institution, 2017; Sastry & VanLandingham, 2009; Van Zandt et al., 2012; Zhang & Peacock, 2009). In the context of increasingly frequent threats from natural hazards, longstanding inequities, and a worsening rental affordability crisis, it is more important than ever to understand the risks posed to socially vulnerable populations.

This report analyzes the extent to which the federally assisted housing stock and its residents are in communities at greatest risk of negative impacts from natural hazards. Specifically, it examines overall and hazard-specific risks for federally assisted homes compared to all rental and owner-occupied homes. The report concludes with policy recommendations for mitigating the impact of natural hazards and disasters on federally assisted properties and improving outcomes for residents.

METHODOLOGY

Federally assisted homes include properties that receive subsidized mortgages, tax credits, or subsidies from a federal program in exchange for charging rents affordable to low-income households. These properties were identified using the National Housing Preservation Database (NHPD), which is a deduplicated list of properties assisted by the Low Income Housing Tax Credit (LIHTC), Public Housing, Project-Based Rental Assistance (PBRA), U.S. Department of Agriculture (USDA) Section 515, 514, and 538 programs, Section 202 Direct Loans, HOME Assistance, U.S. Department of Housing and Urban Development (HUD) insurance programs, Mod Rehab, or Project Based Vouchers.

These properties were matched to the March 2023 edition of FEMA's census tract-level National Risk Index (NRI) (FEMA, 2023). Renter- and owner-occupied household data from the 2017-2021 (5-yr) American Community Survey were also matched to the NRI to provide points of comparison. The NRI estimates the expected annual losses for each census tract for 18 types of hazard: riverine flooding, earthquake, tornado, hurricane, wildfire, wind, volcanic activity, avalanche, mudslide, coastal flooding, heat wave, cold wave, winter weather, ice storm, drought, hail, lightening, and tsunami. The NRI assesses overall risk based on expected annual loss, social vulnerability, and community resiliency metrics for each tract. Expected annual loss is based on the economic value of property, agriculture, and people exposed to each hazard (exposure), the annualized frequency of the event (frequency), and the value of previous damage in the area (loss ratio). Social vulnerability represents the susceptibility of a community's social groups to adverse impacts of natural hazards. The social vulnerability measure is composed of 16 social, economic, demographic, and housing factors that impact community members' ability to prepare for, respond to, recover from, and adapt to hazards. These factors, measured for census tracts, include the percentage of the population with low incomes, percentage over the age of 65, percentage with a disability, English language proficiency, race, vehicle access, and housing types like mobile homes. Community resiliency represents the degree to which a community can prepare for anticipated hazards and recover from a disaster quickly. It includes 49 metrics that measure social, economic, and community capital; housing/infrastructure; institutional capacity; and environmental conditions (FEMA, 2023).

FEMA uses these metrics to estimate an overall score for the aggregate potential impact from the 18 hazards, in addition to scores for each individual component and hazard. Risk scores compare community risk based on historic event data and are not predictive of future impacts (Zuzak et al., 2022). Scores range from 0 to 100 and reflect the community's risk percentile ranking within the nation and their state. In this report, we identified census tracts with the highest relative risk by classifying risk scores by quintile. Homes with the greatest risk

are in census tracts with NRI scores that rank in the top quintile in the nation or their respective state. FEMA also classifies scores into the following rating categories using k-means clustering: very high, relatively high, relatively moderate, relatively low, and very low. We compared the number of homes at risk using FEMA's risk rating and the quintile of each risk score. We found that the overall trends were the same, but the magnitude of homes at risk was larger when using quintiles because more high-risk census tracts were identified.

FEMA also estimates an expected annual loss rate, which represents the percentage of the population, buildings, and agriculture in a census tract estimated to be impacted by natural hazards annually. We adjust this value based on the social vulnerability and community resilience of the area. This measure accounts for differences in community size when assessing potential impacts from natural hazards. The NRI is subject to change as new data become available or as FEMA makes methodological improvements. Since launching the tool, FEMA has released four iterations of the NRI, with substantial methodology changes released in August 2021 and March 2023.

The NRI can be a powerful tool for assessing overall risk of natural hazards to communities. However, it may be less effective for estimating risk to less resourced communities and to individuals of more vulnerable social groups. Census tracts' overall risk scores are strongly correlated to expected annual losses (r=.965) and less correlated to social vulnerability (r=.279) and community resiliency (r=-.263). A study of non-coastal flood events between 2008 and 2012 found that social vulnerability was a larger predictor of death and property damage than flood intensity (Tellman et al., 2020). While the NRI estimates expected annual losses for populations based on deaths or injuries caused by natural hazards, it does not estimate economic losses from displacement and mental distress caused by disasters, which are shown to impact low-income households at higher rates (Brennan et al., 2022; Fothergill & Peek, 2004; NLIHC, 2023).

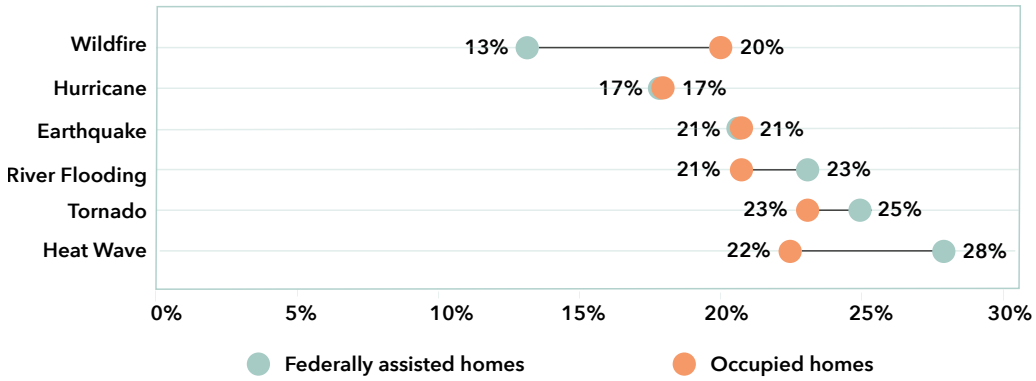
HAZARDS IN FOCUS

Most federally assisted rental homes are in census tracts of high risk for at least one natural hazard – i.e., census tracts scoring in the top 20% nationally for expected annual losses from one of the 18 hazards included in the NRI.

Among the six most destructive hazards, which are responsible for 85% of total annual losses, 28% of federally assisted homes are in census tracts with the greatest risk of losses from heat waves, 25% are in census tracts with the greatest risk of tornado-related losses, 23% are in tracts with greatest risks from riverine flooding-related losses, and 21% are in census tracts with the greatest risk of earthquake-related losses (Figure 1).[1] Compared to all owner-occupied and renter-occupied homes, federally assisted rental homes are disproportionately located in census tracts with the greatest expected losses from heat wave, tornadoes, and riverine flooding. They are less likely in census tracts with the greatest risk of wildfire-related losses. Natural hazards associated with the greatest monetary damages (flooding) and number of mortalities (extreme heat) nationwide are described in more detail in the following section.

FIGURE 1

Percent of Federally Assisted and Occupied Homes in Census Tracts with Greatest Risk of Losses for Top Six Most Destructive Hazards



Sources: National Housing Preservation Database (January 2023), American Community Survey five-year estimates (2017-2021), and National Risk Index (March 2023)

FLOODING

Flooding causes $5 billion in property damage in the U.S. annually and is the leading cause of monetary damage from natural hazards (NOAA, 2023; Swiss Re, 2021). Floods can also cause mortality, injury, and displacement, often impacting low-income households at higher rates (Brennan et al., 2021; Lindersson et al., 2023; Doocy et al., 2014). Flooding can take three main forms: flash, riverine, and coastal. Each of these natural hazards is forecasted and assessed differently and can be triggered by other weather events, such as hurricanes, severe thunderstorms, and snowmelt.

1 FEMA increased the value of a statistical life in the March 2023 edition of the NRI, likely increasing the expected annual losses associated with heat waves relative to earlier versions of the NRI.

In total, 1.1 million federally assisted homes are in census tracts with the greatest risk of riverine flooding-related losses. Twenty-three percent of federally assisted homes scored in the top quintile for riverine flood risk, compared to 20% of renter-occupied and 21% of owner-occupied homes. Federally assisted homes may be at greater risk in certain regions, however. Other research has found that federally assisted homes were more likely to be in the floodplain for Hurricane Harvey (Chakraborty et al., 2021). The portion of federally assisted homes at the highest risk for riverine flood may be understated, since flood maps are not available or are outdated in many communities (R Street, 2020).

> **1.1 million federally assisted homes are in census tracts with the greatest risk of riverine flooding-related losses.**

Research following Hurricane Harvey found that Black and Hispanic residents located outside of floodplains were more likely to experience flooding. This could be due to neighborhood disinvestment in stormwater infrastructure and the prevalence of people of color living in neighborhoods on the fringes of 100-year floodplains (Smiley, 2020). An analysis from First Street Foundation found that Black, Asian, and Hispanic neighborhoods in Houston were more likely to be in "federally overlooked 100-year flood zones," meaning they have high flood risk but have yet to be classified into 100-year floodplains by FEMA (Flores et al., 2022). This suggests FEMA's flood maps may underestimate risks to communities of color, which could further increase the number of people of color impacted by flooding as the climate changes (Smiley, 2020).

Nationwide, 545,000 federally assisted homes – or 11% of the total number of such homes – are in census tracts at the greatest risk of losses from coastal flooding, compared to 9% of renter-occupied and owner-occupied homes. An analysis from First Street Foundation found that the number of affordable homes in areas prone to coastal floods is expected to triple by 2050 (Buchanan et al., 2020). Exposure varies dramatically across states and cities, with much of the risk of coastal flooding concentrated in certain cities in the northeast and in California. Three-quarters of federally assisted homes projected to be at the greatest risk of coastal flooding in the next 30 years are in 20 cities.

Compounding these disparities, low-income households are less likely to be protected from flooding through climate adaptation measures. A report by the U.S. Environmental Protection Agency (EPA) found that low-income and Indigenous people are more likely to live in areas where the largest portion of land at risk of coastal flooding is projected to be excluded from climate adaptation due to cost-benefit analyses (EPA, 2021).

HEAT WAVES

Extreme heat is the leading cause of weather-related deaths in the U.S. (U.S. Department of Commerce, 2023). Heat stress can increase the risk of heart attack, stroke, and breathing problems. Heat exposure is more likely in populations that are low-income, non-white, live in affordable housing, have limited education levels, or have limited English proficiency (Voelkel et al., 2018). The impacts of heat exposure are expected to increase due to climate change, particularly for low-income households and people of color.

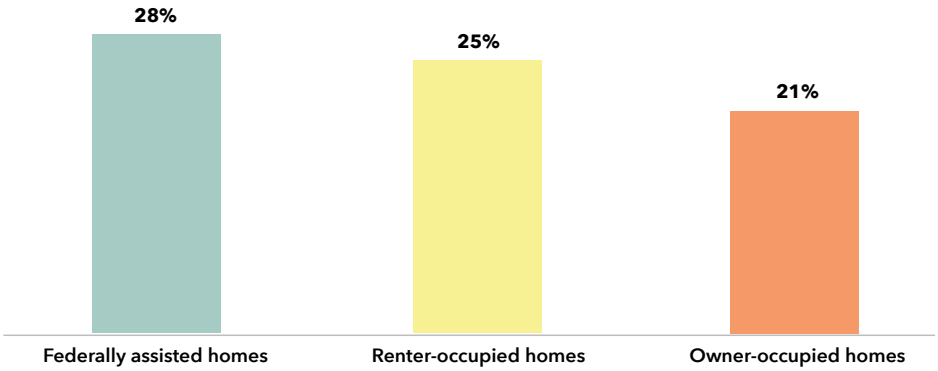
Twenty-eight percent of federally assisted homes are in census tracts with the greatest risk for extreme heat-related losses nationwide, compared to 25% of renter-occupied homes and 21% of owner-occupied homes (Figure 2). These disparities are likely driven by differences in tree canopy, historic redlining policies, building characteristics, financial insecurity, and utility allowance policies. Subsidized homes are less likely to be in neighborhoods with tree canopies and more likely to be in areas with high heat and social vulnerability (Gabbe & Pierce, 2020). Disproportionate exposure to extreme heat is linked to historic redlining policies that prevented people of color from moving into certain neighborhoods and buying homes. A study of 108 urban areas found that historically redlined neighborhoods are on average 2.6 degrees Celsius warmer than non-redlined neighborhoods (Hoffman et al., 2020). Many of the earliest federally assisted homes were built in redlined neighborhoods due to the low cost of land, likely contributing to the disparities in exposure to extreme heat among assisted families that persist today. The 2021 American Housing Survey shows that 11% of renters living in federally assisted homes do not have air conditioning. These renters may be particularly susceptible to the impacts of extreme heat (Hall, 2009; Aurand et al., 2021b).

Twenty-eight percent of federally assisted homes are in census tracts with the greatest risk for extreme heat-related losses nationwide, compared to 25% of renter-occupied homes and 21% of owner-occupied homes.

Federally assisted homes tend to have older appliances, less efficient insulation, and consume more energy compared to market-rate housing, contributing to larger energy burdens for the people who live in these buildings (Brown et al., 2020; Reina & Kontokosta, 2017). These energy burdens are amplified by utility allowance policies. While some households receiving housing assistance receive an allowance to cover the cost of utilities, they are required to pay for the cost of air conditioning if their household does not include an older adult or person with a disability (Ludden, 2023). Nearly half of voucher holders across four cities in Florida received utility bills above the allowances established by their local public housing authority (PHA) leading to higher cost burdens, with residents living in single-family homes most at risk (Ray et al., 2019). Energy insecurity is associated with debt, utility shut-offs, frequent moves, exacerbated health conditions, and excessive mortality rates during extreme weather (Dorsey-Palmateer, 2020; Hernández, 2016; Jessel et al., 2019).

FIGURE 2

Percent of Homes in Census Tracts Scoring in the Top Quintile for Heat Risk by Housing Type



Sources: National Housing Preservation Database (January 2023), American Community Survey five-year estimates (2017-2021), and National Risk Index (March 2023)

EXPECTED ANNUAL LOSS, SOCIAL VULNERABILITY, AND COMMUNITY RESILIENCY

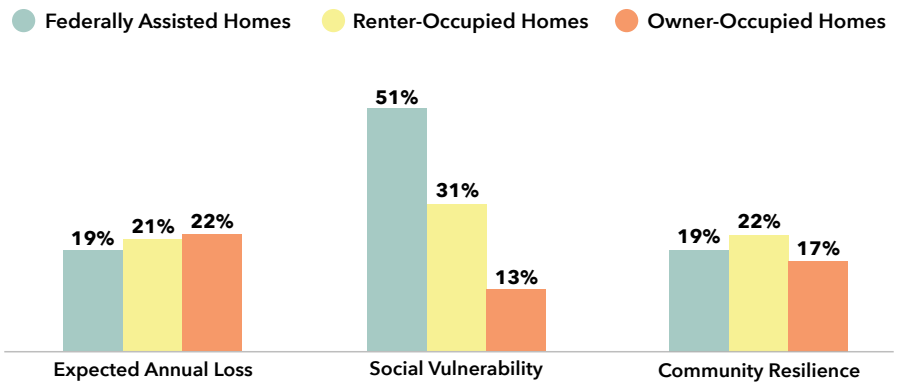
The expected annual losses associated with individual natural hazards are just one component of risk included in the NRI. The NRI also considers a community's social vulnerability and resiliency. Social vulnerability captures a community's susceptibility to adverse impacts from natural hazards, while resiliency represents the degree to which a community can prepare for and recover from impacts quickly.

Communities and households with fewer social and economic resources are more socially vulnerable and less resilient to negative impacts from natural hazards. Past research has found that people of color, people with disabilities, and seniors are particularly socially vulnerable and thus more likely to suffer adverse impacts from natural hazards. These populations are disproportionately represented among federally assisted renters. Federally assisted homes also tend to be sited in more disadvantaged neighborhoods, suggesting they may be located in less resilient communities. In this section, we look separately at each of the three broad components that make up the NRI – Expected Annual Loss, Social Vulnerability, and Community Resiliency – to better understand how each of these components contributes to natural hazard risks for federally assisted homes compared to renter-occupied and owner-occupied homes. In the next section, we assess overall risk by considering how these components combine.

Regarding expected annual losses from the 18 hazards included in the NRI, 19% of federally assisted homes are in census tracts ranking in the top quintile for risk of hazard-related losses nationally (Figure 3). Twenty-one percent of renter-occupied and 22% of owner-occupied homes are in census tracts with the greatest risk for potential economic losses from natural hazards. While federally assisted homes are slightly less likely to be in census tracts with the highest risk for economic loss from natural hazards, the NRI's social vulnerability and community resiliency factors suggest that they may still be at a greater risk of negative impacts from a disaster.

FIGURE 3

Percent of Homes in Census Tracts with Greatest Expected Annual Loss and Social Vulnerability Scores and Lowest Community Resiliency Scores by Housing Type



Sources: National Housing Preservation Database (January 2023), American Community Survey five-year estimates (2017-2021), and National Risk Index (March 2023)

The NRI's social vulnerability component measures 16 socioeconomic factors thought to increase communities' susceptibility to the adverse impacts of disaster.[2] Fifty-one percent of federally assisted homes are in census tracts with the highest social vulnerability scores, compared to 31% of renter-occupied and 13% of owner-occupied homes. This finding suggests that a large portion of federally assisted homes are in census tracts whose populations could have a more difficult time evacuating from a disaster, absorbing subsequent income shocks, or affording recovery needs. This is not surprising given that the socioeconomic factors contributing to social vulnerability include the percentage of people with incomes below 150% of the poverty line and the racial makeup of residents in the census tract, along with the prevalence of multifamily homes – three factors that are likely influenced by the presence of large-scale developments of federally assisted homes.

The NRI's community resilience component is based on 49 measures of social, economic, and community capital; institutional capacity; housing/infrastructure; and environmental factors that could increase communities' ability to plan for, adapt to, and recover from disasters (FEMA, 2020). Community resilience is measured at the county level. Nineteen percent of federally assisted homes are in counties with the lowest-ranking community resilience scores, compared to 22% of all renter-occupied homes and 17% of owner-occupied homes. FEMA's community resilience score may overestimate the resilience of neighborhoods with federally assisted homes where public infrastructure and other investments may be less prevalent than in other neighborhoods in the same county. Research suggests that low-income people and people of color are less likely to benefit from community-wide investments in resiliency or recovery and mitigation funds (Emrich et al., 2022; Hong et al., 2021; Tan, 2021).

2 NRI technical documentation can be found at https://bit.ly/4794Twx.

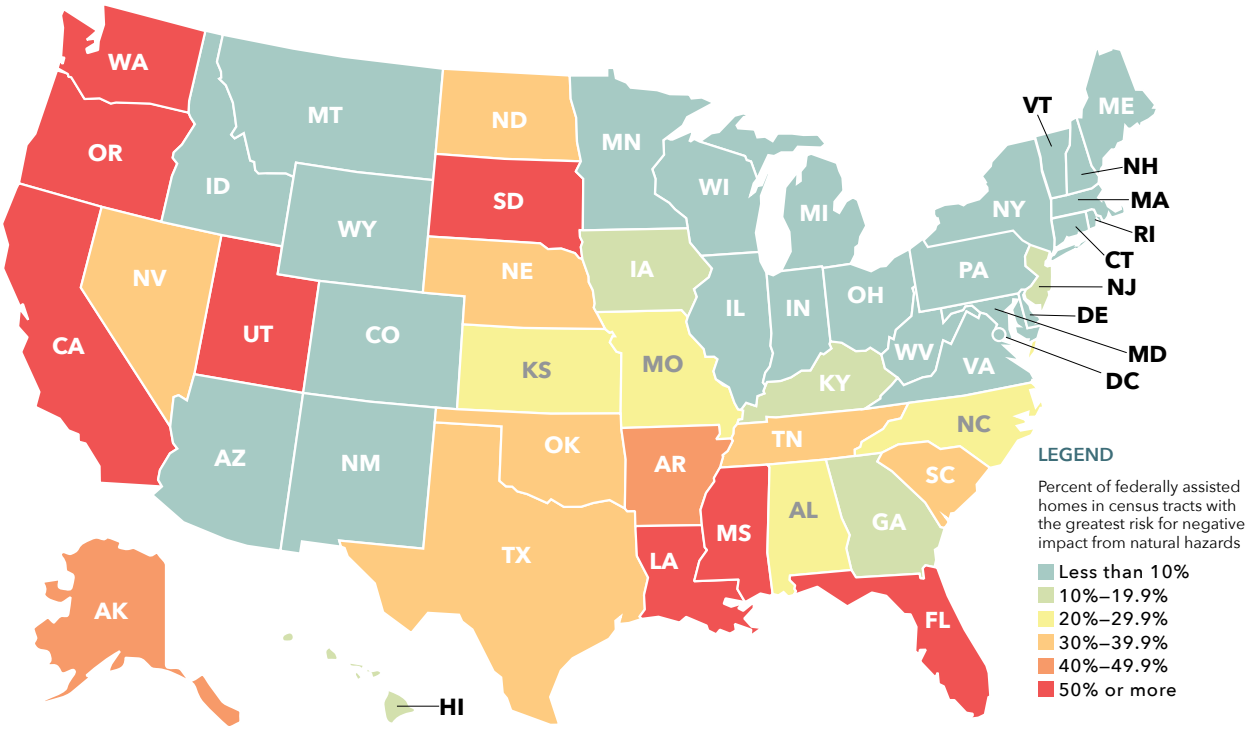
FEDERALLY ASSISTED HOMES AND OVERALL HAZARD RISK

RISK RELATIVE TO NATION

This section combines expected annual loss, social vulnerability, and community resiliency to present a more comprehensive assessment of community-wide risks using overall census tract NRI scores. The number of federally assisted homes in census tracts at the greatest risk for negative impacts from natural hazards increases when accounting for social vulnerability and resiliency in addition to annual expected losses. Nearly 1.2 million federally assisted homes, or 24% of the affordable rental housing stock, are in census tracts with the greatest overall risk of negative impacts from natural hazards relative to the nation. The number and percent of federally assisted homes in census tracts with the greatest overall risk varies greatly by state (Appendix A). More than half of federally assisted homes in the following states are in census tracts with the greatest risks for impacts from natural hazards: Florida (71%), California (64%), Oregon (57%), Utah (56%), South Dakota (56%), Mississippi (54%), Louisiana (53%), and Washington (50%) (Map 1). Generally, the South and West Coast have greater shares of federally assisted homes in census tracts at greatest risk, while the Midwest and Northeast have lower shares at risk. These differences are due to variation in the frequency of severe weather, damage from past storms, and the populations and property values exposed to natural hazards across census tracts in these states.

MAP 1

Percent of Federally Assisted Homes in Census Tracts with the Greatest Risk for Negative Impacts from Natural Hazards by State



Sources: National Housing Preservation Database (January 2023), National Risk Index (March 2023)

With regard to metropolitan areas, those located along the Gulf and southeastern coasts, in Tornado Alley, and in the western U.S. have a larger share of federally assisted homes in census tracts at greatest risk. In six of the 50 largest metropolitan areas, more than three-quarters of the federally assisted rental stock is located in census tracts of greatest risk, while in 10 of the 50 largest metropolitan areas, more than half of the federally assisted rental stock is located in areas of greatest risk (Appendix A). Some of the metropolitan areas with the greatest shares of federally assisted homes at the greatest risk of hazard impacts – like Tampa, FL; Riverside, CA; Los Angeles, CA; and Houston, TX – also have the most severe shortages of rental housing affordable and available to extremely low-income renters, according to a recent analysis by NLIHC (Aurand et al., 2023). Damage from natural hazards could further exacerbate affordable housing shortages where affordability is already an acute challenge.

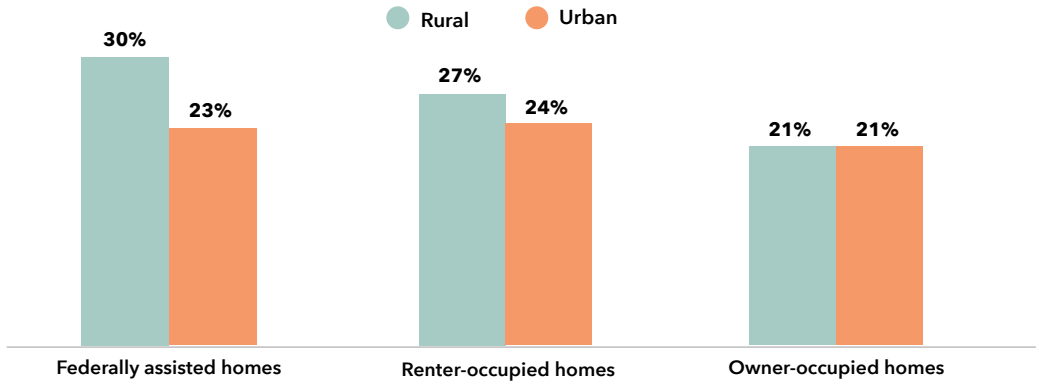
Nationally, federally assisted homes are slightly more likely than owner-occupied homes and equally likely as other renter-occupied housing to be in census tracts at the greatest overall risk of negative hazard-related impacts. Twenty-four percent of federally assisted and renter-occupied homes are in census tracts with the greatest risk, compared to only 21% of owner-occupied homes.

Federally assisted homes located in rural areas are more likely than those in urban areas to be in census tracts with the highest overall risk. Thirty percent of federally assisted homes in rural areas are in census tracts in the top quintile for overall risk compared to 23% of federally assisted homes in urban areas (Figure 4). A similar, but smaller, disparity in risk exists for all renter-occupied homes between rural and urban census tracts (27% vs. 24%), while there is no disparity for owner-occupied homes.

> Federally assisted homes located in rural areas are more likely than those in urban areas to be in census tracts with the highest overall risk.

FIGURE 4

Percent of Homes in Census Tracts with Greatest Risk by Housing Type and Urban Rural Status



Sources: National Housing Preservation Database (January 2023), National Risk Index (March 2023)

Nationally, rural communities face an elevated exposure to natural hazards (Brennan & Flint, 2007; Tate et al., 2021). People living in rural areas tend to be older, experience greater health challenges, have fewer resources to prepare for and respond to a disaster, and be more likely to work in occupations that expose them to severe weather (Cutter et al., 2016; Drakes et al., 2021; Molinsky & Forsyth, 2022; Tellman et al., 2020). Compounding the impacts of these disparities, rural areas also have less administrative and financial capital to respond to and mitigate risks (Brennan & Flint, 2007). A case study of communities impacted by Hurricane Rita found that isolation and higher poverty rates slowed the speed of recovery in rural counties (Tootle, 2007). Rural communities may also be at a disadvantage when applying for federal funds to invest in mitigation projects due to limited resources and governmental capacity (CAP, 2022; Headwaters Economics, 2023). Residents of federally assisted homes may be particularly vulnerable, as affordable housing groups were less likely to participate in hazard mitigation plans in rural counties (Horney et al., 2017).

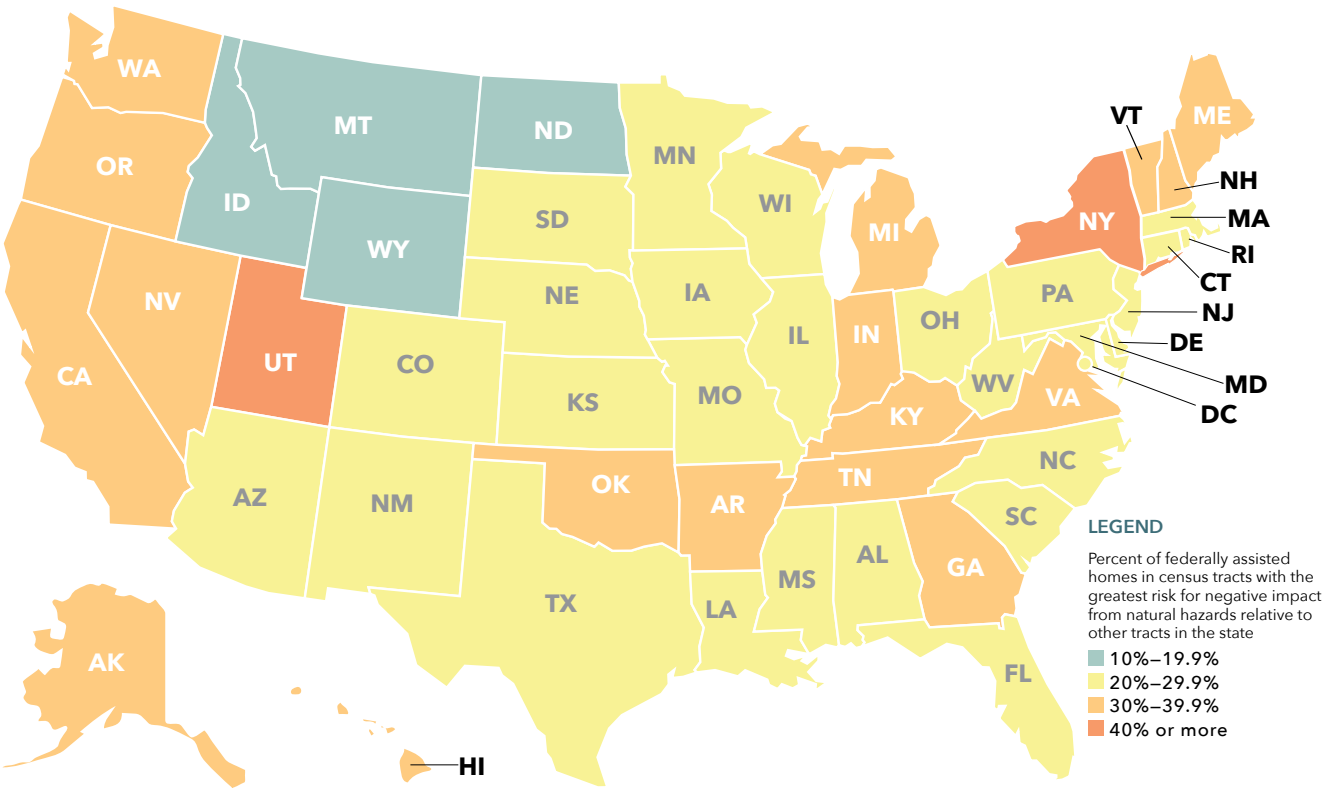
RISK RELATIVE TO STATE

In the previous section, we measured the share of federally assisted homes in census tracts of greatest risk relative to other tracts across the nation, but state-level policymakers will likely consider the share of assisted housing located in census tracts of greatest risk relative to other tracts in their state to make policy decisions. In New York, for example, 4% of federally assisted homes are in tracts with greatest risk relative to the nation, but 40% are in tracts with greatest risk relative to the state, mostly because New York is a low-risk state relative to the nation.

Nearly 1.5 million federally assisted homes, or 29% of the stock, are in census tracts with the greatest risk in their state for negative impacts from natural hazards, compared to 24% of renter-occupied homes and 23% of owner-occupied homes. The difference in state-level risk between federally assisted and owner-occupied homes is even larger in 21 states (Appendix A). In 19 states and the District of Columbia, more than 30% of federally assisted homes are in tracts with the greatest risk in their respective state (Map 2).

MAP 2

Percent of Federally Assisted Homes in Census Tracts with the Greatest Risk in Their State for Negative Impacts from Natural Hazards



Sources: National Housing Preservation Database (January 2023), National Risk Index (March 2023)

Metropolitan areas along the coasts and in the Midwest tend to have a larger share of federally assisted homes in census tracts at greatest risk relative to other state tracts of hazard-related negative impacts. Metropolitan areas with fewer federally assisted homes also tend to have a larger share of these homes in census tracts with the greatest risk relative to other tracts in the state. Among the 50 largest metropolitan areas, six have more than 50% of their federally assisted homes in census tracts with the greatest risk relative to the state (Appendix A).

CONCLUSION AND POLICY RECOMMENDATIONS

Nearly a quarter of federally assisted homes are in census tracts with the greatest risk of negative impacts from natural hazards nationwide, and this share surpasses 50% in eight states. Federally assisted homes, which are the product of decades of public investment, provide affordable and stable housing to some of the nation's lowest-income renters and are difficult to replace if lost. We must protect federally assisted housing, and the residents who rely upon it, from the growing risks posed by natural hazards.

The bipartisan Reforming Disaster Recovery Act, a bill recently reintroduced in the U.S. Senate by Senators Brian Schatz (D-HI) and Susan Collins (R-ME) alongside 12 of their Republican and Democratic colleagues, includes key improvements to federal recovery policy that would benefit federally assisted homes. The bill would permanently authorize the Community Development Block Grant-Disaster Recovery (CDBG-DR) program and make important reforms to achieve more equitable disaster recovery and resilience. CDBG-DR is one of the most important federal resources for infrastructure and housing recovery after disasters. Permanently authorizing the CDBG-DR program would expedite the distribution of funds to impacted communities by requiring HUD to allocate CDBG-DR funds within 60 days of approval by Congress. This would ensure that recovery funds reach federally assisted properties and their residents more quickly and shorten the time it takes to implement mitigation and resilience programs.

The Reforming Disaster Recovery Act requires federal recovery dollars to prioritize one-for-one repair or replacement of federally assisted rental housing damaged or destroyed by a disaster, while also requiring that the housing rebuilt or substantially repaired using federal recovery dollars in flood-prone areas meets mitigation standards. The bill would also require HUD to release recovery data disaggregated by race, geography, and any classes protected under federal fair housing and civil rights laws. These data would allow community advocates and survivors to hold states accountable for ensuring racial equity during recoveries, including for the residents of federally assisted homes. The bill would also require states to develop plans for compliance with federal fair housing obligations in recovery contexts.

Extreme heat is the leading cause of weather-related deaths in the U.S. The disproportionate exposure of federally assisted homes to heat risk raises important questions about both the siting and quality of these homes, as well as policies regarding utility allowances in federal housing programs. Greater investments must be made to improve heat resilience in neighborhoods, such as by improving tree canopy coverage in communities where federally assisted homes already exist, while efforts should also be made to site new assisted housing in neighborhoods with less exposure to extreme heat. There is also a need to reinvest in older federally assisted homes to improve energy efficiency and provide sufficient air conditioning. Greater energy efficiency can reduce carbon emissions, lower costs for housing providers, and reduce energy cost burdens for tenants. Given that air conditioning is often not included in utility allowances, the federal government should also revise utility allowance policies in housing programs to make all households eligible for assistance with air conditioning costs (HUD, 2008).

> "We must protect federally assisted housing, and the residents who rely upon it, from the growing risks posed by natural hazards.

Federal agencies should provide more resources to help local housing providers assess their own risks and access the appropriate mitigation resources. At the same time, templates for business continuity planning and other disaster planning aids could help local housing providers prepare for future impacts from natural hazards. Resources for resident preparedness are critical, too, as assisted renters are less likely to be prepared for a disaster than low-income unassisted renters (Aurand et al., 2021b; McCarthy & Freidman, 2023).

State and local housing policy also has an important role to play. Communities implementing hazard resistant building codes save $1.6 billion in building losses annually from floods, earthquakes, and hurricane winds (FEMA, 2020). State qualified allocation plans (QAPs), the documents governing LIHTC allocations, can also play a key role in mitigating exposure to natural hazards in our nation's largest affordable housing production program. QAPs can incentivize or require building materials, practices, or site selection that mitigate future exposure to natural hazards. For example, some QAPs prohibit construction in flood plains, establish building elevation requirements, or mandate compliance with the National Flood Insurance Program (Freddie Mac, 2022).

This report assessed the potential for natural hazards to negatively impact federally assisted homes compared to renter-occupied and owner-occupied homes more generally by identifying properties in census tracts in the top quintile of risk based on FEMA's NRI and hazard-related expected annual losses. Whether these are the best measures of risk across census tracts and across populations to guide mitigation investments and recovery planning is an open question, however. In future research, PAHRC and NLIHC will compare alternative measures of risk that can be derived from the NRI with a particular focus on racial equity.

Federally assisted homes must be protected against climate change and the growing threat of natural hazards through better planning and stronger investments in resilience. Failing to provide such protection will only exacerbate the affordable housing crisis and endanger federally assisted renters, many of whom are especially susceptible to the negative impacts of disasters.

APPENDIX A: SUPPLEMENTAL TABLES

TABLE: PERCENT OF HOMES IN CENSUS TRACTS SCORING IN THE TOP NRI QUINTILE WITHIN NATION AND STATE IN 50 LARGEST METRO AREAS

	NATIONAL RISK INDEX (RELATIVE TO NATION)			NATIONAL RISK INDEX (RELATIVE TO STATE)		
CBSA Name	Federally Assisted Homes	Renter-Occupied Homes	Owner-Occupied Homes	Federally Assisted Homes	Renter-Occupied Homes	Owner-Occupied Homes
San Jose-Sunnyvale-Santa Clara, CA	94%	89%	84%	55%	45%	37%
Miami-Fort Lauderdale-Pompano Beach, FL	83%	78%	79%	33%	29%	31%
Riverside-San Bernardino-Ontario, CA	83%	78%	71%	51%	41%	36%
Los Angeles-Long Beach-Anaheim, CA	79%	66%	55%	28%	21%	16%
Houston-The Woodlands-Sugar Land, TX	78%	74%	78%	57%	51%	57%
Tampa-St. Petersburg-Clearwater, FL	77%	70%	71%	23%	19%	20%
San Francisco-Oakland-Berkeley, CA	72%	70%	69%	41%	34%	30%
Salt Lake City, UT	62%	41%	27%	50%	28%	18%
Seattle-Tacoma-Bellevue, WA	60%	51%	34%	43%	35%	21%
Portland-Vancouver-Hillsboro, OR-WA	57%	44%	31%	34%	21%	12%
Memphis, TN-MS-AR	47%	47%	44%	56%	53%	47%
New Orleans-Metairie, LA	45%	53%	65%	16%	17%	22%
Orlando-Kissimmee-Sanford, FL	40%	37%	42%	2%	4%	6%
St. Louis, MO-IL	30%	32%	23%	44%	43%	35%
Jacksonville, FL	29%	25%	31%	2%	3%	6%
Nashville-Davidson--Murfreesboro--Franklin, TN	28%	14%	7%	38%	22%	14%
Las Vegas-Henderson-Paradise, NV	23%	15%	8%	19%	13%	6%
Dallas-Fort Worth-Arlington, TX	21%	18%	22%	9%	9%	11%
San Diego-Chula Vista-Carlsbad, CA	19%	13%	16%	4%	6%	9%
Birmingham-Hoover, AL	18%	11%	4%	18%	11%	4%
Virginia Beach-Norfolk-Newport News, VA-NC	15%	15%	15%	64%	57%	55%
Oklahoma City, OK	14%	9%	12%	14%	11%	13%
Sacramento-Roseville-Folsom, CA	13%	8%	8%	7%	4%	4%
Austin-Round Rock-Georgetown, TX	11%	6%	5%	6%	3%	2%
Louisville/Jefferson County, KY-IN	7%	4%	2%	37%	23%	22%
San Antonio-New Braunfels, TX	6%	12%	15%	3%	5%	6%
Denver-Aurora-Lakewood, CO	6%	3%	5%	23%	18%	20%
New York-Newark-Jersey City, NY-NJ-PA	5%	3%	5%	42%	30%	29%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	4%	2%	2%	45%	44%	35%
Kansas City, MO-KS	4%	2%	2%	4%	3%	2%
Minneapolis-St. Paul-Bloomington, MN-WI	4%	2%	2%	21%	18%	19%
Raleigh-Cary, NC	3%	1%	1%	5%	1%	1%
Baltimore-Columbia-Towson, MD	2%	2%	1%	27%	29%	24%
Cincinnati, OH-KY-IN	2%	2%	1%	39%	38%	31%
Detroit-Warren-Dearborn, MI	2%	1%	1%	29%	30%	31%
Washington-Arlington-Alexandria, DC-VA-MD-WV	1%	1%	0%	20%	14%	13%
Charlotte-Concord-Gastonia, NC-SC	1%	1%	1%	1%	1%	1%
Atlanta-Sandy Springs-Alpharetta, GA	1%	0%	0%	7%	5%	3%
Indianapolis-Carmel-Anderson, IN	1%	1%	1%	13%	12%	12%
Phoenix-Mesa-Chandler, AZ	0%	1%	2%	8%	6%	11%
Chicago-Naperville-Elgin, IL-IN-WI	0%	1%	1%	15%	19%	17%
Richmond, VA	0%	1%	2%	12%	14%	22%
Boston-Cambridge-Newton, MA-NH	0%	0%	0%	25%	25%	28%
Hartford-East Hartford-Middletown, CT	0%	0%	1%	7%	7%	9%
Columbus, OH	0%	0%	0%	17%	12%	14%
Providence-Warwick, RI-MA	0%	0%	0%	17%	18%	24%
Milwaukee-Waukesha, WI	0%	0%	0%	6%	4%	5%
Cleveland-Elyria, OH	0%	0%	0%	4%	3%	4%
Pittsburgh, PA	0%	0%	0%	3%	1%	1%
Buffalo-Cheektowaga, NY	0%	0%	0%	3%	1%	1%

Sources: National Housing Preservation Database data (January 2023), American Community Survey five-year estimates (2017-2021), and National Risk Index (March 2023).

TABLE: PERCENT OF HOMES IN CENSUS TRACTS IN THE TOP NRI QUINTILE WITHIN NATION AND STATE BY STATE

	NATIONAL RISK INDEX (RELATIVE TO NATION)			NATIONAL RISK INDEX (RELATIVE TO STATE)		
State Abbreviation	Federally Assisted Homes	Renter-Occupied Homes	Owner-Occupied Homes	Federally Assisted Homes	Renter-Occupied Homes	Owner-Occupied Homes
AK	41%	45%	50%	33%	21%	26%
AL	26%	24%	21%	29%	25%	22%
AR	48%	34%	28%	40%	26%	21%
AZ	4%	3%	5%	23%	16%	23%
CA	64%	57%	52%	31%	24%	22%
CO	8%	6%	8%	24%	20%	23%
CT	0%	0%	1%	24%	24%	25%
DC	4%	3%	1%	32%	23%	16%
DE	5%	4%	5%	25%	21%	22%
FL	71%	67%	69%	27%	24%	26%
GA	17%	12%	10%	31%	23%	20%
HI	19%	15%	19%	32%	27%	29%
IA	17%	16%	15%	22%	21%	21%
ID	5%	6%	9%	20%	17%	21%
IL	5%	4%	5%	24%	24%	25%
IN	4%	3%	2%	30%	25%	24%
KS	26%	18%	22%	27%	18%	22%
KY	14%	10%	9%	36%	25%	22%
LA	53%	57%	65%	22%	25%	28%
MA	1%	1%	0%	21%	22%	26%
MD	8%	6%	6%	29%	26%	26%
ME	1%	1%	1%	31%	28%	24%
MI	1%	0%	0%	30%	28%	27%
MN	4%	3%	3%	24%	22%	24%
MO	28%	24%	21%	29%	25%	22%
MS	54%	47%	40%	29%	25%	22%
MT	7%	7%	10%	16%	19%	24%
NC	27%	19%	19%	29%	21%	20%
ND	33%	37%	39%	19%	19%	23%
NE	36%	25%	28%	28%	18%	22%
NH	0%	0%	0%	35%	28%	23%
NJ	11%	8%	9%	23%	19%	25%
NM	10%	10%	11%	21%	20%	21%
NV	39%	26%	21%	33%	23%	19%
NY	4%	2%	2%	40%	29%	25%
OH	1%	1%	0%	29%	24%	25%
OK	36%	23%	25%	37%	25%	26%
OR	57%	49%	41%	33%	25%	19%
PA	2%	1%	1%	28%	29%	23%
RI	0%	0%	0%	21%	22%	26%
SC	39%	40%	37%	24%	26%	26%
SD	56%	58%	62%	24%	23%	25%
TN	30%	21%	14%	38%	28%	20%
TX	39%	35%	38%	25%	22%	24%
UT	56%	38%	29%	43%	27%	21%
VA	6%	5%	5%	30%	24%	23%
VT	1%	1%	0%	34%	29%	25%
WA	50%	43%	31%	37%	29%	19%
WI	2%	1%	1%	26%	23%	27%
WV	1%	2%	2%	26%	22%	22%
WY	2%	5%	8%	14%	20%	24%
TOTAL	**24%**	**24%**	**21%**	**29%**	**24%**	**24%**

Sources: National Housing Preservation Database data (January 2023), American Community Survey five-year estimates (2017-2021), and National Risk Index (March 2023).

APPENDIX B: OVERALL RISK RATE AS AN ALTERNATIVE MEASURE OF RISK

Tracts with greater agricultural production, property values, and population density exhibit higher annual expected losses from natural hazards than other tracts, holding constant the frequency of natural hazards. At the same time, the NRI is much more strongly correlated to expected annual losses than to social vulnerability or community resiliency. This means that overall NRI scores may underestimate the relative risks to communities with lower property values, smaller populations, and lower agriculture value.

To address this issue FEMA provides an expected annual loss rate, which is the percentage of buildings, population, and agriculture expected to be lost due to natural hazards each year. The expected annual loss rate can be adjusted by social vulnerability and community resiliency of the census tract to calculate an NRI rate. Relative to the NRI, the NRI rate is slightly more correlated to social vulnerability and community resiliency and slightly less correlated to expected annual loss. This suggests the NRI rate may offer a more equitable way to assess risk, particularly for communities with smaller property values, populations, and agriculture value at risk.

In preparing this report, we estimated the number of federally assisted homes in census tracts at greatest risk for natural hazard-related negative impacts using the NRI rate. However, we chose not to publish our findings because they were similar to those using the NRI to assess risk relative to the nation, and data limitations prevented us from estimating risk within states using the NRI rate.

REFERENCES

Agha-Kouchak, A., Chiang, F., Huning, L. S., Love, C. A., Mallakpour, I., Mazdiyasni, O., Moftakhari, H., Papalexiou, S., Ragno, E., & Sadegh, M. (2020). Climate extremes and compound hazards in a warming world. *Annual Review of Earth and Planetary Sciences, 48*(1), 519–548.

Association of American Medical Colleges. (2023). Rural Americans find little escape from climate change. Washington, DC: Author.

Aurand, A., Emmanuel, D., Foley, E., Clarke, M., Rafi, I., Yentel, D. (2023). The Gap: A Shortage of Affordable Homes. Washington, DC: National Low Income Housing Coalition.

Aurand, A., Stater, K., Emmanuel, D., McElwain, K., & Ward, A. (2021a). Picture of preservation 2021. Washington, DC: Public and Affordable Housing Research Corporation and National Low Income Housing Coalition.

Aurand, A., Stater, K., Emmanuel, D., McElwain, K., & Ward, A. (2021b). Taking stock: Natural hazards and federally assisted housing. Washington, DC: Public and Affordable Housing Research Corporation and National Low Income Housing Coalition.

Aurand, A. & Emmanuel, D. (2019). Long-term recovery of rental housing: A case study of highly impacted communities in New Jersey after Superstorm Sandy. Washington, DC: National Low Income Housing Coalition.

Brennan, M., Srini, T., Steil, J., Mazereeuw, M., & Ovalles, L. (2022) A perfect storm? Disasters and evictions. *Housing Policy Debate, 32*(1), 52-83.

Brennan, M. & Flint, C. (2007). Uncovering the hidden dimensions of rural disaster mitigation: Capacity building through community emergency response teams. *Southern Rural Sociology, 22*(2), 111-126.

Brookings Institution. (2017). Hurricanes hit the poor the hardest. Washington, DC: Author.

Brown, M., Soni, A., Lapsa, M., Southworth, K., & Cox, M. (2020). High energy burden and low-income energy affordability: Conclusions from a literature review. *Progress in Energy, 2*(4).

Buchanan, M. K., Kulp, S., Cushing, L., Morello-Frosch, R., Nedwick, T., & Strauss, B. (2020). Sea level rise and coastal flooding threaten affordable housing. *Environmental Research Letters, 15*(12).

CAP. (2022). How FEMA can build rural resilience through disaster preparedness. Washington, DC: Author.

Chakraborty, J., McAfee, A. A., Collins, T. W., & Grineski, S. E. (2021). Exposure to Hurricane Harvey flooding for subsidized housing residents of Harris County, Texas. *Natural Hazards, 106*(3), 2185–2205.

Collins, T. (2008). What influences hazard mitigation? Household decision making about wildfire risks in Arizona's White Mountains. *The Professional Geographer, 60*(4), 508-526.

Cutter, S. L., Ash, K. D., & Emrich, C. T. (2016). Urban–rural differences in disaster resilience. *Annals of the American Association of Geographers, 106*(6), 1236–1252.

Donner, W., Rodriquez, H. (2008). Population Composition, Migration, and Inequality: The Influence of Demographic Changes on Disaster Risk and Vulnerability. *Social Forces*, 87(2), 1089-1114.

Doocy, S., Daniels, A., Murray, S. & Kirsch, T. (2013). The human impact of floods: A historical review of events 1980-2009 and systematic literature review. *PLoS Currents, 5*.

Dorsey-Palmateer, R. (2020). Outsized impacts of residential energy and utility costs on household financial distress. *Economics Bulletin, 40*(4), 3061-3070.

Drake, O., Tate, E., Rainey, J. and Brody, S. (2021). Social vulnerability and short-term disaster assistance in the United States. *International Journal of Disaster Risk Reduction, 53* (2021).

Emrich C. T., Aksha S. K., Zhou Y. (2022). Assessing distributive inequities in FEMA's disaster recovery assistance fund allocation. *International Journal of Disaster Risk Reduction, 74*(May).

EPA. (2021). Climate change and societal vulnerability in the United States: A focus on six impacts. Washington, DC: Author.

Fair Share Housing Center, Latino Action Network, & NAACP New Jersey State Conference. (2015). The state of Sandy recovery (second annual report). Retrieved from http://fairsharehousing.org/images/uploads/State_of_Sandy_English_2015.pdf

Federal Emergency Management Agency. (2020). Building codes save: A nationwide study of losses avoided as a result of adopting hazard-resistant building codes. Washington, DC: Author.

Federal Emergency Management Agency. (2023). National Risk Index technical documentation. Washington, DC: Author.

Flores, A. B., Collins, T. W., Grineski, S. E., Amodeo, M. F., Porter, J. R., Sampson, C., & Wing, O. (2022). Federally Overlooked Flood Risk Inequities in Houston, Texas: Novel Insights Based on Dasymetric Mapping and State-of-the-Art Flood Modeling. Annals of the American Association of Geographers, 113(1), 240–260. https://doi.org/10.1080/24694452.2022.2085656

Fothergill, A., & Peek, L. A. (2004). Poverty and disasters in the United States: A review of recent sociological findings. *Natural Hazards, 32*, 89–110.

Fothergill, A., Maestas, E., & Darlington, J. (1999). Race, Ethnicity and Disasters in the United States: A Review of the Literature. *Disasters*, 23(2):156–173.

Freddie Mac. (2022). Climate resiliency incentives in LIHTC qualified allocation plans. Washington, DC: Author.

Fussell, E. & Harris, E. (2014). Home ownership and housing displacement after Hurricane Katrina among low-income African-American mothers in New Orleans. *Social Science Quarterly, 95*(4), 1086-1100.

Gabbe, C. J., & Pierce, G. (2020). Extreme heat vulnerability of subsidized housing residents in California. *Housing Policy Debate, 30*(5), 843–860.

Government Accountability Office. (2010). Federal assistance for permanent housing primarily benefited homeowners; Opportunities exist to better target rental housing needs. Washington, DC: Author.

Hall, J. (2009). *The early developmental history of concrete block in America*. Ball State University Library.

Hamideh, S. et al. (2021). Housing type matters for pace of recovery: Evidence from Hurricane Ike. *International Journal of Disaster Risk Reduction, 57*(15).

Hamideh, S. & Rongerude, J. (2018). Social vulnerability and participation in disaster recovery decisions: Public housing in Galveston after Hurricane Ike. *Natural Hazards, 93*, 1629–1648.

Hernández, D. (2016). Understanding "energy insecurity" and why it matters to health. *Social Science & Medicine, 167*, 1–10.

Hoffman, J. S., Shandas, V., & Pendleton, N. (2020). The effects of historical housing policies on resident exposure to intra-urban heat: A study of 108 US urban areas. *Climate, 8*(1), 12.

Hong, B., Bonczak, B.J., Gupta, A. Kontokosta, C. (2021). Measuring inequality in community resilience to natural disasters using large-scale mobility data. *Nature Communications, 12*(1), 1870.

Horney, J., Nguyen, M., Cooper, J., Simon, M., Ricchetti-Masterson, K., Grabich, S., Salvesen, D., & Berke, P. (2017). Accounting for vulnerable populations in rural hazard mitigation plans: Results of a survey of emergency managers. *Journal of Emergency Management, 11*(3), 201.

Howell, J. & Elliott, J. R. (2018). As disaster costs rise, so does inequality. *Socius: Sociological Research for a Dynamic World, 4*.

HUD. (2008). Utility allowance guidebook. Washington, DC: Author.

Jessel, S., Sawyer, S., & Hernández, D. (2019). Energy, poverty, and health in climate change: A comprehensive review of an emerging literature. *Frontiers in Public Health, 7*.

HuangLee, J. Y. & Van Zandt, S. (2019). Housing tenure and social vulnerability to disasters: A review of the evidence. *Journal of Planning Literature, 34*(2), 156-170.

Lindersson, S., Raffetti, E., Rusca, M., Brandimarte, L., Mård, J., & Baldassarre, G. (2023). The wider the gap between rich and poor the higher the flood mortality. *Nature Sustainability, 6*, 995–1005.

Ludden, J. (2023, August 1). Withering heat is more common, but getting AC is still a struggle in public housing. *NPR*.

McCarthy, S. & Freidman, S. (2023). Disaster preparedness and housing tenure: How do subsidized renters fare? *Housing Policy Debate, 33*(5), 1100-1123.

Molinsky, J., & Forsyth, A. (2022). Climate change, aging, and well-being: How residential setting matters. *Housing Policy Debate, 33*(5), 1029–1054.

NLIHC. (2023). New data from the Household Pulse Survey suggest disparities among households displaced by disasters. Washington, DC: Author.

NOAA. (2023). Severe weather 101: Frequently asked questions about floods. Washington, DC: Author.

Peacock, W., Van Zandt, S., Zhang, Y. Highfield, W. (2014). Inequities in long-term housing recovery after disasters. *Journal of the American Planning Association 80*(4), 356-371.

R Street. (2020). Do no harm: Managing retreat by ending new subsidies. Washington, DC: Author.

Ray, A., Wang, R., Nguyen, D., Martinez, J., Taylor, N., & Searcy, J. K. (2019). Household energy costs and the Housing Choice Voucher program: Do utility allowances pay the bills? *Housing Policy Debate, 29*(4), 607–626.

Reina, V. & Kontokosta, C. (2017). Low hanging fruit? Regulations and energy efficiency in subsidized multifamily housing. *Energy Policy, 106*, 505–513.

Rice Kinder Institute for Urban Research. (2017). Hurricane Harvey relief fund: Needs assessment phase one. Houston, TX: Author.

Rumbach, A., & Makarewicz, C. (2016). Affordable Housing and Disaster Recovery: A Case Study of the 2013 Colorado Floods. In Sapat, A. & Esnard, A.-M., eds., *Coming Home After Disaster: Multiple Dimensions of Housing Recovery*. Boca Raton, FL: Routledge, 99–111.

Rummukainen, M. (2012). Changes in Climate and Weather Extremes in the 21st Century. *Wiley Interdisciplinary Reviews: Climate Change, 3*(2), 115-129.

Sastry, N. & VanLandingham, M. (2009). One year later: Mental illness prevalence and disparities among New Orleans residents displaced by Hurricane Katrina. *American Journal of Public Health, 99*.

Smiley, K. T. (2020). Social inequalities in flooding inside and outside of floodplains during Hurricane Harvey. *Environmental Research Letters, 15*(9).

Smith, A.. (2023, January 10). *2022 U.S. billon-dollar weather and climate disasters in historical context*. NOAA Beyond the Data Blog.

Spader, J. & Turnham, J. (2014). CDBG Disaster Recovery assistance and homeowners' rebuilding outcomes following Hurricanes Katrina and Rita. *Housing Policy Debate, 24*(1), 213–237.

Swiss Re. (2021). Secondary perils: Rising waters in the Americas. Zürich, Switzerland: Author.

Tan, S. (2021). Measuring community resilience: A critical analysis of policy-oriented indicator tool. *Environmental and Sustainability Indicators, 12*.

Tate, E., Rahman, A., Emrich, C., & Sampson, C. (2021). Flood exposure and social vulnerability in the United States. *Natural Hazards, 106*(9).

Tellman, B., Schank, C., Schwarz, B., Howe, P.D., de Sherbinin, A. (2020). Using disaster outcomes to validate components of social vulnerability to floods: Flood deaths and property damage across the USA. *Sustainability, 12*(15):6006.

Tootle, D. (2007). Disaster recovery in rural communities: A case study of Southwest Louisiana. *Southern Rural Sociology Special Issue: Rural Communities and Disasters, 22*(2), 12–31.

U.S. Department of Commerce. (2023). Weather related fatality and injury statistics. Washington, DC: Author.

Van Zandt, S., Peacock, W., Henry, S., Grover, H., Highfield, W., & Brody, S. (2012) Mapping social vulnerability to enhance housing and neighborhood resilience. *Housing Policy Debate, 22*(1), 29-55.

Voelkel, J., Hellman, D., Sakuma, R., & Shandas, V. (2018). Assessing vulnerability to urban heat: A study of disproportionate heat exposure and access to refuge by socio-demographic status in Portland, Oregon. *International Journal of Environmental Research and Public Health, 15*(4), 640.

Zhang, Y. & Peacock, W. (2009). Planning for housing recovery? Lessons learned from Hurricane Andrew. *Journal of the American Planning Association, 76*(1), 5–24.

Zuzak, C., Mowrer, M., Goodenough, E., Burns, J., Ranalli, N., & Rozelle, J. (2022). The national risk index: Establishing a nationwide baseline for natural hazard risk in the US. *Natural Hazards, 114*, 2331–2355.

NOVEMBER 2023

Natural Hazards and Federally Assisted Housing

A joint report by

The Public and Affordable Housing Research Corporation &
The National Low Income Housing Coalition

PAHRC℠
Public and Affordable Housing Research Corporation

NATIONAL LOW INCOME HOUSING COALITION