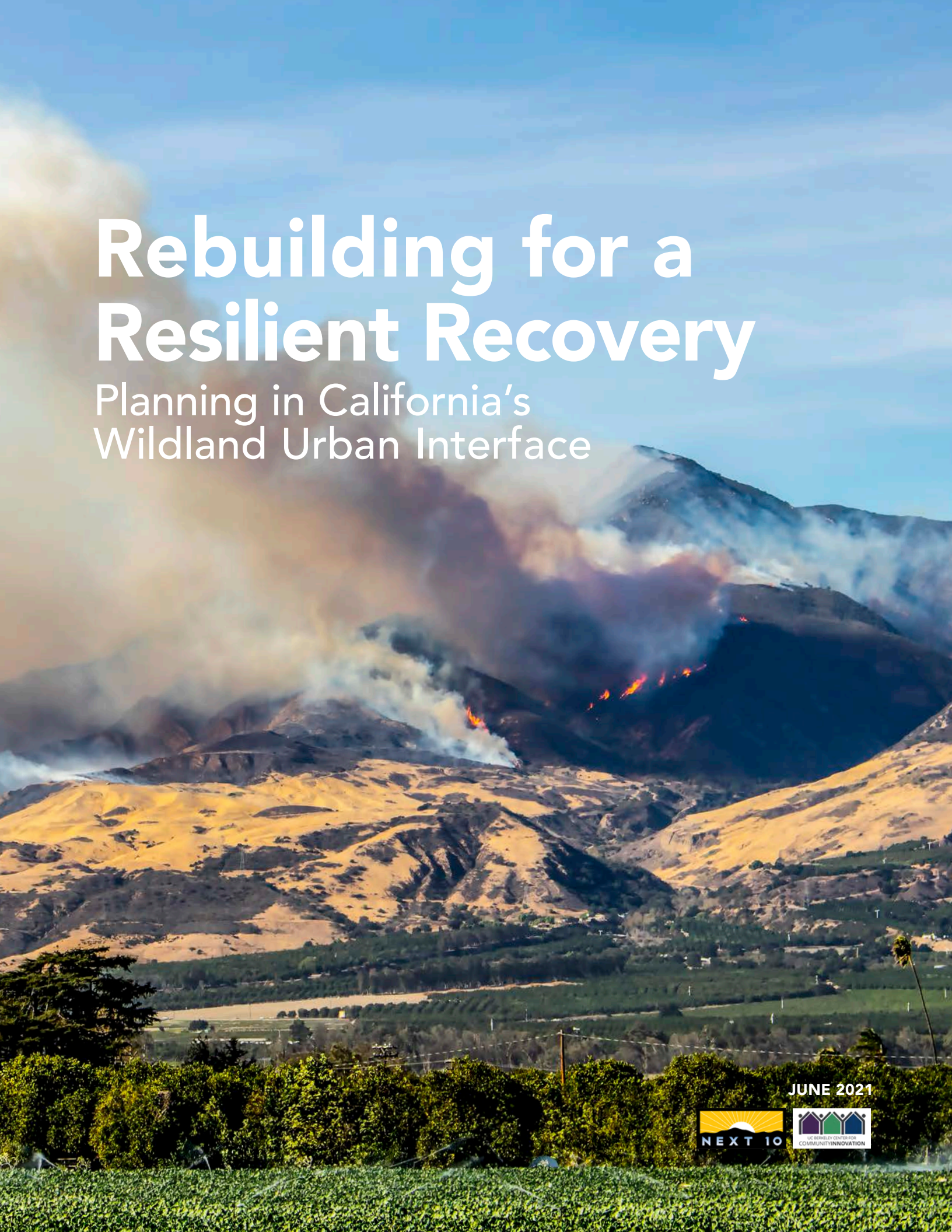

Rebuilding for a Resilient Recovery

Planning in California's Wildland Urban Interface

JUNE 2021

NEXT 10

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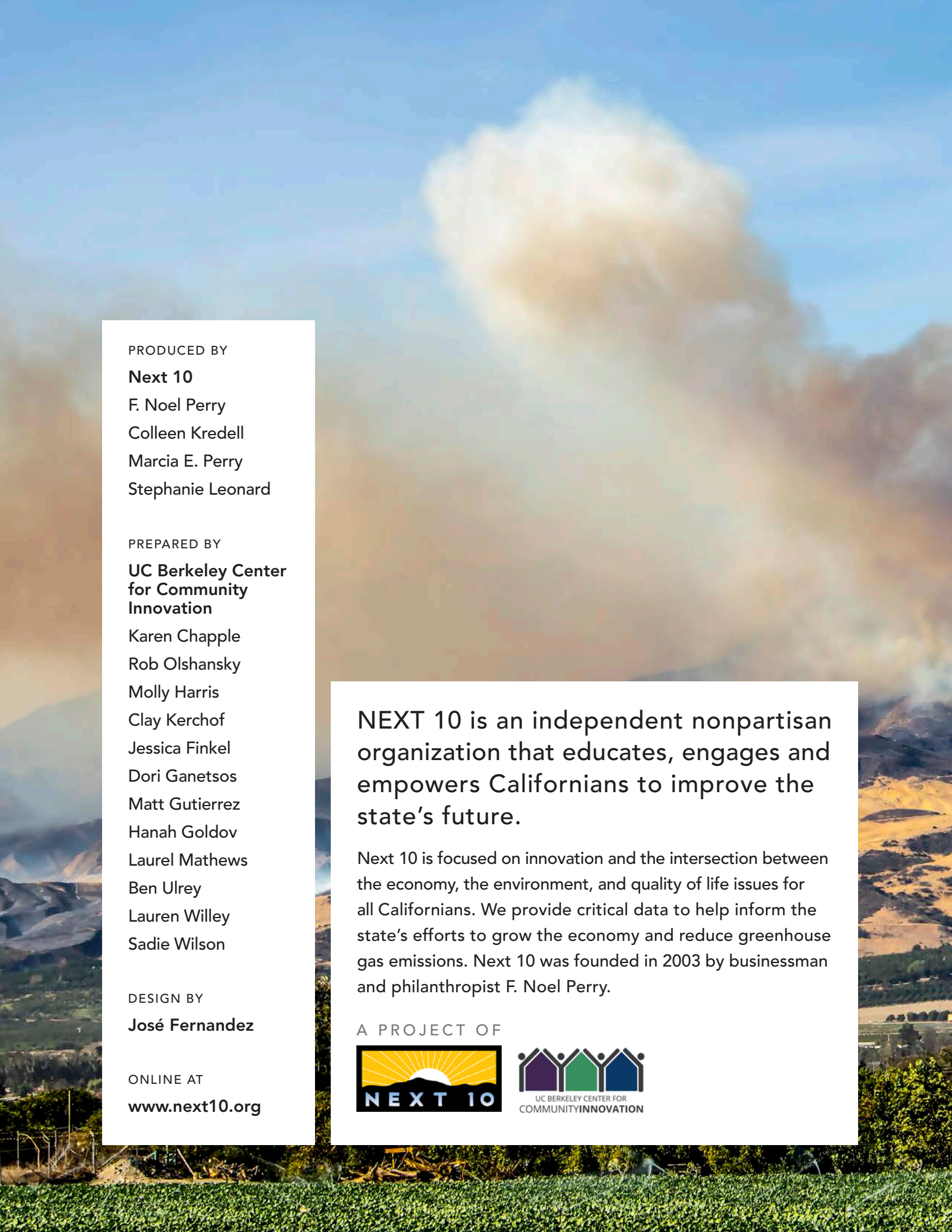

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NEXT 10 is an independent nonpartisan organization that educates, engages and empowers Californians to improve the state's future.

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

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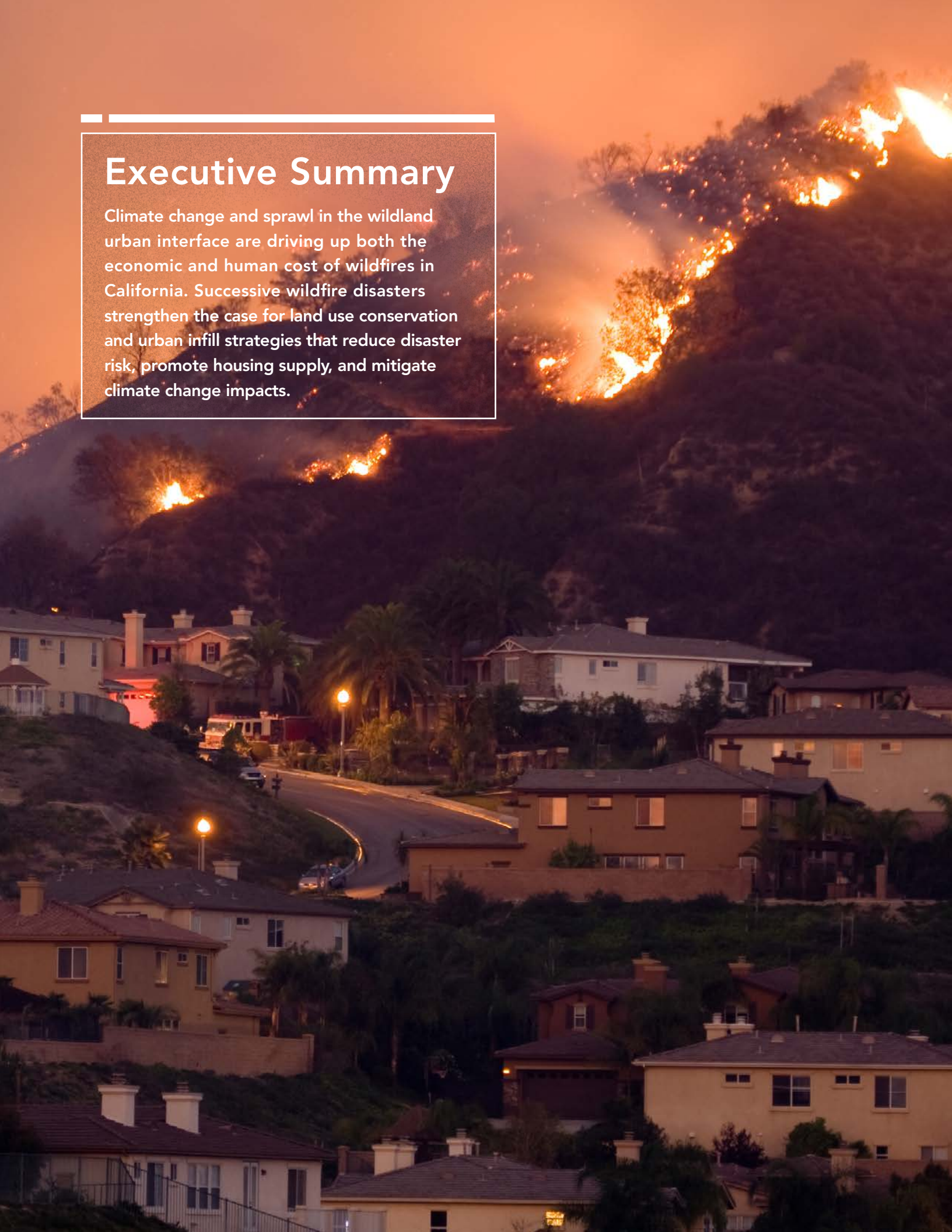


Executive Summary

Climate change and sprawl in the wildland urban interface are driving up both the economic and human cost of wildfires in California. Successive wildfire disasters strengthen the case for land use conservation and urban infill strategies that reduce disaster risk, promote housing supply, and mitigate climate change impacts.

Wildfires in California are increasing in frequency and intensity. Accelerating climate change, changing land use patterns, and reduced forest management practices are major contributing factors. In 2020, California experienced five of the six largest wildfires in recorded history. Wildfire proliferation threatens the lives and homes of more than one quarter of the state's population; approximately 11.2 million people, in 4.5 million homes, are at-risk in the wildland-urban interface (WUI).[1,2]

Rather than redirecting development away from high fire risk areas in the WUI, state and local policies primarily emphasize retrofitting existing homes, imposing stricter building codes and site design standards for new homes, and ensuring that jurisdictions have sufficient evacuation routes and shelter-in-place plans in case of an emergency. Building on prior land use research addressing infill development, sprawl management, and land conservation, this report suggests that continued development in the WUI will make California's already constricted supply of housing more vulnerable, will undermine state efforts to curb carbon emissions, and will further degrade the state's wildland habitats. The growing risk of wildfires also creates fiscal challenges for state and local governments, given the high cost of post-disaster recovery.

To inform state policymakers, this report studies three communities recently affected by fires. The research combines a scenario exercise, secondary data analysis, and interviews to understand the impacts and possible recovery trajectories of the Tubbs Fire (2017), Thomas Fire (2017), and Camp Fire (2018) on the communities of Santa Rosa, Ventura, and Paradise, respectively. By analyzing three case study communities with different physical and socioeconomic characteristics, the policy recommendations reconcile a variety of goals, including reducing wildfire risk, increasing housing supply and resilience, and mitigating climate change, that are applicable across the state.

Using a scenario planning approach, this report summarizes the impacts of different post-fire land use patterns on a jurisdiction's housing supply, fire risk, affordability, and climate metrics such as greenhouse gas (GHG) emissions, residential energy use, and vehicle miles traveled (VMT). Scenarios at the city and regional level explore moving homes out of the WUI, incorporating greenbelts and wildfire buffers, increasing density in existing commercial cores, adding gentle density in the form of 'missing middle'[3] housing and accessory dwelling units (ADUs) to areas not in the WUI, and embracing manufactured housing as an affordable-by-design approach. The social, economic, and environmental impacts inform policy recommendations.

Each case study community explores three rebuilding scenarios:

1. **(Re)Building as Usual,** in which existing recovery plans and historical growth trends guide anticipated development patterns;
2. **Managed Retreat & Urban Density,** in which disaster survivors choose or are incentivized to move to lower risk locations, while land use planning and incentives promote infill development in existing urban nodes; and
3. **Resilience Nodes,** in which communities rebuild some housing in high-risk areas but incorporate robust wildfire mitigation features, including development clusters surrounded by defensible space

The analysis shows that there are more resilient paths to recovery than rebuilding as usual. Communities selecting either Managed Retreat or Resilience Nodes will be able to reduce fire risk for their residents, while also meeting housing and climate goals. Managed Retreat provides the biggest impact in terms of safety and climate, but presents new potential displacement risks. Resilience Nodes offers the most potential for economic growth, with fewer negative social equity impacts, but less of a guarantee in terms of future fire risk. If the State of California wishes to address its dual climate and housing crises, it will need to develop the right set of carrots and sticks to persuade jurisdictions not to simply pursue the greatest economic return.

Key findings from the case study analysis include:

- Urban growth boundaries and conservation easements protect environmentally valuable natural and working lands while also reducing wildfire disaster costs;
- Infill development has fewer GHG emissions, relative to existing patterns of sprawl that are common throughout the WUI. In addition to higher emissions, WUI sprawl increases the risk of wildfires and undermines state land conservation and carbon sequestration goals;

Table ES.1 Summary of Impacts by Scenario

	SANTA ROSA			PARADISE (BUTTE COUNTY)			VENTURA		
Scenario	(Re) Building-as-usual	Managed Retreat	Resilience Nodes	(Re) Building-as-usual	Managed Retreat	Resilience Nodes	(Re) Building-as-usual	Managed Retreat	Resilience Nodes
Housing Impacts									
Population	179,200	167,600	173,300	236,800	236,800	237,600	108,400	97,500	122,400
% change		-6.5%	-3.3%		0.0%	0.3%		-10.1%	12.9%
Dwelling Units (DUs)	70,900	76,100	76,100	103,900	104,800	104,700	42,900	43,000	52,300
% MF	18%	34%	41%	19%	20%	18%	16%	23%	32%
% change		7.3%	7.3%		0.9%	0.8%		0.2%	21.9%
DUs in Fire Hazard Zone	12,300	5,700	20,600	13,200	11,900	12,100	9,800	4,700	11,700
% change		-53.7%	67.5%		-9.8%	-8.3%		-52.0%	19.4%
Household Costs	$17,800	$11,300	$14,300	$26,900	$25,300	$23,800	$15,500	$13,000	$13,600
% change		-36.5%	-19.7%		-5.9%	-11.5%		-16.1%	-12.3%
Environmental Impacts									
GHG Emissions (metric tons/year)	1,142,800	929,500	967,800	2,320,000	2,180,000	2,320,000	730,400	641,600	772,700
% change		-18.7%	-15.3%		-6.0%	0.0%		-12.2%	5.8%
GHG Emissions (metric tons per DU)	10.9	9.4	9.7	22.3	20.8	22.2	10.9	9.4	9.7
% change		-13.5%	-11.0%		-6.8%	-0.7%		-13.5%	-11.0%
VMT (DU/year)	23,000	14,200	18,400	33,200	31,200	33,300	11,500	9,500	10,100
% change		-38.3%	-20.0%		-6.0%	0.3%		-17.4%	-12.2%
Change in Carbon Stock (metric tons/year)	-2,300	22,900	81,800	-95,400	-68,900	-79,700	0	-300	-230
Economic Impacts									
One-time construction jobs	24,500	66,700	95,900	44,600	51,000	57,300	2,100	17,200	36,600
One-time economic output	$1.82 billion	$4.98 billion	$7.22 billion	$6.61 billion	$7.58 billion	$8.39 billion	$0.32 billion	$2.72 billion	$5.03 billion

WUI Development	Statewide
Dwelling Units in High and Very High Fire Risk Areas	1,456,300
Minimum Residential Structure Replacement Cost in High and Very High Fire Risk Areas	$610 billion
Capacity for Additional Units in High and Very High Fire Risk Areas	523,000
Annual Revenue from 0.25% Levy on Existing DUs in High and Very High Fire Risk Areas	$1.81 billion

- (Re)Building as Usual recovery scenarios miss an opportunity to reduce wildfire risk, expand the supply of affordable housing, and reduce per household GHG emissions;
- Post-disaster relocation within the region depends on the ability of the regional housing market to absorb disaster survivors. If the disaster is too large for the housing market, people will be displaced to more distant locations; and
- Lack of integration between local and regional land use planning, housing policy, and state wildfire management undermines California's efforts to address the concurrent climate and housing crises.

Scenario analysis findings are summarized in Table ES.1. Based on parcel-level tax assessor data compiled by Urban Footprint, as of 2020, California has 1.4 million homes in high or very high fire hazard severity zones alone, representing a minimum of $610 billion in potential replacement costs if these homes were to be impacted by wildfires. Local land use and state hazard mitigation policies currently protect only a small share of these properties. In addition to existing at-risk homes, there are more than 555,000 underbuilt residential parcels in the WUI. If development in the WUI continues apace, the scale of potential losses will continue to grow rapidly.

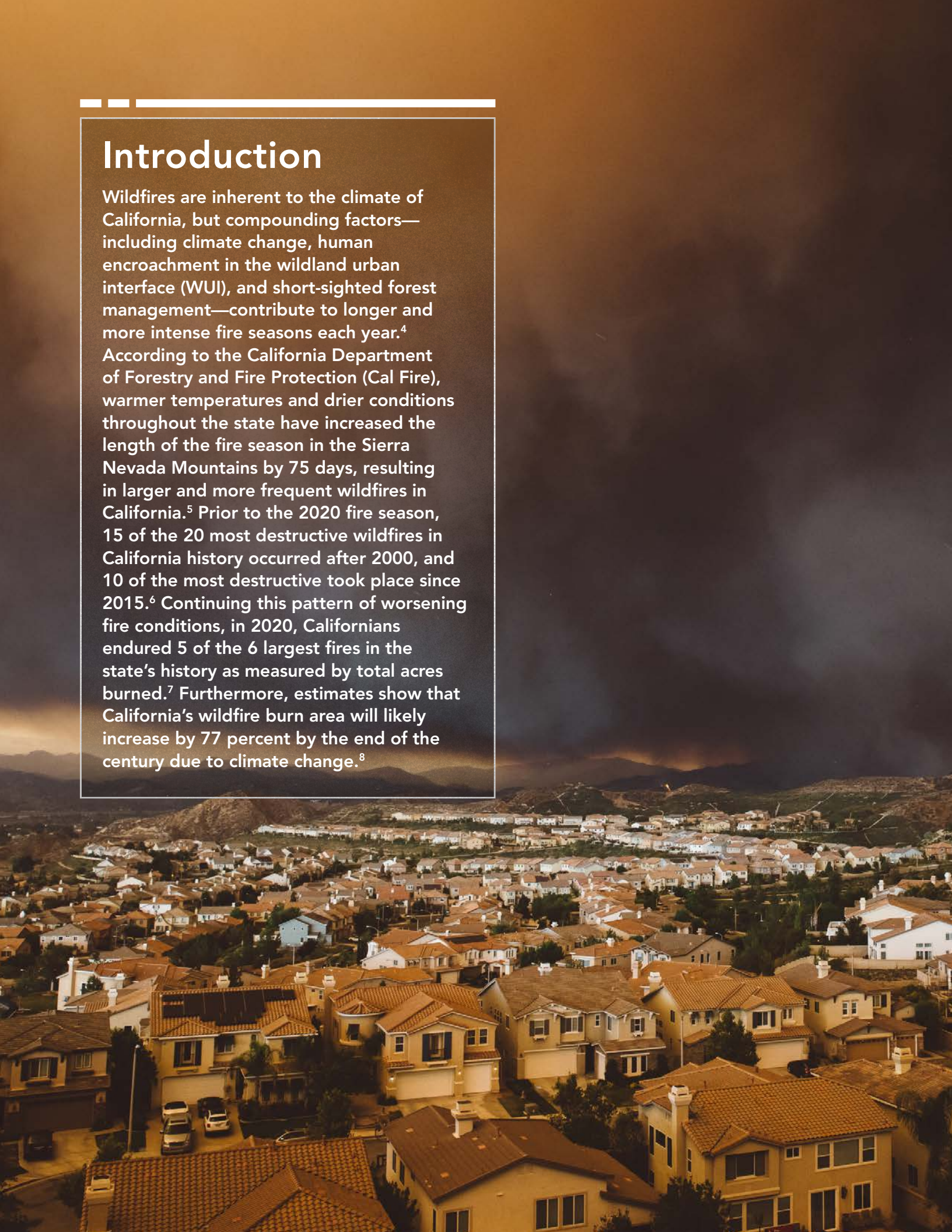
Informed by the case study analysis and statewide fiscal assessment, the report proposes a series of policy recommendations for implementation at the state and local levels. Effectively addressing the escalating risk of wildfire requires large-scale cooperation, coordination, and political mobilization. Planning and policies for disaster recovery and wildfire resilience must recognize the costs of WUI sprawl along with the benefits of reorienting new development towards urban infill. Disaster recovery is an opportunity for California's regions and communities to reduce wildfire vulnerability, support housing supply and resilience, and promote climate change mitigation goals.

Key policy recommendations include:

- **Identify new revenue sources and financing mechanisms:** To effectively manage California's growing wildfire risk and disaster recovery costs, policymakers must identify new funding streams and financing mechanisms for adaptation and resilience in the WUI. For example, by levying a 0.25 percent fee on the assessed value of existing residential properties in high and very high fire hazard severity zones, the state could generate more than $1.8 billion to reinvest in wildfire risk reduction planning and projects;
- **Prevent displacement:** State and local disaster housing policies must acknowledge that wildfire disasters disproportionately displace and unhouse renters and low-income homeowners and therefore should proactively plan for disparate disaster impacts and prioritize these residents in hazard mitigation and disaster recovery funding;
- **Incentivize lower-risk development:** Limiting WUI sprawl while not worsening California's housing crisis requires the state to provide disincentives against risky development and incentives for infill housing affordable to people of all income levels; and
- **Improve local capacity:** Institutional reinvention that builds capacity at regional and local levels will enable California and its communities to proactively and equitably govern recovery and adaptation in the WUI.

Introduction

Wildfires are inherent to the climate of California, but compounding factors—including climate change, human encroachment in the wildland urban interface (WUI), and short-sighted forest management—contribute to longer and more intense fire seasons each year.[4] According to the California Department of Forestry and Fire Protection (Cal Fire), warmer temperatures and drier conditions throughout the state have increased the length of the fire season in the Sierra Nevada Mountains by 75 days, resulting in larger and more frequent wildfires in California.[5] Prior to the 2020 fire season, 15 of the 20 most destructive wildfires in California history occurred after 2000, and 10 of the most destructive took place since 2015.[6] Continuing this pattern of worsening fire conditions, in 2020, Californians endured 5 of the 6 largest fires in the state's history as measured by total acres burned.[7] Furthermore, estimates show that California's wildfire burn area will likely increase by 77 percent by the end of the century due to climate change.[8]



This increase in the frequency and severity of fires has serious urban planning, environmental, and economic implications for California. Under current estimates, more than one in 12 Californian homes are located in areas identified as having a high risk of burning in a wildfire event.[9] Notably, the State of California last updated its fire risk maps in 2007. Consequently, these maps underrepresent the true extent of wildfire risk in the state.[10]

Another way to assess fire risk to human-made structures is to consider whether those properties are located in the WUI.[11] Although the literature contains many definitions of the WUI—thus making it difficult to map and measure—the California Governor's Office of Planning and Research (OPR) defines it as any developed area located adjacent to wildland areas, resulting in those human-made buildings and structures having a high susceptibility to damage by wildfires.[12] The WUI boundaries typically account for housing density, vegetation in the area, and the amount of buffer between housing and nearby vegetation.[13] Low-density areas with high amounts of vegetation located close to homes are particularly dangerous for the local residents and structures. Human presence in wildland areas is a major cause of fires, accounting for approximately 85 percent of all wildfires.[14] In the event of a fire, firefighters struggle to protect these areas, and limited road networks—often a staple of low-density development found in the WUI—makes it particularly challenging for residents to evacuate.

The insurance impacts of continued development in high-risk areas of the WUI threaten to impose high costs on homeowners and destabilize the insurance industry. From 1964 to 1990, the insurance industry paid out an average of $100 million per year in fire insurance claims in California. From 2011 to 2018, that figure increased to $4 billion per year. The 2018 Camp Fire and 2017 Tubbs Fire alone resulted in $9 billion and $12 billion in insurance claims, respectively.[15] Despite improvements in fire science and wildfire risk modeling, the outdated state fire maps and regulations that limit insurance rate increases undervalues the economic risk of development in the WUI.[16]

Rather than redirecting development away from the WUI, state and local legislation largely focuses on retrofitting existing homes to be more fire resistant, imposing stricter building code and site design standards for newly-constructed homes, and supporting jurisdictions to create emergency evacuation routes and shelter-in-place plans.[17] To be eligible for federal funds from the Hazard Mitigation Grant Program (HMGP), states must have approved State Hazard Mitigation Plans (SHMP), and the local governments must have approved Local Hazard Mitigation Plans (LHMPs).[18] LHMPs vary widely in quality, and many smaller jurisdictions struggle to turn their LHMPs into projects or even compete for the competitive HMGP funds. In 2008, California strengthened building code standards for all new residential construction built in high fire risk areas, and Assembly Bill 2140 (2006)[19] and Senate Bill 1241 (2012)[20] mandates that jurisdictions address wildfire risks in their General Plans. State and local governments, however, have been slow to embrace some of the more politically challenging approaches to hazard mitigation and disaster resilience and recovery. In 2020, the Governor of California vetoed SB 182, which aimed to restrict how much housing local jurisdictions could permit in very high fire-hazard severity zones (VHFHSZs).[21]

By deploying creative policies and financing for land use and rebuilding, the state and local governments can legislate and implement cross-sector policies that break down siloes and achieve multiple state policy goals of fire safety, housing, and environment. Based on an in-depth analysis of three communities impacted by wildfires—Santa Rosa in Sonoma County (Tubbs Fire, 2017), Paradise in Butte County (Camp Fire, 2018), and the City of Ventura in Ventura County (Thomas Fire, 2017)—this report recommends a mix of state, regional, and local-level policies and strategies for promoting and funding programs that would reduce wildfire vulnerability, support housing supply resilience, and mitigate the impacts of climate change. This analysis summarizes the pre-disaster characteristics of each community, outlines wildfire disaster impacts, analyzes disaster recovery efforts, and explores the economic, environmental, and land use implications of various rebuilding scenarios. By studying communities with distinct demographic, geographic, and land use contexts, conclusions can be translated into scalable and flexible state-level policies that support state, regional, and local wildfire resilience.

This report finds that California's housing shortage and urban land use regulations encourage development sprawl into the WUI, which intensifies wildfire risk. This, in turn, exacerbates regional housing shortages. Planning and policies for disaster recovery and wildfire resilience must recognize the environmental, social, and fiscal costs of sprawl in the

WUI and the affiliated benefits of prioritizing urban infill development. The analysis suggests the need for targeted land use interventions that allow for lower risk development patterns, greater enforcement of resilient building codes and structural hardening, and limitations on new development in high wildfire risk areas. Not only would this altered approach to land use planning reduce wildfire risk, it would also promote insurance affordability, provide needed housing in safer and more accessible locations, reduce carbon emissions, and provide long-term fiscal benefits.

The State should embrace policies like transfers of development rights (TDR), conservation easements, and homeowner buyouts. Additionally, planners, policymakers, emergency managers, and insurers alike need comprehensive and standardized wildfire risk and disaster data to develop informed and coordinated policy solutions for these interconnected challenges. Importantly, any future policies also must consider potential impacts on vulnerable communities and adopt strategies to mitigate the risk of displacement or other harm.

This report begins by summarizing the existing policies at all levels of government that address fire risk and disaster recovery, as well as the existing literature on these topics. After outlining the research methodology, the report then summarizes findings from the case study analysis. The conclusion of Part I presents recommendations for state policymakers to achieve the complementary goals of reducing risk in the WUI, addressing the growing housing crisis, and mitigating climate change. Part II consists of the full case studies.

Background

GOAL 1:

Reduce Vulnerability in the Wildland Urban Interface

California's wildfire strategy prioritizes fire suppression and fuel management over comprehensive land use planning to limit development in the WUI. A historical trend of fire suppression has left the state's forests "unnaturally dense," and therefore increasingly vulnerable to fire in the face of a warmer, drier climate.[22] More recently, the state has taken steps to reduce hazardous fuel surrounding communities in the WUI, largely through forest thinning and prescribed burns. The state's mitigation strategies are informed by the California Strategic Fire Plan (2018) and the California Vegetation Treatment Program[23] and a recent federal commitment to match fuel management efforts on 500,000 acres of forest land per year through the Shared Stewardship Agreement (2020) has bolstered these efforts—a critical partnership given that the federal government owns 58 percent of California's forestland.[24] Thus far, the state has not taken bolder steps such as curbing development in the WUI.

Hazard mitigation planning: Beyond forest management as a strategy for reducing vulnerability in the WUI, the state enacted strict building codes for homes built after 2008 within Cal Fire-defined VHFHSZs,[25] which include using specific building materials to "harden" homes to stray embers and creating defensible space around buildings.[26] The responsibility falls on homeowners to pay for these hardening efforts, placing a higher cost burden on low-income families. Further mitigation planning falls onto local governments in the form of LHMPs, Community Wildfire Protection Plans (CWPPs), and various elements of the general plan—and is largely driven by financial incentives at the state and federal levels.

A series of state bills encourage municipalities to also incorporate wildfire mitigation and risk reduction for high-risk zones into their general plans. AB 2140 (2006) incentivizes municipalities to incorporate LHMPs into the Safety Element by tying them to eligibility for state funding for post-disaster projects through the California Disaster Assistance Act.[27] AB 1241 (2012) goes a step further to explicitly require wildfire mitigation policies and programs in the Safety Element for cities and counties within an SRA (State Responsibility Area) or VHFHSZ.[28] SB 379 (2015) requires local governments to assess local vulnerability to climate change and adopt adaptation and resilience goals, policies, and implementation measures as part of the Safety Element and/or LHMP.[29] SB 1035 (2018) added a regular review and update for flood, wildfire, and climate adaptation components of the Safety Element every eight years.[30] OPR's Integrated Climate Adaptation and Resiliency Program provides further guidance suggesting hazard mitigation planning and climate change adaptation. AB 1823 (2019) requires the State Board of Forestry and Fire Protection to develop criteria for and maintain a list of "Fire Risk Reduction Communities" located within the SRA and VHFHSZs.[31] These criteria include the local mitigation planning efforts described above as well as participation in Fire Adapted Communities and Firewise USA programs. Finally, SB 99 (2019)[32] and AB 747 (2019)[33] mandate the addition of evacuation routes and their conditions in the LHMP and Safety Elements.

Hazard mitigation funding: Despite the cost-effectiveness of hazard mitigation, the state spends several times more on wildfire suppression and disaster recovery costs per year than on hazard mitigation for wildfire risks.[34] Each federal dollar spent on wildfire mitigation in the WUI saves $3 in avoided disaster recovery costs, while each dollar spent on improving building safety above baseline code requirements saves $4 in avoided recovery costs.[35] In 2020, California spent $3 billion on wildfire suppression, including $1.3 billion in supplemental emergency funds, during a fiscal cycle when the COVID-19 pandemic diminished spending on mitigation programs.[36]

Federal funding for hazard mitigation is generally available after disasters, and state hazard mitigation funding is not adequate or stable. Beginning in 2011, most of the state's wildfire mitigation funding came from a flat $153 per parcel State Responsibility Area Fire Prevention Fee (SRAFPF) on homes in high and very high-risk areas. However, the state rescinded this fee in 2017. Beginning in 2017, the Greenhouse Gas Reduction Fund (GGRF), funded through the state's cap-and-trade auction, has provided most of the state's wildfire mitigation funds.[37]

In April 2021, Governor Newsom and the Legislature agreed to a $536 million down payment on wildfire suppression and mitigation measures.[38] A full $350 million of this deal would go towards suppression and fuels management efforts, and only $25 million will go towards hardening older homes that were built before the stricter WUI building code was introduced in 2008.[39] This funding represents the largest yet state investment in wildfire prevention and mitigation, but it is only a fraction of the investment needed to get California's wildfire risks under control. Recent research on the cost of reducing California's wildfire risk makes a conservative estimate that the cost of reducing California's wildfire risk would cost $3 billion per year for 10 years—or $30 billion over 10 years, although it could cost even more. This investment would include $1 billion to harden 100,000 homes per year; $500 million to create community fuel breaks in 10 percent of at-risk communities per year; $1 billion to for prescribed burns and fuels management on 1 million acres per year; and $500 million per year to coordinate the implementation of these wildfire risk management actions.[40]

Pre-disaster planning: Prior to 2000, most disaster planning occurred following a catastrophic event, with a focus on emergency response operations and facilitation of relief funding. The Federal Disaster Mitigation Act (2000), however, spurred pre-disaster mitigation planning by making Federal Emergency Management Agency (FEMA) funding contingent on communities having a LHMP in place.[41] By both requiring local mitigation planning and also providing mitigation grants, the federal government facilitates local actions that can reduce the consequences of future disasters. Communities must revise and renew their LHMPs at least every five years to remain eligible.

Planning for recovery after a disaster poses many challenges. In the wake of trauma, community residents have a strong desire to rebuild as they were before, but this limits opportunities for reducing future risk.[42] Time compression compounds the difficulties of planning for long-term recovery in the wake of a disaster, as local governments must move quickly and concurrently through processes that would usually take years.[43] Therefore, pre-disaster recovery planning not only improves the speed and quality of decision making following a disaster, leading to a faster recovery—it also better positions communities to receive federal and state funding as it becomes available.[44]

Although these regulations have prompted more local governments to do pre-disaster mitigation planning, paradoxically, most project funding, including FEMA Hazard Mitigation Grants, flows after a disaster due to increased attention to the issue. Despite the increase in hazard mitigation planning, LHMPs remain largely procedure-oriented, with a focus on emergency operations and less emphasis on land use controls.[45] Similarly, CWPPs tend to focus on fuel management in surrounding forest lands, rather than on land use controls. Academic research and federal and state officials generally advocate that localities incorporate hazard and disaster planning throughout each element of the general plan—beyond simply the Safety Element—to foster community resilience, which can reduce the damages and associated costs following a disaster.[46]

Role of Land Use Planning

Despite the known risk to properties located within the WUI, local governments continue to underutilize land use planning to reduce development in fire-prone areas. Following a fire, many municipalities opt to "adapt in place" instead of attempting to move people out of high fire risk areas, pointing to the statewide housing shortage and lack of public support for any sort of climate migration strategy.[47] Recent research noted negative public sentiment towards regulation and land use planning in general as a major impediment to the use of land controls in wildfire mitigation.[48]

City staff in communities affected by wildfire often disagree about the efficacy of land use planning for wildfire mitigation. Some communities with dispersed development and large, single family lots believe that individual fuel management is sufficient. Planning for wildfire mitigation also presents a challenge of scale, as planning across jurisdictional boundaries requires coordination between regional and state governance bodies. Some jurisdictions are concerned that land use restrictions will impede real estate development and place their fiscal security at risk.[49]

However, local governments systematically underestimate their fiscal exposure to growing wildfire risks. After disasters, municipal finances may be bolstered by insurance payouts; federal and state recovery funding; increased property assessments and tax revenues made possible by increased assessments that were kept artificially low by Proposition 13; and by increased sales tax revenue spending associated with rebuilding. Despite this, the overall local fiscal impact of wildfires is decidedly and meaningfully negative. Wildfire disasters often result in municipal bond rating downgrades that make local borrowing more expensive.[50] Growing wildfire risks not only make municipal budgets more vulnerable—they also make insurance more expensive, often prohibitively so. Local governments need to consider both costs when making land use decisions in high wildfire risk areas.

The state's housing shortage places significant development pressure on both prime agricultural land and high wildfire risk areas. At the current rate of growth and under current growth patterns, an additional 645,000 housing units will be developed in VHFHSZs by 2050.[51] For communities that insist on continued development in the WUI, community- or neighborhood-scale mitigation tactics may increase the safety of these homes and people. The latest community-scale risk reduction measures for new development comprise four design categories: landscape setting, separation from wildfire source, density management, and infrastructure.[52] These considerations may require significant capital investment and inter-governmental cooperation and governance. For example, at the county level, Local Agency Formation Commissions could work more closely with fire specialists to prevent sprawl in high-risk areas.[53] Such recommendations underscore the growing need for science-informed land use planning and urban design.

There is also evidence that multi-scale community partnerships can effectively reduce wildfire risk. For example, the Montecito Fire Protection District has established lines of defense between Montecito residents and the Los Padres National Forest through fuel thinning, code enforcement, defensible space surveys, and community outreach.[54] The effectiveness of this strategy was proven in the Thomas Fire of 2017, during which minimal damage was sustained. Yet without external assistance, many communities would struggle to replicate Montecito's model, as they lack the resources to hire their own 'wildland fire specialists.'[55]

The premise of establishing greenbelts as wildfire buffers has received greater consideration in recent years as a means of reducing risk to homes in the WUI or a VHFHSZ. Greenbelts are a nature-based solution that may take the form of managed natural space or highly-manicured and irrigated parks, agricultural land, or sports fields and golf courses. This strategy rests on the assumption that the higher water content and reduced fuel loads of these buffers would impede flame fronts and ember ignition.[56,57] In addition to potentially preventing structural ignition, greenbelts offer a number of co-benefits, such as recreational greenspace, emergency gathering points, staging areas for firefighters, and—depending on the type of greenbelt—ecosystem restoration.[58]

Overcoming tensions between affordability and risk in the insurance market

Government actors aren't alone in attempting to reduce risk and vulnerability in the WUI. Facing increasing losses and stringent state regulation of rates, insurance companies are dropping the highest-risk policyholders from the more affordable 'admitted market.' Existing

state policies complicate these business decisions for the industry. Proposition 103, which California voters approved in 1988 to protect consumers from price shocks in insurance markets, requires insurers to charge rates pre-approved by the Department of Insurance for most policies on the admitted market.[59] Regulations also limit insurers to using historical damage data to determine risk estimates even though updated catastrophe models can provide more realistic risk determinations that reflect climate change's impacts on the frequency and intensity of wildfires.

Insurers paid out approximately $26 billion to homeowners in California following the 2017 and 2018 fire seasons alone. Escalating losses, coupled with regulatory price controls, create a fiscally unsustainable business environment for insurers and drive many to terminate policies on the admitted market.[60] This results in increased enrollment in the Fair Access to Insurance Requirements (FAIR) Plan, the 'insurer of last resort,' which provides barebones coverage at rates that can be several times higher than the admitted market.[61] In response, the Department of Insurance enacted and extended a moratorium on policy termination by insurance companies, preventing policyholders in or near areas that experienced a wildfire in the past year from losing coverage. This short-term fix has stemmed policyholder movement into the FAIR Plan and allowed policymakers more time to develop solutions that can address interrelated hazard mitigation, land use, and insurance market challenges.[62] An unsuccessful bill AB 2167 (2020) would have allowed insurers to use catastrophe modeling to inform insurance risk and rates, essentially allowing them to request greater rate increases in some of the highest risk counties than are currently allowed on the admitted market.[63]

In recent years, some insurance companies have introduced limited innovations in the insurance model in an attempt to continue providing coverage to homeowners in high fire risk areas. Some insurers make coverage conditional on homeowners in fire-prone areas implementing mitigation tactics.[64] In Boulder, Colorado for example, homeowners can work with Wildfire Partners, a county-operated organization, to create defensible space around their homes to meet insurance requirements.[65] Other communities participate in the Firewise Communities certification program, a designation overseen by the National Fire Protection Association that affirms that residents have reduced their risk. Insurance companies often advise these organizations and accept their certifications in exchange for coverage.

In 2020, a new law and voter proposition created two new incentives that can support post-disaster relocation. AB 3012 (2020) allows policyholders to use their insurance payout to buy a different home of equal or lesser value, without deducting the value of land at the new location.[66] Proposition 19 (2020) allows homeowners, including wildfire victims, who relocate to transfer their prior property tax base, so long as their new home is of equal or lesser value.[67] These together create new pathways for disaster survivors to move out of high-risk areas, though they do not disincentivize rebuilding in high-risk areas.

GOAL 2:

Incentivize Infill Housing Supply and at All Income Levels

A single wildfire can abruptly erase years of housing supply.[68] Lost housing supply can cause housing market shocks, increasing home values and rents for households struggling to recover from disaster. Without adequate oversight, some landlords and contractors can engage in price gouging, disproportionately harming low-income and vulnerable households.[69]

Even in the absence of wildfires, California struggles to build housing quickly enough to shelter its growing population. As of 2019, 97 percent of California cities did not issue enough permits to meet their residential construction targets.[70,71] Construction costs per square foot—already high in California—increased by 25 percent over the last decade.[72] New housing developments can take years to break ground because of environmental review, state permitting requirements, local requirements like design review, and resistance from neighbors.[73] While development stagnates, housing prices skyrocket and low-income people pay the price. As of 2019, 51 percent of renters in California paid more than 30 percent of their income in rent, and 26 percent of renters paid more than 50 percent of their income in rent.[74]

Subsidized WUI housing units in California are disproportionately rural. Socio-economic factors like income, education, and immigration status, and housing factors like tenure and quality make the residents of the 140,000 subsidized units in the WUI particularly vulnerable. Residents of manufactured housing communities (MHCs) on aggregate have incomes 50 percent lower than single family homeowners.[75]

Wildfires and displacement: When homes burn, people are displaced. In the latter months of 2018, an estimated 350,000 California residents were forced to flee, overwhelming shelters across the state.[76] In addition to the initial displacement during the "sheltering" period immediately after a disaster, long-term displacement can occur when survivors move away rather than rebuild. Though displacement impacts vary by individual experience, relocation due to a disaster is on average associated with more psychological distress than returning.[77] Post-disaster displacement separates victims from core social networks that are critical for recovery.[78]

Disparate impacts of disasters: Although wildfires can be traumatic for everyone affected, renters and low-income households face increased challenges in accessing permanent housing afterward. A recent report on the impacts of climate change on displacement identifies "stark inequities in the post-fire recovery process, with renters and low-income individuals facing the biggest barriers for rebuilding and returning home."[79] Many renters do not have renters insurance and those who do are frequently ineligible for the natural disaster relocation assistance provided to insured homeowners.[80] Insufficient recovery assistance, coupled with a severe affordable housing shortage, results in increased rates of homelessness in disaster-affected regions.[81,82]

Communities of color, immigrants, and non-English speakers especially face challenges in recovering from wildfires. Though affluent, white people are the population most likely to live in fire-prone areas in the United States, people of color are far more likely to lack the resources necessary to recover from a fire.[83] Linguistic isolation compounds vulnerability for immigrant and undocumented populations. The challenges these groups encounter include—but are not limited to—working outdoors in hazardous conditions without masks, a lack of multilingual emergency response information, and, for undocumented people, exclusion from FEMA aid. In the absence of governmental support, non-governmental organizations have at times been the primary safety net for these individuals. Some advocate for more inclusive, culturally appropriate community engagement but also note that inadequate healthcare, wages, working conditions, housing, and transportation all increase the wildfire vulnerability of disadvantaged populations.[84]

Wildfire recovery and infill housing: One commonly proposed solution to add housing and reduce long-term wildfire risk is to increase density and cluster development. Although structure-to-structure ignition in clustered neighborhoods is possible, compact development facilitates shared defensive space and requires fewer firefighting teams during emergencies.[85] Because of this, studies show that structures are more likely to burn in low-density areas and within the WUI.[86,87,88] Structural fire-hardening is especially important in dense communities at risk of wildfire or post-seismic conflagration to reduce home-to-home spread.[89] One way to add more housing without significantly changing the urban form of a neighborhood completely is to build "missing middle" housing, or multi-unit buildings like duplexes and four-plexes that are not significantly larger than a single, large house. Manufactured housing communities (MHCs) may also offer opportunities for denser housing typologies that are affordable to lower-income households, but MHCs face political, regulatory, and funding barriers to rebuilding post-disaster. Increasing density in existing suburban areas and repurposing underutilized retail space can potentially alleviate California's housing shortage and direct development to lower-risk areas,[90] all while fostering economic growth.

GOAL 3:

Reduce Greenhouse Gas Emissions & Preserve Open Space

California has led the nation in reducing GHG emissions thanks to legislation passed in the early 2000s. AB 32 (2006)[91] mandated that California's GHG emissions return to 1990 levels by 2020, which was achieved four years ahead of schedule in 2016. It also empowered the California Air Resources Board (CARB) to lead state agencies in cutting emissions across all sectors of the economy and laid the groundwork for subsequent climate action. Despite instituting a cap-and-trade program and a range of energy efficiency regulations, the state's population and economy has grown steadily. In 2018, California's per capita tons of CO_2-equivalent was 10.7, far below the national average of 19.9.[92] While the state has seen tremendous success in decarbonizing its energy sector, reducing emissions from other sectors of the economy—especially buildings and transportation—may prove a more difficult feat. In order to continue meeting its climate targets, and thereby curbing wildfire frequency and severity, California will need to aggressively curtail sprawling suburban development and preserve natural and working lands (NWL).

Infill development and reduced GHGs: Low-density suburbs have considerably higher household carbon footprints than dense urban cores, largely due to more vehicle miles traveled (VMT) and higher home energy use.[93] Infill development can significantly reduce these emissions per capita. Given that nearly 40 percent of California's emissions result from transportation, creating compact communities that are more walkable, bikeable, and connected to public transit could have dramatic impacts.[94] One predictive analysis suggests that constructing nearly two million infill dwelling units (DU) in California by 2030, as opposed to single-family sprawl, could reduce annual GHG emissions by at least 1.79 million metric tons.[95] Nevertheless, simply densifying urban cores may not adequately reduce overall emissions, because neighboring suburbs with high household carbon footprints may negate these benefits.[96]

Preserved lands and carbon sequestration: Preserving California's carbon sinks is another crucial climate mitigation measure. In 2014, CARB estimated that NWL stored 5.5 billion metric tons of carbon within their biomass and soils.[97] Maintaining, if not expanding, their storage capacity would be highly consequential. Marvin et al. (2018) developed predictive scenarios to compare potential land management interventions in California and found that conserving these lands would provide the greatest GHG reductions by 2100.[98] Unfortunately, current trends point in the opposite direction; as low-density sprawl continues to spread throughout California, roughly 50,000 acres of farms and rangelands are lost annually.[99] CARB data suggests that existing NWL may now emit more carbon than they sequester due to California's catastrophic wildfires, which released GHG emissions equivalent to 68 million metric tons of carbon dioxide-equivalent gases ($MMTCO_2e$)in 2018 alone.[100,101] To put this in context, in 2016 California's electricity generation emitted 76 $MMTCO_2e$.

Consequently, preserving NWL is an increasingly significant component of California's climate strategy. For instance, SB 1386 (2016) instructs state agencies to consider the carbon sequestration implications of decisions affecting NWL, so as not to undermine the State's GHG reduction goals.[102] In addition, *California's 2017 Climate Change Scoping Plan* proposed a target of both sequestering and averting a minimum of 15 MMTCO2e by 2030 through conserving and restoring NWL.[103] This prompted several state agencies to co-develop the *California 2030 Natural and Working Lands Climate Change Implementation Plan (January 2019 Draft),* which calls for a 50-75 percent reduction in the annual rate of land conversion by 2030.[104] State funding significantly backs up these burgeoning NWL efforts; as of 2019, $800 million of California Climate Investment funds were directed towards climate mitigation strategies in NWL.[105] Using these resources, the *Implementation Plan* compels state agencies to improve conservation incentives and assist regional and local actors in their infill initiatives.[106] Establishing greenbelts is a promising resilience strategy at the local level. While the most direct impact of these buffers would be wildfire protection, they could also increase carbon sequestration.

Understanding Fire Impacts Across California's Diverse Landscape:

The Cases of Santa Rosa, Paradise, and Ventura

California's WUI encompasses a diversity of communities, from urban to suburban to rural, and housing types, from working-class subdivisions to luxury vacation homes. Wildfires have not just impacted communities in the very high fire hazard severity zones, but also reached into the middle of urban neighborhoods. They burn both remote affordable hamlets in the forest, and exclusive new suburban communities housing mega-commuters. In this section, scenario analysis is used to explore the climate, housing, and economic impacts of rebuilding after fire in three different types of communities. The case studies featured—the Tubbs Fire in Santa Rosa, the Camp Fire in Paradise, and the Thomas Fire in Ventura—explore alternative land use patterns that would achieve the three stated goals—reduce risk in the WUI, increase housing supply and resilience, and mitigate climate change. The findings are summarized in the following chapter, while Part II: Full Case Studies presents the case studies in greater detail.

Table 1 Characteristics of Case Study Communities

	Population	% Non-White Population *(2018 ACS 5 yr)*	Median Home Value	% Homeowners *(2018 ACS 5 yr)*	Density	% WUI *(mod., high, and very high)*	Fire History	Fire Damage	% Remaining in County by 2019	Pace of Recovery
Santa Rosa	181,038	45%	$490,000	54%	Suburban	44%	Extensive	6,692 homes	96%	Rapid
Paradise	26,543	14%	$218,400	70%	Rural	71%	Extensive	14,000 homes	73%	Slow
Ventura	110,234	45%	$661,000	54%	Suburban	36%	Mostly Recent	530 homes	99%	Medium

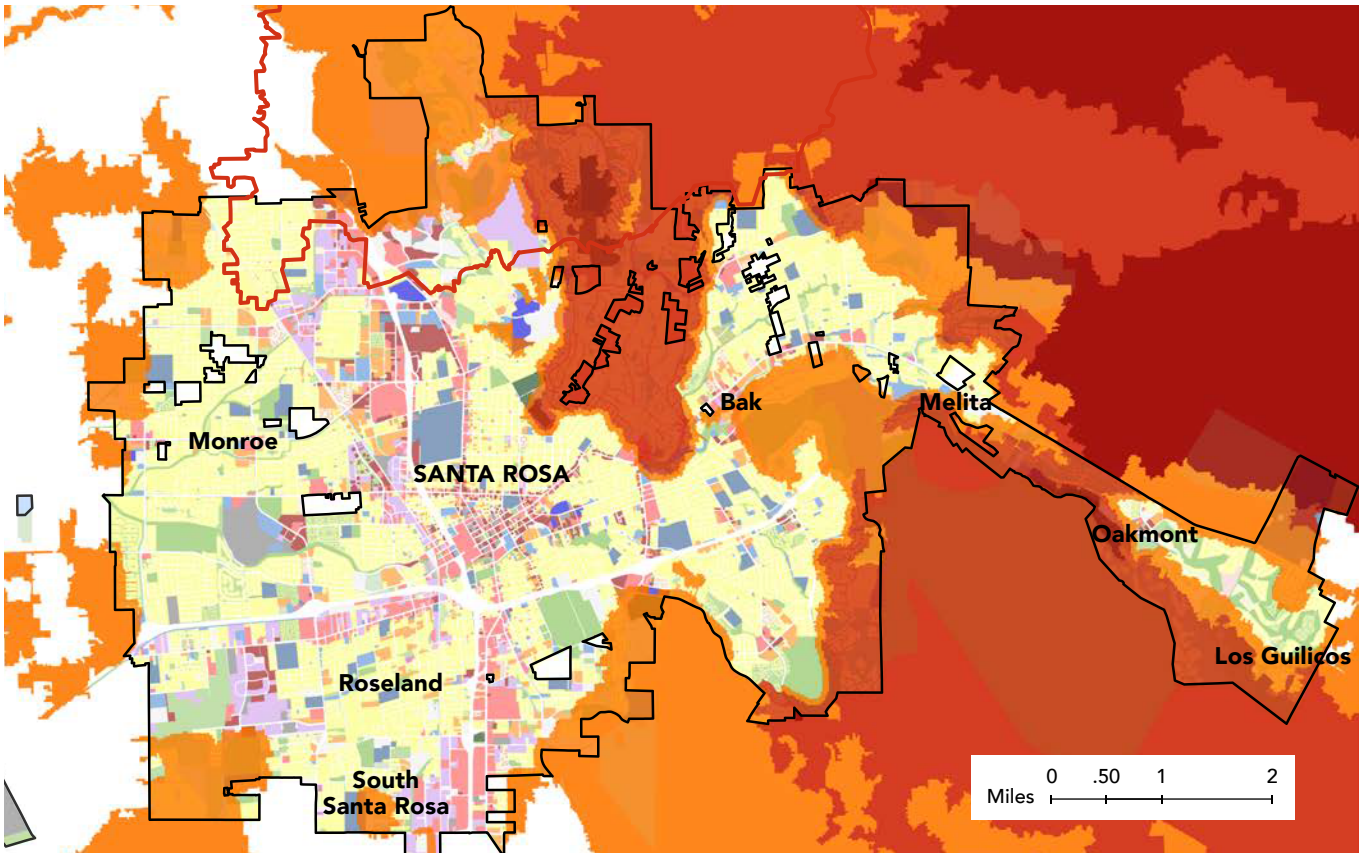
Stakeholder interviews informed the scenario development process (for more on methodology, see Appendix A). The research team interviewed more than 65 diverse stakeholders, including community stakeholders, local and regional government officials, state government officials, and experts in fire science, hazard mitigation, disaster recovery, insurance, fire response, and community resilience.

To describe community demographics and explore household mobility post-fire, this report draws from the American Community Survey (2014-2018 Five-Year Estimates) and Data Axle, a consumer research firm that combines real estate records, tax assessments, voter registration, utilities, bills, and other sources to create geospatial panel datasets. The scenario analysis used UrbanFootprint, a scenario planning and analysis software, and IMPLAN, an economic impact modelling software. Part II provides the full case study methods and findings.

Context

Although recent wildfires have devastated each of the three case study communities, they differ in geographic and socio-economic context, as well as pace of recovery (Table 1). Located mostly in the WUI, Paradise, the least affluent and most rural of the three, has struggled to rebuild, despite significant state and federal recovery funding. In contrast, in the affluent suburban coastal community of Ventura, which has just over one-third of its land in the WUI, the majority of homeowners have chosen not to rebuild. Santa Rosa, a slightly higher density, middle-class suburban community almost half in the WUI, is rebuilding rapidly in place with significant government assistance. The following describes the fire disaster and recovery process for each community in more details.

Figure 1 Land Use, Cal Fire's Fire Hazard Severity Zones and Tubbs and Nuns Fire Boundaries in Santa Rosa



LAND USE

- Mixed Use
- Single Family
- Multifamily
- Retail / Commercial
- Office
- Civic / Education
- Transportation / Utilities
- Parks / Recreation
- Open Space
- Agriculture
- Natural

CALFIRE FHSZ

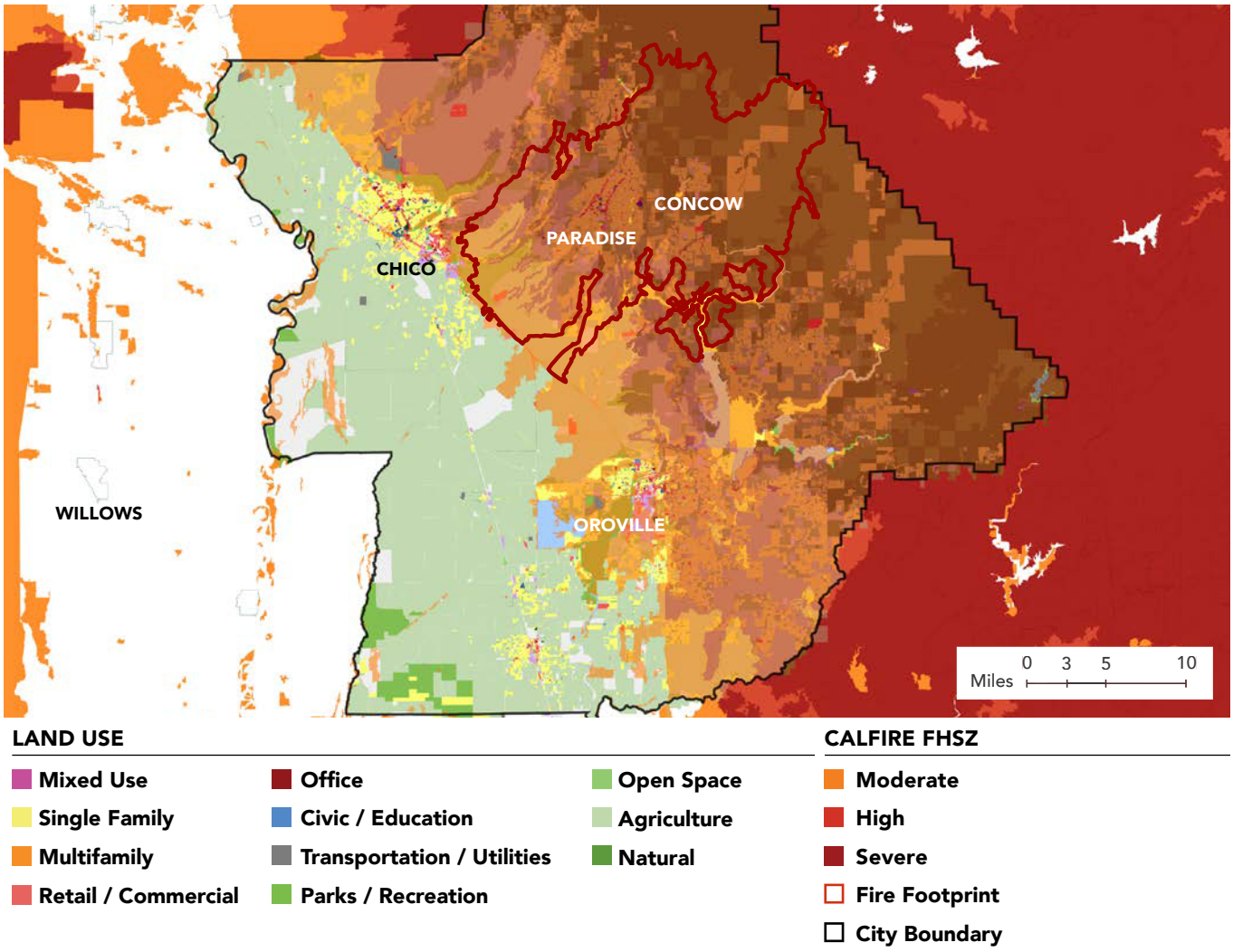
- Moderate
- High
- Severe
- Fire Footprint
- City Boundary

Santa Rosa

The largest city in California's wine country, Santa Rosa has experienced destructive wildfires for hundreds of years due in part to the hot, dry Diablo winds in spring and fall. Cal Fire's Fire Hazard Severity Zones (FHSZs) cross into the City of Santa Rosa from the west, north and east (Figure 1). The 2017 Tubbs fire killed 22 people and destroyed 2,834 homes across not just the eastern neighborhoods with very high fire hazard, but also low-risk central areas. The fire displaced both homeowners and renters, and movers were particularly likely to have children or be short-term renters. Yet, most of the displaced residents (96%) remained in Sonoma or adjacent Napa County one year later, indicating an inclination to stay nearby.

The City of Santa Rosa worked hard to rebuild, adopting an urgency ordinance to expedite the process and waive regulations for those trying to rebuild. Officials quickly launched a permit center exclusively for fire survivors' rebuilding efforts in and amended its Downtown Station Area Specific Plan in an attempt to draw development into downtown Santa Rosa. Despite the city's efforts, rebuilding activity has concentrated in the WUI, rather than in infill locations.

Figure 2 Land Use, Camp Fire Footprint, and Cal Fire's Fire Hazard Severity Zones in Butte County and Paradise

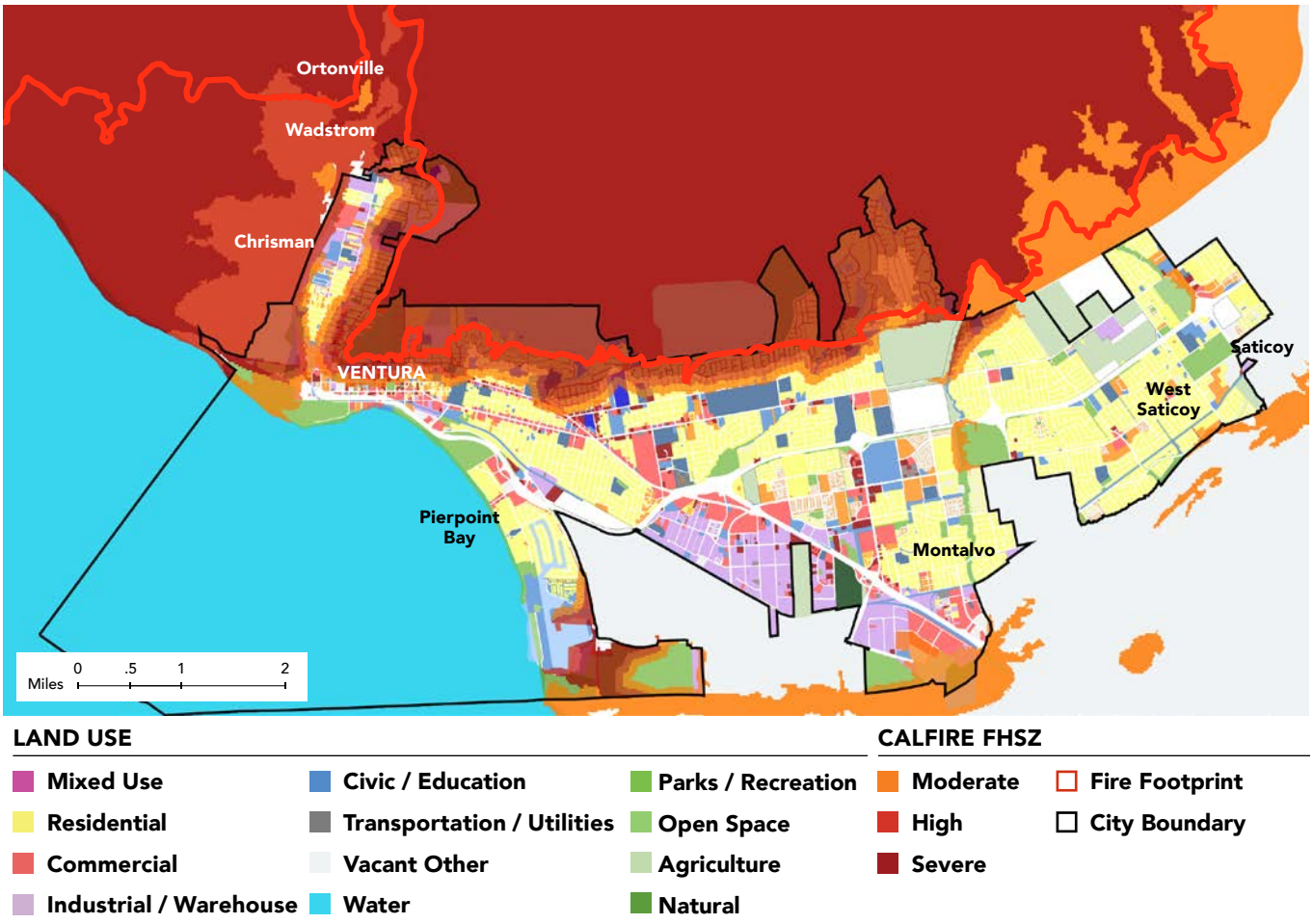


Paradise

Located in Butte County, approximately 15 miles east of Chico, Paradise is a small, rural town with a large population of retirees and commuters attracted by its affordable housing stock, despite its repeated wildfires in recent decades (Figure 2). The 2018 Camp Fire burned more than 150,000 acres over the course of two weeks, destroying nearly 19,000 structures and killing 85 people.[107,108] Nearly 85 percent of those who perished were over the age of 60,[109] and the huge amounts of debris, tree damage, and water infrastructure damage left the town with up to $18 billion in damages.[110,111] Investigators later determined that outdated electrical transmissions lines owned and operated by Pacific Gas and Electricity (PG&E) sparked the fire. One year after the Camp Fire, only about 73 percent of wildfire-affected households were still living in Butte County.

To guide their rebuilding and recovery efforts, the Town of Paradise adopted the Long-Term Recovery Plan in June 2019.[112] However, very little rebuilding has yet occurred, due to the lack of sufficient wildfire insurance and delays in receiving FEMA, HUD, and PG&E funding. With major infrastructure repairs needed, as well as thousands of hazardous trees at risk of falling, Paradise still faces daunting obstacles to recovery.

Figure 3 Land Use, Thomas Fire Footprint, and Cal Fire's Fire Hazard Severity Zones in the City of Ventura



Ventura

The second largest city in Ventura County, Ventura (officially San Buenaventura), is a coastal incorporated city with a vibrant tourism industry (Figure 3). The surrounding mountains have a long history of wildfires but are largely undeveloped because of decades-long agricultural land and open space preservation policies (the Save Open Spaces and Agricultural Resources ordinance, or SOAR). The 2017 Thomas Fire, which ignited due to problems with Southern California Edison's electrical equipment, thus taking only two lives and burning only 1,603 structures despite being the largest fire in California history to that point (282,000 acres).[113] Efforts to combat the Thomas Fire brought together 8,500 firefighters, the single largest wildfire fighting force in California history, and demanded a record $230 million in suppression costs.[114,115] Almost 60 percent of homeowners chose not to rebuild after the fire, and those who moved away were disproportionately seniors and higher-income households. Missing from some of the data, however, are the undocumented farmworker residents, who lived in the unincorporated WUI areas; those who lost their homes there were not eligible for federal assistance from FEMA and HUD.

Ventura is steadily rebuilding homes to more stringent code standards, with over 400 units rebuilt or in the pipeline.[116] At the same time, the City is producing unprecedented numbers of multifamily infill units, largely because of market demand coupled with SOAR and higher Regional Housing Needs Assessment (RHNA) allocations. Thus, Ventura serves as a statewide model for limiting development in the WUI while facilitating more infill development.

Table 2 Summary of Scenarios

	Santa Rosa (Tubbs Fire)	Paradise (Camp Fire)	Ventura (Thomas Fire)
(Re)Building as Usual	Follows Santa Rosa's expected trajectory, with modest densification in city core	Assumes 25-50% of pre-fire population in Paradise, due to the scale of the disaster Serves as middle ground between the other two scenarios, with clustered development and slightly more condensed town footprint	Serves as a status quo scenario and point of comparison for Scenarios 2 and 3 Assumes one-for-one replacement of residential units within the City of Ventura that were destroyed in the Thomas Fire
Managed Retreat & Urban Density	Moves most WUI residents on east side of city to the west side where wildfire risk is lower Modestly densifies the west side through single family housing and low-rise multifamily housing in infill areas	Assumes 25% of pre-fire population in Paradise Stresses relocation to locations outside of high fire risk areas and outside Paradise Reconfigures land use around significantly condensed town footprint surrounded by a green buffer	Moves residents out of Thomas Fire perimeter and high fire risk zone Residents are relocated throughout the city in ADUs and missing middle housing located in close proximity to transit
Resilience Nodes	Reconfigures land use to create dense, walkable "nodes" surrounded by green buffers Serves as compromise, allowing people to stay in WUI while increasing resilience	Assumes 50-75% of pre-fire population in Paradise Reconfigures land use around higher density residential "nodes" surrounded by green buffers Emphasizes affordable manufactured housing	Meets City and County RHNA targets by greatly increasing the density of residents around high quality transit nodes Does not remove existing residential units from high fire risk zones, but entails home hardening, defensible space, and wildfire buffers.

Scenario Analysis

In order to examine different pathways to a more resilient recovery, the research team developed scenarios working closely with both community and state stakeholders. The first is **(Re)Building as Usual,** which assumes recovery follows typical pre-disaster development patterns and provides a baseline for comparison. **Managed Retreat** relocates residents out of high fire risk areas and gently increases density in some residential areas, prioritizing reduced wildfire risk for existing residents. **Resilience Nodes** creates higher-density nodes to accommodate projected population growth, increasing protection against wildfire risk with denser built forms, in addition to supporting broader community resilience by significantly reconfiguring land uses in key sites. (See the Case Studies section for maps of all the scenarios.)

Table 2 describes how the scenarios play out in the specific communities under study. (Re)Building as Usual generally assumed that recent trends will continue. For Santa Rosa, that means reconstruction in the WUI, with modest densification downtown. Given the scale of its disaster, Paradise's status quo means that up to half of the population returns, residing in a condensed town footprint. Ventura rebuilds in place.

Managed Retreat generally means the relocation of the majority of WUI residents to safer areas. In Santa Rosa, residents move to the western side of the city into

Table 3 Summary of Impacts by Scenario

	SANTA ROSA			PARADISE (BUTTE COUNTY)			VENTURA		
Scenario	(Re) Building-as-usual	Managed Retreat	Resilience Nodes	(Re) Building-as-usual	Managed Retreat	Resilience Nodes	(Re) Building-as-usual	Managed Retreat	Resilience Nodes
Housing Impacts									
Population	179,200	167,600	173,300	236,800	236,800	237,600	108,400	97,500	122,400
% change		-6.5%	-3.3%		0.0%	0.3%		-10.1%	12.9%
Dwelling Units (DUs)	70,900	76,100	76,100	103,900	104,800	104,700	42,900	43,000	52,300
% MF	18%	34%	41%	19%	20%	18%	16%	23%	32%
% change		7.3%	7.3%		0.9%	0.8%		0.2%	21.9%
DUs in Fire Hazard Zone	12,300	5,700	20,600	13,200	11,900	12,100	9,800	4,700	11,700
% change		-53.7%	67.5%		-9.8%	-8.3%		-52.0%	19.4%
Household Costs	$17,800	$11,300	$14,300	$26,900	$25,300	$23,800	$15,500	$13,000	$13,600
% change		-36.5%	-19.7%		-5.9%	-11.5%		-16.1%	-12.3%
Environmental Impacts									
GHG Emissions (metric tons/year)	1,142,800	929,500	967,800	2,320,000	2,180,000	2,320,000	730,400	641,600	772,700
% change		-18.7%	-15.3%		-6.0%	0.0%		-12.2%	5.8%
GHG Emissions (metric tons per DU)	10.9	9.4	9.7	22.3	20.8	22.2	10.9	9.4	9.7
% change		-13.5%	-11.0%		-6.8%	-0.7%		-13.5%	-11.0%
VMT (DU/year)	23,000	14,200	18,400	33,200	31,200	33,300	11,500	9,500	10,100
% change		-38.3%	-20.0%		-6.0%	0.3%		-17.4%	-12.2%
Change in Carbon Stock (metric tons/year)	-2,300	22,900	81,800	-95,400	-68,900	-79,700	0	-300	-230
Economic Impacts									
One-time construction jobs	24,500	66,700	95,900	44,600	51,000	57,300	2,100	17,200	36,600
One-time economic output	$1.82 billion	$4.98 billion	$7.22 billion	$6.61 billion	$7.58 billion	$8.39 billion	$0.32 billion	$2.72 billion	$5.03 billion

WUI Development	Statewide
Dwelling Units in High and Very High Fire Risk Areas	1,456,300
Minimum Residential Structure Replacement Cost in High and Very High Fire Risk Areas	$610 billion
Capacity for Additional Units in High and Very High Fire Risk Areas	523,000
Annual Revenue from 0.25% Levy on Existing DUs in High and Very High Fire Risk Areas	$1.81 billion

a mix of attached single-family townhomes and 'missing middle,' multifamily units. Paradise residents mostly relocate to other urban areas in Butte County, with just 25 percent of the pre-fire population returning to live in the town center in a mix of housing units surrounded by a buffer of recreational and working lands. In Ventura, most residents relocate from the high-risk WUI to housing distributed throughout the city in the form of ADUs and missing middle housing close to transit.

Resilience Nodes attempt to find a safe way for residents to live in the WUI, by concentrating them in dense, walkable nodes alongside protective green buffers, thereby reducing risk from future fires. Additionally, the layout of these nodes may further maximize defensible space by mandating setbacks from the edge of slopes and concentrating homes along roadways. In Santa Rosa, the WUI thus not only retains its existing residents but gains significant new population, in order to create the

dense new nodes. The Paradise scenario allows up to 75 percent of residents to return to live in moderately higher-density residential nodes of affordable manufactured homes surrounded by green buffers that could slow the advance of a fire and create defensible space around homes and businesses. Ventura experiences significant new growth in high-density nodes near transit, with modest densification in surrounding neighborhoods and continued inhabitation of homes in the high-risk WUI.

Depending on the type of community, the three approaches create quite different impacts on housing, environment, economy, and equity (Table 3). In general, communities see maximum benefits for housing and environment from managed retreat, but stronger economic and equity impacts from resilience nodes. For rural areas like Paradise, managed retreat provides relatively more economic benefits (although nodes are still best), but the environmental benefits are less pronounced. Thus, communities face challenging trade-offs in deciding which path to follow. If the State of California wishes to address its dual climate and housing crises, it will need to develop the right set of carrots and sticks to persuade jurisdictions not to simply pursue the greatest economic return. The following sections explore the impacts of each scenario on fire risk, housing, climate, the economy, and social equity.

Fire Risk

Not surprisingly, the Managed Retreat approach removes homes from the fire hazard severity zone across all types of communities. This approach works best to prevent fire risk in urban or suburban communities where it is possible to build elsewhere; in rural communities that lie mostly within the WUI, it is not possible to remove a significant number of homes from fire risk areas. Resilience Nodes have the potential to mitigate fire risk over the long term as they add density and thus defensible space, but in the short term, much housing will remain at risk in the WUI.

Housing

Both the Managed Retreat and Resilience Nodes approaches facilitate adding infill housing supply, and there is significant capacity in single-family urban and suburban communities to add ADUs and missing middle housing. The case of Ventura shows that by densifying around transit, housing supply can increase by over 20 percent. For affordability reasons, rural jurisdictions may best rely on manufactured homes; however, these pose issues for fire safety. Both approaches offer potential for households to reduce energy and water costs, with the most significant savings under the Managed Retreat approach and the least change overall in rural communities.

Climate

Changing the approach to rebuilding after fire will have significant impacts on greenhouse gas emissions, particularly via Managed Retreat, but also through Resilience Nodes. Under Managed Retreat, overall decreases in greenhouse gas emissions range from 6 percent in a rural community like Paradise, to almost 19 percent in Santa Rosa, even as it adds over 5,000 new dwelling units. This is in part because of the energy savings from replacing inefficient single-family homes with townhomes and multifamily units. Climate benefits from Resilience Nodes are lower, but still result in an 11 percent decrease for emissions per dwelling unit. VMT also decline significantly in both Managed Retreat and Resilience Nodes scenarios, although Managed Retreat performs better due to the ability to use transit and active transportation (walk/bike) modes. VMT reductions are minimal in rural communities because of continued auto dependence, particularly for work commutes. The potential of these scenarios to sequester more carbon by reverting formerly developed areas to natural and working lands varies across context; in Santa Rosa, the Resilience Nodes scenario in particular yields higher sequestration, while in Paradise and Ventura, the scenarios all reduce sequestration.

Economy

Economic impacts come primarily from new construction jobs and output. The Resilience Nodes approach provides the most economic benefit by far, primarily because of the additional housing development it would facilitate. The coastal suburban areas also would experience more benefits than rural communities generally, because of the greater potential for infill development. All communities would also experience ongoing economic growth from the new households that move into infill developments.

Equity

Whatever approach to rebuilding jurisdictions choose to adopt, marginalized communities may struggle to benefit. Managed retreat poses the most risks, for several reasons. First, renters and undocumented immigrants currently lack protections and access to the resources that homeowners and documented residents are entitled to. Second, more affluent homeowners may choose to ignore buyout programs and simply purchase more fire insurance instead, while lower-income homeowners may have to participate. Third, relocating residents to new infill housing developments could increase housing costs, as the cost of new development is higher than pre-existing affordable housing. And fourth, as a new amenity, the new greenbelts and buffer areas could increase property values and price residents out of their communities. Resilience Nodes present similar challenges in terms of gentrification and displacement. Regardless of the rebuilding approach, the state and local governments will need to proactively address the needs of vulnerable residents. The report's policy recommendations offer some solutions for these issues.

Case Study Conclusions

Key takeaways from this case study scenario analysis are outlined below. This analysis shows that there are more resilient paths to recovery than rebuilding as usual.

Summary of Key Takeaways from Scenario Exercises

1. **Urban growth boundaries and conservation easements protect environmentally valuable natural and working lands while also reducing wildfire disaster costs;**
2. **Infill development has lower greenhouse gas emissions, relative to sprawl in the WUI.** In addition to higher emissions, WUI sprawl increases the risk of wildfires and undermines state land conservation and carbon sequestration goals;
3. **Post-disaster relocation within the region depends on the ability of the regional housing market to absorb disaster survivors.** If the disaster is too large for the housing market, people will be displaced to more distant locations; and
4. **Lack of integration between local and regional land use planning, housing policy, and fire prevention interventions undermines California's efforts to address the climate and housing crises.**

Communities selecting either Managed Retreat or Resilience Nodes will be able to reduce fire risk for their residents, while also meeting housing and climate goals. Managed Retreat provides the biggest impact in terms of safety and climate, but presents new potential displacement risks. Resilience Nodes offers the most potential for economic growth, with fewer equity impacts, but less of a guarantee in terms of future fire risk.

Changing course from rebuilding as usual will require jurisdictions to win the support of their residents. Ideally, communities would work together to co-create the scenarios that fit the local context best. But pursuing either Managed Retreat or Resilience Nodes would require significant changes in both incentive structures—which currently encourage homeowners to stay put in the WUI—and community sentiment—which overwhelmingly favors rebuilding in place.

This report's case studies and scenario analysis reveal that different rebuilding choices result in hard trade-offs in terms of climate, housing, economic, and equity impacts—as well as protection from future wildfires. The examples of Santa Rosa and Ventura in particular show that it is feasible to address the climate and housing crises while also mitigating fire risk, but with potential economic and equity costs. Rebuilding in rural areas like Paradise presents greater challenges in terms of ability to mitigate the climate crisis, as well as overall costs. These takeaways help provide a path forward for the State of California in terms of policy recommendations, as summarized in the Policy Recommendations chapter.

California's Fiscal Exposure to Wildfires

In addition to understanding potential housing and land use implications to different rebuilding scenarios, it is critical to understand the fiscal implications of rebuilding after wildfires in order to best determine a path forward for future development patterns. Wildfire costs borne by the state are rising as wildfires become more frequent and intense due to a warmer, drier climate and greater urban development in the WUI. These climate and land use factors increase wildfire hazard exposure and disaster risk. Between 1990 and 2010, half of all new housing development in California took place in the WUI, in part due to the state's municipal finance structures that limit property tax revenues and rely on fees generated from new development.[117] California now has over 4.5 million homes in the entire WUI, the large majority of which are single family units.[118]

Table 4 Emergency Fund Fire Suppression Expenditures, Selected Fiscal Years[125]

FY 10-11	FY 11-12	FY 12-13	FY 18-19	FY 19-20	FY 20-21
$90,100,000	$140,000,000	$310,000,000	$890,000,000	$691,000,000	$373,000,000

Wildfire risk in the WUI exacerbates the fiscal burdens that low density sprawl places on municipal and state governments because of higher infrastructure and service costs per unit.[119] Greater wildfire vulnerability and more frequent disasters pose direct and indirect costs for both the state and local governments. WUI development incurs higher direct costs for fire suppression, hazard mitigation, and emergency response. Other intermediate and long-term indirect costs include business interruption, lost ecosystem services, lower property values, and lost tax revenue.[120] In the long-term, wildfires also result in per capita tax revenue declines and increased likelihood of budget deficits.[121]

The state spends only a fraction on wildfire mitigation of what it does on wildfire suppression, even though each dollar invested in wildfire mitigation funding saves 2 to 4 dollars in avoided disaster costs (based on national estimates).[122,123] Table 4 lists state expenditures for Cal Fire's Emergency Fund, which essentially represents the state's fire suppression cost overruns for each fiscal year, showing significant increase in costs in recent years. The FY 2020-21 emergency fund figure fell, despite an active wildfire season, because the Legislature appropriated more for Cal Fire than before—$2.59 billion for fire protection, up from $2.16 billion in FY 2019-20.[124]

Added development in the WUI increases wildfire suppression costs, as fire departments need to protect more development. One report estimates that fire suppression costs in California increase by seven percent when the number of homes in a six-miles radius doubles. Adding new homes in a previously undeveloped area increases suppression costs the most, since highly developed areas already have more firefighting capacity.[126] Therefore, the per unit cost of wildfire suppression is highest for high-risk, low-density areas.[127] The state and federal governments pay most suppression costs. Although the state does not systematically track the costs of home hardening and defensible space or wildfire rebuilding and recovery costs, its spending on mitigation and recovery is trending upwards.[128,129]

While mitigation is more cost-effective than reactive rebuilding and disaster preparedness, limiting development in high-risk areas offers the greatest fiscal benefits. Urban infill outside of Fire Hazard Severity Zones avoids the growing hazard mitigation, emergency management, and disaster recovery costs incurred by WUI sprawl. While hardened homes with defensible space are safer than unmitigated development, choosing not to develop in risky places is even safer and less expensive for state and local governments. Policies that expand greenbelts and open spaces near existing WUI development while encouraging more infill development will offer the greatest fiscal benefits while promoting wildfire resilience alongside California's housing and climate goals.

Fiscal Impact Analysis of WUI Development

Currently, there is more than $830 billion in assessed property value in the WUI (including both land and improvement value, and conservatively defined here as the 1.4 million homes in only the high or very high-risk zones, rather than the 4.5 million in the entire WUI). Approximately 80 percent, or $668 billion, is on single-family parcels. The loss of these homes, in today's dollars, would decrease the state's annual property tax revenues by $8.3 billion and result in at least $610 billion in housing replacement costs (Table 5).[I] This demonstrates the large-scale vulnerability of WUI sprawl, particularly as this housing form is challenging and costly to protect against wildfire risk.

To understand the risk of continued sprawl in the WUI—as well as the potential economic impact of not building new homes—the analysis determined the number of underbuilt parcels, defined as those with an assessed improvement value less than the assessed land value. (Appendix B presents the full fiscal impact analysis.) If every vacant and underbuilt parcel zoned for residential were built out to an improvement-to-land ratio of one, the value of property in the WUI would increase by more than $128 billion. Using the average improvement value of

I Assumes all existing single family and multifamily units are replaced one-for-one, based on conservative construction cost estimates.

Table 5 Assessed Value of WUI Development & Fiscal Impacts

Current value of all land and buildings in the WUI, statewide	$830,927,200,000
Value of single family detached parcels in VHFHSZs	$668,090,620,000
Share of value of single family detached parcels	80%
Development capacity in the WUI (i.e., potential additional value of improvements if underbuilt residential and vacant parcels reach a 1-to-1 building to land ratio)	$128,495,000,000
Estimated additional DUs in the WUI at full capacity	522,950
Estimated potential property tax revenue loss from loss of all residential WUI properties	$8,309,270,000
Annual revenue from residential and vacant WUI parcels, assuming a 0.25% fee	$1,812,555,000
30-year net present value of revenue from 0.25% annual fee	$23,187,220,000

dwelling units, this increase could equal close to 523,000 additional units built in the WUI.

Understanding the current assessed value of properties in the WUI, it is possible to estimate the scale revenue opportunities should the state seek to implement a WUI levy. With a tax of 0.25 percent on the assessed value of existing development in high and very high fire hazard risk zones, the state could generate more than $1.8 billion per year to fund wildfire suppression, mitigation, and adaptation projects.

Policy Recommendations for a Resilient Wildland Urban Interface

This report adds to the growing body of evidence demonstrating how the risk of wildfire disasters is growing due to a drier and warmer climate and expansion of suburban and rural sprawl in the wildland urban interface (WUI). WUI sprawl is in turn a product of short-sighted land use and housing policies across the state that constrain multifamily infill development near jobs and amenities and push development pressure out to the urban periphery and rural areas in the WUI. WUI sprawl is vulnerable to wildfire disasters, but it also poses fiscal costs to budget-constrained local governments and increases carbon emissions through degraded natural lands and increased vehicular emissions—as well as associated emissions from wildfires. While bolder state leadership and increased funding is needed to reduce vulnerability for existing WUI residents, more governing mechanisms and financial incentives need to work together to restrict new development in high-risk places.

Table 6 Policy Recommendations for a Resilient Wildland Urban Interface

Policy Type	Policy Goal	Policy Recommendation	Level of Governance	Feasibility Considerations
Funding & financing	Reducing vulnerability	Authorize disaster resilience financing districts	Local and/or regional	Limited opposition to formation Flexibility to future debt-financed resilience investments
	Housing supply and resilience	Support post-disaster funding for multifamily and missing middle infill housing development.	State and/or local	Broadly popular, but new state appropriation needed
	Reducing vulnerability	Statewide property insurance surcharge for hazard mitigation and climate adaptation	State	Unpopular in metropolitan and lower-risk areas, but popular in rural areas Socializes wildfire risk across full population but offer large and stable revenue source
Protecting vulnerable populations	Housing supply and resilience	Promulgate post-disaster community preference policies for renters	Local	Build off of existing community preference policies for renters – but can be controversial
	Housing supply and resilience	Award pre and post-disaster planning grants for supporting resilience and recovery of manufactured housing communities (MHCs) in disaster-affected regions	State	MHCs are often stigmatized – but education and planning can be used to promote
Incentives & disincentives	Reducing vulnerability Housing supply and resilience	Promulgate risk ratings and insurance premiums that incentivize community-scale home hardening, defensible space, and wildfire buffers	State	Unpopular for homeowners who will pay more with insurance premiums that reflect real risk Requires more sophisticated wildfire catastrophe modelling and oversight of modelling methods
	Reducing vulnerability	Wildfire prevention and mitigation fees on property owners in high and very fire hazard risk zones – suggested 0.25 percent on property value.	State	Very unpopular in high risk areas, but is essential for sending a price signal and internalizing wildfire risk
	Reducing vulnerability	Offer tax incentives for households that relocate out of the WUI	State	Popular and can build off of existing Prop 19 and AB 3012
	Protecting natural and working lands Reducing vulnerability	Award grants and offer preferential state assistance to regions or localities for affordable housing or climate adaptation that adopt and enforce urban growth boundaries that protect natural and working lands.	State	Popular carrot approach to incentivizing UGBs Could be integrated into SCS funding process

Table 6 (continued) Policy Recommendations for a Resilient Wildland Urban Interface

Policy Type	Policy Goal	Policy Recommendation	Level of Governance	Feasibility Considerations
Institutional innovation and local/regional capacity building	Reducing vulnerability	Authorize MPO/COGs to raise revenue for disaster resilience and climate adaptation investments	State	Popular and could build off of success of the SF Bay Restoration Authority's Measure AA
	Reducing vulnerability Protecting natural and working lands	Integrate disaster resilience and hazard mitigation planning into existing regional planning processes, including Regional Housing Needs Assessments and Sustainable Communities Strategies in metropolitan regions.	Regional	Avoids creating a new resilience silo and cold help provide more clarity on what resilience planning expectations are
	Reducing vulnerability	Create regional adaptation authorities to authorize them to raise revenue and manage wildfire and climate resilience programs in rural counties	Regional	Untested and could face county resistance
	Reducing vulnerability Housing supply and resilience	Require all local governments to conduct pre-disaster recovery and resilience planning as a component of all existing General Plan elements and in alignment with Local Hazard Mitigation Plans.	Local	Feasible with state technical assistance and planning grants Pilot program might be warranted to determine best practices

Policies that help California's WUI communities adapt to growing wildfire risks should also seek to mitigate climate impacts and bolster the resilience of the state's housing supply at the same time as these issues have become deeply entwined over time. To meet its climate and housing goals without putting people and property in harm's way, California needs to align and promote policies that incentivize regional and local governments to direct new growth out of high-risk areas and promote density in existing urban centers. Major investments in new housing supply, structural hardening, land use reconfigurations, and green infrastructure are necessary. The state should identify and develop new resilience financing mechanisms at the state, regional, and/or local levels to fill the gaps left behind from federal hazard mitigation and disaster recovery programs.

While the policy recommendations that follow emphasize regional and community cooperation, they provide significant space for consumer choice and resident agency to make decisions about where to live, while protecting safety and taxpayer dollars. These recommendations are scalable, and depending on political and fiscal feasibility, their implications could range from incremental and achievable in the near future to politically contentious but potentially transformative. Policy recommendations are summarized in Table 6 and followed by a detailed discussion of considerations. (For more on the policy recommendations, see detailed matrix in Appendix C).

To effectively manage California's growing wildfire risk and disaster recovery costs, policymakers must identify new funding streams and financing mechanisms for adaptation and resilience in the WUI.

Federal hazard mitigation funds, while helpful, only scratch the surface of needed investment in structural hardening, vegetation management, and hazard mitigation planning. Meanwhile, insurance claims for wildfire losses are rising unsustainably, destabilizing property insurance markets in the state. California should take concurrent actions to invest in wildfire hazard mitigation, infill housing development, and land conservation.

New state-level funding sources should be used to complement and incentivize new regional and local-level funding for resilience adaptation. Demonstrated support for a multi-billion-dollar climate resilience bond already exists, and the current Legislature should act to leverage incoming funds from the American Rescue Act just signed into law by President Biden. Research on the economic impacts of the proposed resilience bond indicates that

it would create up to 119,000 new jobs and $15 billion in local economic activity throughout California.[130] Funding that provides statewide benefits and evenly spreads costs may prove more attainable than more targeted taxes and fees that also aim to disincentivize development in high-risk areas.

For regional resilience financing, the State can authorize regional planning agencies like Councils of Government to issue bonds for regional climate resilience and adaptation projects, subject to voter approval. Allowing existing regional agencies like Councils of Government and Metropolitan Planning Organizations to raise revenue and distribute funds for resilience projects would allow for both regional revenue- and risk-sharing and integration of resilience funding to be aligned with funding for regional transportation and land use planning through the Sustainable Communities Strategies. This approach to raising revenue may be more feasible in metropolitan regions that span multiple counties and have voter support, but regional disaster resilience districts may also prove valuable in rural regions where small counties and local government have limited resources to manage massive wildfire risk. Regional adaptation authorities in rural areas could raise revenue and fund projects alongside regional resilience planning across multiple counties with shared hazard risks, economies, and politics.

The state could also consider levying a statewide fee on homeowners insurance policies in fire hazard risk zones to fund hazard mitigation and climate adaptation investments. While this may be initially unpopular when targeted exclusively for wildfire mitigation, such an approach may garner more political support if designed to target the full range of hazard risks across the state, including for sea level rise, landslides, and earthquakes. Different regions in California experience different hazard risks, but all Californians are exposed to one or more hazards. Furthermore, renters and the uninsured are more vulnerable to disasters but have benefitted the least from California's real estate market and economic dynamism. The costs of disasters pose huge shared risks to all Californians, directly and indirectly, and some resilience and adaptation costs should be borne by all. In addition, the state could explore implementing a property tax levy on existing homes in high- and very-high fire risk areas. As this analysis shows, it has the potential to generate more than $1.8 billion per year.

State and local disaster housing policies must acknowledge that renters and low-income homeowners are more likely to experience displacement or become unhoused due to wildfire disasters and prioritize these residents in hazard mitigation and disaster recovery funding.

Due to the existing funding pathways, adaptation to the changing climate generally occurs through the disaster recovery process. However, disasters are likely to reinforce and exacerbate existing inequities in the absence of pre-disaster planning that envisions how a community or region can build back equitably. Disasters reduce the housing supply and cause involuntary displacement. Shortcomings in the federal disaster response and recovery system leave many renters, low-income homeowners, and other vulnerable populations behind. Widespread displacement and housing shortages undermine local and regional economies and reduce their tax contributions to the state. Without proactive anti-displacement, rental, and affordable homeownership recovery policies, wildfire disasters exacerbate disparities among different socioeconomic and racial groups, in addition to lost economic potential to society at large.

Through legislation, the state can require local governments to plan for recovery after disasters before they happen so that disaster-affected residents and agencies can build a stronger consensus on what a more resilient and equitable future looks like for them. This may look like and complement SB 379, which requires local governments to consider climate adaptation in their General Plans. Disaster resilience and recovery planning for WUI communities should specifically identify steps for reducing the vulnerability of manufactured housing communities (MHCs) to wildfires and strategies for prioritizing rebuilding of MHCs and multifamily housing during post-wildfire recovery. Given the precedent of similar planning requirements for climate adaptation and environmental justice along with set-aside requirements for disadvantaged communities through California Climate Investments, formalized requirements to prioritize vulnerable and disadvantaged communities in disaster resilience and recovery planning and programs seems both achievable and necessary in the near term.

Restricting WUI sprawl while not worsening California's housing crisis requires the State to provide incentives that both limit risky development and promote infill housing affordable to people of all income levels.

The incentive structures for new development need to make WUI and greenfield sprawl more costly and complicated, while removing barriers for infill near jobs and amenities. Targeted investment, taxes, and regulatory barriers can work together to protect open space and redirect new development into lower risk areas, achieving policy goals for wildfire risk reduction, housing supply, and climate change mitigation.

The state should offer fiscal incentives for urban growth boundaries and greenbelts that support the conservation of environmentally valuable but high-fire-risk forests and open spaces and agricultural working lands. The state can award grants and offer preferential state assistance to regions or localities to: 1) permit and promote infill housing development; and 2) adopt and enforce urban growth boundaries that protect natural and working lands. Such investments would build on existing California Climate Investments in the Affordable Housing and Sustainable Communities (AHSC) program and the Sustainable Agricultural Lands Conservation (SALC) programs, but they need to be significantly expanded to reshape development incentives.

The state should also incentivize movement out of risky areas by building on Proposition 19 and AB 3012, which respectively allow wildfire victims to transfer their existing property tax base to a new location and allow survivors to use their insurance payout to relocate. Proposition 19 and AB 3012 both reduced barriers for wildfire survivors to relocate after a disaster. However, this report proposes that the state go further in proactively encouraging relocation away from high-risk areas, both before and after disasters. The state could provide tax incentives directly to homeowners who relocate from high-risk areas to lower risk areas. This could include extending the basis for property tax assessments to qualifying homeowners in the highest risk areas who relocate before a disaster. Building on AB 3012, the state should also consider engaging with insurers to support the sale of insurance policies that include relocation requirements in the event of a wildfire as a part of the contract. These are incremental and attainable incentives that support policy goals and would be popular with voters.

The suggested incentives above would be most effective when paired with aligned disincentives that create revenue to fund the incentives. A real estate transfer tax for properties in medium, high, and very high wildfire hazard severity zones represents a disincentive to developing in and moving into risky areas. A transfer tax could be used to internalize the cost of wildfire suppression on those who create wildfire risk and benefit the most from taxpayer-funded suppression activities. While potentially unpopular in affected areas, the state should also reinstate a development impact fee on new development in high and very high hazard severity zones, within both the state and Local Responsibility Areas. While the prior fee rescinded in 2017 was politically unpopular, this fee could be distributed more broadly, rather than just the SRA. While the state may not be able or even want to prohibit all new development in high-risk WUI areas, it should disincentivize it. While these policies could be administered at the state level new regional revenue authority and increased local capacity may be a more desirable approach in many regions.

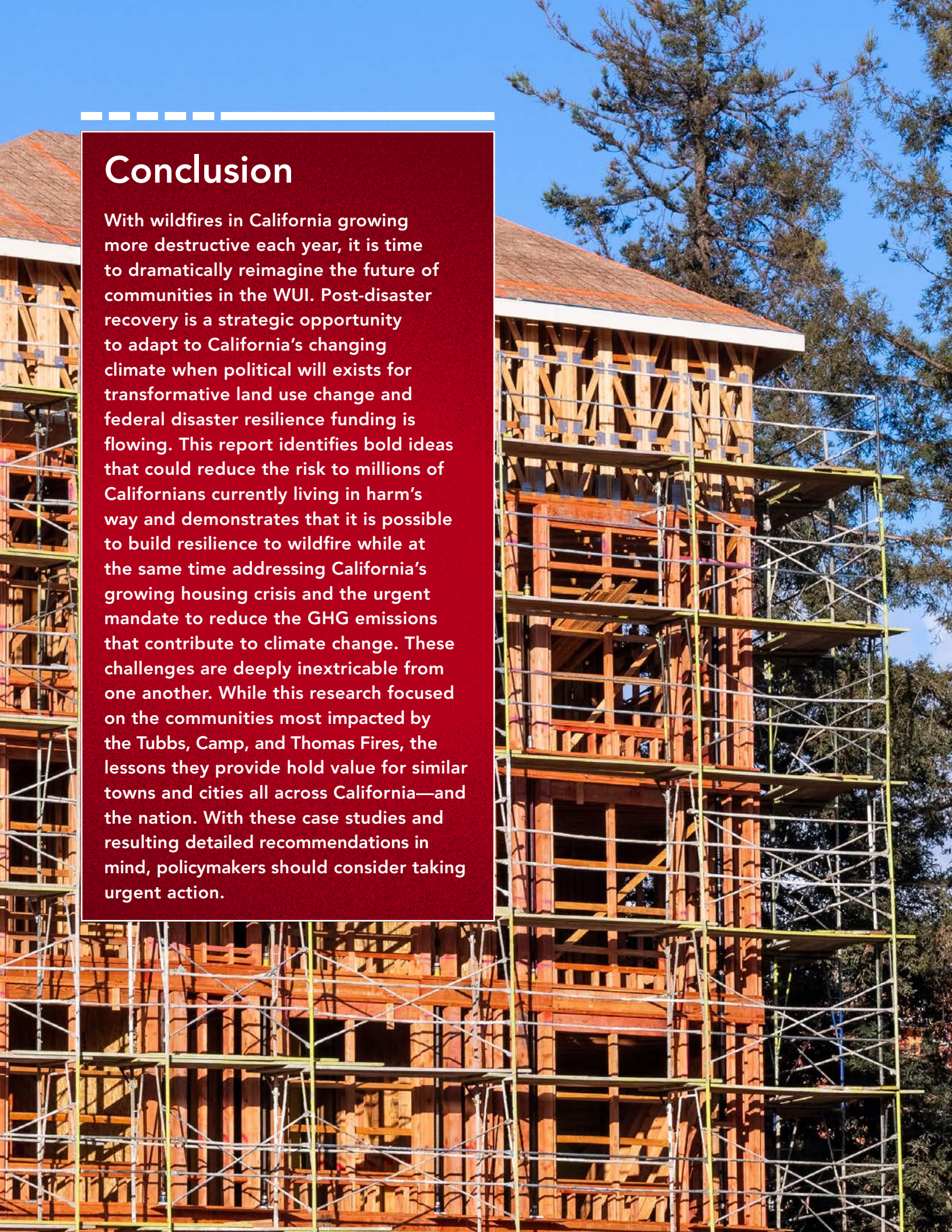
Another key incentive that the state must leverage is the property insurance market. While a contested process that places greater costs on homeowners in the WUI, the state should allow insurance companies to use catastrophe models to set more granular risk ratings, while protecting vulnerable households from unaffordable premiums. A community-scale approach is needed, since one structure's exposure is dependent upon surrounding structures and vegetation. Admitted market insurance rates in the WUI should rise to reflect increasing risk, but policyholders should be encouraged to lower their rates through home hardening and vegetation management. Fire Departments or Fire Safe Councils can receive additional funding to support planning and home hardening programs. Disaster Resilience Financing Districts, described above, could also be instrumental in facilitating community or regional scale hazard mitigation efforts. Insurance companies need to be able to use catastrophe models to assess risk and set rates, but policyholders should be entitled to adjust any resulting rate increases down by carrying out risk reduction measures, certified by a local fire department or third-party entity like a Fire Safe Council. To allow insurers to set climate change-informed rates, the state must offer grants or no-interest loans to low and moderate-income households to ensure that the most vulnerable households are not left behind.

Institutional reinvention that builds capacity at regional and local levels will enable California and its communities to proactively and equitably govern recovery and adaptation in the WUI.

Wildfire resilience and WUI adaptation requires regional collaboration, revenue-sharing, and land use planning. Regional cooperation proved necessary for effective recovery in each of this report's case studies, but regional land use planning in Ventura County demonstrated its multiple benefits by protecting environmentally significant resources while also avoiding disaster costs that would have occurred if the County had more WUI sprawl. Wildfires do not adhere to municipal boundaries and have landscape-scale consequences. Regional cooperation of local governments and empowered regional planning authorities are needed to align hazard mitigation, land use, and housing strategies at the landscape scale to reduce disaster risk and protect valuable natural and working lands.

Similar to California's Sustainable Community Strategies (SCS) for reducing regional vehicular emissions by aligning land use and transportation planning, wildfire resilience and recovery planning are regional issues. Regional planning bodies like COGs and MPOs can integrate disaster resilience and hazard mitigation planning into their Regional Housing Needs Assessments and Sustainable Communities Strategies in metropolitan regions. Doing so would help regions break down siloes between housing, land use, and hazard mitigation planning processes and ensure alignment of goals and investments. Just as areas near transit should be targeted for infill housing, areas with high wildfire risk should not be targeted for new development.

Legislation and state guidance would be necessary to promote regional resilience planning action across regions, and new regional resilience planning requirements should learn from the governing lessons of the SCS and RHNA processes. Legislation that would have taken wildfire hazard severity zones into account when determining RHNA allocations passed the Legislature in 2020 but was vetoed by Governor Newsom on the basis that it would create burdensome requirements and potential housing production loopholes for local governments. This report's authors propose ways to address these concerns. A future bill could include language that directs a greater share of housing allocations towards jurisdictions with more available land outside of the WUI. To address potential intra-regional housing production inequities, the state could target existing and supplemental housing grants for 'receiving communities' where more future growth is anticipated, especially in the event of disaster-induced displacement. Second, to reduce the appearance of duplicative requirements, disaster resilience could be integrated into regional Sustainable Community Strategies (SCSs) so that climate mitigation and wildfire resilience planning happen concurrently. Implementation ultimately occurs at the local level, so local governments will need planning grants and project funding to support this integrated planning approach.



Conclusion

With wildfires in California growing more destructive each year, it is time to dramatically reimagine the future of communities in the WUI. Post-disaster recovery is a strategic opportunity to adapt to California's changing climate when political will exists for transformative land use change and federal disaster resilience funding is flowing. This report identifies bold ideas that could reduce the risk to millions of Californians currently living in harm's way and demonstrates that it is possible to build resilience to wildfire while at the same time addressing California's growing housing crisis and the urgent mandate to reduce the GHG emissions that contribute to climate change. These challenges are deeply inextricable from one another. While this research focused on the communities most impacted by the Tubbs, Camp, and Thomas Fires, the lessons they provide hold value for similar towns and cities all across California—and the nation. With these case studies and resulting detailed recommendations in mind, policymakers should consider taking urgent action.

PART II

Full Case Studies Santa Rosa, Paradise, and Ventura

Santa Rosa

Santa Rosa is the largest city in California's wine country and is home to 181,038 residents. The city is primarily suburban in character, with two-thirds single family housing units and one-third multifamily units. Santa Rosa's homeownership rate is 54 percent, and the median home value is $490,000—$14,100 higher than the median home value in California. The city is 55 percent White, and 33 percent of people are Hispanic/Latino. Slightly less than 25 percent of residents are over the age of 60. Most Santa Rosa residents (91 percent) work in Sonoma County and have an average commute of 24 minutes. The median household income is $71,347, and 7 percent of residents live below the poverty line, compared to 7 percent for California.[131]

Fire Risk and Fire History

Cal Fire's Fire Hazard Severity Zones (FHSZs) cross into the City of Santa Rosa from the west, north and east, which indicates that much of the city is at risk of wildfire. The city is highly susceptible to the hot, dry Diablo Winds that blow toward the southwest in the spring and fall and have contributed to repeated wildfires over the past two centuries. These cyclical fires appear to follow a pattern: the Great Fire of 1870 and the 1964 Hanly Fire burned a similar footprint to the 2017 Tubbs Fire,[132] and the 2020 Glass Fire threatened neighborhoods nearby.

Tubbs Fire

The Tubbs Fire primarily burned structures in the Fountaingrove, Coffey Park, and Larkfield-Wikiup neighborhoods. Buildings in other neighborhoods caught fire from embers carried up to half a mile on the strong winds. In total, the fire destroyed 2,834 homes and killed 22 people. At the time, the Tubbs Fire was the most destructive fire in California history, later surpassed by the Camp Fire the following year.

Displacement from the Tubbs Fire

The Tubbs Fire damaged the homes of 6,692 households. Of these households, 1,881 (28 percent) moved to another census tract by 2019. Of the households that moved census tracts, 33 percent were senior-led, compared by 38 percent of households that stayed. The average number of children of households that moved was 0.43, compared by 0.32 for those that stayed, indicating in this case that households with more children were more likely to move. While 36 percent of all households in the fire area were renters, only 15 percent of those who moved census tracts were renters.

Households that moved on average saw dramatic losses in household income, suffering an average net loss of $92,582 in the first year after leaving and experiencing an increase of $9,951 in the second year. Of the households that moved, the average income in their pre-disaster census tract was $99,351. The average household income in the receiving census tracts was $79,171 in 2018 and $84,014 in 2019.

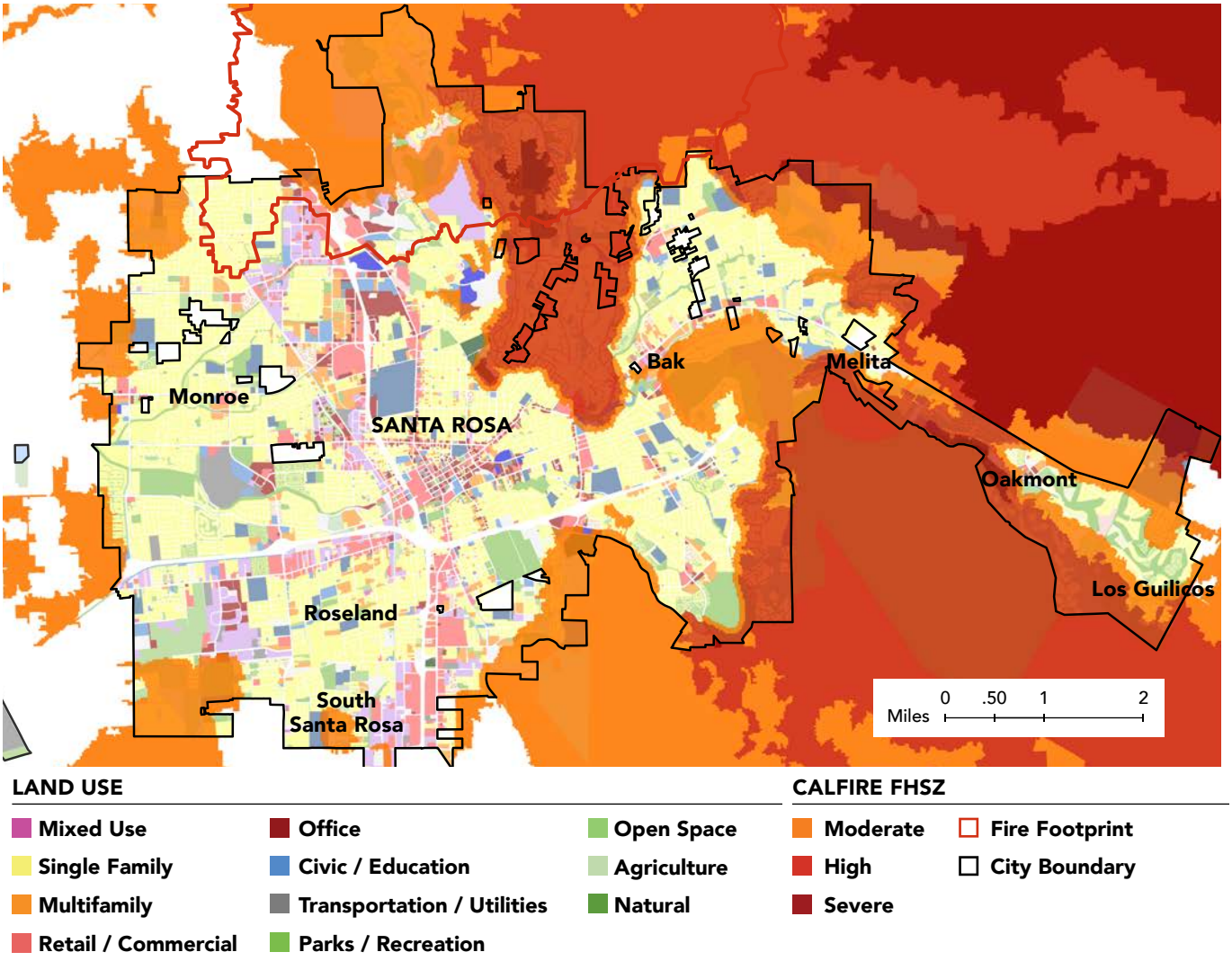
Over the following days and weeks, an estimated 10,000 people in Sonoma County evacuated their homes.[133] Though some survivors of the Tubbs Fire dispersed across the country, 96 percent remained in Sonoma or Napa County one year out from the fire. Though 88 percent of those displaced had been owners, short-term renters were also vulnerable. Renters who moved away in the first year after the fire had lived in Sonoma or Napa for an average of three years, whereas renters who stayed had lived there for an average of 13 years prior to the fire.

Tubbs Fire Recovery

After the fire, City of Santa Rosa officials, community foundations, and local leaders quickly planned efforts to rebuild. Commissioning an "After Action Report," the city assessed its preparation leading up to the fire and its response, and then identified lessons for the future. The general consensus was that emergency responders, residents and good Samaritans went above and beyond to save lives and property, but that a fundamental lack of resources and insufficient communication systems had likely caused preventable damage.

Housing experts in the region conveyed that one of Santa Rosa's biggest challenges post-Tubbs Fire is solving the housing affordability crisis, and that repeated wildfires destroying an already-constrained supply of housing will only make things worse. They noted that there has been a worrying "exodus of people" out of Santa Rosa since the fire. To combat the housing crisis, there is a desire among some city leaders and residents to densify downtown with both market-rate and affordable housing. Other housing advocates spoke about how the housing crisis has disproportionately affected people of color, people who are lower income, and people who are undocumented. They noted that the actual density of neighborhoods on the west side of the city is likely high-

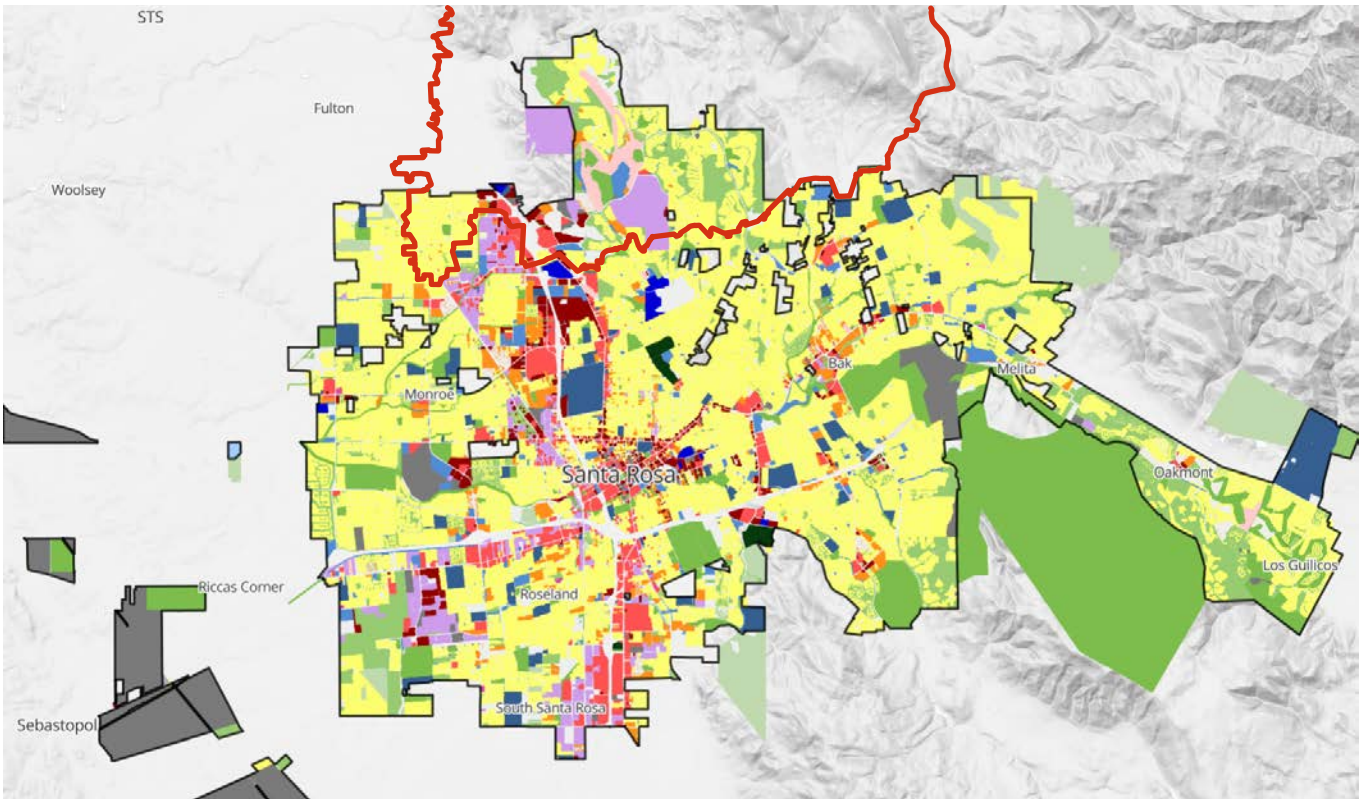
Figure 4 Land Use, Cal Fire's Fire Hazard Severity Zones and Tubbs and Nuns Fire Boundaries in Santa Rosa



er than reported due to undocumented residents sharing low-density, single-family units. Additionally, many interviewees reported that the recovery process in Santa Rosa has also been inequitable to these same groups. A leader at a local non-profit organization told researchers, "The response after the Tubbs Fire has been egregious. I can't overstate that enough. There is no connection between the Latinx community and the decision-makers in the planning process and in the development process."

A significant amount of effort has gone into rapidly rebuilding Santa Rosa back to how it was pre-fire, and into making the city attractive to developers. The city council adopted an urgency ordinance to expedite the process and waive regulations for those trying to rebuild."[134] They also approved funding for a separate permit center exclusively for fire survivors' rebuilding efforts in order to expedite the building permit process. In addition, the city amended its Downtown Station Area Specific Plan in an attempt to draw development into downtown Santa Rosa. Despite the city's efforts to remove red tape and incentivize development, there has been little new construction downtown.[135]

Figure 5 Santa Rosa Pre-Tubbs Fire Land Use



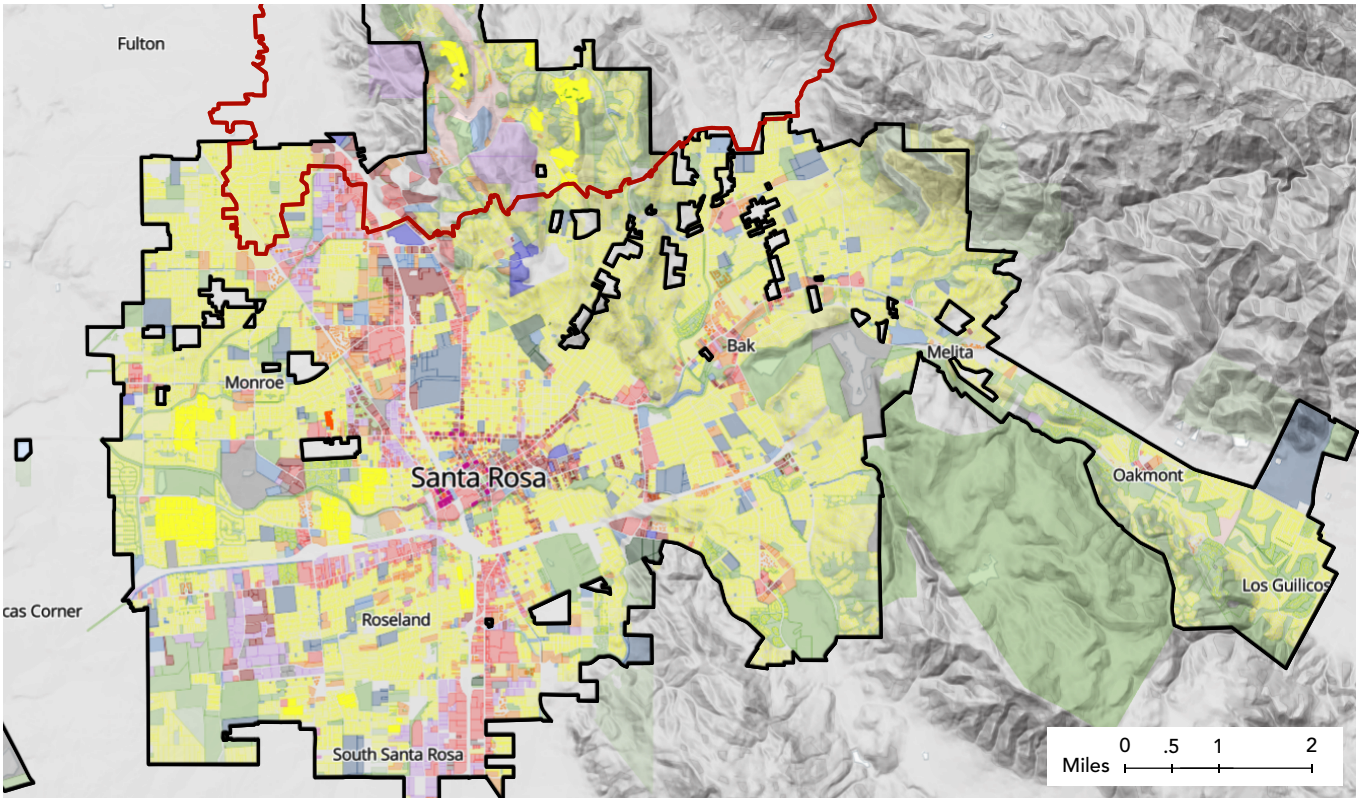
Santa Rosa Scenarios

These scenarios were built to examine the impacts of four possible recovery pathways in Santa Rosa. Each addresses meeting regional housing needs, reducing greenhouse gas emissions, mitigating future wildfire risks, and fiscal and economic impacts. Per the Regional Housing Needs Assessment (RHNA), Santa Rosa has projected a need for 8,125 new housing units by 2030.[136] Each scenario illustrates how Santa Rosa might aim to meet this target goal while also reducing fire hazard in the WUI. Because this scenario exercise was used to explore possible recovery strategies for Californian cities facing similar wildfire risk, the scenarios are not planning proposals for Santa Rosa specifically.

Table 7 Santa Rosa Scenarios Overview

Policy Type	Policy Goal
1: (Re)Building as Usual 'Usual'	Follows Santa Rosa's expected trajectory, with modest densification in city core
2: Managed Retreat & Urban Density 'Retreat'	Moves most WUI residents on east side of city to the west side where wildfire risk is lower Modestly densifies the west side through single family housing and low-rise multifamily housing in infill areas
3: Resilience Nodes 'Nodes'	Reconfigures land use to create dense, walkable "nodes" surrounded by green buffers Serves as compromise, allowing people to stay in WUI while increasing resilience

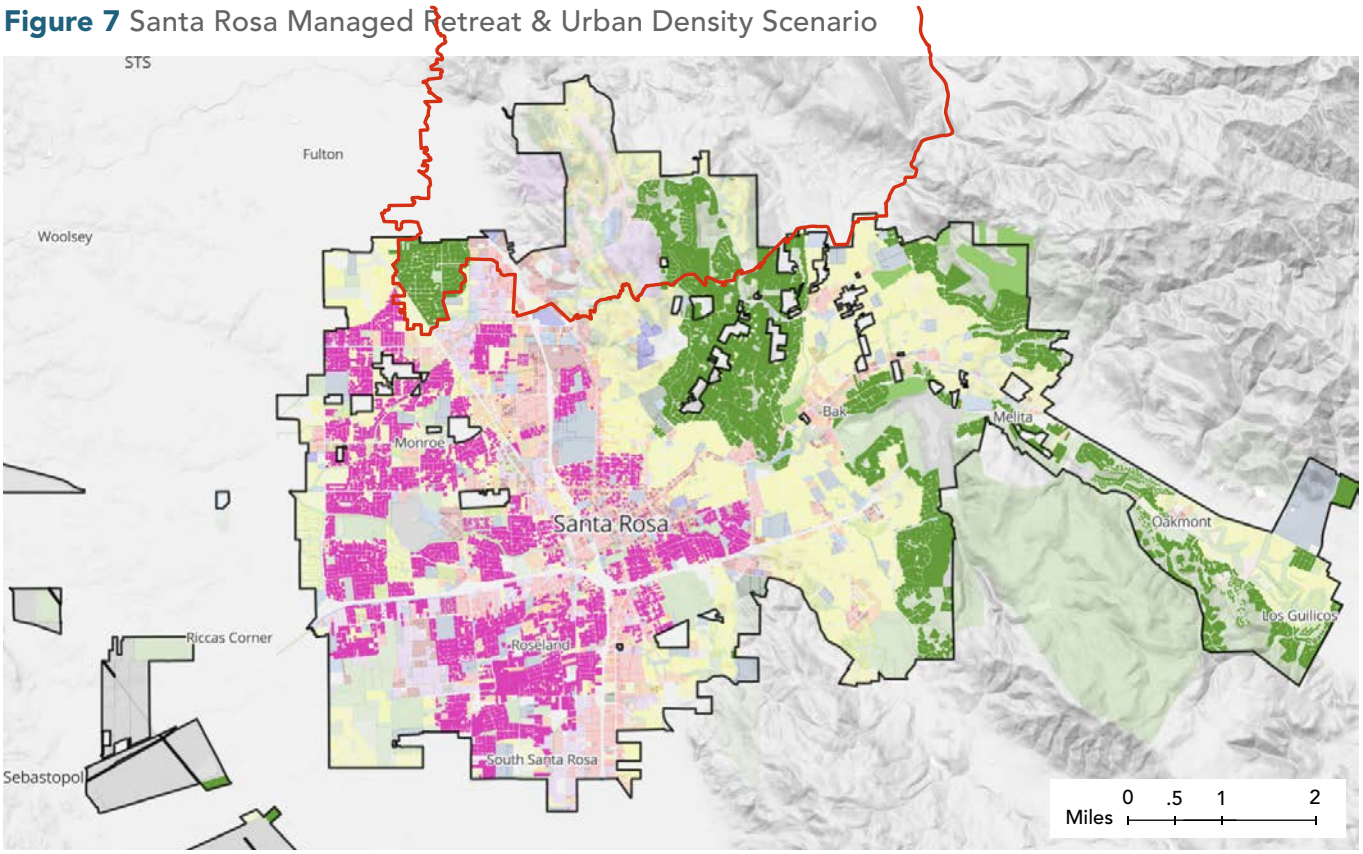
Figure 6 Santa Rosa (Re)Building as Usual



Scenario 1: (Re)Building as Usual

This scenario projects what will happen in Santa Rosa through the year 2030 given no significant policy or land use changes. This scenario assumes that all of the homes that burned in the Tubbs Fire will be rebuilt, and that 250 of them will add ADUs. In this scenario, Santa Rosa builds housing at the same pace that they have permitted housing over the past 20 years: 37 percent of their RHNA target, or in this case 3,006 units through 2030. 'Maintain the Status Quo' is presented as a point of comparison for scenarios 2, 3, and 4, described below.

Figure 7 Santa Rosa Managed Retreat & Urban Density Scenario



LAND USE

- Mixed Use
- Single Family
- Multifamily
- Retail / Commercial
- Office
- Civic / Education
- Transportation / Utilities
- Parks / Recreation
- Open Space
- Agriculture
- National
- Fire Footprint
- City Boundary

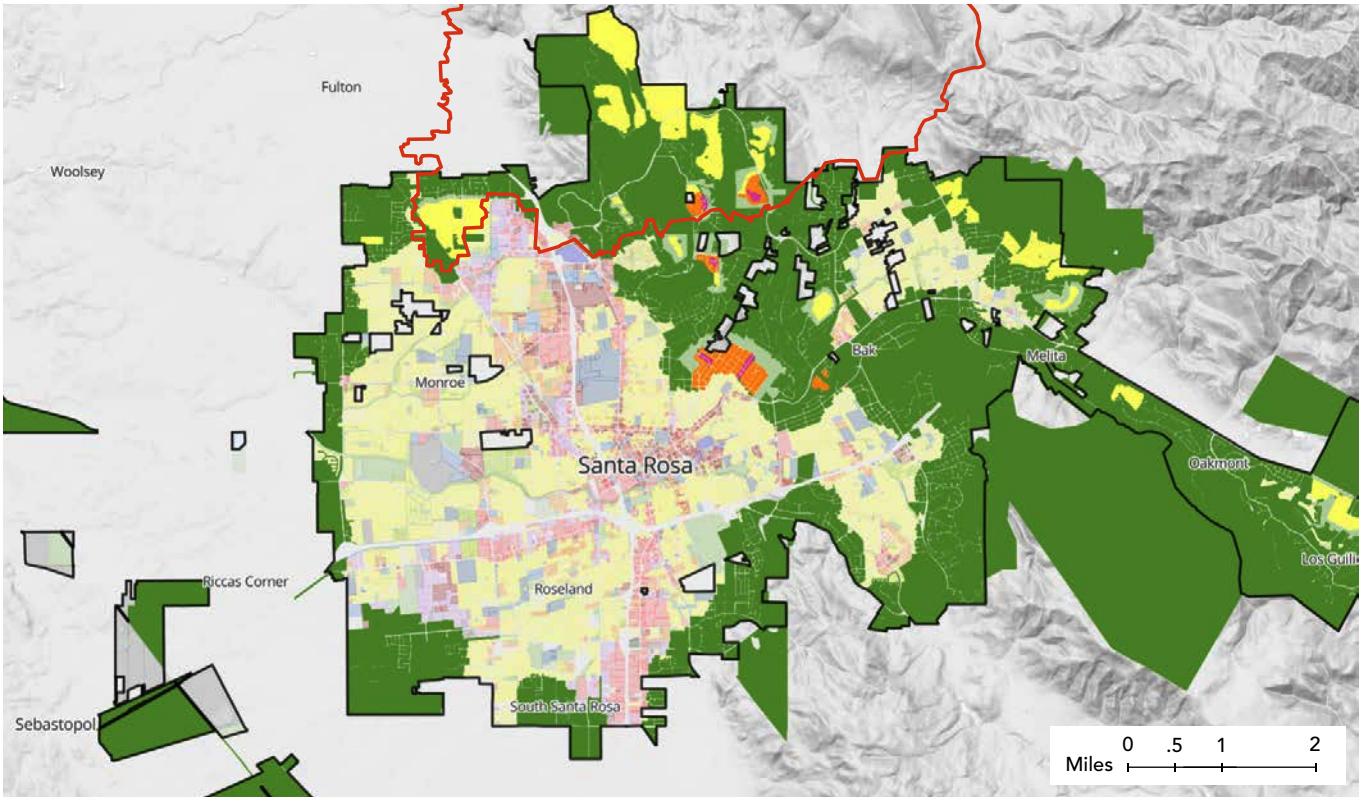
Scenario 2: Managed Retreat & Urban Density

This scenario models a managed retreat in which the majority of WUI residents relocate to the western side of Santa Rosa, where there is lesser wildfire risk. In addition to sparing lives and property damage during future fires, emphasis on infill density is intended to reduce GHG emissions as well as transportation, energy, and housing costs per dwelling unit.

The Managed Retreat scenario assumes that after the Tubbs Fire, 70 percent of homeowners whose properties burned would participate in a voluntary buyout program. Funding a buyout program like this would require substantial funding from federal, state, and local sources. This would allow them to move to safety and turn their properties into NWL. The remaining 30 percent of burned homes are rebuilt in place, back to their original state. The buyout program also applies to unburnt homes in the WUI and assumes that 30 percent of these homeowners participate. In order to replace the 8,165 units that were removed from fire hazard areas, as well as adding 8,112 RHNA units, modest densification occurs throughout the western side of Santa Rosa.

In order to accomplish this, while also addressing local desires to maintain Santa Rosa's suburban character, the research team added attached single-family townhomes and 'missing middle,' multifamily units. The model assumes that 46 percent of new units are multifamily and 54 percent are single family. The multifamily units have an average height of 4.5 floors and are all mixed-use. Although this density would change the City's urban form considerably, the authors believe these building typologies, particularly compact townhomes, would be feasible in cities like Santa Rosa.

Figure 8 Santa Rosa Resilience Nodes Scenario



LAND USE

- Mixed Use
- Single Family
- Multifamily
- Retail / Commercial
- Office
- Civic / Education
- Transportation / Utilities
- Parks / Recreation
- Open Space
- Agriculture
- National
- Fire Footprint
- City Boundary

Scenario 3: Resilience Nodes

This scenario models how changing the urban form may reduce risk for residents who wish to live in lower-risk portions of the WUI. Concentrating residents in dense, walkable nodes of buildings alongside protective green buffers would reduce risk from future fires. Additionally, the layout of these nodes may further maximize defensible space by mandating setbacks from the edge of slopes and concentrating homes along the inner side of roadways. The road network itself can also be designed in such a way to provide easy access to these perimeter roads for firefighters. This scenario generally places nodes relatively close to the edge of the city proper and where there is easy access to open space.

In this scenario, 80 percent of homeowners in the WUI and 80 percent of the Tubbs Fire survivors, whose homes needed to be rebuilt, accept a buyout that allows them to move to one of the new dense nodes. The remaining 20 percent for each group rebuild their homes to their original state and in their original place. This effectively moves approximately 15,000 units from their current location into the nodes, as well as the additional 8,114 homes allocated to Santa Rosa from RHNA. While new homes are being built in higher fire hazard risk zones, wildfire resistant building material and methods as well as defensible space and wildfire buffers are central to this scenario. All other areas of the city remain as they were in 2017, both in form and population. To meet these increased densities, the model assumes that 80 percent of the nodes' units will be multifamily and 20 percent will be single family. All single-family homes were modeled as single-family-attached, rather than single-family-detached, to stay in accordance with the nodes' inherently compact nature while maintaining the potentially desirable single-family occupancy. The multifamily units have an average height of 4.5 floors and are all mixed-use.

This scenario aims to find a safe way for residents to live in the WUI. During interviews, the research team heard that many Santa Rosa residents chose to live in the WUI to enjoy a close proximity to nature and to be located away from the bustle of downtown. This scenario attempts to compromise between the desire for this type of lifestyle and the safety risks inherent to life in the WUI. And because a denser, more concentrated node is a notable change from the current sprawl, the researchers specifically chose to model housing close to the 'missing middle' typology to better fit this new urban form with Santa Rosa's aesthetic preferences. Indeed, these nodes do not need to be excessively population-dense—its layout and compactness, rather than higher numbers of residents per acre, provide the bulk of the node's protective advantages.

Equity Implications of Santa Rosa Scenarios

It is crucial to understand how these scenarios might exacerbate or ameliorate existing equity issues in cities like Santa Rosa. This is especially important in the context of disasters, which can accelerate existing inequality in how resources are distributed. Californians who are renters, low-income, uninsured and underinsured, and non-English speakers face additional barriers in recovering after a fire because of the state's prohibitively high housing costs, unequal access to amenities and opportunity, and a lack of community self-determination. These are the lenses through which this equity analysis is framed.

The 'Retreat,' and 'Nodes,' scenarios increase the housing supply in accordance with the RHNA unit requirements for Santa Rosa in 2030. Because RHNA requires new housing units for all income levels, meeting the RHNA threshold means these scenarios would likely alleviate housing insecurity through their increased supply of mixed-income housing. However, the 'Retreat' scenario moves higher-income residents to lower-income areas, (or, at least, underdeveloped areas) close to downtown, which could lead to increases in land values and home costs in the immediate area. As a result, either scenario would need to be paired with powerful anti-displacement policies and renter protections to be truly equitable.

In addition, the Managed Retreat and Resilience Nodes scenarios assume that the majority of residents in the WUI voluntarily accept a buyout offer. In practice, however, this process may lead to inequitable outcomes. Low-income households that are unable to afford rising insurance premiums may have no choice but to accept buyouts and move from their home. Any new ones should require a certain percentage of funds support low and moderate-income households.

The dense, mixed-income, mixed-use neighborhoods envisioned for the 'Retreat' and 'Nodes' scenarios could ideally create more access to amenities and opportunity through greater walkability. Residents of these areas might no longer need a car to travel to schools, grocery stores, job centers, and public transportation hubs. This would be especially important for lower-income people who are less likely to be able to afford a car. However, simply constructing low-income housing does not guarantee greater equity. Proximity and connectivity between housing, amenities, and opportunities would have to be proactively planned for and monitored to ensure that low-income, renter, under-insured, and other vulnerable populations have access to what they need. Local governments recovering from a disaster may want to pass a community preference policy to ensure that `residents with ties to the community or region have priority access to rebuilt and affordable housing units.

Historically, planning that is exclusively top-down and technocratic has excluded marginalized voices and led to displacement. With that in mind, the Managed Retreat and Resilience Nodes scenarios dramatically reimagine land use in ways that affect entire populations. If any of these scenarios were to be implemented, they would need to be tailored to a community's unique needs and collective vision. Local leaders, organizations, and groups—especially from marginalized communities—must be given real power to direct how these scenarios take form. For instance, if a city were to implement a 'Nodes' strategy in an equitable manner, residents would wield significant discretion over where the nodes are located as well as what types of housing and amenities they contain.

Santa Rosa Findings

Because the 'Retreat' and 'Nodes' scenarios significantly curtail suburban sprawl in the WUI, they have approximately half as many large-lot detached single-family units as under the 'Status Quo' and 'Density' scenarios. Table 8 shows that every scenario has comparable numbers of small lot detached single-family units. While 'Retreat,' 'Nodes,' and 'Density' all contain more attached single-family units (townhomes) than 'Status Quo,' 'Retreat' features a significantly higher share of the increase. Similarly, these three scenarios all feature far more multifamily units than 'Status Quo,' with 'Nodes' containing nearly two and a half times as many. The implications of these differences are elaborated on below.

Table 8 Housing Supply in Santa Rosa Scenarios

Housing Supply			
	Scenario 1: 'Usual'	Scenario 2: 'Retreat'	Scenario 3: 'Nodes'
Population	179,222	167,588	
Dwelling Units (DU)	70,940	76,050	76,052
Net Change in DU vs Pre-Tubbs Fire	*+3,002*	*+8,112*	*+8,114*
Net Change in DU vs Scenario 1		*+5,110*	*+5,112*
Large Lot Detached Single-Family	29,391	15,587	16,668
Small Lot Detached Single-Family	21,442	17,001	16,769
Attached Single-Family (Townhomes)	7,551	17,589	11,657
All Multifamily	12,556	25,873	30,958

Notes: The above table represents the housing units simulated in the UrbanFootprint scenario planning software. Population represents UrbanFootprint estimation based on the number and type of housing units.

Table 9 Fire Risk in Santa Rosa Scenarios

Fire Risk			
	Scenario 1: 'Usual'	Scenario 2: 'Retreat'	Scenario 3: 'Nodes'
DU in the Fire Hazard Severity Zone *	12,302	5,650	20,602
Net Change in DU vs Scenario 1		*-6,652*	*+8,300*
Moderate Fire Hazard Severity Zone	7,218	4,792	8,511
Net Change from Scenario 1		-2,426	+1,292
High Fire Hazard Severity Zone	4,881	855	11,760
Net Change from Scenario 1		-4,026	+6,879
Very High Fire Hazard Severity Zone	203	3	331
Net Change from Scenario 1		-200	+128

* Table represents the number of units in the present day FHSZs, which may change due to the addition of vegetation in Scenarios 2 ('Retreat') and 3 ('Nodes').

Table 10 Estimated Household Costs in Santa Rosa Scenarios

Household Costs			
	Scenario 1: 'Usual'	Scenario 2: 'Retreat'	Scenario 3: 'Nodes'
Residential Energy Cost (dollars/dwelling unit/year)	$1,607	$1,301	$1,313
Net Change from Scenario 1		-$306	-$294
Transportation Cost (dollars/dwelling unit/year)	$15,549	$9,537	$12,525
Net Change from Scenario 1		-$6,012	-$3,024
Water Costs (dollars/dwelling unit/year)	$652	$486	$480
Net Change from Scenario 1		-$166	-$172

Notes: Table is presented in 2020 dollars and does not account for inflation through 2030. Transportation cost combines fuel cost with other vehicle costs. Transportation cost is calculated based on present day transportation and commute patterns.

Much like 'Status Quo,' 'Density' assumes that neighborhoods in FHSZs, including those that burned in the Tubbs Fire, would return to or maintain their original state. Consequently, 'Density' does very little to remove Santa Rosans from fire risk areas. However, Table 8 notes that this scenario precludes 5,000 future dwelling units (DUs) from being built in FHSZs across Sonoma County and instead directs them to downtown Santa Rosa.

Narrowing the scope to Santa Rosa itself reveals that 'Retreat' is the most effective at removing individuals from FHSZs. Relative to 'Status Quo,' it removes 6,652 DUs from these areas, dwarfing the 269 removed by 'Density.' 'Nodes,' on the other hand, adds 8,300 DUs to these areas. This increase deserves further context. Unlike fault zones, for example, FHSZs are dynamic and can be altered by reconfiguring WUI development. 'Nodes' assumes that creating urban clusters with defensive green buffers would fundamentally change the WUI itself and thus FHSZs. Therefore, adding 8,300 DUs to the WUI does not necessarily mean increasing housing in future FHSZs. There are compelling arguments in support of this theory, yet the interviews completed suggest that more sophisticated wildfire risk modeling will be needed to confidently direct growth towards WUI nodes.[137] Until this fire science is further clarified, 'Retreat' offers the greatest assurance of protecting Santa Rosans from future wildfires.

Table 10 shows that every scenario but 'Status Quo,' average household costs decrease. 'Retreat,' 'Nodes,' and 'Density' all build more compact housing types—many without lawns—which use water and energy more efficiently. 'Retreat,' which spreads duplexes, fourplexes, and townhouses across wide swaths of the city, results in a per-dwelling unit reduction in transportation costs of more than $6,000.

'Retreat' and 'Nodes' replace large numbers of detached single-family units with denser development to reflect the assumption that residents accepted buyouts. In addition, both scenarios add over 5,000 entirely new attached single-family and multifamily units. Despite their increases to housing stock, these two scenarios have lower overall GHG emissions than 'Status Quo,' seen in Table 11. Homes that share common walls are generally more energy efficient, so the high numbers of townhomes and multifamily units in 'Retreat' and 'Nodes' likely contribute to their lower residential energy use and costs per DU. Conversely 'Density' replaces fewer detached homes because its changes are confined almost entirely to downtown. This leaves less-efficient WUI suburbs intact.

Table 11 Climate Impacts in Santa Rosa Scenarios

	SANTA ROSA		
	Scenario 1: 'Usual'	Scenario 2: 'Retreat'	Scenario 3: 'Nodes'
Greenhouse Gas Emissions			
Total Greenhouse Gas Emissions (metric tons/year)	1,142,797.4	929,466.6	967,828.1
Net change from Scenario 1		*-213,330.7*	*-174,969.3*
Total carbon stock (metric tons)	578,038.7	603,203.6	662,109.8
Net change from Scenario 1		*+25,165.0*	*+84,071.1*
Greenhouse Gas Emissions (metric tons/DU/year)	16.1	12.2	12.7
Net change from Scenario 1		*-3.9*	*-3.4*
Residential Energy Use			
Residential Energy Use (million British thermal units/DU/year)	64.9	55.0	54.7
Net change from Scenario 1		*-9.9*	*-10.2*
Transportation			
Vehicle Miles Traveled (miles/DU/year)	22,977.1	14,201.2	18,408.4
Net change from Scenario 1		*-8,775.9*	*-4,568.7*

Notes: Total Greenhouse Gas Emissions is made up of GHG emissions produced by passenger vehicles, total building energy use, and water use. Carbon stock was calculated using The Nature Conservancy's Conservation Module. Carbon stock combines above ground carbon (like vegetation) and below-ground carbon (like oil and soil). Residential energy use combines electricity and methane.

'Retreat' and 'Nodes' both significantly decrease annual VMT per DU by contracting Santa Rosa's overall footprint. Nevertheless, relative to 'Status Quo,' 'Retreat' lowers per-unit VMT almost twice as much as 'Nodes.' Annual per-unit transportation costs in the 'Retreat' and 'Nodes' scenarios reflect a nearly identical discrepancy. 'Nodes' may have a higher per-unit VMT than 'Retreat' because the nodes are located further from downtown Santa Rosa, requiring node residents to drive further to reach public amenities, such as schools. If actually implemented, nodes would need to include

such amenities so that their inhabitants could walk and bike for frequent outings.

Relative to 'Status Quo' and 'Density,' 'Retreat' and 'Nodes' sequester more carbon by reverting formerly developed areas to natural and working lands (NWL). 'Nodes' sequesters more carbon because it assumes that 80 percent of homeowners living in the FHSV will accept buyouts and unbuild their homes, whereas 'Retreat' assumes that 20 percent of homeowners will accept buyouts. Expanding and protecting NWL can sequester more carbon and help further California's climate goals.

The IMPLAN economic analysis in Table 12 shows that every departure from '(Re)Building as Usual' results in more economic benefits due to the large amount of new housing construction as well as the types of housing built (e.g., multifamily buildings). This chart highlights that when decision makers look for solutions to reduce wildfire damage and risks, they should feel encouraged that addressing these problems has economic benefits too.

Table 12 IMPLAN Economic Impacts Analysis, Sonoma County

	SONOMA COUNTY		
	Jobs	Economic Output	Sales, Income, and other Local and State Taxes
One-Time Construction Impacts			
Scenario 1: 'Usual'	24,454	$1,818,417,454	$201,123,135
Scenario 2: 'Retreat'	*66,653*	*$4,975,982,277*	*$531,466,716*
Scenario 3: 'Nodes'	95,939	$7,223,529,362	$712,956,225
Ongoing Impacts*			
Scenario 1: 'Usual'	0	$0	$0
Scenario 2: 'Retreat'	2,957	$487,872,610	$23,806,969
Scenario 3: 'Nodes'	2,957	$487,872,610	$23,806,969

Estimates generated by IMPLAN

*Ongoing impacts calculated by multiplying the projected household growth with median household income. Countywide household growth is held constant across scenarios, explaining lack of variation across scenarios.

Paradise

City and Demographics[138]

Paradise is an incorporated town located in Butte County, approximately 15 miles east of Chico. It has traditionally had a small, rural town feel, with many families having lived there for generations. Paradise is among a handful of communities on what is known as "the Ridge," along with Concow, Magalia, Pulga, and several others. Residents on the Ridge lean politically conservative and are known for their independent streak, self-reliance, and desire for space and privacy.

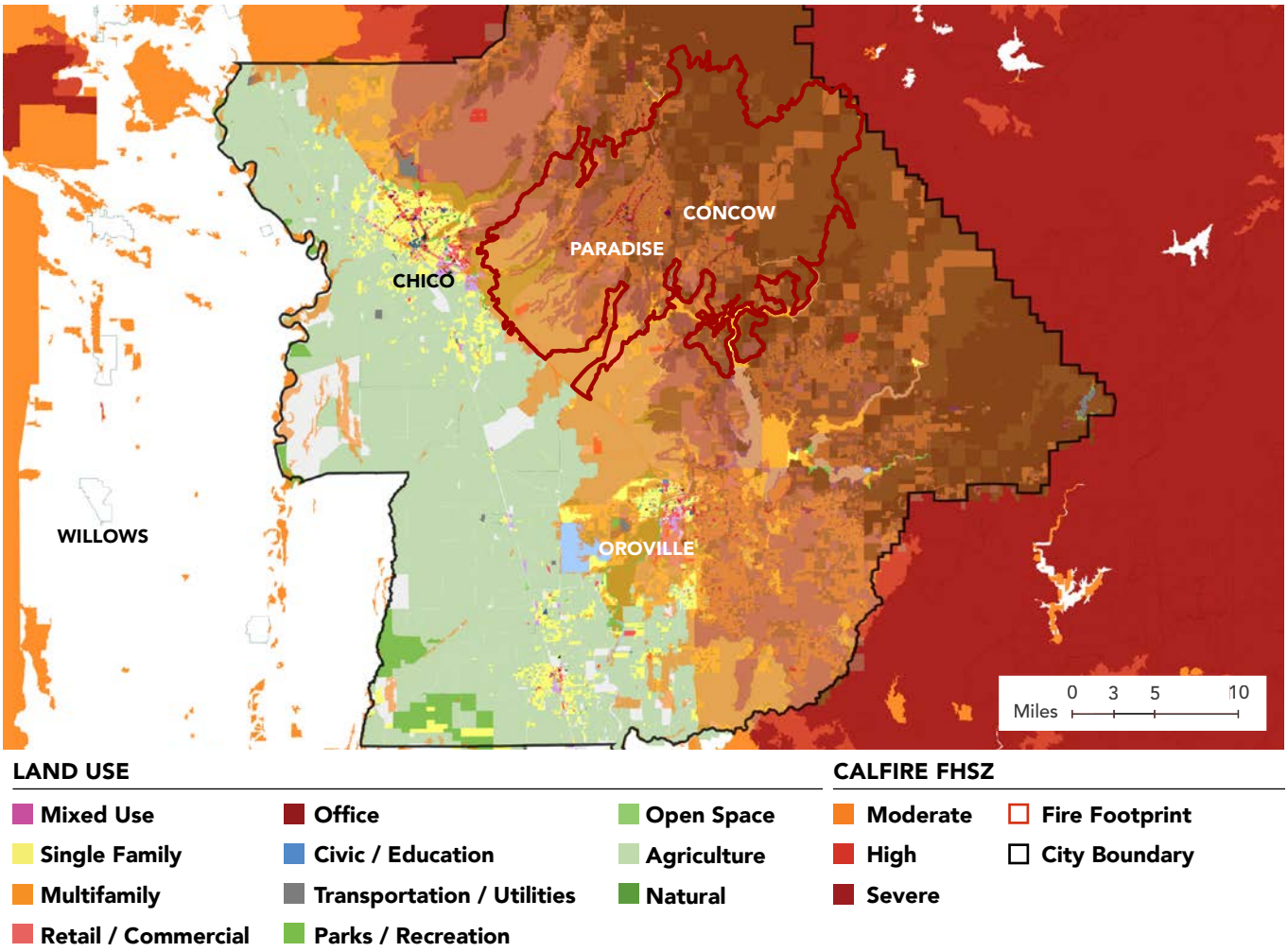
Before the fire, Paradise had nearly 27,000 residents, including a large population of retirees (35% of residents were over 60 years old, including 7% over 80 years old), and served as an affordable housing option for young families and individuals commuting to Chico for work. The median household income in Paradise was $49,270, with approximately 6 percent of families living below the poverty line. It was made up primarily of single-family homes, with very low-density development. Before the Camp Fire, approximately 70 percent of residents owned their homes, higher than the 55 percent homeownership rate statewide. The median home value of $218,400 was nearly half the average home value in California, which is $475,900. Mobile and manufactured homes[139] represented approximately 17 percent of Paradise's housing supply. Interview informants also indicated that many owned their homes outright or inherited their homes, both of which negated the requirement to have a property insurance policy as part of a mortgage.

Camp Fire and Fire Risk

The Camp Fire burned more than 150,000 acres over the course of two weeks, destroying nearly 19,000 structures, and killing 85 people.[140,141] Nearly 85 percent of those who perished were over the age of 60,[142] pointing to the vulnerability of older residents, particularly those with disabilities and those who are more socially isolated. The fire left behind huge amounts of debris and hazardous trees and damaged the town's water infrastructure and supply.[143] With estimates of up to $18 billion in damages, the Camp Fire surpassed the 2017 Tubbs Fire as the deadliest and costliest fire in California history.[144] Investigators determined that outdated electrical transmissions lines owned and operated by Pacific Gas and Electricity (PG&E) sparked the fire. PG&E later pleaded guilty to 84 counts of involuntary manslaughter and one felony count of unlawfully starting a fire. They declared bankruptcy a year later.[145] As of December 2020, some victims of the fire are still waiting to receive compensation from the settlement.

Paradise and nearby areas have faced a number of fires over the decades. In fact, the area within the Camp Fire burn scar had experienced more than ten large wildfires

Figure 9 Land Use, Camp Fire Footprint, and Cal Fire's Fire Hazard Severity Zones in Butte County and Paradise



between 1999 and 2018, notably including the Humboldt Fire in June 2008, which destroyed nearly 23,000 acres of land between Chico and Paradise, on the town's southwestern end.[146] The residents on "the Ridge" continue to live be extremely vulnerable to wildfire disaster. The North Complex Fires sparked by lighting in August 2020 led to evacuations, re-traumatizing many survivors who are working to rebuild their lives in Paradise and surrounding communities.

Displacement Resulting from the Camp Fire

The Camp Fire displaced roughly 40,000 people overnight from communities across the Ridge, primarily to nearby Chico.[147] In the Town of Paradise, which was hit the hardest by the Camp Fire, 95 percent of the Town's buildings were destroyed, resulting in the net loss of 19,000 total buildings and 14,000 homes.[148] In 2019, one year after the devastating Camp Fire, most of the former residents in the Camp Fire Footprint in Butte County, found themselves scattered across the country.

The Camp Fire displaced 13,314 households, and of those, 5,679 (43%) had moved to a new census tract by 2019. Of those who moved census tracts, 2,148 (38%) were senior-led households. The average household income of households that moved was $54,153, higher than $49,974 for the households that did not move. Low-income households represented 41 percent of households that relocated, compared to 50 percent of households that stayed, indicating that lower-income households were less likely to move. While 34 percent of all affected households were renters, 40 percent of households that moved were renters. Households that moved did not experience the significant income losses seen among Thomas and Tubbs survivors, perhaps due to the already low incomes in the region.

Those displaced from Paradise lived in their homes for generations, were more likely to live in a single-family home than the average California and were more likely to own their homes than the average Californian. This indicates that these residents likely have a strong connection to place, and, in the case of the homeowners, a vested financial interest in the Town. The lower incomes of the residents of Paradise ($49,270), when compared to the average Californian ($71,228), have implications regarding where those displaced by the Camp Fire will be able to relocate. Prior to the fire, Paradise was a relatively affordable Californian community. If the cost of rebuilding is too high, former Paradise residents may choose to permanently move out of the state in search of cheaper housing options elsewhere. These relatively lower incomes point to the need for affordability and financial compensation to be at the forefront of any state-level re-housing policy after fires.

Camp Fire Recovery

Town of Paradise officials anticipate that only half of former residents will return. To guide their rebuilding and recovery efforts, the Town of Paradise embarked on a long-term planning process in early 2019, and the Town Council adopted the Long-Term Recovery Plan in June 2019. Now more than two years since the Camp Fire, Paradise is still very much in the recovery phase, with very little rebuilding occurring in the Town.

Despite its efforts to plan for and accommodate recovery, Paradise faces many challenges. From interviews with several individuals and organizations working on recovery efforts, some of whom experienced the fire firsthand, the researchers learned that many residents did not have wildfire insurance or were significantly underinsured when the Camp Fire tore across the Ridge. In addition, rebuilding costs have increased substantially due to demand and, more recently, to COVID-19, making it more expensive to rebuild; moreover, residents are still waiting on relief funding from FEMA and the U.S. Department of Housing and Urban Development (HUD), as well as settlement money from PG&E. As a result, many residents cannot afford to rebuild. As of this report, several hundred people are still living in tent cities on the Ridge and in Chico, and others are dry camping or living in recreational vehicles in Paradise. It is clear that while some residents have moved into the recovery phase, others are still struggling to have their basic needs met.

Another major obstacle to recovery is the immense amount of work still needed to repair the town's infrastructure. The Camp Fire severely damaged roads and septic tanks, which contaminated the town's water supply and soil. It also left thousands of hazardous trees at risk of falling on the right of way and on individual properties. Paradise has made progress in addressing these concerns; however, high costs to remedy them, only some of which are reimbursable by state and federal programs, have delayed households' ability to rebuild.

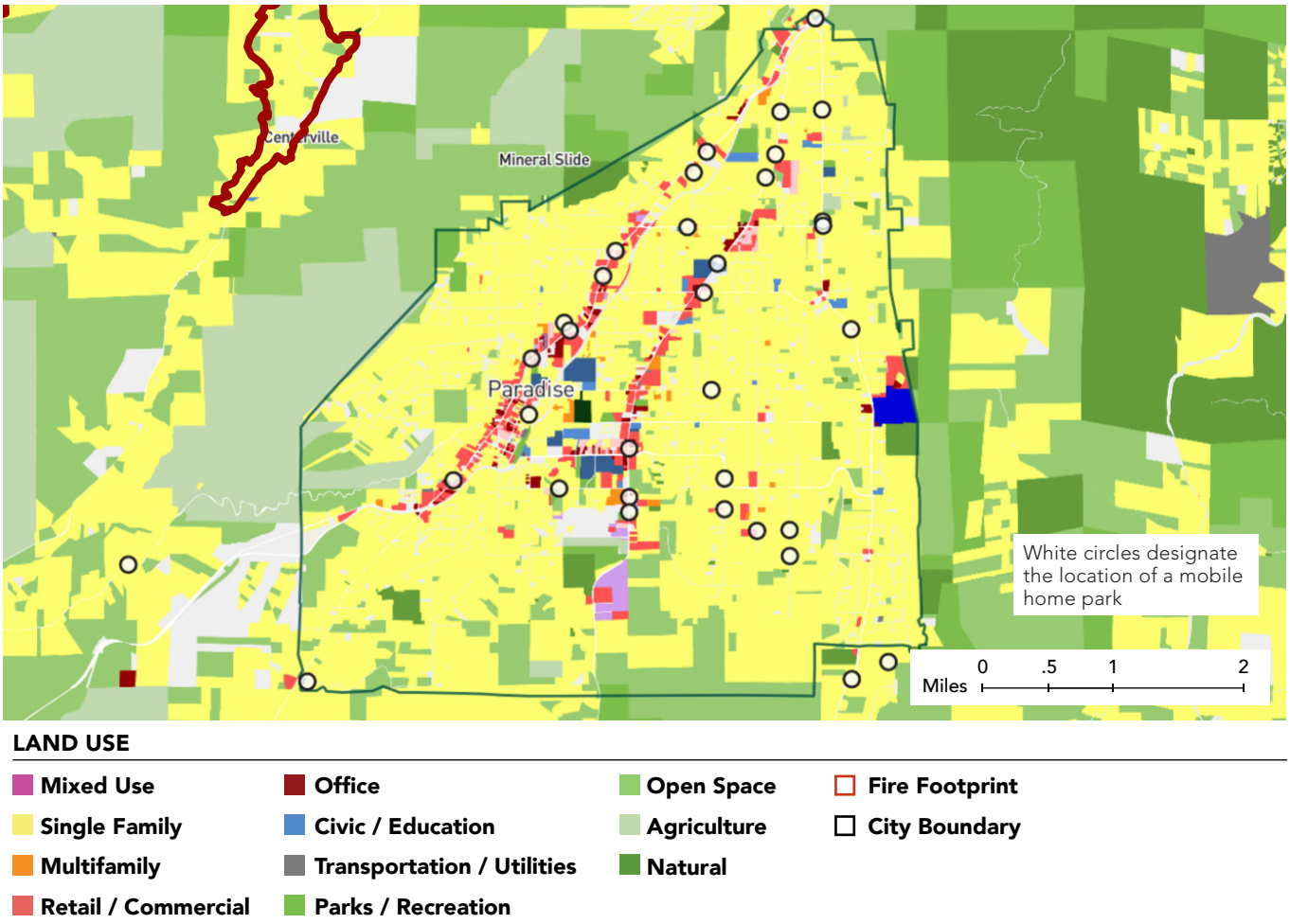
The Camp Fire had housing market impacts across all of Butte County and the greater North Valley region. Absorbing these numbers of displaced persons has strained nearby cities like Chico and Oroville, which absorbed thousands of new residents overnight. As one Chico resident interviewed put it, immediately after the fire, "despite tensions around politics and gender, [they] were like a blended family. [They] really rallied to be "Butte Strong." However, as months and years passed, while there is still sympathy and desire to help, there is a growing weariness." Prior to the Camp Fire, Chico was experiencing a housing crunch, with an extremely low vacancy rate, rising rental and real estate prices, and increasing numbers of residents experiencing homelessness. The influx of additional people and the continued displacement has exacerbated these issues. This suggests that any fire mitigation program should look more broadly at a county or regional level for strategies and solutions.

Paradise Scenarios

Three scenarios were designed and analyzed at both the Paradise and Butte County level to examine the impacts of different possible recovery pathways in terms of meeting regional housing needs, reducing greenhouse gas emissions and meeting the state's climate change goals, mitigating future wildfire risks, and accounting for fiscal and economic impacts. Through its RHNA, Butte County projected a need for 15,506 additional housing units by 2030. These three scenarios examine three different pathways for how Butte County could meet this target while also reducing risk in the WUI. The scenarios also take into account the return of non-residential uses, including retail, industrial, office, and public uses in assessing potential impacts.

Informed by interviews and data analysis, the researchers used these scenarios as a basis for exploring a variety of policies and strategies that may be extrapolated to

Figure 10 Paradise Pre-Camp Fire Land Use



other cities and regions facing a high—and increasing—risk of wildfire in the coming years due to climate change. In particular, the authors considered mechanisms and strategies to fund and incentivize wildfire buffers and land use patterns that mitigate fire risk; community risk transfer policies and strategies; ways to finance 'missing middle' housing in receiving communities; and community land ownership models and financing models with respect to manufactured housing.

Scenario 1: (Re)Building as Usual

The (Re)Building as Usual scenario most closely resembles the Long-term Community Recovery Plan that Paradise adopted in June 2019.[149] Assuming that 25-50 percent of the pre-Camp Fire population (approximately 10,800 residents) returns, it centers around a mixture of return and relocation based on resident preferences and maintains the previous character of Paradise's housing unit typology, density, and geographic spread. This scenario maintains the highest proportion of single-family detached homes (51%), with manufactured homes as the second most populous typology (30%), which is roughly the same number of manufactured homes as before the fire. The remaining units consist of ADUs (15%), 'missing middle' housing (2%) and multi-family housing (2%). At the county level, surrounding jurisdictions would absorb more residents through a combination of single-family homes, ADUs, and manufactured housing communities (MHCs).

Similar to the other scenarios, '(Re)Building as Usual' incorporates natural greenbelts surrounding the town to serve as fire buffers. Housing is clustered within the center of town near commercial areas and between the two main thoroughfares, to allow for further firebreaks. Where possible, this scenario employs greenbelts between clustered housing to further mitigate against fire damage.

Clustered development around commercial nodes and the main roads helps Paradise achieve increased walkability surrounding downtown, which residents indicated as a desirable feature in their long-term recovery planning process.[150] Sixty-six percent of residents are within a 10-minute walk to a park and 52 percent are within a 15-minute walk to a school—both the highest rates of walk access amongst the Paradise-only scenarios.

'(Re)Building as Usual' significantly reduces the number of dwelling units in the VHFHSZ (7,362) through the reduction in total development in the town of Paradise and the movement of dwelling units to primarily non-WUI areas in Butte County. Given the dominance of single-family homes, this scenario produces the highest amount of GHG emissions (12% higher than 'Affordability' and 7% higher than 'Migration'). However, given the compact nature of the development pattern in this scenario, it produces lower VMT per household than 'Resilience Nodes' (0.4% less), which has a more dispersed development pattern.

This scenario requires a mixture of community and individual risk responsibility. Residents of single-family homes would need to rebuild to the current home hardening standards and the community would need to maintain the green buffers. Given the need for a localized approach to fire mitigation in Paradise, a special district could be considered as a possible funding mechanism for ongoing mitigation and fire resilience efforts. While insurance rates will climb given rebuilding in the town, development impact fees through the implementation of a special assessment district could fund community mitigation measures. Similar to 'Managed Retreat,' this scenario would likely benefit from a buyout or transfer of development rights (TDR) program to remove homes from the town's edges and create the greenbelts.

Scenario 2: Managed Retreat & Urban Density

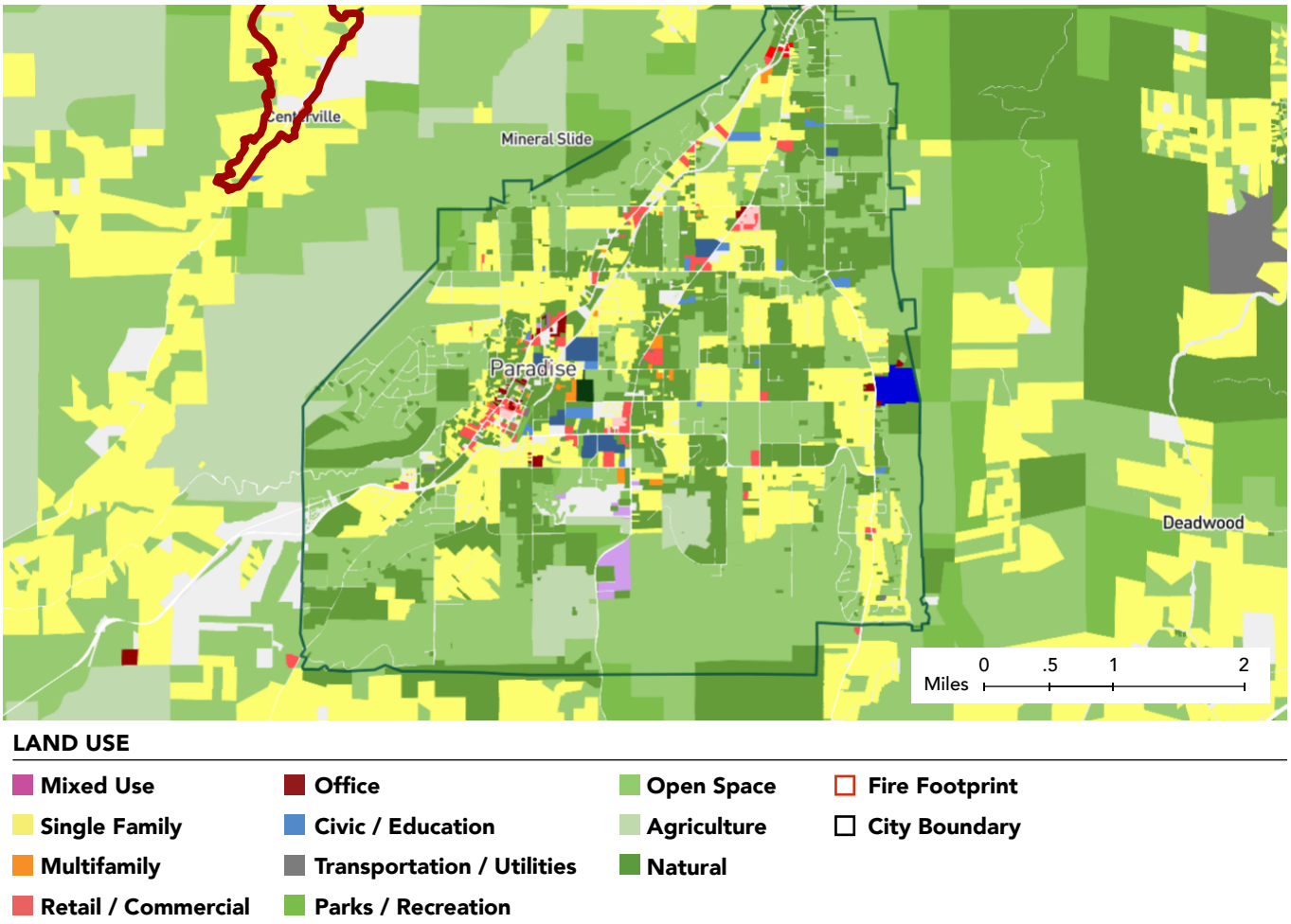
This scenario aims to reduce fire risk in Paradise by incentivizing migration to Butte County's existing urban nodes outside of the WUI. This rebuilding strategy has the potential to achieve the greatest amount of risk reduction while also producing co-benefits from reduced vehicle emissions associated with more job capture in Chico.[151] This scenario assumes that roughly 25 percent of the pre-Camp Fire population (approximately 5,400 residents) return to Paradise. This condensed footprint would be clustered around the town center and heavily buffered with natural land uses. Ideally, these land uses would act as a fire buffer to protect the town, while also allowing for recreational and economic activities to support remaining residents. The housing mix in Paradise would largely mimic the mix of pre-fire Paradise, with a slight shift towards manufactured housing units that would make up roughly half of the town's 2,700 total units. To absorb the residents leaving Paradise, this scenario assumes that Chico enacts pro-development policies and that market conditions, or policy mechanisms, allow for Chico to grow as an economic hub in the region. This scenario imagines that the widespread adoption of ADUs and infill development in Chico will facilitate this growth.

The primary intent of the 'Managed Retreat' is to model the impacts of reducing development in the WUI by pur-

Table 13 Paradise Scenarios Overview

Scenario	Overview
(Re)Building as Usual	Assumes 25-50% of pre-fire population in Paradise, due to the scale of the disaster Serves as middle ground between the other two scenarios, with clustered development and slightly more condensed town footprint
Managed Retreat & Urban Density	Assumes 25% of pre-fire population in Paradise Stresses relocation to locations outside of high fire risk areas and outside Paradise Reconfigures land use around significantly condensed town footprint surrounded by a green buffer
Resilience Nodes	Assumes 50-75% of pre-fire population in Paradise Reconfigures land use around higher density residential "nodes" surrounded by green buffers Emphasizes affordable manufactured housing

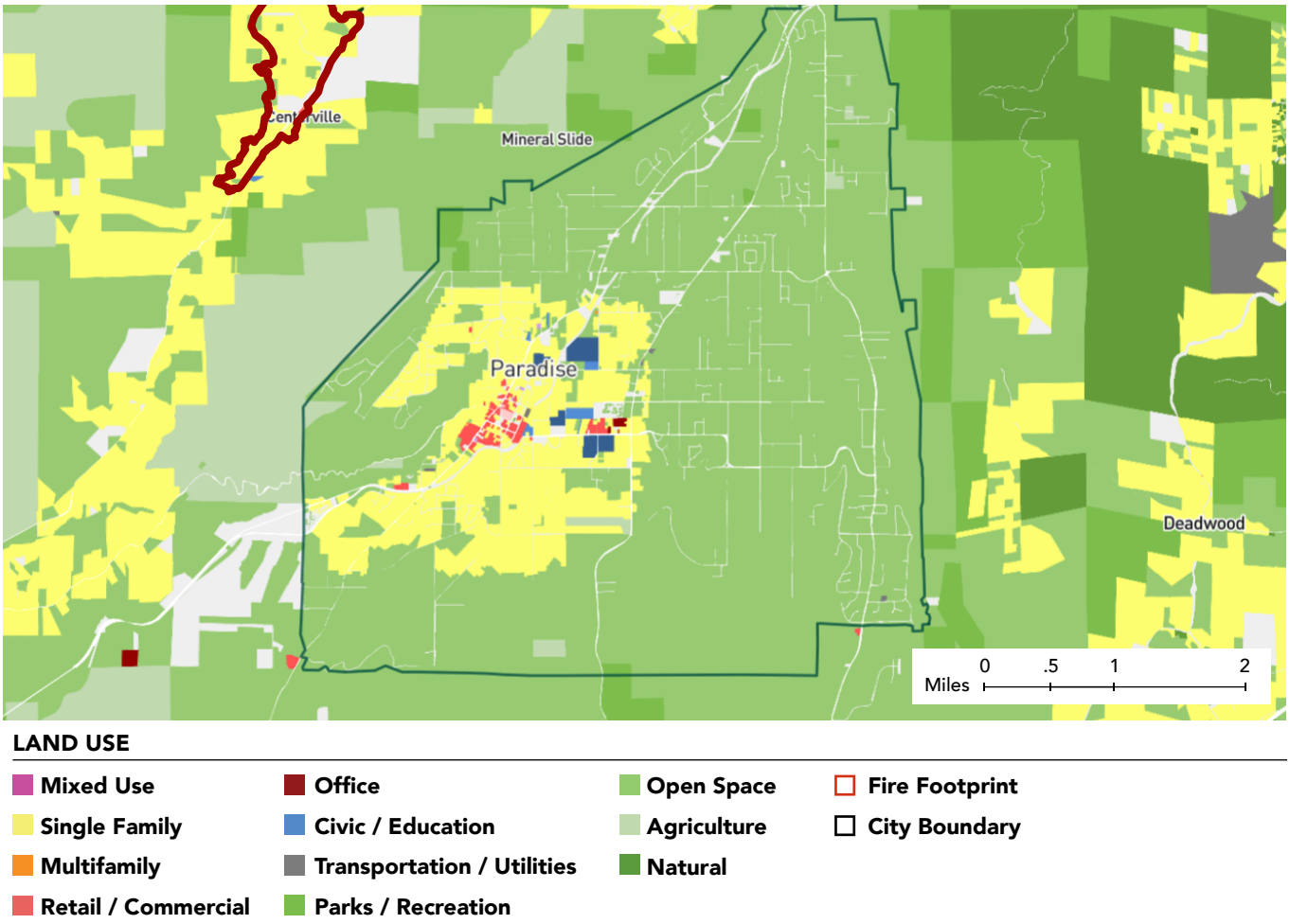
Figure 11 Paradise (Re)Building as Usual Scenario



posefully focusing development into infill locations. With the entire Paradise town footprint located in the VHFHSZ, this scenario reduces the population in the VHFHSZ by 9,531 units, or 66 percent. While all scenarios test the feasibility of various mitigation strategies for creating fire adapted communities, such as buffers, home hardening, and land use configurations, these strategies could very well be rendered meaningless in the case of another disaster-level wildfire event. With that in mind, removing people from the FHSZ is the most effective way to minimize the loss of life and property if disaster strikes again. However, without planned development elsewhere, there is potential for former Paradise residents to relocate to other WUI locations, which would negate the positive effects of limiting the Town's population. Infill development, as previously discussed, is associated with lower vehicle and household emissions as compared to typical suburban development.[152] While all three scenarios reduce VMT (miles/DU/year) when compared to pre-fire development patterns, this scenario produces the most significant reduction of roughly nine percent or a VMT reduction of 3,150 miles/DU/year. Additionally, this scenario projects the lowest residential energy use (million British thermal units/DU/year), a 15 percent reduction from the base, and the lowest GHG emissions (metric tons/DU/year), a 19 percent reduction from the base canvas.

While this scenario addresses many of the intended goals of this analysis, there are significant barriers to implementation. Conversations with local stakeholders revealed a strong attachment to place and a desire to maintain a certain way of life found on the Ridge. This suggests that a program to relocate people to an even denser Chico could be culturally inappropriate and garner strong opposition. Policymakers would need to develop tools that effectively incentivize growth and relocation to infill locations, while targeting both receiving

Figure 12 Paradise Managed Retreat & Urban Density Scenario



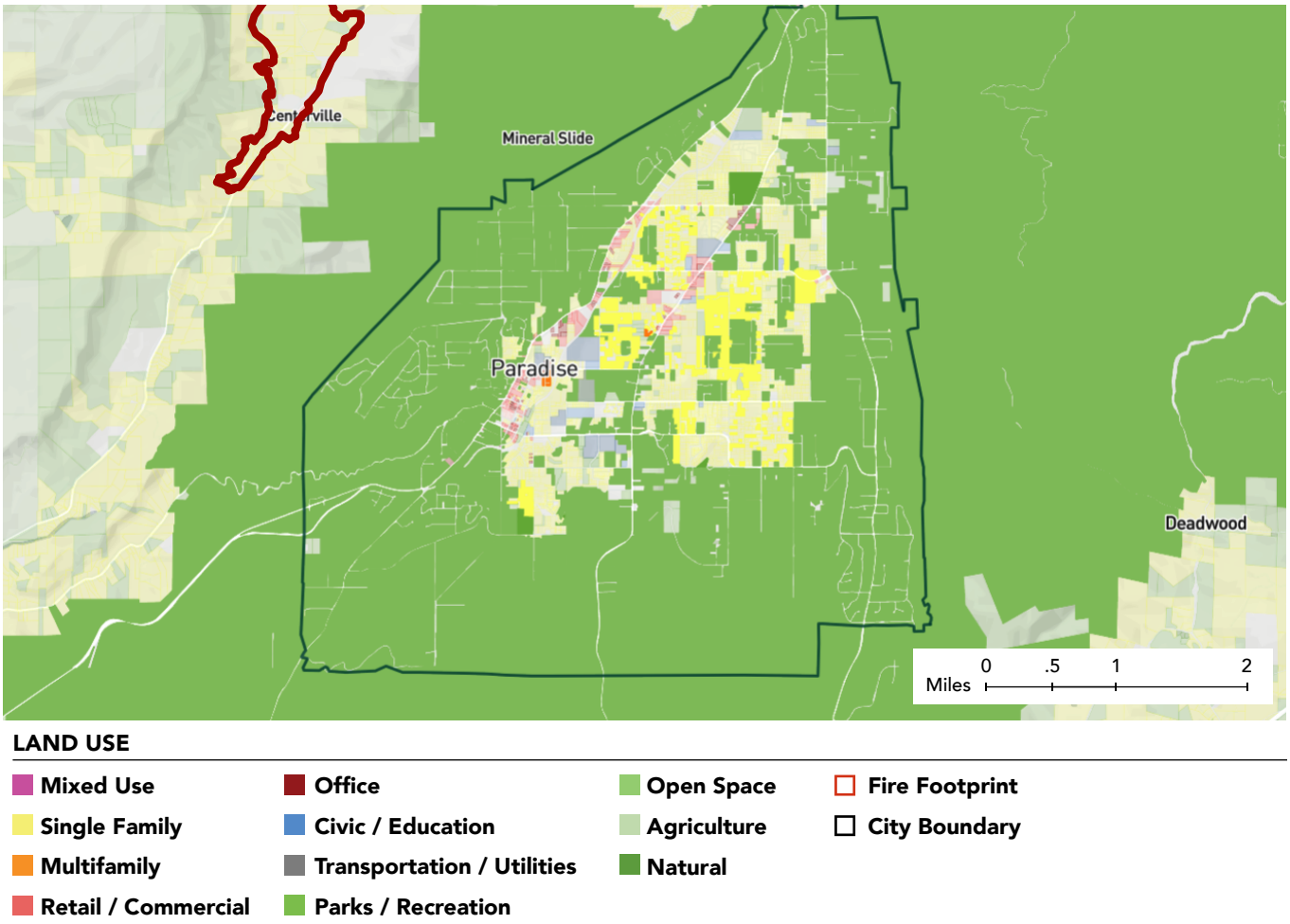
communities (Chico) and migrating residents. In particular, policymakers should explore buyout programs and TDRs as valuable tools for facilitating relocation out of high-risk communities and financing housing elsewhere. Additionally, widespread ADU development would likely need support in the form of reduced barriers to development (e.g., streamlined permitting, reduced complexity), specialized financing tools, and other incentive programs that could target homeowners in fire safe locations.

Scenario 3: Resilience Nodes

The 'Resilience Nodes' scenario prioritizes the urgent housing shortage and displacement challenges as a result of the Camp Fire and offers a more affordable, and potentially more politically acceptable, pathway for recovery in Paradise and Butte County. Interviews with key stakeholders in Paradise and Butte County provided a measured hope that communities on the Ridge like Paradise would be able to rebuild enough to return to the sense of community that residents enjoyed before the fire. Officials from the Town of Paradise anticipate that realistically that only half of displaced residents will ultimately return, noting the multi-decade recovery process ahead. With over 40,000 people displaced in one morning, the Camp Fire affected the housing market and security for all of Butte County, and the County and its cities face an urgent challenge of replacing enough housing affordable for disaster survivors while also meeting supply needs for the future. This scenario assumes greater return to Paradise than in the '(Re)Building as Usual' scenario, because it aims to explicitly address the housing issues facing the region. This scenario explores what it looks like if that development necessarily needs to be in higher fire risk areas like Paradise to respond to both the housing shortage and the expressed desire from residents to rebuild their community.

'Resilience Nodes' explores land use, housing rebuilding, and fire mitigation strategies that could facilitate a

Figure 13 Paradise Resilience Nodes Scenario



safe, affordable return to Paradise. Assuming that 50-75 percent of the pre-Camp Fire population (approximately 16,200 residents) returns, it posits that redevelopment would focus around moderately higher-density residential nodes surrounded by green buffers that could slow the advance of a fire and create defensible space around homes and businesses. This land use configuration aligns with the approach that has been recommended by some land use and fire science experts. Other county jurisdictions would absorb some previous Paradise residents.

To meet affordability needs and production targets, 'Resilience Nodes' emphasizes manufactured housing sited in clustered patterns. It envisions 16,616 manufactured units in the county, fully 5-6,000 greater than the other two scenarios. Manufactured housing communities (MHCs) are more energy and resource efficient than single family homes and can be sited in more space-efficient ways. However, the scenario does place more development back in high-risk areas than the following two scenarios, although there would still be 1,712 fewer units in the FHSZ than before the Camp Fire. Since Paradise and Butte County already had a significant share of manufactured homes, local opposition to additional units should be limited. The Town of Paradise and Butte County could further support the security and safety of MHCs by zoning land for MHCs to prevent turnover and evictions and by investing in land banks that can offer greater stability and wealth building opportunities for residents.

Housing affordability is the primary concern of this scenario; thus, it provides the greatest number of new units in Paradise. However, it also offers less than the other scenarios in terms of job creation and economic and fiscal impact. Based on the siting and associated transportation patterns of the housing clusters, it results in largest

increase in emissions both through reduced carbon sequestration and increased vehicular emissions. Thus, the economic, carbon, and risk impacts of 'Resilience Nodes' are all less desirable than '(Re) Building as Usual' and 'Managed Retreat.'

Because this scenario involves significant repopulation of a high wildfire risk area, significant investments in wildfire mitigation projects and maintenance are necessary to protect these rebuilt assets. Therefore, while there are fewer upfront housing costs, future building code updates, vegetation management, and the potential for another disaster pose greater long-term costs. Because many of the rebuilt units are manufactured, and manufactured home residents are generally lower-income than single family residences, this scenario raises equity concerns about relocating so many low- and moderate-income households back into higher-risk areas and recreating patterns of vulnerability.

Equity Implications of Paradise Scenarios

Similar to Santa Rosa, these alternative futures pose concerns related to an equitable recovery process that benefits all affected residents, especially those most vulnerable to displacement and financial hardship. Each of these scenarios encourage some level of relocation to other non-WUI areas of the county, such as Chico, and rely on a buyout or TDR program to remove homes from the VHFHSZ. Given that the average home value in Paradise is half that of the state average, this could place a financial burden on homeowners if their compensation does not match the cost of living in the receiving geography. Furthermore, the researchers learned from stakeholder interviews that many residents of Paradise were uninsured or underinsured, which may drastically impact their ability to rebuild in a higher income area if they do not receive assistance from an insurance payout.

Each scenario also incorporates greenbelts as fire buffers both surrounding the town and within town amongst residential development nodes. Depending on their designated use and design, these could also drive up land values and therefore housing costs in Paradise, ultimately impacting its affordability.

Table 14 Paradise Scenarios Outputs Summary, Butte County

	PARADISE (BUTTE COUNTY)			
	Base Canvas	(Re) Building as Usual	Managed Retreat & Urban Density	Resilience Nodes
Fire Risk				
Units in the Fire Hazard Severity Zone (FHSZ) *	46,819	41,894	37,814	45,107
Net Change from Base		*-4,925*	*-9,005*	-1,712
Housing Supply				
Population	232,784	236,778	236,816	237,589
Households	89,691	92,284	93,231	93,038
Dwelling Units (DU)	101,961	103,941	104,799	104,703
Large Lot Detached Single-Family DUs	67,400	60,450	57,416	58,231
Small Lot Detached Single-Family DUs	9,150	17,420	18,597	19,262
Attached Single-Family DUs (Duplex & Townhome)	6,933	6,646	7,890	8,784
All Multifamily DUs	18,478	19,426	20,895	18,426
Affordability				
Residential Energy Cost (dollars/DU/year)	$2,141	$1,840	$1,809	$1,624
Transportation Cost (dollars/DU/year)	$28,096	$24,148	$22,710	$21,394
Water Costs (dollars/DU/year)	$950	$876	$797	$745
Climate Mitigation				
Residential Energy Cost (dollars/DU/year)	$2,141	$1,840	$1,809	$1,624
Transportation Cost (dollars/DU/year)	$28,096	$24,148	$22,710	$21,394
Water Costs (dollars/DU/year)	$950	$876	$797	$745

** Based on Cal Fire hazard risk maps as they appear in 2020*

Table 15 IMPLAN Economic Impacts Analysis, Butte County

	BUTTE COUNTY		
	(Re)Building as Usual	Managed Retreat & Urban Density	Resilience Nodes
One-Time Economic and Fiscal Impact			
Economic Output	$8,391,157,905	$7,577,879,467	$6,612,593,189
Sales, Income, and Other Local and State Taxes	$357,214,143	$323,110,661	$281,963,907
Jobs Created	57,348	51,005	44,631

Estimates generated using IMPLAN

Each scenario also relies on the development of mobile or manufactured homes as a means of creating affordable housing stock. However, manufactured homes present their own challenges, as manufactured home residents are generally lower-income and more vulnerable than populations in single family homes and do not own the land under their homes, putting them at risk of displacement. The Resilience Nodes scenario recommends the greatest amount of redevelopment back in the VHFHSZ with mobile homes as the dominant housing type (60%), therefore raising concerns about relocating so many low- and moderate-income households back into higher risk areas potentially recreating patterns of vulnerability. For homeowners deciding to remain in Paradise and rebuild, building costs will be higher due to more stringent building codes and the high demand for local labor and materials. They will also likely face higher insurance costs into the future. This has the potential to place increased financial burdens on residents, the majority of whom are living on a fixed income.

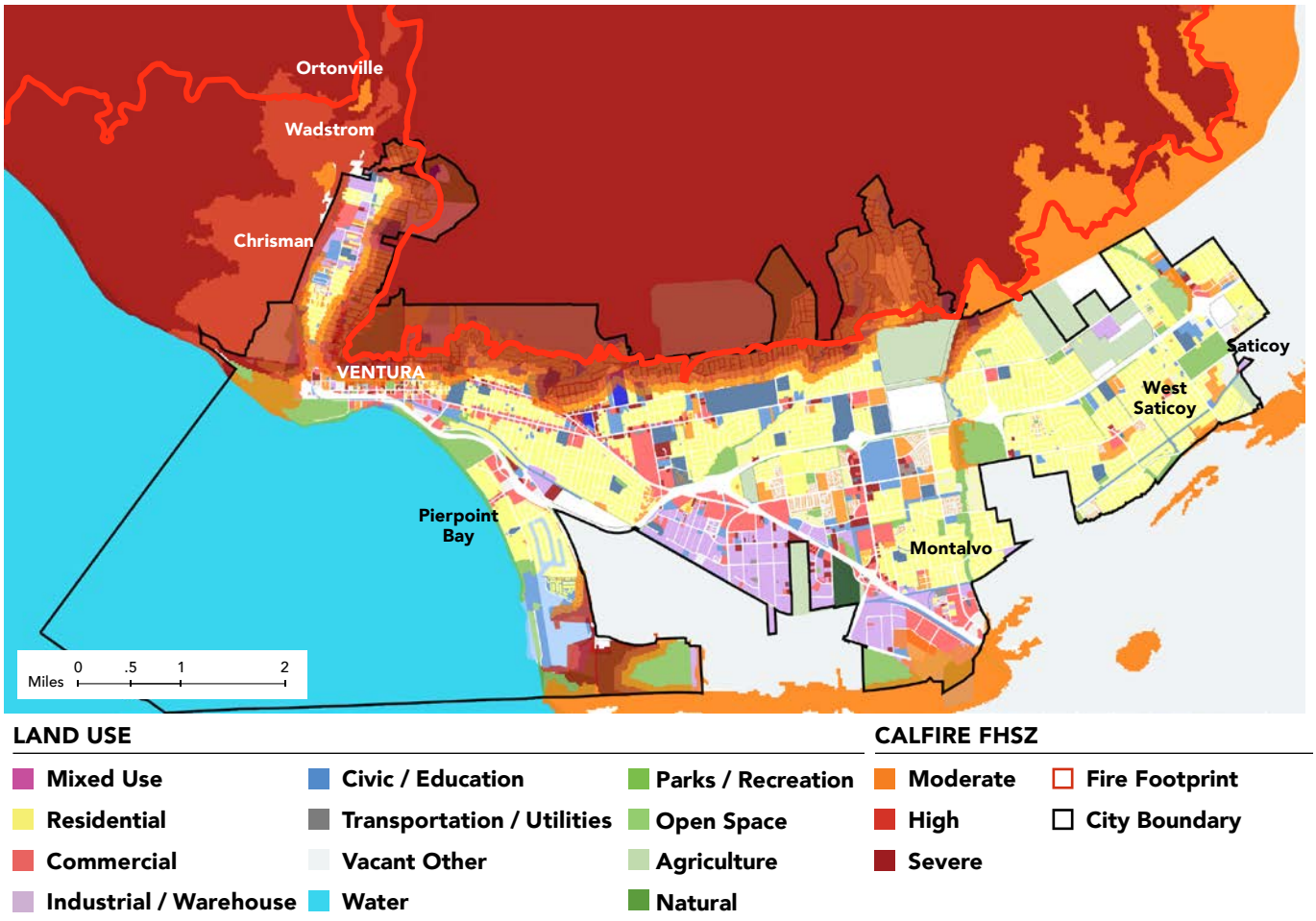
Rebuilding scenarios for Paradise face unique challenges due to the decimation of so much naturally occurring affordable housing. Without significant public subsidies, the rebuilt housing will have to be more expensive to reflect the price of new development and the infrastructure costs of rebuilding (e.g., sewer, roads).

Paradise Findings

Strategic relocation from the WUI to infill locations is associated with reductions to VMT and GHG emissions. ADUs offer potential for affordable and regionally appropriate density, but widespread adoption will likely require advantageous policy and financing incentives for homeowners. Manufactured housing offers affordability benefits and upfront building cost savings, but there may be barriers to widespread use of manufactured units. These include siting relative to jobs and associated GHG emissions, ensuring fire safety in community design, and developing community ownership models, as the authors recognize that existing models for manufactured communities are often exploitative in nature.

Table 15 shows that the (Re)Building as Usual scenario has the greatest estimated economic and fiscal impacts at the county level. This is likely due to the number of single-family homes projected in that scenario. Many municipalities rely on fiscal and economic impact studies like these when approving new development and considering land use changes. However, these snapshots fail to include the costs associated with increased environmental harm (e.g., greenfield development, higher VMT), decreased housing affordability, and most significantly, potential wildfire destruction. Better evaluation metrics would allow municipalities to understand the real economic and fiscal impacts of sprawling single family land use development.

Figure 14 Land Use, Thomas Fire Footprint, and Cal Fire's Fire Hazard Severity Zones in the City of Ventura



Ventura

City and Demographics

Ventura, officially San Buenaventura, is a coastal incorporated city in Ventura County with strong cultural and economic ties to the surrounding farm economy and a vibrant tourism industry. It is the second largest city in Ventura County with 109,910 people. The City's population is 86 percent White, and 36 percent of residents identify as Hispanic/Latinx. The median household income is $78,882, and the median home value is $661,000.153 Single-family detached homes make up 56 percent of the City's units, while 11 percent are attached single family; five percent are mobile/manufactured; eight percent are "missing middle" (2-4 units); and 26.5 percent are larger multifamily (5+ units).[154]

The Thomas Fire in Ventura County, and specifically its impacts on the City of Ventura, offer a markedly different wildfire resilience profile than the previous two case studies. Being in southern California, Ventura's surrounding landscape is drier and scrubbier than the other two case studies. The City is primarily located on a coastal alluvial plain at the base of the Ventura foothills. The surrounding mountains have a long history of wildfires but have been primarily left undeveloped because of decades-long agricultural land and open space preservation policies.

The City of Ventura adopted a Save Open-spaces and Agricultural Resources (SOAR) ordinance during the late 1990s that prohibits conversion of open and agricultural lands for urban development, except when a qualifying project is approved by a voter majority. Seven other cities in Ventura County have subsequently enacted SOAR. In 2016, Ventura County cities extended SOAR through

2050.[155,156,157] Strong political support for protecting Ventura's natural resources also reduces development on high wildfire risk land. However, local support for preserving the agricultural character of the County and its cities also creates opposition to community change. Ventura County regionally has a reputation for being tough on developers, and NIMBYism continues to be a potent political force in the City of Ventura and other incorporated jurisdictions in Ventura County.[158]

Thomas Fire

The Thomas Fire ignited near Santa Paula on December 4, 2017 due to problems with electrical equipment owned by the electric utility company Southern California Edison. Powerful Santa Ana winds pushed the fire 12 miles west to the City of Ventura in only a few hours.[159] While the Thomas Fire was spatially the largest fire in California's history at the time (exceeded by yet larger fires, including the Camp, in subsequent years) burning nearly 282,000 acres, it only burned 1,603 structures—far fewer than the 5,643 structures burned in the Tubbs Fire and over 18,000 burned in the Camp Fire. The Thomas Fire itself only resulted in one firefighter and one civilian casualty. However, winter rains that followed the fire resulted in widespread landslides that resulted in 21 civilian fatalities in Montecito in neighboring Santa Barbara County.

The Thomas Fire still inflicted $2.2 billion in damage, forced over 100,000 people to evacuate their homes, and incurred $230 million wildfire suppression costs, greater than the $100 million for the Tubbs Fire and $150 million for the Camp Fire. Efforts to combat the Thomas Fire brought together 8,500 firefighters, the single largest wildfire fighting force in California history.[160,161] These costs indicate that even if suppression is effective at reducing damage and harm, development in high-risk areas imposes indirect costs on state taxpayers, who reimburse local wildfire commissions.

Displacement from the Thomas Fire

The Thomas Fire displaced 2,774 households and of those, 368 (13%) had moved to a new census tract by 2019. Of those who moved census tracts, 150 (41%) were senior-led households. There were 0.34 children per household for those who moved, compared to 0.44 children per households for those who stayed, indicating that having children is negatively associated with relocating. Low-income households represented 17 percent of households that relocated, compared to 25 percent of households that stayed, indicating that lower-income households were less likely to move. While 14 percent of all affected households were renters, 16 percent of households that moved were renters.

Households that moved census tracts saw significant income losses, with the average household income drop of $81,209 in the first year after moving, and an increase of $8,698 in the second year after moving. Households that moved also on average moved to lower income census tracts. Of the households that moved, the average household income in the pre-disaster census tract was $101,677, while the average household income in the post-disaster census tract was $82,875.

Thomas Fire Recovery

This case study looks at the City of Ventura because it exemplifies the wildfire risk, housing, and land use regimes throughout Ventura County. The City of Ventura lost 530 homes to the Thomas Fire, which primarily affected more expensive single-family homes built in the foothills.[162] According to a City official, more vulnerable lower-income neighborhoods, which are primarily lower-income Hispanic/Latinx and have fewer emergency evacuation routes, were fortunately spared. One former City official speculated that the Thomas Fire's death toll would have been much higher had the fire swept down the hillside and into neighborhoods on the east side of Ventura. Ventura saw near total compliance with the evacuation orders in advance of the Thomas Fire, potentially influenced by the experience of residents who suffered the deadly wildfires in Northern California (Tubbs) earlier that year. This context also helps explain why the Thomas Fire's death toll was so low.

After disasters, local officials feel political pressure to support rebuilding lost homes, but given alternatives, many disaster survivors would prefer to relocate somewhere without the wildfire risk.[163] Of the 530 homes that burned, approximately 200 of the homeowners chose to rebuild, while close to 300 took their insurance money and moved somewhere else, according to a City official. Many of these residents are older and may not want to deal with the rebuilding and home hardening process. Many of the burned lots are for sale for future buyers,

Table 16 Ventura Scenarios Overview

Scenario	Overview
(Re)Building as Usual	Serves as a status quo scenario and point of comparison for Scenarios 2 and 3
	Assumes one-for-one replacement of residential units within the City of Ventura that were destroyed in the Thomas Fire
Managed Retreat & Urban Density	Moves residents out of Thomas Fire perimeter and high fire risk zone
	Residents are relocated throughout the city in ADUs and missing middle housing located in close proximity to transit
Resilience Nodes	Meet City and County RHNA targets by greatly increasing the density of residents around high quality transit nodes
	Does not address residential units in high fire risk zones

who could build new homes on them. The City of Ventura has already approved 308 units for rebuilds and has 47 units pending approval; 42 units have been rebuilt and approved for occupancy.[164] Thanks to state regulations, these homes need to rebuild to more stringent code standards than required when they were first built.

While the disaster and the rebuilding process primarily affected Ventura households with the insurance coverage and resources to rebuild or relocate, the rebuild area will continue to be exposed to the same types of large wind-fueled wildfires in the future. Moving forward, the City of Ventura could work with survivors to plan for an alternative rebuilding process that does not put new homes back in such high-risk areas and could reconsider where new housing in the City could go to house relocated residents and future growth.

Some City of Ventura elected officials demonstrate an understanding that infill development is both needed and inevitable. The City is producing unprecedented numbers of multifamily infill units. One former City employee explained that "all of the stars aligned" in Ventura a decade ago when it had a majority on the City Council supporting upzoning for infill development. Its pro-infill leadership set the City up to better meet a previously unmet demand for multifamily rental units, with nearly 3,000 multifamily units recently completed or nearing completion.

Additionally, greater state enforcement of existing housing laws reduces some regulatory and process chokepoints for new infill and affordable housing development. Proposed legislation SB 9 (2021) would allow for duplexes by right on any parcel in California currently zoned for a single-family residence— his is in contrast to previous failed bills (SB 827 and SB 50) that would have expanded housing capacity largely through transit-oriented development corridors in job-rich neighborhoods.[165] One official recognized that, because of SOAR, all of Ventura's new development is infill development and new housing laws mean that if more housing supply isn't permitted, then "a judge will be making decisions on the future of development in the City of Ventura."[166] One City of Ventura employee posited that when "you think about the tens of thousands of single-family housing we have, if just a fraction of those built ADUs it would make a difference."[167] One former official commented that "those same advocates for SOAR need to be at the table advocating for infill housing, that is the missing link."[168] Higher RHNA allocations and new state housing laws strengthening enforcement of housing production—including SB 35 for streamlining housing approval and SB 166 for no net loss of zoned housing capacity—provide political cover for local officials who recognize the need to enable infill housing but face constituent pressure.[169]

Vegetation management and wildfire suppression also involves multiple jurisdictions; while the City of Ventura saw 500 homes burn down in the Thomas Fire, it ignited and spread rapidly through unincorporated Ventura County, only then reaching the City. According to at least two local officials, more robust vegetation management may have prevented some structural losses. However, California's post-Proposition 13 fiscal regime strains

Table 17 Housing Supply in Ventura Scenarios

	HOUSING SUPPLY		
	(Re)Building as Usual	Managed Retreat & Urban Density	Resilience Nodes
Population	108,371	97,517	122,364
Dwelling Units (DU)	42,858	42,966	52,342
Net Change in DU vs Scenario 1		*+108*	*+9,484*
Large Lot Detached Single-Family	17,655	5,654	16,738
Small Lot Detached Single-Family	11,185	10,160	10,543
Attached Single-Family (Townhomes)	7,080	17,150	8,368
All Multifamily	6,938	10,002	16,693

Notes: The above table represents the housing units simulated in the UrbanFootprint scenario planning software. Population represents UrbanFootprint estimation based on the number and type of housing units.

municipalities,[170] which are facing concurrent challenges, including pension obligations, deteriorating infrastructure, and the housing crisis—and now climate change and disaster recovery.

Based on the interviews that informed this report, local governments might not have the appetite or capacity to fund expanded wildfire adaptation or buyout and relocation programs, even if such programs reduce their fiscal vulnerability to wildfires and could have beneficial fiscal impacts on the long-term. Relocation or retreat could be politically divisive propositions, and local governments do not want to risk losing residents and their associated tax revenues. In 2020, the Strategic Growth Council awarded the City of Ventura a $200,000 grant from the BOOST pilot program funded by the Proposition 84 Wildfire Resiliency and Recovery Planning Grant to support future wildfire preparedness.[171] Such state investments mark a starting point for investing wildfire resilience in WUI communities.

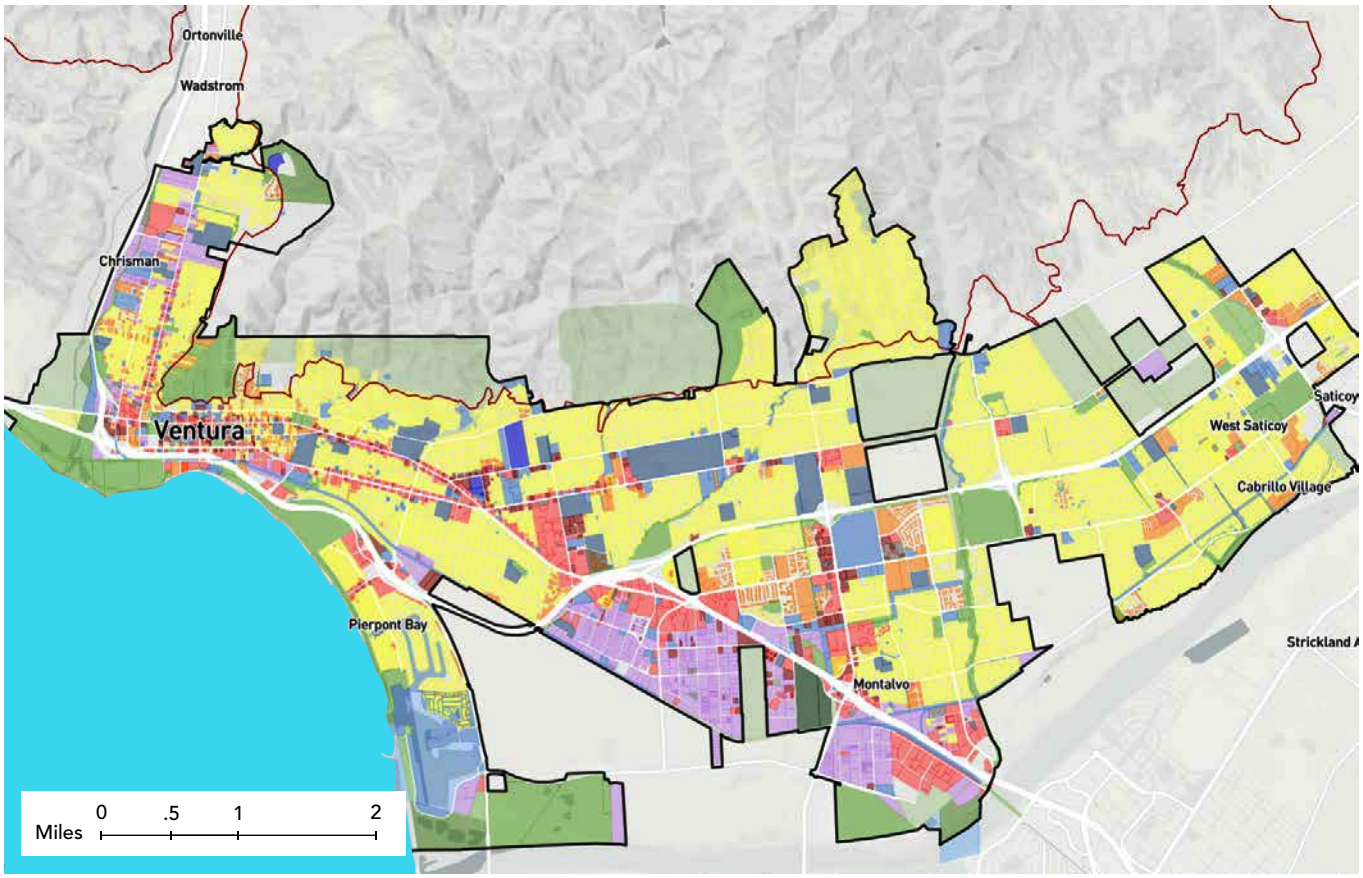
Until 2050, Ventura and other cities in the County are set to protect their existing working lands and limit new development in the wildland urban interface. The challenge will be ensuring that enough housing supply affordable for all income levels can meet the demand of its growing population.

Equity Implications in Ventura

Additional social equity issues emerge, especially for people living in the unincorporated areas of the County, such as farmworkers and undocumented residents. Many undocumented farmworker-residents whose homes burned down in the Thomas Fire do not live in the City proper but rather in farmworker housing in WUI areas of the unincorporated County. These represent some of the highest risk housing in the whole County. This is not just a housing and urban development issue, but also a labor rights issue. Many farm owners required farmworkers to continue working during the Thomas Fire, despite the hazardous smoke. Even though undocumented residents paid over $2.5 billion in taxes in 2019, they are not eligible for federal assistance from FEMA and HUD, so the state, local governments, and philanthropy have had to attempt to fill in the gap.

The 805 UndocuFund, based on the UndocuFund piloted in Sonoma County after the Tubbs Fire, provided case management, temporary housing, and other disaster assistance for undocumented residents. Effective advocacy resulted in Governor Newsom approving a Disaster Relief Fund for undocumented Californians, including $75 million in state funding and $50 million from philanthropic partners. This fund provides $500 for individuals and $1000 for households.[172] This is a start but does not begin to match the assistance available for homeowners post-disaster, though insurance, individual assistance, low-interest federal loans, and block grants.

Figure 15 Ventura Pre-Thomas Fire Land Use



LAND USE

- Mixed Use
- Residential
- Commercial
- Industrial / Warehouse
- Civic / Education
- Transportation / Utilities
- Vacant Other
- Water
- Parks / Recreation
- Open Space
- Agriculture
- Natural
- Fire Footprint
- City Boundary

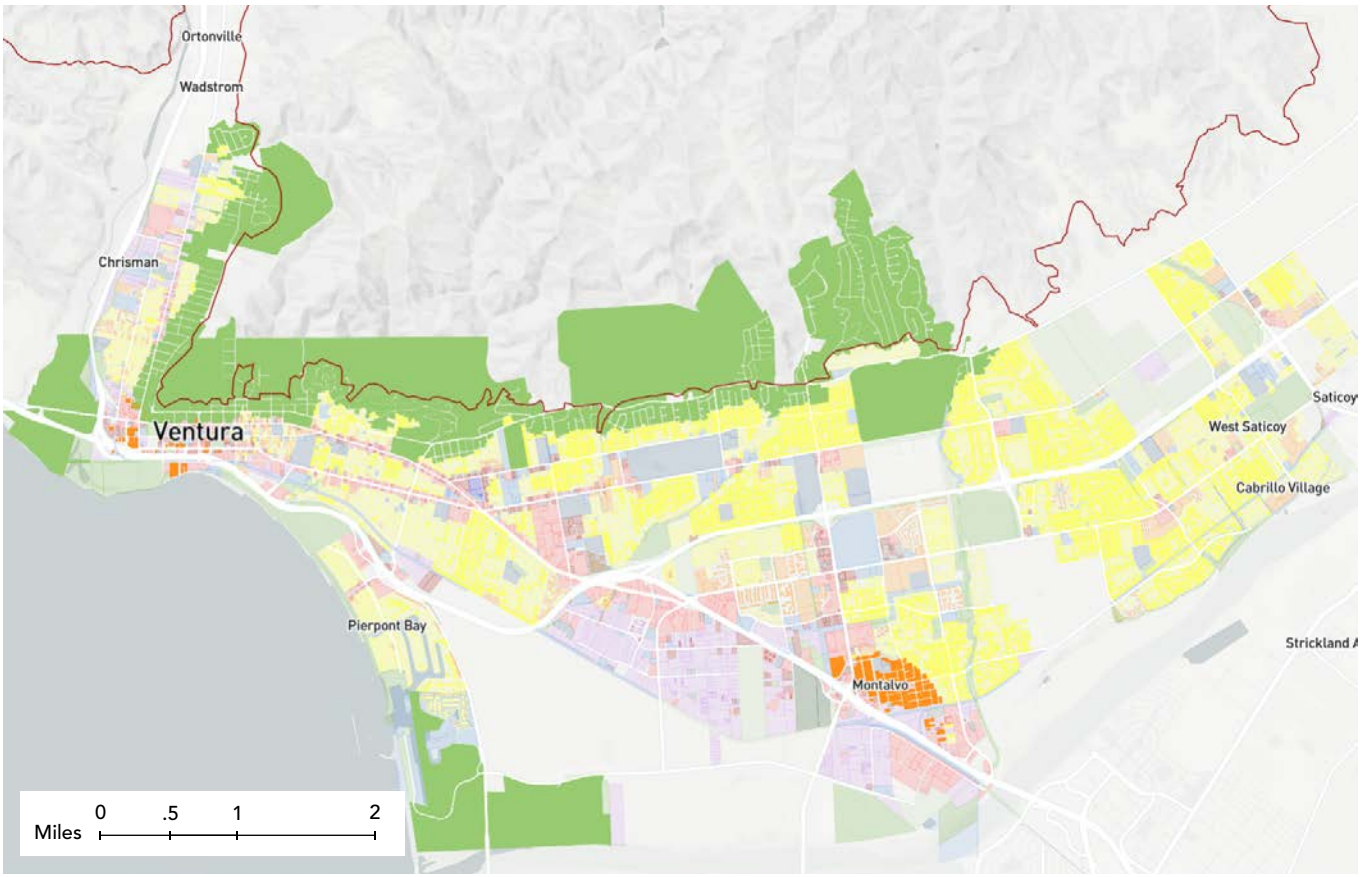
Ventura Scenarios

The research team built these scenarios to examine the impacts of one baseline and two alternative recovery pathways in Ventura. The scenarios demonstrate different approaches to address regional housing needs (projected as 7,100 new units by 2029), reduce greenhouse gas emissions, mitigate future wildfire risks, and generate fiscal and economic impacts. The alternative recovery scenarios are intended as illustrative approaches to inform similar Californian cities' strategies, rather than as prescriptive planning proposals for Ventura.

Scenario 1: (Re)building as Usual

This scenario anticipates no significant policy or land use change, and does not anticipate additional development in Ventura above one-for-one replacement of the units destroyed in the Thomas Fire. The majority of the approximately 500 replacement units are single family dwellings. One low-rise and one high-rise multifamily building are envisioned as part of this scenario.

Figure 16 Ventura Managed Retreat & Urban Density Scenario



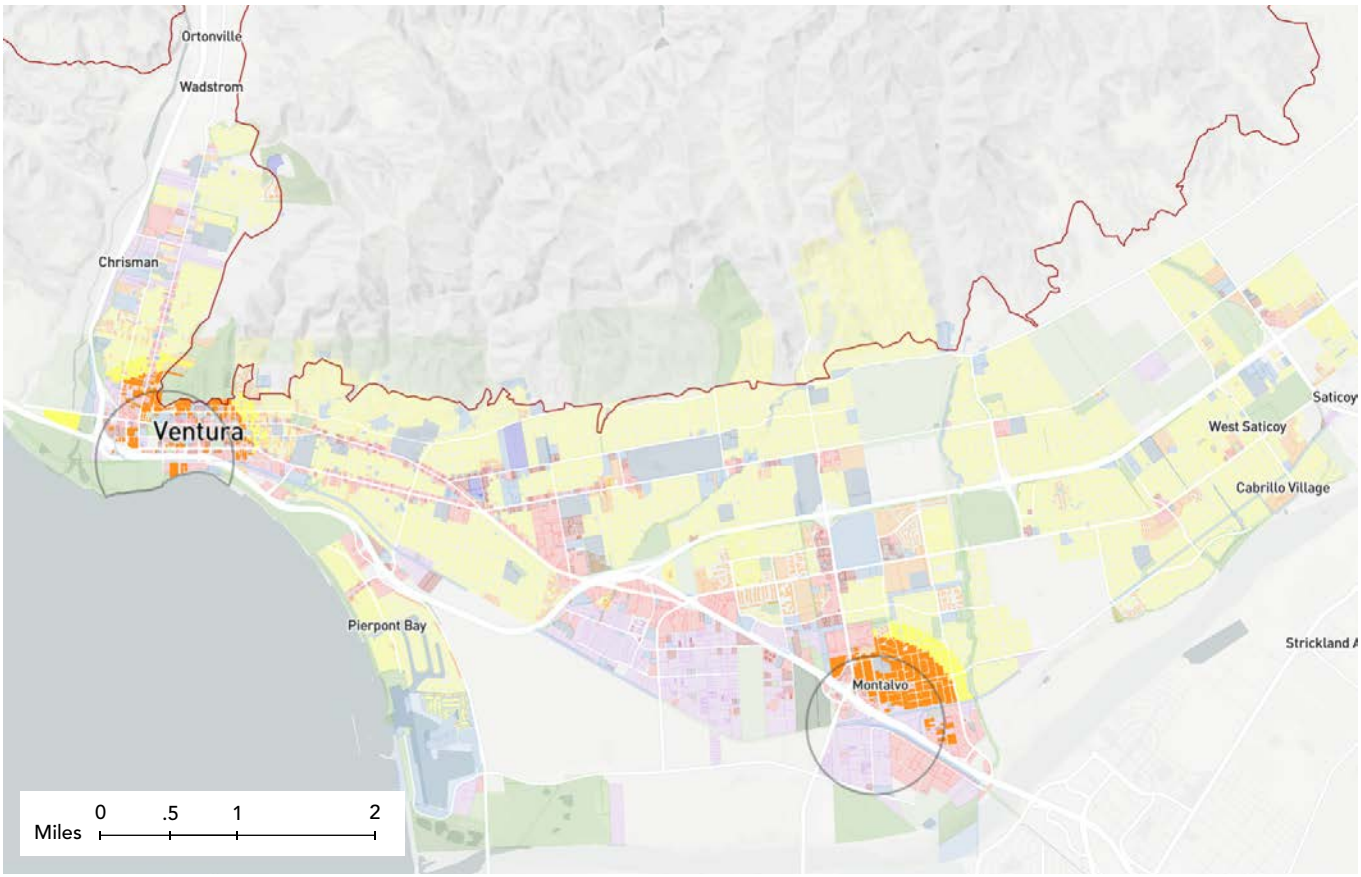
Scenario 2: Managed Retreat & Urban Density

This scenario models a managed retreat of residents relocating from the high-risk WUI to lower risk areas throughout the city. The gentle density envisioned under this scenario—anticipated as ADUs dispersed throughout the city and a 'missing middle' typology in close proximity to transit—aims to reduce GHG emissions as well as transportation, energy, and housing costs per unit. Approximately 5,500 units are relocated out of the WUI; half are rebuilt as ADUs and half as missing middle units. On average, the 'missing middle' typology is three stories tall and has a floor area ratio of one.

While this scenario effectively reduces the share of units in high fire risk areas, it does not add residential supply to the city overall and therefore does not meet RHNA targets. Land in high fire risk areas is maintained as open space, creating a large contiguous green buffer on the edge of the city's urban development.

Given that many residents who lost their homes in the Thomas Fire have not yet begun rebuilding or chose not to rebuild in place, there are a number of vacant parcels that are ideal targets for buyouts to protect high-risk land from future development and wildfire disaster costs. Historically, Ventura has opposed higher density zoning; this approach therefore respects local resistance to upzoning while providing safer housing to Ventura's existing residents.

Figure 17 Ventura Resilience Nodes Scenario



Scenario 3: Urban Nodes

This scenario models how the regional housing need can be met through development in high-density nodes with high-quality access to transit. It does not, however, address units in high-fire risk areas within the city.

Recognizing that the region has significant unmet housing needs (8,780 units by 2029), this scenario creates sufficient supply in dense, walkable nodes. Residential parcels located within High Quality Transit Areas, as designated by the Southern California Association of Governments (SCAG), are modelled as podium multifamily, with an average height of four stories and average FAR of two. To complement this higher density core, single family parcels within 200 yards of the High-Quality Transit Areas are modelled as a slightly less dense form, with an average height of three stories and FAR of one. Finally, the city and county RHNA targets are met by converting single family parcels within 450 yards of the High-Quality Transit Areas as suburban townhomes, which are envisioned as averaging 2.6 stories and 0.8 FAR.

The urban nodes scenario emphasizes transit-oriented development, with concentrically decreasing density around transit nodes. SCAG's High Quality Transit Areas are defined by proximity to major transit stops or high-quality transit corridors. This definition is based on language in SB 375.

As noted, this scenario does not reduce the fire risk for existing residents. It is assumed that a transit-oriented development approach could be paired with other strategies to reduce risk for individual residents, such as home hardening subsidies.

Table 18 Fire Risk in Ventura Scenarios

	FIRE RISK		
	(Re)Building as Usual	Managed Retreat & Urban Density	Resilience Nodes
DU in the Fire Hazard Severity Zone *	9,758	4,676	11,739
Net Change from Scenario 1		*-5,082*	*1,981*
Moderate Fire Hazard Severity Zone	2,579	2,800	2,761
Net Change from Scenario 1		*221*	*182*
High Fire Hazard Severity Zone	*2,327*	*1,862*	2,463
Net Change from Scenario 1		*-465*	*136*
Very High Fire Hazard Severity Zone	4,852	14	6,516
Net Change from Scenario 1		*-4,838*	*1,664*

Table 19 Estimated Household Costs in Ventura Scenarios

	HOUSEHOLD COSTS		
	(Re)Building as Usual	Managed Retreat & Urban Density	Resilience Nodes
Residential Energy Cost (dollars/DU/year)	$1,944	$1,638	$1,753
Net Change from Scenario 1		*-$306*	*-$191*
Transportation Cost (dollars/DU/year)	$12,887	$10,779	$11,359
Net Change from Scenario 1		*-$2,108*	*-$1,528*
Water Costs (dollars/DU/year)	$663	$597	$532
Net Change from Scenario 1		*-$66*	*-$132*

Notes: Presented in 2020 dollars. Transportation cost combines fuel cost with other vehicle costs. Transportation cost is calculated based on present day transportation and commute patterns.

Ventura Findings

While the Managed Retreat & Urban Density scenario models a marginal increase in overall units (adding 108 above the baseline), the population is projected to decrease. This is likely due to the reduction in single family units and increase in multifamily, which are typically smaller and therefore accommodate fewer household members. Though the Managed Retreat & Urban Density scenario does not project a large increase in total units, the distribution of units is different from the baseline, with a major increase in non-single-family units.

The Resilience Nodes scenario projects an increase of approximately 14,000 residents in nearly 9,500 households. While this scenario does not anticipate major changes to the number of single-family units, there is a significant increase in the number of multifamily units (from 6,900 in the Rebuilding as usual scenario to nearly 16,700).

The Managed Retreat & Urban Density scenario projects an overall decrease in the number of units in the WUI, eliminating more than 5,000 units from fire hazard severity zones. The vast majority of these units are cut from the Very High Fire Hazard zone, greatly reducing the share of units in Ventura at-risk of wildfire. The Resilience Nodes scenario, in comparison, adds units to fire hazard severity zones. In this scenario, more than 1,660 units are added in the highest fire hazard severity zone. As this scenario adds nearly 9,500 units in total, the increase of units in fire hazard zones is not proportionate to the overall increase in units—but does not support wildfire risk reduction goals.

Both the Managed Retreat and Resilience Nodes scenarios offer household cost savings. These scenarios build more compact and denser housing types, which use water and energy more efficiently. The greatest cost savings are in transportation, as the denser typologies reduce residents' travel needs.

Table 20 Climate Impacts in Ventura Scenarios

	BUTTE COUNTY		
	(Re)Building as Usual	Managed Retreat & Urban Density	Resilience Nodes
Greenhouse Gas Emissions			
Total Greenhouse Gas Emissions (metric tons/year)	730,403	641,571	772,665
Net change from Scenario 1		*-88,832*	*42,262*
Greenhouse Gas Emissions (metric tons/DU/year)	10.9	9.4	9.7
Net change from Scenario 1		*-1.47*	*-1.20*
Residential Energy Use			
Residential Energy Use (million British thermal units/DU/year)	72.5	66.3	65.6
Net change from Scenario 1		*-6.12*	*-6.89*
Transportation			
Vehicle Miles Traveled (miles/DU/year)	11,495	9,456	10,059
Net change from Scenario 1		*-2,039*	*-1,437*

Estimates generated by Urban Footprint

Notes: Total Greenhouse Gas Emissions is made up of GHG emissions produced by passenger vehicles, total building energy use, and water use. Residential energy use combines electricity and methane.

Table 21 IMPLAN Economic Impacts Analysis, Ventura County

	VENTURA COUNTY		
	Jobs	Economic Output	Sales, Income, and other Local and State Taxes
One-time Construction Impacts			
Scenario 1: (Re)building as usual	2,094	$324,042,462	$16,577,005
Scenario 2: Managed retreat & urban density	17,162	$2,718,589,091	$139,785,921
Scenario 3: Resilience nodes	36,575	$5,033,019,001	$248,164,323
Ongoing Impacts			
Scenario 1: (Re)building as usual	0	$0	$0
Scenario 2: Managed retreat & urban density	1,922	$305,690,885	$16,164,279
Scenario 3: Resilience nodes	3,449	$555,843,732	$29,378,945

The Managed Retreat scenario, while maintaining the same number of overall units but in a different built form than Re(Building) as Usual scenario, reduces total GHG emissions by nearly 90,000 annual metric tons. The Resilience Nodes scenario adds more than 40,000 annual metric tons of emissions; this is likely due to the increase of nearly 9,500 total units. On a dwelling unit basis, both the Managed Retreat and Resilience Nodes scenarios project a decrease in GHG emissions. This can be attributed to more efficient land use patterns and unit layouts. Both alternative scenarios also forecast a reduction in residential energy use. The Managed Retreat scenario anticipates a reduction of more than 2,000 vehicle miles travelled per unit per year; the Resilience Nodes scenario forecasts a slightly smaller reduction in VMT of approximately 1,400 per year.

While the (Re)Building as Usual scenario generates some economic and fiscal benefits, both the Managed Retreat and Resilience Nodes scenarios catalyze significantly more economic activity. The scale of economic impact is directly related to the scale of residential development; in addition, on a per square foot basis, multifamily development

generates more economic activity. Construction of new units in the Managed Retreat scenario will generate more than 17,000 one-time jobs and more than $2.7 billion in economic output; the Resilience Nodes scenario will generate nearly twice the impact, creating more than 36,500 jobs and $5 billion in direct, indirect, and induced economic activity. Both alternative scenarios will also generate sizable ongoing impacts. The Managed Retreat scenario will create nearly 2,000 ongoing jobs (FTE) and more than $305 million in annual economic impact; the Resilience Nodes scenario will create nearly 3,500 ongoing jobs and more than $555 million in annual economic impact.

Appendix A provides supplemental details about the report's methodology for scenario exercise and displacement analysis.

ENDNOTES

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