

PLANTING THE SEED OF
COMMUNITY RESILIENCE
FEDERAL, STATE, AND PRIVATE
STRATEGIES



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ASHRAE WISE Policy Fellow 2018

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Acronyms

100RC	100 Resilient Cities
AIAA	American Institute of Architects
ANCR	Alliance for National and Community Resilience
CARRI	Community and Regional Resilience Institute
CBDG	Community Development Block Grant
CDF	Community Development Fund
CRO	Chief Resilience Officer
CRPG	Community Resilience Planning Guide
CRRO	Colorado Resilience and Recovery Office
CRWG	Colorado Resiliency Working Group
EDA	Economic Development Administration
EDG	Economic Decision Guide
EHMP	Enhanced Hazard Mitigation Plans
FEMA	Federal Emergency Management Agency
FMA	Flood Mitigation Assistance
GAO	Government Accountability Office
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HUD	US Department of Housing and Urban Development
ICC	International Code Council
LEED	Leadership in Energy Efficient Design
MMC	Multihazard Mitigation Council
NDRC	National Disaster Resilience Competition
NFIP	National Flood Insurance Program
NIBS	National Institute of Building Sciences
NIST	National Institute of Standards and Technology
NIST	National Institute of Standards and Technology
NOAA	NOAA U.S. National Oceanic and Atmospheric Administration
ORR	NYC Office of Recovery and Resiliency
PDM	Pre-Disaster Mitigation
SRO	State Resilience Office
USCRT	U.S. Climate Resilience Toolkit
USCRT	U.S. Climate Resilience Toolkit
USGBC	United States Green Building Council
USGCRP	United States Global Change Research Program

Preface

About the WISE Program

The Washington Internship for Students of Engineering is nine-week program for upperclassman undergraduates studying engineering or computer science. Each intern is sponsored by an engineering society tasked with the goal of writing and presenting a paper on a topical engineering-related public policy issue. The program also houses each student in Washington, DC and schedule activities in the area to learn about how government officials make decisions based on engineering/technology issues. The goal of the program is to prepare future leaders of the engineering profession to understand and contribute as a liaison between technology and public policy.

About the Author

Victor is entering his final year at the University of Central Florida (UCF) where he is pursuing a bachelor's degree in mechanical engineering. In his time at UCF Victor has been president of the ASHRAE student chapter, Ronald E. McNair Scholar, Louis Stokes Alliance for Minority Participation (LSAMP) Scholar, and researcher at the NanoScience Technology Center (NSTC). Upon graduating from UCF Victor plans on pursuing a graduate level degree in engineering with a focus on policy.

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Executive Summary

Every year, natural disasters affect millions of people across the country. In 2017, the U.S. had its most costly year on record with \$306 billion in damages according to the U.S. National Oceanic and Atmospheric Administration (NOAA). Although the impact of these events is immediate, the road to recovery can be a slower and extremely costly process. For this reason, it is important to implement strategies that address these challenges. This paper focuses on the strategy of building more resilient communities utilizing a holistic approach to disaster planning by incorporating strategies such as mitigation planning and spending. Studies have shown that proper resilience planning saves money and lives. Therefore, the U.S. Federal government should look to reform its current disaster recovery policies to better align with these cost-effective strategies that will also protect its citizens. This report will explore current disaster recovery policies, the current barriers from a public policy standpoint, the need for increased investment in community resilience, and explore how to encourage/incentivize federal, state, local, and private entities to invest in these programs.

Background

Defining Resilience

Before any steps can be taken to address community resiliency, it is important that a definition is agreed upon by public and private stakeholders. A concrete definition for community resilience that incorporates a diverse set of partnerships ensures that the efforts going forward with the partners will work in cognizance with each other. This requires a mutual understanding between state, local, private and public entities; if not, the goals and their implementation will not be uniform.

The word resilience has been around for hundreds of years and the origin of the term provides an interesting insight into its meaning. It is derived from the present participle of the Latin verb *resilire*, meaning "to jump back" or "to recoil."¹ Essentially this is what the core of the term still means. However, over time the term has expanded in meaning as a description that applies to components that make up the built environment.

¹ "Resilience." Merriam-Webster. Accessed July 2018. <https://www.merriam-webster.com/dictionary/resilience>.

The industry recently developed a statement to define resilience in the built environment. The statement was developed by the American Institute of Architects (AIA) and the National Institute of Building Sciences (NIBS) and supported by over two dozen other organizations in the building industry, including ASHRAE and the Federal Emergency Management Agency (FEMA), among others. Industry has defined resilience as “the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.”² This was the first step required for organizations with common resilience building goals to come together and plan in unison.

Resiliency planning must be treated as a system to better protect communities since its more than just one building or neighborhood. The concept of community resilience is a subset of resiliency. A report put together by the Community and Regional Resilience Institute (CARRI) tracked the history of the phrase. The first time the phrase resilience was used regarding community efforts occurred in the 1980s. Over time, they have identified five common themes that have been characterized as important to community resiliency which are³:

1. Attribute, defining resilience as a quality
2. Continuing, the essential importance resilience in the community
3. Adaptation, the ability to adapt to the changing field
4. Trajectory, the ability to achieve positive outcome for the community relative to its state after the crisis
5. Comparability, the fact that there are levels of resilience which allows communities to be compared in terms of their ability to positively adapt to adversity.

Based on these themes, CARRI has defined community resilience as “the capability to anticipate risk, limit impact, and bounce back rapidly through survival, adaptability, evolution, and growth in the face of turbulent change.”⁴ This definition captures the goal for building more resilient communities. It’s the idea that community and building systems have the ability to adapt when the environment around them changes. As communities look to understand resilience, they too will have to define what it means to them. A community is composed of a diverse group of social, environmental, and economic elements, often described as the triple bottom line. There are too

² Industry Statement on Resilience. Report. AIA, NIBS.

³ Definitions of Community Resilience: An Analysis. Report. CARRI, Community and Regional Resilience Institute. 2013. 2.

⁴ Definitions of Community Resilience: An Analysis. Report. 10.

many components for one organization to do the work on their own since adaptability requires improvements that will need expertise from several industries.

Resilience in Urban Areas

Community resilience is particularly important since most of the U.S. population lives in urban areas. According to the United States Census Bureau, more than 80 percent of the US population lives in Urban Areas, meaning territories of 50,000 or more people.⁵ Urban areas also contribute to a majority of the U.S. economy as well. As reported by the McKinsey Global Institute, large cities contribute to almost 85 percent of the U.S. Gross Domestic Product (GDP) and in the next 15 years will contribute to more than 10 percent of global GDP growth.⁶ When a disaster strikes it can sometimes take weeks, months, or years to recover, which in an urban environment can have detrimental effects on the local economy. Therefore, it is vital to focus on these densely populated areas in the market of designing, building, and maintaining a more resilient built environment.

Resilience in the Built Environment

The built environment includes the man-made areas and surroundings where people, love, work, and shop. These areas are responsible for keeping the U.S. population comfortable for most of their daily activities, in addition to providing shelter and protection from extreme weather events. However, the existing and new built environment is in danger of being damaged during disasters if changes are not made. Natural disasters are frequently exceeding more than \$1 billion in damages. Per the National Centers for Environmental Information, 2017 was a record year where 16 of these kinds of events occurred at a cost in excess of \$300 billion dollars. This broke the previous record of \$220 billion in 2005.⁷ (See Figure 1) Disasters continue to happen each year and have increased the burden on the American taxpayer as rebuilding costs have increased.

5 Branch, Geographic Products. "2010 Census Urban and Rural Classification and Urban Area Criteria." United States Census Bureau. September 01, 2012. Accessed July 2018. <https://www.census.gov/geo/reference/ua/urban-rural-2010.html>.

6 Manyika, James, Jaana Remes, Richard Dobbs, Javier Orellana, and Fabian Schaer. "Urban America: US Cities in the Global Economy." McKinsey & Company. Accessed July 2018. <https://www.mckinsey.com/featured-insights/urbanization/us-cities-in-the-global-economy>.

7 Adam.Smith@noaa.gov. "Billion-Dollar Weather and Climate Disasters: Overview." National Climatic Data Center. Accessed July 2018. <https://www.ncdc.noaa.gov/billions/>.

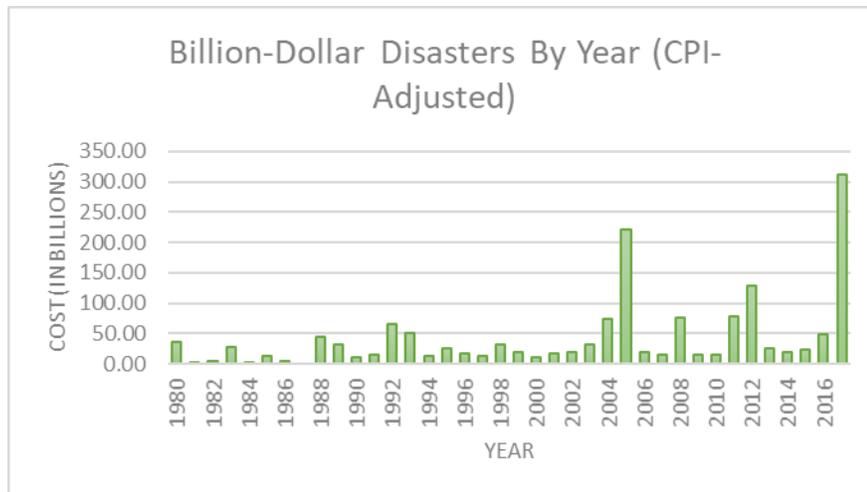


Figure 1

Resilience vs Hazard Mitigation

Due to the high cost of rebuilding, private organizations and the federal government have begun to examine preventative financing measures to help reduce future rebuilding costs which is commonly referred to as hazard mitigation. Hazard mitigation is a part of resilience that specifically focuses on financing efforts beforehand for disaster preparation. A recent study by the National Institute of Building Sciences (NIBS), co-founded by FEMA, showed that hazard mitigation efforts resulted in a national benefit of \$6 for every \$1 invested.⁸ This demonstrates damage mitigation strategies for resilience purposes would lessen the cost of future rebuilding efforts. Therefore, there is an economic incentive for investing money into these types of resilience strategies.

Resilience is often coupled with the term hazard mitigation. Although these activities contribute towards making a community resilient, they do not capture the whole definition of resilience. Hazard mitigation and similar activities are the act of providing a community with strategies, tools, and funding to prepare for disasters. Resilience on the other hand incorporates those activities and investigates the underlying reasons for why the community is at risk. Resilience takes a holistic approach at preparing a community, which leads to better community planning that aligns with the goal of becoming more resilient. Therefore, it is fair to say that hazard mitigation can be a part of resiliency, but hazard mitigation itself is not resilience.

The ability to adapt is another component of resilience. Adaptation refers to a community's ability to change the way they conduct their day to day activities in a changing environment.

⁸ Natural Hazard Mitigation Saves: 2017 Interim Report. Report. Multihazard Mitigation Council, National Institute of Building Sciences.

Adaptation activities include recovery efforts after a disaster and improving areas with the greatest vulnerabilities. These efforts could include reinforcing floodgates, retrofitting buildings to resist damage, or increasing educational resources to the community for techniques to address hazards. No one can fully predict the time and strength of a storm. Devastating storms can come as a surprise and cause unintended damages. The ability to learn from each disaster and taking that knowledge to adapt for the next will contribute towards higher levels of resilience.

Disaster Cycle

To aid communities in adapting activities, it is important to categorize hazards through the use of a 'disaster cycle' diagram (See Figure 2). The disaster cycle describes the process of a disaster: actions before, in terms of mitigating damage from the disaster and preparing for the disaster; and actions following a disaster, in terms of response to a disaster and recovery efforts. This is where mitigation and adaptation meet. Mitigation requires preparing ahead of time for potential disasters based on a community's identified hazards. On the other hand, once a disaster passes it is likely areas of weaknesses will present itself and will require adapting to those hazards for the future. The scope of a community's level of mitigation and adaptation to disasters has been coined as closing the 'Resilience Gap' by the Union of Concerned Scientists.⁹ (See Figure 3) Higher levels of resilience require a greater effort of closing this gap. The 'disaster cycle' and 'Resilience Gap' put into prospective the dynamics of a disaster and importance of preparing beforehand and adapting to a changing environment.



Figure 2

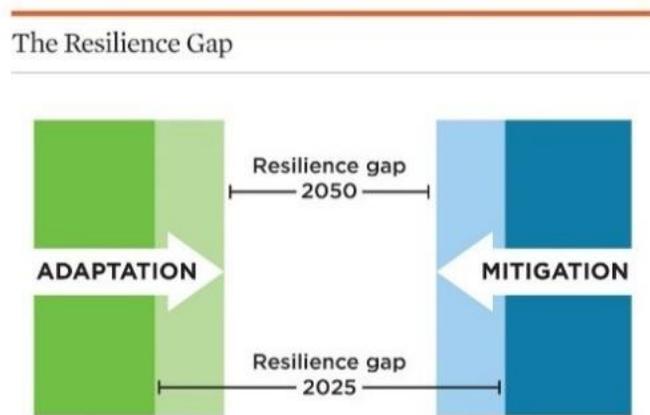


Figure 3¹⁰

⁹ Britz, Peter, Susanne Moser, and Jalonnie White-Newsome. Toward Climate Resilience A Framework and Principles for Science-Based Adaptation. Report. Union of Concerned Scientists'. 2.

¹⁰ "Toward Climate Resilience: A Framework and Principles for Science-Based Adaptation (2016)." Union of Concerned Scientists. Accessed July 2018. <https://www.ucsusa.org/global-warming/science-and-impacts/impacts/climate-resilience-framework-and-principles#.W19q6tJKg2w>.

Current Federal Strategies

The role of the federal government is to provide funding, regulation, and data/tools for addressing community resilience. The three federal agencies leading efforts in the field and provide the most funding for disaster relief or mitigation are FEMA, HUD, and USACE. (Figure 4)

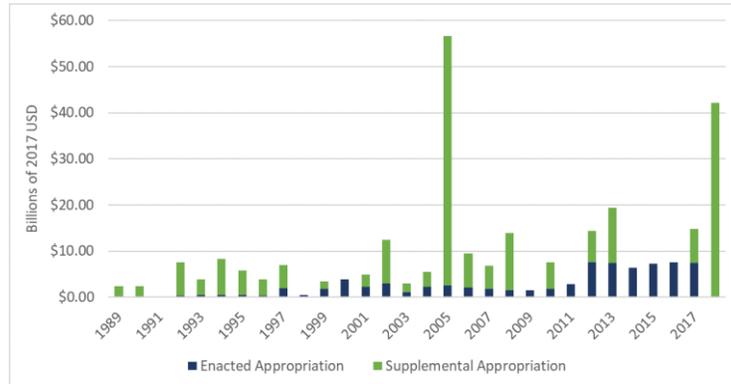


Figure 4

According to the Government Accountability Office (GAO), from 2005 through 2014, the federal government supplied at least \$277.6 billion dollars across 17 federal departments and agencies for disaster expenses.¹¹ 2017 was the most expensive year on record for the federal government with spending totaling over \$130 billion.¹² The biggest problem is that most of the funding comes in the form of supplemental appropriations which occurs after the disaster, rather than utilizing mitigation spending efforts beforehand. (Figure 5)

11 FEDERAL DISASTER ASSISTANCE. Report. Report to Congressional Committees, United States Government Accountability Office. 2016.

12 Lingle, Brett, Carolyn Kousky, and Leonard Shabman. "Federal Disaster Rebuilding Spending: A Look at the Numbers." Risk Management and Decision Processes Center. June 18, 2018. Accessed July 2018. <https://riskcenter.wharton.upenn.edu/disaster-aid/federal-disaster-rebuilding-spending-look-numbers/>.

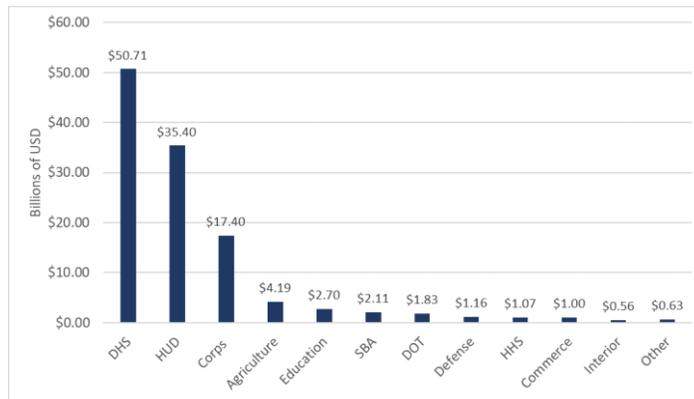


Figure 5

Federal organizations that have the most influence in the realm of building community resilience by providing funding, tools, standards and research are the National Institute of Building Sciences (NIBS), the Federal Emergency Management Agency (FEMA), the National Institute of Standards and Technology (NIST), and the U.S. Climate Resilience Toolkit (USCRT).

National Institute of Building Sciences (NIBS)

In the early 1970s the federal government began to gain interest in advancing efforts in building science due to lack of information and private/public relationship in the industry. As a result of this need, Congress authorized the creation of the National Institute of Building Sciences (NIBS) in the Housing and Community Development Act of 1974. NIBS is a unique organization that is led and funded by both public and private agencies. This allows for multilateral representation for the common goal of improving the built environment.

In 2017, NIBS Multihazard Mitigation Council (MMC) conducted a study of the economic benefits mitigation provides. Because of this study they were able to show that between 1993-2016 federal grants made by FEMA, the Economic Development Administration (EDA) and HUD, resulted in a national benefit of \$6 for every \$1 invested.¹³ This updated the previous study from 2005 which demonstrated savings of \$4 to \$1. The study also revealed that by designing new structures to exceed the provisions of the 2015 code requirements from the International Building Code (IBC), the International Residential Code (IRC) and the International Wildland-Urban Interface Code (IWUIC) resulted in a national benefit of \$4 for every \$1 invested. Furthermore, the study showed that over the same time span federally funded natural hazard

¹³ *Natural Hazard Mitigation Saves: 2017 Interim Report*. Report. Multihazard Mitigation Council, National Institute of Building Sciences.

mitigation is estimated to prevent approximately 1 million nonfatal injuries, 600 deaths and 4,000 cases of Post-Traumatic Stress Disorder.

There are various categories of disasters and each one causes different types of damages. The cost benefit of \$6 for every \$1 invested represented above is an average of all hazards. Included below, from the study, is a breakdown of each disaster with their cost benefits provided in Figure 6.

National Benefit-Cost Ratio Per Peril <small>*BCR numbers in this study have been rounded</small>		Federally Funded	Beyond Code Requirements
Overall Hazard Benefit-Cost Ratio		6:1	4:1
 Riverine Flood		7:1	5:1
 Hurricane Surge		Too few grants	7:1
 Wind		5:1	5:1
 Earthquake		3:1	4:1
 Wildland-Urban Interface Fire		3:1	4:1

Figure 6¹⁴

The data provided on the cost-benefit of mitigating either through investing or building beyond code minimums plays a significant role in the support of pre-disaster mitigation efforts. Many federal, state, and private agencies have cited this study as a reason to support resilience projects. Studies like these allow for the economic argument to be considered, which can sometimes be a more convincing one. Although it is only one component of a community's triple bottom line (social, environmental and financial), it can spark reasons to support the start of addressing vulnerabilities. This heavily cited economic study proves to be a valuable asset for supporting resilience efforts.

Federal Emergency Management Agency (FEMA)

The Federal Emergency Management Agency (FEMA) is an agency under the Department of Homeland Security that leads the federal government's response when natural disasters strike. Their mission statement is simply: Helping people before, during, and after disasters.¹⁵ FEMA is also one of the few federal agencies with funds available for disaster mitigation purposes. Funding and support are provided through the Hazard Mitigation Assistance (HMA) grant programs (Hazard Mitigation Grant Program, Pre-Disaster Mitigation, and Flood Mitigation

¹⁴ *Natural Hazard Mitigation Saves: 2017 Interim Report.*

¹⁵ "About the Agency." What Is Disaster Assistance? | FEMA.gov. Accessed July 2018. <https://www.fema.gov/about-agency>.

Assistance).¹⁶ As a condition for receiving funding from these programs, FEMA requires state, tribal, and local governments to develop and adopt hazard mitigation plans.

The Hazard Mitigation Grant Program (HMGP) supports cost effective post-disaster projects. Their website supports this program by citing the 2005 NIBS study that reported potential savings of \$4 for every \$1 invested. As a follow-up, FEMA co-funded the follow-up study conducted by NIBS in 2018 which showed a potential greater savings of \$6 to \$1.¹⁷ HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act to help communities implement hazard mitigation measures following a Presidential Major Disaster Declaration.¹⁸ All mitigation measures approved under the State's grant will be subject to the cost sharing provisions established in the FEMA-State Agreement. The cost sharing provision provides 75 percent of funding for a given project and the rest either comes from the state, city, or individual themselves.¹⁹ For larger projects the percentages are much lower. FEMA provides up to 15 percent of the first \$2 billion; however, that amount goes up to 20 percent for states with Enhanced Hazard Mitigation Plans (EHMP).²⁰ (See Figure 7) As of April 1, 2018, only 12 states have received FEMA approval of an enhanced state mitigation plan, while all 50 states, the District of Columbia, and five territories (Guam, American Samoa, Northern Mariana Islands, Puerto Rico, and U.S. Virgin Islands) have FEMA-approved state mitigation plans.²¹

Typical projects that are funded through the HMGP include adopting new tools, regulations, up-to-date building codes, protecting natural areas, retrofitting homes/businesses/schools to withstand hazard events, or simply implementing outreach programs to educate the public about risks.²² The overall purpose of this grant program is to increase the resilience of communities recovering from disasters with the intention of saving money if a similar disaster were to happen again. Although the federal government is still spending money on disaster recovery efforts, there is an acceptance to the fact that hazard mitigation saves money and more importantly, lives.

¹⁶ "Hazard Mitigation Plan Requirement." What Is Disaster Assistance? | FEMA.gov. Accessed July 2018. <https://www.fema.gov/hazard-mitigation-plan-requirement>.

¹⁷ *2018-2022 Strategic Plan*. Report. FEMA, Federal Emergency Management Agency. 2018. 13.

¹⁸ "Hazard Mitigation Grant Program." What Is Disaster Assistance? | FEMA.gov. Accessed July 2018. <https://www.fema.gov/hazard-mitigation-grant-program>.

¹⁹ "\$206.432 Federal Grant Assistance." ECFR - Code of Federal Regulations. Accessed July 2018. https://www.ecfr.gov/cgi-bin/text-idx?SID=517446e2ecb486a02814ae1620c18397&mc=true&node=se44.1.206_1432&rgn=div8.

²⁰ "Hazard Mitigation Grant Program." What Is Disaster Assistance? | FEMA.gov. Accessed July 2018. <https://www.fema.gov/hazard-mitigation-grant-program>.

²¹ "Hazard Mitigation Plan Status." What Is Disaster Assistance? | FEMA.gov. Accessed July 2018. <https://www.fema.gov/hazard-mitigation-plan-status>.

²² *FEMA Fact Sheet: Mitigation's Value to Your Community*. Report. Federal Emergency Management Agency. 2017.



Figure 7²³

Through the Pre-Disaster Mitigation (PDM) grant program FEMA supplies funding for disaster preparation before the disaster occurs. The main difference between the HMGP and PDM is the timing of when funding is provided. The grant is authorized by Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, and is designed to assist States, U.S. territories, federally-recognized tribes, and local communities in implementing a sustained pre-disaster natural hazard mitigation program.²⁴ Furthermore, the PDM Grants are funded through Congress appropriations to reduce the need for federal funding in future disasters. Congress's support through funding for PDM further iterates the fact that investing money beforehand saves money in the long run. This is a great example of how the federal government funds projects that raise the awareness of the importance of preparing for disasters beforehand.

The third grant program is the Flood Mitigation Assistance (FMA) program authorized by Section 1366 of the National Flood Insurance Act of 1968, as amended, with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP).²⁵ The purpose of this program is very similar to that of the PDM program, except it is used exclusively for flood protection purposes.

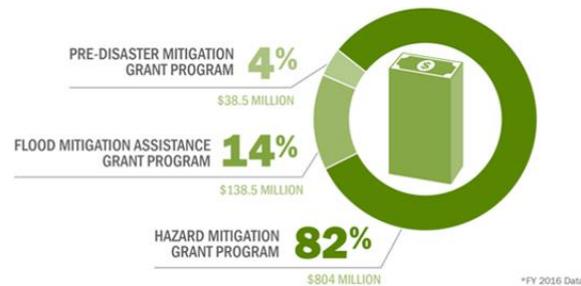
The HMGP and PDM programs are very similar. While both programs are intended for the same purpose of mitigating costs of future disasters, the PDM program provides funding for changes in advance of a disaster and the HGMP program provides post disaster funding relief. Unfortunately, both programs do not receive the same amount of funding. The HGMP program receives a lot more funding than the PDM program. (See Figure 8)

²³ "Hazard Mitigation Plan Requirement." What Is Disaster Assistance? | FEMA.gov.

²⁴ "Pre-Disaster Mitigation Grant Program." What Is Disaster Assistance? | FEMA.gov. 2018. Accessed July 2018. <https://www.fema.gov/pre-disaster-mitigation-grant-program>.

²⁵ "Flood Mitigation Assistance Grant Program." What Is Disaster Assistance? | FEMA.gov. 2018. Accessed July 2018. <https://www.fema.gov/flood-mitigation-assistance-grant-program>.

In 2016, nearly
ONE BILLION DOLLARS in Pre- and Post-Disaster
Hazard Mitigation Assistance Grants
 was delivered to states, tribes, and communities
 that will result in mitigation actions that **reduce risk**



In 2016, almost \$1 billion dollars was delivered to communities via the HMA program.

Figure 8²⁶

The third grant program is the Flood Mitigation Assistance (FMA) program authorized by Section 1366 of the National Flood Insurance Act of 1968, as amended, with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP).²⁷ The purpose of this program is very similar to that of the PDM program, except it is used exclusively for flood protection purposes.

As seen in the chart above more than 80 percent of the HMA grant programs funding went to the HMGP. Although FEMA helped sponsor the NIBS study and pre-disaster savings are acknowledged, the program that receives the most funding provides support for after the disaster has occurred. This is where a change in thinking needs to occur given the cost savings.

All of these programs use FEMA funds to support the overarching topic of resilience. Support for community resilience is also noted in FEMA's planning documents. As part of the 2018-2022 FEMA five-year plan, the first strategic goal is to build a culture of preparedness, stating "Resilience is the backbone of emergency management."²⁸ They further this idea by promoting the idea that everyone should be prepared before disasters strike by understanding our community's needs, our diverse cultures, and the resources available to us as a diverse nation. In other words, all levels of our society must work together to achieve the goal of community

²⁶ "Pre-Disaster Mitigation Grant Program." What Is Disaster Assistance? | FEMA.gov.

²⁷ "Flood Mitigation Assistance Grant Program." What Is Disaster Assistance? | FEMA.gov. 2018. Accessed July 2018. <https://www.fema.gov/flood-mitigation-assistance-grant-program>.

²⁸ 2018-2022 Strategic Plan. Report. FEMA, Federal Emergency Management Agency. 2018. 12.

resilience since this goal cannot be achieved without first recognizing that one agency is not the panacea. Rather a culture of preparedness must be fostered for our nation to be resilient.

The US Department of Housing and Urban Development (HUD)

The US Department of Housing and Urban Development (HUD) mission is to create strong, sustainable, inclusive communities and quality affordable homes for all.²⁹ According to a report developed by the 100 resilient cities network, these cities have identified a lack of affordable housing and intractable homelessness among their resilience challenges: Atlanta, Boston, Boulder Greater Miami and the Beaches, Honolulu, Los Angeles, Minneapolis, Nashville, New Orleans, Oakland, Pittsburgh, San Francisco, including Washington DC.³⁰ Where a person lives has major repercussions on their health and well-being. Healthy, stable, and affordable housing enables residents to focus on work, education, and general well-being.

HUD provides funding to help address the lack of affordable housing. One of these programs is the Community Development Block Grant (CDBG). This program was established by the Housing and Community Development Act of 1974 (like NIBS) and helps a wide range of community development needs, including housing, job development, and resilience projects.

According to a report by CDBG, from fiscal year 2005 to fiscal year 2014, the programs economic development activities have directly created or retained more than 353,237 permanent jobs. Furthermore, for every \$100 million of CDBG funding provided results in approximately 11,168 jobs and 11,889 new affordable housing.³¹ Providing affordable housing is extremely important for addressing the problems communities face in building resilience. This allows for residents to focus on work and other activities that contribute to the U.S. economy. Providing affordable housing is extremely important, but CDBG has not addressed making these homes safer by mandating resilience standards. The federal government currently does not have a minimum resiliency standard for these households; however, if they were to embrace one it would save more money.

Furthermore, there is an opportunity for extra funds through the Section 108 Loan Guarantee Program under the CDBG program. This provides a guaranteed loan that could also cover resilience among other things. According to their website, “The Section 108 Loan Guarantee Program (Section 108) provides communities with a source of financing for economic

²⁹ "Mission." HUD.gov / U.S. Department of Housing and Urban Development (HUD). Accessed July 2018. <https://www.hud.gov/about/mission>.

³⁰ SAFER AND STRONGER CITIES STRATEGIES FOR ADVOCATING FOR FEDERAL RESILIENCE POLICY. Report. 100 Resilient Cities. 40.

³¹ 2016 Summary Statement and Initiatives. Report. Community Development Block Grant, Housing and Urban Development. 2015.

development... including improvements to increase their resilience against natural disasters... project costs can be spread over time with flexible repayment terms, and borrowers can take advantage of lower interest rates than could be obtained from private financing sources.”³² The flexibility of the program and the fiscally attainable characteristics can be a powerful tool for building resilience. It is directly accessible to the average homeowner and shows that there are opportunities out there funded by the federal government that can go towards resiliency projects.

In a HUD report from 2012, they were able to show that most of the funded projects through their Section 108 Program also received additional funding from outside sources. In fact, for every dollar provided through the program they were able to receive an extra \$4.62 from private funders.³³ This is an incentive for the federal government to provide more funding since private funders have shown to include supplemental funding. This is a unique way for public and private funds to be combined for the benefit of resiliency projects. Although all the projects were not intended for resiliency purposes, the ones that were can be scaled into bigger programs with previous proof of success.

Due to Hurricane Sandy and other related disasters between the years 2011-2013, Congress enacted the “Community Development Fund” (CDF) that provided \$16 billion to assist communities in recovering.³⁴ Funding for this program was provided through HUD’s CDBG program as a long-term recovery mechanism for communities that encountered disasters. One billion dollars was made available from CDF funding to create the National Disaster Resilience Competition (NDRC) as a measure to help communities with funding to begin resilient planning.³⁵ The funding through this competition was specifically intended to assist communities that faced a disaster, therefore ensuring fair allocation of resources and opportunity administered to those most in need. Also, the competition was introduced as a two-phase process; (1) risk assessment and planning; and (2) design and implementation, with available funding for both phases. This encouraged broad participation to begin the process of communities becoming involved in the thought process. Furthermore, the competition made sure to fully engage all affected

³² "Section 108 Loan Guarantee Program." HUD Exchange. Accessed July 2018. <https://www.hudexchange.info/programs/section-108/>.

³³ *Study of HUD's Section 108 Loan Guarantee Program*. Report. Office of Policy Development and Research, U.S. Department of Housing and Urban Development. 2012. 21.

³⁴ PUBLIC LAW 113-2, § 127 STAT. 15 (2013).

³⁵ *NATIONAL DISASTER RESILIENCE COMPETITION*. Report. HUD, U.S. Department of Housing and Urban Development.

stakeholders while helping provide guidance so the whole community aspect is considered, and potential outside funders could become involved.

Results from these programs show great promise in helping to build community resilience, however CBDG funding lacks support from the executive branch. CBDG funding has decreased by 25 percent since 2010.³⁶ In 2015 CBDG funding was at \$3.95 Billion and the most recent appropriation approved by Congress was \$3.0 Billion. Funding continues to decrease although there is a clear need and benefit. These cuts are a direct result of the executive's branch lack of support of the program. In the most recent white house budget proposal for FY 2018 the administration called for the elimination of the program.³⁷

The CBDG, Section 108 Loan Program, the Community Development Fund, and the National Disaster Resilience Competition are all great examples of how one federal agency can provide funding and incentivize private funding for projects that contribute to resilience. At the same time the programs provide economic benefits to the community through housing and jobs, which are declared issues cities face against building resilience. These programs can be further leveraged to support greater efforts for building community resilience, as exemplified through the Section 108 and NDRC examples. The current administration should work to strengthen these efforts, rather than defund them.

National Institute of Standards and Technology (NIST)

The National Institute of Standards and Technology (NIST) is a national lab and non-regulatory agency of the U.S. Department of Commerce. Their purpose is to promote U.S. innovation and industrial competitiveness through scientific measurements and standards.³⁸ Resilience is one of the featured topics NIST focuses on. Through their Engineering Lab they have developed several guides and standards to help communities build resilience.

In 2015 NIST awarded \$20 Million for a research center to help communities increase resilience to disaster. At the same time, acting Under Secretary of Commerce for Standards and Technology and acting NIST Director, Willie May, was quoted stating "This center complements NIST's long-standing efforts to improve the performance of the built environment against natural hazards... The tools developed by the center will help to further advance the important goal of disaster

³⁶ Boyd, Eugene. *Community Development Block Grants: Recent Funding History*. Report. Congressional Research Service. 2014.

³⁷ America First A Budget Blueprint to Make America Great Again. Report. Office of Management and Budget, The White House. 2017. 25.

³⁸ "NIST Mission, Vision, Core Competencies, and Core Values." NIST. January 26, 2017. Accessed July 2018. <https://www.nist.gov/about-nist/our-organization/mission-vision-values>.

resilience from ambitious concepts to cost-effective solutions that communities can implement over time."³⁹ As part of these efforts, NIST has developed the Community Resilience Planning Guide (CRPG). The guide is composed of two volumes that are dedicated to describing all the dynamics of community resilience planning.⁴⁰

Volume I describes a six-step process that helps communities evaluate their triple bottom line regarding resilience planning.⁴¹ (See Figure 9)



Figure 9⁴²

Volume II describes ways to characterize the triple bottom line of resiliency such as chapter 17, which analyzes the most common resilience metric systems.⁴³ They mention that the economic resilience metric is the most developed and tractable when compared to the social and

39 "NIST Awards \$20 Million for Research Center to Help Communities Increase Resilience to Disaster." NIST. February 19, 2015. Accessed July 2018. <https://www.nist.gov/news-events/news/2015/02/nist-awards-20-million-research-center-help-communities-increase-resilience>.

40 "Community Resilience Planning Guide." NIST. May 08, 2017. Accessed July 2018. <https://www.nist.gov/topics/community-resilience/community-resilience-planning-guide>.

41 Report. Community Resilience Planning Guide for Buildings and Infrastructure Systems, NIST. Vol. 1. 2015.

42 Report. Community Resilience Planning Guide for Buildings and Infrastructure Systems, NIST. Vol. 1. 2015.

43 Report. Community Resilience Planning Guide for Buildings and Infrastructure Systems, NIST. Vol. 2. 2015.

environmental factors. This describes a flaw in the fact that when measuring level of community resilience, it can be easy to forget about the environmental and social dimensions in planning.

In an attempt to compare metric systems, the report compared nine different metric systems and compare them in terms of (1) scope, (2) utility, and (3) impacts assessed.

None of the metrics were strong in all three categories, which provides the opportunity for a metric to be developed that incorporates all three dimensions. As a follow up this research, NIST developed their own community resilience Economic Decision Guide (EDG).⁴⁴ They recognized that there are gaps that remain in characterization of robust, benefit-cost effective measures of community resilience that provide distinct guidance on the selection among potential resilience-based alternative investments, which EDG seeks to address. EDG provides a process for considering alternate methods for increasing community resilience through cost-effective investments in the built environment. The model includes a 7-step process which includes:

1. Select Candidate Strategies;
2. Define Investment Objectives and Scope;
3. Identify Benefits and Costs;
4. Identify Non-Market (Non-Economic) Considerations;
5. Define Analysis Parameters;
6. Perform Economic Evaluation; and
7. Rank Strategies

The EDG points out some difficulties in communities incorporating resilience metrics. Mainly, there is a need for general thinking to move away from thinking about one building or system and rather think about them as an interconnected system of systems. Also, the EDG or any other guide should be incorporated into current economic and social plans to be affective in a way that supports community resilience.

⁴⁴ Community Resilience Economic Decision Guide for Buildings and Infrastructure Systems. Report. Applied Economics Office Engineering Laboratory, NIST. 2015.

U.S. Climate Resilience Toolkit (USCRT)

The U.S. Climate Resilience Toolkit (USCRT) is an online resource developed by an inter-agency initiative under leadership of the United States Global Change Research Program (USGCRP). The website is currently managed by the National Oceanic and Atmospheric Administration (NOAA), which is an agency that operates under the United States Department of Commerce just like NIST. Its purpose is to “improve people’s ability to understand and manage their climate-related risks and opportunities, and to help them make their communities and businesses more resilient to extreme events.”⁴⁵ The online toolkit provides a bevy of resources including specific steps, case studies, tools such as advanced climate maps and forecasts, and expertise through reports and courses. The information can be filtered by region or topic of interest as well. The five-step process is like others and includes exploring hazards, assessing vulnerability and risks, investigating options, prioritizing options and plans, and taking action.

Out of these 5 steps the first one and the last one is the most important. Exploring your hazards requires the forming of a team and giving someone or a group of people the responsibility of addressing the state of resilience in one’s community.⁴⁶ This responsibility can be provided through a Chief Resilience Officer or an office with similar responsibilities. More on this topic is mentioned in the City chapter below. Second, taking action includes the responsibility of monitoring results and improving on previous decisions and projects.⁴⁷ Often once a plan is implemented it is easy to forget about it and move on to the next subject. This might be fine for other problems, but when it comes to building resilience it is a task that requires constant review and adjustments

The USCRT provides in depth analysis of vulnerabilities in the built environment. This is another example of a tool that can be used by communities to understand their vulnerabilities better. Its user-friendly platform, along with the depth of resources available can prove to be valuable for building community resilience. They recognize the vulnerabilities the built environment faces due to the majority of the US population living in urban environments and the dependence we have on buildings to keep us safe in the face of disaster. The tool highlights a few key areas that require attention in the built environment before, during and after a disaster occurs. That includes an understanding of our dependence on the safety and performance of buildings, understanding

⁴⁵ "About U.S. Climate Resilience Toolkit." 2015. Accessed July 2018. <https://toolkit.climate.gov/content/about>.

⁴⁶ "Explore Hazards." U.S. Climate Resilience Toolkit. March 7, 2018. Accessed July 2018. <https://toolkit.climate.gov/steps-to-resilience/explore-hazards>.

⁴⁷ "Take Action." U.S. Climate Resilience Toolkit. March 7, 2018. Accessed July 2018. <https://toolkit.climate.gov/steps-to-resilience/take-action>.

the domino effect of one service failure, the social aspects of disadvantaged communities, and collaborative planning between public and private sectors. USCRT states, “Many of our nation’s infrastructure elements—including buildings of all types, as well as components of our energy, transportation, water, and sanitation systems—were not built to withstand the impending range of climate conditions and increased frequency of extreme weather events projected for the future.”⁴⁸ They follow-up with support of using up-to-date model building codes, building life cycle assessments, and resilient rating systems to reduce vulnerabilities and increase safety.

These activities are some of the common strategies many other agencies have also suggested to increase levels of community resilience. Lastly, USCRT supports the NIST guide which provides six-steps for building community resilience.

Summary of Federal Strategies

There are more organizations working together to accomplish the goal of bringing awareness to the importance of resilience. The work will need to continue to strengthen to increase levels of community resilience. NIBS will prove to be a valuable asset towards this goal with their continued studies that show the economic incentive for investing in resilience projects. Studies like these will help convey the importance of pre-disaster mitigation projects. As noted, many agencies have used their studies to justify investments.

FEMA's HMA programs are valuable for communities to receive funding for resilience projects. In one year alone, they provided almost \$1 billion to states. The problem here is that while FEMA recognizes the value in pre-disaster mitigation through support for the NIBS study a majority of the funding they provide goes towards post-disaster mitigation.

In addition, HUD is another vital government organization supplying direct funding for resilience projects. The benefits the program provides include permanent housing, jobs, and increased building resilience. These programs have also been able to generate outside private funding, which verifies the interest by private industry. Although their programs have a clear benefit for community resilience, they lack support from the current administration and are continually facing cuts to the program.

The Federal government also supplies a lot of tools through NIST and USCRT that help outline the path to community resilience. NIST provides specific steps that help with developing resiliency

⁴⁸ "Built Environment." U.S. Climate Resilience Toolkit. August 29, 2016. Accessed July 2018. <https://toolkit.climate.gov/topics/built-environment>.

plans and economic guidelines to measure levels of resilience. Their depth of coverage and user-friendly tools make it easier for communities to understand vulnerabilities and prepare for disasters.

These groups will continue to play an important role in this field and their efforts deserve to be strengthened or restructured to maximize efforts.

Local Government Strategies

Where the federal government lacks in efforts, local government will need to fill the void. (This paper refers to State and City government as local government.) Federal government agencies can only provide general resources that benefit the whole nation. With that in mind, the programs tend to cover general efforts rather than specific assistance. Every community has different vulnerabilities; therefore, every local government needs to view resilience through different viewpoints. When local governments find value in resilience they tend to take similar steps towards addressing hazards. Those steps include some of the steps suggested by NIST in the section above. The following sections will review local government policies and efforts for increase in community resilience from NYC, Colorado, and Oregon.

New York City (NYC)

NYC was one of the first cities to join the 100 Resilient Cities (100RC) network, a program created by the Rockefeller Foundation to help break down barriers to sharing solutions and creative problem solving. They joined in order to develop resources to address levels of resilience throughout the city. (The concept, purpose, and scope of 100RC will be discussed in greater detail in Private Industries section below.) In June 2013 following Hurricane Sandy, Daniel Zarrilli was named the City's first Director of Resiliency and was later appointed in March 2014 by Mayor Bill de Blasio as the Director of the Mayor's Office of Recovery and Resiliency (ORR) for the City of New York.⁴⁹ The first project Zarrilli initiated was the City's OneNYC resilience program. This is a document highlighting NYC's definition of resilience and the areas of focus to increase awareness. His position was vital in the development of NYC's resilience program because it puts someone in charge of allocating resources towards building resilience.

⁴⁹ "New York City's Resilience Challenge." 100 Resilient Cities. Accessed July 2018. <https://www.100resilientcities.org/cities/new-york-city/>.

According to the reports website, “OneNYC is New York City’s plan to become the most resilient, equitable, and sustainable city in the world.”⁵⁰ Their plan revolves around four guiding principles: Growth, Equity, Sustainability, and Resiliency. Although resilience is not the only focus of the ORR, this shows that resilience is part of the bigger problem of looking at the core issues communities face and the holistic approach required to address it. The transparency of the activities makes it easy for one to learn about the efforts NYC is actively involved in. Specifically, the OneNYC initiatives document highlights all the current projects and the previous/current milestones set to achieve those goals.⁵¹ This document reports on hundreds of initiatives NYC is taking part in in association with State and Private industries. There are many examples one can observe from OneNYC and modify them to fit the needs of other cities looking at building resilient communities.

Two of the biggest takeaways from NYC’s resilience efforts include the City’s over \$20 billion resiliency program that provides funding for resilience projects and the new Climate Resiliency Design Guidelines that institutionalizes climate-smart construction across the city. Other cities can learn from this program and NYCs efforts and begin leading funding efforts for resilience projects in their cities even if the federal government is not providing funding. Finally, , NYC is joining the effort to incentivize new and current buildings to be constructed with updated building codes.

NYC’s new director of ORR, Jainey Bavishi, states that NYC will continue to work with stakeholders “in achieving the resiliency goals set forth in OneNYC by working closely with federal, state and city agencies to ensure the implementation of these vital resiliency investments occur in a manner which accurately reflects community priorities, while promoting equity across our city.”⁵² Community resilience building is an ongoing effort that requires constant review and updates to policies and practices. As long as the ORR is maintained with qualified candidates along with the support of the city’s mayor, NYC will continue to be a leader in building community resilience and be an example to other cities trying to do the same.

Colorado

Colorado is one of the States leading the efforts towards becoming resilient. They are fully committed to the goal and are preparing their communities by taking a holistic approach to the

⁵⁰ "The Plan for a Strong and Just City." #OneNYC. Accessed July 2018. <https://onenyc.cityofnewyork.us/#content>.

⁵¹ *OneNYC Initiatives*. Report. OneNYC. 2018.

⁵² Bavishi, Jainey. "Director's Message." NYC Office of Recovery & Resiliency. Accessed July 2018. <https://www1.nyc.gov/site/orr/about/directors-message.page>.

problems and providing the tools necessary to get there. The Colorado Resilience and Recovery Office (CRRO) was established by the Colorado Department of Local Affairs which is staffed by a resilience director, program manager, and advisor. By Colorado taking the first step and putting someone in charge they were able to take resilience seriously and begin the process of preparing and assisting local communities.

In an effort of taking a holistic approach to the problem, the CRRO established the Colorado Resiliency Working Group (CRWG), which includes wide representation from several state, local and federal agencies. This group was tasked with defining what resilience meant to them and the values they will focus on. As a result, they first defined resilience as: “The ability of communities to rebound, positively adapt to, or thrive amidst changing conditions or challenges—including disasters and climate change—and maintain quality of life, healthy growth, durable systems, and conservation of resources for present and future generations.”⁵³ Second, the group took the time to think about all the assets important to Colorado and developed the Colorado Resiliency Framework. This framework highlights the sectors Colorado will focus on to understand potential weaknesses in the face of a disaster and develop strategic plans to address them. (See Figure 10)



Figure 10⁵⁴

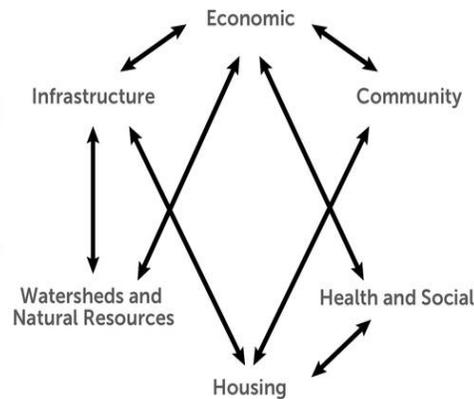


Figure 11⁵⁵

5353 "Understanding Resiliency." Colorado Resiliency & Recovery Office. 2017. Accessed July 2018. <https://coresiliency.squarespace.com/understanding-resiliency/>.

54 "How Resiliency Creates Better Communities." Colorado Resiliency & Recovery Office. Accessed July 2018. <http://www.coresiliency.com/how-resiliency-creates-better-communities/>.

55 "How Resiliency Creates Better Communities."

Colorado recognizes the value in taking a holistic approach at resilience by understanding their triple bottom line. They state that a resilient community is not only prepared for natural and economic shocks, but examines its social, economic, and natural conditions and acts to minimize vulnerabilities in these areas. Also, although the sectors mentioned above are different in scope, they can work together to achieve some of the same goals. The value in knowing your target areas allows one to dedicate resources that provide multiple benefits. A city works like a machine, and the more interconnected the systems are the more resilient a community will be. (See Figure 11) Lastly, the planning required to reach the goals set by Colorado can be incorporated into the plans the city already has. For example, local governments can build in resiliency into several local plans, including master or comprehensive plans, land use plans, hazard mitigation plans, etc.

Colorado is a fine example of how states can provide resources for communities to understand and build resilience. They support various industry efforts including being part of the 100RC network and the NIBS report on saving of \$6 for every \$1 invested. The development of the CRRO was the first and most important step. This led to the gathering of in state experts that were able to define vulnerable areas and establish sectors of importance. Furthermore, their holistic approach provides a strong value in the ability to work across sectors and provide multiple benefits.

Oregon

Oregon is another state that leads efforts for resilience planning. In 2013 they conducted an internal review of vulnerable systems and communities. As a result, a report was released titled, *The Oregon Resilience Plan*, which contains plans and recommendations for Oregon's preparation for the next big earthquake or tsunami, which are their biggest threats.⁵⁶ One of biggest problems the report addressed was the fact that Oregon did not have a State Resilience Office (SRO). Therefore, a recommendation was made to appoint an SRO. The justification for Oregon was that the office would serve as the central point for resilience planning.

Since the release of the report, Oregon passed HB 2270 (2015) which appointed a SRO in June 2016.⁵⁷ The staff is tasked with the responsibility of evaluating policies and procedures,

⁵⁶ *The Oregon Resilience Plan*. Report. Oregon Seismic Safety Policy Advisory Commission. 2013.

⁵⁷ "Oregon Resiliency Report." Accessed July 2018. <https://www.oregon.gov/gov/policy/orr/Pages/execsummary.aspx>.

developing tools for communities to make resilience a priority, work with other sectors to coordinate plans, and take the time to understand and consider their resilience gap.

Oregon's biggest threats are earthquakes and tsunamis. Therefore, existing buildings and structures are the most vulnerable, so they must be retrofitted to newer standards. It is a very expensive process to retrofit a building so Oregon suggested incentivizing building construction upgrades. As a result, SB 311 (2017) authorizes cities and counties to adopt an ordinance or resolution providing property tax exemptions to commercial, industrial and multi-family buildings built before January 1, 1993, that will be seismically retrofitted, for a period not to exceed 15 years.⁵⁸ By Oregon allowing cities to adopt this ordinance, it provides one type of financial incentive for building owners to take part in pre-hazard mitigation efforts.

Another financial incentive Oregon provided came in the form of private loans. SB 85 (2015) allows cities and counties to create loans or loan guarantee programs for seismic upgrades of private buildings.⁵⁹ This unique funding opportunity takes advantage of the incentives states can provide to encourage building owners to retrofit. Also, it allows for funding to be provided to those who can't necessarily afford to complete upgrades on their own, which can contribute toward pre-hazard mitigation projects in low-income communities.

Summary of Local Government Strategies

These are a few of the many local governments working on addressing levels of community resilience. A few key trends can be noted from each one. Their efforts can be replicated by other local governments and scaled to fit different needs.

NYC, Colorado, and Oregon all began their journeys (and this is the most important step) by establishing a position within their administration responsible for organizing resilience efforts. The title of the position varies, but the scope of the responsibilities is the same. Only after this position was established local communities were able to increase their levels of resilience.

Furthermore, local governments were able to work on policies and programs that encourage projects directly associated with increasing resilience. Such as NYC's \$20 billion resiliency program and Oregon's tax cuts and loan guarantee program. Local governments will have to

⁵⁸ "Tracking Senate Bill 311 in the Oregon Legislature." Your Government :: The Oregonian. 2017. Accessed July 2018. <https://gov.oregonlive.com/bill/2017/SB311/>.

⁵⁹ Summary of Legislation 2015. Report. Oregon. 59.

continue to find unique ways to fund resilience projects due to limited opportunities available at the federal level.

Private industry is a great resource to find outside funding opportunities and will be vital for the process of closing the resilience gap. This holistic approach benefits both private and public stakeholders. The next chapter takes a look at a few of the private industries in the field and areas of promise.

Private Industry Strategies

Private industry has played a crucial role in supporting community resilience awareness. Through standards and financial support, they have been able to contribute towards closing the resilience gap of many communities. Private funders have supported their own set of projects, while also investing in resilience projects that the Federal or local government initiate, as observed in the earlier sections. Private industry has an interest in building resilience because it affects their bottom line when disasters strike, and people cannot get to work. The following sections will analyze the work of the United States Green Building Council, the International Code Council, and the Rockefeller Foundation 100 Resilient Cities Network.

United States Green Building Council (USGBC)

The United States Green Building Council (USGBC) is a member-based organization formed in 1993 for the purpose of promoting sustainability-focused practices in the building industry.⁶⁰ From this coalition the idea of a universal green building rating system came about which led to the formation of the Leadership in Energy Efficient Design (LEED) rating system which is recognized across the building industry. Furthermore, dozens of cities, states, and the federal agencies have mandated LEED certification. The plaque a building receives once certified is often viewed as a great marketing tool for building owners. Although USGBC is mainly focused on sustainability and energy efficient standards, some of the practices lends itself towards resilient measures.

USGBC was also one of the signatories of the AIA & NIBS industry statement on resilience and define resilience through the same scope: “the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.” In recognition for the importance of

⁶⁰ "About USGBC | USGBC." LEED | USGBC. Accessed July 2018. <https://new.usgbc.org/about>.

promoting resilient buildings and communities, USGBC established The Center for Resilience.⁶¹ Through this initiative USGBC can appropriately focus all of the organizations resilience activities.

As a push to relate LEED standards to resilience, USGBC has developed tools and adopted new standards. One of these tools is the Climate Resilience Screening Tool. This tool identifies opportunities to increase levels of resilience through LEED credits.⁶² A recent study by the University of Texas was able to demonstrate that greater than 60 percent of the total LEED credits enhanced the building against flooding, hurricanes, and tsunamis.⁶³ Those numbers were less than 50 percent for winter storms and less than 23 percent for fires and earthquakes. Although some of LEED's standards help contribute to resilient building, it is not comprehensive enough to account for disaster specific crises. Therefore, the need for adopting a new standard with greater adaptability is important.

USGBC is currently dedicated towards resilience specific standards. In 2017, they decided to take over with the development of RELi. RELi was first developed by private industry as a resilience rating system. It is a comprehensive standard that evaluates the level of resilience of a given building and provides guidelines to achieve greater resilience. USGBC made the decision to adopt, strengthen, and promote RELi as one of their standards due to the increasing importance society has placed on resilient building. Since the partnership of RELi and USGBC, a Resilience Steering Committee has been formed and is working on the strengthening and mainstreaming of RELi.

Mahesh Ramanujam, President and CEO, USGBC and GBCI said "We are committed to scaling RELi to become a national and international rating system... "⁶⁴ USGBC has a lot of experience promoting standards, as shown with their LEED certification. USGBC is an example of a private organization coming together to develop standards that are then adopted by federal and state agencies. They have yet to show the same strides with the RELi standard.

International Code Council (ICC)

The International Code Council (ICC) is a member-based organization dedicated to developing model codes and standards used in the design, build and compliance process to construct safe, sustainable, affordable and resilient structures.⁶⁵ Their codes and standards have been adopted

⁶¹ "The Center for Resilience | USGBC." LEED | USGBC. Accessed July 2018. <https://new.usgbc.org/center-for-resilience>.

⁶² "LEED Climate Resilience Screening Tool for LEED V4 Projects." U.S. Green Building Council. Accessed July 2018. <https://www.usgbc.org/resources/leed-climate-resilience-screening-tool-leed-v4-projects>.

⁶³ Langar, Sandeep. Focus of Resilience within Building Rating Systems. Report. College of Architecture, Construction and Planning, University of Texas Austin. 2018.

⁶⁴ Holowka, Taryn. "GBCI and the RELi Resilience Standard Work Together."

⁶⁵ "About ICC." ICC. Accessed July 2018. <https://www.iccsafe.org/about-icc/overview/about-international-code-council/>.

in all 50 states by both state and federal agencies. The ICC incorporates resilience into the various codes and standards they develop. Instead of making resilience seem as an obsolete option, ICC builds resilience directly into the codes already developed and use.

Their building codes address resilience in four ways: efficient disaster mitigation and recovery, ensuring occupant mental and physical health and wellbeing, improving building life cycles, and creating a sustainable community.⁶⁶ The ICC makes sure to incorporate these values into their codes and standards to contribute to building community resilience. In a conversation with ICC's Director of Resilience Initiatives, Bryan Soukup, he explained that resiliency starts with building codes.

Building to the newest building codes has been supported by various organizations largely due to the recognition that new codes take into account lessons learned from previous disasters. Financial support has also been studied by NIBS who proved average savings of \$4 for every \$1 invested in incorporating ICC's most recent building codes.⁶⁷

Furthermore, in support of building community resilience, the ICC co-founded the Alliance for National and Community Resilience (ANCR).⁶⁸ The objective of the coalition is to help communities implement good practices that increase resilience. The primary goal of ANCR is the development of a system of community benchmarks that will allow local leaders to assess and improve their resilience across all functions of a community. In a conversation with ICC's Director of Resilience Initiatives, Bryan Soukup, he explained committees were established in 18 different areas that contribute towards resilient buildings and are tasked with composing guidelines in the form of a self-assessment checklist's to be available for communities. Lastly a third-party agency would come in and verify the checklist to then give the city a rating for the level of resilience they met.⁶⁹ Just as UFSGBC's rating system is in its beginning stages, it would be interesting to see how quickly the benchmark ANCR is developing gains support from private and public stakeholders.

Rockefeller Foundation - 100 RC Network

100 Resilient Cities (100RC) was pioneered under the Rockefeller Foundation at the world's first-ever Chief Resilience Officer (CRO) Summit in New Orleans in November 2014. They launched the 100RC Chief Resilience Officer Network to help break down barriers to sharing solutions and

⁶⁶ "Resiliency." About ICC | ICC. Accessed July 2018. <https://www.iccsafe.org/about-icc/safety/resiliency/>.

⁶⁷ Natural Hazard Mitigation Saves: 2017 Interim Report.

⁶⁸ "Resilient Alliance." ANCR. Accessed July 2018. <http://www.resilientalliance.org/>.

⁶⁹ "ICC Director of Resilience Initiatives." Interview by author. June 26, 2018.

creative problem solving.⁷⁰ The Chief Resilience Officer (CRO) is an innovative position in municipal government that was introduced by 100 Resilient Cities. A CRO often reports directly to the city's chief executive, and acts as the city's point person for preparing the city for its risks, helping to coordinate all the city's resilience efforts. The former Managing Director at the Rockefeller Foundation, Michael Berkowitz, said "At 100 Resilient Cities, we believe that one critical step cities can take to facilitate their resilience building is to hire a CRO. The CRO is an innovative position in government that ideally reports directly to the city's chief executive, and acts as the city's point person for resilience building."⁷¹ By establishing such a position, it sends a serious message to the state that resiliency is a priority. The position would be fulfilled by at least one person and could consist of positions associated with assisting the CRO. They would be responsible for coordinating efforts throughout the state to assist local communities gain knowledge and access to resiliency planning guides and available for funding such projects.

At the summit, CRO's stated the need for a network to be developed so that cities could share information with each other for resilience planning. Therefore, 100RC emphasizes their priority is about people and not tools and created a network so leaders can share experiences and advice with each other. There are currently 100 cities in the network, as the title suggests, from all around the world. They have developed a report that offers a menu of federal recommendations for resilience policy.⁷²

According to the 100RC report, inadequate investments in infrastructure systems are threatening the resilience of their communities. Cities are left to rely on disaster recovery assistance after disasters have occurred. As mentioned before, this is not a cost-effective solution since it's been proven mitigation spending results in higher savings. Projects that are completed do not always build to the newest standards, or do not account for future potential environmental changes. The technology and resources are currently available to build to new standards, however the standards should be embraced and encouraged by city officials.

Another problem is the lack of affordable housing and intractable homelessness that contribute to their resilience challenges. This area is of importance for community resilience because where a person lives affects their health and well-being. Safe, stable, and affordable housing allows

⁷⁰ "State Resilience and Economic Growth Summit." Smart Growth America. Accessed July 2018. <http://old.smartgrowthamerica.org/resilience/state-resilience-and-economic-growth-summit/>.

⁷¹ Berkowitz, Michael. "What a Chief Resilience Officer Does." The Rockefeller Foundation. September 7, 2014. Accessed July 2018. <https://www.rockefellerfoundation.org/blog/what-a-chief-resilience-officer-does/>.

⁷² *Ten Principles for Building Resilience*. Report. Urban Land Institute. 2018.

people to focus on work and their health. In the face of disasters these conditions only get worse and become more difficult to address. 1 in 4 renters are severely rent burdened, meaning 50 percent or more of their income goes to housing. An analysis by Enterprise Community Partners and the Harvard Joint Center for Housing Studies, finds that the number of households spending 50 percent or more of their income on rent is expected to rise at least 11 percent from 11.8 million to 13.1 million by 2025.⁷³ The 3 federal agencies that support affordable housing are HUD, Department of Energy (DOE), and FEMA. The work of HUD and FEMA have been acknowledged and their efforts should continue to support addressing lack of affordable housing.

The 100RC network initiated an important movement in the realm of building resilience. It was acknowledged that the first step should be to put someone in charge and this is exactly what the network addressed. By bringing together various cities from across the globe to define the CRO position and create tools that scale across different communities allows for lessons to be shared. These conversations allow for cities to learn from each other and avoid making mistakes on their own. Efforts by private organizations like the Rockefeller Foundation are vital for the sharing of experiences and further defining of what it means to be a resilient community.

Summary of Private Industry Strategies

The efforts USGBC and ICC have been part of help define resilient codes and standards, which is a bare minimum for safe homes and businesses. USGBC has a history of being a great marketing organization that brings an economic value when using their standards. Their newest commitment to work on a resilient specific standard, through the RELi standard, shows great promise and deserves attention. ICC has done great work in creating standards that address resilient safety measures. NIBS study of \$4 savings for every \$1 in designing buildings with the newest ICC building codes further verifies their positive impact in addressing safe buildings and homes.

In support of the private industries efforts, former Associate VP, Managing Director, Asia, The Rockefeller Foundation, Ashvin Dayal, stated, "It has long been recognized that the private sector can and must play a significant role in helping to make our cities more resilient."⁷⁴ Philanthropic efforts like those from 100RC continue to play a valuable role in bringing awareness to the role

⁷³ "Projecting Trends in Severely Cost-Burdened Renters." Enterprise Community Partners. 2015. Accessed July 2018. <https://www.enterprisecommunity.org/resources/projecting-trends-severely-cost-burdened-renters-13350>.

⁷⁴ Dayal, Ashvin. "Surfacing Innovative Solutions Through Public-Private Partnerships." The Rockefeller Foundation. September 12, 2014. Accessed July 2018. <https://www.rockefellerfoundation.org/blog/surfacing-innovative-solutions-through/>.

private industry has in building community resilience. Their efforts have jumpstarted many efforts in local governments around the world.

These organizations, along with others not mentioned, have marked great strides in developing standards and codes along with philanthropic donations for organizing tools and people. These efforts have helped bring awareness to community resilience and contributed to the closing of the resilience gaps many communities continue to face. There is still room for more to be done to build resilient communities and private industries will continue to play a vital role in this process.

Recommendations

Resilience Metrics

A major problem is that a common understanding of what it means to be a resilient community hasn't been established. All levels of government and private industries need a reason to learn about the importance of resilience and the benefits it provides. This includes being able to measure levels of resilience within a given community. This will allow for government agencies to better understand the topic and in turn have an incentive to provide resources to address the issues. These resources include financial, physical, and social resources to address hazards affecting communities' triple bottom lines. One way to do this is to define a resilience metric system. Therefore, the first policy recommendation is:

Private industries should work together to define a common resilience metric system, so government agencies can better measure resilience to then have reason to further support resilient strategies that protect communities.

Two things are needed to come out of this for the guides to be effective. One, the industry needs to come to a consensus on which standards and codes are to be used and focused on for community resilience planning, and those plans need to be approved by community leaders. Two, upon receiving approval, the guides, codes, and standards need to be incorporated into current systems in a user-friendly manner that focuses on community involvement. By providing a guide with these criteria's, all interested stakeholders can have a better way of addressing community resilience.

As mentioned earlier, there are a few agencies already doing work in this realm. The issue is that the metric systems have yet to be embraced by a large portion of the industry. Also, community leaders have yet to incorporate one standard in their decision-making processes.

Appointing CRO

Once communities better understand the importance of resilience planning they will start to take steps towards preparing. Yet, in this growing field of resilience planning it can be confusing to know what steps to take. The NIST CRPG volume I has a set of six-steps a given community should take. Step one is to identify a team and choose a leader. (More details about the six-steps can be found in the NIST section above). This is important because it allows for a community to analyze their triple-bottom line and build resilience. Such a role is often referred to as a CRO.

The idea of incorporating a state CRO has gained a lot of traction in recent years as states are looking into best practices in this growing field. In 2014 a State Resilience and Economic Growth Summit brought together hundreds of professionals across a couple of dozen states associated with federal, private and local resilience related agencies to discuss ways to improve resiliency. As a result of their findings, the Governors' Institute on Community Design (GICD), with support from the U.S. Environmental Protection Agency (EPA) released a report with recommendations.⁷⁵ Their first recommendation was the idea of incorporating a Chief Resilience Officer (CRO) position, or role with similar responsibilities. This idea has been suggested by the 100RC network, and every State mentioned in in this paper. By a State or City initiating such a position, they are then able to move forward with making resources available for increasing levels of resilience. Therefore, my next recommendation is:

Governors Should Establish a Role Within their Administration Responsible for Organizing Resilience Efforts

Such as a state CRO or an office with similar responsibilities. This role is different than any other position in government, but they would be responsible for working across the board with various stakeholders. Cities are complex interconnected environments that each have their own unique circumstances that can affect community resiliency. For example, Florida will need to focus on protecting their population from hurricanes, while California would be focused on wildfires and earthquakes. State's need an officer who is equipped to analyze and develop polices unique to

⁷⁵ *Building Resilient States-Smart Growth America*. Report. Governors Institute, Smart Growth America.

their resiliency challenges and status. CRO's lend the image of the direct contact for state resiliency planning and here are some of the responsibilities that have been detailed by GICD:

- Serve as a central point for resilience planning;
- Coordinate resilience efforts across state agencies;
- Ensure state spending on infrastructure and public facilities supports resilience;
- Liaise with regional entities (MPOs, planning organizations, etc.) and local governments;
- Serve as the state's resilience contact for federal, NGO, and other partners; and
- Coordinate public outreach efforts.

These are some of the responsibilities a position as CRO would hold. Just as with any other task a state sets to achieve, there must be a leader in place to guide the process. It is only at that point that achieving community resilience becomes a direct focus. All of the cities mentioned in this paper, including ones not mentioned only began the process of allocating resources for the sole purpose of increasing community resilience after such a position was established.

HUD CDBG Funding

It was mentioned previously in the USGBC section that a building location has repercussions on a person's health and well-being. This is due to the fact that healthy and stable housing allows for residents to focus on other aspects of life like work and education. Communities that do not represent healthy environments are at risk, especially in the face of a disaster. Underrepresented low-income communities often are the most vulnerable to hazards. HUD addresses this concern in part through their CDBG funding programs.

In general, CBDG funding tackles this issue by providing permanent jobs, housing, and grant/loan programs for home resilience projects. These programs have lasting benefits for society and help increase community resilience. Although congress funds these programs, it has been observed that they are able to leverage additional funding from private funders.

Despite the fact that HUD's CBDG programs directly increase community well-being and increase in resilience levels, they have lacked support from lawmakers. As a result, funding has been cut by 25 percent since 2015. Therefore, my next recommendation is:

Congress Should Refrain from any Future Cuts to the HUD CBDG Program

The HUD CBDG Program has seen its funding cut and the private sector and state officials should work to educate federal lawmakers on the program's success. Current funding has already helped address many issues including permanent jobs and increased funding available for resilience projects. More avenues should be explored to expand this into a private-public-partnership.

FEMA PDM funding

FEMA is one of the most important federal agencies dedicated to funding towards pre-hazard mitigation. In their updated five-year plan, their first objective to accomplish the goal of building a culture of preparedness is to incentivize investments that reduce risk, including pre-disaster mitigation, and reduce disaster costs at all levels.⁷⁶ Furthermore, through their Mitigation Framework Leadership Group FEMA is dedicating efforts towards working with congress and private industries to increase pre-disaster mitigation funding. FEMA recognizes the importance of investing beforehand to save money and lives. Working groups such as the one FEMA has created helps initiate the process and foster partnerships. Although FEMA is directly making these claims, efforts have yet been fostered to reach these goals. Therefore, my recommendation is:

FEMA Should Lay Out Exact Plans for Increasing Pre-Disaster Mitigation Funds and Congress Needs to Update Current Disaster Response Policies

FEMA has described efforts to work towards this goal; however, it has yet to come into fruition. There are current bills that have been introduced to Congress to make this happen. The Disaster Recovery Reform Act (DRRA), which has passed the House of Representatives is one example. This bill introduces various policies including some on disaster mitigation and building codes. A section in the bill would establish a separate account called the National Public Infrastructure Predisaster Mitigation Fund.⁷⁷ This portion of the bill will work in similar scope of FEMA's limited PDM grant program, except with increased availability of funds. The Senate is also working on its own version of DRRA (S.3041 - Disaster Recovery Reform Act of 2018). The bill would allow FEMA to contribute funds for adopting and enforcing the "latest published editions of relevant consensus-based codes, specifications, and standards." According to ASHRAE, this would help with the "need not to simply rebuild but building back stronger to combat future disasters that

⁷⁶ 2018-2022 Strategic Plan. Report. FEMA, Federal Emergency Management Agency. 2018.

⁷⁷ Disaster Recovery Reform Act, H.R. 4460, 115th Cong. (2017).

threaten communities.”⁷⁸ This will strengthen the PDM grants program and contribute to higher levels of community resilience.

Using Updated Building Codes and Standards

As part of NIBS MMC study, they were able to show that projects that build to the most recent codes would result in 87,000 new, long-term jobs to the construction-material industry. It would increase construction costs by \$3.6 billion each year.⁷⁹ Which is only 1 percent more than current annual construction costs. The USCRT, and FEMA, and NIST, which are all federally funded programs, support the use of resilience-specific criteria and using the most updated standards pre and post disaster. However, current law prevents them from doing so. Therefore, my next recommendation is:

Require that all Federal Grants Issued for Mitigation Purposes to Include the Most Updated Building Codes and Standard

Federal and State agencies are working to create innovative ways to fund resilience projects, however more can be done to restructure some of the Federal Programs already in place. Some of the federal programs offer funding or loan opportunities for making the appropriate changes, but funding is limited to mostly post-disaster projects. States and cities can place the same requirements on grants to ensure the latest codes and standards are being used. Another solution would be for the federal government to provide certain tax exemptions and deductions. This would incentivize building owners to invest resilient buildings without additional funding.

The resources and technology are already in place and should be mandated by state and federal agencies and financial incentives should be created to help building owners retrofit their properties. Such as how Oregon passed bills allowing for tax exemptions and private funding opportunities for building owners wanting to make their properties more resilient.

As important as it is for new buildings to utilize the latest standards and codes, existing buildings are the biggest opportunity to increase resiliency. The average age of an existing building in the United States is almost 42 years, and over 80 percent of all of the US building stock is 15 years old or older.⁸⁰ Consensus based standards and guides from organizations such as ASHRAE are a great resource for older buildings to incorporate retrofits. Although these standards are readily

⁷⁸ "ASHRAE DRRA." Bjarne Olesen to The Honorable Mitch McConnell. June 18, 2018.

⁷⁹ Natural Hazard Mitigation Saves: 2017 Interim Report

⁸⁰ U.S. Energy Information Administration (EIA)

accessible, they are not always used. One reason that it's hard to building owners to make large investments or convince the government to allocate resources to the pre-disaster mitigation phase of the disaster cycle when a problem does not already exist. Enforcement of standards and codes also pose an issue. This why I also recommend that:

Federal and State Government Increase Enforcement of already Adopted Consensus Based Codes and Standards

This could be done through increase commissioning or in the case of States, have the federal government withhold funding until the latest codes are adopted. Even if they are adopted, there are issues with implementation due to the lack of enforcement.



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