Housing in America

INTEGRATING HOUSING, HEALTH, AND RESILIENCE IN A CHANGING ENVIRONMENT

Urban Land Institute Building Healthy Places Initiative

Urban Land Institute Terwilliger Center for Housing

About the Urban Land Institute

The mission of the Urban Land Institute is to provide leadership in the responsible use of land and in creating and sustaining thriving communities worldwide. Established in 1936, the Institute today has more than 32,000 members worldwide, representing the entire spectrum of the land use and development disciplines. ULI relies heavily on the experience of its members. It is through member involvement and information resources that ULI has been able to set standards of excellence in development practice. The Institute has long been recognized as one of the world's most respected and widely quoted sources of objective information on urban planning, growth, and development.

Suggested bibliographic listing:

McIlwain, John, Molly Simpson, and Sara Hammerschmidt. *Housing in America: Integrating Housing, Health, and Resilience in a Changing Environment*. Washington, D.C.: Urban Land Institute, 2014.

About the ULI Building Healthy Places Initiative

The ULI Building Healthy Places Initiative is leveraging the power of ULI's global networks to shape projects and places in ways that improve the health of people and communities.

In January 2013, ULI's board of directors approved a focus on healthy communities as a cross-disciplinary theme for the organization. Through the Building Healthy Places Initiative, launched in July 2013, ULI is working to promote health in projects and places across the globe. ULI is focusing on four main areas of impact:

Raising Awareness. Raise awareness of the connections between health and the built environment in the real estate community, and work to make sure health is a mainstream consideration.

Defining the Approach. Help to define and share information about the design elements, programming strategies, materials, and other approaches that improve health for people.

Exploring the Value Proposition. Build understanding of the market and nonmarket factors at play in building healthy places, and the value proposition of building and operating in health-promoting ways.

Advancing the State of Practice and Policy. Using the ULI membership as a lever, and in partnership with others, advance the state of policy and practice. Incorporate considerations about transportation, connectivity, and access, and encourage shifts in built-environment shaping policies.

Learn more at uli.org/health.

About the ULI Terwilliger Center for Housing

The mission of the ULI Terwilliger Center for Housing is to expand housing opportunity by leveraging the private sector and other partners to create and sustain mixed-income, mixed-use urban and suburban neighborhoods that incorporate a full spectrum of housing choices, including workforce housing, compact design, and connections to jobs, transit, services, and education.

The Center achieves its mission through a multifaceted program of work that includes conducting research, publishing, convening thought leaders on housing issues, and recognizing best practices that support the mission of the Center.

Learn more at uli.org/terwilliger.

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Acknowledgments

The project team for *Housing in America: Integrating Housing, Health, and Resilience in a Changing Environment* deeply appreciate the participation of ULI members and others who provided input to this publication. The team would specifically like to thank the communities of Cedar Rapids, Iowa; Greensburg, Kansas; and San Diego, California, for their contributions to this publication, as well as the following individuals:

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Contents

Introduction

Housing plays a crucial role in the lives of all Americans, no matter where they live. The Housing Act of 1949 set a goal of a "decent home and a suitable living environment for every American family,"[1] and while that may not yet have been achieved for all Americans, it remains a core aspiration.

A decent home starts with a structure that is safe, warm, and dry, with what we have come to accept as the basics for living a healthy life, including clean air and water and sanitation. However, these components are being threatened by an increase in extreme weather events. For a home to be safe and healthy today, it must also be resilient in the face of a growing list of unpredictable events, including floods, fires, droughts, wind, heat waves, and more.

Changes in weather patterns combined with a rapid accumulation of people in urban areas have led to increased losses and damages from extreme weather events. Sea-level rise exacerbates and expands the threat from storm surges. Floods with an expected return period of 100 years are returning with greater frequency. We are seeing unprecedented droughts, more frequent and intense forest fires, and heat waves and cold snaps that are stressing both people and systems.

Since many of these climatic changes are predicted to worsen more quickly in the future, building resilience into the places we live is critical to ensure healthy, robust, and thriving communities. Truly resilient communities also look beyond climate change to encompass aspects that lead to safer, healthier, and more productive lives for people at all times, not only in the face of a disaster.

This edition of ULI's *Housing in America* report explores how households and communities across the country are responding to the impacts of extreme weather events. Through three case examples, this report also shares how communities are creating and sustaining healthier and more resilient environments in the face of an ever-evolving climate.

The Climate Crisis: Why Resilience and Health Matter

Two indisputable trends are converging to make the need for resilience truly urgent: first, land use patterns in the United States have encouraged population concentration in cities and suburban areas, mostly in coastal regions;[2] and second, the climate is changing, bringing with its warmer atmosphere and higher seas a slew of dangerous, unpredictable weather events that are having an impact on coastal and inland communities alike.

The Intergovernmental Panel on Climate Change (IPCC) provides a clear review of the latest science on the changes in the climate. The IPCC's latest release—IPCC Assessment Report Five, a series of three technical reports—reviews in clear, indisputable language the dramatic shifts in the Earth's atmosphere and seas that have begun to occur over the past several decades. For instance, the Summary for Policymakers of the IPCC's *Climate Change: The Physical Science Basis* states:

> Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased.[3]

Climate change is projected to continue to evolve over this century and beyond. The average global temperature has risen about 1.5 degrees Fahrenheit since 1895, with 80 percent of this increase occurring since 1980. The most recent decade was the warmest on record. The global sea level has risen by about eight inches since reliable record keeping began in 1880. It is projected to rise an additional one to four feet by 2100 and will vary across regions.

Average precipitation across the United States has increased since 1900. Heavy downpours are increasing in most regions, with the largest increases occurring in the Midwest and Northeast. Further increases in frequency and intensity of extreme precipitation events are projected for most areas. Western regions have seen an increase in the prevalence of more intense heat waves and eastern regions have seen increases in intense flooding events as well as an increase in overall strength of hurricanes and the number of strong hurricanes in the North Atlantic since 1980. Meanwhile, other parts of the United States have seen decreased precipitation and are facing record droughts, including portions of the Southeast, Southwest, and Rocky Mountain States.

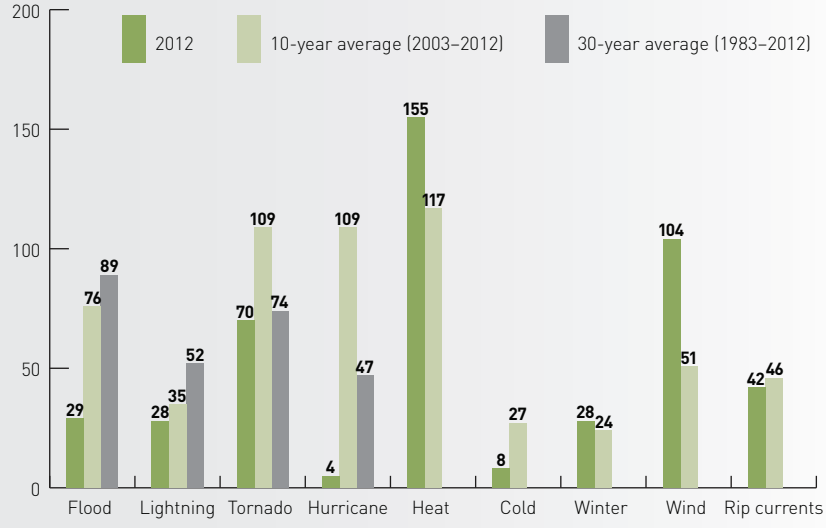
The impacts of climate change not only alter the physical environment, but also have ripple effects on the health of populations. The 2014 National Climate Assessment describes the impacts of climate change on human health, stating:

> Climate change, together with other natural and human-made health stressors, influences human health and disease in numerous ways. Some existing health threats will intensify and new health threats will emerge. Not everyone is equally at risk. Important considerations include age, economic resources, and location… Health effects of these disruptions include increased respiratory and cardiovascular disease, injuries and premature deaths related to extreme weather events, changes in the prevalence and geographical distribution of food- and waterborne illnesses and other infectious diseases, and threats to mental health.[4]

In addition, a second IPCC technical report, *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, explores pathways by which climate change affects health, including direct exposure based on changes in weather, including extreme heat and cold. These health impacts include altering food production cycles and inhibiting nutrition, exposing vulnerable populations to extreme heat waves, adding stresses on mental health, and impeding access to health care during disasters, among other impacts.[5]

Weather-related fatalities, specifically due to hurricanes and tornados, have increased substantially in the last ten years. In 2012 alone there were 155 fatalities due to extreme heat, with an additional 1,062 reported injuries. In addition to injuries and fatalities in populations subject to a weather catastrophe, these environmental conditions are resulting in increased incidences of severe stress and endemic trauma, which can result in growing declines in public health.

FIGURE 1. Weather-Related Fatalities in the United States, 2012



Source: Authors, using data from *Summary of Natural Hazard Statistics for 2012 in the United States*, National Weather Service. Retrieved from http://www.nws.noaa.gov/om/hazstats/sum12.pdf.

In addition to the health impacts of weather-related disasters, communities are also subject to the economic impacts of the loss of homes, businesses, and other community assets. In the United States, insured catastrophic losses in the 2000s totaled $139 billion. This represents a 56 percent increase over the 1990s amount of $89 billion.[6] From 1980 to 2011, 133 extreme weather events caused an estimated $881.2 billion in damage.[7] In 2012 alone, the National Weather Service and the National Oceanic and Atmospheric Administration estimate $37.2 billion in weather-related property damage, chiefly due to tornados, coastal storms, high winds, and drought-related fires.[8]

Entire communities are at risk of the loss of economic value due to business interruption, declining populations, restrictions on financing, and increased insurance costs. A new focus on resilience is needed to begin to alleviate much of this risk.

What Are Resilient and Healthy Homes and Communities?

Resilience is becoming a widely used term, although it can refer to a number of differing concepts. In this paper, we take resilience to mean "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events."[9] The ULI report *After Sandy* states that resilience is "the ability not only to bounce back [after a disaster] but also to 'bounce forward'—to recover and at the same time to enhance the capacities of the community or organization to better withstand futures stresses."[10]

Similarly, *health*—often understood to mean the absence of disease—has been expanded in recent decades to a more holistic definition. The World Health Organization definition—"a complete state of physical, mental, and social well-being"—

FIGURE 2. Disasters Ranked According to Recorded Economic Losses (United States, 1970–2012)

Disaster type	Year	Economic loss
Storm (Katrina)	2005	146.9
Storm (Sandy)	2012	50.0
Storm (Andrew)	1992	43.4
Storm (Ike)	2008	32.0
Storm (Ivan)	2004	21.9
Drought	2012	20.0
Storm (Charley)	2004	19.5
Flood	1993	19.1
Storm (Rita)	2005	18.8
Storm (Wilma)	2005	16.8

Source: *Atlas of Mortality and Economic Losses from Weather, Climate, and Water Extremes*, World Meteorological Association. Retrieved from http://www.wmo.int/pages/prog/drr/transfer/2014.06.12-WMO1123_Atlas_120614.pdf.

refers to not only individual health, but also the myriad inputs that determine health, including genetics, behavior, access to health care, economic opportunities, and the living and working conditions in homes and communities.[11]

Good health and well-being provide an individual with more resources with which to meet weather-related emergencies. These include the energy and ability to take care of themselves, their families, and their communities, as well as financial resources from decreased medical costs. Individual health is also important in everyday life. The health and well-being of people are greatly affected by the house and community in which they live.

Resilient and healthy people, homes, and communities have similar characteristics. These characteristics operate at the individual level as well as the level of the house and the community and, when well designed, work together to support each other. In order to protect the health and welfare of people in the face of extreme climate change, homes and communities need to become more resilient and healthier than ever before.

Definitions

What is resilience?

- "The ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events."

  From Disaster Resilience: A National Imperative.[12]

What is health?

- "Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity."

  From the World Health Organization.[13]

What is resilient housing?

- Resilient housing accommodates itself to the stresses that a weather event can provide. It is part of an extensive support system to create and maintain resilient people and communities.

  Adapted from the National Center for Healthy Housing[14] *and Plough et al 2013.*[15]

What is healthy housing?

- Healthy housing minimizes threats to health and safety and also promotes physical, mental, social, and environmental well-being. Healthy homes are a key part of a sustainable and resilient community.

  Adapted from the World Health Organization[16] *and Shaw 2004.*[17]

Interconnections: Housing, Health, and Resilience

A safe, resilient, and healthy home and community constitute a holistic system. The level of physical and psychological health and resilience can either support or undermine the entire system. With increasing threats from extreme weather, people and communities face damages, injury, and loss of life due to insufficient housing, lack of coordination in the face of events and after them, and inadequate planning for future events.

As environmental changes persist and extreme weather events occur with more frequency, it is becoming clear that most of our housing and communities are not adequately designed and operated to meet these changing conditions and protect the health and well-being of residents. While there is no standard approach to designing and building homes and communities to be resilient and healthy in the face of climate change, several tools, designs, and practices are presented in the community case examples featured in this report: Greensburg, Kansas; San Diego, California; and Cedar Rapids, Iowa.

Most important, strategies must constantly evolve as new information becomes available and the evolving needs of communities become clearer. Continuing innovation in housing and community design practices, building standards, and infrastructure

can help mitigate the growing risks presented by weather volatility and sea-level rise, while enhancing the livability and health of communities and strengthening their triple bottom line: social, environmental, and economic performance. Places and people who are healthy prior to disasters have a greater chance of resilience when faced with a disaster.[18]

From small towns with single-family homes on large lots to densely populated cities with medium- and high-density residential buildings, homes and communities across the country are evolving to be healthier and more resilient. Regardless of housing and neighborhood typology, innovations are occurring at every scale to make places more resilient in the face of a changing environment.

Building and sustaining truly healthy and resilient communities requires a comprehensive approach as shown in the community case examples presented in this report. A comprehensive approach not only improves a community's ability to withstand a disaster, but also allows it to become stronger and more sustainable for future generations.

Elements of Creating and Sustaining Resilient and Healthy Communities

The impacts of climate change present both persistent and unpredictable challenges for the built environment. In order to withstand and thrive in this uncertain future, communities across the country are reenvisioning their cities, neighborhoods, and homes to better withstand natural disasters. In doing so, these places not only are more physically resilient when faced with adverse impacts of future events, but also are strengthening their community health and well-being. Creating and sustaining resilient housing and communities takes a comprehensive approach.

The following five elements must be considered when developing with an eye toward health and resilience:

Developing Compact, Walkable, and Mixed-Use Places. People do not live just in houses: they also live in and experience neighborhoods. From small towns to high-density urban areas, neighborhoods in the United States can take many forms. However, regardless of typology, research has shown that neighborhoods that are pedestrian friendly, built with a mix of housing types, and proximate to retail, services, and other amenities are, in most cases, better able to withstand the impacts of extreme weather events.[19]

Positive health outcomes are generated through community designs that encourage active transportation—walking and cycling—and reduce environmental impacts.[20] Compact and walkable communities promote a healthier lifestyle, which includes lower body mass index and lower prevalence of high blood pressure.[21]

The design of communities also contributes to how residents relate to and interact with each other.[22] The configuration of a community has been shown to have an impact on social networks, which influences individual and collective resilience as well as health. Research also has shown that walkable, mixed-use neighborhoods encourage these social networks and improve social capital through characteristics that increase interactions between people.[23, 24] Creating these types of places—i.e., with pedestrian-oriented design and neighborhood amenities—will also contribute to the likelihood that a community will be resilient in the face of a disaster.

Compact, walkable, and mixed-use places are viable community hubs and clustered activity centers that can be repurposed in times of natural disaster. A study of the 1995 heat wave in Chicago found that residents—particularly vulnerable populations, including low-income individuals and the elderly—were at lower mortality risk during the heat wave if they lived in neighborhoods with "dense commercial activity" and "streets with more vibrant social ecologies."[25] This reduced risk was attributed to the fact that residents without air conditioning were more readily able to seek relief from high temperatures in local stores. A dense mix of uses and pedestrian-friendly environments enabled the neighborhood's most vulnerable residents to seek shelter from the extreme heat. Accessible, mixed-use neighborhood centers can serve as lifelines for residents in the wake of disaster and provide access to amenities and services during better times.[26]

Encouraging Greater Equity. Vulnerable populations, including racial and ethnic minorities, the elderly, children, the unemployed or underemployed, those with low educational attainment, and those with physical or mental disabilities, can be especially limited in their ability to adequately respond to a disaster due to a lack of economic or social resources, and are therefore more susceptible to the impacts of extreme weather events.[27, 28] Vulnerable populations also are more susceptible to poor health outcomes, including respiratory and cardiovascular issues and injury, due to inadequate living conditions.[29, 30]

A 2007 study of the impacts of Hurricane Katrina in New Orleans found that although preexisting socioeconomic conditions were not predictors of the extent of flood damage, vulnerable populations were disproportionately affected in postdisaster response and recovery.[31] This was attributed to the limited financial resources and decreased mobility of those vulnerable populations following the disaster.

Encouraging greater equity in communities, through land use decisions and other measures, can reduce these negative impacts. Examples of these types of interventions range from the provision of low-interest loans to allow affordable housing owners and low- and moderate-income families to update and retrofit their homes to improve durability and resilience, to participatory planning efforts, such as charrettes, that engage an array of community stakeholders to proactively plan for disaster recovery and long-term sustainability. Such planning activities may also include forming new partnerships or using health impact assessments (HIAs) to integrate individual health, equity, and community well-being into the planning process.[32] Provision of high-quality housing also plays a major role in reducing disproportionate health impacts for vulnerable populations, and investment in housing can improve resilience of these individuals and entire communities.[33]

Investing in Social Capital. Research shows that social connectivity and the ability of people to help each other are critical for survival and rebounding during and following natural disasters. Though disaster preparedness is primarily thought of in terms of the resilience of physical assets, a 2012 study of four natural disasters found that social capital, or the presence of a strong and interconnected community, is a prerequisite for recovery following catastrophic events.[34] Research has also shown that social networks and high levels of community cohesion have positive impacts on health.[35]

Similarly, in the wake of Hurricane Sandy, Brooklyn residents who were without access to water and electricity gained access to emergency relief resources, including free food and donated household items, at a makeshift community resilience center housed in the IKEA store in the borough's Red Hook neighborhood.[36] When basic services, such as telephone and electricity, are disrupted following a disaster, place-based social connections are vital to successful individual- and community-level responses.[37]

From a public health perspective, trust and partnerships among residents, civic organizations, and local government are key to a thriving social infrastructure. These connections help ensure that communities have access to the types of resources needed when faced with a disaster and otherwise.[38] The ability to set up this type of social infrastructure prior to disaster is critical to bridging individual and community resilience.[39]

Developers of new communities can help set up social infrastructure through opportunities for people to meet each other, including programming, physical activity opportunities, and physical connectivity to other parts of the city.[40] To be truly resilient, communities must go beyond traditional physical and built-environment approaches and invest in methods that build long-term social capital.[41]

Building Resource-Efficient and Durable Housing. Sustainable design and construction constitute a cornerstone for developing healthy and resilient communities. To maximize its ability to mitigate the impacts of climate change and withstand future extreme weather events, housing must be designed to be resource-efficient and durable. Resource-efficient housing uses green design and construction techniques and is optimized to reduce energy and water use, thereby lowering utility bills for building occupants.[42] On-site renewable generation can provide reliable power supply in the event of grid failure.

Furthermore, durable housing is not only designed to withstand extreme weather events, but also consciously constructed to be geographically sensitive to anticipated impacts of climate change. Along with design and construction, the location of housing within a community is a significant factor in its resilience. Homes located nearer to flood zones or wooded areas can be more vulnerable to certain weather events.

There are numerous examples of new resource-efficient and durable residential design and construction innovations, from model housing projects in tornado-prone Greensburg, Kansas, to rebuilding efforts on Long Island, New York, following Hurricane Sandy.[43, 44] These strategies range from incorporating on-site renewable energy, to efforts to reduce environmental impact and reliance on the electrical grid, to elevating buildings and moving mechanical systems to the roof in an effort to make buildings more flood-resistant.[45]

In addition, a comprehensive resilience strategy should include a focus on retrofitting existing structures and communities. Modern building codes are pushing new construction to be increasingly efficient and sustainable; however, retrofitting older homes, which make up the majority of the nation's housing stock, poses a different challenge.

The opportunities for greening existing housing are significant and bring opportunities for positive health outcomes, including improving indoor air quality and reducing other hazardous environmental exposures. The report *U.S. Housing Stock: Ready for Renewal* reviews opportunities for green and energy-efficient investments, referencing a 2009 U.S. Department of Energy report that noted that retrofitting housing built before 1970 to meet present-day energy-efficiency standards would decrease residential energy use nationwide by 10 percent. A 2013 report published by the Joint Center for Housing Studies of Harvard University, however, found that cutbacks in housing investments since the Great Recession have eroded the nation's existing housing stock, due to a lack of capital for improvement and repairs.[46] The result is that much of the needed greening of the existing housing stock has yet to occur, due to a lack of financial resources.

In addition to decreasing energy use, energy efficiency improvements correlate with improved occupant health. A 2013 study titled *Watts to Well-Being*, conducted by the National Center for Healthy Housing (NCHH) and Tohn Environmental Strategies, tracked pre- and post-retrofit metrics such as temperature, reported occupant comfort, and resident health outcomes.[47] This study found improved outcomes for general health following energy-efficient retrofits in both single-family and multifamily housing in Boston, Chicago, and New York.[48, 49]

In addition to these co-benefits, there are substantial opportunities to minimize negative health impacts by adhering to the National Healthy Housing Standard, recently released by the NCHH and the American Public Health Association.[50] Finally, when homes are being retrofitted, any strategies that are formed to update existing housing for one of these purposes should also include the others: disaster resilience, energy efficiency, and healthy housing.

Continuously Adapting for a Changing Environment. Resilient housing and communities need to be able not only to withstand extreme weather events and the adverse impacts of climate change, but also to "more successfully adapt to adverse events." This means that individual homes and neighborhoods should be able to collectively emerge from natural disasters stronger than they were previously.

In the wake of Hurricane Sandy, New York City planning officials are using a suite of tools to ensure that the city's future landscape is more resilient to more intense and persistent weather events and rising coastlines. In addition to planning for the 500-year floodplain, the city is providing tools like flood resilience zoning to encourage new development out of the floodplain, voluntary buyout programs for the most vulnerable existing homes, and design guidelines to promote flood-resilient construction that also encourages street-level vibrancy.[51]

Across the United States, individual households, community leaders, municipal officials, planners, developers, and others are reimagining their cities to be stronger and more sustainable, despite the threats of a changing environment. Taking all the above-referenced elements into account, creating and sustaining healthy, resilient housing and communities is an iterative process.

Adapting to a Changing Environment: Profiles of Housing, Health, and Resilience

Extreme weather events are having an impact on communities across the country. The following profiles explore three of these events: tornado, wildfire, and flood. The profiles—Greensburg, Kansas; San Diego, California; and Cedar Rapids, Iowa—are all stories of communities that used disaster, or the threat of disaster, to enhance their built environments and housing stock to encourage community and individual resilience and health. While these communities and the impacts vary in size and scale, it is important to note that this report does not feature a profile of extreme weather events in large urban areas; however, the lessons learned may be applicable to communities both large and small. These communities have confronted the impacts of a changing environment and are proactively planning for a healthier and more resilient future.

These profiles are explored using the five elements of creating and sustaining resilient and healthy communities outlined in the previous section. Not all elements are discussed within each profile, though it becomes clear that it is a comprehensive approach to planning and building—using multiple elements—that is helping each city become more resilient, sustainable, and healthy.

Greensburg, Kansas: Tornado

After a tornado devastated the town of Greensburg, Kansas, destroying 600 homes, residents and community leaders used the disaster as an opportunity to rebuild in a new and more sustainable way. Extensive community planning processes immediately after the tornado helped engage residents in shaping a vision for the town and creating a long-term plan for recovery and a new sustainable comprehensive plan. Techniques emphasizing energy efficiency and sustainability have led to a large number of Leadership in Energy and Environmental Design (LEED) certified buildings. In addition, the town has focused on providing opportunities for healthy behavior as the community rebuilds, including parks and recreation. Through all of these efforts, Greensburg has been able to create something positive out of tragedy and provide inspiration for communities facing similar disasters.

In May 2007, the small town of Greensburg, Kansas, was nearly wiped out by an EF5 tornado—the strongest and most damaging type.[52] Ninety percent of structures in the town were either destroyed or severely damaged, with 600 homes lost. In the wake of the event, the community faced not only infrastructure and housing concerns, but also serious mental and physical health issues. Approximately 1,500 residents were living in Greensburg at the time of the tornado; 800 live there today.

Steve Hewitt, current city manager of Clinton, Oklahoma, and former city administrator for Greensburg, estimated that damage to municipal buildings exceeded $100 million, with the full costs to be community totaling more than $500 million. Hewitt cited a variety of financial sources for recovery, including grants from the Federal Emergency Management Agency (FEMA), the U.S. Department of Agriculture, and the Environmental Protection Agency; state emergency grants and appropriations; and federal Housing and Urban Development Community Development Block

MICHAEL RAPHAEL/FEMA

The town of Greensburg, Kansas, saw widespread devastation of homes and other buildings after a May 2007 EF5 tornado.

Grants. In addition, homeowners received some FEMA assistance, Small Business Administration grants and loans, and some state funding for mortgage assistance, although individual home and business owners were largely responsible for paying for their own rebuilding efforts, through insurance settlements or their own resources.

The residents of Greensburg saw the devastation as an opportunity to rebuild their town using strategies for sustainable living. They hoped to create a new standard for energy efficiency and resiliency in rural communities, rooted in the Kansan values of respect for land and a commitment to future generations. Residents recognized that they should not simply rebuild, but should instead create a plan to address challenges that faced Greensburg prior to the event. In this way, the community would also have plans in place for potential future weather events.

Developing Compact, Walkable, and Mixed-Use Places

Building on the preexisting compact size of the town—one mile across—the vision for the new downtown presented in the 2008 Sustainable Comprehensive Plan is mixed use with walkable streets. The rebuilding process gave Greensburg the opportunity to also plan parks and other outdoor recreational and sports facilities. Healthy lifestyles, healthy diets, and physical activity are key components to the physical and emotional well-being of the community as recovery continues. In 2013, in recognition of these health-focused efforts, Greensburg won a BlueCHIP Award from Blue Cross and Blue Shield of Kansas and the Kansas Recreation and Park Association.

Rebuilding Greensburg homes was a top priority for city leadership, and remains a priority today. Providing new housing for residents with a range of incomes has occurred within the community. An example of this includes a project developed by

the Commercial Group, a Topeka, Kansas–based housing development and management firm that focuses on construction of low-income housing. The Commercial Group built six affordable single-family homes in Greensburg. The town's land use patterns enabled the homes to be located within walking distance of a grocery store, parks, the school, the hospital, and City Hall. It was important to both the developer and to Orval Howell, the general contractor, to locate these homes near services and amenities, and the site selected previously accommodated a mix of homes and vacant lots.

Investing in Social Capital

After the tornado, the community came together to determine how to proceed with rebuilding and moving forward. Daniel Wallach, the executive director and founder of the nonprofit Greensburg GreenTown, had the role of helping Greensburg's residents best understand how to be involved in the proposed green initiative. "When people have been through a tragedy, they want to make sense of it. In a community tragedy like this, there is a collective sense of wanting to redeem it. So people really worked hard together to do this very unlikely collective project," said Wallach. "They grieved together but also worked to make something positive out of it."

Immediately after the event, displaced community members relied on out-of-town family, friends, and FEMA trailers for temporary housing. Still, the community rallied around creating the Greensburg Sustainable Comprehensive Plan, which was completed with broad-based input. It was through this strong community integration that Greensburg's green and sustainability initiatives were adopted. According to Wallach, "We spent a lot of time listening to people and getting a sense of how best to make this initiative authentic to this particular community." Social cohesion in Greensburg was critical to residents immediately after the tornado as the healing process began.

Building Resource-Efficient and Durable Housing

Sustainable and healthy building strategies were used to rebuild public facilities and extend Greensburg's new housing stock. Of the 600 single-family detached homes that were lost to the tornado, 300 have been rebuilt, largely on the sites where they previously stood. Wallach noted that although there were no mandates to rebuild in any certain way, 150 of the 300 homes adopted energy-efficient and sustainable building strategies—including recommendations from the ASHRAE Advanced Energy Design Guides—and are seeing average energy savings of 42 percent over homes that were not rebuilt with energy-efficient features.[53] "With good planning, the increase in [building] costs can be minimal to nothing," said Wallach.

According to Raj Trivedi, director of operations at Commercial Group, the firm's six affordable single-family homes were financed by the Kansas Housing Resource Corporation (KHRC) through tax credits and grants. They were built following plans from the U.S. Department of Energy. Said Trivedi, "The KHRC wanted us to follow specific guidelines for high winds and energy efficiency." To ensure resident safety, all homes also have storm shelters—self-contained rooms with their own air vents—built under the front porch and separated from the rest of the basement by a steel door.

Howell, who was involved in rebuilding a number of homes and other buildings in Greensburg, cites reinforcement and ensuring that the entire structure is bolted to the concrete as appropriate techniques to increase the chances of a structure's survival during high wind events. Howell worked on the Meadowlark House with Greensburg GreenTown, which incorporated a prefabricated wood block wall system used in Europe, known as the Highly Insulated Building (HIB) system. Though still under construction, the house serves as a demonstration project for the innovative system. The cost of shipping the blocks produced overseas makes it an expensive strategy in the United States today, but the housing assembly technique using the blocks is quick, and the blocks themselves are toxin free and can withstand winds up to 195 miles per hour. Howell has been involved in several efforts to locate an HIB facility within the United States.

GREENSBURG GREENTOWN/JOAH BUSSERT

Installation of a Highly Insulated Building system for the Meadowlark House, a new house being constructed with a number of sustainable design features.

Continuously Adapting for a Changing Environment

Two extensive planning efforts, bolstered by residents' power and desire to rebuild, helped shape a community vision and provide concrete steps to create a more sustainable and resilient Greensburg. The Long-Term Community Recovery Plan, a guide for decision makers looking to determine priorities to ensure sustainability and resiliency for rebuilding, was adopted in August 2007. The Greensburg Sustainable Comprehensive Plan, providing an overarching vision for redevelopment and also addressing community issues such as jobs, health, social equity, and housing, was adopted in May 2008, a year after the tornado.

Though much of the Sustainable Comprehensive Plan is yet to be implemented, innovations that have been completed include stormwater recovery along the main streets and construction of demonstration buildings and homes that are considered models of sustainability. Greensburg is now home to the most U.S. Green Building Council LEED-

certified buildings per capita in the world, including LEED Platinum Kiowa County Memorial Hospital. As of December 2007, the city requires that all publicly funded buildings larger than 4,000 square feet be built to the LEED Platinum certification standard. The tornado—and the recognition that these types of events are increasing in nature—have helped change the way the town is rebuilding for existing and future residents.

What's Next

Wallach cites the great examples of sustainable design and building and the vision that the community had coming to fruition as the major successes of the Greensburg story. The town's recovery has served as an incubator for new innovation. Based on the experience in Greensburg, Wallach has consulted with other cities on their recoveries after similar events.

One lesson learned involves the importance of strong leadership from elected officials—not only immediately after the disaster, but also during the many years of rebuilding. Wallach also noted the difficulty of sustaining community engagement as time passes: "It's been seven years and people are largely back into their comfort zones, which reduces their impetus to take risks. In some ways, people just want to get back to life as 'normal.' "

Though many hoped that the green initiative and the planning efforts would help spur growth in Greensburg, the town is currently stagnant at half of the pre-tornado population seven years after the event. New industry and job growth is critical to attracting new residents to what is thought to be the greenest town in rural America.[54] Said Wallach, "This has been a good lesson in the importance of follow-through and a continued push. You have to figure out how to keep that energy going."

Talmadge, San Diego, California: Wildfire

Talmadge, a community located within the city of San Diego, drafted and adopted a Community Wildfire Protection Plan after severe fires in 2003 devastated the surrounding area. Though Talmadge has not directly experienced a disaster, the community joined forces to proactively plan for a potential disaster. With strong leadership and the assistance of national and state fire safety programs, residents of Talmadge have implemented strategies to help protect existing homes and other structures in the event of encroaching wildfire. New home construction in the San Diego area also requires specific strategies for protection from wildfire, including specific building materials and clear brush standards.

The San Diego area is very susceptible to wildfires that can cost millions of dollars in damage to homes, due to the flammability of the region's vegetation and the design of the homes themselves.[55] Even though the San Diego community of Talmadge, in the city's highest fire hazard zone, has not experienced a major fire, it has adopted and implemented a Community Wildfire Protection Plan.[56, 57]

Residents of Talmadge were spurred to action by the 2003 Southern California Fire Siege, which burned nearby parkland that was visible from the community.[58]

NFPA FIREWISE COMMUNITIES PROGRAM

Community leaders in Talmadge demonstrate wildfire safety challenges on a site visit with Firewise representatives.

Said Kathy Finn, former president of the Talmadge Fire Safe Council, "We didn't suffer a direct burn, but we saw what was happening."

The densely populated urban community, established in the 1920s, primarily follows a gridded street system and surrounds the 62-acre Talmadge Canyon. In 2005, with the fear in the community associated with the 2003 fire still front of mind, a local Fire Safe Council was informally started to work with neighbors to create defensible space, thin the vegetation near homes, and implement other aspects of San Diego's brush management regulations.

Finn worked with the California Fire Safe Council and Firewise Communities/USA, a voluntary program of the National Fire Protection Association (NFPA) that encourages local communities to work with individual homeowners to take responsibility for protecting their homes from the risk of wildfire. These organizations helped Finn and the Talmadge Fire Safe Council facilitate a property assessment process, which brought federal, state, and city agencies together with a community of homeowners. Talmadge became an official Firewise community in 2005.

Firewise communities are required to create an action plan, hold a yearly educational event, and document community activities aimed at fire protection. Michele Steinberg, wildland fire projects manager at the NFPA, noted that the program is most successful when the community, rather than the local fire department, owns the process. But it does require champions within communities (known by Firewise as "spark plugs") to push the efforts.

Investing in Social Capital

The compact and dense nature of the community exacerbates the risk of structure-to-structure ignition during a wildfire. However, this same proximity of neighbors bolsters social capacity, which was integral in creating the Community Wildfire Protection Plan and implementing the defensible space around the homes.

The community was already fairly well connected before the planning process, holding block parties and having established a crime patrol and maintenance district. Involvement in the Community Wildfire Protection Plan process and implementation gave residents more opportunity to get to know one another through community-wide meetings, property assessments, and smaller meetings in private homes explaining the grants the community received.

Over the past decade, Steinberg has observed a general increase in social cohesion among Firewise communities throughout the country as a result of the program's emphasis on encouraging residents to work with their neighbors to protect their homes and commonly owned areas. She noted that the required yearly educational event "signals to others that something is changing and gives people a chance to get to know each other. . . . Knowing your neighbors in fun situations can also help you a lot in an emergency."

Building Resource-Efficient and Durable Housing

The homes in Talmadge were primarily constructed in the 1930s and 1940s and are located approximately ten feet apart; homes closer than 50 feet apart have the potential to ignite each other. As the community has yet to see damage from a fire, there has not yet been a need to rebuild any homes.

However, the assessment facilitated by Firewise found that 33 homes in the community were constructed with wood shake roofs, which the Community Wildfire Protection Plan encourages replacing with a Class A Fire Rated roof. Guidelines for roof replacement were developed based on a guide created by the University of California at Berkeley.[59] To date, 23 shake roofs have been replaced, at the expense of the individual homeowners.

While residents of Talmadge were not able to receive financial assistance for roof replacement, the city of Big Bear Lake in San Bernardino County received a FEMA grant that included direct help for homeowners looking to replace their shake roofs. Homeowners are required to apply for a grant, and funding priority is based on certain location and structural characteristics of the home.[60]

Though roof replacement can be expensive, other Firewise strategies are less onerous. For example, metal screening on attic vents that does not block air flow can help prevent large embers from getting in and igniting.

Steinberg noted that all residents of fire-prone areas should take steps to protect their homes. "A fire could be a mile away and you're getting embers on your roof," she said. Houses are typically the most flammable objects in neighborhoods, and embers can be more dangerous to houses than the flames themselves. "That's not to say that people

shouldn't create defensible space," said Steinberg, "but if you have a wood roof, it's all over."

For new homes being built in San Diego County, certain building construction standards are required. Mike Rust, vice president at Newland Real Estate Group, described the standards used at the 4S Ranch development in San Diego County, which has become the standard for back-country development in the county. "The standards require the roof and home siding to be resistant to fire, all homes to have sprinklers, all roof eaves to be enclosed, and the windows to have frames that don't melt in a fire," said Rust. "The clear brush standards are the big factor in allowing a home to be [safer] in a brush fire. Those brush management distances vary depending on the source of brush fuel and so are determined by a review of each homesite."

While evacuation in the event of a fire is recommended by fire departments, the way new homes are constructed at 4S Ranch minimizes the likelihood of property damage and provides a greater level of ignition resistance. This also provides a relatively safe option for residents to remain in their homes during a fire in the event that evacuation is not possible.

Continuously Adapting for a Changing Environment

Activities that the Talmadge Fire Safe Council undertook to ensure that homes within the community were as protected as possible included producing a parcel map showing the location of homes with flammable shake roofs, and completing the Community Wildfire Protection Plan. Upon completion of the plan, the Talmadge Fire Safe Council applied for and received grants, with the help of the California Fire Safe Council, to help homeowners offset the costs of creating 150 feet of defensible space along the canyon rim, thinning vegetation, and creating a separation between trees, shrubs, and other items that could catch fire.

According to Finn, the work in Talmadge could not have occurred without coordination and assistance from a variety of groups, including the U.S. Forest Service, the California Fire Safe Council, the California Department of Forestry and Fire Protection, the San Diego County Fire Safe Council, San Diego County Parks and Recreation, the San Diego City Fire Department, private grant funders, and the individual homeowners who volunteered as neighborhood coordinators and funded improvements to their homes in order to make their community safe. Said Finn, "In order to get change in urban neighborhoods, many people need to be involved and work together at each of their levels."

What's Next

Finn retired as president of the Talmadge Fire Safe Council in 2012, which has since morphed from a nonprofit organization that proactively worked to enhance the safety of homes to a volunteer community council that mainly provides the community with additional fire safety information. According to Finn, using the grant money to thin vegetation and create defensible space within Talmadge went on for several yearws, with good progress made throughout the community. Though new roofs are costly, replacing the ten remaining shake roof remains a priority for those residents.

The unpredictable nature of wildfire could affect Talmadge in a number of ways in the future, but the steps that the community has taken to protect homes and other structures have put Talmadge in a better position should a fire occur.

Cedar Rapids, Iowa: Flood

In June 2008, a record-setting flood caused serious damage to the housing and building stock of Cedar Rapids, Iowa, affecting over 5,000 residential properties and nearly 20,000 residents.[61] Planners and public officials quickly mobilized residents to create a vision and plan for rebuilding, with a goal of protecting the city from similar events through modified land use plans. A process was implemented to encourage developers to rebuild in areas of the city close to downtown, using high-quality and sustainable techniques. Post-flood, many partners and stakeholders in Cedar Rapids have been working diligently on flood recovery and future planning strategies to create sustainable, resilient, and healthy homes, buildings, and places.

DON BECKER, USGS

Flooding in downtown Cedar Rapids after the Cedar River rose a record-setting 31 feet.

Cedar Rapids is no stranger to floods, but on June 13, 2008, the Cedar River rose a record-setting 31 feet—over ten feet higher than previous floods. The event caused an estimated $6 billion in damage, affecting 14 percent of the city, displacing thousands of residents—yet resulting in no loss of life—and damaging many of the city's core services buildings, including City Hall.

A robust community engagement process—established months before the 2008 flood—helped ensure quick and inclusive recovery planning that led to long-term

planning and visioning documents. "One thing we heard from other communities that had suffered natural disasters was that it was important to have a plan rather quickly, because people naturally become nostalgic and just say, 'Well, I want it the way it was before,'" said Jennifer Pratt, assistant director of planning services for the city of Cedar Rapids.

"We were able to harness public participation and do a group visioning to seed something else in the future," added Pratt. "Having a plan on paper was important. It was also a critical part of the healing process for the community. And it became a recurring theme—we're not just building back, but we're building back stronger." Development that has occurred post-flood is primarily focused on rebuilding near downtown, using both flood-resistant and mixed-use strategies.

Developing Compact, Walkable, and Mixed-Use Places

Before the flood, city staff and officials were already looking to increase density in Cedar Rapids, focusing on workforce housing and infill development strategies so that new housing was located near existing municipal services and employment centers. Ensuring a continuum of housing choices—as Cedar Rapids primarily consisted of single-family housing stock—was an initiative that had begun prior to the event but was accelerated after the flood. After the flood, the focus became rebuilding an array of housing options, including multifamily housing, in the downtown core. Connectivity and walkability also were strongly considered within plans adopted after the flood.

Cedar Rapids has amended zoning policies and established an overlay district to make centrally located parcels more suited for higher-density infill replacement housing. The city has also added a significant amount of dedicated green space via property acquisition. As part of the recovery process, municipal staff worked to guide development out of the flood-prone areas, through offering voluntary property acquisition and replacement housing assistance. A main purpose of acquiring these properties was to help homeowners move on financially. Any structure located in the 100-year floodplain, or with damage costs estimated to be at least 50 percent of assessed value, was eligible. The city purchased approximately 1,400 properties, a significant proportion of those eligible. Some structures were relocated, and some located outside the 100-year floodplain were rehabbed, but most were demolished due to the extent of the damage.

Chad Pelley, business development manager for Compass Commercial Services, said that the development community is noticing growing interest among residents and city staff for more urban living and a preference for compact, mixed-use development.[62] "We are going after incentives [state and local tax credits] to build downtown," Pelley said. "Mixed use is how you get incentives locally." Compass Commercial is also intentionally integrating its developments with rental and owner-occupied units, both affordable and market-rate. "We changed our strategic focus based on the flood. Financing and other mechanisms are available that draw us to these types of projects," he said.

Encouraging Greater Equity

After a community conversation about the benefits of density within neighborhoods, building multifamily housing to add density was widely embraced. "We have not experienced the resistance that we have in the past. There is much less of the 'not-in-my-backyard' attitude," said Pratt. Added Paula Mitchell, grant programs manager in the city's Housing Services office, "Neighborhood leaders who have been through these planning processes have really been the champions of these efforts."

City staff has been very aggressive about rebuilding within city limits, including a variety of affordable housing options to ensure that people of all income levels have access to homes in this area. Rebuilding and expanding affordable housing also were identified as priorities in the planning processes that occurred immediately after the flood. Using available Community Development Block Grant resources, which requires that a percentage of units remain affordable, has provided opportunities to create mixed-income housing within the neighborhoods. City staff meets fairly regularly with affordable housing groups in the community to identify gaps in housing and examine which neighborhoods are underserved in terms of grocery stores and other services that make a high-functioning and equitable community. The banking community also has been at the table to help identify funding opportunities for affordable and workforce housing in targeted neighborhoods. Said Pratt, "I do think it is a more well-rounded approach than pre-flood."

Building Resource-Efficient and Durable Housing

Immediately after the flood, the city worked quickly to identify the needs of the nearly 20,000 displaced residents. Said Mitchell, "We worked with FEMA on temporary housing. City staff also reached out to the rental community and called property managers to identify any temporary housing."

In order to obtain recovery funding for rebuilding, the city formed a number of public/private partnerships. Funding was a tiered approach: initially there were some immediate FEMA resources and a lot of local resources from a variety of nonprofit organizations. Volunteer organizations from all over the country also came to offer their services in Cedar Rapids. The next wave of funding—Jumpstart Funding—came from the state before federal funding, which included $300 million from the Community Development Block Grant program. Mitchell noted that one challenge to rebuilding is that there are limited dedicated disaster resources tailored to the urgency of rehousing and rebuilding that exists post-disaster, so communities still need to go through the more traditional community funding channels.

One strategy that the city council used to promote development in safe areas was through the distribution of funding for rebuilding. Parcels that are located within the path of the city's new flood control system and properties in the 100-year floodplain were not given public resources for rehabilitation, due to the high likelihood of future impacts to those properties.

The now city-owned parcels—obtained through the voluntary acquisition program and located outside the 100-year floodplain—are providing developers with infill develop-

ment opportunities, with tax incentives provided by the city. All new projects are joint ventures between developers and the city. Pelley described an ongoing, competitive process that the city has instituted for these parcels. The city put out several requests to developers to submit project proposals for the parcels. A committee of city staff, developers, and neighborhood representatives review the proposals. This process ensures that Cedar Rapids gets high-level, high-quality projects that both improve the city's tax base and meet residents' needs. Said Pelley of a recent bid, "We were competing with other developers, so we had to provide a higher-quality design and use green materials and energy efficiency strategies."

Projects being developed by Compass Commercial are also using different building strategies than before the flood, including lifting up the building and changing some of the construction techniques to minimize potential sewer backup. City staff and officials are also encouraging rebuilding in flood-resistant ways. "As we're building back, we're looking at opportunities to build structures with parking on the first floor and elevated mechanical systems," Mitchell said. "Those types of strategies are being incorporated [in various projects]; it really just depends on location and housing product type."

CITY OF CEDAR RAPIDS

The Oak Hill Jackson Brickstones, an affordable multifamily housing project by Hatch Development Group, incorporated parking on the first floor as a flood mitigation strategy.

Continuously Adapting for a Changing Environment

In addition to modified strategies to ensure healthy and resilient homes and buildings, ongoing city planning efforts are striving to create a sustainable future for Cedar Rapids. By the end of July 2008, less than two months after the flood, the city had started the first phase of recovery with public outreach for a flood management strategy. By November 2008, the city council was presented an alignment strategy for flood protection created by city staff, stakeholders, and residents. The strategy proposed was a levy and floodwall system with some floodable greenway, which maintained cultural assets and commercial investments downtown and allowed the community to continue to enjoy the river in residential areas.

Diligent about "working the plan," the city of Cedar Rapids is leveraging recommendations from the Flood Recovery and Reinvestment Plan to secure funding and foster collaboration with other agencies, and the city council is using the plan to guide decision making. The plan identified a Tier One zone near the central core, which is where new housing has been focused. The Tier One boundary was adopted for several reasons, including encouraging development downtown, promoting more walkable and sustainable development, and revitalizing core neighborhoods that will be protected by the new flood management system. The city council dedicated funds to build new homes within this zone; targeting these funds was a critical way to repopulate neighborhoods that were hardest hit by the floods.

Due to the 2008 floods in Cedar Rapids and elsewhere in Iowa, the state legislature created the Iowa Smart Planning Legislation in 2010. This legislation provides a framework for cities and counties creating comprehensive plans.[63, 64] Les Beck, director of planning and development for Linn County, noted that while complying with the legislation is not mandatory, cities and counties that decide to comply are required to create a hazard mitigation element of the plan.

What's Next

Recently, Cedar Rapids has become a Blue Zones Community by achieving milestones related to becoming a healthier place to live.[65] Social connectedness and sense of belonging are critical parts of this achievement. Cedar Rapids is also one of ten National Civic League's All-America City Award winners for 2014, which had a strong focus on healthy communities.[66] The application that Cedar Rapids submitted on its own behalf noted that its recovery has been based on sustainability and building back in healthy ways that increase opportunities for physical activity and social interaction. These recent accolades demonstrate the city's commitment to sustainability, resilience, and health.

Cedar Rapids is also working hard to build back the staggering number of housing units that were lost and is ensuring that they are affordable to a range of incomes. Currently, there are nearly 850 owner-occupied units and nearly 550 multifamily units that have been rebuilt or are in the development pipeline. All units rebuilt must be affordable to households at or below 100 percent area median income (AMI). Approximately half of all of these units are affordable to households earning at or below 80 percent AMI. In addition, 231 affordable multifamily units have been built using low-income housing tax credits.

A key challenge identified has been maintaining momentum within rebuilding efforts. The flood management project was finally able to get the needed funding through federal, state, and local mechanisms, but it is still a 15- to 20-year process and keeping the community invested in the larger goal is critical. At present, all of the planning that happened after the flood in 2008 is being incorporated into Envision CR, the city's comprehensive plan. According to Pratt, this effort has helped refresh the rebuilding process and ensure that key concerns are still being addressed and advanced within the comprehensive plan. Said Pratt: "The plan gives people hope and is the key to resiliency. We know it will change, but that's OK. It helps keep everyone focused on goals and interests, not on the 'how.' "

Key Takeaways: Developing with an Eye toward Healthy and Sustainable Housing and Communities

Greensburg, Kansas; the Talmadge community in San Diego, California; and Cedar Rapids, Iowa, are each working to recover from and/or adapt to the threats of severe weather and the impacts of climate change through diverse approaches. These communities are developing with an eye toward becoming resilient and healthier places that will be able to better withstand both anticipated and unexpected extreme weather events.

Communities across the United States can learn from these examples and adapt their housing and community strategies to create and sustain healthy and resilient places. Key takeaways from this report and these communities include the following.

- **Climate change and health are inextricably linked to each other.** Though often discussed separately, the links among climate change, extreme weather, and health are clear. Research and practice that examine where extreme weather and health intersect can help advance understanding about how best to shape communities of the future to be safe, healthy, and resilient.

- **Communities that prepare for the impacts of climate change can become more resilient as they rebuild.** The environment is changing rapidly. Even if specific impacts are unknown, communities that look ahead and think about opportunities to proactively adapt can enhance resilience and promote the health of people, the environment, and the economy. In some cases, these efforts can help communities hit by a disaster recover faster.

- **Resilience requires a place-, people-, and housing-based approach.** Some parts of the country are more susceptible to extreme weather events than others, and the types of weather threats also vary. Understanding potential threats and linking resilience to health can help create more prepared people and communities. This comprehensive approach requires community engagement and outreach to a diverse array of stakeholders.

  Housing has a large role to play in this linkage—appropriately designed and located housing can improve resilience during and after extreme weather and also improve social and physical health.

- **Compact, walkable mixed-use places are healthier and more resilient.** Communities that are pedestrian friendly, built with a mix of housing types, and proximate to retail, services, and other amenities are healthier and more resilient.

  Dense community design encourages active lifestyles and social interactions among residents. Research has shown that community amenities can serve as vital lifelines during extreme weather events.[67] Greensburg, Kansas, is rebuilding a more walkable, mixed-use town rich with green space and recreational opportunities to promote physical and emotional well-being.

Developing compact, walkable mixed-use communities is an element of building not only healthy and physically resilient communities, but also economically resilient places. For example, Cedar Rapids, Iowa, used its postdisaster planning as an opportunity to build a more compact, mixed-use, and economically competitive downtown core—strengthening the potential to recover its economy and plan a more resilient future.

- **Equity is an integral consideration when it comes to health and resilience.** As extreme weather events occur with greater frequency and impact, vulnerable populations are at increased risk. They are disproportionately affected in postdisaster response and recovery and more susceptible to negative health impacts associated with a changing climate.[68]

  For example, the redevelopment plan for Cedar Rapids calls for a more equitable community for a range of resident needs. The city also invested in a spectrum of housing choices, specifically focusing on affordable and workforce housing and ensuring that low- and moderate-income residents were also connected to essential services and retail.

- **Social capital is invaluable in the face of climate disasters, and can be built through ongoing investments of time and energy among leaders and residents.** Social connectivity and the ability of residents to assist each other are critical for survival and rebounding during and after natural disasters. Research has also shown that social networks and community cohesion have positive health impacts.[69]

  All three communities profiled used participatory planning to develop a collective roadmap for their community and foster community connections. Particularly in Greensburg, these interactions were invaluable in allowing residents to emotionally recover from the trauma after the disaster and move toward a more resilient future.

- **Durable, resource-efficient housing is an essential component of healthy and resilient communities.** Resource-efficient housing uses the latest green building and energy-efficient strategies to reduce environmental impacts and improve occupant health, safety, and comfort. Durable building strategies ensure that homes are more likely to withstand extreme weather events and are appropriate for building in high-risk environments such as flood zones.

  Greensburg used its recovery as an opportunity to pilot new strategies and encourage innovation in housing design. Recognizing the future impacts of a potential wildfire, Talmadge residents banded together to create a more fire-resistant community through retrofitting their existing homes with fire-resistant roofs. In Cedar Rapids, the community took a more comprehensive approach, including a voluntary buyout program to relocate homes and businesses out of flood-prone areas.

- **A changing environment requires constant adaptation and planning for the future.** Resilient homes and communities need to be able not only to withstand extreme weather events and the adverse impacts of climate change, but also to continuously adapt, developing toward a stronger future.

In Greensburg, the community is redeveloping in a way that redefines it as a model of sustainability. In Talmadge, the entire community—from residents to local government agencies—was engaged to protect against the threat of a potential disaster. In Cedar Rapids, planning staff, investors, and the development community are rebuilding in ways that create an economically vital, mixed-income, mixed-use central core. Each of the communities featured in this report has created a vision for a healthier and more resilient community that is strategic, flexible, and forward-looking.

Building healthy and resilient communities requires an integration of the five core elements discussed throughout this report: compact, mixed-use development; greater social equity; investments in social capital; resource-efficient and durable housing; and continuous adaptation. Regardless of the potential impacts of climate change, these strategies can be used to create healthier, resilient, and more sustainable communities.

The environment is rapidly changing, bringing with it an uncertain future. The impacts of climate change are being experienced in communities across the United States. Extreme weather events are challenging places to rethink the way they grow and build, to ensure that they will be able to withstand disaster, and to protect people's health and safety. But climate change provides a lens through which to reenvision day-to-day practice as well: by carefully considering land use patterns, meeting the needs of vulnerable populations, and taking other actions, we can build resilience into the places we live and help ensure that all communities are healthy, robust, and thriving in the decades to come.

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