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MONTEREY, CALIFORNIA

THESIS

DISASTER HOUSING FOR URBAN ENVIRONMENTS

by

Aisha E. Krieger

June 2019

Co-Advisors:

Lauren S. Fernandez (contractor)
Shannon A. Brown

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DISASTER HOUSING FOR URBAN ENVIRONMENTS

Aisha E. Krieger
Captain, San Francisco Fire Department
BA, San Francisco State University, 1995

Submitted in partial fulfillment of the
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Approved by: Lauren S. Fernandez
Co-Advisor

Shannon A. Brown
Co-Advisor

Erik J. Dahl
Associate Chair for Instruction
Department of National Security Affairs

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ABSTRACT

The purpose of this research was to determine how government agencies can provide more effective post-disaster housing in densely populated urban areas where the infrastructure has been damaged. The thesis analyzed the problems of previous disaster housing efforts both in the United States and abroad using the PESTEL analytical model, which considers the political, economic, social, technological, environmental, and legal concerns of a given issue. The research identified issues with the expense of post-disaster housing, the availability of land for placement of housing, deployment time, and the unmet needs of victims and those living near post-disaster housing. The thesis provides policy recommendations for government stakeholders that can address the identified issues.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADA	Americans with Disabilities Act
AHPP	Alternate Housing Pilot Program
DHAP	Disaster Housing Assistance Program
DHS OIG	Department of Homeland Security Office of Inspector General
FEMA	Federal Emergency Management Agency
GLO	General Land Office (Texas)
HUD	Department of Housing and Urban Development
MSD	Office of the Minister for Social Development (New Zealand)
NGO	nongovernmental organization
NIMBY	not in my backyard
NLIHC	National Low-Income Housing Coalition
NYCEM	New York City Emergency Management
SFDEM	San Francisco Department of Emergency Management
SFHA	Special Flood Hazard Area
THU	temporary housing unit
TSA	Transitional Sheltering Assistance

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EXECUTIVE SUMMARY

This thesis asks the question: How can government agencies provide effective post-disaster housing in densely populated urban areas where the infrastructure has been damaged? To answer this question, the research analyzes the problems of past disaster housing efforts—including the challenges of various operating environments—and identifies promising solutions for victims of natural disasters.

The research focuses on densely populated urban environments, detailing five devastating natural and human-induced disasters in the United States, Japan, and New Zealand and revealing the need for improved disaster housing due to climate change and aging infrastructure. The past issues are analyzed using the PESTEL model—which examines the political, economic, social, technological, environmental, and legal aspects of a problem—to develop policy recommendations for better housing outcomes. Common disaster housing problems, presented in Table A, include arcane laws, bureaucratic barriers, the *not in my backyard* (NIMBY) phenomenon, FEMA’s lack of preparedness, and unhealthy and expensive housing options.

Table A. Disaster Housing Problems Based on a PESTEL Analysis

Political	• FEMA has more than one mission • Disaster housing has no constituency • FEMA and HUD have differing goals
Economic	• Poor people rely on disaster housing • Disaster housing is expensive to create and store • Vouchers only work when there is excess housing available • Builders are in short supply
Social	• People who need disaster housing have few resources and need help • Communities are torn apart when there is no available housing, slowing down recovery • People who come to the disaster area to help need housing • Looters need to be kept out

Technological	• Housing is not prepared ahead of time for disasters • Aging infrastructure is fragile and cannot be relied on after a disaster • Disaster housing takes a long time to deploy
Environmental	• Disasters are happening more often • Cities are becoming denser • More people live in dangerous areas • Disaster housing creates huge waste
Legal	• Laws covering disaster housing are complicated • Laws are not implemented consistently • The average person has a difficult time navigating the system to receive aid

To home in on specific problem areas, the thesis details housing responses in the aftermath of five disasters: the Mariel boatlift in Florida; Hurricane Katrina in New Orleans, Louisiana; Japan's Hanshin earthquake and the Fukushima triple disaster; Hurricanes Irma and Maria in Puerto Rico; and New Zealand's double earthquake. The PESTEL analysis for these five vignettes is presented in Table B.

Table B. Past Disaster Housing Responses

	Mariel Boatlift (Florida)	Katrina (Louisiana)	Japan	Puerto Rico	New Zealand
Political	NIMBY made it hard for refugees to find available housing	NIMBY made it hard to place trailers in neighborhoods	<i>Factor not studied for this vignette</i>	As a commonwealth, Puerto Rico has very little to advocate for disaster housing aid	The homelessness issue compounded the disaster

	Maribel Boatlift (Florida)	Katrina (Louisiana)	Japan	Puerto Rico	New Zealand
Economic	Vouchers did not cover rental cost, no rental stock available	Trailers were extremely expensive to create and store	As a result of moving communities, economic recovery was slowed substantially	<i>Factor not studied for this vignette</i>	Leaving only a few people in devastated areas slowed recovery
Social	Tension between locals and refugees	Communities were torn apart, reducing recovery	Communities were moved and separated, damaging the social fabric	<i>Factor not studied for this vignette</i>	People need housing near services and employment
Technological	<i>Factor not studied for this vignette</i>	The trailers were toxic	<i>Factor not studied for this vignette</i>	Infrastructure was devastated, making disaster housing difficult to set up	<i>Factor not studied for this vignette</i>
Environmental	<i>Factor not studied for this vignette</i>	Trailers were designed for one-time use and contributed to landfill	<i>Factor not studied for this vignette</i>	<i>Factor not studied for this vignette</i>	<i>Factor not studied for this vignette</i>
Legal	Long processing period, due to numbers, meant refugees had to stay in camps	<i>Factor not studied for this vignette</i>	Laws did not allow for people to stay in homes or create better temporary homes	Difficult for victims to prove homeownership, reducing the amount of aid they could receive	Building codes did not create durable buildings

The research and analysis reveal that, in all of these disasters, a lack of planning and substandard post-disaster housing response slowed down recovery. To combat such issues in the future, the thesis recommends policy solutions for disaster housing, categorized by PESTEL factors in Table C. In general, disaster housing would be more successful if it were created ahead of time, technologically sophisticated, inexpensive, able to function off-grid, stackable, and easy to deploy. The recommendations presented in the thesis will help stakeholders revise disaster housing policy to better meet these needs.

Table C. Disaster Housing Solutions

Political	• Coordinate with all stakeholders to reduce areas of overlap or gaps in coverage, in particular between FEMA and HUD • Create clear path for victims to receive aid • Create a consistent disaster housing response • Create permanent housing, when appropriate, instead of temporary housing • Preplan for vulnerable communities
Economic	• Use resources that are local or abundant to create disaster housing • Allow victims to supplement vouchers so that they can find units better suited to them • Create disaster housing that can transition to permanent housing • Land bank areas so there are places to put disaster housing when there is a need • Create vouchers for rentals when housing stock is available
Social	• Offer wraparound services to victims • Reduce delay of distributing disaster housing by storing units in key locations • Evaluate vulnerable populations ahead of disasters • Allow victims and neighbors to have buy-in on their disaster housing • Keep communities together and close to home • Give disaster housing victims the option to purchase their disaster housing

Technological	• Increase size and change design of disaster units to accommodate the elderly and disabled • Create an off-grid disaster housing option • Create green disaster housing options • Create prefabricated disaster housing for quicker deployment • Create rapidly deployable disaster housing options • Make options transportable by truck, rail, or ship • Make options easily storable • Create stackable disaster housing
Environmental	• Remove all victims from disaster area to rebuild quickly • Keep people close to services and employment • Remove populations from dangerous areas such as flood zones when possible
Legal	• Increase the amount of time victims can stay in disaster housing • Create legislation that allows for flexible floorplans • Create legislation that would mandate retrofitting high-risk buildings • Create legislation to make buildings safe enough to stay in after a disaster • Create legislation that allows temporary housing to transition to permanent housing

Our country, and countries around the world, will continue to experience disasters; in anticipation of increased disasters, it is imperative that the United States improve its disaster housing policies. An important first step is to streamline the laws and regulations that make it difficult for disaster victims to receive the aid they need. It is also important to create post-disaster housing that is cost-effective, safe, and keeps people close to their homes, families, and work while providing a foundation that helps individuals and communities recover economically and socially.

To achieve these goals, this research recommends planning for post-disaster housing ahead of time, rather than addressing the issue on an ad hoc basis after a disaster

has devastated an area. A major policy recommendation is creating a dedicated workforce such as Job Corps to build and stockpile disaster housing solutions. This dedicated workforce could deploy housing quickly after a disaster and reduce housing problems for victims while also saving taxpayer money. To create needed disaster housing, FEMA should go beyond its standard solution of employing trailers and vouchers and explore cutting-edge technological advances. Technology should be used to create off-grid housing that has a low impact on the environment and that is easy to move and store, modifiable for the needs of the victims, and stackable for high-density areas. By addressing these issues ahead of time, disaster housing can be more functional for its inhabitants and less costly for taxpayers.

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I. INTRODUCTION

A. PROBLEM STATEMENT

The United States has seen an increasing number of natural and human-induced disasters in recent years, including historic flooding in Houston, Texas, in 2017, multiple wildfires in drought-stricken areas of California in 2017 and 2018, and violently destructive hurricanes, such as Hurricane Irma in 2017. There continues to be a high risk of earthquakes on the West Coast, as there are many active fault lines in this region. Scientists speculate that hurricanes such as Katrina, Harvey, and Irma are arriving with increasing frequency and power due to the warming of the oceans where hurricanes form. Published in November 2018, the Fourth National Climate Assessment, the U.S. Global Change Program's quadrennial research and analysis report about climate change, warned of increasing natural disasters around the world.¹ Disaster housing is needed not only for the people who continue to live and work in devastated areas but also for those who come to disaster areas to provide aid and rebuild. Federal, state, and local public health officials, as well as first responders and legislators, need to prepare for both the real-time exigencies and the aftermaths of these predictable disasters.

The need for post-disaster housing is often overlooked in disaster response planning. The federal entities responsible for disaster response and post-disaster housing—the Federal Emergency Management Agency (FEMA) and the Department of Housing and Urban Development (HUD)—have relied primarily on trailers and housing vouchers as solutions to mass housing challenges in the aftermath of disasters. This is a problem for a myriad of reasons: the trailers are difficult to store ahead of time and difficult to place if there is no functioning infrastructure or a strong neighborhood association, they are expensive, and they are unhealthy for occupants. Damage to housing after a disaster can be anticipated and resolved with advance planning, which will help to reduce human

¹ D.R. Riedmiller et al. (eds), *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* (Washington, DC: U.S. Global Change Research Program), 1, <http://doi.org/10.7930/NCA4.2018>.

suffering during the recovery process. Preparation for disaster housing can also improve the social and economic recoveries of communities stricken by catastrophic events.

B. RESEARCH QUESTION

How can government agencies provide effective post-disaster housing in densely populated urban areas where the infrastructure has been damaged?

C. RESEARCH DESIGN

To answer the research question, this thesis analyzes the problems of past disaster housing efforts and identifies promising solutions for victims of natural disasters. It examines the scope of past post-disaster environments, describes the challenges of various operating environments, identifies and evaluates possible solutions, and offers policy recommendations. The research focuses on densely populated urban environments by reviewing five devastating natural and human-induced disasters in the United States, Japan, and New Zealand through the PESTEL analytical model, which considers the political, economic, social, technological, environmental, and legal ramifications of a given strategy.² In their journal article for *Management & Marketing*, Eliza Bivolaru, Robert Andrei, and George Vlad Purcăroiu explain that “PESTEL analysis is useful ... because it offers a systematic, holistic view of the fields, and the respective organizations and institutions, that must be coordinated.”³ The PESTEL model has been used to analyze a wide variety of situations around the world—such as the waste-to-energy incineration industry in China and the relationship between cloud computing and organizational

² Doug Forbes, Simon Smith, and Malcolm Horner, “Tools for Selecting Appropriate Risk Management Techniques in the Built Environment,” *Construction Management and Economics* 26, no. 11 (2008): 1241–1250, <http://doi.org/10.1080/01446190802468487>.

³ Eliza Bivolaru, Robert Andrei, and George Vlad Purcăroiu, “Branding Romania: A PESTEL Framework Based on a Comparative Analysis of Two Country Brand Indexes,” *Management & Marketing* 4, no. 4 (Winter 2009): 111.

sustainability.⁴ Because it is a model primarily used in business scenarios, it is grounded in real-world scenarios and can therefore solutions that are realistic and practical.

The thesis is organized into five chapters; after this introductory chapter, Chapter II examines literature that describes existing issues with disaster housing, to include theories of post-disaster population management. It also analyzes the immediate and longer-term impact of these strategies on the affected communities. Chapter III develops five related vignettes, each of which focus on two elements of PESTEL: the Mariel boatlift in Florida, Hurricane Katrina in Louisiana, the Hanshin and Fukushima earthquakes in Japan, Hurricanes Maria and Irma in Puerto Rico, and earthquakes in Christchurch, New Zealand. The vignettes were selected because they provide a variety of post-disaster housing issues in urban environments:

- The Mariel boatlift housing disaster, which centered around a mass emigration of Cubans to Florida, was caused by human decisions. The research in this thesis examines the economic and political impacts on the Florida community due to the lack of disaster housing.
- Hurricane Katrina had vast social and economic impacts on victims as well as taxpayers; the research discusses the social and environmental impacts resulting from poor planning for and execution of disaster housing.
- Japan's response to the Hanshin earthquake and the triple disaster in Fukushima relied on disaster housing approaches that differ from those in the United States. Japan is a highly urbanized first-world country that has been notably prone to disasters throughout its long history, including earthquakes, tsunamis, and atomic bombs. In a democracy, stakeholders

⁴ Bivolaru, Andrei, and Purcăroiu, 112; Jinbo Songa, Yan Sun, and Lulu Jin, "PESTEL Analysis of the Development of the Waste-to-Energy Incineration Industry in China," *Renewable and Sustainable Energy Reviews* 80 (December 2017): 276–289, <https://doi.org/10.1016/j.rser.2017.05.066>; Tomayess Issa, Vanessa Chang, and Theodora Issa, "The impact of Cloud Computing and Organizational Sustainability," *Annual International Conference on Cloud Computing and Virtualization* (2010): 163–69, https://doi.org/10.5176/978-981-08-5837-7_185.

must agree on solutions to enact post-disaster laws and policies, including those related to disaster housing. Both Japan and the United States have large urban areas as well as remote, less-developed areas, each with their own unique needs for recovery. For Japan, the research examines the social and economic impact of Japan's disaster housing solutions.

- In Puerto Rico, a U.S. commonwealth rather than a state, the lack of political representation in Washington, DC, hindered the recovery process after hurricanes Irma and Maria devastated local infrastructure. The research examines the political and technological impacts of FEMA's disaster housing solutions on the commonwealth.
- In New Zealand—a country that is similar to the United States—two earthquakes struck Christchurch within six months of each other. The research on New Zealand's disaster housing response highlights how well-intentioned local policies that benefit a small number of residents can have consequences for the larger reconstruction effort. The research focuses on the social and legal implications of these solutions.

In Chapter IV, the thesis goes on to analyze housing solutions from the literature against the PESTEL model. Finally, Chapter V describes problems with disaster housing identified by the research, questions that still need to be answered, and solutions that would address current problems.

The output of this thesis is a set of policy recommendations that have applicability to high-density urban communities in the United States. Based on the literature review, it appears that no U.S. city has well-developed emergency housing plans that can meet the sudden requirements of the aftermath of a disaster. This thesis seeks to address this too-long-ignored situation with research, analysis, and innovative recommendations.

D. LIMITATIONS

This thesis focuses on a problem space within a limited period of time: one to two weeks after a disaster, through one to one and a half years later. It does not address the

immediate need for housing during the first few days after a disaster, nor does it address longer-term housing issues or the large-scale permanent relocation of a population that elects not to return to an urban center following a disaster. It also does not address the special housing needs of incarcerated and hospitalized populations after a disaster. This review is extensive but not exhaustive.

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II. EXISTING ISSUES WITH DISASTER HOUSING

This chapter identifies problems with the creation and deployment of disaster housing using the PESTEL analytic model. Providing disaster housing involves multiple interdependent factors, and the PESTEL model creates a framework that underlines the difficulties of delivering disaster housing as they relate to these factors. This analytic framework also highlights the lack of disaster housing options in a disaster zone, which can slow economic recovery and destroy communities. The problems range from dissatisfied disaster victims and their neighbors to the FEMA trailer debacle after Hurricane Katrina.

A. POLITICAL FACTORS

FEMA was not created to handle disaster housing and the agency has often been unclear about its specific mission in various disaster scenarios. Government officials may be averse to spending tax dollars on disaster housing before a disaster strikes because doing so takes funds away from needs communities face today. However, once a disaster hits, producing disaster housing quickly can be more expensive. What's more: disaster victims and their neighbors are often unsatisfied with the common trailer solution for housing and, when no other solutions are available, economic and social recovery is hampered.

Because disasters have devastating impacts, the federal government plays a large role in disaster housing. FEMA, which was originally part of the Cold War civil defense effort under the Office of Emergency Preparedness, was created by Congress in 1979 and brought together more than 100 programs. From the beginning, FEMA has been charged with two core missions: enhance the U.S. government's ability to survive an attack and manage disaster preparedness.⁵ However, FEMA has not clearly delineated which of these missions is most crucial. In addition, other federal agencies have preparedness roles. In an article titled "The Truth about FEMA," James Jay Carafano and Richard Weitz note that "FEMA has never controlled all federal government emergency preparedness efforts. Both

⁵ James Jay Carafano and Richard Weitz, "The Truth about FEMA," The Heritage Foundation, December 7, 2005, <https://www.heritage.org/node/16998/print-display>.

the Department of Defense and the Department of Justice retained major responsibilities in this area.”⁶ Because FEMA has had many roles and does not retain control over all aspects of its responsibilities, it is difficult for the agency to be efficient or effective.

1. Disaster Housing Does Not Have a Natural Constituency

Disaster housing does not have a permanent, long-standing, natural constituency. Politicians may be reluctant to allocate disaster planning funds until a disaster strikes in their jurisdiction. For example, in 2011 Florida Senator Marco Rubio, along with several Republicans and the Senate Democrats, voted down a bill that would have not only stopped a federal shutdown but would have funded over \$3.6 billion for disaster relief.⁷ In 2017, after Florida was hit by several major storms, Rubio changed course and sought to pass a comprehensive new disaster relief bill aimed to help victims of Hurricanes Irma, Maria, and Harvey, as well as victims of the wildfires in California, because it directly affected his constituents.⁸

2. Poverty, Politics, and Disaster Relief: Hurricane Harvey

Hurricane Harvey raged from August 17 through September 2, 2017, dropping fifty-one inches of rain on Houston and southeast Texas. Harvey was responsible for the deaths of 105 people, and destroyed or damaged 300,000 structures. In the storm’s aftermath, 32,000 people needed emergency shelter and 890,000 people registered for FEMA aid. Hurricane Harvey caused \$125 billion worth of damage.⁹ Despite the massive problems encountered in previous recovery processes, such as Hurricane Katrina in 2005,

⁶ Carafano and Weitz.

⁷ William E. Gibson, “Rubio Votes against Disaster-aid Bill,” *Sun Sentinel*, September 23, 2011, <http://articles.sun-sentinel.com/2011-09-23/news/fl-rubio-votes-down-disaster-aid-1-disaster-relief-disaster-aid-spending-bill>; John T. Gasper and Andrew Reeves, “Make it Rain? Retrospection and the Attentive Electorate in the Context of Natural Disasters,” *American Journal of Political Science* 5, no. 2 (2011): 340–55, <http://www.jstor.org.libproxy.nps.edu/stable/23025055>.

⁸ Alex Daugherty, “Nelson and Rubio Urge the U.S. Senate Not to Forget about Disaster Aid,” *Miami Herald*, January 30, 2018, <http://www.miamiherald.com/news/politics-government/article197413659.html>.

⁹ Federal Emergency Management Agency (FEMA), “2017 Hurricane Season FEMA After-Action Report” (report, Department of Homeland Security, July 2018), v, <https://www.fema.gov/media-library-data/1531743865541-d16794d43d3082544435e1471da07880/2017FEMAHurricaneAAR.pdf>.

no government contracts with private vendors to provide disaster housing were in place prior to Harvey. As a result, housing recovery moved quite slowly. Six months after Harvey hit, 8,000 people were still in hotels, 2,000 people were in trailers or RVs, and repairs on only 5,000 of 30,000 severely damaged dwellings had been completed.¹⁰

The post-Hurricane Harvey experiences of low-income residents in the Houston area provide a vivid illustration of how the difficulties of navigating governmental the bureaucracies to obtain needed aid are exacerbated by poverty. FEMA had partnered with Texas General Land Office (GLO) for the first time, which delayed response times; the GLO had to hire and train people to administer FEMA's complicated programs.¹¹ Danny Vinim, reporting for *POLITICO*, says that nine months after Harvey made landfall, many of Houston's middle-class neighborhoods had recovered and life had returned to pre-disaster rhythms. Yet in Kashmere Gardens, where the median annual household income was \$23,000, most houses remained uninhabitable and many of the neighborhood's 10,000 residents were still scrambling for shelter, camping out in one room of their gutted houses or living in tents set up on the lawns of their uninhabitable homes.¹²

Survivors of disasters are inevitably traumatized in varying degrees, and FEMA's Aaron Skolnik, quoting his subordinates, notes that applying for aid is too difficult.¹³ Within this already stressed population, low-income families who may be working multiple jobs and struggling with language barriers, disabilities, lack of computer access, and childcare face additional impediments to navigating FEMA's daunting bureaucratic

¹⁰ "After Hurricane Harvey," Coalition for the Homeless, accessed March 19, 2019, <http://www.homelesshouston.org/after-hurricane-harvey/housing-for-harvey/>.

¹¹ Andrew Natsios, "Hurricane Harvey: Texas at Risk" (report, Texas General Land Office, 2018), 3, <http://www.glo.texas.gov/recovery/files/texas-at-risk-report.pdf>.

¹² Danny Vinik, "Nine Months after Harvey, Middle-Class Houston Has Recovered, but Low-Income Neighborhoods Are in Disarray," *POLITICO*, May 29, 2018, <https://www.politico.com/story/2018/05/29/houston-hurricane-harvey-fema-597912>.

¹³ FEMA transcript, accessed March 19, 2019, <https://www.fema.gov/media-library-data/20130919-1626-27928-9641/transcripts20130919-27928-846378.txt>; James M. Schultz and Sandro Galea, "Mitigating the Mental and Physical Health Consequences of Hurricane Harvey," *JAMA* 318, no. 15 (October 2017): 1437–38, <https://doi.org/10.1001/jama.2017.14618>.

maze.¹⁴ In Kashmere Gardens, those homeowners who successfully navigated the maze were awarded an average of \$4,300, an amount that in most cases was insufficient to make their homes habitable.¹⁵ Although FEMA dispatched personnel to assist Hurricane Harvey victims with applications for aid, complex bureaucratic rules and fallout from pre-disaster conditions prevented many residents from obtaining the help they needed.¹⁶ “People just give up,” said Keith Downey, president of a local organization called Kashmere Gardens Super Neighborhood, which assists local residents with recovery. And Ben Hirsch, a relief worker with Houston’s West Street Recovery, states, “My impression is that low-income homeowners in Northeast Houston really have no idea what the hell is going on at all. They are very confused.... There’s your FEMA grant and your SBA loan, and PREPS and DALHR.”¹⁷

Some residents were denied FEMA aid because they did not have mandated flood insurance. Much of the neighborhood was built on a flood plain, and prior to the disaster many homeowners were either unaware of laws requiring flood insurance or were unable to afford it. At the national level, then FEMA Administrator Brock Long noted at a congressional hearing on April 11, 2018, “We’ve got to streamline a very fragmented recovery process. Recovery funding comes from 17 different federal government agencies and it’s too difficult to understand what you’re entitled to and how to put it to work.”¹⁸

3. FEMA and HUD Friction

In August 2017, HUD attempted to streamline programs for rebuilding by using community development block grants (CDBGs) and the HOME Investment Partnerships Program, funded by FEMA and designed to help HUD provide housing and ownership

¹⁴ Rosemarie Fike and Stefanie Haeffele, “Getting Federal Disaster Assistance Too Difficult: Opinion,” *Sun Sentinel*, November 27, 2017, <https://www.sun-sentinel.com/opinion/fl-op-getting-federal-disaster-aid-difficult-20171121-story.html>.

¹⁵ Manny Fernandez, “A Year After Hurricane Harvey, Houston’s Poorest Neighborhoods Are Slowest to Recover,” *New York Times*, March 9, 2018, <https://www.nytimes.com/2018/09/03/us/hurricane-harvey-houston.html>.

¹⁶ Fernandez.

¹⁷ Vinik, “Nine Months after Harvey.”

¹⁸ Vinik.

opportunities for low-income persons.¹⁹ HUD was also able to grant ninety-day moratoriums on foreclosures and offer Federal Housing Administration loans and mortgage insurance. But HUD did not receive funding from FEMA until June 2018, and it was nearly a year before the federal government approved \$5 billion for HUD to work on long-term recovery solutions.²⁰ Delays in reimbursement to HUD meant delays in relief to disaster victims.

4. TSA versus DHAP

In the aftermath of Hurricane Harvey, FEMA focused its funding on the Transitional Sheltering Assistance (TSA) program and did not implement the Disaster Housing Assistance Program (DHAP), which addresses longer-term infrastructure repairs and housing, often for poorer communities and individuals. Essentially, TSA pays for hotels; DHAP pays for rent. The average TSA allotment (funded by FEMA) is \$3,650 per month, while DHAP allotments (funded by HUD, through FEMA) are \$685 a month. FEMA's TSA program and state-administered programs were able to meet the needs of many of those displaced by Harvey, but because FEMA did not implement the DHAP, many lower-income people who could not meet TSA stipulations, such as credit card deposits in hotels accepting government vouchers, were left without options. The DHAP pays the difference between what a victim can afford and their rent, to a given limit. This assistance is tapered off over several months and the responsibility for paying rent gradually shifts to those living in the rental unit.²¹ As the National Low-Income Housing Coalition points out, using the TSA program instead of the DHAP means that FEMA retains control of the money, doling it out instead of turning it over to HUD through the

¹⁹ "The Home Program: Home Investment Partnerships," Department of Housing and Urban Development (HUD), accessed March 19, 2019, <https://www.hud.gov/hudprograms/home-program>.

²⁰ Rebecca Worby, "HUD Approves a \$5 Billion Hurricane Harvey Disaster Recovery Plan," *Pacific Standard*, June 25, 2018, <https://psmag.com/news/hud-approves-a-5-billion-hurricane-harvey-disaster-recovery-plan>.

²¹ Nyssa Kruse, "State Divies Up \$600,000 Set Aside for Hurricane Maria, Irma Survivors," *Hartford Courant*, July 9, 2018, <http://www.courant.com/news/connecticut/hc-news-funding-puerto-rico-hurricane-maria-housing-20180709-story.html>; Patricia Campbell, "HUD Approves \$5 Billion Texas Disaster Recovery Plan," HUD, June 25, 2018, https://www.hud.gov/press/press_releases_media_advisories/HUD_No_18_060.

DHAP, which has been proven to be more cost-effective. The federal government could have saved \$142 million dollars or housed 3,200 additional families in 2017 by implementing the DHAP instead of the TSA program.²²

Communication broke down between FEMA, the state of Texas, and local governments, which caused a dearth of information at the local level; that local governments had no idea how many people were displaced or if they were getting aid, which made it difficult for them to organize and start rebuilding. In the years since Katrina, it has been recognized that the speedy flow of accurate data can be an important part of recovery. Because renters do not own land, they cannot be offered trailers, or temporary housing units, and landlords are hesitant to rent to them because they are not allowed to run background checks.²³

After Hurricane Harvey in 2017, FEMA, working in conjunction with the GLO, was unable to find adequate housing for those in need. The Coalition for the Homeless, a local nonprofit set up in 1982 to combat homelessness in Houston, stated that starting on September 7, 2017, a campaign organized under the hashtag #HousingForHarvey found 700 units in just two months for those who were forced out of shelters as they were being closed. This drive to house those without homes allowed landlords to offer rental units for six months, and created spaces for 900 people to live safely.²⁴ Renters were able to look at a map and pick their locations after landlords, by taking a seminar, had qualified their units.²⁵ This is an instance in which state and federal bureaucracies were bogged down by

²² “Setting the Record Straight: FEMA’s Failure to Address Long Term Housing Needs of Survivors,” National Low Income Housing Coalition, June 27, 2018, https://nlihc.org/sites/default/files/FEMA_Setting-The-Record-FEMA-TSA.PDF; David Inserra et al., “After the Storms: Lessons from Hurricane Response and Recovery in 2017,” Special Report No. 201 (report, The Heritage Foundation, April 2018), <https://www.heritage.org/sites/default/files/2018-04/SR-201.pdf>.

²³ Brandon Formby, “Abbott and FEMA Are Using Harvey to Reinvent Disaster Response. Some Say That Makes Displaced Texans ‘Guinea Pigs,’” *Texas Tribune*, February 27, 2018, <https://www.texas-tribune.org/2018/02/27/texans-left-limbo-gov-abbott-fema-use-harvey-reinvent-disaster-respons/>.

²⁴ Coalition for the Homeless, “After Hurricane Harvey”; “Texas GLO Signs Agreement Negotiated for Disaster Assistance with FEMA,” Texas General Land Office, September 23, 2017, <http://www.glo.texas.gov/the-glo/news/press-releases/2017/september/texas-glo-signs-agreement-negotiated-for-disaster-assistance-with-fema.html>.

²⁵ Coalition for the Homeless, “After Hurricane Harvey.”

red tape, but an existing, smaller nongovernmental organization (NGO) was nimble enough to be effective, pointing to the possibility that NGOs can be important partners in securing disaster housing.

Because FEMA had thirty ongoing disasters dating back to 2005 to which it was still dedicating resources and personnel, in 2017 the new federal administration decided that FEMA would shift disaster housing responsibility for Hurricane Harvey to the state and local governments while funding the response.²⁶ This shift was intended to support a more proactive partnership in which individuals, local communities, and states would work together with NGOs and insurance companies to create better disaster housing results, with an estimated 6-to-1 return on dollars spent.²⁷ However, prediction that local and state control of disaster recovery would be more efficient and cost-effective did not come to fruition. The existing local agencies were woefully underprepared to handle massive needs for aid. Although the federal government and the governor of Texas decided to have the GLO, instead of FEMA, handle short-term rentals in an attempt to revise disaster relief, the inexperienced leader of the agency was quickly overwhelmed by the enormity of the task. The GLO could not proceed until it hired more staff, who then needed time to learn their new jobs. Of the 40,000 families needing temporary housing, after 100 days only 900 had received aid, with 199 trailers in place and 367 more on order. Additionally, by the time the GLO finally contacted them, 33,000 families had already made other arrangements, but there is a strong possibility that these residents were living in unsafe or unhealthy conditions in their homes.²⁸

²⁶ Daniel Gerstein, “FEMA Wants Local Governments to Step Up,” CNN, June 7, 2018, <https://www.cnn.com/2018/06/07/opinions/fema-shifts-focus-local-governments-for-disaster-prep/index.html>.

²⁷ Texas General Land Office, “Texas GLO Signs Agreement”; Doug Irving, “RAND Researchers Visit Puerto Rico after Hurricane Maria,” RAND, December 19, 2017, <https://www.rand.org/blog/rand-review/2017/12/rand-researchers-visit-puerto-rico-after-hurricane.html>.

²⁸ “GLO and FEMA Working through the Holiday Season to Continue Rollout of Direct Housing for Hurricane Harvey Survivors,” FEMA, November 18, 2017, <https://www.fema.gov/news-release/2017/11/18/glo-and-fema-working-through-holiday-season-continue-rollout-direct-housing>; Formby, Abbott and FEMA.”

These problems to provide temporary housing speak to the need for clear, advance planning about which entities will provide aid, how it will be distributed, and the form the aid will come in. Harvey was an example in which local and state governments were empowered to run the disaster housing programs but ,due to lack of advance planning, the state did not successfully provide disaster housing when called upon to do so.

A year after Hurricane Harvey, the GLO, with its fresh perspective, developed a number of recommendations to improve disaster housing policy so that it is better equipped to help victims. The most significant recommendation introduces the option for more permanent and cost-effective post-disaster housing instead of limiting such housing to eighteen months. “Why spend a hefty chunk of money providing a family with a mobile home for just 18 months if there’s another permanent solution that’s cheaper?” asked Brittany Eck, a spokesperson for GLO.²⁹ FEMA currently offers several disaster housing solutions, including trailers, housing vouchers, low-interest loans, and grants for repairs. But with each disaster, FEMA alone determines which response options will be offered in that area. Victims are not offered *their* choice, although giving stakeholders buy-ins for solutions has proven more successful.³⁰

5. Not in My Backyard

Another, often overlooked, problem with post-disaster housing is the impact of *not in my backyard*—or NIMBY—when situating trailers. NIMBY has become a movement of neighborhood groups with political clout whose goal is to keep what they deem as locally undesirable land uses (LULUs) out of their neighborhoods. A typical example of NIMBY is when an upper-middle class neighborhood blocks a homeless shelter from becoming a part of its community. In general, “Residents worry that their enjoyment of the neighborhood will be undermined by the clients and that certain clients will be a bad

²⁹ Marina Starleaf Riker, “Marina Texas Land Commissioner Wants to Change Federal Law to Make FEMA More Flexible,” *Emergency Management*, August 24, 2018, <http://www.govtech.com/em/disaster/-Texas-Land-Commissioner-Wants-to-Change-Federal-Law-to-Make-FEMA-More-Flexible.html>.

³⁰ Adham Hany Abulnour, “The Post-disaster Temporary Dwelling: Fundamentals of Provision, Design and Construction,” *HBRC Journal* 10, no. 1 (April 2014): 13, <https://doi.org/10.1016/j.hbrcj.2013.06.001>.

influence on children and young people.”³¹ While trying to place FEMA trailers in south Louisiana after Hurricane Katrina, research found that FEMA did not consider the constituent power to block the placement of the trailer parks.³²

With regard to disaster housing, NIMBY makes it much harder to place trailers in neighborhoods that commonly have the infrastructure and wraparound services that can hasten the recovery process.³³ FEMA has long relied on trailers as its primary response to post-disaster housing, but trailers can be placed only in areas that have running water, an operating power grid, and working sewage disposal. The widespread negative cultural perception of trailers contributes to the difficulty of finding suitable locations for them. In many cases, landowners have been unwilling to place trailers on their property and have fought to keep them out of their neighborhoods, further reducing potential sites for post-disaster housing.³⁴

B. ECONOMIC FACTORS

The cost to taxpayers for post-disaster housing is extremely high; FEMA spent \$2.7 billion on temporary housing after Hurricane Katrina in 2005, for example, and HUD spent \$16.4 billion on disaster housing during fiscal years 2011 through 2013.³⁵ By September 31, 2017, FEMA had paid roughly \$6.6 billion for disaster housing alone after hurricanes

³¹ Michael Dear, “Understanding and Overcoming the NIMBY Syndrome,” *Journal of the American Planning Association* 58, no. 3 (Summer 1992): 288–300, <https://doi.org/10.1080/01944369208975808>.

³² Belinda Creel Davis and Valentina Bali, “Examining the Role of Race, NIMBY, and Local Politics in FEMA Trailer Park Placement,” *Social Science Quarterly* 89, no. 5 (December 2008): 1175–94, <https://doi.org/10.1111/j.1540-6237.2008.00563.x>.

³³ Walter F. Carroll, “NIMBY,” in *Green Cities: An A-to-Z Guide*, eds. Nevin Cohen and Paul Robbins (Thousand Oaks, CA: SAGE, 2011), 56, <http://sk.sagepub.com.libproxy.nps.edu/reference/greencities/n106.xml?term=nimby>.

³⁴ Brentin Mock, “Why Houston Housing Is Poised to Get Expensive and Unequal,” CityLab, September 18, 2017, <https://www.citylab.com/equity/2017/09/housing-still-a-problem-in-nola-since-katrina/538371/>.

³⁵ Peter Balonon-Rosen, “The Business of Disaster: How Does the U.S. Spend Relief Money?” Marketplace, November 27, 2017, <https://www.marketplace.org/2017/11/27/world/business-disaster-how-does-us-spend-relief-money>; Daniel J. Weiss and Jackie Weidman, “Disastrous Spending: Federal Disaster-Relief Expenditures Rise amid More Extreme Weather,” Center for American Progress, April 29, 2013, <https://www.americanprogress.org/issues/green/reports/2013/04/29/61633/disastrous-spending-federal-disaster-relief-expenditures-rise-amid-more-extreme-weather/>.

Harvey, Irma, and Maria and the wildfires that rocked California in 2017.³⁶ As of December 2017, FEMA spent about \$150,000 per trailer for disaster housing; this cost does not include utilities, maintenance, or upkeep.³⁷ Housing vouchers can be difficult to track and very expensive. Through HUD, FEMA paid contractors millions of dollars in inspection fees for rentals to verify livability, but no services were rendered. In some cases, post-disaster temporary housing is more expensive than the purchase of a new house.³⁸

The technological challenges of disaster housing can have long-term economic effects as well. For example, in 2017, a year in which the United States saw many disasters, the necessary quantities of FEMA trailers were not available.³⁹ Further, as previously mentioned, trailers must be connected to a functioning infrastructure, limiting where they can be placed.⁴⁰ FEMA's post-disaster temporary housing was not built to transition to permanent housing or to conform with local permanent-building codes because it was created as a last resort for people with no other options.⁴¹ This lack of foresight exemplifies a lost opportunity to reduce waste and find permanent housing for those who have lost their homes.

³⁶ "Disaster Housing Recovery Update," National Low Income Housing Coalition, October 31, 2017, <http://nlihc.org/article/disaster-housing-recovery-update-tuesday-october-31-2017>.

³⁷ Emily Schmall and Michael Sisak, "Despite Temporary Housing Shortage, FEMA's \$150K Disaster Trailers Often Sold," Claims Journal, December 29, 2017, <https://www.claimsjournal.com/news/southcentral/2017/12/29/282274.htm>.

³⁸ *Is Housing Too Much to Hope For? FEMA's Disaster Housing Strategy: Hearing before the Committee on Disaster Recovery and Intergovernmental Affairs*, Senate, 110th Cong., 2 (March 4, 2008), <https://www.hsgac.senate.gov/subcommittees/disaster-recovery-and-intergovernmental-affairs/hearings/is-housing-too-much-to-hope-for-femas-disaster-housing-strategy>.

³⁹ Emily Schmall and Michael Sisak, "FEMA Sells Disaster Trailers Cheaply Despite Victim Demand," *Chicago Tribune*, December 27, 2017, <http://www.chicagotribune.com/news/sns-bc-us--fema-trailers-pricey-policy-20171227-story.html>.

⁴⁰ Mark Ballard, "'Biggest Challenge' Installing FEMA's Mobile Homes for Louisiana Flood Victims," *The Advocate*, October 16, 2016, http://www.theadvocate.com/louisiana_flood_2016/article_39e12f72-9255-11e6-909b-579fd1b3fd0b.html.

⁴¹ ABT Associates Inc. and Amy Jones & Associates, "Developing a More Viable Disaster Housing Unit" (report, FEMA, February 2009), https://www.fema.gov/pdf/about/programs/ahpp/ahpp_ms_cs.pdf.

1. Owner versus Renter and the Need for FEMA

Research by Jee Young Lee and Shannon Van Zandt in the *Journal of Planning Literature* shows that the poor are hit harder by a disaster and that they do not ever fully recover. They explain that disproportionate numbers of poor people rely on aid for housing after a disaster and that poor people tend to rent instead of own, have less money in the bank, less stability in their employment, and fewer ties to their community—all factors that reduce the likelihood that they will be able to recover without federal aid. According to the statistics Lee and Van Zandt discuss in their article, when a disaster hits, poor people cannot find alternate housing and rely on FEMA for disaster housing. In a disaster area with limited rental stock (like many urbanized cities), demand is high and so prices for available housing tend to increase, reducing the chances of renters with vouchers finding alternative housing.⁴² The speedy delivery of housing that is located close to essential services would make vouchers a more viable option for poor people after a disaster, during a rental shortage. The authors recommend policy changes that include rental repair programs and utility payment programs to increase the likelihood that these vulnerable populations might recover.

Statistically, more low-income people live in flood plains and are underinsured than those in other income groups.⁴³ When money is tight, flood insurance may be unaffordable. Lack of insurance increases the likelihood that a person will need aid for disaster housing after a flood or hurricane. Table 1 illustrates the difference in income as it relates to flood insurance holders nationwide. It shows that households with flood insurance make almost twice as much annually as those that do not have flood insurance, and almost twice as many households in the special flood hazard zone do not have flood insurance.⁴⁴ In Special Flood

⁴² Jee Young Lee and Shannon Van Zandt, “Housing Tenure and Social Vulnerability to Disasters: A Review of Evidence,” *Journal of Planning Literature* (2018): 7, <https://doi.org/10.117/0885412218812080>; Jennifer Turnham, “What Have We Learned about Housing Recovery after Disaster Strikes?” ABT Associates Inc., November 13, 2017, <https://www.abtassociates.com/insights/perspectives-blog/what-have-we-learned-about-housing-recovery-after-disaster-strikes>.

⁴³ Department of Homeland Security, “An Affordability Framework for the National Flood Insurance Program” (report, Department of Homeland Security, April 2018), 18, <https://www.fema.gov/media-library-data/1524056945852-e8db76c696cf3b7f6209e1adc4211af4/Affordability.pdf>.

⁴⁴ Department of Homeland Security.

Hazard Areas (SFHAs), 3.3 million households that are vulnerable to floods do not have flood insurance, creating a huge potential housing problem as well as a large bill for the taxpayers when a disaster hits these regions.

Table 1. Median Household Income of Flood Insurance Policyholders and Non-policyholders⁴⁵

	In SFHA	Outside SFHA	Total
Policyholders	\$77,000/annual (1.8M households)	\$88,000/annual (1.9M households)	\$82,000/annual (3.7M households)
Non-policyholders	\$40,000 (3.3M households)	\$56,000 (101.1M households)	\$55,000 (104.4M households)
All Households	\$50,000 (5.1M)	\$57,000 (103.0M)	\$56,000 (108.1M)

Number of households is shown in parentheses

M = millions

NOTE: Data was weighted using ACS sample weights. Median income was rounded to the nearest \$1,000; number of households was rounded to the nearest 100,000.

2. Builders in Need of Laborers Now

To set up disaster housing, workers are needed. Residents and contractors in cities like New York and San Francisco are having difficulty, even in non-disaster times, finding builders. In a recently published article for Bisnow, Mathew Rothstein notes that while New York was having a building boom, many contractors could not fill positions and this was slowing down job completions.⁴⁶ U.S. News reports that builders were looking for 225,000 construction workers per month nationwide in 2018.⁴⁷ An October 2018 *San*

⁴⁵ Adapted from Department of Homeland Security, 11.

⁴⁶ Matthew Rothstein, "Amid Building Boom, New York City's Construction Labor Pool Is Shrinking," Bisnow, February 7, 2018, <https://www.bisnow.com/new-york/news/construction-development/construction-boom-shrinking-labor-problems-84706>.

⁴⁷ Andrew Soergel, "Where Are All the Builders?," US. News, June 15, 2018, <https://www.usnews.com/news/the-report/articles/2018-06-15/the-us-construction-industry-is-booming-but-where-are-the-builders>.

Francisco Chronicle headline further states, “Labor Shortage Could Cripple Bay Area Rebuilding after Next Big Quake.”⁴⁸ After a disaster, this shortage of builders will negatively impact people who need repairs, slowing down recovery and increasing costs.

C. SOCIAL FACTORS

1. Keeping Communities Intact

Studies show that keeping populations in place after a disaster is vital if the area is to recover.⁴⁹ Two very different studies discuss key reasons why this is so important. The first, completed by SPUR, concerns the economic factors discussed in the previous section; it shows that moving more than 5 percent of a population away from its home has—beyond social implications—serious ramifications on the economic recovery of the affected area (this is discussed in greater detail in coming chapters).⁵⁰ The second study, which examined psychological impacts of being moved to a new region after a disaster, was completed by the Japanese Red Cross Society to study Japan’s displaced victims two years after the triple disaster; the study found that there was an increase in depression and other negative mental affects for people who were moved away from their homes.⁵¹

2. Convergence Behavior

After a disaster, in a phenomenon known as *convergence behavior*, many people are drawn to the area of destruction to offer aid and services, whether or not help has been

⁴⁸ Roland Li, “Labor Shortage could Cripple Bay Area Rebuilding after Next Big Quake,” *San Francisco Chronicle*, October 17, 2018, <https://www.sfchronicle.com/business/article/Labor-shortage-could-cripple-Bay-Area-rebuilding-13312821.php>.

⁴⁹ Jasmin K. Riad and Fran H. Norris, “The Influence of Relocation on the Environmental, Social, and Psychological Stress Experienced by Disaster Victims,” *Environment and Behavior* 28, no. 2 (1996): 163–82, <https://journals.sagepub.com/doi/abs/10.1177/0013916596282001>; Chris Poland, “The Resilient City: Defining What San Francisco Needs from its Seismic Mitigation Policies” (report, San Francisco Planning and Urban Research Association, February 2009), https://www.spur.org/sites/default/files/publications_pdfs/SPUR_Seismic_Mitigation_Policies.pdf.

⁵⁰ Francis Markus, “Two Years on, New Psychological Stresses Emerge amongst Survivors of Japan’s Triple Disaster,” International Federation of Red Cross and Red Crescent Societies, March 9, 2018, <https://www.ifrc.org/fr/nouvelles/nouvelles/asia-pacific/japan/two-years-on-new-psychological-stresses-emerge-amongst-survivors-of-japans-triple-disaster-61021/>.

⁵¹ SPUR, “Safe Enough to Stay” (report, SPUR, January 2012), <https://www.spur.org/publications/spur-report/2012-02-01/safe-enough-stay>.

requested—and these people need somewhere to stay. In an article on convergence behavior, Erik Auf der Haide notes that many more people will come than are needed. Auf der Haide also notes that fences are needed to keep people from looting, as are locations for the collection, sorting, and dissemination of a plethora of donations.⁵² Another study by Binu Jacob et al. echoes Auf der Haide’s conclusion that people are generally generous after a disaster, even those impacted by the disaster. The housing needs of people who converge after a disaster to offer help should be factored into planning for post-disaster housing.⁵³

While will be converging temporarily on the disaster site, permanent residents will be leaving. Those who do stay may be doing so because they cannot leave; many people who stay, for instance, have chronic health issues. Dr. Amanda Graves notes that after a natural disaster there is a second disaster of shortages, lasting up to three months, of vital pharmaceuticals.⁵⁴ This can be a death sentence for those who are dependent upon blood pressure, diabetes, anti-seizure, and other medications. Integrating the vital need for medications into disaster housing planning would be a step in the right direction; studies indicate that the people who need temporary post-disaster housing are often elderly, poor, or have disabilities, and will likely need life-saving medication on a daily basis.⁵⁵

Other convergence needs to consider include the need for food preparation sites. Disaster workers and volunteers need to be fed. There may be a need for group kitchens at disaster sites.

⁵² Binu Jacob et al., “Disaster Mythology and Fact: Hurricane Katrina and Social Attachment,” *Public Health Reports* 123, no. 5 (September–October 2008): 555–66, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2496928/>.

⁵³ Erik Auf der Heide, “Convergence Behavior in Disasters,” *Annals of Emergency Medicine* 41, no. 4 (April 2003): 463–66, [https://www.annemergmed.com/article/S0196-0644\(03\)00075-1/fulltext](https://www.annemergmed.com/article/S0196-0644(03)00075-1/fulltext).

⁵⁴ Amanda Graves, “Drug Shortages Plague Healthcare Facilities While Natural Disaster Recoveries Continue,” Strategic Health Solutions, accessed March 19, 2019, <https://strategichs.com/blog/2018/01/29/drug-shortages-plague-healthcare-facilities-while-natural-disaster-recoveries-continue/>.

⁵⁵ Jennifer R. Davis et al., “The Impact of Disasters on Populations with Health and Health Care Disparities,” *Disaster Med Public Health Prep* 4, no. 1 (2010): 30–38, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2875675/>.

D. TECHNOLOGICAL FACTORS

A robust and resilient infrastructure is key to the successful functioning of a modern society. According to a 2017 report by the American Society of Civil Engineers (ASCE) that assessed the physical conditions of sixteen categories of modern life ranging from aviation to wastewater, the infrastructures of cities in the United States are not aging well, earning an overall grade of D+, down from a grade of C when the first ASCE report was published in 1988.⁵⁶ This raises serious concerns for disaster preparedness, as it is unlikely that already weakened infrastructures will be functioning after disasters of serious magnitude. For example, it took eight months to restore limited power in Puerto Rico following Hurricane Maria, and despite a \$3.8 billion repair bill, the power grid is considered likely to fail again during the next hurricane.⁵⁷ Poorly maintained infrastructures may also trigger natural disasters. In 2017, electrical wires downed during a windstorm were blamed for the Carr Fire in California, resulting in \$1.659 billion in damages.⁵⁸

Studies show that keeping populations in place after a disaster is vital if the area is to recover, but doing so is difficult without a functioning infrastructure.⁵⁹ As previously mentioned, FEMA can only place trailers, the agency's temporary housing solution, in areas that have running water, an operating power grid, and working sewage disposal.⁶⁰ Many people in the disaster preparedness field—among them GLO representatives, congressional ad hoc committees, and professional reviewers of public policy—are aware

⁵⁶ “ASCE’s 2017 Infrastructure Report Card,” American Society of Civil Engineers, accessed March 19, 2019, <https://www.infrastructurereportcard.org/>.

⁵⁷ Michael Weissenstein, “Puerto Rico Power Grid Can’t Withstand Hurricane after Billions Spent,” *Las Vegas Review-Journal*, May 31, 2018, <https://www.reviewjournal.com/news/nation-and-world/puerto-rico-power-grid-cant-withstand-hurricane-after-billions-spe>.

⁵⁸ Richard Gonzales, “PG&E Power Lines Blamed for Northern California Wildfires,” NPR, June 8, 2018, <https://www.npr.org/2018/06/08/618444388/pg-e-power-lines-blamed-for-northern-california-wi>.

⁵⁹ Mary C. Comerio, “Disaster Recovery and Community Renewal: Housing Approaches,” *Cityscape* 16, no. 2 (2014): 56, <http://www.jstor.org/stable/26326883>; Poland, “The Resilient City.”

⁶⁰ Tessa Anderson, “On the Hurricane Trail,” CH2M Hill, 2008, https://www.jumpjet.info/Emergency-Preparedness/Neighborly-Response/Outside/So_What_Exactly_Does_It_Take_To_Install_A_FEMA_Trailer.pdf.

of the problems inherent in FEMA's trailer-and-voucher system of emergency housing, but no significant changes have been implemented to improve the state of disaster housing.⁶¹

E. ENVIRONMENTAL FACTORS

The effects of climate change are increasing the need for disaster housing; four of the most destructive hurricanes in U.S. history have occurred in the past thirteen years.⁶² Compounding this environmental issue, more people are moving to urban areas and areas at higher risk for disasters, and disaster housing is inhibiting waste-control efforts.

1. Supersize My City!

People are moving to cities in large numbers and creating megacities, which are increasing in mass either horizontally or vertically.⁶³ For example, "population growth in California's urban centers will surpass land consumption. In the eastern U.S., as well as in the Midwest, urban expansion is expected to increase significantly faster than population."⁶⁴ This urban agglomeration, or blurring of distinct lines between cities, changes the ways in which cities relate to each other; in addition to competing, they are cooperating as well.⁶⁵ But after a disaster, when resources are low, cities may compete rather than cooperate for limited resources such as disaster housing. With open space diminished, it becomes difficult to find placement opportunities for disaster housing. With more people moving into high-rises in city centers, there will likely be an increase in the need for post-disaster housing. As disasters hit these megacities, trailers will not provide a working solution to cope with so many people in relatively small areas.

⁶¹ Formby, "Abbott and FEMA."

⁶² Chris Opfer and Christopher Hassiotis, "10 Worst Hurricanes of All Time," HowStuffWorks, accessed March 19, 2019, <https://science.howstuffworks.com/nature/natural-disasters/10-worst-hurricanes10.htm>.

⁶³ Lahouari Bounoua et al., "A Method for Mapping Future Urbanization in the United States," *Urban Science* 2, no. 2 (April 1, 2018), <https://doaj.org/article/7a3071aa03dd4b06877287cfabc50e80>.

⁶⁴ Bounoua et al.

⁶⁵ Chuanglin Fang and Danlin Yu, "Urban Agglomeration: An Evolving Concept of an Emerging Phenomenon," *Landscape and Urban Planning* 162 (June 2017): 127.

2. More People Are Moving into Danger Zones

Flooding has emerged as an environmental danger of grave concern. A recently published FEMA report notes that many communities in the United States have been built on 100-year flood plains. These vulnerable areas have increased in size and are getting hit hard. There are no plans to move communities out of these high-risk areas, and people affected by future floods are going to need government assistance.⁶⁶

Wildfires are part of the natural cycle of renewal in forests, but as climate change leads to increased droughts, their frequency and intensity have increased dramatically. Ongoing drought was a key factor in California's 2017 and 2018 wildland fires, the worst in recorded history and which claimed more lives as a result of fire in two years than in the previous ten years combined, and destroyed more than 26,000 homes.⁶⁷ As communities expand into formerly uninhabited wooded areas, people are vulnerable to loss of life and property through wildfires.

3. Post-disaster Trailers Are Adding to the Storage Problem

Trailers, which are neither reusable nor recyclable, create another environmental problem: vast quantities of waste. When disaster victims find permanent housing, FEMA's post-disaster trailers often end up stored or sold as scrap. After Katrina, FEMA had to find a way to store, instead of dispose of, nearly such 100,000 temporary housing units because of numerous lawsuits over toxic levels of formaldehyde found in the trailers. The agency stated that the litigation slowed FEMA's efforts to reduce its stock of more than 94,000 travel trailers it had stored, empty and unused, around the country.⁶⁸ After the litigation was settled, some trailers were sold as scrap and then used as homes by the new owners.

⁶⁶ Department of Homeland Security, "An Affordability Framework," vi.

⁶⁷ "Facts + Statistics: Wildfires," Insurance Information Institute, accessed March 19, 2019, <https://www.iii.org/fact-statistic/facts-statistics-wildfires>.

⁶⁸ Pam Fessler, "Trailer Graveyards Haunt FEMA, Neighbors," NPR, July 8, 2008, <https://www.npr.org/templates/story/story.php?storyId=92183909>.

Some trailers are still being stored, at a great cost to the taxpayers, while the government figures out what to do with these toxic boxes.⁶⁹

F. LEGAL FACTORS

1. Conflicting Options

The United States relies on the Robert T. Stafford Disaster and Emergency Assistance Act to guide its priorities in disaster housing. The Stafford Act was enacted in 1988 and continues to be the cornerstone of FEMA disaster relief. It was designed to enable the federal government to assist the local and state governments of areas hit by natural disasters. The Stafford Act mandates that in order to receive funds, local and state governments must develop preparedness plans, mitigate hazards as needed, work together with other stakeholders, and use the National Incident Management System (NIMS) as the operating structure, among other requirements.⁷⁰ It mandates that this framework be adhered to before, during, and after a disaster if a city is to qualify for federal funding, but given the potential state of cities after disasters, it may behoove cities to focus on preparing for disasters and mitigating hazards ahead of need in order to reduce recovery time.

In his 2018 article for *POLITICO*, Danny Vinik notes:

The Stafford Act itself is a study in contradictions. Lawmakers wanted to help communities recover, minimize fraud, and preserve incentives for households to prepare for future disasters. But those goals are in tension: The more money FEMA provides disaster victims, the less incentive they have to prepare for a storm, and the faster FEMA doles out that money, the greater risk that some of it will fall into fraudulent hands.⁷¹

The non-profit Sphere Project, initiated in 1997 by multiple humanitarian agencies, including the Red Cross, developed the internationally acknowledged gold standard for post-disaster housing. Sphere states that the “disaster-affected population should be

⁶⁹ Robert Bullard, “The Color of Toxic Debris,” *The American Prospect*, February 16, 2009, <https://prospect.org/article/color-toxic-debris>.

⁷⁰ Department of Homeland Security, *National Disaster Recovery Framework*, 2nd ed. (Washington, DC: Department of Homeland Security, June 2016), 3, https://www.fema.gov/media-library-data/1466014998123-4bec8550930f774269e0c5968b120ba2/National_Disaster_Recovery_Framework2nd.pdf.

⁷¹ Vinik, “Nine Months after Harvey.”

assisted on the site of their original homes.”⁷² Sphere also urges that affected populations unable to stay near their original homes should be allowed to stay with family or “people (with whom) they share historical or religious ties.”⁷³ When assessing disaster housing options, Sphere reminds planners of the importance of both the land upon which homes are built and the cultural and family ties connected to that land.⁷⁴

In his 2010 Congressional Research Service report, Francis X. McCarthy, an emergency management policy analyst, discusses challenges to FEMA policies and practices. His report echoes Sphere’s conclusions:

It is critical to anticipate the challenge of providing housing assistance that meets diverse individual, household and community needs. Meeting urgent housing needs while enabling individuals, households, and communities to rebuild and restore their way of life is a complex equation that requires all those involved in disaster housing—including all levels of government, nongovernmental organizations, and the private sector—to navigate a broad range of competing and interdependent factors.⁷⁵

These conflicting needs point to the difficulties FEMA faces in developing and implementing a cohesive disaster housing response plan that meets the goals of the Stafford Act as well as Sphere’s standards, especially given the limitations stipulated by the Stafford Act, such as an eighteen-month limit on disaster housing.

McCarthy also outlines the different options that FEMA offers to serve the housing needs of displaced people in declared disaster areas, beginning with temporary housing at large facilities, such as sports stadiums, in the immediate aftermath of a disaster. For the longer term, FEMA offers programs to repair homes and vouchers to pay rent while the victims’ homes are being rebuilt. And as a last resort, FEMA offers the option of trailers

⁷² Seki Hirano and Ela Serdaroglu, “Shelter and Settlement,” in *The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response* (Geneva, Switzerland: Sphere, 2018), <https://handbook.spherestandards.org/>.

⁷³ Hirano and Serdaroglu.

⁷⁴ Hirano and Serdaroglu.

⁷⁵ Francis X. McCarthy, *FEMA Disaster Housing: From Sheltering to Permanent Housing*, CRS Report No. R40810 (Washington, DC: Congressional Research Service, 2010), 15, <https://fas.org/sgp/crs/misc/R40810.pdf>; FEMA, “National Disaster Housing Strategy” (report, Department of Homeland Security, January 2009), 25, https://www.fema.gov/media-library-data/20130726-1819-25045-9288/ndhs_core.pdf.

for post-disaster housing. Each of these programs has a complex set of requirements that must be met before people can apply for them.⁷⁶

2. Permanent and Semi-permanent Housing Programs

FEMA has the legal, if rarely used, option to build permanent houses as a disaster housing solution when it is less expensive than building temporary housing. Known as an *eligible created resource*, this option was not offered after Katrina or Maria because it was very expensive, but may be less expensive than temporary housing that is disposable.⁷⁷

The semi-permanent housing program includes the Post-Katrina Temporary Disaster Housing Pilot Program, which allows victims to stay closer to home during rebuilding, and gives FEMA the option to rent and repair apartments for victims to live in. This assistance may be helpful in creating units when rental markets are tight and vacant units do not meet federal housing standards.

McCarthy's research reveals the need for a more comprehensive disaster housing option, but data shows that the manner in which post-disaster housing has been approached in the recent past does not reflect this need. For example, an ad hoc committee created to address FEMA's response to Katrina recommended finding another temporary housing solution besides manufactured housing units, but after the Carr Fire in California in 2018 FEMA once again considered using trailers for displaced victims.⁷⁸ When McCarthy's report was released in August 2010, he noted:

In anticipation of the release of the strategy, the DHS Inspector General posited four different approaches to FEMA's current practices: Alternatives to FEMA being the primary provider of long-term housing include having:

- (1) States assume housing responsibility,
- (2) HUD assume federal coordination of the housing function,

⁷⁶ McCarthy, *FEMA Disaster Housing*, 14.

⁷⁷ McCarthy, 14.

⁷⁸ Dale Kasler, "FEMA Might Bring 2000 Trailers to House Camp Fire Evacuees," *Mercury News*, November 28, 2018, <https://www.mercurynews.com/2018/11/28/fema-might-bring-2000-trailers-to-house-camp-fire-evacuees/>.

(3) FEMA use permanent types of housing in lieu of travel trailers and mobile homes, and

(4) FEMA make lump sum payouts and rely on disaster victims to find longer term housing that meets their specific needs.⁷⁹

It appears that these four options have either not been employed or have been employed in hybridized or truncated forms, leaving many victims without relief.

3. The Formidable Barrier of Red Tape

While there are currently many ways for disaster victims to receive housing assistance, access to help is impeded by layers of bureaucratic red tape. Because the process of obtaining disaster housing has proven difficult to navigate both for the agencies offering it and for the individuals in need of it, FEMA distributed the National Disaster Housing Strategy Annexes in 2009. In this publication, FEMA acknowledges the bureaucratic barriers to relief, stating, “Previous disaster housing efforts could have benefited from a better understanding of valuable programs across the entire Federal government spectrum, as opposed to within merely one agency’s authorities.”⁸⁰ This published strategy represents FEMA’s attempt to educate the public about the available disaster housing programs. For instance, the document explains that if housing vouchers are not appropriate in the situation, disaster housing, such as FEMA’s trailers, can be used; the federal government, not the victim, chooses which disaster housing options will be offered after a given disaster.

4. The Trailer Option Has Been Costly

FEMA offers direct assistance in the form of temporary housing units (THUs)—i.e., trailers and RVs—with trailers being the more common option. As previously mentioned, THUs are used if none of the other options are available or are not under the Individuals and Households Program cap of \$34,000. In addition to the space and access

⁷⁹ McCarthy, *FEMA Disaster Housing*, 17.

⁸⁰ FEMA, “National Disaster Housing Strategy Annexes” (report, Department of Homeland Security, January 2009), <https://permanent.access.gpo.gov/lps108007/AnnexesAll.pdf>.

to utilities needed for THUs, there are stringent inside air quality standards for trailers that were put in place after Hurricane Katrina.⁸¹

Trailers are a costly option for FEMA, as the agency is responsible for the creating, moving, setting up, securing, repairing, getting utilities for, removing, storing, and disposing the units. If THUs are set up in a remote location, FEMA must also fund wraparound services such as child care, transportation, health care, counseling, and schools.⁸²

In 2007, Congress mandated that FEMA reorganize and create staff positions for better disaster housing oversight. In June 2009, the Office of Inspector General (OIG) released a report on FEMA's THU program and storage site management. The OIG found that "because FEMA did not have adequate contract controls in place, it overpaid for services, hindered operations and posed potential safety hazards."⁸³ It also found that FEMA needs better oversight of work contracted out to NGOs. The report recommends that FEMA hire a staff of trained personnel to monitor contractors' performance in order to verify that they have met their obligations.⁸⁴

In December 2009, the OIG released another report, "FEMA Temporary Housing Property Management Controls," which mandates that FEMA must keep better records for future disaster housing deployments. An audit of inventory showed that almost half of the products could not be located or had incomplete records. According to the OIG, after creating several new positions to oversee management of this temporary housing,

notwithstanding ... recent initiatives, the agency [FEMA] lacks adequate control over some aspects of its accountable property systems and needs to take corrective action to address the conditions that include inaccurate and

⁸¹ McCarthy, *FEMA Disaster Housing*, 7–8.

⁸² McCarthy, 10.

⁸³ Department of Homeland Security Office of Inspector General (DHS OIG), "Costs Incurred for Rejected Temporary Housing Site," OIG-08-86 (report, Department of Homeland Security, August 2008), 3, https://www.oig.dhs.gov/assets/Mgmt/OIG_08-86_Aug08.pdf.

⁸⁴ DHS OIG, 3.

unreliable data, noncompliance with existing procedures, and the lack of an adequate system to manage temporary housing units.⁸⁵

The OIG made only two recommendations: that FEMA (1) require the storage sites to follow protocol by keeping accurate records and (2) diagnose where there is a dearth of data and implement changes to fill these gaps.⁸⁶

Storing THUs so that they are ready when needed again is an additional expense, so FEMA sells trailers to victims whenever possible. By reducing the number of THUs that are being stored, waiting for a disaster, FEMA saves approximately \$133 million annually on storage costs. In 2010, FEMA was paying storage fees for roughly 120,000 THUs; but if FEMA sells too many THUs rather than keeping them on hand for use in future disasters, the agency may need to purchase more units in the future and may invite price gouging after a disaster.⁸⁷ This is a place where FEMA could do better by looking at other options and expanding its institutional imagination.

In June 2013, the OIG published a report with one recommendation: to eliminate the FEMA trailer as a solution to disaster housing. In this report, the OIG states that if FEMA does not come up with a better disaster housing solution, the increased cost to taxpayers will be \$76 million annually.⁸⁸ Although FEMA agreed with this recommendation, it did not comply. When Hurricane Harvey hit in 2017, FEMA again distributed trailers to the victims, albeit six months after the fact.⁸⁹ In the aftermath of the northern California wildfires, FEMA also recommended sending 2,000 trailers for use as

⁸⁵ DHS OIG, “FEMA Temporary Housing Property Management Controls,” OIG-10-24 (report, Department of Homeland Security, December 2009), 2, https://www.oig.dhs.gov/assets/Mgmt/OIG_10-24_Dec09.pdf.

⁸⁶ DHS OIG, 2.

⁸⁷ McCarthy, *FEMA Disaster Housing*, 7–8.

⁸⁸ DHS OIG, “Unless Modified, FEMA’s Temporary Housing Plans Will Increase Costs by an Estimated \$76 Million Annually,” OIG-13-102 (report, Department of Homeland Security, June 2013), 2, https://www.oig.dhs.gov/assets/Mgmt/2013/OIG_13-102_Jun13.pdf.

⁸⁹ Nick Natario, “First FEMA Trailers Arrive in Houston 6 Months after Harvey,” ABC 13, February 23, 2018, <http://abc13.com/first-fema-trailers-arrive-in-houston-6-months-after-harvey/3130867/>.

temporary housing.⁹⁰ Another OIG report states that FEMA paid \$6 million to construction companies that billed FEMA for the inspection of sites that were not ultimately usable for disaster housing. FEMA acknowledged that it had a problem that needed to be addressed, and created a new position within the agency to oversee inspections and disaster housing.⁹¹

G. SUMMARY

The disaster housing problems described in this chapter—based on the PESTEL factors—are summarized in Table 2.

Table 2. Disaster Housing Problems Based on a PESTEL Analysis

Political	• FEMA has more than one mission • Disaster housing has no constituency • FEMA and HUD have differing goals
Economic	• Poor people rely on disaster housing • Disaster housing is expensive to create and store • Vouchers only work when there is excess housing available • Builders are in short supply
Social	• People who need disaster housing have few resources and need help • Communities are torn apart when there is no available housing, slowing down recovery • People who come to the disaster area to help need housing • Looters need to be kept out
Technological	• Housing is not prepared ahead of time for disasters • Aging infrastructure is fragile and cannot be relied on after a disaster • Disaster housing takes a long time to deploy

⁹⁰ Kasler, “FEMA Might Bring 2000 Trailers”; “FAQ: Manufactured Housing Units (MHUs) and FEMA Group Sites,” FEMA, February 20, 2019, <https://www.fema.gov/news-release/2019/02/20/faq-manufactured-housing-units-mhus-and-fema-group-sites>.

⁹¹ DHS OIG, “Costs Incurred,” i.

Environmental	• Disasters are happening more often • Cities are becoming denser • More people live in dangerous areas • Disaster housing creates huge waste
Legal	• Laws covering disaster housing are complicated • Laws are not implemented consistently • The average person has a difficult time navigating the system to receive aid

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III. FIVE VIGNETTES: LESSONS LEARNED

Each of the five disaster vignettes in this chapter focus on two aspects of the PESTEL analysis. For the Mariel boatlift incident, the research examines the economic and political impacts on the community due to the lack of disaster housing. The vignette for Hurricane Katrina focuses on the social and environmental fallout from the poor planning and execution of disaster housing. For Japan, the research examines the response to the Hanshin earthquake and the triple disaster in Fukushima with a focus on the social and economic impacts of disaster housing solutions. The Puerto Rico vignette illuminates the United States' response to Hurricanes Irma and Maria and the impact of FEMA's disaster housing solutions with regard to the political and technological impacts on the commonwealth. Finally, New Zealand's disaster housing solution is examined during the aftermath of the double earthquakes in Christchurch against the social and legal implications.

A. FLORIDA: THE MARIEL BOATLIFT, 1980—REFUGEE IMPACT ON A REGIONAL HOUSING MARKET

In 1920, roughly 125,000 Cuban refugees arrived in the United States via Cuba's Mariel Harbor over a period of six and a half months; the mass emigration affected Florida's housing market and influenced the local economy as well as local, state, and national politics.⁹² The large number of refugees created a market shock that drove up housing costs substantially, which affected Floridians who lived in the area before the influx of refugees. The Mariel boatlift incident exemplifies problems of the post-disaster relocations on people from urban areas.

The boatlift was triggered by a failing Cuban economy that was apparent through lack of housing and jobs for the people living in Cuba, which increased national tension.⁹³ From April 15 to October 31, 1980, Cuban President Fidel Castro allowed any Cuban who

⁹² "Castro Announces Mariel Boatlift," History.com, accessed March 19, 2019, <https://www.history.com/this-day-in-history/castro-announces-mariel-boatlift>.

⁹³ History.com.

wanted to leave the country to exit from the Cuban port of Mariel. These people boarded boats bound for the United States, most of which landed in Miami, Florida, a mere ninety miles away. Many of the refugees were initially assumed to be criminals, but statistics later revealed that only two percent of Mariel Cubans were criminals under U.S. law. These individuals were not allowed to stay in the United States or were incarcerated.⁹⁴

1. Economic Impact

The sudden influx of a large number of refugees to a small area around Miami strained the communities; low- to mid-range rent costs increased by 8 to 11 percent.⁹⁵ The influx of refugees also forced many people to live in closer quarters or to leave the area, thus changing the makeup of the community in four short years. Experts disagree, however, about the overall economic impact the Mariel boatlift had on the housing and the job markets in Miami. Controversial new data shows that this migration of mostly unskilled workers had an impact on local unskilled workforce wages, which dropped by 10 to 30 percent.⁹⁶ According to Princeton economist David Card, while the influx was initially hard on Miami, in the end it created more wealth for the area.⁹⁷

The federal government was unprepared for the sheer number of people who were desperate to leave Cuba. It did not have any sort of accommodations in place for refugees and fell back on the local government and communities to house them during the intake process. Because of this lack of preparation, refugees were placed in unsuitable living situations for months while awaiting and undergoing processing by the federal government.

⁹⁴ “Mariel Boatlift,” Global Security, accessed March 19, 2019, <https://www.globalsecurity.org/military/ops/mariel-boatlift.htm>.

⁹⁵ Albert Saiz, “Room in the Kitchen for the Melting Pot: Immigration and Rental Prices,” *Review of Economics and Statistics* 85, no. 3 (August 2003): 502–21, <https://www.mitpressjournals.org/doi/abs/10.1162/003465303322369687?journalCode=rest>.

⁹⁶ George J. Borjas, “The Wage Impact of the *Marielitos*: A Reappraisal,” *ILR Review* 70, no. 5 (October 2017): 1077–10, <https://doi.org/10.1177/0019793917692945>.

⁹⁷ David Card, “The Impact of the Mariel Boatlift on the Miami Labor Market,” *Industrial and Labor Relations Review* 43, no. 2 (January 1990): 245.

Volunteers stepped in to help, and donations from local communities helped ease refugees' discomfort and confusion.⁹⁸

There was no way to know the total number of people who would be coming from Cuba. An attempt was made to hold and house refugees in a community center in Miami's Little Havana neighborhood, but the facility quickly filled.⁹⁹ Eventually, refugees were taken to the Orange Bowl Stadium and high-profile tent cities were set up under I-95.¹⁰⁰ After refugees were processed they were released from U.S. oversight, and Miami experienced a 10 percent increase in population in one month. Dade County Manager Merrett Stierheim reached out to President Jimmy Carter for help. Stierheim was referred to the National Security Council, whose members recommended staunching the flow of immigrants by stopping the boats.¹⁰¹

2. Political Impact

"The federal government was totally unprepared," Stierheim said recently; "As a result, local governments really had to step in and relieve the problem."¹⁰² To receive federal assistance, Florida Governor Bob Graham declared a state of emergency in Dade and Monroe counties. Mariel refugees were housed for weeks, sometimes months, in old Navy seaplane hangars while being processed by Immigration and Naturalization Service (INS) agents. Florida was so overwhelmed by refugees that many were shipped out to be put behind locked fences in prisons and military bases in Wisconsin, Pennsylvania, and Arkansas until their cases could be processed. Conditions in one of these holding facilities, Fort Chaffee in Arkansas, were so bad that refugees rioted in protest, and several hundred people walked out through an unmanned gate.¹⁰³ Today, historians cite the handling of the

⁹⁸ Alfonso Chardy, "How Fidel Castro and the Mariel Boatlift Changed Lives and Changed Miami," *Miami Herald*, November 26, 2016, <https://www.miamiherald.com/news/nation-world/world/americas/fidel-castro-en/article117206643.html>.

⁹⁹ Chardy.

¹⁰⁰ Chardy.

¹⁰¹ Chardy.

¹⁰² Chardy.

¹⁰³ Chardy.

Mariel boatlift crisis as one of the key reasons that Jimmy Carter lost his bid for a second term as president of the United States, and it may have cost Arkansas Governor Bill Clinton reelection.¹⁰⁴

The mass migration from Cuba to the United States overwhelmed Florida's resources to house those in the lower economic echelons, and fear and anger polarized the communities trying to cope. To stabilize the inflow, the U.S. government sought to place Mariel refugees in holding facilities until they could be processed by the INS, but this process took months to set up. Thus, it fell to the state of Florida and local communities to absorb the newcomers, which did not make for a welcoming environment for refugees. Locals often viewed immigrants as job and house thieves, and expressed resentment toward them. This, in turn, created resentment from refugees, and local tensions rose as people on the margins of local housing and job markets struggled to survive in a suddenly more competitive environment.¹⁰⁵

3. Summary

Though the Mariel boatlift crisis was caused by political decisions rather than natural forces, preplanning for disaster housing would have made the transition easier both for refugees and locals. The refugees had been held in camps for months while processed, a solution that would not be amenable for U.S. citizens. After refugees were released from the camps, they were not given housing options, which had an impact on the local economy by driving up demand for rentals. Refugees were offered vouchers, but this option was not successful; rent prices were too high for vouchers to be effective and the stock was too low. This housing shortage was compounded by false stories that the refugees were spies, criminals, and mentally ill people being deposited by Cuba on the shores of the United

¹⁰⁴ Andrew Glass, "Castro Launches Mariel Boatlift, April 20, 1980," *POLITICO*, April 20, 2018, <https://www.politico.com/story/2018/04/20/castro-launches-mariel-boatlift-april-20-1980-528819>; Justin Wm. Moyer, "The Forgotten Story of How Refugees Almost Ended Bill Clinton's Career," *Washington Post*, November 17, 2015, https://www.washingtonpost.com/news/morning-mix/wp/2015/11/17/the-forgotten-story-of-how-refugees-almost-ended-bill-clintons-career/?noredirect=on&utm_term=.2ec39c6519ec; "Cuban Refugee Crisis," Encyclopedia of Arkansas History & Culture, last updated March 4, 2019, <http://www.encyclopediaofarkansas.net/encyclopedia/entry-detail.aspx?entryID=4248>.

¹⁰⁵ "Mariel Boatlift," Encyclopedia.com, accessed March 19, 2019, <https://www.encyclopedia.com/humanities/encyclopedias-almanacs-transcripts-and-maps/mariel-boatlift>.

States, reducing further rental options—an example of NIMBY. A generation later, the area around Miami retains a strong Cuban flavor, but the former refugees and their families are Americans, fully integrated into American society.¹⁰⁶

B. NEW ORLEANS: HURRICANE KATRINA, 2005—A PERFECT STORM

Hurricane Katrina. Katrina, a Category 5 storm, slammed into New Orleans and the Gulf Coast in the last week of August 2005, causing approximately \$125 billion in damage and leaving hundreds of thousands of people without shelter. Many government committees and agencies, as well as academics, have researched the successes and failures of disaster housing following Katrina; the issue has also been analyzed and reported on extensively by the news media.

1. Social Impact

Although FEMA spent vast sums of money on disaster housing after the storm, many lingering social issues remain nearly fourteen years after Hurricane Katrina. After the storm, some trailer parks experienced drug and crime problems, and some residents in temporary housing did not feel safe.¹⁰⁷

A disproportionately large percentage of the population using post-disaster housing after Hurricane Katrina was composed of elderly people and people with disabilities. The Uniform Federal Accessibility Standard mandates that 5 percent of disaster housing must be compliant with the Americans with Disabilities Act (ADA), but studies show that more than 5 percent of residents who needed housing after Katrina were disabled.¹⁰⁸ One post-Katrina case study revealed that 43 percent of displaced households included a person with

¹⁰⁶ Neil Conan, “30 Years after the Boatlift,” NPR, July 20, 2010, <https://www.npr.org/templates/story/story.php?storyId=128646441>.

¹⁰⁷ Kathy Lohr, “Drugs and Crime Plague FEMA Trailer Park Residents,” NPR, July 19, 2006, <https://www.npr.org/templates/story/story.php?storyId=5565424>; ABT Associates Inc. and Amy Jones & Associates, “Creating a Safe Harbor after Hurricane Katrina: A Case Study of the Bayou La Batre Alternative Housing Pilot Program” (report, FEMA, August 2009), https://www.fema.gov/pdf/about/programs/ahpp/ahpp_al_case_study.pdf.

¹⁰⁸ ABT Associates Inc. and Amy Jones & Associates, “Creating a Safe Harbor.”

disabilities and 30 percent of these families included someone in a wheelchair.¹⁰⁹ In addition, the Uniform Federal Accessibility Standard was not clear in defining its mandated specifications for ADA compliance.

2. Environmental Impact

In the rush to create disaster housing in the wake of Hurricane Katrina, FEMA purchased 120,000 temporary housing trailers from three vendors. These trailers turned out to be unsafe for habitation, with forty times the allowable limit of formaldehyde, as well as other toxic fumes and mold.¹¹⁰ The Centers for Disease Control and Prevention has spent \$3.4 million to track the health of people who lived in these trailers.¹¹¹ Post-Katrina housing lawsuits abound. In 2012, a class action lawsuit resulted in judgments against the companies that built and installed the formaldehyde-heavy trailers, which were fined \$47.7 million.¹¹² Congress has spent countless hours in hearings and legislative debates discussing the ongoing problems associated with FEMA trailers.

3. Summary

Hurricane Katrina devastated an already impoverished area of the United States. Disaster housing solutions compounded existing socioeconomic problems by destroying communities through relocation and creating an unreasonably high taxpayer bill that did not address the underlying issues of the people who needed assistance. The effects are still being felt nearly fourteen years later. The unfit trailers were put into long-term storage because of their toxicity to humans, where they took up valuable land and caused people nearby the storage sites to fall ill.¹¹³

¹⁰⁹ ABT Associates Inc. and Amy Jones & Associates, “Developing a Disaster Housing Unit.”

¹¹⁰ Heather Smith, “People Are Still Living in FEMA’s Toxic Katrina Trailers—and They Likely Have No Idea,” *Grist*, August 27, 2015, <https://grist.org/politics/people-are-still-living-in-femas-toxic-katrina-trailers-and-they-likely-have-no-idea/>; ABT Associates Inc. and Amy Jones & Associates, “Creating a Safe Harbor.”

¹¹¹ Smith, “FEMA’s Toxic Katrina Trailers.”

¹¹² David Friedman, “Class-Action Suit against FEMA Trailer Manufacturers Settled for \$42.6 Million,” *NBC News*, September 28, 2012, http://investigations.nbcnews.com/_news/2012/09/28/14140222-class-action-suit-against-fema-trailer-manufacturers-settled-for-426-million.

¹¹³ Fessler, “Trailer Graveyards.”

C. JAPAN: 1995 HANSHIN EARTHQUAKE AND 2011 FUKUSHIMA TRIPLE DISASTER—HIT HARD

1. The Great Hanshin Earthquake

In 1995, the magnitude 7.9 Great Hanshin earthquake in Kobe, Japan, left 6,434 people dead. The quake destroyed 104,906 houses, leaving people from 186,175 households without shelter. An additional 144,274 houses were partially damaged, creating 274,182 households in distress. In Kobe's old city center, 192,000 buildings were damaged beyond repair.¹¹⁴

Of those displaced by the earthquake, 100,000 needed disaster housing. The government estimated it would take two months to create 48,000 temporary units consisting of two small rooms, a small kitchen, and a bathroom, with no storage—about the size of a FEMA trailer. Construction ended up taking seven months because it was difficult to procure the materials locally. Although the local government made an effort to place these temporary shelters in open areas close to the victims' homes, the lack of available space in Kobe meant that most of the temporary homes had to be placed far away.

a. *Social Impact*

The structures destroyed by the earthquake were occupied primarily by elderly people, students, working class families, and the poor, with elderly, disabled, and single parents making up 70 percent of that population that needed disaster housing; when they were moved away from the center of Kobe and their community, these individuals became isolated.¹¹⁵ Many had to travel up to two hours to reach services, shops, and community organizations. Social workers who worked with the disaster victims found that giving people housing did not necessarily lead to their recovery. The social connections the victims had lost due to displacement and relocation precipitated a high rate of depression

¹¹⁴ Daniel Kaufmann and Veronika Penciakova, "Japan's Triple Disaster: Governance and the Earthquake, Tsunami and Nuclear Crises," Brookings Institution, March 16, 2011, <https://www.brookings.edu/opinions/japans-triple-disaster-governance-and-the-earthquake-tsunami-and-nuclear-crises/>; Fumio Ohtake et al., "Impacts of the Great Hanshin-Awaji Earthquake on the Labor Market in the Disaster Areas" (academic paper, 2012), 47, https://www.jil.go.jp/english/JLR/documents/2012/JLR36_ohtake.pdf.

¹¹⁵ Cassidy Johnson, "Strategic Planning for Post-disaster Temporary Housing," *Disasters* 31, no. 4 (December 2007): 444, <https://doi.org/10.1111/j.1467-7717.2007.01018.x>.

among the survivors. Many people became depressed because they were no longer part of their social network. Over 200 elderly people died within the first five years in their temporary housing.¹¹⁶

Policies surrounding temporary housing and subsequent moves to permanent housing created a rift in the community; the policies stipulated that displaced persons must first live in shelters before they could qualify for temporary housing. Because no one else was considered for low-income housing, this policy further stressed the social fabric of the community.¹¹⁷

b. Economic Impact

The economic impact of disaster housing following the Great Hanshin earthquake was complicated and long-lasting. People displaced by the earthquake were moved out of the city center to more remote locations, and approximately 100,000 people moved to other areas of Japan. This exodus slowed down recovery by reducing the number of people left in Kobe to rebuild the city.¹¹⁸

Additionally, disaster housing recipients relied on the temporary housing for longer than intended. The law mandated that this housing be used for a maximum of two years; three years after the disaster, however, 45 percent of the units were still inhabited.¹¹⁹ Because temporary disaster housing was located up to two hours away from Kobe, it became challenging for the people to work their jobs and rebuild their businesses. Toshihisa Toyoda of Kobe University notes:

During the initial three years, strong demand-pull effects caused by reconstruction activities are observed, and gains rather than losses are produced in the second year. Surprisingly, after the fourth year, the amount

¹¹⁶ Jeffrey Hays, “Kobe Earthquake of 1995,” Facts and Details, last updated July 2011, <http://factsanddetails.com/japan/cat26/sub160/item863.html>.

¹¹⁷ Johnson, “Strategic Planning,” 444.

¹¹⁸ George Horwich, “Economic Lessons of the Kobe Earthquake,” *Economic Development and Cultural Change* 48, no. 3 (April 2000): 521–542, 523, https://www.jstor.org/stable/10.1086/452609?seq=3#metadata_info_tab_contents.

¹¹⁹ Johnson, “Strategic Planning,” 444.

of flow losses became worse and worse, recording the bottom loss in 2003, the 10th year after the quake.¹²⁰

Researchers also discovered that in the years after the earthquake, part-time and full-time jobs went unfilled due to a labor supply shortage. This economic downturn after an initial increase due to reconstruction is thought to be attributable to the fact that so many people left on their own or were removed from their homes and businesses in the center of Kobe. When fewer people live in the area, recovery is slower.¹²¹

2. The Triple Disaster

Sixteen years after the Great Hanshin earthquake, Japan suffered another crisis that required extensive disaster housing. On March 11, 2011, Fukushima, Japan, was hit by a 9.0 earthquake, a 128-foot tsunami, and the largest nuclear generator meltdown in the country's history. These disasters are collectively known as the triple disaster, with a death toll of around 19,000.¹²² After the disaster, 110,000 people needed housing. To respond to this crisis, about 53,000 prefabricated housing units were built under the same 1947 law as the units used following the Great Hanshin earthquake. The law mandated that living quarters not exceed 30 square meters (323 square feet) and be used for a maximum of two years.

a. Social Impact

Five years after the Fukushima disaster, 35,000 people still considered their temporary units home. Unlike Kobe, a modern city where the government was able to procure at least some vacant units to house displaced victims, in rural Fukushima there was scant opportunity to find any vacant units, and most victims who needed housing had to

¹²⁰ Toshihisa Toyoda, "Economic Impacts of Kobe Earthquake: A Quantitative Evaluation after 13 Years," *Proceedings of the 5th International Conference on Information Systems for Crisis Response and Management* (May 2008): 616, https://www.researchgate.net/publication/269621621_Economic_Impacts_of_Kobe_Earthquake_A_Quantitative_Evaluation_after_13_Years.

¹²¹ Toyoda.

¹²² Elise Hu, "5 Years after Japan Disaster, 'Temporary' Housing Is Feeling Permanent," NPR, March 11, 2016, <https://www.npr.org/sections/parallels/2016/03/11/469857023/5-years-after-japan-disasters-temporary-housing-is-feeling-permanent>.

relocate further out. Due to the erosion of coastal land from the tsunami and the contamination of land from the nuclear meltdown, prefab structures were created elsewhere to house entire communities. Exacerbating the problem of creating new, permanent homes for people, many builders were working to prepare Japan for the 2020 Olympics and were unable to assist with the building of permanent homes in this region.¹²³

Also slowing down the recovery process was the attempt to create a cohesive plan for each town, prefecture, and the region as a whole due to laws mandating that decisions be made by the governor of each township. Governors need input from constituents to do this, and many residents no longer lived in the area or were unwilling to return to the area due to health concerns, which added to the difficulty of creating a legally viable plan.

After the triple disaster, the social fabric of the community was damaged when residents were relocated. No longer living near each other, families and communities were torn apart, further slowing recovery efforts and raising new concerns.¹²⁴ If only 50 percent of residents return to their old homes after a disaster, for example, these residents will again be isolated.¹²⁵

Addressing the reality that people had grown reluctant to move out of temporary housing, the Japanese government put a time limit on how long people who were displaced could continue to receive funding while living somewhere other than the original site of the disaster. The government made funding contingent on residents returning to the area. Those affected were frustrated and confused because only designated areas were being rehabilitated; also, some past residents felt that the government was rushing the cleanup process and did not trust that they could remain healthy if they returned to their old homes. Additionally, the seawall in and around Fukushima needed to be repaired and strengthened, and it will take another forty years to dismantle dismantling the power plant.¹²⁶

¹²³ Philip Brator and Masako Tsubuku, "Temporary Disaster Housing Has an Unforeseen Permanence," *Japan Times*, April 2, 2017, https://www.japantimes.co.jp/community/2017/04/02/how-tos/temporary-disaster-housing-unforeseen-permanence/#.W3SPD_5KjOR.

¹²⁴ Brator and Tsubuku.

¹²⁵ Hu, "5 Years after Japan Disaster."

¹²⁶ Brator and Tsubuku, "Temporary Disaster Housing."

The majority of people still residing in short-term disaster housing are elderly. Since many do not intend to return to their old homes, they are forced to cope with isolation from family and community, cramped quarters, no storage, lack of insulation, and the mold and condensation that these disaster houses offer.¹²⁷ As noted in the *International Journal of Environmental Research and Public Health*:

[The evacuees'] mental health status had also been affected by loss of employment and/or community ties due to the nuclear disaster and residential relocation with consequent drastic changes in their living circumstances.¹²⁸

Even though the government helped move people away from the disaster, the social ramifications are far-reaching. Four years after the triple disaster, roughly 3,200 people had died from illnesses exacerbated by the event, or from suicide. Only 15 percent of the needed 29,000 permanent homes have been rebuilt.¹²⁹

b. Economic Impact

After the triple disaster, 154,000 people were resettled away from the damage so the area could be cleaned up and rebuilt; within this cohort, 81,000 were mandated to leave and 73,000 left voluntarily.¹³⁰ Due to the dangers of radiation, there were no longer people living at or near ground zero in Fukushima, and many workers had to be hired from other

¹²⁷ Brasor and Tsubuku.

¹²⁸ Masatsugu Orui et al., "Mental Health Recovery of Evacuees and Residents from the Fukushima Daiichi Nuclear Power Plant Accident after Seven Years—Contribution of Social Network and a Desirable Lifestyle," *International Journal of Environmental Research and Public Health* 15, no. 11 (October 2018), <https://doi.org/10.3990/ijerph15112381>.

¹²⁹ Justin McCurry, "Fukushima Evacuees Face 'Forced' Return as Subsidies Withdrawn," *Guardian*, March 10, 2017, <https://www.theguardian.com/world/2017/mar/10/japan-fukushima-nuclear-disaster-evacuees-forced-return-home-radiation>.

¹³⁰ Shingo Nagamatsu and Akiko Ono, "Job Creation after Catastrophic Events: Lessons from the Emergency Job Creation Program after the 2011 Great East Japan Earthquake" (academic paper, The Japan Institute for Labour Policy and Training, 2013), 113, https://www.jil.go.jp/english/JLR/documents/2017/JLR53_nagamatsu_ono.pdf.

areas. According to Reuters, when people are imported for work their wages can be skimmed by up to 50 percent by the contracting agency.¹³¹

An estimated 140,000 to 200,000 people—mostly farmers, fishermen, and self-employed persons—lost their jobs because of the triple disaster.¹³² Five years later, nearly 60,000 people were still living in temporary housing, away from their former homes and communities.¹³³ Twenty-five percent of available jobs near Fukushima go unfilled. Women and children, who are at the biggest risk from radiation, have moved away from the area while the husbands and fathers who stayed behind struggle to support two households.¹³⁴ One study looking at Japan's program to hire locals to rebuild the communities hit by the triple disaster noted,

The catastrophic damage to the fishing and marine product industry in Minamisanriku meant that large numbers of people immediately lost their means of making a living. If people move away from a town even temporarily in search of work, they may not necessarily return, even if the town's infrastructure is restored. Once the people are gone, the town will not be able to maintain its industry and will go into decline. Minamisanriku therefore needed a means of maintaining its residents' livelihoods until it had recovered.¹³⁵

This study points to the fact that moving communities into disaster housing away from their former homes has lasting effects on the economy and reduces the chances for the area to recover once it is rebuilt.

The Japanese government did offer another solution that was employed after the 1995 Hanshin earthquake: using existing vacant rental units to house evacuees, with the government paying the rent. While this solution was successful in Kobe, it had mixed results in the area around Fukushima. The vacant unit rental system in Kobe was useful

¹³¹ Antoni Slodkowschi and Mari Saito, "Help Wanted in Fukushima: Low Pay, High Risks and Gangsters," *Scientific American*, October 12, 2012, <https://www.scientificamerican.com/article/special-report-help-wanted-in-fukushima-crime/>.

¹³² Nagamatsu and Ono, "Job Creation after Catastrophic Events," 113.

¹³³ Hu, "5 years after Japan Disaster."

¹³⁴ McCurry, "Fukushima Evacuees."

¹³⁵ Nagamatsu and Ono, "Job Creation after Catastrophic Events," 117.

because people were able to live in apartments of normal size, with insulation and standard comforts. However, because it separated families and communities and the units were not necessarily close to where people had lost their homes, this solution also presented problems.¹³⁶ Impediments to wider use of this post-disaster housing solution include a cap of 100,000 yen a month for a family of five or more, and 75,000 yen for a family of four or fewer. If a disaster were to hit high-rent Tokyo, these parameters would only allow for a one-bedroom apartment. There are not enough vacant units within this price range to accommodate potential survivor needs if a 7.3 earthquake were to hit Tokyo. The law also does not consider that people might potentially be interested in self-subsidizing partial rents to receive a larger apartment, so this option is not currently available. When interviewed, a representative of disaster housing in Japan stated that there was no interest in modifying the law because doing so would encourage people to continue to live longer in what is supposed to be temporary housing.¹³⁷ The eighteen-month limit for temporary disaster housing is the same as in the United States.

3. Summary

Well-intentioned laws can have unintended consequences, such as a time limit on temporary housing that is not realistic or a structure that is too small for comfortable living. Japan also struggled to keep communities together to reduce the social devastation. As a result of moving entire communities, economic recovery was stunted.

D. PUERTO RICO: HURRICANES IRMA AND MARIA, 2017—DEVASTATED ISLAND

Puerto Rico is unique in the United States. Comprising 3,500 square miles of land located 1,000 miles off of the Florida coast, Puerto Rico is not a state but rather a commonwealth of the United States. This means that while Puerto Rico is a part of the United States and the 3.3 million people who live there are U.S. citizens, they cannot vote

¹³⁶ Elizabeth Maly and Yoshimitsu Shiozaki, “Towards a Policy that Supports People-Centered Housing Recovery—Learning from Housing Reconstruction after the Hanshin-Awaji Earthquake in Kobe, Japan,” *International Journals of Disaster Risk Science* 3, no. 1 (March 2012): 58.

¹³⁷ Brasor and Tsubuku, “Temporary disaster Housing.”

in U.S. presidential elections and have no representation in either the House of Representatives or the Senate. Puerto Ricans do vote for their governor and have a non-voting representative in the House. As citizens of the United States, Puerto Ricans can freely move between the United States and Puerto Rico..¹³⁸

In the fall of 2017, two powerful back-to-back hurricanes slammed into Puerto Rico, causing massive damage to an already poverty-stricken island. The first, Hurricane Irma, hit the Caribbean as a Category 5 hurricane from August 30 through September 13, 2017, and reached Puerto Rico on September 6. It was the fifth most costly hurricane to hit the United States, with sustained winds of 185 miles per hour that went on for thirty-seven hours.¹³⁹ This hurricane sideswiped Puerto Rico, killing four people immediately and cutting power to about 1 million. About 34 percent of the population lost access to clean water.¹⁴⁰

The second storm, Hurricane Maria, battered the Caribbean and surrounding areas from September 16 through October 2, 2017. This hurricane hit Puerto Rico directly on September 20 and reportedly caused 2,975 deaths. Hurricane Maria, a Category 4, was the strongest to hit Puerto Rico in eighty-five years.¹⁴¹ It caused approximately \$100 billion in damages, leaving 62,000 people without power seven months later. As many as 300,000 homes sustained significant damage.¹⁴²

¹³⁸ “Welcome to Puerto Rico,” accessed March 19, 2019, <http://welcome.topuertorico.org/>.

¹³⁹ Brandon Miller, “All the Records Irma Has Already Broken—and Other Jaw-Dropping Stats,” CNN, September 10, 2017, <https://www.cnn.com/2017/09/10/us/irma-facts-record-numbers-trnd/index.html>.

¹⁴⁰ Alex Johnson et al., “Hurricane Irma Skirts Puerto Rico, Leaves 1 Million without Power,” NBC News, September 7, 2017, <https://www.nbcnews.com/storyline/hurricane-irma/hurricane-irma-skirts-puerto-rico-lashing-it-powerful-winds-flooding-n799086>.

¹⁴¹ David Brindley, “Months after Hurricane Maria, Puerto Rico Still Struggling,” *National Geographic*, July 2018, <https://www.nationalgeographic.com/magazine/2018/03/puerto-rico-after-hurricane-maria-dispatches/>.

¹⁴² Andres Viglucci, “Half of Puerto Rico’s Housing Was Built Illegally. Then Came Hurricane Maria,” *Miami Herald*, February 14, 2018, <http://www.miamiherald.com/news/nation-world/world/americas/article199948699.html>.

1. Political Impact

Because Puerto Rico has no vote in Washington, it is unable to exert political pressure to receive the same aid that is given to people on the mainland. And because Puerto Rico is not a state, its citizens do not have the same socioeconomic standing as their counterparts on the mainland. Due to U.S. shipping laws, Puerto Ricans pay more for international goods than people on the mainland. As noted by CNN, “Because over a century after becoming property of the United States, they have no choice but to scrape by—a Caribbean colony, paying taxes without representation in Congress and voting only in presidential primaries.”¹⁴³ Governor Ricardo Rosselló laments, “In terms of the response, in terms of the unnecessary bureaucracy, in terms of the lack of urgency, for example, of the Corps of Engineers, it is likely that being an American territory and being second-class citizens is playing a huge role.”¹⁴⁴

Most of the bureaucratic problems facing Puerto Rico after Hurricanes Irma and Maria had also been documented after Hurricane Katrina, but subsequent FEMA housing deployment problems continue to plague those in need of disaster housing.¹⁴⁵ In 2018 FEMA made strides to provide housing in Puerto Rico. According to the FEMA website, the Temporary Shelter Assistance (TSA) program funded 7,000 families in over 1,000 hotels in forty-one states, Washington, DC, and Puerto Rico.¹⁴⁶ The TSA option became available to Puerto Ricans a month and a half after hurricanes Maria and Irma hit.¹⁴⁷ But a key feature of the TSA program is that it only lasts six months, after which many

¹⁴³ Bill Weir, “How the U.S. Turned Hurricane Maria from a Natural Disaster to a Man-made Catastrophe,” CNN, September 21, 2018, <https://www.cnn.com/2018/09/21/us/puerto-rico-hurricane-maria-natural-disaster-human-catastrophe-weir/index.html>.

¹⁴⁴ Weir.

¹⁴⁵ “Disaster Recovery Priorities,” National Low Income Housing Coalition, March 8, 2018, https://nlihc.org/sites/default/files/Disaster-Recovery-Priorities-for-FY18-Spending-Bills_022818.pdf; Susan Fowler, “Hurricane Irma: One Year Later,” Direct Relief, September 5, 2018, <https://www.directrelief.org/2018/09/hurricane-irma-one-year-later/>.

¹⁴⁶ “Hurricane Maria,” FEMA, last updated March 15, 2019, <https://www.fema.gov/hurricane-maria>.

¹⁴⁷ “Temporary Shelter Assistance and Other Housing Options Provided to Residents of Puerto Rico,” National Low Income Housing Coalition, November 6, 2017, <https://nlihc.org/article/temporary-shelter-assistance-and-other-housing-options-provided-residents-puerto-ric>.

survivors have no choice but to couch surf, sleep in their cars, and otherwise seek shelter in places they would not normally live.

The U.S. government has allotted \$717 million for housing assistance in Puerto Rico. This may seem like extensive aid, but *New York Times* reporters who went to Punta Santiago, Puerto Rico, one year after Hurricane Maria's landfall found that while middle class neighborhoods were mostly back to normal, poorer neighborhoods have not been restored. Many of the 163 homes toured by the *Times* reporters show signs of devastation, with black mold, no roofs, no electricity, no running water, and no aid coming in the near future from FEMA or anywhere else. FEMA claims that its presence in Puerto Rico is intended as a leg up, not to restore properties to pre-disaster standards. This is understandable but impractical; only 15 percent of Puerto Rican survivors had homeowner's insurance, and only 3 percent had flood insurance. Part of the problem for FEMA stems from the lack of clear land ownership for many Puerto Ricans. Without a clear title, FEMA will not give survivors aid for house repairs. Many survivors have had a hard time locating the documentation they need to qualify for FEMA aid amid the ruins of their homes.¹⁴⁸ Also, because of the way property is passed down from family members, sometimes paperwork is incomplete or lost. This may be because Puerto Rico is a commonwealth and not a state and used to be under Spanish rule. Currently, Governor Rosselló is pushing to grant 48,000 squatters the deeds to their properties at an estimated cost of \$30 million, creating political tension with the federal government.¹⁴⁹

Of the 1.1 million households that requested FEMA aid, 754,336 houses were inspected and 138,572 households received grants for repairs. Two-thirds of those that received grants received less than \$3,000. Only 3,300 people—1 percent of the population—received the maximum grant of \$33,000.¹⁵⁰ To compare Puerto Rico's response from FEMA with the response in Texas after Harvey, nine days after the Harvey,

¹⁴⁸ Frances Robles and Jugal K. Patel, "Puerto Rico's Ruins," *New York Times*, September 20, 2018, <https://www.nytimes.com/interactive/2018/09/20/us/puerto-rico-hurricane-maria-housing.html>.

¹⁴⁹ Lorraine Woellert, "'We Have a Big Problem': Puerto Rico Seeks Aid for Tens of Thousands of Squatters," *POLITICO*, December 31, 2017, <https://www.politico.com/story/2017/12/31/puerto-rico-squatters-hurricane-261495>.

¹⁵⁰ Robles and Patel, "Puerto Rico's Ruins."

FEMA had approved \$141.8 million in individual assistance to Texas victims on the mainland; the amount for victims of Maria in Puerto Rico was just \$6.2 million.¹⁵¹ The median grant given to Puerto Rico for repairs was \$1,800, compared to the median of \$9,127 given to survivors of Harvey in Texas. In total, victims of Hurricane Harvey received twice as much help as victims of Hurricane Maria.¹⁵²

FEMA stated that Maria victims did not need Disaster Housing Assistance Program (DHAP), the program that helps the lowest income survivors with longer-term solutions.¹⁵³ This was an unprecedented decision, but FEMA deemed that DHAP was unnecessary and inefficient for victims in Puerto Rico, although the governor of Puerto Rico and many others had advocated for it.¹⁵⁴ The dire difference between FEMA dollars spent in response to hurricanes Harvey, Irma, and Maria points to the fact that, without political clout in Washington, DC, the needs of all American citizens are not taken seriously. This made disaster response much harder for those in Puerto Rico, especially after disastrous storms in Texas and Florida, states with strong political clout in Washington, because all three disaster sites were competing for the same funding.

As President Donald Trump mentioned, “Puerto Rico is an island surrounded by big water.”¹⁵⁵ This geography has compounded disaster relief by driving up transportation costs and slowing down recovery. Another political issue slowing down recovery is the Jones Act of 1920, which mandates that all goods shipped between U.S. ports must be shipped on American ships. International ships must offload cargo on the U.S. mainland and then goods must be reloaded on U.S. ships to go to any U.S. island, including Puerto Rico and Hawaii, thus driving up costs of goods. While the Jones Act was waived for a

¹⁵¹ Jared Keller, “The Real Cost of Trump’s Negligence in Puerto Rico,” *Pacific Standard*, May 31, 2018, <https://psmag.com/news/the-real-cost-of-trumps-negligence-in-puerto-rico>.

¹⁵² Robles and Patel, “Puerto Rico’s Ruins.”

¹⁵³ National Low Income Housing Coalition, “Setting the Record Straight.”

¹⁵⁴ “Myth and Fact: HUD’s Disaster Housing Assistance Program Is Necessary,” FEMA, September 19, 2018, <https://www.fema.gov/media-library/assets/images/170563>.

¹⁵⁵ Emily Shugerman, “Donald Trump Says Puerto Rico Is ‘an Island Surrounded by Big Water,’” *Independent*, September 29, 2017, <https://www.independent.co.uk/news/world/americas/us-politics/donald-trump-puerto-rico-hurricane-maria-comments-island-big-water-a7975011.html>.

limited time due to political pressure after the hurricanes struck Puerto Rico, it is once again in place, and there is no bill being considered to repeal this nearly 100-year-old law. Without representation in DC for Puerto Rico, this issue is unlikely to be addressed.¹⁵⁶

2. Technological Impact

Technological challenges in Puerto Rico after Maria and Irma were complicated and exacerbated by widespread poverty. However, amazing ingenuity and creativity did help some victims. For example, Carlos Ocasio and Pablo Perez Medina created a communications solution, and Jesse Levin created an innovative point-of-sale mechanism that enabled grocery stores in Puerto Rico sell needed food.¹⁵⁷ But there was no power on the island for many months, and the main cross-island road was so damaged that getting from one side of the island to the other, a trip that used to take three hours, took three days. As William Villafane, chief of staff to the governor of Puerto Rico, told NPR, “We are without power, without water service. No hospital has power service. Our streets are all—you just can’t go through. When you go through and you have to literally take out the trees that are on the streets—it’s the worst hurricane ever.”¹⁵⁸

FEMA cannot address disaster housing needs without a functioning infrastructure. No power in Puerto Rico meant no running water, no cell service, and no refrigeration.¹⁵⁹ Sewage treatment also requires power. Without a working power grid, fishermen could not

¹⁵⁶ Niraj Chokshi, “Would Repealing the Jones Act Help Puerto Rico?,” *New York Times*, October 24, 2017, <https://www.nytimes.com/2017/10/24/us/jones-act-puerto-rico.html>.

¹⁵⁷ Caitlin Dickerson, “Stranded by Maria, Puerto Ricans Get Creative to Survive,” *New York Times*, October 16, 2017, https://www.nytimes.com/2017/10/16/us/hurricane-maria-puerto-rico-stranded.html?ref=collection%2Fbyline%2Fcaitlin-dickerson&action=click&contentCollection=undefined®ion=stream&module=stream_unit&version=search&contentPlacement=1&pgtype=collection; Andy Isaacson, “How Entrepreneurship Is Helping to Save Puerto Rico,” *Entrepreneur*, March 29, 2018, <https://www.entrepreneur.com/article/310161>; Karen Hao, “Hurricane Maria Has Made Puerto Rico a Testbed for New Technology,” *Quartz*, December 12, 2017, <https://qz.com/1148127/hurricane-maria-has-made-puerto-rico-a-testbed-for-new-technology/>.

¹⁵⁸ Laurel Wamsley, “Puerto Rico’s Weak Infrastructure Creates Big Challenges for Recovery,” NPR, September 22, 2017, <https://www.npr.org/sections/thetwo-way/2017/09/22/552990598/puerto-rico-s-weak-infrastructure-creates-big-challenges-for-recovery>.

¹⁵⁹ Brindley, “Months after Hurricane Maria.”

refrigerate their catch, endangering their means of livelihood and adding to the difficulty of paying for repairs to their homes.¹⁶⁰

It was difficult for FEMA to find disaster housing solutions when two of its options—finding available local rentals and FEMA trailers—were not viable. The first option, finding available local rentals, is predicated on the availability of vacant rental housing stock, which had all been destroyed in the hurricanes; the second, deploying FEMA trailers, requires a working infrastructure. Both were lacking after the hurricanes. To address the issue of temporary housing, FEMA distributed 170,000 tarps to be used as a temporary “blue roof” housing solution; as of 2019, many residents still have tarps as roofs.¹⁶¹ These tarps were intended for people to install themselves, but 70,000 people signed up for installation by the Army Corp of Engineers, which created a huge backlog.¹⁶²

When Hurricane Maria hit Puerto Rico, more than 44 percent of the population lived below the poverty level, leaving them with no financial safety net. Per government officials, more than 1 million dwellings had been built or modified without permits, creating circumstances that exacerbated Maria’s devastation.¹⁶³ The U.S. government has spent \$3 billion dollars repairing homes in Puerto Rico, but did not take into consideration the abject poverty of much of the population as well as unclear titles to homes, factors that have slowed down the rebuild. On the lack of rehabilitation of many homes in Puerto Rico, the *New York Times* notes that, “even after years of responding to devastating storms, the federal government struggles to help get people back in functioning homes after a natural disaster.”¹⁶⁴

The United States has put billions into Puerto Rico’s power grid, but reports state that another hurricane could knock it out again.¹⁶⁵ Some of those billions disappeared into

¹⁶⁰ Brindley.

¹⁶¹ Robles and Patel, “Puerto Rico’s Ruins.”

¹⁶² Weir, “Hurricane Maria.”

¹⁶³ Viglucchi, “Half of Puerto Rico’s Housing.”

¹⁶⁴ Robles and Patel, “Puerto Rico’s Ruins.”

¹⁶⁵ Andres Viglucchi, “Puerto Rico: The Forgotten Island,” *Miami Herald*, accessed March 19, 2019, <https://www.miamiherald.com/news/nation-world/national/article217659345.html>.

the \$300,000 given to Whitefish Energy, a tiny—with only two listed employees—but politically connected firm based in Montana that was hired to rebuild the grid; Whitefish Energy was fired soon after arriving in Puerto Rico and the media revealed its connection to DC.¹⁶⁶ The Army Corp of Engineers was then tasked with rebuilding the devastated grid, an undertaking previously outside its purview.¹⁶⁷

Additionally, due to broken water pipes and limited availability of bottled water during the first months after the disasters, many people drank tainted water. Illnesses and deaths due to leptospirosis spiked. The outbreak compounded deaths in hospitals, where doctors and other health-care professionals worked in the dark and under unsanitary conditions. With limited fuel for generators, doctors were forced to choose which patients could stay on ventilators and dialysis machines, increasing deaths by 1,000 people a month when compared to pre-hurricane totals. According to a recent study by George Washington University, lack of power effectively increased the hurricane-attributable death toll from the originally published 64 deaths to 2,975.¹⁶⁸

3. Summary

Disaster housing requires working infrastructure to function. After the hurricanes, Puerto Rico did not have electricity, internet, water, or usable roads. Much of Puerto Rico's housing stock was subpar to begin with. The island's devastation was compounded by a lack of political clout in DC, which had been cumulative since the island became a U.S. commonwealth. This lack of political influence translated into less federal funding, so that the infrastructure was not improved over time. Without this influx of funding, Puerto Rico's fragile infrastructure was destroyed, along with most of its housing, when the two hurricanes hit. FEMA's response was to give the victims vouchers for hotels, which under federal law only last for six months. The problem was that people with destroyed homes needed financial assistance to repair their homes, not to stay in a hotel. Puerto Rico also direly needed to have its infrastructure modernized using technological advances. Without

¹⁶⁶ Weir, "Hurricane Maria."

¹⁶⁷ Weir.

¹⁶⁸ Weir.

representation, this constituency is essentially powerless to improve its situation by political means.

E. NEW ZEALAND: TWO EARTHQUAKES, 2010 AND 2011—BUILDING CODES NOT STRONG ENOUGH

New Zealand is still coping with the effects of two earthquakes in Christchurch, one on September 4, 2010 (7.1 on the Richter scale), and another on February 22, 2011 (6.3 on the Richter scale). These quakes damaged 10,000 homes and businesses. Seventy thousand people, or one-fifth the population of Christchurch, were displaced at least temporarily as a result of these disasters.¹⁶⁹

1. Legal Impact

The city of Christchurch had tried to prepare for earthquakes by implementing modern building codes, which proved to be inadequate. A member of the Christchurch City Council noted, “Even technologically advanced countries with modern building codes are not immune from earthquake disasters. The Christchurch earthquake carried an additional message: Urban devastation can be triggered even by moderate-sized earthquakes.”¹⁷⁰ Although the second earthquake was weaker on the Richter scale, the devastation it caused was much more severe because the epicenter of the earthquake was nearer to the city and closer to the surface.¹⁷¹

2. Social Impact

New Zealand was not prepared for the devastation of these two earthquakes. The disaster housing response was heavily reliant on insurance companies, faith-based groups, and the Red Cross and other NGOs. The New Zealand government’s role was to provide

¹⁶⁹ Sonia Giovinazzi et al., “Assessing Temporary Housing Needs and Issues Following the Darfield and Christchurch Earthquake, New Zealand,” paper presented at the 15th World Conferences on Earthquake Engineering, Lisbon, Portugal, September 24–28, 2012, 4, https://www.iitk.ac.in/nicee/wcee/article/WCEE2012_5417.pdf.

¹⁷⁰ Cecile Meier, “Christchurch City Council Considers Cutbacks to Red Zone Services,” Stuff, August 24, 2015, <https://www.stuff.co.nz/national/71366873/christchurch-city-council-considers-cutbacks-to-red-zone-services>.

¹⁷¹ Giovinazzi et al., “Assessing Temporary Housing Needs,” 4.

shelter to those relatively few people who were not assisted by the aforementioned groups. Scholars who study the effects of the Christchurch earthquakes note that most people displaced by the earthquakes found shelter in the homes of friends or families, and in hotels and motels. Governmental shelters were in operation, but the government did not offer other, longer-term housing options.¹⁷²

Because the government of New Zealand had not been adequately prepared or organized, it needed to create additional governmental work groups after the first earthquake to find a hybrid housing solution that could last between two weeks and six months. These groups investigated longer-term solutions that were both self-contained and transportable, in the form of campers (trailers). In addition, temporary accommodations that would not normally have been allowed by city code were permitted by the Christchurch City Council to house the influx of construction workers and builders during recovery. The New Zealand Department of Building and Housing requested 2,500 modular units, and hundreds of campers were purchased as an interim measure until modular homes could be acquired. The department found four sites for “villages” in the suburbs of Christchurch in which to situate these modular homes. Once the villages were set up, the government had a hard time filling them and, as a result, only three villages were populated.¹⁷³

In 2014, the Office of the Minister for Social Development (MSD) studied the population still displaced by the earthquakes three years after the fact and made recommendations to improve future disaster response. The MSD determined that the root causes of the increase in displaced persons were a reduction in low-cost housing, and the influx of workers to assist with the rebuilding.¹⁷⁴ Because disaster victims who had personal resources did not rely on the government, NGOs, or faith-based groups for aid, the people who did need help were at-risk groups, including people who were impoverished, disabled, or addicted. To better serve these at-risk groups, the MSD

¹⁷² Giovinazzi et al., 3.

¹⁷³ Giovinazzi et al., 9.

¹⁷⁴ Giovinazzi et al., 7.

investigated ways to alleviate the increased homelessness problem that resulted from the earthquakes. The office found that it needed to rent motels for at-risk populations such as families or people with disabilities, mental health issues, and addictions to provide the modicum of stability needed to jump-start the recovery process and allow these populations to become self-sufficient. MSD proposed a six-step transition approach, which included wraparound services (social services) such as budgeting, counseling, advocacy, and employment so that the housing gains made for the at-risk population could be sustained.¹⁷⁵

3. Summary

The people of Christchurch were surprised by the effects of the earthquakes on their modern buildings. They had expected their building codes to protect them from the resulting devastation. After finding out that their buildings would remain vulnerable, they investigated ways to reduce the number of victims needing government resources in the future. They found that poor people and workers coming to the area needed housing but wanted housing that was convenient to city services, not in the suburbs. By proactively addressing the issue of homelessness, they discovered that the number of disaster victims who needed federal aid could be reduced in the future.

F. SUMMARY

The disaster housing problems described for each of the vignettes in this chapter—based on the PESTEL factors—are summarized in Table 3. While the chapter focused on only two factors of PESTEL for each vignette, other common disaster housing problems emerged that have been added in the appropriate categories in Table 3.

¹⁷⁵ “Short-Term Housing Response in Christchurch,” New Zealand Ministry of Social Development, accessed March 19, 2019, 3, <http://www.msd.govt.nz/documents/about-msd-and-our-work/work-programmes/social-housing/background-documents-shrp/2016/doc-2-cabinet-paper-short-term-housing-response-in-christchurch.pdf>.

Table 3. Past Disaster Housing Responses Based on Partial PESTEL Analysis

	Mariel Boatlift (Florida)	Katrina (Louisiana)	Japan	Puerto Rico	New Zealand
Political	NIMBY made it hard for refugees to find available housing	NIMBY made it hard to place trailers in neighborhoods	<i>Factor not studied for this vignette</i>	As a commonwealth, Puerto Rico has very little to advocate for disaster housing aid	The homelessness issue compounded the disaster
Economic	Vouchers did not cover rental cost, no rental stock available	Trailers were extremely expensive to create and store	As a result of moving communities, economic recovery was slowed substantially	<i>Factor not studied for this vignette</i>	Leaving only a few people in devastated areas slowed recovery
Social	Tension between locals and refugees	Communities were torn apart, reducing recovery	Communities were moved and separated, damaging the social fabric	<i>Factor not studied for this vignette</i>	People need housing near services and employment
Technological	<i>Factor not studied for this vignette</i>	The trailers were toxic	<i>Factor not studied for this vignette</i>	Infrastructure was devastated, making disaster housing difficult to set up	<i>Factor not studied for this vignette</i>
Environmental	<i>Factor not studied for this vignette</i>	Trailers were designed for one-time use and contributed to landfill	<i>Factor not studied for this vignette</i>	<i>Factor not studied for this vignette</i>	<i>Factor not studied for this vignette</i>

	Mariel Boatlift (Florida)	Katrina (Louisiana)	Japan	Puerto Rico	New Zealand
Legal	Long processing period, due to numbers, meant refugees had to stay in camps	<i>Factor not studied for this vignette</i>	Laws did not allow for people to stay in homes or create better temporary homes	Difficult for victims to prove homeownership, reducing the amount of aid they could receive	Building codes did not create durable buildings

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IV. SOLUTIONS TO DISASTER HOUSING PROBLEMS FROM THE LITERATURE

This chapter, using the PESTEL framework, focuses on research from around the world that addresses solutions to disaster housing. While there are specific disaster housing solutions, no universal solution has been created. In *Procedia Engineering*, Daniel V. Perrucci, Bianca A. Vazquez, and Can B. Aktas note that no perfect form of temporary post-disaster shelter has yet been devised. The authors recognize that, “To date, an engineered solution to the problem that is low-cost, quick to construct, environmentally and socially sustainable, takes into account the needs of the occupant, and accounts for local climatic conditions has not been found.”¹⁷⁶ However, the researchers discussed in the following sections have found a way to balance the PESTEL factors—political, economic, social, technological, environmental, and legal—discussed in the previous chapters.

A. POLITICAL FACTORS

The National Low-Income Housing Coalition (NLIHC) has put forth policy recommendations that bolster FEMA’s responses to natural disasters and that would improve the government’s response efforts for those who need it most: the elderly, disabled, and poor. For instance, the NLIHC believes FEMA should partner with other federal agencies before a disaster to ensure there are no gaps or overlaps in areas of responsibility and to increase the speed of response to victims with the greatest need after a disaster.¹⁷⁷ The NLIHC recommends creating a clearer path for victims to receive aid from HUD and advocates for more pre-need planning. The NLIHC plan would create better solutions to disaster housing, but political pressure must be exerted to implement recommendations ahead of a disaster.

¹⁷⁶ Daniel V. Perrucci, Bianca A. Vazquez, and Can B. Aktas, “Sustainable Temporary Housing: Global Trends and Outlook,” *Procedia Engineering* 145 (2016): 327, <https://www.sciencedirect.com/science/article/pii/S187770581630087X?via%3DiHub>.

¹⁷⁷ “Federal Emergency Management Agency Disaster Recovery Policy Recommendations,” National Low Income Housing Coalition, September 12, 2018, <https://nlihc.org/sites/default/files/FEMA-Disaster-Recovery-Recommendations.pdf>.

Another possible solution is one that FEMA employed in Guam after an earthquake and flooding in 2009. A rarely implemented law, discussed in Chapter II, allowed the agency to build permanent homes instead of temporary housing.¹⁷⁸ Building these new houses was very expensive, but still less costly than other options. If FEMA had built new houses for victims of Hurricane Maria, modern building codes could have been enforced, thus mitigating potential problems in the future, and green energy could have been incorporated into the new structures. FEMA's response to the Guam disaster shows that with political pressure, there is potential for the creation of permanent rather than temporary housing, thus reducing waste and redundancy.

Politics can be difficult to navigate at both local and federal levels. In 2008, California's Office of Emergency Services, along with the Department of Homeland Security and local governments, published the San Francisco Bay Area Regional Emergency Coordination Plan (RECP), which designates spheres of responsibility during a local disaster. Because the San Francisco Bay Area is so densely populated, and has many municipal governments and agencies, one cross-jurisdictional plan works best to maximize resources and minimize redundancies. The RECP relies on the Red Cross and FEMA to address shelter.¹⁷⁹ However, HUD does not agree with turning disaster housing over to the Red Cross and FEMA. Instead, HUD believes that HUD itself should help victims find housing; HUD does not want local and state governments, funded through FEMA, to handle disaster housing.¹⁸⁰ HUD maintains that it has the contacts and expertise at the local level to help low-income people and people with disabilities find housing, because that is HUD's task on a day-to-day basis. Ongoing bureaucratic conflict between FEMA and HUD is a significant impediment to finding a political solution to post-disaster housing.

¹⁷⁸ McCarthy, *FEMA Disaster Housing*, 13.

¹⁷⁹ Governor's Offices of Emergency Services, "San Francisco Bay Area Regional Emergency Coordination Plan: Base Plan" (emergency plan, San Francisco Department of Emergency Management, March 2008), 1, <https://sfdem.org/ftp/uploadedfiles/DEM/PlansReports/SFRegionalEmergencyCoordinationPlan.pdf>.

¹⁸⁰ National Low Income Housing Coalition, "Disaster Housing Recovery Update."

SPUR—formerly known as the San Francisco Bay Area Planning and Urban Research Association—is a nonprofit that focuses on urban planning for San Francisco, Oakland, and San Jose by researching, educating, and advocating for policies to make these cities more livable and resilient.¹⁸¹ SPUR issued a report in 2012 on the devastating potential of a San Francisco earthquake, and ways to foster community resilience. The report asked, “What will it take for San Franciscans to live safely in their homes after an earthquake? A significant amount of housing may be too damaged to live in while it’s being repaired. Residents may leave. And that will put the city’s recovery at risk.”¹⁸² The report offers two possible solutions to reduce the impact of an earthquake, both of which aim to make 95 percent of homes in the area safe enough to be habitable. The first solution is retrofitting current high-risk buildings, such as concrete buildings built before 1980, and addressing soft-story construction that has large, unreinforced open rooms, such as garages or stores, comprising the bottom floor of buildings. San Francisco passed legislation mandating that all three-story or greater wood buildings with five or more units built with a soft story be sheer-walled and bolted to their foundations by 2020. Ninety-nine percent of building owners have complied, thus reducing the chances of crippling damage to high-risk housing stock that is largely inhabited by high-risk populations. However, this successful retrofit program does not solve all the problems of vulnerable buildings in San Francisco. For example, concrete buildings built prior to 1980 have not been inventoried in San Francisco, nor is there a clear way to retrofit that is not exorbitant to homeowners or the city, spotlighting the role that financial implications have on legislation, no matter how many people may benefit.¹⁸³

The second change recommended by the SPUR report is that building codes be softened temporarily after a disaster so that people are not forced to leave housing that can be “safe enough to stay” during repairs.¹⁸⁴ This recommendation recognizes that the

¹⁸¹ SPUR was formerly known as the San Francisco Bay Area Planning and Urban Research Association; see <https://www.spur.org/>.

¹⁸² SPUR, “Safe Enough to Stay,” 3.

¹⁸³ SPUR, 19–21.

¹⁸⁴ SPUR.

chances for full economic recovery are greatly diminished if the majority of the population is unable to stay in the community. For example, using a fire escape as an entrance for up to a month while a home's front entry is repaired would be considered safe enough after a disaster, though it would not be permitted under normal circumstances. In order to be implemented, the "safe enough to stay" strategy requires a set of post-disaster building standards that must be put in place before a disaster strikes. This is a political issue: changes cannot occur without legislation. Without political clout, legal issues will not be addressed and recommended solutions cannot be implemented.

The SPUR report also discusses different housing options for survivors after a disaster in San Francisco: housing vouchers, interim housing placed in front of damaged properties or in open areas such as parks or vacant lots, and cruise ships docked in the bay.¹⁸⁵ The report does not address alternate intermediate housing units as a solution, as New York City Emergency Management does, but focuses primarily on making existing structures safe enough to stay. However, if the "safe enough to stay" strategy is not written into law ahead of a disaster, people may still be forced to leave their homes. According to the SPUR report, in order for San Francisco to achieve full recovery without a huge economic impact triggered by loss of population, loss of housing stock, and loss of employment, 95 percent of the population must be able to stay in San Francisco during the rebuild portion of disaster recovery.¹⁸⁶ It postulates that after a magnitude 7.2 earthquake, approximately 175,000 people would be displaced, 85,000 housing units would be destroyed by the earthquake, and an additional 6,000 would be lost in subsequent fires.

The SPUR report further conjectures that 20 percent of the population would need disaster housing for at least several months, and some for up to five years, because of housing unit shortfall; 75 percent of housing units projected to be livable, while SPUR's goal for the viability of San Francisco is 95 percent, thus leaving 20 percent of the units uninhabitable.¹⁸⁷ The SPUR report discusses that many elderly people, new immigrants

¹⁸⁵ SPUR, 4.

¹⁸⁶ SPUR, 3.

¹⁸⁷ SPUR, 9, 12.

and non-English speakers will be impacted.¹⁸⁸ It is reasonable to assume that of the roughly 175,000 people displaced, more than half of them may need some sort of federal aid to get back on their feet.¹⁸⁹

Internationally, Christchurch, New Zealand, an oft-compared sister city to San Francisco, made a different set of choices after its populace suffered two devastating earthquakes close together. The government chose to remove almost all survivors from affected areas; in one red-tagged area, it bought out all but 74 residents. After the earthquakes, officials projected that, in the future, they would remove all residents who had houses that were still inhabitable in red-tagged areas due to the high cost of trucking in supplies such as water, and of removing waste.¹⁹⁰ For example, it cost the local government \$500,000 per year to have the sewage removed from the remaining residences.¹⁹¹ San Francisco officials should consider this to be important information: “Experts are sending this message: The building code does not protect cities from earthquakes nearly as much as you might think.”¹⁹² The primary thrust of the SPUR report is that it is possible to make most structures safe enough to stay, but San Francisco could suffer an earthquake that exceeds building codes parameters, similar to the 9.0 earthquake off of Japan. This points to the necessity of having off-grid temporary disaster housing as an option.

¹⁸⁸ SPUR, 16.

¹⁸⁹ Some populations will clearly need to be moved to areas that have not been devastated. These populations include those who are incarcerated, live in group homes, or who need special accommodations, such as disabled. Although the SPUR report does not address these special-needs groups, these groups must be considered when planning for disaster housing. For example, where is the nearest jail/prison with available room that the county jail could move their inmates to? And what form of transportation will be available? Preplanning for these populations’ needs is important to address.

¹⁹⁰ Tina Law, “Infrastructure in Christchurch’s Red Zone to Remain—for Now,” Stuff, December 10, 2015, <https://www.stuff.co.nz/the-press/news/74935108/infrastructure-in-christchurchs-red-zone-to-remain--for-now>.

¹⁹¹ David Walker, “Ratepayers’ Bear Cost of Government’s Red Zone Confusion,” Stuff, March 8, 2018, <https://www.stuff.co.nz/the-press/business/the-rebuild/102067846/ratepayers-bear-cost-of-governments-red-zone-confusion>.

¹⁹² Thomas Fuller, Anjali Singhvi, and Josh Williams, “San Francisco’s Big Seismic Gamble,” *New York Times*, April 17, 2018, <https://www.nytimes.com/interactive/2018/04/17/us/san-francisco-earthquake-seismic-gamble.html>.

Officials in New Zealand learned to reexamine building codes to verify that they are robust enough to keep people safe in buildings hit by earthquakes. They also learned that in addition to housing, it was important to offer wraparound services, such as budgeting, counseling, advocacy, and employment, to help people get back on their feet more quickly. They learned how to reduce the delay of distributing temporary disaster housing by creating premade units staged in strategic locations. New Zealand found that creating “new towns” to house displaced persons was not effective because people tend to want to stay as close to home as possible. And lastly, they clearly defined six stages of housing, from homelessness and “rough sleeping” through independent private housing.¹⁹³

B. ECONOMIC FACTORS

Several sources from the literature emphasize the value of making it possible for residents to remain in their cities while rebuilding takes place.¹⁹⁴ In “A Framework to Construct Post-disaster Housing,” Saumyang Patel and Makarand Hastak state, “It is indispensable to provide housing to victims in their own region to aid its social and economic redevelopment and rebuilding processes.”¹⁹⁵ If residents leave, rebuilding and economic recovery takes longer. Kanu Das and Nagendra Kumar Sharma agree, and discuss the indirect damage of a disaster on people and their employment if they are not housed adequately.¹⁹⁶ To reach its state requirement—that 95 percent of the population must remain in place after a disaster to stabilize communities and start the process of recovery—the SPUR report recommends four possibilities:

1. Keep people in their homes whenever it is safely feasible
2. If people cannot be kept in their homes, keep them in their neighborhoods

¹⁹³ New Zealand Ministry of Social Development, “Short-Term Housing Response,” 3.

¹⁹⁴ SPUR, “Safe Enough to Stay.”

¹⁹⁵ Saumyang Patel and Makarand Hastak, “A Framework to Construct Post-disaster Housing,” *International Journal of Disaster Resilience in the Built Environment* 4, no. 1 (2013): 95–114, <https://search.proquest.com.libproxy.nps.edu/docview/1317740140?OpenUrlRefId=info:xri/sid:primo&accountid=12702.95-114>.

¹⁹⁶ Kanu Kumar Das and Nagendra Kumar Sharma, “Post Disaster Housing Management for Sustainable Urban Development,” *International Journal of Geotechnical Earthquake Engineering* 7, no. 1 (2016), <https://doi.org/10.4018/ijgee.2016010101>.

3. If this is not possible, keep people in their cities
4. If these options are not possible, provide victims with a plan for returning to their communities.¹⁹⁷

C. SOCIAL FACTORS

Among the social factors Jo da Silva considers is the evaluation of the vulnerabilities of potentially affected populations, and the laws that govern them. She identifies which jurisdiction has authority over the affected population, and whether that jurisdiction has plans in place. She recommends discerning ways to mitigate potential hazards in the future.¹⁹⁸

While disaster housing solutions will be different for urban versus rural communities and first world versus third world areas, it is important to realize that housing is a fundamental need and to factor in the human element. It is possible to benefit from relevant disaster housing models that have succeeded in different countries and for different socioeconomic backgrounds. Mary Comerio, a professor of architecture at the University of California, Berkeley, and author of an article titled “Housing Issues after Disasters,” states, “The common denominator in urban disasters is [that] housing and ... recovery issues are quite different in cities than in rural areas, precisely because the losses are concentrated in densely populated areas and the housing loss not only represents a significant financial investment, but also a unique component of the urban infrastructure.”¹⁹⁹

In 2003, a devastating earthquake hit Bam, Iran. In the aftermath, Asal Kamani-Fard, Mohd Hamdan Ahmad, and Dilshan Remaz Ossen completed a study to examine how temporary housing affected reconstruction. Results from this study show that having victims stay close to their homes sped up the recovery process. In addition, keeping disaster

¹⁹⁷ SPUR, “Safe Enough to Stay,” 8.

¹⁹⁸ Jo da Silva, *Lessons from Aceh: Key Considerations in Post-Disaster Reconstruction* (Rugby, UK: Practical Action Publishing, 2010), 13, <https://www.alnap.org/system/files/content/resource/files/main/lessonsfromaceh.pdf>.

¹⁹⁹ Mary C. Comerio, “Housing Issues after Disasters,” *Journal of Contingencies and Crisis Management* 5, no. 3 (September 2002): 167, <https://doi.org/10.1111/1468-5973.00052>.

victims close to their homes during rebuilding created a higher quality of construction because homeowners were there to verify the quality of the work. They found that having owners nearby resulted in a more satisfying rebuilding process overall.²⁰⁰

Research conducted by Ruhizal Roosli, Jestin Nordin, and Geoff O'Brien on post-disaster housing reconstruction in Malaysia recommends four strategies that should be incorporated for a successful outcome:

1. Increase public awareness through outreach for input on housing options
2. Create meetings and activities to carry out recommendations
3. Create policy and planning that is relevant to disaster victims' needs
4. Consider the victims' needs and create government policies in line with those needs, making sure that there are enough assistance programs to support the number of potential victims

The authors stress that disaster housing without consideration for those being housed has failed in the past in Malaysia and that, for success, all stakeholders must work together. When all stakeholders work together, they explain, the government's burden is reduced, resulting in better long-term outcomes.²⁰¹

Research shows that disaster housing recovery plans have a higher rate of success when there is resident buy-in, sometimes called the "bottom-up" approach, as opposed to government-mandated and contractor-created solutions—the "top-down" approach. Housing solutions are more likely to succeed when residents and neighbors feel they have a say in designing the options. This is clearly shown in an article by Adham Hany Abulnour, who explains that the top-down solution may neglect the concerns of the

²⁰⁰ Asal Kamani-Fard, Mohd Hamdan Ahmad, and Dilshan Remaz Ossen, "The Sense of Place in the New Homes of Post-Bam Earthquake Reconstruction," *International Journal of Disaster Resilience in the Built Environment* 3, no. 3 (2012), <https://doi.org/10.1108/17595901211263611>.

²⁰¹ Ruhizal Roosli, Jestin Nordin, and Geoff O'Brien, "The Evaluation of Community Participation in Post-disaster Housing Reconstruction Projects in Malaysia," *Procedia Engineering* 212 (2018), <https://doi.org/10.1016/j.proeng.2018.01.086>.

affected populace.²⁰² Abulnour found that “Top-down solutions tend to neglect cultural and local conditions as well as users’ needs because of the urgency to supply the housing units rapidly.”²⁰³ As Abulnour explains, “community-based approaches ... are successful at integrating reconstruction efforts with development opportunities, thus maximizing the potential of investments.”²⁰⁴

Gayani Karunasena and Raufdeen Rameezdeen agree with Abulnour. In their study, they found that the efficacy of disaster housing increases when end users’ opinions are considered.²⁰⁵ Comerio also agrees, noting, “The U.S. is facing a situation similar to what many developing countries have faced after massive disasters: how to house large displaced populations. The solution is often to lay down as many units of housing in a grid as quickly as possible. This is great for politicians and terrible for the people who end up living there.”²⁰⁶ A study by the Mississippi Alternative Housing Program reports that people who receive innovatively designed homes after living in trailers are more satisfied with them.²⁰⁷ This research indicates that buy-in from the people who have to live in these units for extended periods is important; buy-in improves overall quality of life under very difficult circumstances.

After Katrina, FEMA realized that it needed options for disaster housing beyond rental vouchers and trailers. It created a design competition called the Alternate Housing Pilot Program (AHPP) and funded four projects.²⁰⁸ Two of the four designs, one in

²⁰² Abulnour, “Post-disaster Temporary Dwelling,” 13.

²⁰³ Abulnour, 13.

²⁰⁴ Abulnour, 13.

²⁰⁵ Gayani Karunasena, and Raufdeen Rameezdeen, “Post-disaster Housing Reconstruction: Comparative Study of Donor vs. Owner-Driven Approaches,” *International Journal of Disaster Resilience in the Built Environment* 1, no. 2 (2010): 173–191, <https://doi.org/10.1108/17595901011056631>.

²⁰⁶ Ad Hoc Subcommittee on Disaster Recovery, *Far from Home: Deficiencies in Federal Disaster Housing Assistance after Hurricanes Katrina and Rita and Recommendations for Improvement*, (Washington, DC: Government Printing Office, 2009), <https://www.hsgac.senate.gov/imo/media/doc/Far%20From%20Home%20-%20SDR%20Special%20Report%20Feb%202009.pdf>.

²⁰⁷ ABT Associates Inc. and Amy Jones & Associates, “Developing a More Viable Unit,” 27.

²⁰⁸ “Alternative Housing Pilot Program,” FEMA, last modified August 10, 2016, <https://www.fema.gov/alternative-housing-pilot-program>.

Mississippi and the other in Alabama, were documented for strengths and weaknesses. The two final reports for the AHPP note that the implementation of housing designs faced multiple unforeseen barriers, including finding plots of land for the units, conforming to local building codes, and retrofitting units to make them ADA compliant. But overall, these units were better received by neighbors and inhabitants than FEMA trailers. Residents of these alternative disaster housing units were documented as enjoying the units more than disaster trailers, citing that there was enough room to have family members visit and to move furniture around, two key reasons that the units were deemed successful.²⁰⁹

In “Best Practice Post-disaster Housing and Livelihood Recovery Interventions: Winners and Losers,” Mojgan Tafti and Richard Tomlinson discuss the possibility of temporary housing becoming permanent homes owned by survivors as one of several best practices.²¹⁰ Unlike the disposable FEMA trailer, this option would increase the economic stability and long-term solvency of the country and is well worth considering. The World Bank considers survivors owning their homes to be the gold standard for long-term recovery, but not all people want or can afford to own their homes. Another key finding in the AHPP studies was that although the alternative housing units were originally built for occupants to buy and own, many occupants did not have the resources to do so. These results echo the research of Tafti and Tomlinson. In the end, all units in the Alabama AHPP were built as rentals, and some were offered to renters to buy.²¹¹ These units cost \$180,000 each to create, including planning, land, furniture, and program evaluation expenses. All monies generated from the sale of these homes were used to create more low-income housing.²¹²

²⁰⁹ Larry Buron et al., “Assessing Quality of Life in the Mississippi Cottage: Interim Report on FEMA’s Alternative Housing Pilot Program” (report, ABT Associates, December 2009), 19, https://www.fema.gov/pdf/about/programs/ahpp/ahpp_mississippi_cottage_final_report_12_15_2009.pdf; ABT Associates Inc. and Amy Jones & Associates, “Developing a More Viable Unit,” 77.

²¹⁰ Mojgan Taheri Tafti and Richard Tomlinson, “Best Practice Post-disaster Housing and Livelihood Recovery Interventions: Winners and Losers,” *IDPR* 37, no. 2 (2015): 165–85, <https://doi.org/10.3828/idpr.2015.14>.

²¹¹ ABT Associates Inc. and Amy Jones & Associates, “Creating a Safe Harbor,” v.

²¹² ABT Associates Inc. and Amy Jones & Associates, v.

Lessons learned from the Alabama AHPP were similar to the findings of comparable studies—they emphasize the importance of having a vision and a plan (including building code standards), co-coordinating with all stakeholders, thinking about where the units will go (land banking), considering the quality of building materials and placement of housing before a disaster, and being prepared to be flexible after a disaster.²¹³

Learning from past disasters, the government of Japan has adopted a bottom-up disaster housing policy that reflects the importance the government places on community and family. It has enacted legislation that empowers each community to decide how temporary housing will look and where it will be placed, through a “menu” of options from which communities can choose ahead of need. It supports social and economic recovery by keeping families and communities together to maintain the social fabric and gives first preference to the housing needs of vulnerable populations to ensure can start the recovery process as quickly as possible. In practice, these policies were difficult to realize after the Fukushima triple disaster because the people needed to make such decisions did not remain in the affected areas.²¹⁴ Japan is now able to critically evaluate the potential for natural disasters to trigger cascading events.²¹⁵

Mirroring the lessons learned from the New Zealand earthquakes, the NLIHC recommended that HUD ensure that wraparound services are available to those who need disaster housing. The NLIHC also recommended that HUD ensure that families and communities are kept together, echoing Japanese disaster policies.²¹⁶ While the NLIHC is a progressive NGO, governments that have implemented these recommendations, such as those in Japan and New Zealand, have found them to be successful; they save money and maintain the social fabric of affected communities.

²¹³ ABT Associates Inc. and Amy Jones & Associates, vi; McCarthy, *FEMA Disaster Housing*, 13.

²¹⁴ Abulnour, “The Post-disaster Temporary Dwelling,” 13.

²¹⁵ Elizabeth Ferris and Mireya Solis, “Lessons from Japan’s Triple Disaster: Three Years On,” Brookings Institution, March 10, 2014, <https://www.brookings.edu/blog/up-front/2014/03/10/lessons-from-japans-triple-disaster-three-years-on/>.

²¹⁶ “HUD Disaster Recovery Recommendations,” National Low Income Housing Coalition, accessed December 2018, <https://nlihc.org/sites/default/files/HUD-Disaster-Recovery-Recommendations>.

Social factors, such as providing wraparound services and including the victims and neighbors in housing design decisions, play a large but sometimes ignored role in the effective implementation of disaster housing.

D. TECHNOLOGICAL FACTORS

Current disaster housing solutions fall short of need, are very costly to taxpayers, and lack the holistic, integrated approach that individuals and communities need to recover after a disaster. While in the past FEMA has provided provisional housing, it has not been timely or cost-effective, and in some cases it has been unsafe. These fundamental components of disaster housing are intrinsic to success, and FEMA housing fails to meet them. There is no evidence that FEMA has considered using anything but the traditional trailer and vouchers as housing options.

Improvements in technology for disaster housing are providing new options to explore. Many possible solutions to disaster housing address one or more of the problems identified in this thesis. For instance, several studies have investigated incorporating prefabricated materials and renewable technology, such as photovoltaic (PV) cells, compostable toilets, and water collection units, into the design of disaster housing units. One study, by Ling Dong et al., found that prefabrication led to a quicker dispatch of product at a lower cost, and that the use of renewable technology, such as PV cells, led to improved efficiencies. They created model units that were 85 percent prefabricated and, when disassembled, could be recycled or reused, substantially reducing waste.²¹⁷

Perrucci, Vazquez, and Aktas echo the need for prefabricated disaster housing units that use renewable technology. They explore options for local, renewable resources to create disaster housing, searching for “a structure that is low-cost, energy efficient, and one that uses local renewable or recycled materials, while at the same time being safe and providing shelter to its occupants from the elements.”²¹⁸ These authors, having examined

²¹⁷ Ling Dong et al., “Carbon Reduction Measures-Based LCA of Prefabricated Temporary Housing with Renewable Energy Systems,” *Sustainability* 10, no. 3 (2018): 718, <http://www.mdpi.com/2071-1050/10/3/718>.

²¹⁸ Perrucci, Vazquez, and Aktas, “Sustainable Temporary Housing,” 327.

best practices that would incorporate local climate and housing needs, recommend that since all countries are susceptible to disasters, governments need to have comprehensive disaster housing plans in place ahead of time to maximize resilience.²¹⁹

The following sections present just a few of the new designs that could be considered for disaster victims in the future. They are safe, green, easily modifiable, sturdy, weather-resistant, and can be quickly assembled without much instruction. While some may not be appropriate for high-density urban areas, others are, and could give victims and neighborhoods options for disaster housing.

1. The Plastic Snap-Together House

In Colombia, the company Conceptos Plásticos (Plastic Concepts) is fabricating unrecyclable plastic into building blocks and columns that can be used to construct houses of up to two stories. The material is a heat and sound insulator and is earthquake resistant. The company also has options for water and electrical service and offers roofing options that facilitate passive cooling in hot regions. In twenty-eight days, a crew of fifteen used these building blocks to build forty-two houses for victims of violent displacement in Colombia, with a per-home cost of \$6,800. Conceptos Plásticos has won international awards and grants to continue its work providing modifiable homes for people in need.²²⁰ As a building material for a temporary housing solution, the bricks are easily shippable, sturdy, easy to build with, can create many different floor plans, and use very few natural resources. If these blocks are preplaced in strategic staging areas when a disaster hits, they can be shipped within hours and assembled quickly to house those in need.²²¹

²¹⁹ Perrucci, Vazquez, and Aktas, 327.

²²⁰ Nicholas Valencia, “This House Was Built in 5 Days Using Recycled Plastic Bricks,” trans. Amanda Pimenta, ArchDaily, May 1, 2017, <https://www.archdaily.com/869926/this-house-was-built-in-5-days-using-recycled-plastic-bricks>.

²²¹ Lucy Sherriff, “These Real Life Lego Houses Are Built from Bricks Made of Recycled Plastic,” Huffington Post, last updated October 8, 2016, https://www.huffingtonpost.co.uk/entry/these-real-life-lego-houses-are-built-from-bricks-made-of-recycled-plastic_uk_57ab31f0e4b08ab70dc0f380?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAFUkgbxh1F6RGUuwFPgJJ_GaS_sDF52PAdGYmRYNV6JnqwgxAvZuh8kC3St7r2Q5b1mktQ2975E4W3D3c7uU0N4VZJbuNiYccrT0mug9df_5_MzOozXLMuEvYuGiflvLcXorlc3OCeeQ2EqxunYcMjT1SHL_0Xv-pQklwfZJ3nZt.

2. House Arc

The House Arc prefabricated housing system comprises 90 percent lightweight recyclable steel tubes. The housing unit ships as a 3' x 4' x 10' flat pack box and weighs just 3,000 pounds. When set up, the roughly 150 square-foot units resemble trailers but can resist hurricane winds. They can be set up on uneven ground and have many windows to let in light. The housing units are off-grid and include built-in water catchments and solar power units.²²²

3. The IKEA Option

Swedish ready-to-build furniture company IKEA, in conjunction with the United Nations High Commissioner for, has created a temporary housing model that is solar-powered and safe—the walls are solid and can even resist knife blades. The cost per unit is \$1,300, versus \$150,000 for each FEMA trailer.²²³ Each IKEA unit can sleep a family of five and lasts for three years, which is longer than the useful lives of tents or trailers. The units can be assembled in four hours by four people and are being used extensively and successfully in the Middle East and Ethiopia; the IKEA unites even won London's Design Museum Design of the Year Award.²²⁴ There are downsides to this model, however: the units are not equipped with a kitchen, and a Swiss city that attempted to use the units to house an influx of refugees found them unviable due to a lower fire-resistance rating than regulations mandate.²²⁵

²²² Kimberly Mok, "Modular, Off-Grid 'House Arc' Comes as Flat Pack—It's Also Disaster-Resistant," *Treehugger*, January 31, 2012, <https://www.treehugger.com/modular-design/bellomo-architects-house-arc-modular-flat-pack-house.html>.

²²³ Kurt Kohlstedt, "Details & Diagrams: \$1,000 IKEA Flat-Pack Refugee Shelter," *Web Urbanist*, October 23, 2013, <https://weburbanist.com/2013/10/27/deconstructing-the-1000-ikea-flat-pack-refugee-shelter/>.

²²⁴ Nicole Jewell, "Ikea Flat-Pack Refugee Shelters Awarded Design of the Year," *Inhabitat*, January 31, 2017, <https://inhabitat.com/ikea-flat-pack-refugee-shelters-awarded-design-of-the-year/>.

²²⁵ "Swiss City Buys Ikea Shelters to House Refugees, Then Ditches Them over Fire Risk," *Guardian*, December 19, 2015, <https://www.theguardian.com/world/2015/dec/19/swiss-city-buys-ikea-shelters-to-house-refugees-then-ditches-them-over-fire-risk>.

4. The Container Option

In an article for *Frontiers of Architectural Research*, Yan Hong examines the use of shipping containers for temporary housing in China after a devastating earthquake in 2008 that destroyed 3.47 million homes. He found that shipping containers can be customized by joining or splitting units to meet the specific needs of people being housed. He also found that these units could be rapidly deployed and easily assembled after a disaster, which helps stabilize the population quickly and assists with recovery.²²⁶ Shipping containers could be a potential solution, as there are many containers waiting for uses on the coasts. They are sturdy, stackable, can be made “green,” and are easily modifiable. They can also be made to be off-grid.

E. ENVIRONMENTAL FACTORS

When considering environmentally sound solutions to disaster housing, densely populated areas need solutions that take land constraints into account. In 2014, two years after Superstorm Sandy, New York City Emergency Management (NYCEM) took a hard look at post-disaster housing and came up with alternative solutions. NYCEM reviewed the FEMA practice of using approved vendors to order cookie-cutter trailers as needed and found that New York City needed a different product: stackable units that maximize the use of limited open space. Discussing local housing needs, the NYCEM report states: “The Interim Housing Unit must be rapidly deployable; transportable by truck, rail, and by cargo ship; and must be able to be disassembled and stored off-site for future reassembly and re-use.”²²⁷ In addition, NYCEM indicates a need for prefabricated, modular housing—which will cut down on assembly and transportation time—that still conforms to local building codes, and housing of high enough quality to last beyond the temporary housing unit’s eighteen-month lifespan. NYCEM considered ADA mandates and fire codes when

²²⁶ Yan Hong, “A Study on the Condition of Temporary Housing following Disasters: Focus on Container Housing,” *Frontiers of Architectural Research* 6, no. 3 (September 2017): 374, <https://www.sciencedirect.com/science/article/pii/S2095263517300250?via%3Dihub>.

²²⁷ NYC Emergency Management, *Close to Home: An Urban Model for Post-disaster Housing* (New York: NYC Emergency Management, 2018), 72, http://www1.nyc.gov/assets/whatifnyc/downloads/pdf/close_to_home.pdf.

developing its plan. It requires that the prefabricated units connect to preexisting infrastructure such as water and sewage, if available, and have other options if the infrastructure is not functioning.²²⁸ NYCEM understands that New York City's aging infrastructure might not be operational after a large disaster and is planning for contingencies that would facilitate housing with as few barriers as possible. While NYCEM has developed a comprehensive disaster housing plan, the plan has not been tested yet.

In "Re-thinking Material Selection for Large Scale Post-disaster Reconstruction," Giulia Celentano et al. examined fifteen large-scale post-disaster housing projects from 2004 to 2011. They found that "by rethinking material selection ... it is possible to maximize the use of the available resources, overcoming the challenges faced on post-disaster reconstruction project while providing a rapid sustainable response to the affected population."²²⁹ Experts in Japan are also exploring the idea of a holistic approach to disaster housing that would include open spaces for housing along with services for victims that would help them with recovery; they are also exploring the option of relocating communities, as needed, to areas that would be affected less by earthquakes and their aftermath.²³⁰

While sustainable housing is not FEMA's primary goal in creating temporary disaster housing, a sustainable housing model provides a useful framework for planning disaster housing that could transition into permanent housing if needed. This approach could also reduce the costs of building disaster housing. In her summary of lessons learned from Aceh, Indonesia, after the 2004 tsunami, da Silva discusses approaches for building community resilience after disasters, especially with regard to sustainable housing in Asia and Africa. da Silva employs a three-step approach: planning, design, and construction.²³¹ This differs from FEMA's four-phase framework for emergency management: prepare,

²²⁸ NYC Emergency Management, 22.

²²⁹ Giulia Celentano et al., "Re-thinking Material Selection for Large Scale Post-disaster Reconstruction," ETH Zurich, accessed March 20, 2019, https://www.ethz.ch/content/dam/ethz/special-interest/conference-websites-dam/no-cost-housing-dam/documents/Celentano_Paper.pdf.

²³⁰ Brasor and Tsubuku, "Temporary Disaster Housing."

²³¹ da Silva, *Lessons from Aceh*, 12.

mitigate, respond, and recover, a model that may not be as applicable to disaster housing as da Silva's, because she is discussing rebuilding communities rather than housing people temporarily.²³²

During the design phase in planning for post-disaster housing, da Silva looks at possible site options to determine whether people will be able to safely live there long term and whether the affected communities need to be relocated, investigating types of construction for sustainability, quality-of-life standards, and building requirements for the region. After cost and construction time have been evaluated, the plan is implemented.²³³ da Silva considers who will build the housing, what materials will be used, how the materials will be obtained, and what means of conveyance will be used. Once the materials are onsite, da Silva addresses how to determine who will manage the project to ensure it matches the plan and design is addressed, as well as who will maintain quality of workmanship. da Silva recommends having a process in place to turn over the structures to recipients after they have been completed.²³⁴ While all these steps take time, it would be helpful if they were incorporated into disaster housing.

Because of the density of its cities, the Japanese government also procures existing vacant units to house disaster victims. But, as in the United States, this policy only works when the supply is greater than the demand, and sometimes it is not feasible due to lack of availability or cost. If a disaster hit Tokyo or New York City, the cost of housing those in need in existing units would be cost prohibitive because the demand would exceed the supply. Also, finding areas in which to place temporary housing in cities would be difficult for two reasons: lack of open spaces, and the difficulty to access utilities such as water, power, and waste disposal, which makes it impossible to install existing temporary structures and keep people close to home. But in many areas in the United States, the voucher system for short-term rentals is a viable option and commonly used through an

²³² Department of Homeland Security, *National Disaster Recovery Framework*, 5.

²³³ Da Silva, *Lessons from Aceh*, 5.

²³⁴ da Silva, 16.

application process online. For this to work, however, rental units must be available for a reasonable amount.

F. LEGAL FACTORS

Legal lessons learned from recent disasters should also be considered when weighing future solutions. To address disaster housing in the future, the Japanese government is investigating the option of modifying the existing law to increase the amount of time that people can remain in temporary housing. It would mandate that housing units be better suited to the individuals who have to live in them; this potentially means increasing the size of the units, giving units more storage as well as flexible floor plans, and optimizing the potential for different types of units to accommodate elderly and disabled people. Problems with the existing law, enacted in 1947, were discussed by the Japanese government after the Hanshin earthquake in 1995, but were not modified to make for a better outcome after the Fukushima triple disaster in 2011, the scale and complexity of which were beyond what officials or power plant executives could have imagined.²³⁵

In the planning phase, da Silva discusses the need for context, taking physical, social, economic, and political factors into account. In contrast to da Silva's orderly steps of planning, FEMA's response plan to Hurricane Katrina had not been sufficiently developed, so it was not implemented. Instead, the Ad Hoc Subcommittee on Disaster Recovery found that FEMA engaged in inconsistent ways: FEMA continually changed requirements and deadlines that victims had to adhere, which later led to lawsuits.²³⁶ FEMA's ongoing, ad hoc responses to disasters with regard to housing are puzzling. If there was a clear path to housing aid for victims of a disaster that was streamlined, consistent, and predictable, it would greatly accelerate the recovery process.

G. SUMMARY

Possible solutions to past disaster housing problems presented in this chapter—based on the PSETEL analysis—are summarized in Table 4.

²³⁵ Brasor and Tsubuku, "Temporary Disaster Housing."

²³⁶ Ad Hoc Subcommittee on Disaster Recovery, *Far from Home*, i.

Table 4. Disaster Housing Solutions Based on PESTEL Analysis

Political	• Coordinate with all stakeholders to reduce areas of overlap or gaps in coverage, in particular between FEMA and HUD • Create clear path for victims to receive aid • Create a consistent disaster housing response • Create permanent housing, when appropriate, instead of temporary housing • Preplan for vulnerable communities
Economic	• Use resources that are local or abundant to create disaster housing • Allow victims to supplement vouchers so that they can find units better suited to them • Create disaster housing that can transition to permanent housing • Land bank areas so there are places to put disaster housing when there is a need • Create vouchers for rentals when housing stock is available
Social	• Offer wraparound services to victims • Reduce delay of distributing disaster housing by storing units in key locations • Evaluate vulnerable populations ahead of disasters • Allow victims and neighbors to have buy-in on their disaster housing • Keep communities together and close to home • Give disaster housing victims the option to purchase their disaster housing
Technological	• Increase size and change design of disaster units to accommodate the elderly and disabled • Create an off-grid disaster housing option • Create green disaster housing options • Create prefabricated disaster housing for quicker deployment • Create rapidly deployable disaster housing options • Make options transportable by truck, rail, or ship • Make options easily storable • Create stackable disaster housing

Environmental	• Remove all victims from disaster area to rebuild quickly • Keep people close to services and employment • Remove populations from dangerous areas such as flood zones when possible
Legal	• Increase the amount of time victims can stay in disaster housing • Create legislation that allows for flexible floorplans • Create legislation that would mandate retrofitting high-risk buildings • Create legislation to make buildings safe enough to stay in after a disaster • Create legislation that allows temporary housing to transition to permanent housing

V. RECOMMENDATIONS AND CONCLUSION

This research began with a basic question: How can government agencies provide effective post-disaster housing in densely populated urban areas when the infrastructure has been damaged? Disasters create a need for housing not only for the people who continue to live and work in the affected area but also volunteers who come to provide aid and help to rebuild. This thesis used the PESTEL model to explore the research question and to identify policy solutions that might serve communities in the future. This concluding chapter also employs the PESTEL model to summarize findings, call attention to past practices that might inform future policy, and identify subject areas for additional research.

A. POLITICAL SOLUTIONS

(1) Problems

The head of FEMA is a political appointee who serves at the discretion of the current administration, which reduces his or her sphere of influence. Elected officials are often not motivated to allocate funding to disaster preparedness until their constituency is directly impacted by a disaster; this results in a situation of reaction rather than prevention. History has shown that FEMA and HUD have a contentious relationship with regard to implementation of post-disaster housing. At the local level, neighbors have blocked the deployment of trailers (as a result of NIMBY) because of fears of increased crime and a reduction in their home values, as noted in Chapter II.

(2) Potential Solutions

- Politicians must pass legislation that provides for post-disaster housing ahead of time, rather than addressing this issue on an ad hoc basis after a disaster has devastated an area. One example of optimal pre-disaster planning might be to partner with Job Corps to create and store post-disaster housing. Job Corps would also provide a deployable workforce to be mobilized when a disaster hits. Job Corps is funded by the federal government and thus independent of any particular disaster and has

campuses in every state. This change would shift the political implementation of post-disaster housing from reactive to proactive.

- Government officials should take NIMBY into consideration ahead of time. Organizing neighborhood focus groups to generate design ideas would potentially expand the number of areas where this housing would be accepted and welcomed.
- FEMA should meet with local and state governments to create workgroups to design disaster housing prototypes that are appropriate for the climate and density of the potentially devastated area. These prototypes should then be vetted through neighborhood groups and those populations that tend to require disaster housing. Numerous studies show that shifting focus to local preplanning results in better outcomes for victims and the region. This would allow FEMA to maintain oversight while increasing buy-in at the local level. In turn, this would increase the potential for appropriate disaster housing for the areas of deployment; research demonstrates that one-size housing does not fit all situations.

B. ECONOMIC SOLUTIONS

(1) Problems

As noted in Chapter II, current disaster housing solutions are expensive to purchase, deploy, and maintain, and do not last a long time. Chapter II it also discussed that FEMA's rental voucher solution relies on vacant housing being affordable and available, which is unrealistic in crowded urban spaces. The poor, the elderly, and people with disabilities are the ones who have the greatest need for disaster housing, and these populations tend to lack resources that can help bridge the time gap between the disaster and disaster housing deployment. There is currently a lack of workers in the building and construction trades; after a disaster, there will be an even higher demand for builders, thus increasing the costs and wait times for those who need help rebuilding.

(2) Potential Solutions

- If post-disaster housing is already on hand, it will be less expensive than paying top dollar for housing solutions after a disaster, when there is a greater demand for it to be produced and delivered quickly.
- Including Job Corps in the building of post-disaster housing would be another possible means of saving money, since this workforce is already being paid, but not producing a product. Job Corps would know the product and its systems, be deployable, and be able to modify the units on-site as needed for the victims' use. This workforce could also supplement the dearth of builders and potentially assist with home repairs, reducing both the cost and the wait time.

C. SOCIAL SOLUTIONS

(1) Problems

A community needs to maintain its cohesion in order to recover. SPUR estimates that 95 percent of people need to stay in the community if the community is to recover. While housing is critical, since it allows victims to stay near their homes, this is often just the start of the community's recovery. A wide range of social services, called wraparound services, such as counseling and medical help, are needed to enhance community recovery, as noted in Chapter III's discussion of New Zealand's disaster housing. Since many victims are elderly, poor, or disabled, these kinds of services are crucial for their recovery. People who are not given choices in their housing options do not recover as quickly. Additionally, people tend to converge on the disaster site to offer aid, creating an added need for housing, straining transportation networks, and creating waste disposal problems in the disaster zone. There is also a need for barriers to keep people from nefarious activities while buildings are being repaired. The needs of incarcerated people will have to be addressed, as well as the needs of those in hospitals.

(2) Potential Solutions

- HUD should identify and locate the people and populations that will need disaster housing ahead of time so that housing solutions can be created and stored for fast deployment.
- HUD should identify and locate the wraparound services that are key to helping vulnerable populations recover from a disaster.
- Job Corps should identify and locate open spaces that can be used for disaster housing ahead of time to assist with speedy deployment of housing after a disaster.
- Local governments should create a deployment plan that includes the above factors identifying the stakeholders necessary for buy-in.
- Job Corps should create prototypes that neighborhood groups can review to avoid NIMBY issues after a disaster.
- Job Corps should allow those who will use the disaster housing to have a say in the layout of their units.
- Job Corps should make the disaster housing easily modifiable so populations with special needs can be accommodated easily.
- Job Corps should create off-grid housing that will allow people to stay locally after a disaster without relying on the potentially damaged infrastructure.
- SFDEM should identify populations that will need to be moved to areas without damage for survival and safety, such as those who are incarcerated or who are living in group homes.
- SFDEM should create departure plans and areas of refuge for them.

- SFDEM should create a plan for housing workers who converge on the area after a disaster.

D. TECHNOLOGICAL SOLUTIONS

(1) Problems

The infrastructure of the United States is failing. Trailers, one of FEMA's standard post-disaster housing solutions, will not work in a densely populated urban environment where an already failing infrastructure is further impacted by a disaster.

(2) Potential Solutions

- FEMA should go beyond trailers to explore cutting-edge technological advances in post-disaster housing.
- Technology could be used to create off-grid housing that has a low impact on the environment, is easy to move and store, can be modified to meet the needs of the victims, and is stackable for high-density areas.
- There could be several models to choose from so that recipients feel that they are part of the solution. Also, by creating several models, testing could be done to determine the options that are the most useful in various circumstances.
- Technological solutions can be developed to streamline the process of obtaining post-disaster housing to ensure the system is easier for all victims to navigate.

E. ENVIRONMENTAL SOLUTIONS

(1) Problems

The climate is changing and the frequency of natural disasters is increasing, along with their destructive power. Space is already limited in cities, and people are continuing to move to them, making it extremely difficult to place disaster housing in these densely packed urban environments. As cities expand, many more people live in increasingly

hazardous areas—such as in flood zones, near earthquake faults, and in areas vulnerable to wildfire. FEMA trailers are single-use, not recyclable or reusable, and end up as garbage in landfills.

(2) Potential Solutions

- The United States should create disaster housing that is environmentally friendly so that housing solutions do not create disposal problems.
- Disaster housing should be stackable for cities where space is at a premium.
- Disaster housing should have the option of being off-grid in case the infrastructure goes down in a given disaster area.

F. LEGAL SOLUTIONS

(1) Problems

FEMA's system for delivering post-disaster housing aid is arcane, overly complicated, and inconsistently implemented, making it difficult for victims to receive necessary help. FEMA has had difficulty partnering with other federal agencies, as well as state and local governments.

(2) Potential Solutions

- Legislation should be implemented at the federal level that would allocate resources to disaster-stricken areas in a more fair and equal way, while simplifying the process.
- The federal government should enact legislation that would empower federal agencies as well as state and local governments to create appropriate post-disaster housing in a timely manner. For example, at the local level, Job Corps could build and deploy disaster housing, which would be funded by the federal government.

G. CONCLUSION

Researchers and experts have noted that there is no one disaster housing solution that fits all needs. But by examining disaster housing through the PESTEL framework, this research gained insights into key components that should be considered, balanced, and factored into solutions.

Disasters are going to be a part of the future in the United States and every other country, and post-disaster housing that is safe and meets the needs of communities is a critical part of the recovery process. As seen in Japan, disasters can trigger cascading events that exponentially compound the original disaster. Individuals and communities recover faster and more completely when people have a say in their housing, and when they are able to stay close to home, near friends, family, and work. These are valuable lessons that can benefit the United States and the rest of the global population. With the certainty that our country is going to experience disasters in the future, it is imperative that we plan for post-disaster housing that is cost-effective, keeps people close to their communities, is safe, and provides a foundation that helps individuals and communities make complete economic and social recoveries.

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