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Housing + Climate Policy: Building Equitable Pathways to Sustainability and Affordability

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Introduction

In the face of a rapidly changing climate, the intersection of housing and climate policy has emerged as a critical area of focus. The policies that impact where and what type of housing and communities are built are inextricably linked to environmental sustainability and resilience. Yet the research on housing and housing policies is often distinct from that on transportation, energy, and climate. In this report, we present a high-level review of the research on the links between housing and climate in the United States, summarizing the existing literature and pointing to important areas where additional data and research are needed to inform better alignment between housing and climate policies.

In the first section, "Housing Policy as Climate Action," we examine how housing production strategies can further climate mitigation, a term used to describe actions aimed at limiting the magnitude of climate change. We review the ways that housing and land use policy influence household- and community-level energy use and carbon pollution (i.e., greenhouse gas emissions). In the second section, "The Impacts of Climate Change on Housing," we focus on how the impacts of climate change affect renters, homeowners, and the broader U.S. housing industry.

Housing Policy as Climate Action

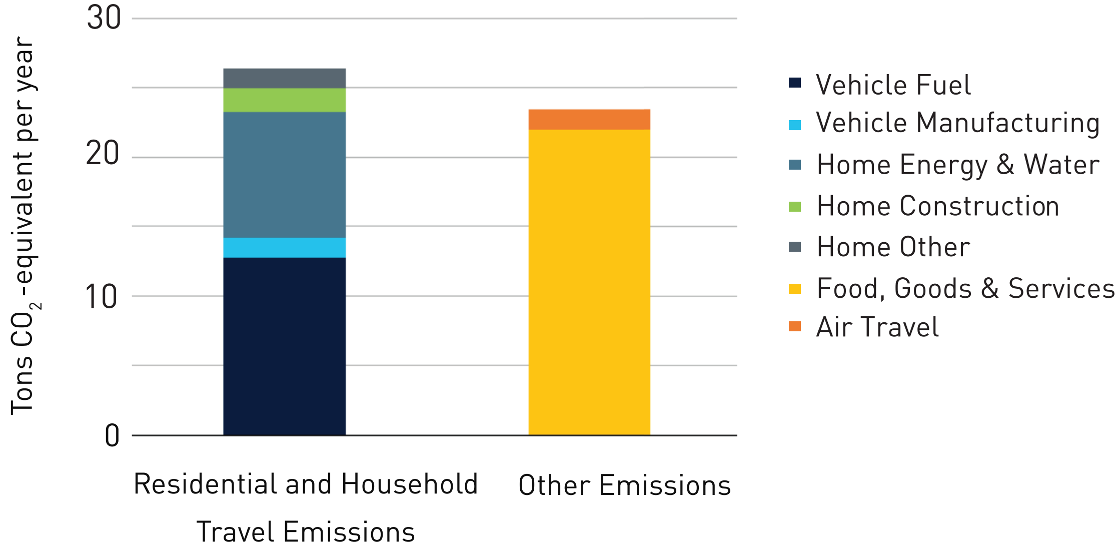
Where and how housing is built has significant impacts on the environment, including via greenhouse gas (GHG) emissions that contribute to climate change. For instance, home construction can increase emissions through land clearing for new developments, and through the production and transportation of building materials. Household energy use is also a major contributor. The location and neighborhoods in which people live have even larger implications,[1] for example, by shaping transportation habits and placing demands on public infrastructure systems. In turn, public infrastructure decisions incentivize and constrain housing policy.[2]

Overall, housing policy directly or indirectly influences approximately 53 percent of emissions from the average U.S. household (Figure 1). Policies that shape housing production and location are fundamental to reducing global carbon pollution and helping to mitigate climate change. Nevertheless, housing policy solutions are too often overlooked by climate policy, and housing policy researchers have scarcely engaged with the energy system decarbonization "pathways" modeling studies increasingly used to project climate policy scenarios and assess progress towards climate targets.[3]

Energy Efficiency of Housing and Building Decarbonization

Residential buildings are responsible for about 20 percent of total primary energy consumption in the U.S.—from heating; cooling; and powering household lighting, appliances, and other devices.[4] Given the long lifespan of most buildings, decisions made during the design and

Figure 1: Average U.S. Household Carbon Footprint



Source: Adapted from Jones, C. & Kammen, D. (2014). "Spatial Distribution of U.S. Household Carbon Footprints Reveals Suburbanization Undermines Greenhouse Gas Benefits of Urban Population Density."[5]

construction of housing—such as size, fuel sources, appliances, building materials, and housing type—are critical to shaping long-term energy use and greenhouse gas emissions.[6]

Reducing emissions from residential energy use requires a combination of strategies to 1) improve energy efficiency, 2) move to carbon-free sources of electricity and other forms of energy supply (referred to as "decarbonization"), and 3) transition from devices consuming fossil fuels to those using clean energy sources such as electricity (referred to as "electrification").[7] This involves both designing new homes for lower emissions and retrofitting existing ones.

Building decarbonization has become a key target of federal and state policy to reduce emissions.[8] Researchers estimate that it, along with grid decarbonization, could reduce over 80 percent of building-related carbon emissions by 2050.[9] Decarbonization strategies can also improve households' well-being, for example, by improving air quality, reducing energy bills, and increasing energy security and resilience.[10] Retrofitting older homes can also build resilience to climate change by improving insulation, incorporating cooling measures, and upgrading air filtration systems.[11]

However, the implementation of decarbonization strategies needs to be designed in ways that avoid adverse outcomes such as concentrating indoor air pollutants (i.e., making homes airtight with inadequate filtration or ventilation).[12] Moreover, these interventions typically involve a trade-off of upfront costs for longer term energy cost savings, raising challenges for maintaining financial viability of existing affordable housing, for stabilizing renters, and for financing new construction.

Over the last 40 years, research has made significant advances in modeling and advancing construction methods to reduce their environmental impacts and improve energy efficiency.[13] This research and technology development has already led to considerable improvements: modern building codes mandate improved insulation, energy-efficient windows, tighter construction to reduce air leakage, and other advances (e.g. addressing stormwater runoff and water conservation). Programs such as EPA's ENERGY STAR have also spurred the energy efficiency of new homes and appliances.[14] As a result, the average energy use in a U.S. home per square foot has dropped by over 30 percent since 1970, even after adjusting for weather effects and efficiency improvements in electricity generation.[15]

While advances in construction and housing decarbonization promise lower residential energy use, additional research is needed to advance the science and promote policies to make homes less carbon intensive while also minimizing impacts to housing cost and affordability.

Removing barriers to retrofitting the existing housing stock, particularly for affordable housing and homes in lower-income communities and communities of color

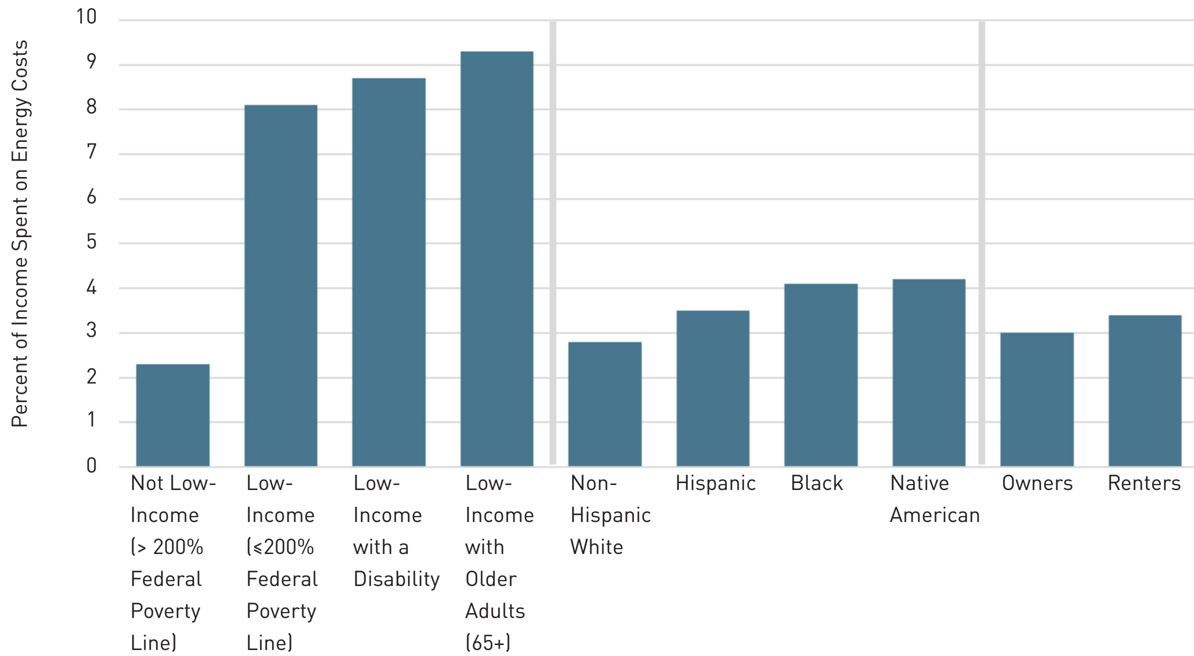
The challenge of decarbonizing the existing housing stock is great: half of U.S. homes were built before 1980, an era preceding the regulation of residential energy efficiency.[16] As of 2020, 61 percent of housing units—more than 88 million homes—used natural gas for energy, and 14 percent used other fossil fuels such as propane and fuel oil.[17] Retrofitting these homes will require more funding for residential electrification, as well as the development of scalable and transferable implementation models.[18]

Equitably scaling up housing decarbonization will also require removing the barriers for participation among Black, Indigenous, and People of Color (BIPOC) and low-income households.[19] While research has identified these barriers—including factors such as cost, access to finance, access to information, technical capacity, owner-renter split incentives, renter displacement risk, and trust—less is known about how to design implementation pathways to overcome them.[20]

More research on equitable housing decarbonization could lead to significant benefits for renters and other low-income households, since they tend to live in less energy efficient homes; spend a larger fraction of their household income on utilities for heating, cooling, and other home energy services; and have higher exposure to air pollution (Figure 2).[21] Policies to advance a coordinated and equitable transition to electricity are also critical for ensuring that low-income households are not incurring increased costs from being the final customers on the gas system as it is transitioned out.[22]

More research is also needed to guide new federal climate funding. Under the 2022 Inflation Reduction Act (IRA), several new opportunities are becoming available for retrofitting existing public housing and Low-Income Housing Tax Credit (LIHTC) properties: the Residential Clean Energy Tax Credit, the Investment Tax Credit for Energy Property, the Green and Resilient Retrofit Program, and the Greenhouse Gas Reduction Fund.[23] They can also stack onto state-administered IRA-funded programs such as Home Energy Rebates, with tools

Figure 2. Household Energy Cost Burdens



Source: Drehobl, A., L. Ross, and R. Ayala. (2020). How High Are Household Energy Burdens? Washington, D.C.: American Council for an Energy-Efficient Economy. Retrieved from: https://www.aceee.org/sites/default/files/pdfs/u2006.pdf.

newly becoming available to help organizations navigate the complicated array of incentives.[24] However, there are significant challenges to administering these funds and making sure that affordable housing developers–especially smaller, BIPOC-led community based organizations–have the capacity to tap into these diverse programs and take on retrofit projects. Lenders and investors will also need to shift some of their risk assessment and underwriting practices to reflect the costs and benefits of green building.

As these programs are implemented, further research can promote equitable outcomes, evaluate efficacy, and provide data-based feedback to improve program design.

Advancing green building construction adoption

Innovations in green building are rapidly evolving, offering promising solutions for more sustainable construction and operation of buildings (also see discussion of "embodied carbon" emissions below). Innovations include net-zero energy buildings (which generate as much energy as they consume, typically through renewable energy sources like solar panels), passive building design, smart building technologies, the development of low-carbon concrete, sustainable timber, recycled materials, and water efficiency technologies like greywater recycling systems.[25] Research also suggests that modular or industrialized construction could lead to additional advances in new buildings' sustainability by reducing waste in the production process and improving material and energy efficiency.[26]

However, important financing, regulatory, and workforce barriers remain to adopting these types of innovations more broadly.[27] More research on how to overcome these barriers—as well as case studies of successful implementation—would support scaling innovations in the construction sector.

This is particularly important in the affordable housing finance sector, where public subsidies for the construction of new affordable housing through the LIHTC program and other subsidy sources fall well below need. All states have incorporated some form of green building criteria in their LIHTC Qualified Allocation Plans, either by requiring developers to participate in a green building rating system or by offering additional scoring points on their application.[28] However, sustainable building technologies can increase development costs in the short-term, translating to fewer affordable homes built.[29]

Ensuring that residents receive the health- and cost-saving benefits of living in greener buildings without decreasing the number of homes built

Green building approaches mandated by the building code—rather than adopted voluntarily or incentivized by new funding—risk adverse impacts to housing affordability. Even approaches that look cost-effective on paper may pose financing barriers for some builders, forcing them to rely on future cost savings to pay for upfront investments.[30] Further research could illuminate the relationships between building code mandates, affordability, and production, and provide policy makers with guidance on how to balance these priorities.

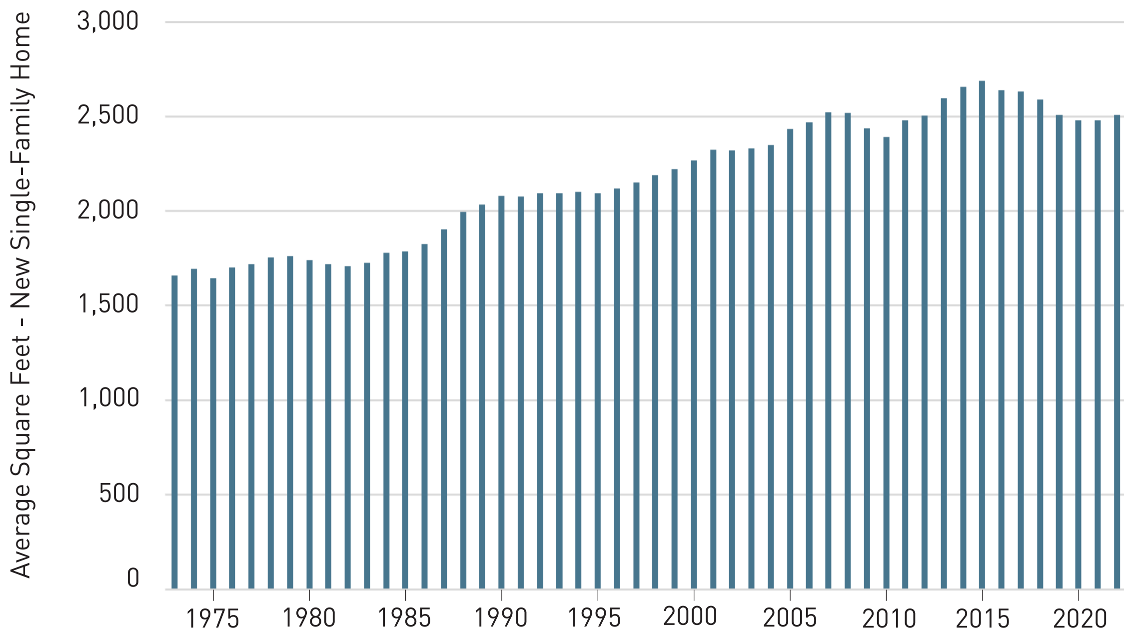
Research that comprehensively evaluates the relative economics and carbon savings of green building could also help to prioritize the most cost-effective approaches, as well as unlock more public subsidies to address gaps in financing and expand the supply of green lower-cost housing.[31] For instance, several studies have found net upfront cost savings from all-electric new construction, as well as the potential for large carbon reductions over time.[32] In contrast, both home solar and efficiency measures tend to add upfront costs while becoming less effective at reducing GHG emissions as the overall grid gets cleaner. These measures do provide non-GHG benefits, but these should be weighed against any adverse impacts on housing affordability, or designed to avoid affordability impacts altogether.

Research could also identify other opportunities where green building construction could have direct synergies with affordability: for instance, cross-laminated timber or industrialized construction could support carbon reductions as well as lead to cost and time savings for new housing.

Understanding the role of housing supply and demand in determining the size and typology of homes and associated energy use and emissions

Energy retrofits without efforts to increase housing density and reduce the size of the average home in the U.S. may have limited ability to address GHG emissions. Over the last five decades, the average new U.S. house size has increased from 1,660 square feet in 1973 to 2,509 in 2022, offsetting many of the energy efficiency gains from building innovations (Figure 3).[33] This increase has occurred even as the average household size has been shrinking. In addition, rising demand for suburban, larger homes—a

Figure 3. Average Size of New Residential Homes, 1973–2022



Source: U.S. Census Bureau. Characteristics of New Housing, Single-Family Completed. Retrieved from: https://www.census.gov/construction/chars/index.html.

trend that may have intensified during the COVID-19 pandemic[34]—threatens to further undermine energy efficiency gains.

Building type also directly influences energy use and emissions.[35] U.S. residents of multifamily and attached housing use 41 percent less energy than residents of detached single-family homes.[36] Smaller floor space and residents' income accounts for some of this.[37] However, shared walls, ceilings, and floors in multifamily housing provide direct efficiency by effectively enhancing insulation, which reduces heating requirements (though cooling requirements may increase, controlling for floor space). Few studies have investigated the relative importance of each of these factors and their interactions.[38]

In addition to energy efficiency, shared walls in multifamily housing and other compact home types also increase materials efficiency and can reduce materials and construction emissions. All of this suggests that increasing the share of multifamily housing could be a significant component of strategies to reduce these emissions ("embodied carbon"; see below).[39] This depends on the specific building typology, however: tall multifamily buildings requiring concrete and steel may increase embodied carbon relative to low- and mid-rise wood-frame buildings.[40]

Although some of the research gaps in this area relate to building science, understanding the supply of different housing types—as well as the drivers of housing demand—requires more research into how land use and zoning policy, market conditions, socio-cultural factors, and household formation are shaping housing consumption.[41] For example, minimum lot sizes and development impact fees are just two of the factors that lead to the production of larger, lower-density homes, which in turn undermine affordability and sustainability goals. Research that can quantify these impacts could inform policies that would encourage a return to people living in smaller or more compact—and thus more energy- and materials-efficient—homes.

Expanding research that focuses on embodied carbon and life-cycle analysis

Most energy studies address GHG emissions from the day-to-day use of residential buildings. Fewer focus on the emissions associated with production of building materials, transportation and construction processes, and end-of-life material disposal, which are known as "embodied carbon." New technologies and alternative building methodologies are emerging as strategies with large potential to reduce embodied carbon (e.g., mass timber products, recycled building materials, low carbon concrete mixes, modular and panelized construction).[42] However, estimates of attributable GHG emissions can vary significantly, and are affected not only by the construction materials and process but also by the size and typology of homes.[43] More research can determine how to remove the barriers to using low-carbon alternatives for common building materials like concrete and steel, as well as methods for recycling and reusing building materials.

Land Use and Housing

Beyond strategies to directly reduce emissions from residential energy and construction, land use policies are increasingly being seen as one of the most powerful levers to mitigate climate change.[44] Research suggests that the U.S. needs to build an estimated 3.8 million homes to meet the current supply deficit, let alone meet demand for future population growth.[45] Where those homes are built, at what affordability levels—as well as their size and building footprint—will all do more to influence energy use and greenhouse gas emissions than many other climate policy levers.

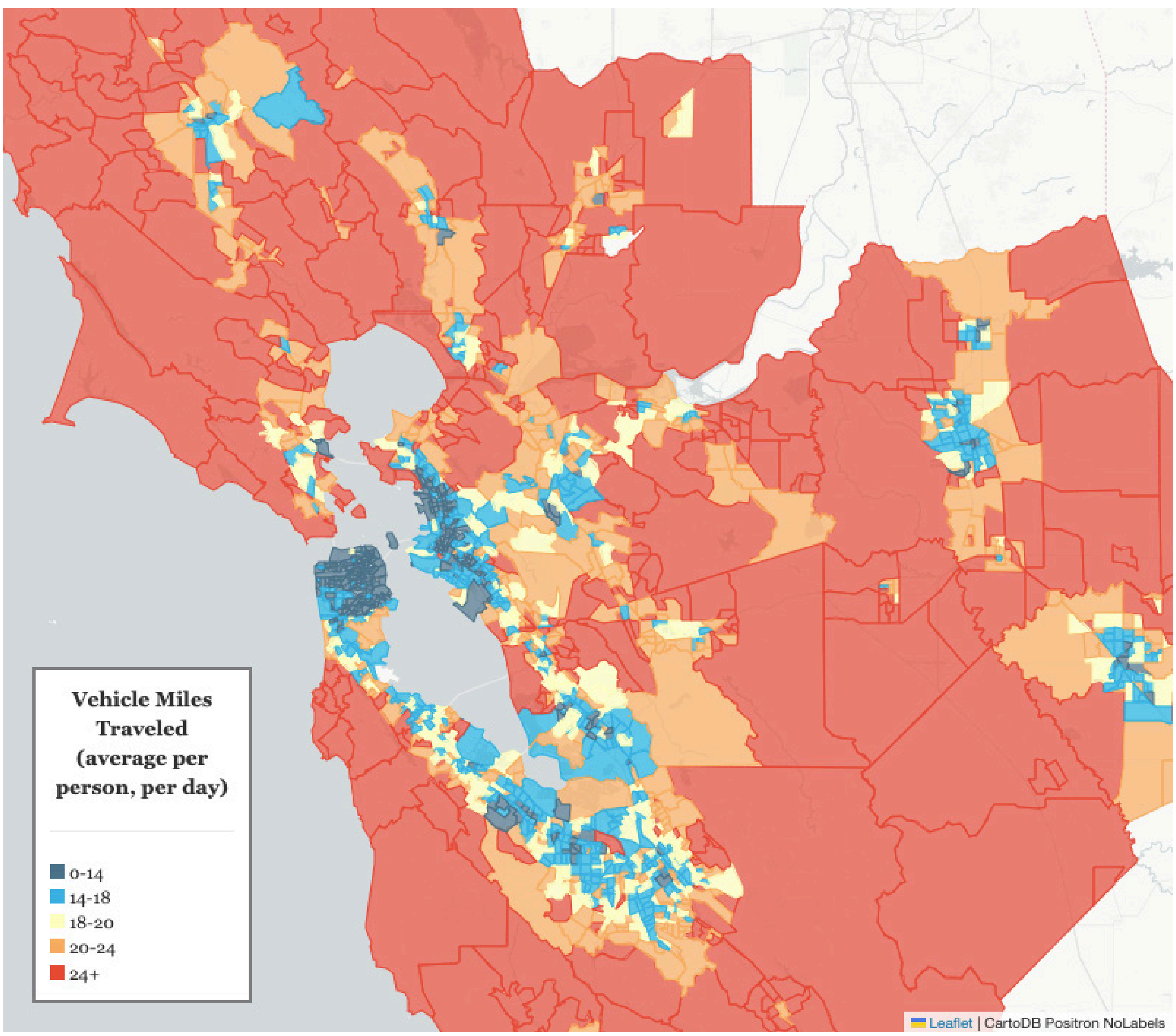
Unless there is a dramatic change in housing and land-use patterns going forward, the majority of new homes and their residents will be located in single-family neighborhoods, often in low-density suburbs or in new developments that displace natural and working lands such as farmlands and forests. Indeed, since the 1970s, new housing development has been characterized by larger homes, in neighborhoods designed entirely around cars.[46] Exurban housing development can also displace natural and working lands such as farmlands and forests. This type of greenfield development not only places more homes under increasing threat from climate disasters, it also reduces the critical role these lands play in carbon sequestration and other climate mitigation and adaptation processes.[47] Continuing this same development path will undermine climate goals, as well as have negative impacts on affordability and accessibility.

The role of housing policy, and specifically the decisions made by local governments around zoning and land use, is therefore fundamental to advancing climate mitigation goals. One study found that enabling more infill housing was the most powerful lever available to local policy makers in many California cities, from San Francisco to Stockton to Santa Monica.[48] Nevertheless, the benefits of infill housing are challenging to account for and typically not quantified in local climate action plans, resulting in a lack of potential alignment between housing and climate policies.[49]

There is a significant body of research that demonstrates that carbon pollution per household is related to population density,[50] and the relationship is strengthened when controlling for income.[51] Low-density development patterns translate into higher land consumption, residential energy use, and energy costs, as well as more intensive waste production and runoff.[52] Infill and higher density development patterns, in contrast, reduce energy consumption and emissions, from reduced vehicle use and manufacture, lower residential energy and materials consumption, and avoided land conversion.[53] The balance of where new housing development happens also matters: while higher density urban areas consistently demonstrate lower household GHG emissions, higher emissions in the suburban areas in the surrounding metro regions may be more than offsetting those climate benefits.[55]

Much of the research on housing development patterns and climate has focused on its role in shaping travel behaviors and vehicle miles traveled (VMT).[56]

Figure 4: Vehicle Miles Traveled by San Francisco Bay Area Residents, Spring 2023



Source: Authors' calculations of Replica California-Nevada data.[54]

Researchers have characterized the relationship between urban form and its impact on VMT as resulting from five dimensions: density, diversity of land uses, design, destination accessibility, and distance to transit.[57] Although studies vary significantly in their data and methodological approaches (including accounting for self-selection bias), there is a growing consensus that residents of denser, mixed-use, and transit-rich areas drive less than their suburban and rural counterparts.[58] Figure 4 illustrates this relationship with a map of the Bay Area, showing that average daily per capita VMT is twice as high in the region's suburban areas than it is in its urban core.

Denser areas also encourage people to buy smaller and fewer cars, which results in less fuel burned per mile and fewer emissions.[59] Research has shown that a transition to electric vehicles is necessary but insufficient to rapidly decrease these emissions: both vehicle electrification and reduced car-dependence enabled by more compact land use are needed.[60] Denser neighborhoods characterized by a more diverse typology of housing such as accessory dwelling units (ADUs) and apartment buildings also have additional benefits beyond GHG reductions, including the potential for more affordable housing and access to higher resourced neighborhoods,[61] as well as increased physical activity and improved health.[62]

Despite widespread recognition that denser land use patterns and a shift toward smaller, multi-family units can help to achieve climate goals, the number of studies that explicitly examine the role of housing policies in facilitating denser development patterns and moving the needle on VMT and residential energy use is small.[63]

Quantifying the role of increased housing density throughout a metropolitan region on GHG reductions

Most studies linking housing policies and travel behavior have focused on transit-oriented development (TOD), typically consisting of multifamily housing development close to rail stations and high-frequency bus stops. However, much less research focuses on the impacts of increasing density throughout a metropolitan area—including in single-family neighborhoods. Because most developed areas in the U.S. are heavily auto-centric, any housing production strategy that neglects areas lacking good transit access will have only a modest effect on supply, and consequently limited impact on GHG mitigation.

More research can illuminate how increasing density via missing middle housing shapes travel behavior and energy use. Missing middle housing—defined in multiple ways but often referring to small-scale real estate development, including ADUs, duplexes, and other residential structures less than 20 units in size[64]—could play a critical part in a comprehensive climate mitigation strategy.

This is also an area of possible alignment with affordability goals. Missing middle housing is generally assumed to be more affordable than single-family dwellings, as it uses lower-cost construction techniques associated with low rise housing while still requiring less land per home. The units are also typically smaller and have fewer amenities (e.g., lower ceiling heights and less natural light). However, studies on these benefits are limited (in part due to the recency of policy reforms to spur missing middle production). Research quantifying both the sustainability and affordability benefits of missing middle housing would help to scale and/or strengthen adoption of these types of policies.

Understanding how the lack of affordable, infill housing impacts residential moves and subsequent GHG emissions.

The lack of affordable housing near jobs—particularly in supply constrained markets—is associated with longer commutes, as households trade off proximity with affordability.[65] This lack has led households in higher-cost, temperate areas like San Francisco—which tend to have lower per capita GHG emissions—to move to exurban areas, or to states such as Arizona and Texas, where housing costs are lower but household carbon consumption is higher.[66] The rise in remote work post-pandemic may also be reinforcing residential patterns in which more people live in less dense areas, as well as spurring migration to parts of the country with greater climate vulnerability.[67] Understanding household mobility and housing choice decisions and the factors that lead to migration to higher energy use areas is critical.

How states account for the climate benefits of more infill and affordable housing can also be improved. For example, California's policies tend to be focused on reducing its own statewide emissions, without considering how displacement to more carbon intensive states is leading to an overall increase in emissions, even as the state's own emissions decline. Further research can connect local climate policy to efforts to reduce emissions at state, national, and global scales.

Evaluating the impact of land use and housing policy reforms on housing production and GHG emissions.

One key research gap is in how housing policies influence housing production, and in turn, how this new housing changes energy consumption. To date, most climate studies compare VMT or energy use across existing communities with different densities or land use patterns, rather than measuring changes in VMT and energy use that result from changes in the housing stock. We need "before and after" studies of housing policy reforms to assess first, which housing policies are the most effective at producing new housing (including lower cost, smaller, and infill homes), and second, how those changes impact VMT and other forms of residential energy use.[68]

This is particularly critical because both states and local jurisdictions have made significant changes to zoning and land use laws in recent years, including laws that incentivize denser, transit-oriented and more climate friendly development patterns. Understanding the impacts of these policies will require longitudinal studies that examine how these reforms interact with market conditions to produce more supply.

There are also still significant gaps in our understanding of what policies work in what types of market contexts to spur more supply, and especially lower-cost supply. Research has shown that land use reforms don't lead to housing supply changes overnight, especially when market conditions create headwinds for new development.[69] Research and models that consider land use reforms in tandem with market conditions can help to identify how or whether the pace and scale of housing development can sufficiently "bend the curve" on emissions to meet climate targets.

Understanding how to align climate-friendly land use reforms with affordability, equity, and environmental justice goals.

Exclusionary zoning—including laws that limit the development of affordable housing or that impose minimum lot sizes or extensive design requirements—has largely functioned as a way to enforce racial and class segregation.[70] In addition to its climate benefits, reforming single-family zoning and encouraging denser development patterns could result in greater housing affordability and access to higher resourced neighborhoods.[71] Densifying suburban areas can also lead to increased demand for transit or pedestrian and biking infrastructure, justifying further investments in climate-friendly transportation modes. In this way, housing policy and climate policy are strongly aligned.

However, climate-focused policies, if not devised with attention to housing affordability and accessibility, may come with unwanted tradeoffs. For example, if transit oriented development leads to more higher-income households living near transit, VMT and emissions might decline, but lower-income people may be displaced, particularly if the effects of TOD increase local land and house prices.[72] Transit-accessible areas—particularly those around fixed rail—tend to have relatively higher concentrations of Black and Hispanic households, as well as renters.[73] Developing new housing only in these areas has raised concerns over gentrification and displacement, although more research is needed to understand these potential impacts.[74]

Similarly, denser development that enables more walking and biking[75] or reduced overall driving (and thus both regional air pollution and global climate pollution) can yield large health benefits. However, denser urban areas also tend to increase exposure to local air pollution and susceptibility to urban heat islands.[76]

The potential for harm to vulnerable communities is of particular concern when new housing development intersects with segregated land use patterns that have placed low-income and communities of color in locations most impacted by air and toxic pollution and lacking protection from heat.[77] For instance, highways were intentionally routed through Black urban neighborhoods,[78] and planners have routinely used apartment buildings as buffers from high traffic roadways for wealthier communities.[79]

A better understanding of the policies and urban design features that best protect vulnerable communities could support new housing development that improves health rather than furthering harm. Examples of urban design principles that could support these aims but may need better integration with housing policy reforms include: integrating trees and green space while limiting paved parking space,[80] extending upzoning beyond single-roadway corridors,[81] and converting high traffic roadways to safer and multimodal "complete streets."[82]

One strategy to protect vulnerable communities from further harms associated with development is to rebalance housing production towards higher resourced areas. Additional research could shed light on how adding new, lower-cost supply to these areas could make them more accessible to lower-income households, and identify the extent of and solutions to transportation trade-offs due to these areas being less transit-accessible. In addition to potentially improving the jobs/housing balance for those households, neighborhoods with relatively high resources (or relatively low levels of poverty) produce positive long-run economic and health outcomes for children who move there.[83] Yet these neighborhoods also tend to be most resistant to denser, multi-family housing developments.

Nascent climate policies such as California's guidance under Senate Bill 743 that intend to encourage development in less car-oriented neighborhoods while discouraging development in more car-oriented neighborhoods also can run counter to fair housing goals.[84] While this may be beneficial from a climate standpoint, some developers and advocates for racial equity in homeownership have raised concerns that this guidance may prevent the production of lower cost housing or expanding access to housing in higher resourced areas. These are important issues for housing and climate policy, but research on the net effects on housing affordability and access of different policies remains scant or nonexistent. Connecting the dots between the housing policy objectives of affirmatively furthering fair housing and creating access to opportunity with climate goals is a critical area for future research.

Finally, we need to better understand how to give communities a voice in planning decisions while at the same time ensuring that those processes don't prevent critical new investments in housing and climate infrastructure.[85] Historical environmental policy, intended to protect ecosystems and communities from development—yet inextricably linked to exclusionary land use policy—has contributed to today's housing crisis.[86] Laws like the National Environmental Protection Act (NEPA) and the California Environmental Quality Act (CEQA) address the equity implications of new projects by evaluating their potential impacts, ensuring community engagement in the decision-making process, and by acknowledging local concerns during the assessment process.[87] However, these laws can also present barriers to new housing development (especially infill)[88] as well as replicate power dynamics in the review and approval of projects across diverse communities.[89] Research could help to identify how NEPA and CEQA reforms could ensure that their goals—including correcting for historical inequitable and environmentally destructive practices—are maintained, while not undermining new production.

Climate Risk and its Impacts on Housing

Climate disasters are on the rise, with devastating effects on communities, built infrastructure, and ecosystems. After adjusting for inflation, the U.S. experienced more than twice the number of billion-dollar disasters in the 2010s than it did in the 2000s (Figure 5).

Among the many consequences of climate change, the U.S. has experienced diminishing water quality and supplies; extreme heat and droughts that have produced longer fire seasons and larger wildfires; and rising sea levels that, along with coastal storms, increase the dangers associated with storm surges, flooding, groundwater incursion, and coastal erosion. The Fourth National Climate Assessment estimated that more than $1 trillion of coastal real estate and 13.1 million people were threatened by rising sea levels, higher storm surges, and higher tidal flooding.[90] Climate change can also worsen indirect stressors such as vector-borne disease;[91] outdoor air pollution and allergen burdens;[92] and housing, utility and/or insurance costs.[93]

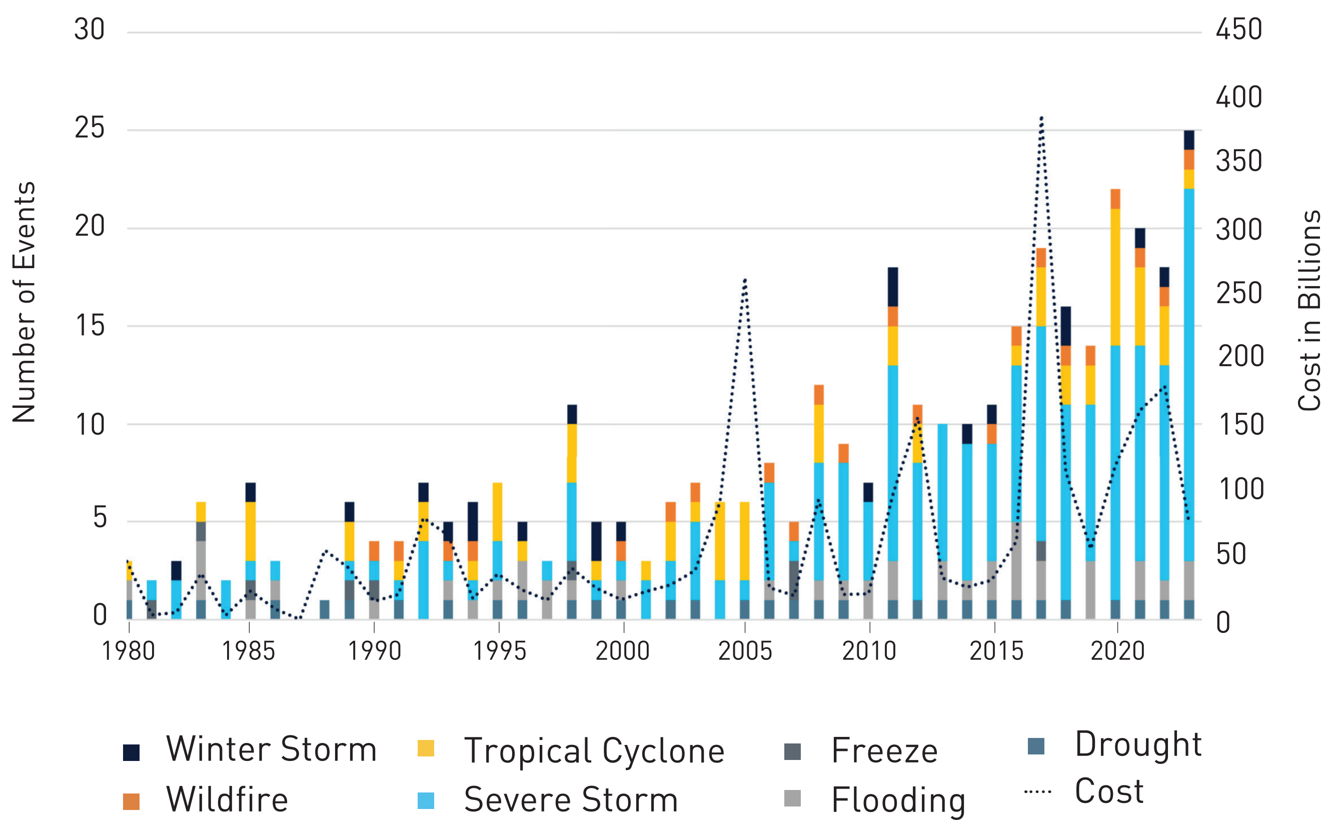
Research has focused both on risks to homes from catastrophic events like hurricanes and wildfires,[94] and the risk of chronic climate stressors to communities from drought and severe heat.[95] Rising coastal groundwater levels also pose a threat to the housing stock, leading to potential flooding of basements, leakage through cracks in sewer lines, and disruption of underground infrastructure.

These climate-related events have profound impacts on housing, including the loss or damage of homes; displacement; and disruptions to critical infrastructure such as electricity, water supply, and transportation systems. Research has highlighted the ways in which these impacts will be distributed unevenly across regions and neighborhoods.[96]

Lower-income households, renters, and people of color tend to be the most vulnerable groups, in part due to past discriminatory policies such as redlining.[97] For example, estimates suggest that in the San Francisco Bay Area, rising groundwater levels could impact twice as much land area as coastal flooding alone, most of it located in low-income and BIPOC communities.[98]

As the impacts of climate change continue to grow, researchers will continue to work to understand how these risks affect the housing sector. However, important questions remain as to how these trends impact housing access and affordability, and how government policies can respond to these disasters more equitably.

Figure 5: Trends in Climate-Related Disasters Incurring over $1 Billion in Costs



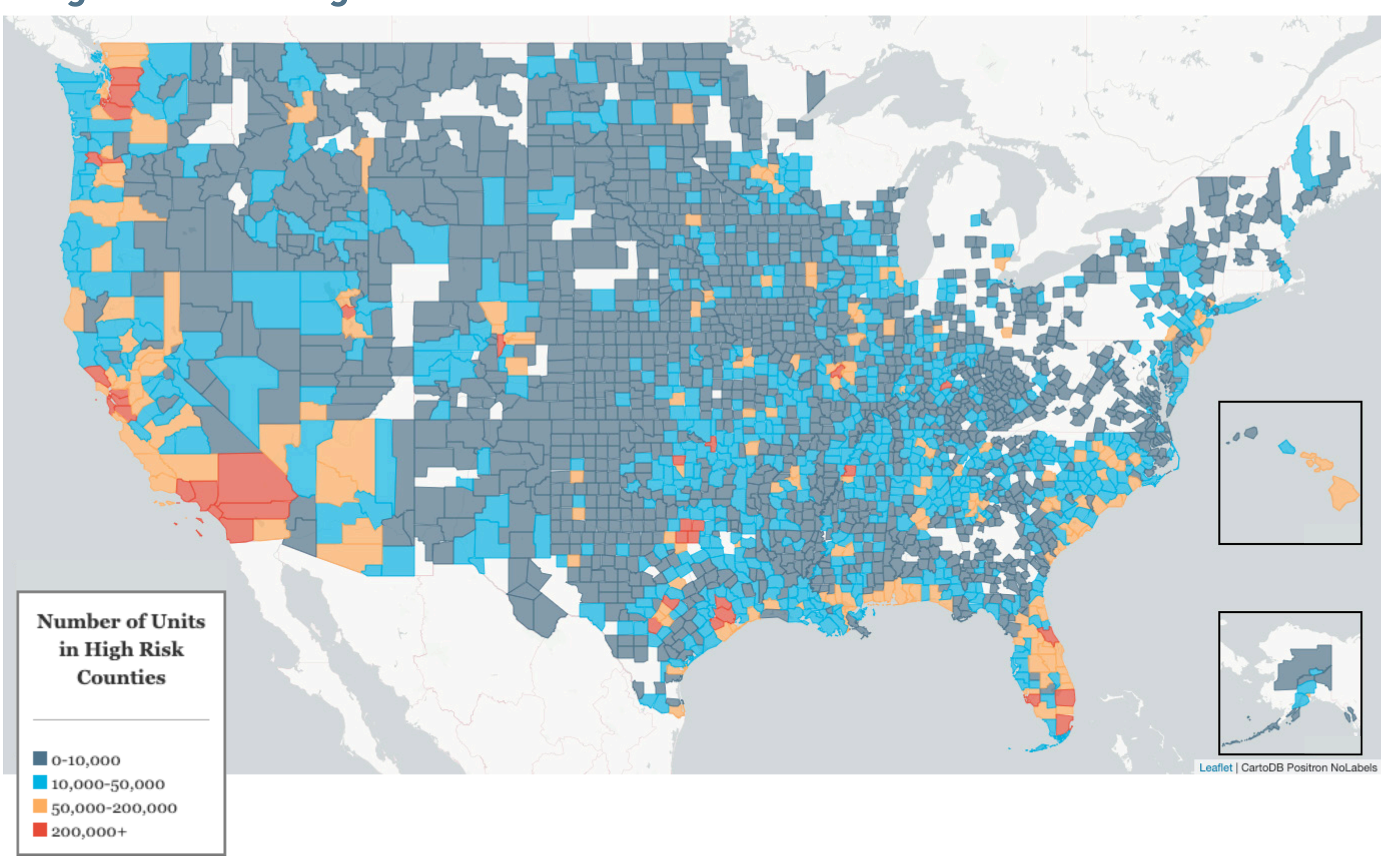
Source: NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2024). Retrieved from: https://www.ncei.noaa.gov/access/billions/, DOI: 10.25921/stkw-7w73.

Quantifying the impacts of climate change on the housing sector

Historically, risks to the housing stock have been quantified and shared across the housing industry. But as climate change has ratcheted up the scale and frequency of risk exposures, those systems have lagged in their ability to adapt. Insurers and government regulators are trying to respond to increased risks by improving their risk assessment modeling. For example, the federal government's National Flood Insurance Program (required for homeowners with federally-backed mortgages) relies on FEMA's 100-year flood maps to designate Special Flood Hazard Areas (SFHA)—places with at least a 1 percent annual chance of experiencing a flood.[99] But with current models projecting a 40-fold increase in the frequency of these floods,[100] far more homes are exposed to significant risk than are required to carry flood insurance.

The potential for more frequent and severe disasters is also leading to significant implications for insurance cost and coverage. For example, in 2021, the National Flood Insurance Program shifted to a risk-based pricing scheme with implications for affordability among households in flood-prone areas.[101] Private home insurance providers are similarly raising premiums on homeowners in high-flood or fire risk areas or are pulling out of some regions of the country like California altogether, leading to significant pricing and coverage concerns.[102] Researchers have also suggested that climate risk will lead banks and other financial institutions to scale back lending in "bluelined" flood

Figure 6: Housing Stock at Risk of Climate-Related Disasters



Source: Joint Center for Housing Studies, Harvard University. (2023). "The State of the Nation's Housing." Retrieved from: https://www.jchs.harvard.edu/sites/default/files/reports/files/Harvard_JCHS_The_State_of_the_Nations_Housing_2023.pdf. All rights reserved.

prone, low-lying areas, with potential impacts on access to homeownership and community investments.[103]

Balancing insurance solvency with affordability is a daunting challenge. A central question is who should bear the costs of homes located in areas at risk of climate impacts—should it be taxpayers, insurers, or households? If those costs are shared, what is the right combination of responsibility? Further research would provide answers to ensure equitable outcomes. For example, the lessons learned from the housing voucher program could help to inform how to create a means-tested affordability insurance program, which could offer more equitable protections.[104]

Research could also focus on how housing policies could proactively mitigate flood, fire, and other climate risks for new development through planning and building requirements. Some examples include zoning that limits new development in hazard prone areas, strengthened building codes, or higher resilience standards for publicly funded affordable housing.[105] Research could also illuminate how urban form intersects with climate resilience to inform housing policy. For instance, homes at low to moderate density may be more vulnerable to wildfires than either very rural or urban homes, due to the combination of frequent ignitions, high fuel loading, and low defendability.[106] At the same time additional building code requirements or prohibiting construction in areas of high climate risk could adversely affect housing affordability by lowering supply or raising development costs. Further research will help to balance these important policy trade-offs.

Assessing the impact of climate change on housing supply and demand

Nationally, exposure to sea-level rise, flooding, and higher insurance premiums is beginning to have a negative impact on property values, which can not only impact wealth building and property tax revenues, but also influence the likelihood of new housing development.[107] In states like Arizona, the lack of adequate groundwater supply is leading to restrictions on new construction, a shift that signals potential housing impacts in other regions where drought and climate change are straining water supplies.[108]

As exposure to climate hazards increases and costs of adaptation and disaster recovery escalate, an increasing number of households may move away from relatively vulnerable locations to those perceived as lower risk, either voluntarily or as a response to financial pressure (e.g., from unavailable or unaffordable home insurance or mortgages) or deliberate government policy to relocate households. The magnitude of future climate-induced migration could be very large, with some studies estimating more than 13 million domestic households by 2100 due to sea level rise alone.[109] The potential for international immigration to the US from countries with even more severe exposure to climate hazards could be even larger.[110]

Where will these households move to, with what impacts on destination housing markets (including the potential for gentrification and displacement)? Will these places be able to foster housing supply to affordably and equitably accommodate new residents? Is it wise that cities are beginning to advertise themselves as “climate havens?”[111] Research is only beginning to address these questions.[112]

Improving government emergency response policies for renters and other vulnerable populations

The costs of recovering from disasters have strained the fiscal, administrative, and response capacities of the Federal Emergency Management Agency (FEMA) as well as state and local governments, whose existing programs and funds are far outstripped by the scale of climate impacts and needs.[113] The immediate consequences of disasters and obstacles to recovery are particularly acute for low-income households, renters, and communities of color—even as existing programs may be less well targeted to them (i.e., greater financial assistance available to homeowners than renters).[114] The Community Development Block Grant Disaster Recovery (CDBG-DR) fund has often been the source for additional recovery funds, but this program has never been permanently authorized.[115]

Further research can inform how to structure recovery programs, expand protections and funding for renters, and build emergency response system capacity to handle large-scale disasters.[116] There are a number of emerging innovations, such as the establishment of climate resilience centers in low-income and BIPOC communities.[117] Another example—proposed but not yet executed—is rapidly deploying ADUs following disasters,[118] or creating a net increase in housing stock by bringing traditional temporary housing trailers up to code so they can remain as ADUs even as neighboring homes are rebuilt. Research could identify opportunities to fund and scale these innovations more broadly.

Research can also identify approaches to making climate adaptation investments in ways that don't exacerbate spatial inequalities. Climate adaptation projects—such as building a seawall or making other investments in green infrastructure—have been shown to reinforce patterns of disinvestment and/or gentrification.[119] For example, the neighborhoods where Philadelphia expanded household green infrastructure to absorb stormwater saw the highest levels of gentrification.[120] Identifying approaches to ensure that resilience measures benefit existing residents and scaling community-level adaptation efforts could help protect entire communities against growing threats and ensure that climate efforts are aligned with affordable housing and community development goals.

A particularly challenging set of questions involve the concept of "managed retreat"—deliberate government policies designed to relocate households away from areas with the most severe exposure to climate hazards.[121] Such policies are intended to prevent future harm to human health and property and to manage the fiscal burdens of climate impacts and adaptation.[122] However, if cost savings are not weighed against values such as community self-determination, they also have the potential to harm low-income communities and communities of color.[123] Proactive and inclusive planning is needed to support equitable outcomes in the face of climate risks, and will require additional research that integrates community development perspectives into conversations focused on climate adaptation.[124]

Improving emergency responses for people experiencing homelessness

To date, very little research has focused on the intersections between climate disasters and homelessness. However, flooding and fires can lead to increases in the number of people experiencing homelessness. In addition, unhoused populations are the most vulnerable both during and in the aftermath of a disaster. They also have distinct needs, since they often lack the tangible (e.g. transportation, documentation) and intangible resources (e.g. social supports) that others rely on to prepare for and recover from disaster.[125]

Current systems to address climate disasters and support people experiencing homelessness are insufficiently coordinated and funded. For example, after Hurricane Harvey, FEMA's Transitional Sheltering Assistance (TSA) program—which provides financial assistance to victims of housing loss who cannot return to their primary residence due to home damage—was less likely to reach lower-income households displaced from their homes, and these households were less likely to access shelter.[126] More research is needed to identify effective practices in disaster response, as well as understand the lived experiences, behaviors, and gaps in resources for those experiencing homelessness.

Conclusion

Housing policy is key to addressing climate change, both in terms of mitigating the scale of global warming and ensuring that communities are protected from its worst effects. Both require a rethinking of housing policy and coordinated actions to:

- Transform land use and housing development patterns to improve housing affordability and access to jobs, schools, and other neighborhood amenities;
- Retrofit the existing housing stock, with a specific focus on preserving affordable housing;
- Spark innovations in construction materials and methods; and
- Improve the capacity of governments to respond to climate disasters.

A sustained focus on integrating these different measures will have benefits not only for climate change, but also for creating more affordable and equitable access to housing and healthy neighborhoods.

Similarly, climate interventions have the potential to align with long overdue efforts to improve housing affordability and housing access for low-income people and people of color. Yet they also have the potential to run counter to these efforts if not thoughtfully integrated with housing policy reforms. Improving the evidence base can help policy makers more effectively weigh these trade-offs and identify areas of alignment.

These are not going to be easy changes. Multiple, overlapping agencies govern both climate and housing policy at different scales, creating fragmentation and jurisdictional complexity that can be hard to resolve.[127] Addressing historical and contemporary forms of racial inequality in both housing and climate policies will also require grappling with systems that continue to produce disparate outcomes.

Sustained, coordinated, and bold efforts will be needed to jointly solve our housing and climate crises. There has already been some progress towards these aims. For instance, the recent wave of state planning reforms to enable more housing supply[128] via infill and compact development promises both housing affordability and climate benefits. In many jurisdictions, new climate policies are being implemented thoughtfully, solving for multiple social objectives and with efforts to not repeat the mistakes of earlier generations of environmental policy that left the most vulnerable communities behind. The Inflation Reduction Act of 2022 is also the most significant piece of climate legislation in U.S. history, unlocking billions of dollars in investments to increase the energy efficiency of new and existing housing, as well as facilitate the broader energy transition. By researching these efforts, and providing data, case studies, and best practices that can inform the development of equitable and sustainable housing policies, we hope to build on this positive momentum.

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