

Codes and Climate: Building Codes Driving Climate Mitigation and Adaptation

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ABSTRACT

Communities are facing unprecedented challenges in responding to the increasing magnitude and frequency of hazard events, many driven by climate change. In response, governments are establishing bold climate and resilience goals. In the United States, buildings are the largest contributor to greenhouse gas (GHG) emissions and account for roughly one-third of GHG emissions by electricity end use (EPA 2019). Buildings play a critical role in GHG emissions reduction to mitigate and adapt to the detrimental impacts of climate change. Building and energy codes must be at the core of any climate mitigation and adaptation effort. Energy codes continue to advance towards achievement of zero energy buildings as building codes are the most cost-effective policy mechanism for communities to mitigate their hazards risks, providing up to \$11 of savings for every \$1 invested in pre-disaster mitigation (NIBS 2019).

This paper examines the intersection of climate adaptation and mitigation and the central role of codes in delivering policy solutions. It explores the solutions select jurisdictions have enacted to support increased energy efficiency and resilience of their building stock.

Introduction

Amidst climate disasters, governments are looking for solutions to stem the greenhouse gas (GHG) emissions that continue to drive changes in climate. The built environment is central to both enhancing resilience and mitigating GHG emissions. Buildings are our shelter against the storm, the homes of our governments and institutions, drivers of economies, and symbols of our ideals. At the same time, buildings are significant users of energy and materials.

In the United States, residential and commercial buildings account for roughly 31 percent of GHG emissions by electricity end use (EPA 2019). The building sector is also the largest contributor to overall GHG emissions, accounting for roughly 40 percent of total U.S. emissions. In response to the compounding impacts of climate change, many states and localities have set GHG reduction goals or established zero-energy building targets. The United States Government has set zero-energy building goals of 2030 for new construction and 2050 for all buildings. The Biden-Harris Administration also set a nationally determined contribution (NDC) target, in line with signing on to the Paris Climate Agreement, to achieve a 50 to 52 percent reduction from 2005 levels in economy-wide net GHG pollution by 2030. The focus being to tackle the climate crisis by creating equitable jobs as a leader in global clean energy technologies.

National, state and local governments cannot meet their GHG reduction goals and reduce their vulnerabilities to the impacts of climate change without addressing buildings and thus having building and energy codes that align with these goals.

Importance of Tackling Climate Mitigation and Adaptation

Since 1980, 310 disasters each causing \$1 billion in damage or more have occurred in the U.S. (NOAA 2022).¹ The number and costs of these events have been rising: in 2021, there were 20 disaster events with losses of \$1 billion or more, accounting for over \$145 billion in damages and causing 688 deaths (NOAA 2022). These billion-dollar disasters occur across the country and included 1 drought event, 2 flooding events, 11 severe storm events, 4 tropical cyclone events, 1 wildfire event, and 1 winter storm event. 2021 had the second most such disasters behind the 22 events in 2020, was third in associated monetary losses behind 2017 and 2005 and had the sixth highest death-toll. In the past five years (2017–2021) an average of over 17 billion dollar weather and climate events annually have impacted the U.S. Since 1980, these disasters have cost \$2.159 trillion, with 2017 alone costing over \$300 billion (NOAA 2022).

While these statistics alone are staggering, it is important to recognize that they represent individual lives, livelihoods and communities that are impacted. It is important to note that these impacts disproportionately affect communities of color and low- and moderate-income (LMI) households. It is also important to note that these events will only continue to increase in frequency and grow in intensity if climate mitigation and adaptation are not focal points of building regulation aligned across national, state and local governments.

The Role of Codes in Climate Mitigation and Adaptation

Trying to respond to major disaster events in real time has proven unsustainable—too many lives are impacted, and the economic costs are too high and compounding. Pre-disaster mitigation, generally defined as investments in actions that can reduce the impacts of hazards, has been proven to be highly cost effective. These activities include adopting up-to-date building codes, implementing above code measures, and retrofitting existing buildings. The National Institute of Building Sciences (NIBS), a research organization established by the U.S. Congress, found that investments in pre-disaster mitigation can save the U.S. between \$4 and \$11 for every \$1 invested (NIBS 2019). The continual update of building codes provided the greatest benefit at \$11. These benefits represent avoided casualties, property damage, business interruptions, first responder expenses, and insurance costs, and are enjoyed by all building stakeholders—from developers, titleholders, and lenders, to tenants and communities (NIBS 2019).

The U.S. Federal Emergency Management Agency (FEMA) in its *2020 Building Codes Save: A Nationwide Study* found that the International Residential Code (IRC) and International Building Code (IBC) provided more than \$27 billion in cumulative mitigation benefits against flood, hurricane wind, and earthquake hazards from 2000 to 2016. If construction continues at the pace the study observed and if the proportion of that construction adhering to the codes is consistent with the trend the study identifies, codes could help communities avoid \$132 billion to \$171 billion in cumulative losses through 2040. If all new buildings across the U.S. were built to modern codes, the country would save more than \$600 billion by 2060 (FEMA 2020).

In addition to protecting residents from the impacts of hazard events, buildings use energy to support occupant comfort and health, and facilitate important socio-economic functions. Assuring buildings use energy efficiently is essential for protecting human health,

¹ These statistics do not include disasters causing less than \$1 billion in damage which can still have significant implications for communities.

economic prosperity, and reducing the impacts of climate change—both through mitigation and adaptation.

Just as building codes provide significant benefits against the impacts of hazard events, energy codes are highly effective in reducing energy use and GHG emissions while also saving building owners and tenants money and enhancing their resilience. Implementation of energy codes also results in job creation.

The U.S. Department of Energy (DOE) evaluates improvements in the International Energy Conservation Code (IECC) once a new edition is released every three years. Since 2006 the residential provisions of the IECC have delivered about a 40 percent improvement in energy savings, as shown in *Figure 1* (DOE 2021). Improvements in the residential and commercial provisions of the IECC since 2009, as presented in *Figure 2*, will provide over 350 million metric tons (MMT) of CO₂ savings for residential buildings and 340 MMT for commercial buildings, totaling nearly 700 MMT of savings.² The residential provisions in the 2021 edition of

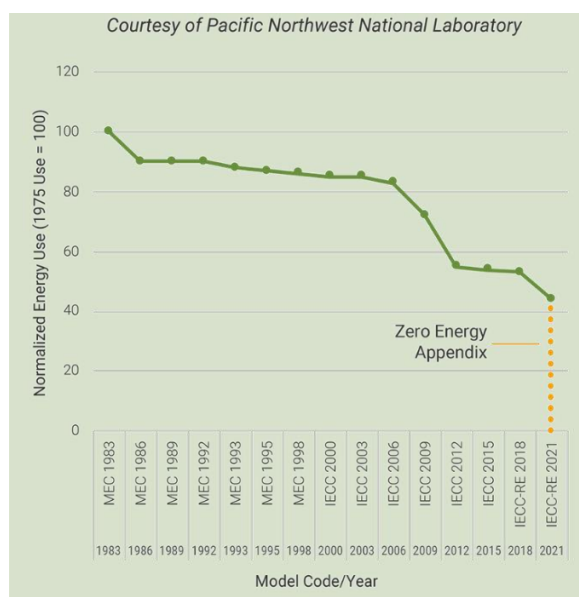


Figure 1. Improvement in energy use for residential model energy codes (1983-2021).

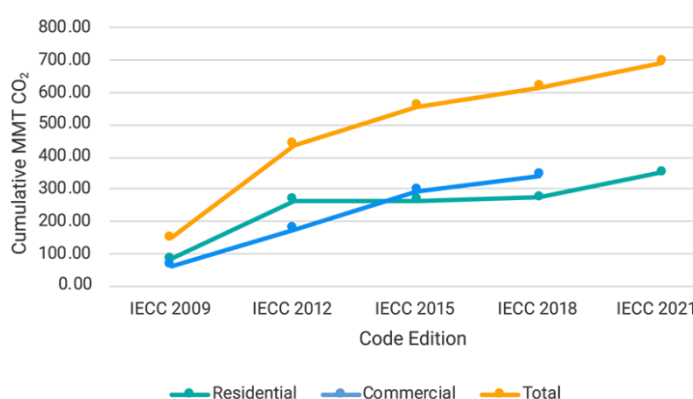


Figure 2. Cumulative CO₂ savings from each edition of the International Energy Conservation Code (2009-2021). Note: DOE has not yet completed analysis on the 2021 IECC commercial provisions.

the IECC provide a 9.4 percent improvement in site energy use and an 8.7 percent reduction in carbon emissions over the 2018 edition (DOE 2021). The 2021 IECC also includes appendices for achievement of zero energy buildings. DOE has also found that use of the 2021 IECC will save U.S. homeowners an average of \$2,320 over the lifetime of a typical 30-year mortgage and, if implemented nationally, would create over 22,000 jobs in the first year and 632,000 jobs cumulatively over 30 years (DOE 2021).

According to DOE (2021), from 2010 to 2040, if consistently implemented and regularly updated, model energy codes for residential and commercial buildings are projected to save \$138 billion in energy cost savings, 900 MMT of avoided CO₂ emissions, and 13.5 quads of primary

² DOE has not yet completed analysis on the 2021 IECC commercial provisions.

energy. These savings equate to the annual emissions of 195 million passenger vehicles, 227 coal power plants, or 108 million homes.

Increasing community resilience and sustainability are imbedded into modern building and energy codes. Continued implementation of enhanced energy efficiency provisions is essential for increased social and infrastructural resilience, while creating equitable jobs, increasing housing affordability and mitigating and adapting to the impacts of climate change.

Defining Building Climate Resilience

In considering national and local level efforts to enhance resilience, particularly against the impacts of climate change, it is important to convey a common starting point. Given the myriad pressures on society from natural and man-made hazards and social and economic stresses, resilience in its broadest sense must recognize the changing risk posed by climate change. While this holistic vision is important for setting national and sub-national goals, achieving these goals requires action within individual disciplines or segments of the economy. *Figure 3* illustrates some of the ways in which several groups in the sector define resilience.

The International Code Council has developed a broad definition of resilience that reflects engagements with communities from the individual building level to community-wide resilience benchmarking. The definition captures the value of a holistic perspective that includes both social and organizational considerations and allows the Code Council's building resiliency work to mesh with other resilience initiatives in other sectors.



Figure 3. Select definitions of resilience.

The Alliance for National and Community Resilience™ (ANCR™) recognizes the importance of a holistic vision for communities which identifies and captures the important factors that lead to community resilience. ANCR has developed Community Resilience Benchmarks® (CRB™), through the identification of 19 community functions that define a

community to evaluate their resilience within and across these functions and chart a path towards increased resilience. In the context of their work and through the CRBs, ANCR has adopted the U.S. Presidential Policy Directive 8's definition for resilience.³

The Alliance for a Climate Resilient Earth (ACRE) presents their principles for a climate resilient earth, acknowledging that communities are facing increased risk to the emerging impacts of climate change. ACRE takes a multi-faceted approach to provide a comprehensive view of resilience in the context of climate change.

The Global Resiliency Dialogue (GRD) is focused on those hazards associated with climactic and weather-related events likely to be influenced by a changing climate. The GRD, through their analysis of comparative findings on the incorporation of climate change projections in building codes, agreed on a definition of building climate resilience. The GRD's definition for building climate resilience shall be the foundational representation of the term for the purpose of this paper.

Energy Codes Enhance Climate Resilience

Building energy codes are an important policy tool in both climate mitigation and adaptation. As outlined above, buildings and construction account for a substantial amount of GHG emissions and energy usage (EPA 2019). Any efforts to achieve climate goals or GHG emissions reduction targets that do not address buildings are overlooking an essential opportunity. Energy codes are the foundation to any effort to drive new buildings towards zero energy and zero carbon and set requirements for how to renovate existing buildings.

Increasing levels of energy efficiency in buildings can lead to less energy demand—thus decreasing reliance on fossil fuels and enhancing the ability to achieve zero energy goals through increased renewable energy deployment. Additional buildings policies including incentives to drive retrofits or ongoing performance requirements should be coordinated with building energy codes to ensure a holistic policy approach aligned with overall energy and GHG reduction goals.

To date, energy codes have primarily been focused on reducing energy costs, energy use, and GHG emissions. However, as climate adaptation becomes a priority, energy codes are also being recognized for their contributions to resilience which is highlighted in *Figure 4*. Climate change is expected to result in an increase in extreme temperature events (NASEM 2021). Through provisions for efficient building design and operations, including guidance on envelope design, heating, ventilation, air-conditioning and refrigeration equipment, and shading and reducing solar heat gain, energy codes can reduce the impacts of such extreme events. Additionally, during these extreme events, the energy grid may become strained. Reduced energy demand to achieve comfortable indoor temperatures through increased building efficiency can also enhance resilience of the energy grid (ICC 2019a).

Figure 5 outlines research which has shown the various benefits associated with energy efficiency measures in buildings including during emergency response and recovery, for social and economic resilience, and for climate mitigation and adaptation (Ribeiro et al. 2015).

³ This directive was issued in 2011 with an aim of strengthening the security and resilience of the United States. More information can be found at <https://www.dhs.gov/presidential-policy-directive-8-national-preparedness>.



Figure 4. Energy code contributions to resilience.

However, according to DOE, 24 states' residential energy codes are currently at least 15% less efficient than the 2021 IECC.⁴ Absent federal interventions, housing in these states will be built to older requirements that burden building occupants with higher than necessary energy bills every month.

Energy insecurity, fuel poverty or high energy burdens impact the social resilience of LMI populations.⁵ Energy insecurity intersects with other hardships, compounding the severity of the others and contributing to detrimental health consequences. Competing needs and hardships, such as food insecurity, water insecurity, and housing insecurity, result in tradeoffs where basic needs are prioritized and sometimes foregone. The stress from having to make tradeoffs between basic needs profoundly affects adult and child mental health, exacerbating many kinds of physical health and social issues (Jessel, Sawyer, and Hernández 2019).

In the U.S., low-income households face energy burdens two to three times that of median households. Of all U.S. households, 25 percent (30.6 million) face a high energy burden (i.e., pay more than 6 percent of income on energy bills) and 13 percent (15.9 million) of U.S. households face a severe energy burden (i.e., pay more than 10 percent of income on energy) (Drehobl, Ross, and Ayala 2020). Building codes and weatherization or retrofit programs provide important mechanisms for reducing energy burdens. Importantly, such efforts can improve quality of life and health outcomes while providing economic stimulus and job creation (Drehobl, Ross, and Ayala 2020; RIBA 2020).

⁴ Statistic was extracted from the Department of Energy figure entitled Residential Energy Code: State Energy Index Relative to Current Model Code (2021 IECC), which was presented at the Resilient and Efficient Codes Implementation Request for Information Workshop.

⁵ Energy insecurity, fuel poverty or high energy burdens refer to inability to access energy sources or the cost of using such sources is significant compared to monthly income.

Benefit type	Energy efficiency outcome	Resilience benefit
Emergency response and recovery	Reduced electric demand	Increased reliability during times of stress on electric system and increased ability to respond to system emergencies
	Backup power supply from combined heat and power (CHP) and microgrids	Ability to maintain energy supply during emergency or disruption
	Efficient buildings that maintain temperatures	Residents can shelter in place as long as buildings' structural integrity is maintained.
	Multiple modes of transportation and efficient vehicles	Several travel options that can be used during evacuations and disruptions
Social and economic	Local economic resources may stay in the community	Stronger local economy that is less susceptible to hazards and disruptions
	Reduced exposure to energy price volatility	Economy is better positioned to manage energy price increases, and households and businesses are better able to plan for future.
	Reduced spending on energy	Ability to spend income on other needs, increasing disposable income (especially important for low-income families)
	Improved indoor air quality and emission of fewer local pollutants	Fewer public health stressors
Climate mitigation and adaptation	Reduced greenhouse gas emissions from power sector	Mitigation of climate change
	Cost-effective efficiency investments	More leeway to maximize investment in resilient redundancy measures, including adaptation measures

Figure 5. Resilience benefits of energy efficiency (Ribeiro et al. 2015).

Climate Driven Hazards and the Role of Codes

Climate change is accelerating the occurrence of hazard events with growing frequency, variability and intensity (NASEM 2016). These anticipated climatic hazard events include hurricanes, cold snaps and heat waves; each posing consequential social challenges like property damage or loss, human health impacts or casualties, energy insecurity, growing poverty or homelessness, or economic downturn. The devastating impacts of these events are becoming long-lasting, cyclical, and are being exacerbated by a lack of adoption of up-to-date, modern building codes and standards. According to FEMA (2020), about two-thirds of communities do not have hazard-resistant codes and about 30 percent of the construction undertaken in the U.S. is in communities with no codes or codes that precede the 21st century. Thus, it is essential to increase comprehensive community resilience in response to climate change through the implementation of sustainable and resilient design and construction practices, including modern building energy codes. This section will explore various natural hazards, specifically extreme weather events, that are being driven by climate change and the opportunities for increased resilience and sustainability.

A new study shows that rapid warming in the Arctic, associated with climate change, is a possible driver of recent extreme winter weather events in the U.S. (Cohen et al. 2021). Extreme winter weather events include intense snowfall and anomalous cold snaps, which have become more frequent (Cohen et al. 2021). In February 2021, the U.S. Southern Plains experienced a cold wave that resulted in the collapse of Texas' energy grid and associated damages of nearly \$200 billion. Extreme winter weather has not historically been commonly experienced in the

Southern U.S., and a lack of planning led to record losses and extreme energy insecurity. This event comes after a 2011 winter storm that caused significant blackouts, which further highlights insufficient planning to strengthen Texas's energy infrastructure.

In addition to extreme winter weather events, climate change is also making heat waves hotter, lengthier and more frequent (NASEM 2021). More severe and frequent heat waves have an increasingly direct impact on human health outcomes and can also impact the availability and functionality of critical infrastructure, including homes, energy grids, and critical facilities. Often, an initial adverse event may produce cascading impacts or secondary events that further stress a community. The lack of power following a disaster, particularly in the middle of summer or winter when extreme weather events are more likely, can lead to additional negative impacts. This was the case in a Florida elder care facility, where 12 people died due to extreme heat following Hurricane Irma's destructive path that led to loss of air-conditioning capacity (O'Matz, 2017). Passive survivability⁶, through enhanced energy efficiency measures, would have increased the resilience of the facility and provided a safer indoor environment.

As extreme weather events become more likely and intense, the necessity for adoption of modern building and energy codes is increasingly apparent. Enhancing the passive survivability of structures, through energy efficiency provisions outlined in the code and reduced reliance on energy grids, will ultimately enhance community resilience in response to the impacts of climate change. Buildings constructed to be energy efficient maintain temperatures longer and require less energy to provide heating or cooling, resulting in less stress on the grid (Urban Green Council 2021). This may allow the grid to remain functional during such an event, resulting in decreased overall impact to the entire community.

Multiple provisions within the energy code contribute to conditions that support passive survivability. Enclosure criteria around insulation, air barriers, solar heat gain, glazing and fenestration support temperature- and ventilation-related concerns. While the building enclosure performance garners most of the attention around passive survivability, other code provisions are also relevant. Pipe insulation can prevent the freezing of pipes during extreme cold events. Daylighting can support continued use of spaces when emergency lighting is insufficient or when back-up power runs out. Access to daylight may also support occupant mental health during an otherwise stressful time. Using energy codes to provide enhanced passive survivability provides significant co-benefits. Community and individual resilience are enhanced while building owners and tenants reap energy efficiency related benefits every day in the form of lower energy bills and greater cost certainty.

Other natural hazards impacted by climate change and possible opportunities for enhanced building regulation to support increased resilience are discussed below.

In recent years, long-duration dry conditions have contributed to the increasing number and intensity of wildland fires—wildfires are more frequent, larger and more intense than in the past (CoreLogic 2021). 2020 was one of the most destructive wildfire seasons to date, with wildfires burning and damaging nearly 17,700 structures. Across the country, the most damaging wildfire seasons have been in recent years, including 2017, 2018, and 2020, accounting for 62 percent of the structures lost over the last 15 years (Barrett 2020). As the wildland urban

⁶ Passive survivability is the ability for a building to remain habitable in the face of an event or crisis resulting in the loss of energy, water or sewage services. The need for passive survivability may surface during extreme heat or cold events when the grid is severely taxed or secondary to other hazard events. Temperature extremes can stress the grid, resulting in blackouts.

interface⁷ (WUI) grows and the risk of wildland fire increases, communities must be prepared to implement strategies that enhance their resilience. A McClatchy analysis following the California Camp Fire in October 2018 found that 51 percent of the structures built after a WUI code was implemented escaped damage compared to 18 percent of the 12,100 structures built prior (Gustus 2019). In addition to protecting individual livelihoods, the International Wildland-Urban Interface Code (IWUIC) also supports community resilience by providing a holistic approach to reducing risks (ICC 2020).

Climate change also impacts flood events—increased future flood conditions have been associated with sea level rise, coastal erosion, subsidence, increase and variability in precipitation, extreme weather events like hurricanes and increased development and runoff. Future conditions of high flood elevations are predicted to result in more frequent flooding events, increased flood damage to older and lower-elevated buildings, increased frequency of substantially damaged buildings and compromised critical infrastructure (FEMA 2021). Modern, future-focused building regulation is needed to address risk and support community resilience when considering that an increase in water elevations have proven to result in more frequent high flood elevation events, which today's buildings are not built to withstand (FEMA 2021). Future flood conditions must be incorporated into design requirements to ensure long-term resiliency and function of the built environment, preventing future damage, reducing expensive retrofit mitigation and ensuring social and economic stability.

Other extreme hazards like tornadoes have not yet been assessed to have a direct link to climate change due to limited data, variability of yearly events, and the difficulty of modeling such events due to the nature of their small size (C2ES 2022). Although it is still unknown if climate change has a direct contribution to frequency of tornado events, it may have a relationship with some shifts in trends. Occurrences of 30 or more tornadoes in a day, density of tornado clusters, and the strength of tornadoes are all trends that have increased throughout the United States since the 1950's, which could have linkages to climate change (C2ES 2022). Among other trends, the distribution of tornadoes has shifted eastward, and variability of seasonality and intensity have also increased (Henson 2021). It is important to note that these trends have not been directly attributed to climate change but the growing intensity, frequency and variability of severe thunderstorms and hurricanes, which are linked to climate change, may provide a glimpse of what is to come. Due to the growing variability of tornadoes, it is critical for communities to bolster their resilience and reduce the impact of such events which include severe infrastructural and economic damages and loss of life. Especially in tornado-prone areas, communities can enhance their resilience by adopting more stringent building codes to meet standards set forth by the National Storm Shelter Association, the Code Council and FEMA.

Building Codes as a Path to Resilience

In addition to energy efficiency, building codes address multiple other important climate factors including water use, materials and waste, indoor air quality including ventilation and filtration, and sustainable economic growth and job creation. Building codes address climate-based risks including flooding, tropical cyclone/hurricane, wildfire/bushfire, and extreme snow through the provision of either performance or prescriptive requirements for structural loads, material properties, enclosure characteristics, and other design requirements.

⁷ The Wildland Urban Interface is the zone of transition where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

Building codes are a fundamental contributor to community resilience. A community cannot be resilient without resilient buildings and the codes that support their development. Resilience in the built environment starts with strong, regularly adopted, and properly administered building codes (ICC 2019b). These resilient outcomes are highlighted in *Figure 6*.

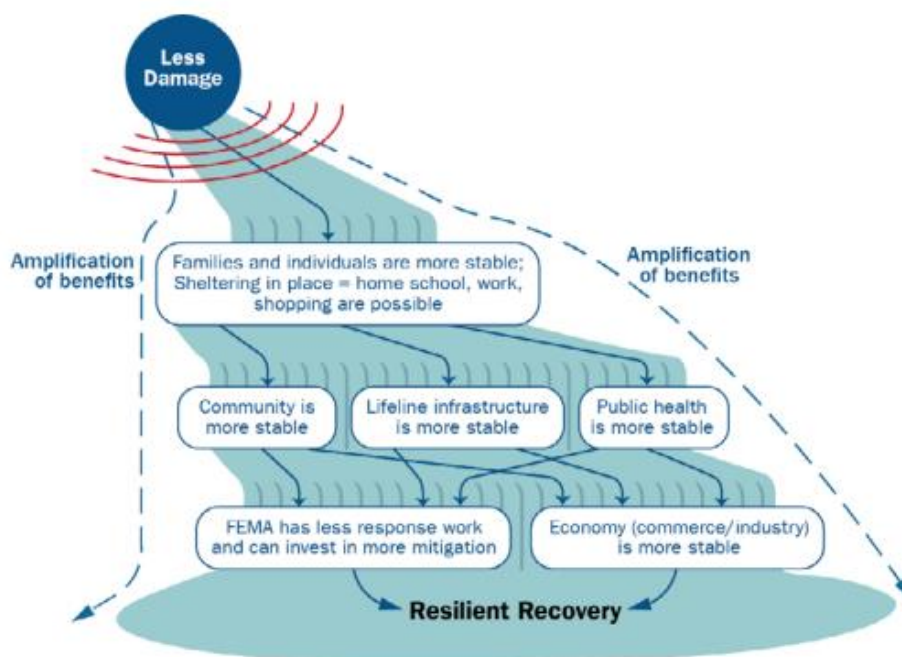


Figure 6. Cascading benefits from implementation of building codes.

Stretch Energy Codes

Advanced energy codes and regulations, often known as “stretch codes” or “reach codes,” provide a means to advance energy efficiency in a jurisdiction. They are a tool to allow cities and counties with ambitious climate goals to move forward at a different pace than others in the state. Stretch energy codes are an important tool to drive a quicker pace of GHG emissions reductions, mitigating and adapting to the impacts of climate change and enhancing the returns from the associated energy efficiency benefits. As stretch code cities demonstrate the constructability and affordability of higher-performance buildings, statewide adoption of such rules is facilitated, generating a virtuous cycle.

The Code Council, in partnership with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the Massachusetts Department of Energy Resources (DOER), published a base and stretch code titled *2020 Massachusetts Energy Codes*. This ninth edition of the Massachusetts Building Energy Code is based on the 2018 IECC and ANSI/ASHRAE/IES⁸ Standard 90.1-2019, which contains specific requirements designed to meet the needs of the commonwealth. The adoption of new and improved building codes is an integral part of Massachusetts’ strategy to meet their climate and energy goals, through the improvement of energy efficiency throughout their building stock. The adoption of the base code is consistent with the Green Communities Act of 2008, which requires the commonwealth to

⁸ ANSI refers to the American National Standards Institute and IES refers to the Illuminating Engineering Society.

update their base code every three years to be as stringent as the most recent edition of the IECC. The streamlined energy code is fully integrated and updates the stretch energy code, an above-code appendix alternative, to provide communities with the choice of adopting more rigorous energy efficiency and renewable energy provisions to promote progress towards their energy goals and enhancing their community's resilience in response to a changing climate.

Integrating Sustainability with Adaptation

Planning for resilience must be at the forefront for critical facilities to support comprehensive community resilience. Integrating sustainable building elements with climate adaptation planning proved successful for Partners HealthCare who, in 2013, built the \$225 million LEED Gold-certified⁹ Spaulding Rehabilitation Hospital at the Charleston Navy Yard in Boston, Massachusetts. The waterfront site was a remediated brownfield which has become increasingly vulnerable to natural hazards including risks of hurricanes, storm surges, and sea-level rise leading to potential coastal flooding and power loss (ULI 2021). As one of the largest electricity consumers in the State, Partners have reduced the building's energy requirement by nearly half that of comparable hospitals through implementation of high-efficiency mechanical systems including a cogeneration system for heat and power (ULI 2021). These elements made the site a multi-pronged resilience planning project, balancing energy efficiency with hardened infrastructure to withstand the waterfront risks of high winds and flooding from coastal storms.

Partners HealthCare, in partnership with architects Perkins+Will, established innovative strategies to prepare for the associated impacts of climate change and built off lessons learned from Superstorm Sandy, which occurred during the construction of the hospital. The resilience strategies of the Spaulding Rehabilitation Hospital include elevation of the first floor 30 inches above the 500-year floodplain, installing all mechanical systems on the roof to ensure operation during flooding, floodproofing the primary diesel storage system, enhanced insulation elements of the building envelope to reduce heat loss and increase energy efficiency, and construction of swales and earth berms to reduce the impacts of waves and storm surge (ULI 2021). These resilience mechanisms reduced the first-year operating costs by \$400,000 and by \$500,000 in following years through continued enhancements to the energy efficiency systems, which also vastly reduced the emissions of the building and enhanced the indoor environment for patients.

Setting the Path to Climate Resilience

In adapting to the impacts of climate change, it is critical to recognize that the risks the built environment will face in the future are different than those of the past while also acknowledging the role that the built environment plays in mitigating the impacts of the climate crisis. Codes, standards and the design process must adapt to recognize these changing risks and mitigate the associated impacts. FEMA found in their 2020 report that currently 65 percent of counties, cities, and towns across the U.S. have not adopted modern building codes, only 50 percent of cumulative post-2000 construction adhered to the I-Codes, and 30 percent of new construction is occurring in communities with no codes at all or codes that are more than 20 years outdated (FEMA 2020). Without building codes in place, buildings could lock in higher than necessary emissions and costs while also failing to build in resilience measures across their

⁹ LEED certification, developed by the U.S. Green Building Council, provides a framework for green building design, construction, operations and performance through built-in strategies with related outcomes.

entire life cycle. Integrating energy efficiency measures is relatively simple and can be done at little to no cost during the planning and design stage but becomes more difficult and expensive once the building is complete (Laustsen 2008). There are several pathways that can support communities in the analysis of their current building regulatory system and the adoption and implementation of policy mechanisms, like building and energy codes, which support enhanced climate resilience. These pathways are explored within this section as possible avenues to curb inconsistencies in code adoptions and reducing risk through building resilience.

Federal Support to Drive Progress

Federal grant programs are a critical tool for communities to implement projects that reduce their risk to the impacts of climate change and become leaders in community resilience. These programs support historically underserved and marginalized communities, providing the necessary technical assistance to enhance their energy efficiency through modern energy code adoption and implementation, and adapt to their unique climate-related shocks and stresses.

The Infrastructure Investment and Jobs Act (IIJA) established a new DOE-led program, Resilient and Efficient Codes Implementation (RECI), to award competitive grants for sustained cost-effective implementation of updated energy codes. The RECI provides \$225 million—\$45 million annually from 2022 to 2026—to support implementation of updated building energy codes. The IIJA has also made available \$550 million for the Energy Efficiency and Conservation Block Grant Program (EECBC) and \$500 million for the State Energy Program (SEP) to support energy code and energy efficiency related activities. These programs provide formula funding to jurisdictions for a range of activities, including energy code development, adoption and implementation, along with energy efficiency and renewable energy upgrades, financing, energy audits, and electric vehicle (EV) charging station installations.

The IIJA also provides an additional \$1 billion for FEMA’s Building Resilient Infrastructure and Communities (BRIC) program over five years. BRIC funds hazard-resistant code adoption and implementation activities with a 25 percent local cost-share. Mitigation projects submitted for BRIC funding are made more competitive based on the statewide adoption and implementation of recent editions of the IBC and IRC, as well as Building Code Effectiveness Grading Schedule (BCEGS) ratings between 1 and 5.

FEMA also provides \$3.5 billion, \$700 million annually, for the Flood Mitigation Assistance (FMA) program, providing grants to governments for flood mitigation projects. The U.S. Department of Agriculture has also made \$500 million available to establish a Community Wildfire Defense Grant Program for at-risk communities. Funds may be used to develop or revise and implement community wildfire protection plans, which address hazard mitigation and structural protection. Eligible applicants must have adopted standards equal to or more stringent than the Code Council or National Fire Protection Association’s roof construction standards.

The Alliance for National and Community Resilience

The Alliance for National and Community Resilience (ANCR) was established by the Code Council and U.S. Resiliency Council to support communities in understanding and improving their resilience. As discussed previously, ANCR has been developing Community Resilience Benchmarks—identifying 19 community functions or ‘links’ covering the social, organizational, and infrastructural aspects of communities that influence their resilience and is developing benchmarks for each of the identified functions. The Buildings, Housing and Water

Benchmarks represent the first three CRBs developed. In 2021, ANCR completed CRB designations with the cities of Martinsville, Virginia¹⁰ and Oakland Park, Florida¹¹, which provided lessons learned on the importance of resilience benchmarking and avenues to enhance the effectiveness of the evaluation process.

The benchmarking process provides an objective measure of a community's priorities and their likelihood to remain functional when faced with hazards. Pertinent to this discussion, the Buildings Benchmark's—which covers all occupiable structures in a community including new and existing buildings, both residential and commercial—first requirement is centered on an assessment of the adoption of building codes in a community. This requirement measures a community's commitment to the ongoing adoption of codes, and thus the resilience of the covered buildings. Adoption of modern, up-to-date codes like the 2021 IRC and IBC would highlight an at-risk communities' understanding and commitment to mitigating their risk to the impacts of hazards, ultimately increasing their comprehensive resilience.

Resilience planning is an essential component of assuring communities are prepared for the evolving risks presented by climate change. The ANCR CRB process recognizes the importance of addressing the shocks and stresses a community faces today and those they are likely to face in the future. Resilience benchmarking is an important tool in the planning process to establish community priorities, identify metrics and monitor progress. The CRB process can also assist in attracting new businesses and residents while also potentially impacting bond ratings or the community's competitiveness for grants to support enhanced resilience. Community resilience can only be achieved through a holistic approach that captures the impacts and influences of multiple systems and services and the experiences and perspectives from the diversity of a community's members.

The Global Resiliency Dialogue

To date, most building codes base requirements on risk calculations based on historical data and past events. However, as climate change drives changes in the frequency, intensity, duration, and location of extreme events, codes must adapt to ensure that buildings, their owners, and occupants can remain safe throughout their lifecycle. International building code development and research organizations came together to form the Global Resiliency Dialogue, a joint initiative to inform the development of building codes that draw on both building science and climate science to improve the resilience of buildings and communities to intensifying risks from weather-related natural hazards.

The GRD has gathered information on this topic through two surveys and is using that information to produce international resilience guidelines for buildings. The first survey captured information on how climate data is currently used in building codes and standards (GRD 2021a), while the second covered potential methods and research needs to effectively address future climate risk in codes (GRD 2021b). The Global Building Resilience Guidelines currently under development will aid jurisdictions across the globe to better prepare the building stock to withstand extreme weather events, including high wind, flooding, and wildfire, that the evidence and science indicate have been and will continue to increase in frequency and duration. Building

¹⁰ For more information on the City of Martinsville's CRB designation see <https://www.resilientalliance.org/martinsville/>.

¹¹ For more information on the City of Oakland Park's CRB designation see <https://www.resilientalliance.org/oaklandpark/>.

codes and the activities that support their effective use are central to the realization of a climate resilient future.

Looking to the Future

As states and local governments set the path forward to climate resilience, the role of buildings and building codes in achieving the U.S. NDC while also lessening the impacts of climate change is clear. Policies at the state and local levels to achieve net-zero emissions and enhance community resilience must include a strong focus on current and future buildings. Building codes and the activities that support their effective use are central to the realization of a climate resilient future.

While establishing a building regulatory scheme—including development and adoption of codes; education and training of regulators, designers, and constructors; and product testing and evaluation capacity—may take time, organizations like the Code Council can provide tools and expertise to help jumpstart the process. Additionally, while such schemes develop, jurisdictions should lead by example and help build capacity through their procurement processes.

Further engagement on the role of building codes, partnered with strategic climate finance, to mitigate the impacts of and adapt to climate change is increasingly important when looking to the future and further U.S. engagement at the Conference of Parties (COP). It is critical for all governments to adopt and enforce building codes aligned with domestic climate goals for reduced GHG emissions and enhanced resilience in response to the climate crisis.

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