



THE RESILIENCE OF AMERICA'S URBAN FOOD SYSTEMS: EVIDENCE FROM FIVE CITIES

Kimberly Zeuli and Austin Nijhuis
JANUARY 2017

SUPPORTED BY:



The
ROCKEFELLER
FOUNDATION



ICIC

THE ROCKEFELLER FOUNDATION: For more than 100 years, The Rockefeller Foundation’s mission has been to promote the well-being of humanity throughout the world. Today, The Rockefeller Foundation pursues this mission through dual goals: advancing inclusive economies that expand opportunities for more broadly shared prosperity, and building resilience by helping people, communities and institutions prepare for, withstand, and emerge stronger from acute shocks and chronic stresses. To achieve these goals, The Rockefeller Foundation works at the intersection of four focus areas—advance health, revalue ecosystems, secure livelihoods, and transform cities—to address the root causes of emerging challenges and create systemic change. Together with partners and grantees, The Rockefeller Foundation strives to catalyze and scale transformative innovations, create unlikely partnerships that span sectors, and take risks others cannot—or will not. To learn more, please visit www.rockefellerfoundation.org.

THE INITIATIVE FOR A COMPETITIVE INNER CITY: ICIC is a national, nonprofit research and advisory organization founded in 1994. Its mission is to drive economic prosperity in America’s inner cities through private sector investment. For more information about ICIC, please visit www.icic.org.

AUTHORS:

Kimberly Zeuli, Ph.D., is Senior Vice President and Director of Research at ICIC.

Austin Nijhuis is Senior Research Analyst at ICIC.

The views and opinions expressed in the report are those of the Initiative for a Competitive Inner City and do not necessarily reflect the views and opinions of The Rockefeller Foundation.

For inquiries about this report, please contact Kim Zeuli at kzeuli@icic.org.

Published January 2017. ©ICIC.



ICIC

56 WARREN STREET, SUITE 300 ■ ROXBURY, MA 02119



@ICICORG ICIC.ORG

Contents

The Importance of Food Systems in Resilience Planning	4
An Urban Food System Resilience Framework	7
Hurricane and Earthquake Threats to Food Systems	17
Characteristics of a Resilient Urban Food System	34
The Economic Resilience of Food-Based Economies	38
The Reduction of Food Waste and Resilience Planning	46
A Playbook for Building a Resilient Food System	51
Endnotes	60

The Importance of Food Systems in Resilience Planning

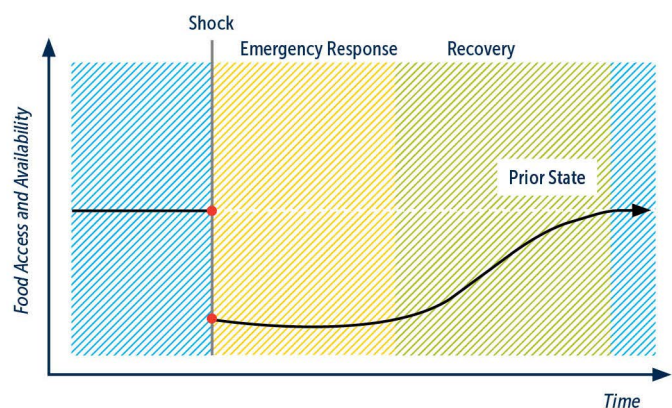
Many cities in the U.S. are prioritizing resilience planning to better prepare for severe natural disasters such as earthquakes, hurricanes and superstorms. Food systems, however, have been largely overlooked in these planning efforts. Most cities expect to provide residents with food for a relatively short period of time—a few weeks at most—during the immediate aftermath of a natural disaster. But as Hurricane Katrina demonstrated, food system disruptions may last months or years. Such long-lasting disruptions can create significant food access issues, especially for populations that are already food insecure.

City leaders may assume that resilience planning for the city's infrastructure in general is sufficient, since food distribution and retail depend on transportation and utilities. While resilient transportation networks and utilities are critical components of a resilient food system, they are not the only parts that matter. In addition, having a food system perspective in resilience planning will prioritize the most critical infrastructure investments to strengthen food distribution and food retail. City leaders may also mistakenly assume that since food

systems are predominantly comprised of private-sector businesses, food businesses have sufficient resources and motive to rapidly return to normal operations. However, this may not always be true. Evacuations create market uncertainties and smaller grocery stores or corner stores (bodegas) typically do not have sufficient resources to deal with major catastrophes.

Cities that intentionally develop resilient food systems will ensure that food supplies return to pre-disaster levels as quickly and as equitably as possible, so that all residents have adequate access to food in their neighborhoods. To better understand the vulnerabilities of urban food systems in America's cities, the Initiative for a Competitive Inner City (ICIC) conducted a comprehensive study of five unique municipalities: Los Angeles, Madison (Wisconsin), New Orleans, New York City and Portland (Maine). The cities were chosen to represent diverse geographies, unique food system characteristics, and different threats to food systems. Los Angeles, New Orleans, and New York City also participate in the 100 Resilient Cities network. This research was supported by a grant from The Rockefeller Foundation.

FIGURE 1: RESILIENCE TIMELINE



A food system perspective in resilience planning will prioritize the right strategies to ensure that the food system returns to normal as quickly as possible.

We focused on vulnerabilities to significant natural disasters in each city except for Portland, where we analyzed the resilience of the city’s food-based urban economy to an economic disaster. A truly resilient city will be able to withstand not only natural disasters, but also social upheavals and significant economic shocks such as the Great Recession. Portland represents other cities that are growing their local food sector, leveraging the explosion of consumer interest in local and artisanal food, including farm-to-table restaurants and craft breweries. We analyze the impact of an expanded local food sector on the resilience of Portland’s economy to an economic shock.¹

ICIC developed a groundbreaking urban food system resilience framework that was first applied to Boston’s food system in 2014.² The framework is oriented around a specific situation—a disaster that directly impacts a city’s residents, businesses and infrastructure—and surfaces food system vulnerabilities to different types of natural and economic disasters. As such, it exposes critical food system weaknesses that are unique to each city and that city leaders could address. By analyzing food access at the neighborhood level, the framework also surfaces specific areas (and populations) within the city that would be disproportionately impacted by food system disruptions. Within the framework, the research for this report analyzed public and proprietary data and included interviews with over 140 individuals representing various components of the food system in different urban markets.

ICIC’s groundbreaking food system resilience framework surfaces vulnerabilities to natural and economic disasters.

The report provides a set of recommendations to guide city leaders, including Chief Resilience Officers (CROs), on how best to incorporate food systems into resilience planning and outlines strategies that will improve the resilience of their cities’ food systems and better the lives of all residents, including those who are already food insecure. The report also begins to explore the potential impact of food waste reduction on the resilience of food systems to a natural disaster and, thus, starts to integrate what are frequently treated as two disparate food system initiatives. This work complements the 100 Resilient Cities platform, which is supported by The Rockefeller Foundation and works towards creating comprehensive urban resilience, defined as the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience. The platform also provides funding for CROs, a city government position that acts as a city’s point person for resilience planning. The research also supports The Rockefeller Foundation’s YieldWise initiative, which works globally to demonstrate how food waste and loss can be cut in half over the next five years. As Monica Munn, Senior Associate at the Foundation and lead on its work to reduce food waste in U.S. and European cities, notes, “Through our work, we have seen how reducing food waste and loss can make households, communities, and cities more resilient by reducing chronic economic and infrastructure stress.”

URBAN FOOD POLICY PRIORITIES

The Milan Urban Food Policy Pact is the most prominent global initiative that encourages city leaders to consider food systems in resilience planning, although it does so through a sustainability framework.³ It was established in 2015 to promote the development of sustainable food systems that are inclusive, resilient, safe and diverse, and able to adapt to and mitigate impacts of climate change. Leaders from more than 120 cities around the world, including seven U.S. cities (including New York City), have signed the Pact, pledging to work across government departments and food industry sectors to build resilient and sustainable food systems. The Food and Agriculture Organization (FAO) of the United Nations helped to develop the framework of the Pact and works to support compliance, enable exchange of information and best practices between cities, and promote expansion of the program to more cities around the world. While the Pact serves as a guiding force to help city leaders think about urban food systems, its focus on sustainability means that it does not fully consider the multidimensionality of resilience.

C40, a network of more than 80 cities across the globe committed to addressing climate change, is another high-profile initiative. Its Food Systems Network includes 26 cities, including four U.S. cities, that support efforts to reduce carbon emissions and increase resilience throughout their food systems.⁴ The Mayors of Los Angeles and New York City are members of C40's Food Systems Network.

For most cities in the U.S., food policy priorities typically include improving food security, managing nutrition assistance programs, promoting healthy eating, and perhaps managing farmers markets, city gardens and other urban agriculture, but not food system resilience. Urban food policy is typically guided by a food policy council or task force that includes representatives from public- and private-sector food organizations. Some cities also have government offices (e.g., Office of Food Initiatives or Director of Food Policy) dedicated to implementing food priorities.

All five cities we studied have food policy councils or task forces and Madison and New York City have government offices directing their food priorities. Madison's current mayor serves as the chair of the U.S. Conference of Mayors Food Policy Taskforce, which is comprised of mayors from 15 to 20 cities, including New Orleans and New York City.

As part of their involvement in 100 Resilient Cities, New York City, New Orleans and Los Angeles have committed to developing resilience plans for their cities. Improving the resilience of the city's food supply is a key part of New York City's resilience plan, *One New York: The Plan for A Strong and Just City*. The plan includes an initiative to invest in making the city's fresh food distribution center (Hunts Point) more resilient to better prepare it for power outages, coastal flooding, job losses and other disruptions from extreme weather events. In 2015, the City secured \$150 million in funding for a 10-year investment in Hunts Point to upgrade and strengthen the resilience of its facilities and create new jobs.⁵

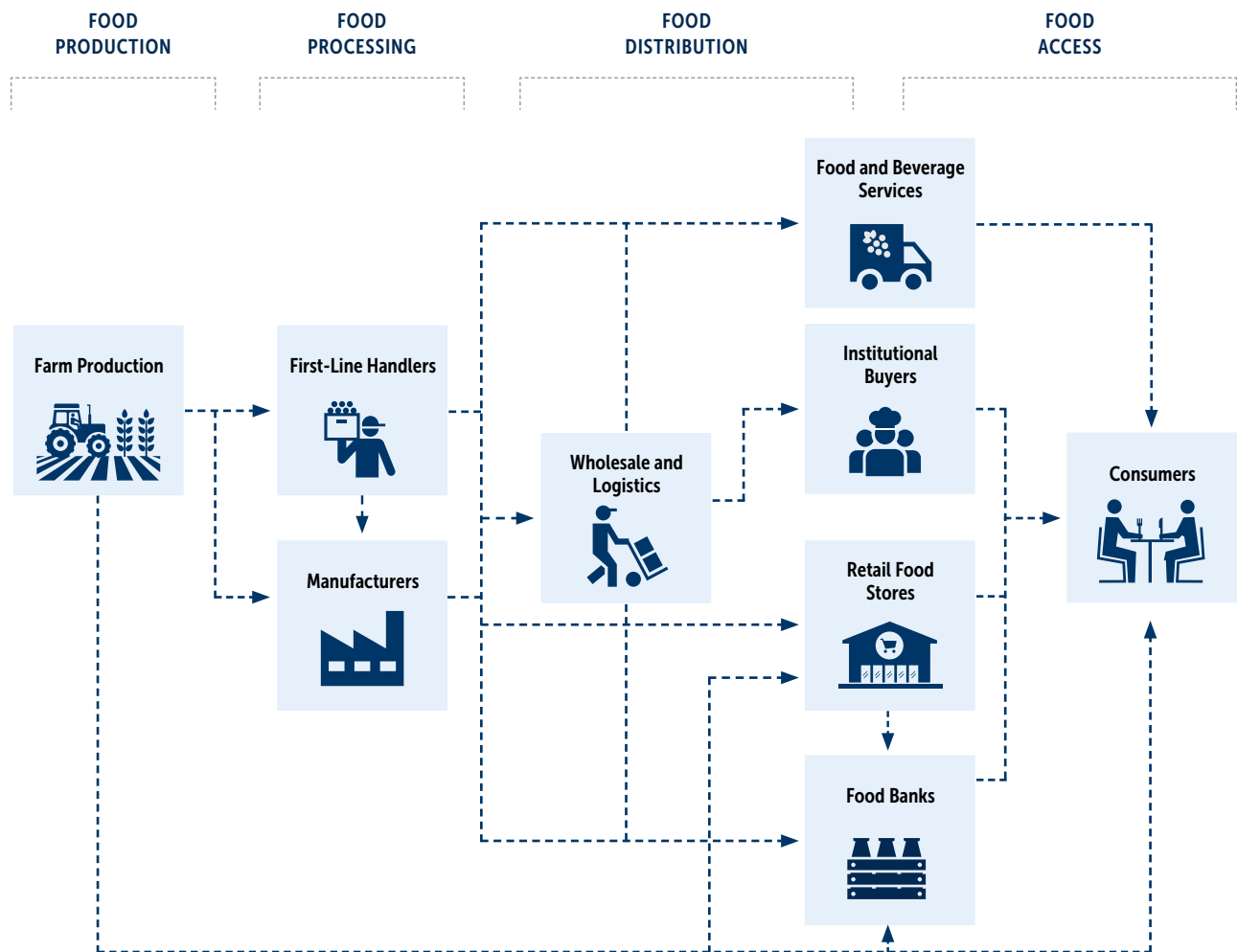
The resilience plan for New Orleans, *Resilient New Orleans*, does not emphasize food resilience to the same degree that New York City's does, but it includes a discussion of how existing initiatives can be utilized to help build the resilience of the city's food system.⁶ The resilience plan for Los Angeles is forthcoming, and strategies to improve the resilience of the food system have been discussed as part of the planning process.

New York City and Los Angeles have also commissioned studies on the resilience of their food supply chains. The New York City Economic Development Corporation (NYCEDC) and the Mayor's Office of Recovery and Resiliency commissioned a comprehensive study in 2016, *Five Borough Food Flow*, that analyzes the resilience of the New York City region's food distribution system.⁷ In Los Angeles, the Emergency Management Department (EMD) received technical assistance planning support from the Federal Emergency Management Agency (FEMA) National Integration Center to complete a high-level, food supply chain resilience study in early 2015.⁸ The study analyzed the impact of a 7.8 magnitude earthquake on large grocery store supply chains.

An Urban Food System Resilience Framework

A food system comprises four main components involved with moving and transforming food from farm to table: food production, food processing, food distribution and food access (Figure 2). Food production refers to all activities associated with growing crops and raising livestock. Food processing covers all aspects of the transformation of food from point of production to distribution and includes cleaning, packaging, and processing at manufacturing facilities. Food distribution concerns the complex process that moves food products from processing facilities to points of food access (e.g., grocery stores, restaurants, institutions, and food banks).

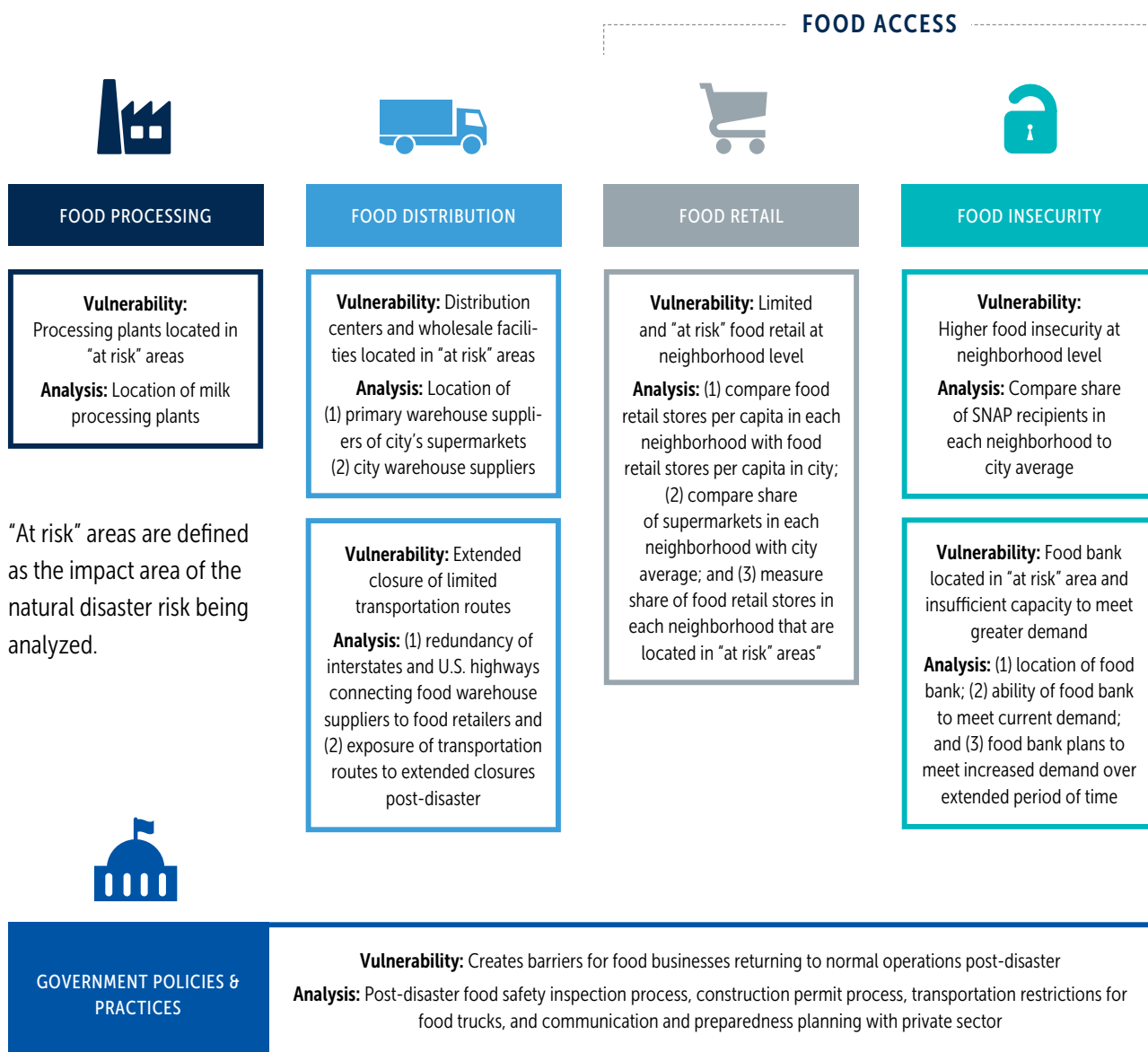
FIGURE 2. THE FOOD SYSTEM



Source: Adapted from Nesheim, Malden C., Maria Oria, and Peggy Tsai Yih, eds. *A framework for assessing effects of the food system*. National Academies Press, 2015.

ICIC developed a seminal framework (Figure 3) that allows cities to analyze the resilience of their food systems to different types of disasters and identify critical areas of weakness. The framework is grounded in a thorough understanding of food system dynamics and was informed by a framework developed by the International Institute for Sustainable Development, but adapted to urban food markets in the U.S.⁹ The framework is designed to surface vulnerabilities that are greatest within the city and that city leaders could ostensibly address. As such, it includes only three food system components—food processing, food distribution and food access. Food access is analyzed at the neighborhood level to identify specific areas (and populations) within the city that would be disproportionately impacted by food system disruptions.

FIGURE 3. ICIC’S FOOD SYSTEM RESILIENCE FRAMEWORK



“At risk” areas are defined as the impact area of the natural disaster risk being analyzed.

LOCATION VULNERABILITIES

A major source of vulnerability that cuts across all three parts of the food system is the location of buildings in areas that are “at risk” of impact from a natural disaster that strikes a city. We define “at risk” areas as a function of the natural disaster risk being analyzed. For example, in our previous analysis of Boston’s food system, we defined “at risk” areas as those within a 75-mile radius of Boston (which corresponds to the typical range of hurricane force winds) and areas that would be flooded by a hurricane generating a 7.5-foot storm surge at high tide (which is what the Boston Harbor Association used to model the flooding impact of an event similar to Superstorm Sandy).¹⁰ Clearly, the actual areas impacted by natural disasters, and the extent of damage, will vary depending on the magnitude and location of the natural disaster. Our analysis provides a starting point for exploring locational vulnerabilities in urban food systems due to the most likely natural disaster scenarios.

A major source of vulnerability is the location of buildings in areas that are “at risk” of impact from a natural disaster.

Earthquakes pose the greatest risk for Los Angeles, which is situated near multiple fault lines. The most recent major earthquake to hit Los Angeles was the Northridge earthquake of 1994 (magnitude 6.7), which caused extensive damage in some parts of the city to highways, gas lines, power, and buildings.¹¹ The EMD food supply chain study used a hypothetical magnitude 7.8 earthquake (with an epicenter approximately 150 miles from Los Angeles) for its analysis because this has been identified by earthquake experts as one of the most likely major earthquake scenarios in California.¹² We use the same scenario to identify locations in Los Angeles that are “at risk” for earthquake damage. An earthquake of this size would likely result in “severe” to “extreme” shaking, causing widespread damage across the city.¹³ Severe shaking is expected to cause slight damage to specially designed structures and considerable damage to ordinary structures, while extreme shaking would destroy many types of structures.¹⁴

Hurricanes or superstorms are the greatest threat to New Orleans and New York City. Hurricane Katrina in New Orleans and Superstorm Sandy in New York City provide us with an opportunity to analyze the actual impact of a natural disaster. Hurricane Katrina, which struck the Gulf Coast in August 2005, flooded 80 percent of New Orleans.¹⁵ The storm severely impacted the city’s infrastructure, including transportation and communication networks and utilities. The city was functioning at less than half of pre-Katrina capacity a year after the storm.¹⁶ We use Katrina flood maps produced by FEMA to identify locations in New Orleans that are “at risk” for flooding from a major hurricane.¹⁷

Superstorm Sandy (downgraded from hurricane status) hit New York City in October 2012. Storm damage varied widely across the city, but some neighborhoods experienced flooding from storm surges nine feet above high tide,¹⁸ power outages and damaged transportation networks (including the city’s subway system, which closed for several days, with key sections shut for a week or longer).¹⁹ The hardest hit areas were in the Brooklyn-Queens waterfront, the Eastern and Southern Shores of Staten Island, South Queens, Southern Brooklyn and Southern Manhattan. These areas experienced severe flooding, extensive damage to buildings and prolonged power outages. We use Sandy flood maps produced by FEMA to identify locations in New York City that are “at risk” for flooding from another superstorm.

Located in the Upper Midwest, Madison, Wisconsin does not face the same natural disaster risks as coastal cities. The most likely events to disrupt the food system in this city are a tornado or winter storm (blizzard or ice).²⁰ To date, the city has not experienced any natural disaster that disrupted its food system, and a 1976 ice storm was the last storm to create any significant disruption in the city.²¹ As one local food industry expert we interviewed put it, “Even if we were hit by a very large tornado, the region is still not shutting down everything.” A severe and widespread blizzard or ice storm is the greatest threat to Madison’s food system. Because the modeling of a winter storm impact is less precise than with earthquakes or hurricane flooding, we assumed a scenario in which the storm hit Madison and defined “at risk” locations as anything within the city limits.

FOOD PROCESSING VULNERABILITIES

Because of the global nature of the food system, a very small share of total food consumed in a city is processed and packaged locally. Food processing, therefore, does not typically create vulnerabilities for local food availability because most food consumed locally is processed elsewhere. For example, if a major earthquake in Los Angeles did impact food processing plants located in the region, it would have minimal impact on the food supplied to Los Angeles, which is sourced from plants across the country and world. There are some exceptions. Milk, for example, is highly perishable and has to be transported from farm to consumer relatively quickly. Therefore, in many cities, milk is supplied and processed by regional dairy farms and processing facilities. In Boston, for example, we found that 12 processing plants within 75 miles of the city supply the majority of Boston’s milk. To identify relevant food processing vulnerabilities for this study, we analyzed the location of regional milk processing plants in “at risk” areas.²² A full analysis of all food processing vulnerabilities was beyond the scope of this study.

Because of the global nature of the food system, a very small share of total food consumed in a city is processed and packaged locally.

In many cities, local food production (urban farming) and local food processing are expanding. This is being done in part to help mitigate risks associated with importing food grown in areas susceptible to climate change issues (e.g., drought in California). Efforts to increase the number of local food manufacturing companies also supports the creation of local jobs, often in areas with high unemployment. In addition, new technology (e.g., vertical and container farms) creates the possibility of growing enough food in urban areas, even in northern climates, to meet at least some demand for fresh food.²³ While it is unlikely that food produced in cities would become a significant share of food consumed locally in the near future, this could eventually pose an additional vulnerability. A greater reliance on locally-produced and processed food would increase food system vulnerabilities associated with local natural disasters. The increase of farms and processors within a city creates greater vulnerability because of the likelihood that the disaster would destroy the farms and processing facilities. In that event, food retailers and households would need to find alternative sources of food and rebuild food supply chains, which cannot be done quickly. In each city we explored the share of food consumed that was produced and processed locally. Although definitive data was lacking, the experts we interviewed said the current share of locally-produced food (defined as food grown within the city or very proximate surrounds) was still relatively low.

FOOD DISTRIBUTION VULNERABILITIES

The distribution of food in the U.S. is a complex process and food products follow different paths from farm to retail. Our focus is on the vulnerability of food retail supply chains. Food retailers generally receive all of their products from three different types of suppliers: a primary warehouse supplier (also called wholesaler or distribution center), secondary suppliers, and direct store delivery.²⁴ Warehouse suppliers purchase products from processing facilities, store the products and ultimately deliver them to food retailers.²⁵ The primary warehouse supplier sources the majority of products sold by the retailer. Secondary suppliers provide additional products that the primary supplier doesn't carry, including more specialty products and unique brands. With direct store delivery, products are shipped directly from the grower or processing facility to the food retailer. Direct store delivery is limited to certain products—typically carbonated beverages, milk, bread, salty snacks, prepared frozen foods and some fresh produce.²⁶ Supermarkets typically have a vertically-integrated supply chain, meaning they own their primary warehouse supplier.²⁷ Smaller stores generally rely on independently-owned warehouse suppliers.

Large warehouse supplier facilities are generally located outside of city limits, while some smaller secondary suppliers, local wholesalers and distribution centers are located within the city. In some cities, local wholesalers and distribution centers (generally dealing primarily with fresh meat, fish and produce) are clustered together in one industrial area. In addition, many coastal cities have a large fresh food distribution center (also called a fresh food wholesale market) with wholesalers and distributors that primarily serve the city's smaller grocery stores and corner stores.²⁸

To identify food distribution vulnerabilities, we analyze the location of warehouse supplier facilities in “at risk” areas. We include the majority of warehouse suppliers (vertically-integrated and independently-owned) serving a city's supermarkets, regardless of their location, and all warehouse suppliers operating in the city.²⁹ We are prevented from identifying all warehouse suppliers that serve a city's smaller, independently-owned grocery stores and corner stores because of the number of stores involved. However, we know that they typically rely on local warehouse suppliers, meaning that many of their suppliers are likely operating in the city. In New York City, data limitations also prevented us from identifying all warehouse suppliers serving the city. Instead, we identified the wholesalers operating in the city's fresh food wholesale market, which is relevant for the unique food retail landscape in New York City (it comprises more corner stores and smaller grocery stores than other cities).

The food distribution industry has become more consolidated and very competitive, and in the event of a natural disaster, warehouse suppliers will do everything they can to recover as quickly as possible and deliver supplies to avoid losing customers. Many large food retailers require their warehouse suppliers to have business continuity plans in place in order to secure their purchasing contracts. Large food retailers also may work

The distribution of food in the U.S. is a complex process and food products follow different paths from farm to retail. Our focus is on the vulnerability of food retail supply chains.

directly with suppliers to improve their business continuity planning. For example, in an interview with Price-waterhouseCoopers, Walmart’s Senior Director of Global Emergency Management explained that Walmart works with its suppliers to make sure they meet minimal standards of business continuity, stating, “If they’re not able to provide the goods we need, then—even if we have the best continuity plans as a company—that’s going to impact our ability to recover from a disaster.”³⁰

Food distribution networks are generally fragmented, with different suppliers in different locations, creating some resilience. National and vertically-integrated warehouse suppliers are also better prepared to handle disruptions because they have multiple locations and resources to invest in structural improvements to withstand disasters, including backup power and buildings designed to withstand earthquakes. Smaller, local warehouse suppliers and distributors are less likely to have business continuity plans in place, generally operate in only one location, and are less likely to invest in making their facilities more resilient to disaster. This creates a greater likelihood of supply disruptions to the food retailers they serve—mostly smaller grocery and corner stores.

Nearly all food is distributed to retail points by truck, making roads, bridges and tunnels critical points of vulnerability for food distribution. Reliance on one primary transportation route creates additional vulnerabilities. For example, 94 percent of Boston’s food arrives by truck and a storm surge the same size as Superstorm Sandy could flood most of the major north-south interstate in Boston, a critical route connecting warehouse suppliers to Boston retailers.

Nearly all food is distributed to retail points by truck, making roads, bridges and tunnels critical points of vulnerability for food distribution.

To identify transportation vulnerabilities for this report, we analyze two factors: the existence of alternative food truck transportation routes into the city, and the vulnerability of major transportation routes into the city to extended closures after a natural disaster. For each city, we identify all major interstates and U.S. highways that traverse the city. We assume the same scenarios as in our “at risk” analysis. For this report we did not analyze two additional potential food distribution vulnerabilities: fuel supplies and “last mile” transportation within the city to food retailers. They were beyond the scope of our research.

FOOD RETAIL VULNERABILITIES

Three characteristics of urban food retail environments *at the neighborhood level* matter for resilience: the number of food retail stores per capita (i.e., is the neighborhood underserved); the mix of supermarkets, grocery stores and corner stores; and the location of food retail stores in “at risk” areas. Food retailers include supermarkets, grocery stores, and corner stores (which include bodegas and convenience stores). Supermarkets are formally defined in this report as grocery stores with \$2 million or more in annual revenue, the definition used by the Food Marketing Institute.³¹

A neighborhood analysis is important because city averages can mask significant disparities in food access. In most cities, neighborhoods are not equally served by the same number of food retail stores, creating local food availability vulnerabilities. While the concept of food deserts refers to limited access to a grocery store or other healthy, affordable food retail stores, we are concerned with the availability of food in general.³² In areas that are underserved by all types of food retailers, individual store closures will have a significant impact on food availability.

Smaller grocery stores and corner stores that are independently-owned, and not part of a national or regional chain, are likely to be less resilient to natural disasters. This group of food retailers may face longer periods of closure after a natural disaster because they have fewer resources and are less likely to have adequate business continuity plans or sufficient insurance (e.g., flood, earthquake or business interruption).³³ For example, research has found that small businesses in the Gulf Coast impacted by Hurricane Katrina had not adequately planned for a disaster and did not have

access to sufficient capital for recovery.³⁴ Independent owners of smaller food stores typically need to cover all costs associated with reopening their business while waiting for reimbursement from their insurance companies and assistance from public agencies. For some business owners, these costs can be prohibitive and they simply don't have the resources to reopen. They may also lack sufficient insurance to cover extensive damages. However, New York City's food supply study found that food retailers are more likely to purchase insurance to prepare for a disaster instead of making capital investments, such as purchasing a backup generator, because insurance is often the lower cost option. Further, many food retailers rent and therefore do not have the incentive (or may not be allowed) to improve their business space. In addition, the application process for public disaster recovery funds often requires a lot of time for business owners and the distribution of funds is often delayed and inefficient.

The majority of supermarkets are likely to have short- and long-term business continuity plans in place. Smaller grocery stores are likely to have short-term business continuity plans, but may not be prepared for long-term supply chain disruptions. In addition, as one national retail expert explained, "The absence of planning for catastrophes isn't just an oversight. In many cases stores are at the mercy of distribution chains and there may not be much they can do other than cross their fingers and hope for the best." Independently-owned corner stores are unlikely to have any continuity plans in place and have limited access to supply chains, meaning it would take them longer to fully restock their food.³⁵

The location of food retail stores in "at risk" areas creates additional food availability vulnerabilities. Food retail stores in neighborhoods that are likely to be hardest hit by a natural disaster clearly face the greatest risk of closure, regardless of their size. For example, in Boston, a storm surge the same size as that created by Superstorm Sandy could flood nine grocery stores and 59 corner stores, disproportionately impacting food availability in three neighborhoods.

Smaller grocery stores and corner stores that are independently-owned, and not part of a national or regional chain, are likely to be less resilient to natural disasters.

Thus, we define neighborhoods with vulnerable food retail as those that have no food retail stores or that have the following characteristics: (1) fewer food retail stores per capita than the city average (i.e., the neighborhood is underserved); (2) the share of supermarkets is lower than the city average (i.e., residents rely more on smaller grocery and corner stores for daily food needs); and (3) more than 50 percent of all food retail stores are located in “at risk” areas. To analyze the location of food retail stores, we use Dun and Bradstreet data.³⁶ Our analysis excludes general retail stores that sell food (e.g., Target and Walmart). Our analysis also excluded another potential retail vulnerability: the ability of food retail employees to make it to work. This was beyond the scope of our research.

In our framework, we do not consider food consumption at institutions (e.g., schools, hospitals and prisons), caterers, and restaurants, and focus solely on food retailers and food banks. Most institutions are supplied by national food service providers that would not be vulnerable to a local natural disaster, and universities, hospitals and institutions would likely be evacuated if there was advance notice of a disaster. Restaurants are an important component of urban food systems, and while we don’t address this sector specifically, they would be impacted by distribution vulnerabilities in a similar manner as retailers.

FOOD INSECURITY

In the U.S., roughly 48 million people (or 15 percent of the population) are food insecure (unable to purchase adequate food).³⁷ In the aftermath of a disaster, households that are already food insecure face additional challenges, while other households may become food insecure due to disaster-related expenses and hardships, such as loss of income or property damage.

The two primary federal nutrition assistance programs that subsidize food purchases are the Supplemental Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), both of which are managed by the U.S. Department of Agriculture (USDA). While the USDA is not a first response agency, it is able to assist food insecure households after a disaster by providing USDA Food to help supplement meals distributed by disaster feeding organizations and approving a state to operate a Disaster Supplemental Nutrition Assistance Program (D-SNAP).³⁸ D-SNAP provides one month of nutrition assistance benefits to households who may not normally qualify for SNAP, but meet certain income criteria and incur disaster-related expenses, such as loss of income, property damage, relocation expenses, and, in some cases, food loss.³⁹ D-SNAP is only available for households that are not currently receiving SNAP benefits. Applicants must apply in-person for D-SNAP benefits at designated application sites. For households already receiving SNAP benefits, USDA may authorize disaster supplements for one month, providing benefits equitable to D-SNAP recipients. In addition, USDA can provide a waiver to allow for the purchase of hot, prepared foods through SNAP or D-SNAP, which are normally not eligible for purchase.

Food insecurity, the inability to purchase adequate food because of limited financial resources, is a significant problem that was worsened by the Great Recession.

States must request approval from USDA to operate D-SNAP and have a D-SNAP plan in place to administer the benefits. USDA recommends beginning D-SNAP operations no earlier than one week after a disaster hits to ensure that food retail stores are open and there is sufficient time for damage assessments, publicity, staff training and site preparations. In addition, SNAP and D-SNAP benefits are issued through an Electronic Benefits Transfer (EBT) card, meaning telecommunication networks need to be functioning in order to process benefits. Few purchasing restrictions exist for SNAP and D-SNAP, but there are restrictions for WIC, which vary by state. Not all WIC state agencies have transitioned to EBT and some still issue vouchers or checks. In these states, authorized WIC retailers are not allowed to accept vouchers or checks if the participant does not purchase all of the items listed on their voucher or check. The retailers are not allowed to substitute items. In the aftermath of a disaster, retailers may not have all the products eligible for WIC benefits, making it difficult for food insecure households to use this benefit. WIC regulations allow state agencies flexibility in program design and administration to support continuation of benefits during disasters.⁴⁰ Additional requests, such as partially redeeming WIC benefits or substituting certain food items or food package sizes, are reviewed and approved by USDA on a case-by-case basis.

Local food pantries also play a pivotal role in supplementing food supplies for food insecure households. Food pantries typically obtain most (approximately 75 percent) of their food from a regional food bank.⁴¹ In the aftermath of a disaster, demand for food from food pantries, and thus from food banks, is likely to increase for a prolonged period of time. Neither, however, may have the capacity or resources to meet increased demand over a longer time period. Feeding America, a nationwide network of 200 member food banks and 60,000 food pantries, provides food to its members during disasters, but this assistance is meant to be short-term. Feeding America also plays an active role in recovery efforts following major disasters by providing local organizations with food, water and trained staff, while also providing specialized disaster training for its food banks around the country. Feeding America has a long-standing engagement with other non-governmental organizations involved with disaster relief through National Voluntary Organizations Active in Disaster, an association of organizations providing support services after a disaster. In 2005, Feeding America formalized its commitment to providing aid during times of disaster with FEMA and the partnership was renewed in 2009. Feeding America has a similar partnership with the American Red Cross. In addition, food banks in the Feeding America network may be able to access additional food resources from the U.S. Department of Agriculture's Emergency Food Assistance Program (TEFAP) after some disasters.⁴² Feeding America provides ongoing expertise and resources to aid long-term recovery.

In the aftermath of a disaster, demand for food from food pantries, and thus from food banks, is likely to increase for a prolonged period of time. Neither, however, may have the capacity or resources to meet increased demand over a longer time period.

In spite of the support from Feeding America, hunger relief organizations are vulnerable because of the uncertainty surrounding how they would meet increased demand for an extended period of time. To analyze this issue, we focus on food bank vulnerabilities since food banks are the backbone of urban food safety nets. In

particular, we look at the ability of food banks to meet current demand, their plans to meet sustained increased demand (including funding models), and their location in “at risk” areas.

To analyze food insecurity at the neighborhood level, we use the share of households receiving SNAP benefits as a proxy. Studies have shown that individuals receiving SNAP benefits are significantly more likely to be food insecure than individuals not receiving SNAP benefits.⁴³ We identify neighborhoods with vulnerable food access as those identified as having vulnerable food retail and higher SNAP rates than the city average.

THE ROLE OF GOVERNMENT IN FOOD SYSTEM RECOVERY

City, county and state governments play an important role in helping the food system recover after a natural disaster. Adequate disaster preparedness planning with private industry can ensure more effective and coordinated responses in the aftermath of a disaster. During a disaster, efficiently and effectively sharing information between government agencies and private-sector food businesses can help businesses return to normal operations as quickly as possible. Businesses may be confused about who to contact for relevant and timely information and, in turn, government agencies may not know the best way to effectively share information. In each state and city, we analyze the relationships between food retail trade associations (which exist at the state level) and city or state emergency management offices, including whether they have a seat at the table in Emergency Operations Centers during declared states of emergencies. Such partnerships help to marshal the business community to assist with disaster recovery (e.g., providing donated food and water supplies) and identify the resources businesses need to prepare for disasters and quickly return to normal operations (e.g., identifying transportation routes or other infrastructure requiring maintenance). Finally, the associations also help to catalyze food retailers to establish business continuity plans and assist them with resilience planning.

Government agencies can also provide capital to business owners to help them rebuild and reopen for business. They are also essential in ensuring food insecure households have access to D-SNAP benefits and opportunities to use WIC benefits after a disaster. In each state and city, we explore the existence of emergency funding plans for food businesses and D-SNAP plans.

However, government agencies also have policies and practices that may unintentionally impede the recovery of food businesses. We focus on food safety inspections, the construction permit process and food transportation restrictions. In most cities, food processing plants, warehouse suppliers and food retail stores are routinely inspected by local or state agencies to ensure a safe food supply. After a disaster, businesses may be unable to resume operations until passing a food safety inspection. This process, coupled with limited resources for inspections, may lead to delays in the re-opening of food businesses. In addition, construction can often not begin on buildings until after a construction permit is obtained, which may slow rebuilding efforts of damaged facilities. Finally, transportation restrictions, such as prohibiting food distribution trucks from entering impacted areas, will slow the distribution of food immediately after a disaster.

Hurricane and Earthquake Threats to Food Systems

Our analysis of Los Angeles, New Orleans and New York City surfaces new insights into urban food vulnerabilities. The comparative analysis finds both shared vulnerabilities and unique weaknesses that are a function of differences in each city's food system and their exposure to different natural disaster risks. We found very minimal food processing vulnerabilities in the three cities.⁴⁴ As a result of this finding, we focus our discussion on food distribution and food access vulnerabilities.

FOOD DISTRIBUTION VULNERABILITIES

All three cities face food distribution vulnerabilities because of the location of some warehouse supplier facilities in “at risk” areas. Los Angeles faces the greatest risk, with the vast majority of its warehouse suppliers subject to earthquake damage. In New Orleans and New York City, only local warehouse suppliers are at risk, creating greater risks for their smaller grocery and corner stores,

which rely more on local warehouse suppliers for their food supplies. Hunts Point, New York City's fresh food distribution market, highlights the unique vulnerabilities associated with this type of market.

All three cities face food distribution vulnerabilities because of the location of some warehouse supplier facilities in “at risk” areas.

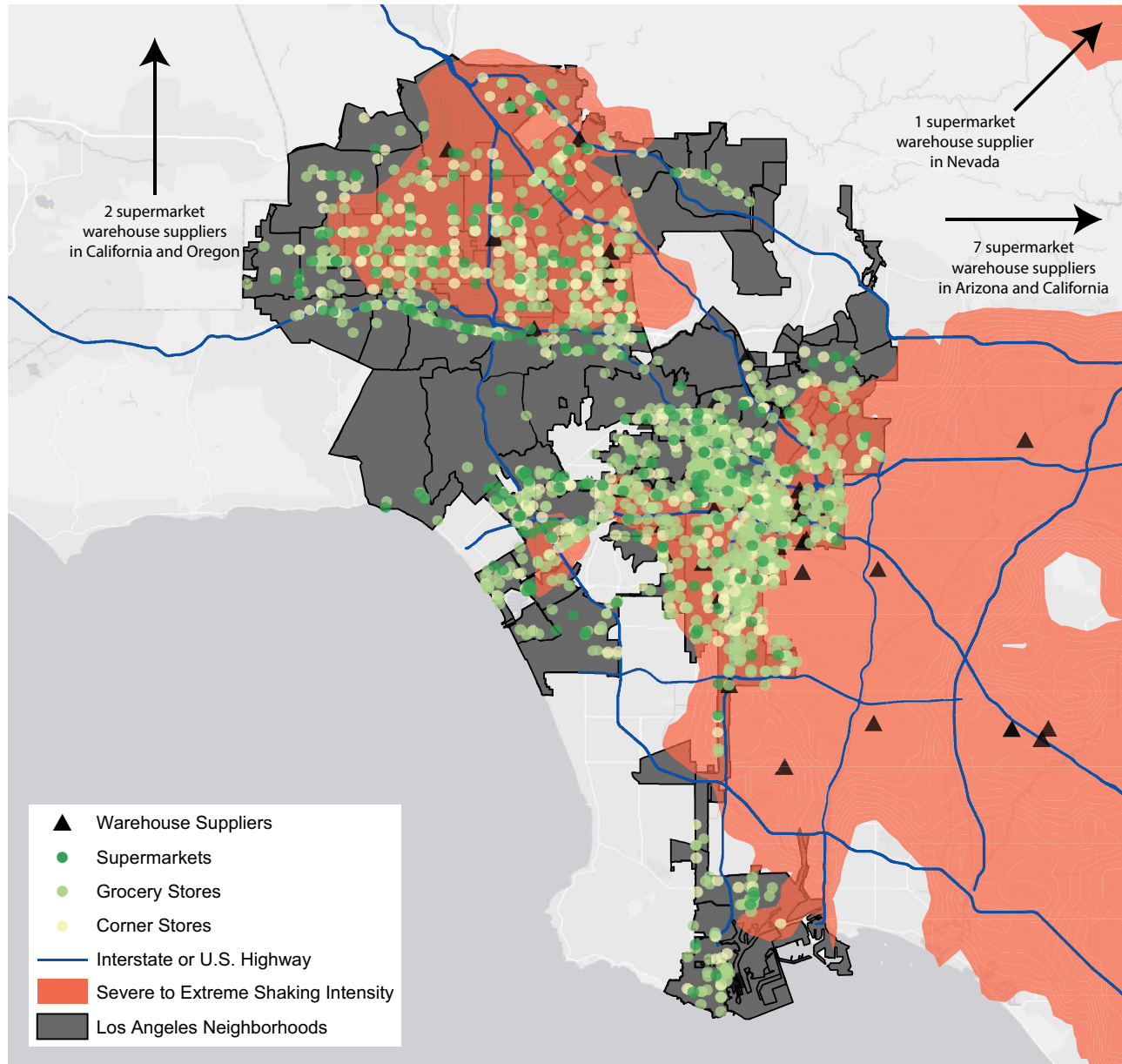
In Los Angeles, 15 of its 22 supermarket warehouse suppliers (68 percent) are located in “at risk” areas, putting them at risk for slight damage to specially-designed structures and considerable damage to ordinary structures (Figure 4). Of the 60 warehouse suppliers located in Los Angeles, 42 (70 percent) are located in “at risk” areas. In addition, Los Angeles has a fresh food distribution market, the Wholesale Produce Market, which serves the city's smaller grocery stores and corner stores. It is also located in an “at risk” area. Our findings are consistent with the EMD study. The EMD study, which included additional warehouse suppliers beyond those serving supermarkets, also noted that most warehouse suppliers located outside of the city are located in areas expected to experience “strong” to “extreme” shake intensity levels and may be vulnerable to facility damage or road closures in the event of an earthquake. Eighteen warehouse suppliers located in Riverside and San Bernardino Counties, east of Los Angeles, are also located in “at risk” areas.⁴⁵

The Wholesale Produce Market was built in 1986 and, therefore, is not likely to be able to withstand strong or extreme shaking. According to a distribution expert that worked in the Produce Market, individual companies that either own or lease space within the Produce Market explored the feasibility of adding an emergency generator, but ultimately decided that it wasn't feasible because of structural issues with the building.

New warehouse supplier facilities built in the last few years in Los Angeles are likely able to withstand significant damage. For example, in 2015, Whole Foods built a 128,000 square foot distribution center in Los Angeles County that serves the company's 56 stores in Arizona, Hawaii, Southern California and Nevada. The state-of-the-art facility meets the latest seismic standards and is fitted with earthquake-resistant racking that helps prevent product damage.⁴⁶

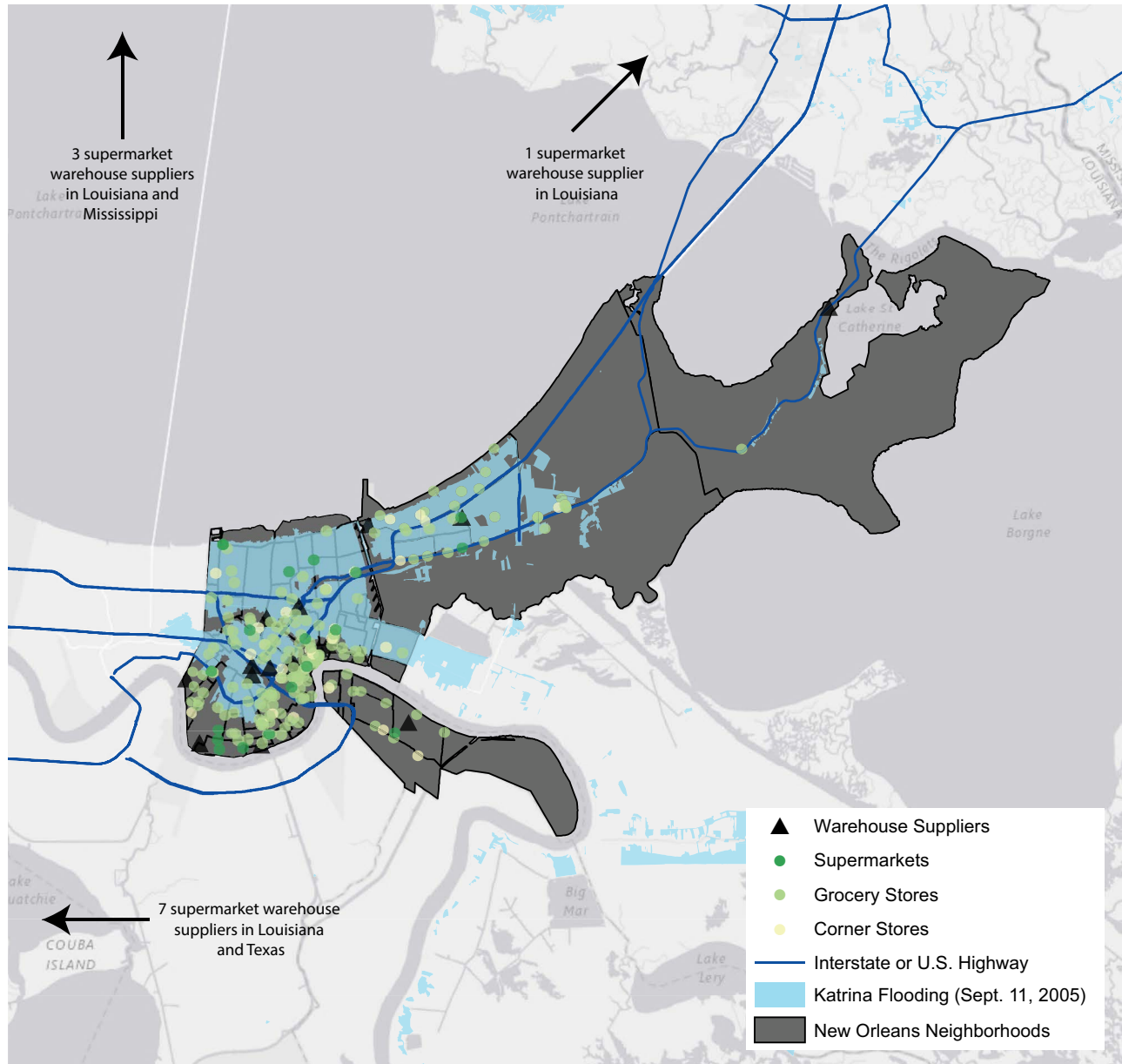
In New Orleans, none of the city's 11 supermarket warehouse suppliers are located in "at risk" areas (Figure 5). Of the 19 warehouse suppliers located in New Orleans, seven (37 percent) are located in "at risk" areas. New Orleans does not have a fresh food distribution market.

FIGURE 4. LOS ANGELES FOOD SYSTEM



Sources: Dun and Bradstreet's Hoover's Database (2016); U.S. Geological Survey, *Earthquake Planning Scenario ShakeMap: Shakeout Scenario* (2008); Zillow, *Zillow Neighborhood Boundaries* (n.d). Warehouse suppliers were identified using City or State business data and as those publicly listed on websites, annual reports and industry reports as suppliers for supermarkets operating in Los Angeles.

FIGURE 5. NEW ORLEANS FOOD SYSTEM



Sources: Dun and Bradstreet's Hoover's Database (2016); Federal Emergency Management Agency, *Katrina Receded Flood September 11, 2005* (2005); The Data Center, *New Orleans Neighborhoods* (2005). Warehouse suppliers were identified using City or State business data and as those publicly listed on websites, annual reports and industry reports as suppliers for supermarkets operating in New Orleans.

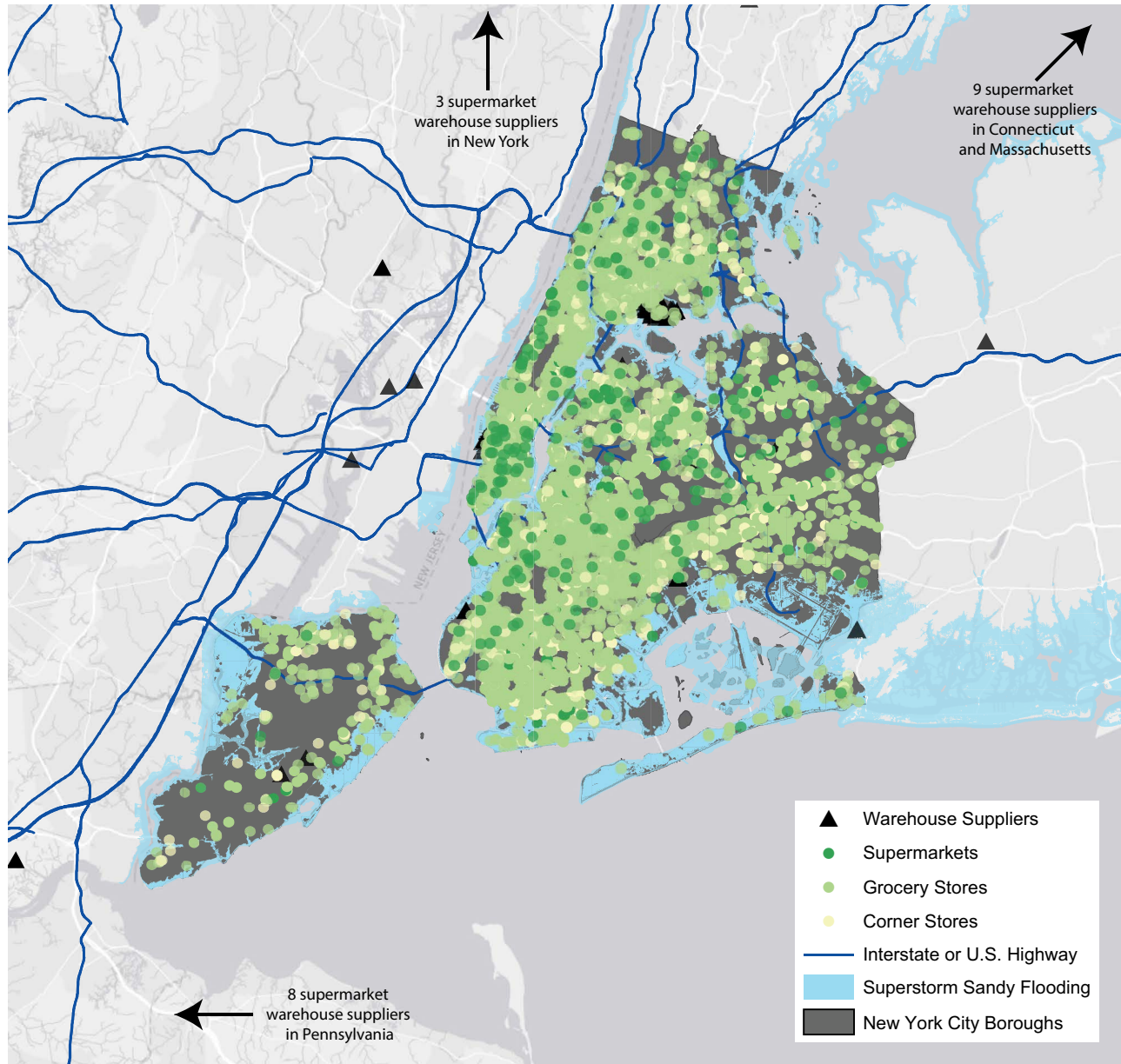
In New York City, none of the city's 25 supermarket warehouse suppliers are located in "at risk" areas (Figure 6). Of the 229 wholesalers located in the city's fresh food wholesale markets, only 10 (four percent) are located in "at risk" areas. Most of the city's wholesale facilities (70 percent) are located in the city's largest fresh food market, Hunts Point Food Distribution Center, which was only marginally impacted by Sandy. These findings are consistent with the *Five Borough Food Flow* study, which points out that the highly fragmented nature of the City's food distribution network creates some resilience to food supply disruptions: "Because of the high fragmentation of the food distribution system (i.e., thousands of distributors serving tens of thousands of stores), the food system is unlikely to be significantly impacted by disruption to a single distributor..."⁴⁷

Hunts Point poses the greatest single point of food distribution vulnerability for the city because of the concentration of wholesalers in a single location, its relative importance to the city's food retailers and its location. This one market plays a disproportionate role in food distribution relative to similar markets in other cities because smaller grocery stores and corner stores, which rely more on fresh food markets, dominate the food retail landscape in New York City. Hunts Point is the largest food distribution center in the world and comprises three markets: the Hunts Point Produce Market, Hunts Point Cooperative Market (meat market) and the New Fulton Fish Market. In addition, there are a number of independent warehouses located in Hunts Point. The *Five Borough Food Flow* study finds that 25 percent of produce, 35 percent of meat, 45 percent of seafood, and 12 percent of all food distributed within the City moves through Hunts Point.

Hunts Point is located on 329 acres on a peninsula in the Bronx, surrounded by rivers on three sides, making it vulnerable to flooding from storm surges. Hunts Point was not flooded during Sandy largely because the storm hit the area at low tide. *A Stronger, More Resilient New York*, a comprehensive report that includes recommendations to increase the resilience of New York City based on lessons learned from Sandy, strongly urges the City to focus on the risks of another superstorm, which may have a greater impact: "Sandy spared Hunts Point the worst of its impacts largely because it hit New York at low tide in the Long Island Sound. However, complacency in the wake of Sandy would be a mistake, as the food supply system may not escape significant impacts in the next extreme weather event."⁴⁸ According to the New Fulton Fish Market manager, "Sandy could have been a lot worse, causing a long-term disruption to the seafood supply chain for the 40 seafood wholesalers and thousands of dependent businesses down the supply chain, leaving businesses scrambling to find ways to operate." While the Fish Market has flood insurance that would cover damage to the buildings, the individual wholesalers operating in the market have to carry their own business interruption insurance to cover their losses.

Hunts Point poses the greatest single point of food distribution vulnerability for New York City because of the concentration of wholesalers in a single location, its relative importance to the city's food retailers and its location. This one market plays a disproportionate role in food distribution relative to similar markets in other cities.

FIGURE 6. NEW YORK CITY FOOD SYSTEM



Sources: Dun and Bradstreet's Hoover's Database (2016); Federal Emergency Management Agency, *Federal Emergency Management Agency Modeling Task Force – Hurricane Sandy Impact Analysis* (2015); New York City Department of City Planning, *Borough Boundaries* (2016). Warehouse suppliers were identified using City or State business data and as those publicly listed on websites, annual reports and industry reports as suppliers for supermarkets operating in New York City.

It would be difficult for wholesalers in Hunts Point to return to normal operations quickly if the facilities were closed for an extended period of time because of storm damage. It is difficult and costly to find temporary alternative distribution sites, in part because of health regulations, the dearth of large, vacant facilities that could handle the volume and transportation needs of a wholesaler, and additional transportation costs if the alternative site was not proximate to the city. In addition, it would take some time to establish alternative operations. It is unknown how many wholesalers at Hunts Point have business continuity plans in place to deal with a natural disaster. Backup generators could maintain some level of operations in the event of power outages as long as there was access to sufficient fuel. However, they are costly to install and the facility may not have the physical structure to support a backup generator large enough to maintain full operations. According to a representative from the Hunts Point Produce Market, the Produce Market currently does not have the capability to hook up to modern generators for backup power. The representative assumes the same is true for the other Hunts Point markets.

Vulnerable Transportation Routes

All three cities have vulnerable transportation routes, creating potential supply chain disruptions in the aftermath of a disaster. Although all three cities have multiple routes food trucks can take to enter the city, some of the major roadways are vulnerable to extended closures in the aftermath of a disaster. Both New York City and New Orleans are surrounded by water, funneling food distribution trucks onto bridges and tunnels, some of which are inherently prone to flooding because of their proximity to water. In Los Angeles, most of the transportation routes into the city would be impacted by the earthquake scenario we analyzed.

All three cities have vulnerable transportation routes, creating potential supply chain disruptions in the aftermath of a disaster.

Of the three cities, New York City has the most major roadways: four east-west interstates and U.S. highways, and eight north-south interstates and U.S. highways. In New York City, trucks travel on various bridges and tunnels into the five boroughs, although some tunnels are closed to truck traffic due to low clearance.⁴⁹ The *Five Borough Food Flow* study reported that 50 percent of the city's food travels through four major bridges and two tunnels. The George Washington Bridge, connecting Fort Lee, New Jersey to Manhattan over the Hudson River, is used the most for food transportation. It is estimated that nearly 30 percent of the truck traffic over the bridge is carrying food⁵⁰ and over 45 percent of deliveries to Hunts Point use the George Washington Bridge.⁵¹

Sandy surfaced some of the potential bridge and tunnel vulnerabilities in the city, although they were not significantly impacted by the storm. Due to concerns about high winds and flooding, the city's major bridges and tunnels (with the exception of the Lincoln Tunnel) were closed prior to Sandy hitting landfall. All of the city's 15 major bridges were reopened the day after the storm was over. Due to flooding, three major tunnels remained closed for multiple days. Other tunnels took longer to reopen, up to three weeks after Sandy.⁵² Although bridges reopened quickly, many bridges (excluding the George Washington Bridge) restricted single

occupancy vehicles (including trucks) for three days, leading to minor delays in food transportation.⁵³ Despite delays, the Hunts Point Distribution Center was able to receive deliveries the day after Sandy. Overall, food distribution continued to function “reasonably well” after the storm.⁵⁴

New Orleans has the fewest major transportation routes of the three cities. The city is served by four east-west interstates and U.S. highways (I-10, US-90, I-510, I-610) and two north-south interstates and U.S. highways (US-11, US-61). I-10, one of the metropolitan area’s major trucking routes,⁵⁵ is the only interstate running through New Orleans, making it the most critical route for food transportation into New Orleans. The I-10 Twin Span Bridge, a six-mile causeway, crosses Lake Pontchartrain and connects New Orleans to other parts of Louisiana. Interstate traffic from I-10 east of New Orleans must cross the Twin Span Bridge to enter the city.

Hurricane Katrina damaged at least 33 bridges and destroyed sections of major transportation routes, including I-10 and the LA-Causeway, a 23.8-mile causeway crossing Lake Pontchartrain.⁵⁶ Highways and bridge repairs took one month to complete for the LA-Causeway and six months for I-10.⁵⁷ A warehouse supplier, Associated Wholesale Grocers, opened a new facility across Lake Pontchartrain in 2013. This facility serves independent grocery stores across the Gulf Coast.⁵⁸ If I-10 were to close again, this would likely cause significant delays in food shipments to these stores in New Orleans. It is the only warehouse supplier located in this area.

Los Angeles has multiple interstates and U.S. highways running through the city, including four east-west interstates and U.S. highways (I-10, I-110, I-210, I-710) and four north-south interstates and U.S. highways (I-5, US-101, I-105, I-405). In the aftermath of the 1994 Northridge Earthquake, two major interstates (I-10 and I-5) and other roads were closed, but food distribution trucks were able to find alternative, albeit longer, routes.⁵⁹ However, the EMD study and other experts we interviewed cited roadways as perhaps the biggest vulnerability for the city’s food system. The EMD study identified I-10, I-15 and California Highway 14 as critical food transportation routes connecting warehouse suppliers to retailers in the city. The study estimated that damage to these roads could lead to road closures lasting days or weeks. However, many of the food distribution and emergency management experts we interviewed admitted that it was difficult to imagine a scenario where road access to all grocery stores would be completely cut off.

FOOD RETAIL VULNERABILITIES

Our analysis of food retail quantity, mix, and location suggests that for every city, food availability in some neighborhoods will be disproportionately impacted by a natural disaster. The greatest disparities in food availability still exist in New Orleans, but all three cities have some neighborhoods where food retail is vulnerable. We learn from Katrina and Sandy that delayed or inadequate insurance and government assistance payments can hold up the reopening of smaller grocery and corner stores, adding another layer of food availability vulnerability in these neighborhoods.

Los Angeles and New Orleans represent typical American cities with a mix of national and regional supermarket chains, independent grocery stores, and corner stores, but the mix varies by neighborhood. The food retail environment in New York City is unique in the U.S. in that most food retailers in the city are smaller grocery stores and corner stores distributed relatively evenly throughout the city.

Throughout Los Angeles, 51 percent of supermarkets, 64 percent of grocery stores and 65 percent of corner stores would likely be significantly damaged by the earthquake scenario we analyzed. There are 16 neighborhoods out of 84 (19 percent) with vulnerable food retail.⁶⁰ One of the neighborhoods has no food retail stores. These neighborhoods are located throughout Los Angeles, but are largely concentrated in the northern, southern and eastern tips of the city. The EMD study identified an additional seven communities as potentially facing challenges in accessing food in the immediate aftermath of a disaster.⁶¹ Additional research is needed to assess how many food retail stores have been upgraded or were designed to meet seismic standards.

In Los Angeles, there are 16 neighborhoods out of 84 (19 percent) with vulnerable food retail.

In New Orleans, there are 23 neighborhoods out of 73 (32 percent) with vulnerable food retail.⁶² Twelve of the neighborhoods have no food retail stores. Throughout the city, 53 percent of supermarkets, 42 percent of grocery stores, and 53 percent of corner stores are located in areas that were flooded after Katrina. Food access disparities existed pre-Katrina, but were exacerbated by the hurricane. In 2007, two years after Katrina, predominantly African-American neighborhoods were 65 percent less likely to have access to an additional supermarket compared to non-African-American neighborhoods.⁶³ Due to the extent of the damage it caused in New Orleans, Katrina made it difficult for even the largest supermarkets to return to normal operations. Roads remained closed and many areas lacked power for extended periods of time. Two years after the storm, half of the city's supermarkets remained closed.⁶⁴ Six months after Katrina, only one of the two Walmart stores operating in New Orleans had reopened.⁶⁵ The other, located in New Orleans East, permanently closed. In that same time period, the two Whole Foods operating in the New Orleans area reopened, but neither were located in neighborhoods that experienced extensive flooding.⁶⁶ In 2005, there were 392 total "food access points," which includes supermarkets, grocery stores, and corner stores, in New Orleans. By 2007, the number of food access points had decreased by 62 percent to 148.⁶⁷

In New York City, four percent of supermarkets, four percent of grocery stores and four percent of corner stores are located in areas that were flooded by Sandy. We identified only seven neighborhoods out of 195 (four percent) with vulnerable food retail.⁶⁸ All neighborhoods have some food retail stores. Four vulnerable neighborhoods are located in Brooklyn and three are located in Queens. Parts of Brooklyn and Queens were some of the hardest hit areas by Sandy.

According to food access and grocery store experts, in the aftermath of the storm, some local grocery stores and corner stores in Staten Island and in the Rockaways were closed for an extended period of time—in some cases months or over one year. For example, a Key Food supermarket located in the Rockaways suffered extensive damage after Sandy and reopened "one year, five months and six days" after the storm.⁶⁹ Grocery stores and corner stores were impacted by flood damage, power outages and mandatory resident evacuations that prevented business owners from returning to their stores. The situation in these communities also highlights the importance of public transportation for some populations as a means to access food. The Rockaways is a coastal peninsula with limited public transportation access. Due to infrastructure damage, public transporta-

tion service to the Rockaways was closed until May 2013, over half a year after Sandy, making it difficult for some residents to travel to purchase food in other areas.⁷⁰ Emergency food distribution programs operated through that spring in the Rockaways to ensure people had access to adequate food.⁷¹ In contrast, in other harder hit areas in the city, a greater number of retail options and access to public transportation prevented food availability issues.

In both New York City and New Orleans, delayed or inadequate insurance and government assistance payments also hampered the reopening of smaller grocery and corner stores. In the case of New Orleans, many businesses were denied private insurance claims, offered lower than expected settlements, and payouts were delayed in some instances for years.⁷² Federal disaster assistance loans were also often denied. For example, an Associated Press investigation found that 55 percent of businesses seeking low-interest disaster loans from the U.S. Small Business Administration (SBA) after Katrina were denied, and 60 percent of approved loans never reached applicants.⁷³ The situation was similar in New York City. The extended closures of smaller food retail stores were due in part to businesses having inadequate private flood or business interruption insurance,⁷⁴ as well as delayed SBA disaster loans. A federal investigation found that the SBA took roughly twice as long as intended to approve disaster loan applications for home and business owners. It took the SBA 45 days on average to process disaster loan requests for damages and 38 days to process financing requests to cover economic losses.⁷⁵ SBA disaster loans are administered by the federal government. In the aftermath of Sandy, both the City and State launched new low-interest loan programs to assist small businesses in need of financial assistance. The State's Small Business Recovery Loan Fund was activated less than a month after Sandy and the City's Hurricane Sandy Business Loan and Grant Recovery Program was launched seven months after the storm.⁷⁶

The extended closures of food retail stores in New Orleans also reflect the market uncertainties businesses have to face in the aftermath of a disaster that causes a massive evacuation. One year after the storm, the city's population overall had declined by approximately 50 percent, with some neighborhoods losing an even greater share of their residents.⁷⁷ Since food retail stores serve local populations, doing business in some of these neighborhoods may have no longer seemed profitable to their owners. When asked about why some grocery stores were slow to return to the city, one food policy expert in New Orleans responded, "I can't speak to their business reasons, but I imagine in an area that's just not coming back and with no promise of customers because no one knew if NOLA would come back, there was a lot of uncertainty."

In response to the lack of food retail stores in the city, the City of New Orleans has prioritized increasing the number of grocery stores and improving access to healthy foods. The City's strategic recovery and rebuilding plan included recommendations to increase the number of supermarkets within most of the City's recovery zones.⁷⁸ To increase the number of grocery stores in New Orleans' neighborhoods that are traditionally

In the aftermath of the storm, some local grocery stores and corner stores in Staten Island and in the Rockaways were closed for an extended period of time—in some cases months or over one year.

AN INDEPENDENT FOOD STORE'S RESILIENCE

Circle Food Store, an independently-owned grocery store in the inner city 7th Ward neighborhood in New Orleans, flooded during Hurricane Katrina. While the outside structure remained in good shape, a host of electrical and plumbing issues were uncovered during the initial clean-up and rebuilding effort. Lacking sufficient insurance, Circle Food Store needed to secure funding to reopen. After eight years, with \$8 million in financing from state and federal tax credits and funds from the city and state, as well as technical assistance from Tulane University's architecture and business schools, Circle Food Store was able to reopen.⁷⁹

underserved by fresh food retail, the City of New Orleans launched the Fresh Food Retail Initiative (FFRI) in 2011, in partnership with Hope Enterprise Corporation (HOPE) and The Food Trust. The program provides forgivable or low-interest loans to supermarkets, grocery stores, and other fresh food retailers. The City provided \$7 million in Community Development Block Grants Disaster Recovery Assistance from the U.S. Department of Housing and Urban Development, while HOPE provides additional matching funds.⁸⁰ FFRI has been able to support the rebuilding efforts of local, independent grocery stores and attract national retailers to underserved communities.

FOOD INSECURITY INCREASES NEIGHBORHOOD FOOD VULNERABILITIES

Food insecurity is greatest in New Orleans, but all three cities we studied are struggling with significant rates of food insecurity, which is consistent with national trends. We also find that many of the vulnerable food retail neighborhoods identified in the previous section also include a higher share of SNAP recipients than the city average, creating vulnerable food access situations in these areas. Food banks in all three cities pose a vulnerability because of their locations in “at risk” areas and the challenges they would face meeting higher demand in the aftermath of a disaster for a prolonged period of time, given that they struggle to meet current demand.

In Los Angeles County, 14 percent of the population is food insecure, which is less than the national average (15 percent).⁸¹ Between 2002 and 2013, food insecurity increased by 40 percent, reaching what one report deemed “crisis levels.”⁸² Of the 16 neighborhoods identified as having vulnerable food retail, 14 have higher SNAP rates than the Los Angeles average.

IS URBAN FARMING PART OF THE SOLUTION?

In New Orleans, urban farming has been espoused as one response to addressing limited food access in low-income neighborhoods. Urban farms increased from one in the city pre-Katrina to 13 in 2015.⁸³ Experts caution, however, that such farms and farmer markets are not enough to meet the needs of the city's population and may have limited benefits for lower-income communities. Although farmers markets have been able to supplement some of the residents' demand for produce, they have limited capacity to provide a variety of healthy and affordable food items.⁸⁴ As the founder of Grow Dat, the largest urban farm in New Orleans put it bluntly, "It's hard to make it as a farmer, and I'm not faulting farmers for not meeting the needs of low-income communities. What we have is essentially a boutique local food movement serving a tiny percent of the population. We're the largest farm in the city and we're tiny—two acres. We make money because we sell 70 percent of our produce at high dollar to support our programs and allow us to donate 30 percent of our product at low or no cost." While the growth of urban farms and farmers markets after Katrina created some social and economic benefits, research found that alternative local food systems in New Orleans only provided temporary relief to food access gaps because of their limited inventory, limited business hours, and limited accessibility in comparison to full-service supermarkets.

The Los Angeles Regional Food Bank supports more than 600 food pantries, soup kitchens and other partner agencies in the County of Los Angeles.⁸⁵ According to a representative of the Food Bank, it is currently able to meet demand from the agencies it serves. In order to meet an increase in demand after a major earthquake, the Food Bank has a disaster relief fund set up to solicit and receive financial contributions through various relationships and partnerships. In addition, it would increase its hours of operation and work with local organizations in Emergency Network Los Angeles, a local network of Volunteer Organizations Active in Disaster to provide food. Additional funding would be needed for expanded operations. Based on a magnitude 7.8 earthquake scenario, our analysis shows that the Food Bank's facilities are located in an "at risk" area with the potential to experience "severe or extreme shaking." According to a Food Bank representative, one of the Food Bank's two facilities has recently been retrofitted to withstand a 7.8 magnitude earthquake, while the other has not yet been retrofitted.

In New York City, 16 percent of the population is food insecure, which is slightly higher than the national average.⁸⁶ Of the seven vulnerable neighborhoods, three have higher SNAP rates than the New York City average. In some parts of the city, Sandy increased food insecurity rates, at least temporarily. Citywide, a majority (60 percent) of food pantries and soup kitchens reported feeding more people at least partially due to Sandy a year after the storm.⁸⁷

Food Bank for New York City, which serves New York City, provides food for approximately 1,000 members, including food pantries, soup kitchens and schools.⁸⁸ The Food Bank provides approximately 63 million meals per year, but it cannot meet current demand. The Food Bank would need to provide 242 million additional meals per year to ensure all New York City residents had access to adequate food year-round.⁸⁹ Food Bank for New York City's warehouse is located in the Hunts Point Cooperative Market, which as noted above, is exposed to some flooding risk. The Food Bank played a critical role in disaster relief after Sandy, providing 4.5 million meals to the hardest hit communities in 2012. In addition, the Food Bank helped Sandy survivors access \$23 million in tax refunds available for Sandy relief.⁹⁰ After Sandy, Food Bank for New York City and

its member agencies worked with Toyota to improve the efficiency of its food distribution and feeding operations.⁹¹ According to a representative from Food Bank for New York City, the organization has a backup generator installed in its warehouse in preparation for a future disaster. It does not have a formal plan to meet an increase in demand from a future disaster, but would advocate for additional funding.

In New Orleans, approximately one-quarter of the population is food insecure—more than 1.5 times the national average.⁹² Of the 23 neighborhoods we identified as having vulnerable food retail, 18 have higher SNAP rates than the New Orleans average. According to Natalie Jayroe, the organization’s President and CEO, Second Harvest Food Bank (the food bank that serves most of Southern Louisiana, including New Orleans) provided 30 million meals to 500 partner agencies in 23 parishes (counties) in 2015. Jayroe estimates that Second Harvest Food Bank would need to provide 65 million meals annually to ensure that every person had access to sufficient food.

In New Orleans, approximately one-quarter of the population is food insecure—more than 1.5 times the national average.

While the Food Bank’s New Orleans facilities did not flood during Katrina, it was forced to operate out of a previously closed Walmart near Baton Rouge because there was no electricity at the Food Bank and because of the extensive damage to the city’s infrastructure. At the time, it became the world’s largest food bank.⁹³ Katrina caused a severe shortage of food in New Orleans and southern Louisiana that lasted many months. As Jayroe explained, “Seventy-five percent of Second Harvest’s 300 partner agencies based in neighborhoods across south Louisiana ceased to operate. In the earliest days, staff was living on the floor of the Walmart we were operating out of. Government response was inadequate at all levels. The local food and funding from individuals and corporate donors that a food bank relies on were gone or stretched thin trying to meet the incredible needs of a community rebuilding from scratch. Despite all this, the amount of food Second Harvest provided in September 2005 alone increased more than 800 percent, from one million to eight million pounds in a single month. We succeeded in doing this because of the incredible outpouring of love and generosity from around the country and the globe, and the power and innovativeness of the Feeding America network. Millions of pounds of food poured into south Louisiana from food manufacturers, retailers and producers. Millions of dollars came from individuals, international disaster response organizations and corporations. Millions of volunteers come into the region, including hundreds of ‘food bank experts’ from other Feeding America food banks who drove trucks, set up inventory control systems, ran the warehouse, drove the forklifts and helped with communications.”

Katrina completely changed how food banks operate during disasters. According to Jayroe, “Our idea of disaster response pre-Katrina was a 12-week window, following federal guidelines as a way to differentiate between disaster response and recovery. After Katrina, we were still in disaster response for a couple years after the event.” Second Harvest Food Bank worked with Feeding America and FEMA to coordinate disaster response feeding efforts. Feeding America has since formalized a relationship with FEMA as a first responder.⁹⁴ Since Hurricane Katrina, Second Harvest Food Bank has opened a second facility in Lafayette, Louisiana, which did not flood from Katrina, or Hurricane Rita, which devastated much of southwest Louisiana in 2005.

They improved relationships with first responders, local, state, and federal emergency management offices, and various government offices assisting in disaster response and recovery. In addition, Second Harvest Food Bank has shifted its priorities to not only provide supplemental food assistance, but also to focus on the root causes of food insecurity.

Food access issues in some neighborhoods in New York City after Superstorm Sandy highlight how federal programs created to address food insecurity may be insufficient and may not be flexible enough to respond to limited food supply in the aftermath of a disaster. In the aftermath of the storm, food insecurity increased in some neighborhoods. To respond, the state and city governments requested to operate D-SNAP in 82 zip codes.⁹⁵ Only two sites were designated as D-SNAP application sites (one in Brooklyn and one part-time facility in Staten Island), making it difficult for some residents in disaster areas to apply for benefits. Extended D-SNAP benefits were approved for one month in 12 of the affected zip codes at the State's request. According to hunger relief advocates interviewed by *The Wall Street Journal*, the decision to limit the extension of D-SNAP to only a few of the affected zip codes meant that tens of thousands of people no longer had access to D-SNAP benefits.⁹⁶ D-SNAP extensions are rarely requested—typically only in response to very severe disasters, such as in the case of Hurricane Katrina, when, D-SNAP (then called Disaster Food Stamps) benefits were extended an additional two months.⁹⁷ According to USDA representatives, this is the longest the program has been deployed.

Federal programs created to address food insecurity may be insufficient and may not be flexible enough to respond to limited food supply in the aftermath of a disaster.

In New York State, WIC recipients must buy all of the food items listed on their monthly WIC checks and cannot substitute products. Retailers are not allowed to accept WIC benefits if the recipient does not purchase all of the items listed on their check(s). There were no emergency protocols in place to relax requirements for WIC although many retailers did not have all WIC authorized foods after the storm. As one New York City grocery store industry representative explained, “If you were a WIC recipient, you were stuck and you couldn't buy anything. Grocers couldn't sell it to you. The problem lasted for 10 days.” New York State eventually announced that it would temporarily suspend some WIC purchasing requirements, allowing WIC participants to either partially redeem WIC benefits if not all the items listed on the check were available or substitute certain foods (milk, bread, cheese and peanut butter) if WIC brand or specified package sizes were not in stock. The temporary policy change went into effect November 8, 2012, two weeks after Sandy made landfall.⁹⁸

GOVERNMENT POLICIES AND PRACTICES THAT IMPACT FOOD SYSTEM RECOVERY

The California Grocers Associations (CGA) is the trade association for 300 food retailers operating thousands of stores in the state of California.⁹⁹ CGA partners with state emergency management offices, but does not have any formal protocols in place with the local emergency management office in Los Angeles. The State of California's Office of Emergency Services (CalOES) and FEMA maintain strategic partnerships with CGA and other private sector entities through the Business Operations Center (BOC). BOC, which is operated by CalOES, facilitates coordination of public- and private-sector agents in emergency response initiatives. BOC helps facilitate community operations overall during disasters through enhanced situational awareness and information sharing between the public and private sectors.¹⁰⁰ BOC plays an active role in California's State and Regional Emergency Operations Centers, the central emergency management command centers operated by the CalOES during a natural disaster.

In each state, food retail trade associations coordinate with city or state emergency management offices and have a seat at the table in Emergency Operations Centers during declared states of emergencies.

The Louisiana Retailers Association is the state trade association representing over 4,000 retailers of all types, including approximately 1,580 food retailers, manufacturers and wholesalers.¹⁰¹ It coordinates with the Louisiana Governor's Office of Homeland Security and Emergency Preparedness through the Louisiana Business Emergency Operations Center (LA BEOC). LA BEOC is Louisiana's emergency operations center dedicated to disaster preparedness, response and recovery for businesses. LA BEOC serves as an annex of the state's Emergency Operations Center and facilitates communication with the private sector to enhance Louisiana's emergency management efforts. LA BEOC is led by Louisiana Economic Development, the Governor's Office of Homeland Security and Emergency Preparedness, and includes members from public and private sectors.¹⁰² At the local level, the New Orleans Office of Homeland Security and Emergency Preparedness collaborates with the private grocery industry to share best practices in emergency management and identify ways to improve their coordination.

The Food Industry Alliance of New York State (FIA) is the trade association for New York State, representing 850 supermarket chains, independent grocery stores, convenience stores, wholesalers, and manufacturers.¹⁰³ FIA partners with the New York City Office of Emergency Management through its Public/Private Initiatives Unit, which supports the resilience of the City's private sector through "information sharing, partnership building, training and education on preparedness principals and the City's preparedness plans."¹⁰⁴ Through the Public/Private Initiatives Unit, a representative from FIA sits with city, state, and federal agencies in the City's Emergency Operations Center during major incidents, contributing as a full partner in the City's response and recovery efforts. At the state level, FIA is part of the Multi-Agency Feeding Task Force that is convened by the New York State Office of Emergency Management for some disasters to identify available food assets to ensure residents have access to food.¹⁰⁵

While relationships between food retail trade associations and emergency management offices provide important public-private sector coordination to prepare for and recover from natural disasters, they are not completely sufficient. The trade associations do not include all food retailers in any city. Most members are supermarkets. Additional mechanisms are needed to coordinate with smaller grocery stores and corner stores. Further, with the exception of New York City, similar partnerships between food retailers and emergency management offices at the city level need to be established in all cities.

According to representatives from the Louisiana Department of Health, which is responsible for inspecting food processing and manufacturing plants, wholesale facilities and food retail establishments, the Department lacked sufficient manpower after Katrina to inspect all the businesses impacted by the hurricane. The Department inspected all facilities that experienced structural damage, flooded or lost power prior to reopening to make sure operations would ensure food safety. In some cases it took weeks to conduct the necessary inspections to reopen the facilities because of the unprecedented number of businesses that required inspections.

After Sandy, obtaining construction permits made it difficult and more costly for food retailers to begin repairs. All businesses in New York City that required emergency repairs, including food retailers, initially had to acquire a construction permit from the Department of Buildings within two days of beginning repair work. A month after Sandy, the City extended the application period to 90 days after beginning repair work, while also waiving application and permit fees.¹⁰⁶ There was also confusion, on the behalf of businesses and city agencies, regarding the types of inspections needed for different types of food businesses. For example, the New York State Department of Agriculture and Markets Division of Food Safety and Inspection is responsible for inspecting the state's food manufacturers and food retailers. According to the Division, some local agencies think that grocery stores cannot reopen until inspection; however, stores are able to continue operating without inspection as long as they maintain food safety standards.

In our analysis of the impact of Katrina and Sandy on the food system, food safety inspections, the construction permit process, transportation restrictions, and lack of communication impeded the recovery of the food system.

Transportation restrictions after Sandy also delayed deliveries to food retailers. As in many states, food distribution trucks are not considered emergency vehicles in New York State and are not allowed on roads during travel bans. In some states, such as Massachusetts, food delivery trucks can apply for waivers granting them access to roads during emergencies. The road closures and traffic delays after Sandy also increased the time truck drivers needed to reach their destination, limiting their ability to reach the same number of food retailers. As one food manufacturer and distribution expert told us, some food distribution companies could not send drivers out because the time that it would take to reach their destination would exceed federal Hours of Service regulations issued by the Federal Motor Carrier Safety Administration, which limits the number

of consecutive hours a driver can work.¹⁰⁷ This issue was also highlighted as a barrier in our Boston study. As one food distribution expert explained, “Let’s say you send out a hundred drivers on a given day. If 10 work 14-hour days because of the conditions, then they can’t work the next day—too many hours. Then I only have 90 drivers. If that happens again and again, I won’t have enough people.”¹⁰⁸

Sandy also surfaced the type of vulnerabilities that exist when clear communication protocols between the City and private businesses are not established. According to a regional distribution professional, multiple layers of communication between federal, state and local governments coordinating with food distributors led to communication breakdowns between emergency management officials and distributors, creating confusion about road closures in the aftermath of the storm. As he remembered it, “We were monitoring carefully which bridges were closed. Officials were telling people the Tappan Zee Bridge was closed when it was open. There was a tremendous amount of miscommunication creating chaos.”

Sandy also surfaced the type of vulnerabilities that exist when clear communication protocols between the City and private businesses are not established.

Characteristics of a Resilient Urban Food System

Madison, Wisconsin is known for its progressive and large local food system, including the largest producer-only farmers market in the country. Based on the research we completed for this report, however, we would argue that Madison should be recognized instead for the resilience of its food system. Its location clearly matters. Located in the Upper Midwest, Madison does not face the same degree of natural disaster risks as coastal cities. The characteristics that make Madison a useful model for resilient urban food systems, regardless of its location, include: very few warehouse suppliers located in “at risk” areas, redundant transportation networks that are not highly vulnerable, a food bank that is not vulnerable, and very strong partnerships between state and local governments and private food businesses. In addition, in spite of being the capital of a dairy state, Madison faces minimal food processing vulnerabilities.¹⁰⁹

WAREHOUSE SUPPLIERS ARE LOCATED OUTSIDE OF THE CITY

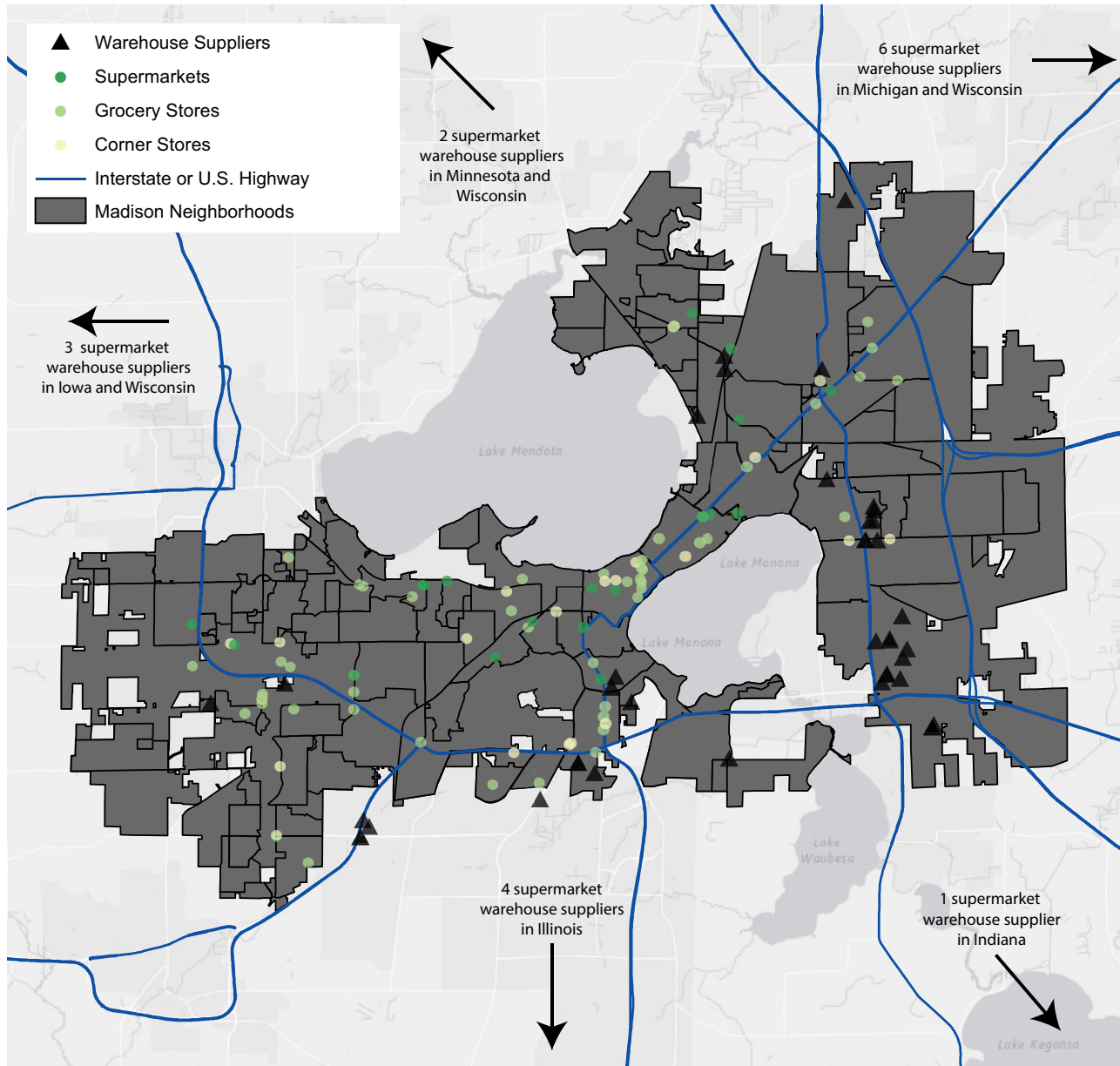
While 39 warehouse suppliers are located in Madison, nearly all (18 of 20) supermarket warehouse suppliers are located outside of the city. Our analysis finds that the supermarket warehouse suppliers are located on average within a three-hour drive from Madison and, therefore, are not at risk for a tornado, blizzard or ice event that hits Madison. According to the President of the Wisconsin Grocers Association, the only supermarket warehouse supplier located in Madison (which operates two adjacent facilities in the city) services more than 100 grocery stores in Wisconsin and Illinois and approximately 10 retail stores in Madison as either a primary or secondary supplier. Madison does not have a fresh food distribution market.

REDUNDANT TRANSPORTATION NETWORKS

As with other cities, the majority of Madison’s food is distributed by truck. The difference in Madison is the presence of many alternate truck routes into the city—none of which depend on bridges and tunnels over water (Figure 7). Madison has four east-west interstates and U.S. highways and three north-south interstates and U.S. highways, providing multiple transportation options, while many of the city’s state and county roads are also designated as truck routes.¹¹⁰

It is highly unlikely that even a massive tornado would destroy all transportation routes into the city. In addition, City officials feel that they are well equipped to clear roads quickly in the event of a very severe snow or ice event. One emergency management official noted that snow is relatively easy for the City to clear, but significant ice may pose a problem: “It would have to be some massive blizzard or ice storm to disrupt the food system, something like an inch of ice that can’t be grated off or we do not have enough motor graders to chisel through.” Regardless, officials do not anticipate even the most severe ice storm to close major roads for more than a week.

FIGURE 7. MADISON, WI FOOD SYSTEM



Sources: Dun and Bradstreet's Hoover's Database (2016); Zillow, *Zillow Neighborhood Boundaries* (n.d). Warehouse suppliers were identified using City or State business data and as those publicly listed on websites, annual reports and industry reports as suppliers for supermarkets operating in Madison.

VULNERABLE FOOD RETAIL NEIGHBORHOODS?

Madison is served by a typical mix of national and regional supermarket chains, independent grocery stores, and corner stores. Overall, the city is served by 20 supermarkets, 48 grocery stores and 21 corner stores, which is higher per capita than the national average.¹¹¹ However, this masks disparate service across the city's neighborhoods. We find 86 neighborhoods out of 124 (69 percent) that are underserved by supermarkets or have limited food retail stores of any kind. Eighty-two of the neighborhoods have no food retail stores.¹¹² Given our assumption that all food retail stores in Madison would be "at risk" for damage due to a severe winter storm, we did not include "at risk" store locations in the neighborhood food vulnerability analysis. In addition, Madison is divided into numerous (124), small neighborhoods (for example, it has more defined neighborhoods than Los Angeles and nearly as many as New York City), which skews the results and highlights an important caveat to this type of analysis. Since the neighborhoods are geographically small, residents of some neighborhoods that are underserved may be very close to a supermarket in a proximate neighborhood.

A RESILIENT FOOD BANK

As with the other cities we studied, Madison is grappling with an increasing share of food insecurity, although it is lower than the national average and the lowest of the five cities we studied. About 12 percent of the population in the county is food insecure.¹¹³ Of the 86 neighborhoods identified as having vulnerable food retail, 41 have higher SNAP rates than the city average.

However, Madison has a strong food bank (Second Harvest Foodbank of Southern Wisconsin) that has the capacity to meet current and growing demand. Second Harvest Foodbank of Southern Wisconsin is located in Madison and supports approximately 240 partner agencies and programs across 16 counties in southwestern Wisconsin. The Food Bank's ability to meet current demand is due in part to a strong partnership with agricultural processing plants in the region, including Del Monte Foods, and the Food Bank's Field to Foodbank and Invest an Acre programs that expand food and financial donation partnerships with nearby farms.¹¹⁴ In 2015, 75 percent of the Food Bank's food was donated from farms, processors, wholesalers and distributors and grocery stores. The Food Bank also partners with Second Harvest Heartland, a large regional food bank serving Minnesota and western Wisconsin, to increase the amount of fresh produce donations. Second Harvest operates a regional food hub that coordinates purchasing and distribution of surplus produce from regional farms.¹¹⁵ Further, the Food Bank is located in an industrial park and transportation hub in the southeast side of Madison, with easy access to multiple interstates and U.S. highways.

To address food insecurity, the City of Madison launched the Healthy Retail Access Program in 2015 to increase food retail stores in targeted neighborhoods that have households with the following characteristics: a combination of low-income, poor access to food, and low vehicle ownership rates.¹¹⁶ The program provides funds to business owners to improve healthy food access in existing stores (e.g., by purchasing equipment to accept SNAP payments or providing transportation to food retailers) or support technical assistance to help them open a new food retail store in these neighborhoods.

STRONG PUBLIC-PRIVATE SECTOR COORDINATION AND PLANNING

The strong public- and private-sector coordination and disaster preparedness planning for its food system sets Madison apart from the other cities we studied. This coordination and planning happens at the city, county and state level. In 2008, The Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) launched a project examining the agency's capabilities for responding to a large-scale disruption to Wisconsin's food distribution system. The study found that since most of the state's food is supplied by the private sector, an

effective disaster response from the government is to coordinate planning efforts with private businesses.¹¹⁷ Since then, DATCP has built partnerships across the food industry, including with the Wisconsin Grocers Association, which is the state's food retail trade association representing approximately 1,000 food businesses across the state.

DATCP and Wisconsin Emergency Management (WEM) play the lead coordinating roles between emergency management and the food industry. They involve the City of Madison and Dane County Offices of Emergency Management, the Wisconsin Grocers Association, and the Wisconsin Agro-Security Resource Network (which includes food industry and government agency representatives) in their planning and response efforts. DATCP has a dedicated Emergency Management Coordinator and team that is a liaison between the food industry and WEM. DATCP and WEM also participate in regular tabletop exercises with food businesses that simulate a disaster. In the past, tabletop exercises have focused on food contamination, winter weather events, and disease outbreaks. WEM has also developed an Agriculture and Natural Resources Emergency Response Plan for the recovery of agriculture and food processing industries in the event of a natural disaster.

During disasters, the DATCP team is tasked with identifying any food system facility (e.g., processing facility, warehouse suppliers or food retailer) that may have been impacted. They can do this efficiently because DATCP is responsible for conducting food safety inspections for processors, warehouse suppliers, and approximately half of Wisconsin's food retail stores (with the remainder inspected by local health departments) and thus knows who to contact at each organization. DATCP food inspectors (sanitarians) are assigned to relatively small geographic areas and maintain regular contact with food businesses. During an emergency, inspectors will contact the businesses to assess any damage and make arrangements to provide onsite assistance for various issues, such as power outages and refrigeration issues. As long as businesses meet food safety requirements, they are allowed to maintain operations and do not need to go through a re-inspection process. Emergency management experts in Madison estimated that the State could assess damages and provide necessary resources to get the food system back to normal operations within a day after a significant snow or ice storm.

The strong public- and private-sector coordination and disaster preparedness planning for its food system sets Madison apart from the other cities we studied. This coordination and planning happens at the city, county and state level.

The Economic Resilience of Food-Based Economies

Portland, Maine, a top “foodie” destination that has a relatively small economy, offers important insights into the economic resilience of a food-based economy. Over the past decade, Portland has been recognized as a top “food city,” rounding out rankings that include the country’s largest cities. In 2015, for example, Portland ranked eighth in Zagat’s Top 17 Food Cities.¹¹⁸ Per capita, Portland has more restaurants than San Francisco.¹¹⁹ We find that in spite of the growth of the food and tourism sector in Portland, the economy is still resilient to an economic shock because of a strong traditional food cluster.

Risk management theory predicts that increased reliance on a single sector would decrease Portland’s economic resilience because the economy becomes less diversified. In addition, the local food movement is relatively new, creating questions around its long-term sustainability. If Portland’s economy is based on a fad, what happens when consumer tastes change? Finally, many local food products could be considered luxury goods (i.e., a good for which demand increases proportionally to increases in income, such as an expensive farm-to-table restaurant or craft beer). As such, they are in theory susceptible to an economic downturn that decreases disposable household income.

THE IMPORTANCE OF FOOD TO PORTLAND’S ECONOMY

In 2013, there were 36 food and beverage processing establishments operating in Portland, but this has certainly increased over the last three years due to the growth of craft businesses (breweries in particular). The number of breweries in Portland increased from three in 2008 to nine in 2013.¹²⁰ At least three Portland breweries invested over \$8 million to expand manufacturing facilities and increase production in 2015.¹²¹ Craft brewery growth in the state has been attributed to new legislation in Maine enacted in 2011 allowing breweries to sell beer directly to consumers in their tasting rooms.¹²²

The food and beverage processing industry also includes traditional businesses such as commercial dairy processing, fresh and frozen seafood processing and commercial bakeries. For example, regional and national companies, including HP Hood, Oakhurst Dairy, B&M Beans, and Bristol Seafood (one of the largest seafood processors in Maine) have facilities located in Portland. Overall, this industry provides a substantial number of local jobs (over 1,588 people or 2.5 percent of total employment), but generates just over \$60 million in sales annually (less than one percent of all sales).

Portland's more than 300 restaurants provide a substantial number of local jobs (over 5,000 people) and generate \$224 million in annual sales (three percent of all sales). Portland's 74 food retail stores employ over 2,000 people and generate nearly \$300 million in sales annually (close to four percent of all sales). The food wholesale and distribution sector within the city includes just 34 business establishments that employ over 700 people, but they generate \$210 million in annual sales (nearly three percent of all sales).¹²³

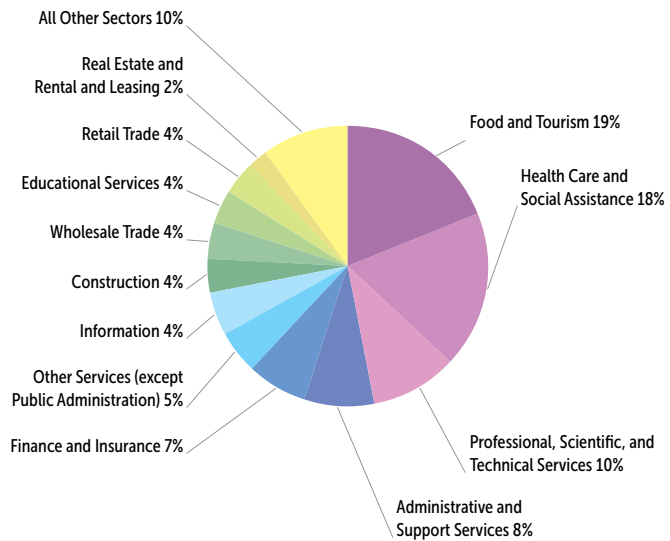
Portland's award-winning restaurants and popular craft breweries also have helped to increase local tourism. According to the Maine Office of Tourism, 58 percent of tourists who visited Maine and stayed overnight identified culinary or beverage interests as their reason for visiting.¹²⁴ The increase in culinary tourism has spurred the growth of tourist-related businesses (food and alcohol tours), new hotels and increased hotel occupancy rates.

Overall, the food and tourism sector is the largest economic sector in Portland in terms of employment (19 percent) (Figure 8). However, Portland has a relatively diverse economy comprising 17 different sectors, although 12 are small (accounting for five percent or less of employment). Other significant economic sectors include health care and professional and administrative services.

In terms of employment, the growth of the food and tourism sector between 2003 and 2013 outpaced the rest of Portland's economy, suggesting that its importance to the local economy will continue to increase (Figure 9).¹²⁵ Further, while the growth of the local food sector has occurred in part organically, the City of Portland also includes the food sector in its economic development plan, focusing on growing food production and food service industries.¹²⁶ The city's economic development plan, *Economic Development Vision + Plan*, was established in 2011 and identifies the food production/food service (including fishing and seafood) and tourism sectors as two of 11 target sectors.

In addition, the U.S. Economic Development Administration designated Greater Portland as one of the nation's 24 Manufacturing Communities under the Investing in Manufacturing Communities Partnership (IMCP) initiative

FIGURE 8. PORTLAND, MAINE'S ECONOMIC SECTORS BY EMPLOYMENT SHARE (2013)



Notes: Economic sectors are defined using sector (two-digit) NAICS codes used by the U.S. Census Bureau. The "Food and Tourism" Sector combines employment data from 97 industries in the following seven NAICS codes: Agriculture; Manufacturing; Wholesale Trade; Retail Trade; Transportation and Warehousing; Health Care and Social Assistance; and Accommodation and Food Services. Employment data for these industries were excluded from estimates of Portland's other economic sectors. "All Other Sectors" includes the Arts, Entertainment, and Recreation; Management of Companies and Enterprises; Manufacturing; Transportation and Warehousing; and Utilities sectors. "Administrative and Support Services" refers to the Administrative and Support and Waste Management and Remediation Services sector.

Source: U.S. Census Bureau ZIP Business Patterns, 2013

sponsored by the U.S. Department of Commerce. The designation supports the growth of Greater Portland’s food processing industry by giving the region preferential consideration for certain federal grants aligned with the region’s IMCP goals. The Greater Portland Council of Governments, a non-profit regional economic development and planning organization, leads the initiative, which is called the Greater Portland Sustainable Food Production Cluster. The initiative has a goal of doubling the region’s food manufacturing employment in 10 years through investments in workforce training, improvements in supplier networks, research and innovation, infrastructure and site development, trade assistance and investment, operational improvements, and capital access.¹²⁷

FIGURE 9. EMPLOYMENT GROWTH BY SECTOR IN PORTLAND, MAINE (2003-2013)



Note: "All Other Sectors" refers to all economic sectors in Portland except for the "Food and Tourism" sector
 Source: U.S. Census Bureau ZIP Business Patterns, 2003-2013

WHAT HAPPENS TO PORTLAND’S ECONOMY WHEN THERE ARE NO MORE “FOODIES”?

If the consumer interest driving the explosion of local food businesses shifts, obviously the businesses serving this niche market will experience declining demand and could ultimately go out of business if they are not able to adapt to meet different consumer preferences. However, even in this worst case scenario, the direct impact to Portland’s economy would be relatively minimal and tourism would likely take the biggest hit.

Although the numbers have been steadily increasing, there are still relatively few “destination restaurants” opened by renowned chefs (such as the five James Beard award nominated restaurants or chefs in 2016)¹²⁸ or featuring more expensive, farm-to-table menus, compared to the majority of Portland’s 300 restaurants. The direct impact on employment and sales in Portland would be relatively minimal if the destination or local food restaurants closed their doors. There would also be little negative impact on food suppliers since the farms that supply them are located outside of Portland and the seafood they purchase is a very small percentage of the seafood consumed and purchased in the city.

If craft breweries, local coffee roasters and other niche food and beverage manufacturers went out of business, the economic impact would be greater. We estimate that currently, niche food and beverage manufactures account for approximately 250 jobs and \$41 million in annual sales.¹²⁹ In addition, the craft breweries in par-

ticular drive tourism to the area and their closure would certainly lead to some decline in tourism to Portland. The tourism impact is difficult to assess, however, because Portland also has a long history of drawing tourists for other reasons, including Maine lobster. The food retail, wholesale and distributors in Portland would likely not be impacted by these changing preferences since they are largely focused on meeting traditional food needs.

LESSONS LEARNED FROM THE GREAT RECESSION

The food and tourism sector in Portland was not significantly impacted by the Great Recession (2007-2009), and it was actually during this period that local/craft food businesses and culinary tourism significantly increased. For example, the Harvest on the Harbor festival, Portland's annual three-day food and spirits festival, was launched in 2008 by the Greater Portland Convention and Visitors Bureau. In its first year, 1,712 tickets were sold. Over the past eight years, more than 28,000 people have attended the festival.¹³⁰

Some industry experts consider 1996 to be the year Portland's restaurant scene started to be recognized, with the opening of the Fore Street restaurant, which has received national recognition and awards. Many more restaurants, including those featuring celebrity chefs, opened more recently after the recession. For example, three of the five James Beard nominated restaurants opened in 2012 or later. As one restaurant industry expert noted, "In 2007 to 2011 there were maybe 15 restaurants under development at any one time. These days it's 35 to 45. Around 2013 it seems like all of a sudden people were moving here from elsewhere and a lot more new openings were happening."

The majority of Portland's restaurants, serving moderately priced menus, seem relatively "recession proof." As one long-time Italian restaurant owner shared, "The economy is always burgeoning here in the summer. I don't care if gas prices are high or the economy is bad, people always find money for chowder and beer." The "cachet" associated with the Portland restaurant scene, which helped to increase tourism throughout the recession, also helped all restaurants weather the recession. Portland's tourism wasn't negatively impacted by the recession in part because it is a regional destination that is a short drive for millions in the Northeast, with relatively inexpensive accommodations. As such, it was a substitute for more expensive vacation destinations.

The "cachet" associated with the Portland restaurant scene, which helped to increase tourism throughout the recession, helped all restaurants in the city weather the recession.

Craft breweries in Portland and the national beer market stayed relatively constant during the recession. Nationally, at 12.2 percent, the market share of craft breweries has more than doubled over the past five years.¹³¹ However, with another recession, consumers may return to the cheaper, large brands. There is also concern among some in the industry that the craft beer industry is getting saturated and the bubble may burst.¹³² The number of establishments in both the food retail and food wholesale and distribution sectors

remained relatively constant during the recession, but employment in these sectors grew.¹³³ Grocery stores are relatively resilient to economic shocks because of their ability to adapt to changes in consumer demand relatively quickly. As one supermarket representative noted, “We have been through a lot of economic cycles and have been quite resilient to meeting demands and needs over time. The grocery business is something people need. Food is less elastic than other things. The nature of the business is that it is more about changing our product mix than overall impact. We needed to change our product mix somewhat because of declines in disposable income.”

Grocery stores are relatively resilient to economic shocks because of their ability to adapt to changes in consumer demand relatively quickly.

The number of establishments in the food and beverage processing sector remained constant between 2007 and 2010, but employment grew nearly four percent.¹³⁴ The impact of the recession on traditional food processing and manufacturing companies in Portland varied by industry. Given the regional importance in this sector, we focus on vulnerabilities to the seafood industry. Portland is the third largest port in Maine for fisheries by value, bringing in \$34 million (approximately six percent of the total Maine catch) in 2015.¹³⁵ Fish arriving in Portland is most often shipped out of the state, catering to regional, national, and international markets.¹³⁶ The Portland fishing and seafood industry is looking to expand access to foreign markets through the expansion of cold storage facilities to prepare product for long-range transport. It is also working with Eimskip, an Icelandic shipping company specializing in transatlantic refrigerated shipments, to expand its North American routes to allow for more frequent container shipments between Europe and Portland. Eimskip moved its North American East Coast headquarters from Norfolk, Virginia to Portland in 2013.¹³⁷ The diversity in markets builds resilience to a U.S. economic recession. As one leading fish processor stated, his dependence on the Portland market is insignificant: “If everyone left Portland and never came back, but if my employees still came to work, I probably wouldn’t even notice.”

The lobster industry was hit hardest by the recession, with shrinking demand, historically-low lobster prices and high bait and fuel prices in 2008. Although by 2011, the industry had largely rebounded to pre-recession strength.¹³⁸ Ninety percent of lobsters caught in the United States are from Maine, 10 percent of which is landed in the Portland area.¹³⁹ Seventy percent of lobsters landed in Maine are shipped to Canada for processing.¹⁴⁰ Many Canadian lobster processing plants were funded by Icelandic banks and were shut down during the recession because of the bank closures in Iceland. To prevent a similar crash in the future, then-Governor John Baldacci established a taskforce on the Economic Sustainability of Maine’s Lobster Industry in 2008 with the goal of identifying opportunities for expanding and diversifying live and processed markets for Maine lobster.¹⁴¹ In 2010, a change in Maine law expanded the types of products seafood processing plants can process. In 2014, 13 companies in Maine held licenses to process lobster in Maine, double the amount in 2010.¹⁴²

The seafood industry faces greater vulnerabilities on the supply side, but for non-economic reasons. The Gulf of Maine’s seafood industry (seafood harvesting, specifically) has experienced significant decline in recent years due to depleted groundfish fisheries, environmental change and increased harvesting restrictions.¹⁴³

The resilience of the seafood harvesting industry ultimately depends on the sustainability of its fisheries. As one seafood industry representative told us, “If you want to process seafood, you need a model where you can bring in fish locally, regionally and internationally. If you only source fish locally, demand will outpace fisheries if they are not managed appropriately.”

A STRONG FOOD CLUSTER STRENGTHENS THE RESILIENCE OF PORTLAND’S ECONOMY

The concept of a food cluster is a broader accounting of food businesses in the economy. A cluster is a set of closely related and interconnected industries operating within a particular region. Industries are considered to be part of a certain cluster if they are linked by externalities of various types (e.g., demand, supply, employment, institutions, technology, etc.). Clusters reflect the unique assets and core competencies of a given region that create competitive advantages for certain industries. The co-location of these interrelated food businesses creates an externality, where they mutually benefit

from each other’s success. Research shows that strong clusters were less vulnerable to the Great Recession and recovered faster and experienced higher rates of growth than other clusters.¹⁴⁴ A recent study by Harvard University, *Growing Maine’s Food Industry, Growing Maine*, investigated the cluster dimensions of Maine’s food cluster and identified strategies to grow the cluster and increase sustainable production and processing across Maine.¹⁴⁵ Within Maine, the broadly defined food cluster (agriculture, aquaculture, wild fish and fishing products, food manufacturing and livestock processing) is a large employer, specialized in both fish and fishing products and food manufacturing, and shows strengths upon which to grow. Food, and seafood in particular, has historically been an important component of Portland’s economy because of its port, proximity to agriculture in Maine and other New England states, and proximity to a large population in the Northeast U.S. and Canada.

The food cluster in Portland can be strengthened by supporting policies and initiatives. Over 120 organizations support the cluster through business development, economic development, education, funding, networking and promotion, policy and regulation, and research.¹⁴⁶ In the Portland region, at least 15 organizations are beginning to coordinate efforts to grow the local food sector through the Greater Portland Sustainable Food Cluster.¹⁴⁷ The initiative, a public-private partnership led by the Greater Portland Council of Governments established in 2014, has prioritized strategic infrastructure investments for food aggregation, cold storage, and distribution. These investments include a new cold storage facility on the Portland waterfront to increase exports, expansion of the International Marine Terminal, and improvements to the Portland Fish Exchange. The Greater Portland Sustainable Food Cluster anticipates launching 24 projects and services to support the food sector over five years by securing \$91 million in federal and non-federal funding. Another example is the New England Ocean Cluster House (NEOC), which will incubate new marine (food and non-food) businesses

Clusters reflect the unique assets and core competencies of a given region. Research shows that strong clusters were less vulnerable to the Great Recession.

to increase the marine industry's global competitiveness. NEOC was launched in 2014 by SoliDG, Inc., which manages the International Marine Terminal in Portland, and the Iceland Ocean Cluster, the organization that NEOC is modeled after. NEOC fosters connections between ocean-based businesses throughout New England, and also connects them with companies in the North Atlantic, including Canada and Iceland. NEOC plans to open a collaborative workspace on the Portland waterfront, which will include an incubator space to house early-stage companies.¹⁴⁸

FOOD INSECURITY

Although Portland has a food-based economy, food insecurity is still a challenge for the city because of a relatively high poverty rate (19 percent).¹⁴⁹ During the Great Recession, Portland's unemployment rate increased from 3.6 percent in 2007 to 6.8 percent in 2010. Nearly 1,300 jobs were lost, while many residents were underemployed.¹⁵⁰ Just over 14 percent of the county's population is food insecure.¹⁵¹ During the recession, 42 percent of Cumberland County food pantries experienced increased demand and 82 percent had to modify their services, including decreasing quantities of distributed food and turning clients away.¹⁵² To help meet demand, hunger relief organizations had to find alternative sources to donations and the Food Bank. As one food pantry and soup kitchen representative explained, "We had to buy food for the first time during the Recession and the state isn't meeting the need with assistance for families. Food pantries are now a large part of a family's ability to access food. Either they don't qualify for SNAP or their benefits ran out. Every single month they need to come back to the pantry. The system wasn't built for that sort of demand."

Although Portland has a food-based economy, food insecurity is still a challenge for the city because of a relatively high poverty rate.

The increased demand for food from hunger relief organizations has put increased pressure on Good Shepherd Food Bank of Maine. The Food Bank distributes more than 23 million pounds of food to over 400 hunger relief organizations in Maine annually. Demand for food from Good Shepherd Food Bank of Maine has grown faster than anticipated. The organization has spent \$2 million over the past few years to expand capacity by buying and upgrading warehouses, building new cold storage facilities and purchasing trucks. It plans to spend another \$2 million in the next five years.¹⁵³

The Food Bank and food pantries rely on donated food from retailers for a significant portion of its food. A representative from Wayside Food Programs, an organization that redistributes donated food from food retailers, noted that "When grocery stores saw profits drop during the last recession, they tightened their bootstraps and became more efficient, both in what they donate and who they are hiring or laying off. We were getting less food from grocery stores, and if they lay off employees, those people could become our clients. Our need is increasing, but our supply is decreasing." While the Food Bank has dedicated staff working to secure donations and partnerships from both the retail and agriculture sectors, they are unsure how much more food retailers and farms can be tapped for additional donations: "During a recession, demand would go up and we would need

additional sources of food. There's this idea in the food bank world that there's so much more food that we're not accessing and is going to waste. We're not sure that's accurate. We're already working with all the major retailers and local farms. It would really be a matter of more funding needed to purchase food." In Portland, Good Shepherd Food Bank of Maine has a retail store pickup program, which allows its member agencies to pick up food donations directly from local stores. In 2010, the food bank launched Mainers Feeding Mainers, a partnership between the food bank and local food producers. Since launching the program, the Food Bank has worked with more than 50 farms to distribute over four million pounds of fresh food.¹⁵⁴

The Reduction of Food Waste and Resilience Planning

Food waste or food loss refers broadly to the amount of food (edible and non-edible) that is discarded at any point along the food supply chain, during production, processing, retail or consumption. Up to 40 percent of edible food produced in the U.S. is wasted each year.¹⁵⁵ Diverting edible food from landfills can increase the availability of meals for the food insecure, while diverting non-edible food can create environmental benefits, both of which strengthen a city's resilience. In 2015, the U.S. Department of Agriculture and U.S. Environmental Protection Agency (EPA) announced the first-ever national food loss and waste goal, calling for a 50 percent reduction in food waste by 2030.¹⁵⁶

City leaders are also beginning to focus on food waste reduction as they try to protect environmental resources, support food insecure populations, and reduce landfills. According to Monica Munn of The Rockefeller Foundation, "In addition to the range of environmental, economic, and social benefits that can be realized from addressing wasted food, cities are uniquely positioned to directly intervene in food waste 'hotspots' given the important role they play in affecting what goes into the municipal waste stream and in determining where wasted food ends up—be it a landfill, community composting, or the food recovery network." Of the five cities we studied, Los Angeles and New York City have the most initiatives in place to address food waste, with significant new efforts emerging in Madison and Portland. Food waste reduction is a lower priority for the City of New Orleans, but promising efforts are emerging in the private sector. In all five cities, however, experts acknowledge that more work needs to be done to fully address food waste challenges.

"...cities are uniquely positioned to directly intervene in food waste 'hotspots' given the important role they play in affecting what goes into the municipal waste stream..."

In response to these trends, some food retailers, warehouse suppliers and processors are implementing food waste reduction initiatives that include increasing supply chain efficiencies (i.e., producing less food waste within their operations) as well as diverting edible food from landfills to food banks or food pantries. Nationally, the Food Waste Reduction Alliance (FWRA) was established in 2011 with the goals of reducing the amount of food waste produced, increasing the amount of food donated to those in need and diverting unavoidable food waste from landfills.¹⁵⁷ The initiative is led by national trade associations for the food and beverage manufacturing industry (Grocery Manufacturers Association), the food retail industry (Food Marketing Institute) and the food service industry (National Restaurant Association), and includes over 30 companies and stakeholders, including Feeding America. The business case for diverting edible food from landfills is straightforward. In addition to saving money by reducing their disposal fees, the businesses also receive a tax deduction on qualifying donated surplus food.¹⁵⁸

Efforts that reduce food waste raise questions about the net impact on food donations. Any reduction in food donations would be critical for food banks relying heavily on donations—which is the case in all five of the cities we studied—and other donation-dependent organizations in the food safety net (e.g., food pantries). Food banks report the amount of donated food as either a share of total revenue or share of total food distributed. In 2015, the Los Angeles Regional Food Bank received \$62.8 million in food donations, accounting for 79 percent of total revenue (Figure 10).¹⁵⁹ In New Orleans, in 2015 the Second Harvest Food Bank received \$31.7 million in donated food, accounting for 75 percent of the total food distributed during the year.¹⁶⁰ In 2014, Food Bank for New York City received \$38.6 million in donated food, 50 percent of the total food distributed during the year.¹⁶¹ In fiscal year 2015, Second Harvest Foodbank of Southern Wisconsin received \$20.8 million in donated food, which represents 75 percent of its total support and revenue.¹⁶² In Portland, in 2015, Good Shepherd Food Bank of Maine received \$36.4 million in donated food, accounting for 84 percent of its total revenue.¹⁶³

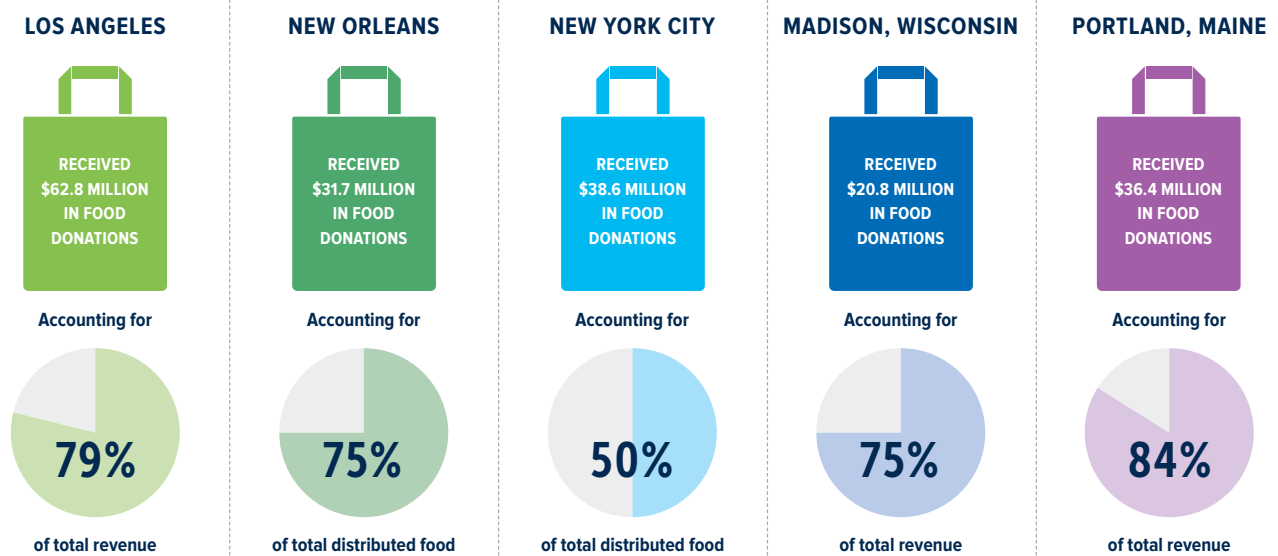
AN EXAMPLE OF FOOD RETAIL WASTE REDUCTION

Hannaford, a regional supermarket chain in New England (owned by international food retail group Ahold Delhaize), was recently recognized by the EPA for its excellent performance in food waste reduction. In 2011, Hannaford joined the Food Recovery Challenge and created a “Moving Towards Zero Waste” pilot program, which aimed to eliminate food waste in 11 of its stores in Maine.¹⁶⁴ During the pilot, Hannaford reduced its waste volume by 30 percent, largely by increasing its composting and recycling of unsalvageable waste.¹⁶⁵ The success of this pilot program led Hannaford to phase in a “Moving Towards Zero Waste” program in all of its stores. Hannaford’s food waste reduction efforts increasingly focus on source reduction and donations of extra food to food banks and pantries. A Leadership Partner with Feeding America, the organization donated 20.6 million pounds of food for hunger relief in 2015.¹⁶⁶ Hannaford also sends all of its damaged or expired food to a processing plant that uses anaerobic digestion to convert food waste into biogas, and thereby achieves complete elimination of food waste in 40 of its supermarkets in central and northern Maine.¹⁶⁷

Because of the incentives and food waste reduction goals, donations to food banks might increase, but this could be offset by increased supply chain efficiencies (a trend also motivated by financial savings and technological improvements) that lead to less surplus food in food businesses. In addition, mismatches can occur between the supply and demand for donated food. For example, a retailer may have a pallet of produce ready for donation but they either may not know which organization to contact for the donation or the organizations they do contact may not need the produce or have the capacity to pick it up or distribute it. In other cases, food banks and pantries may not accept certain donated food surplus, such as commercially-produced baked goods, because of nutrition guidelines.

Food banks are partnering with food processors and retailers, and new food recovery apps are being created in the private sector, to solve these issues and increase the efficiency of the food donation process, which means more surplus food should make its way to food banks and pantries. One food retailer we spoke to said that their increased supply chain efficiencies and decreased food waste have been counterbalanced by increased efficiencies in the food donation process, resulting in more food donations each year, a trend that he expects to continue.

FIGURE 10. FOOD DONATION COMPARISON



FEEDING AMERICA—A NATIONAL FOOD WASTE REDUCTION PARTNER

Feeding America, the largest hunger relief and food rescue organization in the U.S., has worked to divert food from landfills for nearly four decades. In 2016, the organization rescued 2.6 billion pounds of food from over 300 donor partners across the food industry. It is also a member of the Food Waste Reduction Alliance and the Advisory Council for ReFed, a collaboration of over 30 business, nonprofit, foundation and government leaders committed to reducing food waste in the U.S. In 2016, ReFed released the first roadmap for reducing food waste in the U.S. by 20 percent.¹⁶⁸ Feeding America also supports member food banks to help increase food donations while reducing waste through innovative solutions.

According to Karen Hanner, Managing Director of Manufacturing Partnerships at Feeding America, the organization has traditionally focused on securing food donations through national partnerships with food manufacturers and food retailers. In the last decade, Feeding America has focused on expanding these partnerships to include farms and food service companies in order to feed more people while helping to rescue more food from going to waste. For example, in 2016 the Feeding America network of food banks rescued 800 million pounds of produce from agricultural partners and partnered with Starbucks on FoodShare, a new program that enables food banks and pantries to pick up unsold meals from local Starbucks at the end of each day.

Some food banks elsewhere have shifted from relying on donated surplus food to purchasing food. For example, the Greater Boston Food Bank (GBFB) purchases food from warehouse suppliers and then sells it to its member agencies. Purchased food items are sold at cost while GBFB charges a nominal handling fee of 19 cents per pound to member agencies for food donated to the Food Bank.¹⁶⁹

None of the food rescue organizations we contacted are expecting a reduction in food donations. For example, City Harvest, the nation's oldest food rescue organization, is dedicated to diverting edible food from the waste

stream to feed hungry people in New York City. City Harvest picks up excess food from restaurants, grocery stores, manufacturers, and warehouse suppliers, and delivers food free of charge to soup kitchens, food pantries, and other hunger relief organizations. In 2015, City Harvest rescued 51.3 million pounds of food, more than half of which was fresh produce.

PRIORITIZING FOOD WASTE REDUCTION IS GAINING MOMENTUM

Addressing food waste is a priority for the Los Angeles Food Policy Council, which has identified at least 15 organizations working on food waste issues in the city. In 2007, the City of Los Angeles adopted its Solid Waste Integrated Resource Plan, a Zero Waste plan with the goal of diverting 70 percent of waste by 2015.¹⁷⁰ In 2010, the City launched the Restaurant Food Waste Recycling Program, a waste hauler recycling rebate program.¹⁷¹ This voluntary program collects food waste as often as six days per week to be processed by a City-certified food waste processor. According to a representative from the City of Los Angeles Bureau of Sanitation, 387 food service establishments (e.g., restaurants, bakeries and cafeterias) are participating in the program at present, with an average monthly food waste diversion per food service establishment of three tons. Since the inception of the Restaurant Food Waste Recycling Program, the City has diverted 238,000 tons of food waste from landfills.

New York City is launching a number of initiatives specifically focused on reducing household and commercial food waste. As part of New York City's resilience strategy, *One NYC: A Plan for a Strong and Just City*, the City set a Zero Waste goal by 2030, which would reduce the amount of all waste, including food waste, by 90 percent.¹⁷² The New York City Organics Collection Program, which is run by the Department of Sanitation in select neighborhoods, will be expanded citywide to collect food scraps and other organic material from households to be used for composting or conversion to biogas energy. To reduce commercial food waste, Mayor Bill de Blasio launched the Mayor's Food Waste Challenge, which encourages New York City restaurants to reduce food waste to landfills by 50 percent.¹⁷³

As part of New York City's resilience strategy, the City set a Zero Waste goal by 2030.

In Madison, food waste is a new priority for the Madison Food Policy Council and the Food Policy Coordinator. A seven-member food waste reduction taskforce, consisting of members from the Madison Food Policy Council and Dane County Food Policy Council, is reviewing city practices in the area of food waste to identify composting partners and stakeholders that could partner on food waste reduction efforts.¹⁷⁴

In Portland, former Mayor Michael Brennan formed the Mayor's Initiative for a Healthy and Sustainable Food System in 2012 to support initiatives to improve the health and sustainability of the city's food system, including reducing food waste.¹⁷⁵ Currently known as Shaping Portland's Food System, it will soon become the Portland Food Council. The group's policy subcommittee is beginning to investigate policy interventions that could reduce food waste in Portland, including incentives for processing or recycling food waste, enabling redistribution from city institutions and initiating citywide composting.¹⁷⁶ The subcommittee is chaired by

an attorney from the Conservation Law Foundation, an environmental advocacy organization based in New England that is working to address food waste throughout New England. Proposed state legislation has focused on reducing food waste in landfills.

While food waste is not yet a priority for every city, interest in addressing this issue in the U.S. and globally suggests that city-level food waste reduction programs will continue to expand. In June 2016, the U.S. Conference of Mayors adopted a resolution to strengthen food waste reduction initiatives within cities. In addition, with support from The Rockefeller Foundation, the National Resources Defense Council is delving into the waste streams in New York City, Denver, and Nashville, measuring the amount of food that is wasted in homes, businesses, and large institutions and how much of this is edible and could be prevented or recovered. Measuring the amount of food that is wasted is a critical first step for municipal governments as they design strategies to divert edible food from landfills. The project will also generate a toolkit of policies and programs that other cities in the U.S. can use to advance their own food waste prevention, rescue and recycling efforts. There are a growing number of partnerships between municipalities and local institutions, such as universities, to use wasted food as an input into incubators for businesses working on “upcycled” products or community composting programs. More research is needed to fully understand the interplay between food waste reduction and food system resilience.

A Playbook for Building a Resilient Food System

Based on the insights into urban food resilience presented in this report, we outline five recommendations that serve as a playbook for city leaders, including Chief Resilience Officers, on how to strengthen the resilience of their urban food systems and shorten the recovery window needed to return food systems to their normal state. The strategies focus on the points of the food system that can be influenced by local action in the short term, including food distribution and food access. The recommendations intentionally account for food insecure populations and underserved neighborhoods where food access is already limited and the impact of a natural disaster on food availability is likely to be more severe than in other areas. While a strong local government role is essential, the recommendations reflect the fact that strengthening urban food system resilience requires leadership from both the public and private sectors.

Earlier research by the authors of this report into Boston’s food system vulnerabilities has been recognized by the Climate Change Urban Food Initiative, which showcases successful mechanisms and approaches to help cities respond to the challenges of achieving sustainable urban food systems in a changing climate.¹⁷⁷ We share lessons learned from Boston below, which have also informed the recommendations included in this report.

LESSONS LEARNED FROM BOSTON

In 2014, Boston became the first city of its size in the U.S. to study the impact of a natural disaster on its food system. It was motivated by the near miss of Superstorm Sandy. As the newly elected Mayor Walsh wrote in support of the study, “Boston was lucky to avoid the worst of Sandy, but with climate change we can expect a rise in sea levels and more extreme weather events in the future. We must better prepare our food system to be resilient after disruptions like hurricanes, floods, blizzards and other natural disasters.”¹⁷⁸

The study, led by the authors of this report, was commissioned by the City of Boston’s Office of Food Initiatives, Office of Emergency Management, Office of Environment, Energy and Open Space, and the Transportation Department in 2014. The study culminated in a set of 17 recommendations and an implementation roadmap to address gaps in information and provide direction to the City for strengthening Boston’s food system to ensure it can quickly return to normal conditions following a natural disaster.

As part of the study, an 18-member steering committee was organized comprising individuals from all sectors of the food system (Table 1). This cross-sector committee was convened to inform the research, but during the process we learned that it also strengthened, and in some cases created, important connections within Boston’s food system and within the City. For example, new relationships were developed between the Food Bank, the Office of Emergency Management, and the Office of Public Health Preparedness at the Boston Public Health Commission, which would rely on the Food Bank for some services during a disaster. In addition, representatives from various City agencies strengthened their relationships with the Massachusetts Food Association, the state’s food retail trade association. Finally, it connected agencies within the City that did not normally work together, such as the Transportation Department and Office of Food Initiatives, but would need to collaborate on food system resilience plans.

Shortly after the release of the report, Boston was selected to join the 100 Resilient Cities Network and hired its first CRO. The CRO had been a member of the study’s steering committee and is interested in incorporating recommendations from the food system resilience study into the City’s resilience strategy.

The study helped inform climate resilience priorities for the Massachusetts Food Policy Council, a 17-member entity comprised of state agency, legislative and industry representatives. The Council’s new Massachusetts Local Food Action Plan, released in 2015, includes a number of recommendations to improve the resilience of the state’s food system.¹⁷⁹ The study also helped inform the priorities of the Metro Boston Climate Preparedness Taskforce, a group of 14 Greater Boston municipalities working to coordinate regional, cross-government action to prepare for the effects of climate change. It has identified strengthening the resilience of fresh food distribution centers as one of its three 2016 priorities and is conducting additional research on the flood risks facing the region’s food distribution infrastructure.¹⁸⁰

While still in the early stages, the City of Boston is working towards implementing some of the report’s recommendations. The implementation roadmap tasked the Director of the Office of Food Initiatives (OFI) with establishing a food system resilience committee that would include representatives from public- and private-sector food organizations. We recommended having it co-chaired by representatives from Health and Human Services, the Office of Emergency Management and the Office of Environment, Energy and Open Space. This new committee would be responsible for coordinating food system resilience planning. The OFI seemed like an obvious choice given their food mandate and leadership in the resilience study. During the study, however, the OFI was restructured with new leadership and staff, but continued to report to the Chief

TABLE 1. FOOD SECTOR ORGANIZATIONS RELEVANT FOR RESILIENCE PLANNING

Chief Resilience Officer
City Department of Public Health
City Economic Development Department
City Emergency Management Office
City Environment and Sustainability Department
City Food Policy Council
City Office of Food Initiatives
City Office of Small Business Development
City Planning Department
City Transportation Department
Federal Emergency Management Agency (for region)
Food Bank
Food Distribution Company
Food Policy Center
Food Processing and Packaging Company
Food Retail Store
Food Retail Trade Association
Food Safety Net Organization
Harbor Association
Regional Planning Agency
State Department of Agriculture
State Emergency Management Department
Utility Company

of Health and Human Services. As a result, some of the food system resilience planning has lost momentum. Within the OFI, resilience competes with their core focus on nutrition, food access, urban farming, and food truck licensing. The OFI has committed to following through on one of the study's recommendations, which is to support research on food access in neighborhoods with high rates of poverty and food insecurity.¹⁸¹

Boston reminds us that even with widespread support within the City, including from the Mayor's Office, resilience planning of any type is complicated and it takes a long time to build sustainable coalitions that can ultimately implement the plans. In addition, long-term planning always competes with the numerous urgent, immediate issues facing public agencies and the Mayor's Office. And, finally, food system resilience planning involves many agencies and does not fit neatly into a single agency, meaning that it always competes with core agency priorities.

PLAYBOOK STRATEGIES

1. Conduct a food system resilience assessment

As our study shows, every city will have unique food system vulnerabilities and an assessment of the entire food system is needed to inform resilience plans. Urban food systems remain largely unstudied and there is a lack of data on the origin of food, distribution paths and food retail. The framework utilized for this report could provide city leaders with a high-level assessment and point to specific areas requiring in-depth analysis. Additional research will also be needed to identify solutions to mitigate risks associated with a city's unique vulnerabilities.

Many cities are investing in infrastructure improvements to make their cities more resilient overall to natural disasters. A food system resilience study could help cities prioritize investments that directly impact the food system, such as improving the primary roads and bridges used for food distribution, identifying alternative food supply pathways that could include use of ports and railways, and strengthening, protecting or moving food distribution facilities out of "at risk" locations.

FOOD SYSTEM INFRASTRUCTURE INVESTMENT: NEW YORK CITY

As part of its resilience strategy, New York City has prioritized investments in bolstering the resilience of the Hunts Point Food Distribution Center. Resilience investments are guided by Hunts Point Lifelines, a design proposal for the Distribution Center and surrounding neighborhood that was selected as one of the winners of Rebuild by Design, a 2013 competition launched by the Department of Housing and Urban Development to improve coastal area resilience in regions impacted by Superstorm Sandy. The City allocated \$45 million to advance concepts from the Hunts Point Lifelines proposal and implement a resiliency pilot project.¹⁸² In 2015, the New York City Economic Development Corporation (NYCEDC) and the Office of Recovery and Resiliency convened the Hunts Point Advisory Working Group, consisting of Hunts Point industry and community stakeholders, to develop resilience priorities for Hunts Point. As a result of this effort, the City has prioritized flood risk reduction and resilient energy and the first pilot project will be to build a resilient energy grid at the Distribution Center.¹⁸³ In addition to the Hunts Point pilot project, the City allocated \$150 million in funding in 2015 for a 10-year investment to upgrade Distribution Center facilities.¹⁸⁴

Given the global nature of our modern food system, research is also needed to understand the impact of a natural disaster in food-exporting cities on food supply to other cities. For example, the Port of New Orleans is a major hub for global food distribution, including coffee and frozen poultry, and New Orleans Cold Storage (NOCS) is one of the largest suppliers of beef, poultry and pork exports in the nation.¹⁸⁵ We know that Katrina damaged NOCS, which lost 52 million pounds of product in three warehouses, but more research is needed to understand the type of impact this had on the supply of beef, poultry and pork to domestic urban markets.¹⁸⁶

2. Incorporate food systems into resilience planning initiatives and prioritize resilience on urban food agendas

Most cities overlook food systems in their resilience plans. One notable exception is New York City. Food system resilience is a key component of New York City's 2015 resilience strategy, *One New York: The Plan for a Strong and Just City*.¹⁸⁷ The City also plans to integrate findings from the new *Five Borough Food Flow* study into its ongoing resilience planning.

In order to effectively incorporate food systems into resilience planning initiatives, representatives from all parts of the food system (including food businesses, food banks, and public agencies at the state and local levels) should be included in the process. This will ensure that all facets of this complex system are explored and connections across the entire food system are strengthened.

Likewise, most urban food agendas do not currently prioritize resilience planning. There are approximately 200 food policy councils in the U.S., which are designed to influence local and state food policy and typically include representatives from across the food system.¹⁸⁸ In addition, as mentioned above, the U.S. Conference of Mayors has a Task Force on Food Policy. Including food system resilience on the agenda of these policy councils would create an efficient platform to advance resilience policies and initiatives and help them avoid supporting initiatives that may unintentionally create a more vulnerable food system. Food policy councils that are independent public-private partnerships could be especially effective, since resilience planning and implementation is ongoing, and changing administrations and mayoral priorities could disrupt the process. Many cities also have some type of office of food initiatives that could be encouraged to focus on food resilience planning.

Including food system resilience on the agenda of food policy councils would create an efficient platform to advance resilience policies.

3. Develop neighborhood food resilience plans

City leaders should prioritize planning for neighborhoods where food access would be disproportionately impacted by a natural disaster. For example, in Los Angeles, we find that 17 percent of all neighborhoods have vulnerable food access—meaning that food retail is at risk in neighborhoods with relatively high food insecurity rates. One of the neighborhoods has no food retail stores. In New Orleans, a quarter of all neighborhoods have vulnerable food access and 12 of the neighborhoods have no food retail stores.

In the long-term, two key underlying causes of neighborhood food vulnerability—food insecurity (and the poverty that produces it) and a lack of food retail stores, especially grocery stores—need to be addressed. The City of Boston has been a national leader on this front. It has been committed to establishing a grocery store in every neighborhood since the early 1990s when four large supermarkets left underserved neighborhoods. Most residential neighborhoods in Boston currently have at least one grocery store. Madison has also started to address this issue through the Healthy Retail Access Program, discussed above, which seeks to increase food retail stores in vulnerable neighborhoods.

In New Orleans, a quarter of all neighborhoods have vulnerable food access and 12 of the neighborhoods have no food retail stores.

In the short-term, making sure grocery and corner stores have adequate business continuity plans and insurance and increasing the resilience of food banks, the backbone of food safety nets, should be priorities. All food banks in the Feeding America network have adopted a disaster preparedness plan. According to a representative from Feeding America, food banks have increasingly engaged in multi-agency feeding plans developed prior to disasters in conjunction with local and state governments, the American Red Cross, the Salvation Army, and other hunger relief organizations. For example, Food Bank for New York City is working with its member organizations to improve communications during a natural disaster and ensure that they are prepared to remain operable during future disruptions. However, food banks also need to manage the risks associated with their location (e.g., flooding or earthquake damage) and strengthen the resilience of their food and donation supply chains.

As highlighted above, food banks are likely to experience a sustained increased in demand from a greater number of food insecure households well after the disaster, which would create a significant challenge for many food banks that struggle to meet the needs of existing food insecure populations. State and local governments should work with food banks and the private sector to develop a plan for securing more food donations and establishing funding for food banks to support more food purchases after a disaster.

4. Strengthen food business resilience

Supply chain resilience is a food industry priority and many larger food businesses already have business continuity plans in place. Smaller food companies, however, may be underprepared for business disruptions and may have inadequate business continuity plans and insurance coverage in place. These businesses may not be clear about the potential impact a disaster could have on their business, they may not believe that a disaster is likely to happen, or they may not fully understand their insurance policies.¹⁸⁹ They may need to establish or revisit and update their business continuity plans and insurance policies to ensure that they fully cover a wide range of potential disruptions.

Cities should work with the food industry to review business continuity plans and insurance coverage for all food businesses to gain insight into their plans and help them to address any shortcomings. In New Orleans, the City has taken a step in this direction and convened private-sector businesses and emergency manag-

ers to share lessons learned from Hurricane Katrina and other disasters to improve planning for future disruptions.¹⁹⁰ As noted above, trade associations can also help to catalyze and provide resources to their members to improve business continuity plans. For example, Food Marketing Institute, a national trade association for the food retail industry, provides resources and holds forums for sharing best practices on business continuity, crisis management and building organizational resilience.¹⁹¹

Smaller food companies may be underprepared for business disruptions and may have inadequate business continuity plans and insurance coverage.

City leaders could also leverage the expertise of large organizations. Walmart, for example, has always been concerned with the resilience of its supply chain, although Katrina heightened awareness about the issue, according to representatives from the company. Walmart has an Emergency Operations Center (EOC) that monitors weather and other disruptions to business operations. The EOC serves as a hub to engage operations teams throughout the business and ensure that stores are prepared for a disruption. Walmart is able to pre-position supplies in emergency warehouses strategically located throughout the country to ensure ready access after a disaster. Walmart works to restore store operations as soon as possible and can get most stores up and running within 24 hours, depending on the severity of the disaster and its impact on transportation routes. Walmart has leveraged its logistics expertise to support community recovery after disasters, including Hurricane Katrina, Superstorm Sandy and the 2016 Louisiana floods.

In 2015, Walmart also launched a pilot project focused on building community capacity to respond to a disaster, working with local government and non-profit organizations. BRIDGE Corps (Building Resiliency in Disaster-prone Geographies) New Orleans was a short-term volunteer initiative that matched senior level Walmart employees with the City of New Orleans to improve emergency management operations related to emergency food supply storage (e.g., water and Meals Ready to Eat) and warehouse logistics.¹⁹²

New York City has gone a step further and called on their state legislature to mandate larger food retailers (20,000 square feet or more of floor space or 60 or more full- or part-time employees) to install electric generators or to make sure that they have the ability to hook up to a mobile generator or other alternative power source to ensure that food retailers have power to process transactions and operate emergency lighting and fire and security systems during a disaster.¹⁹³ As of 2016, this legislation had not yet passed.

5. Establish government policies and practices that help food businesses quickly return to normal operations

We analyzed three government policies that could pose significant barriers to a quick recovery for food businesses: food safety inspections, the construction permit process, and transportation restrictions. Government agencies should develop a protocol for streamlining the food business inspection and construction permit process in the aftermath of a disaster and for effectively communicating the requirements to every food business. In addition, a process should be developed for identifying additional inspectors with the appropriate training, who can be quickly mobilized to ensure all inspections are completed in a timely manner.

State governments also should have a policy in place for coordinating with the federal government to temporarily suspend federal Hours of Service regulations for food distribution drivers in the aftermath of a disaster. The regulations may be temporarily suspended under declared states of emergencies for drivers providing vital supplies and transportation services to a disaster area. State governments should also pass legislation that designates food distributors and owners of food businesses as “essential” to emergency recovery. For example, in April 2016, Florida passed legislation (SB 1288 – Post-Disaster Re-Entry) enabling businesses that provide “essentials in commerce” to transport their products during a declared emergency. Under this legislation, the Florida Division of Emergency Management will develop a certification system and permit certain activities by certified drivers or employers during a curfew, and authorize law enforcement officers to specify permissible routes for certified persons in a declared disaster area.¹⁹⁴ Food retailers and distributors would be eligible for this certification. Its supporters, including the Florida Retail Federation, anticipate that the law may allow for faster distribution of food supplies in the aftermath of a disaster, potentially decreasing recovery time and thereby improving Florida’s food system resilience.¹⁹⁵

PLANNING FOR INCREASED FOOD BUSINESS INSPECTIONS: LOS ANGELES

The County of Los Angeles, Department of Public Health, Environmental Health Division is responsible for food safety inspections for restaurants, food retail stores and wholesale food processors. The Division is planning for an efficient and effective response in the event of a natural disaster (e.g., earthquake). As part of this effort, it has created an Emergency Response Unit to work across all county departments and coordinate with federal, regional and state emergency management offices. Typically, restaurants, retailers and wholesale food processors are required to pass an inspection prior to re-opening. But in the aftermath of a natural disaster, the County Board of Supervisors may declare a provision to suspend routine inspection requirements, allowing the Division to focus on thoroughly assessing establishments to ensure public health safety. The Division will prioritize its response to impacted businesses to allow them to quickly recover and re-open for business.

Multiple layers of communication between federal, state and local governments coordinating with food distributors and retailers can create confusion in the aftermath of a disaster. Trade associations, which typically operate at a state level, could provide a single point of contact for government agencies. As we learned with this study, some state emergency management offices may already have mechanisms in place to coordinate with

food retail trade associations during natural disasters to improve emergency response and recovery efforts. City leaders should establish similar relationships with food retailers at the local level, such as the relationship in New Orleans between the New Orleans Office of Homeland Security and Emergency Preparedness and the city's private grocery industry. Further, not all grocery stores, especially small grocery stores and corner stores, are members of these trade associations. Non-member stores need to have established lines of communication with government agencies in the aftermath of a natural disaster.

State and local government can also marshal resources to support the recovery of food businesses that lack sufficient capital to reopen. As we learned in both New Orleans and New York City, smaller grocery and corner stores that were severely damaged were slow to reopen in part because of a lack of financial resources and insufficient or delayed insurance payments. While New York City and New York State quickly moved to create new small business recovery loan programs in the aftermath of Sandy, the time it took to implement the programs (seven months after the storm for the City's program) could have been shortened if the programs were put in place in advance of the disaster. For example, Florida has established a Small Business Emergency Loan Program to support small businesses after disasters. The program, managed by the Florida Department of Economic Opportunity provides short-term, interest-free loans to small businesses that experience physical or economic damage from a disaster to help bridge the gap between the time damage is incurred and when a business secures other financial resources, including insurance claims and long-term loans.¹⁹⁶

As we learned in both New Orleans and New York City, smaller grocery and corner stores that were severely damaged were slow to reopen in part because of a lack of financial resources and insufficient or delayed insurance payments.

FINAL THOUGHTS

Not all natural disasters pose the same threat to urban food systems. Our analysis of Boston, Los Angeles, Madison, New Orleans and New York City suggests that hurricanes and earthquakes pose a greater risk to urban food systems than a tornado or severe winter storm. We also find that Madison, Wisconsin, has already built the foundation for a resilient food system. The essential elements of their urban food system resilience include: very few warehouse supplier facilities located in "at risk" areas, redundant transportation networks that are not vulnerable to extended closures, a strong food safety net with capacity to meet increased demand, and very strong partnerships between state and local governments and private food businesses.

Not all natural disasters pose the same threat to urban food systems. Hurricanes and earthquakes pose a greater risk to urban food systems than a tornado or severe winter storm.

The five practical recommendations we set forth can help city leaders, including Chief Resilience Officers, begin to strengthen the resilience of their urban food systems to natural disasters and thereby ensure that food access in all neighborhoods returns to pre-disaster levels as quickly as possible. Every city will ultimately need more research to identify the unique vulnerabilities of its food system, and target appropriate short- and long-term solutions that address response and recovery challenges as well as underlying issues such as food insecurity. Successful implementation of food system resilience initiatives will require broad public- and private-sector coalitions and strong state and local government leadership.

A truly resilient city will be able to withstand not only natural disasters, but also social upheavals and significant economic shocks such as severe recessions. Our study of Portland contributes to a broader understanding of economic resilience by focusing on the implications of expanded local food sectors. We find that an expanded local food sector did not make Portland's economy more vulnerable to an economic shock, but this was due to Portland's strong, traditional food cluster. Other cities that create a food-based urban economy may be less resilient if they lack the same types of competitive advantages.

Finally, our research begins to integrate two disparate policy discussions: food waste reduction and resilience planning. Diverting edible food from landfills can increase the availability of meals for the food insecure, while diverting non-edible food can create environmental benefits, both of which strengthen a city's resilience. The net impact of food waste initiatives on food donations (critical to food banks and other organizations in the food safety net) is unclear. Food waste reduction goals could increase donations to food banks, but this could be offset by increased supply chain efficiencies that lead to less surplus food. However, food banks are partnering with food processors and retailers to increase the efficiency of the food donation process, which means that more surplus food should make its way to food banks and pantries. Any reduction in food donations would be critical for donation-dependent food banks. More research is needed to fully understand the interplay between food waste reduction and food system resilience.

Climate change will only increase the occurrence and severity of natural disasters in U.S. cities, and city leaders need to be prepared to respond. As this report highlights, natural disasters could create extended food supply disruptions, especially in neighborhoods with limited food retail options and food insecure populations. Our pivotal research on urban food system resilience advances both theory and practice and we hope it will catalyze city leaders to begin to address food system vulnerabilities in their resilience planning.

Natural disasters could create extended food supply disruptions, especially in neighborhoods with limited food retail options and food insecure populations.

Endnotes

- 1 We did not examine the parallel question of the resilience of Portland's urban food system to an economic disaster in part because this question requires reframing the analysis to focus on vulnerabilities in global supply chains, which is beyond the scope of this study. Local vulnerabilities would be related to food access if prices increased and unemployment soared, creating even more stress on the local food safety net.
- 2 Kimberly Zeuli and Austin Nijhuis, "Creating a resilience assessment framework for urban food systems," in *Feeding Cities: Improving Local Food Access, Security, and Resilience*, ed. Christopher Bosso (New York, NY: Rutledge, 2017).
- 3 "Milan Urban Food Policy Pact," *Milan Urban Food Policy Pact*, October 15, 2016, accessed October 30, 2016. <http://www.milanurbanfoodpolicypact.org/wp-content/uploads/2016/06/Milan-Urban-Food-Policy-Pact-EN.pdf>. We do not consider sustainability to mean the same as resilience. Sustainability refers to engaging in practices that meet the resource needs of the present without compromising the needs of the future, whereas resilience refers to the ability of systems to survive, withstand and adapt to various shocks and stresses. For a discussion of the differences between sustainability and resilience, see Charles L. Redman, "Should sustainability and resilience be combined or remain distinct pursuits?" *Ecology and Society* 19, no. 2 (2014): 37.
- 4 "Network Overview," C40, accessed November 2, 2016. http://www.c40.org/networks/food_systems.
- 5 The City of New York, *OneNYC 2016 Progress Report* (New York, NY: 2016).
- 6 City of New Orleans, *Resilient New Orleans: Strategic actions to shape our future city* (New Orleans, LA: 2015).
- 7 New York City Economic Development Corporation and New York City Mayor's Office of Recovery & Resiliency, *Five Borough Food Flow* (New York, NY: 2016).
- 8 City of Los Angeles Emergency Management Department, *Supply Chain Resilience-Grocery Sector: Implications for Post-Disaster Operations* (Los Angeles, CA: 2015).
- 9 The framework was developed to analyze the resilience of food systems in Central America. For more details, see Stephen Tyler et al., *Climate Resilience and Food Security: A framework for planning and monitoring* (Winnipeg: The International Institute for Sustainable Development, 2013).
- 10 Ellen Douglas, Paul Kirshen, Vivien Li, Chris Watson, and Julie Wormser, *Preparing for the Rising Tide* (Boston, MA: The Boston Harbor Association, 2013).
- 11 Alan Taylor, "The Northridge Earthquake: 20 Years Ago Today," *The Atlantic*, January 17, 2014, accessed August 28, 2016. <http://www.theatlantic.com/photo/2014/01/the-northridge-earthquake-20-years-ago-today/100664/>.
- 12 Lucile M. Jones et al., *The shakeout scenario, U.S. Geological Survey Open-File Report 1150* (US Geological Survey, 2008).
- 13 "Magnitude / Intensity Comparison," *U.S. Geological Survey*, accessed October 6, 2016. https://earthquake.usgs.gov/learn/topics/mag_vs_int.php.
- 14 "The Modified Mercalli Intensity Scale," *U.S. Geological Survey*, accessed October 6, 2016. <https://earthquake.usgs.gov/learn/topics/mercalli.php>. Severe shaking intensity refers to VIII on the Modified Mercalli Intensity (MMI) scale. Extreme shaking intensity refers to X on the MMI scale and subsequent damage is based on expected ground motion acceleration.

- 15 Allison Plyer, "Facts for Features: Katrina Impact," *The Data Center*, August 28, 2015, accessed August 18, 2016. <http://www.datacenterresearch.org/data-resources/katrina/facts-for-impact/>.
- 16 Robert W. Kates, "Reconstruction of New Orleans after Hurricane Katrina: a research perspective," *Proceedings of the National Academy of Sciences* 103, no. 40 (2006): 14653-14660.
- 17 Federal Emergency Management Agency, *New Orleans September 11th Flood Extent* (2005).
- 18 Ellen Douglas, Paul Kirshen, Vivien Li, Chris Watson, and Julie Wormser, *Preparing for the Rising Tide* (Boston, MA: The Boston Harbor Association, 2013).
- 19 PlaNYC, *A Stronger, More Resilient New York* (New York, NY: 2013), 2.
- 20 Dane County Emergency Management, *Dane County Multi-Hazard Mitigation Plan: City of Madison Annex* (Madison, WI: 2009).
- 21 National Weather Service, *Worst Snowstorms in the State of Wisconsin: From 1881 to Present* (n.d.).
- 22 We identify all milk processing plants included in the U.S. Food and Drug Administration (FDA)'s Interstate Milk Shippers List, a list of dairy processing facilities inspected by individual state agencies that process milk and are permitted to ship or receive milk interstate. We limit our analysis to facilities that process fluid milk.
- 23 For example, according to a report by *PolicyLink*, Community Development Block Grants (CDBGs), administered by the U.S. Department of Housing and Urban Development have been used by cities recently for city gardens, farmer support and other agriculture-based economic development measures. Allison Hagey, Solana Rice, and Rebecca Flournoy, *Growing Urban Agriculture: Equitable Strategies and Policies for Improving Access to Healthy Food and Revitalizing Communities* (Policy Link, 2012). In 2015, Englewood Community Development Corporation, in Indianapolis, received a \$500,000 Urban Agriculture CDBG that covered the building purchase and lighting for the indoor growing units for Farm 360. For more details, see "City Partners with Sustainable Local Foods in Urban Farm Project," *Indianapolis Recorder*, July 23, 2013, accessed September 8, 2016. http://www.indianapolisrecorder.com/aroundtown/article_018966de-3168-11e5-99c2-b72848ed8bda.html.
- 24 Food retailers may also use alternative food vendors for certain products (e.g., local produce), but the three categories of food suppliers covers nearly all food supplied to most food retailers. "Food Industry Glossary," *Food Marketing Institute*, accessed October 25, 2016. <http://www.fmi.org/research-resources/fmi-research-resources/food-industry-glossary>.
- 25 Some warehouses may not handle distribution. Food distribution companies fill this gap.
- 26 Grocery Manufacturers Association, AMR Research, Clarkston Consulting, and The Nielsen Company, *Powering Growth Through Direct Store Delivery: The Impact of DSD* (Grocery Manufacturers Association, 2008).
- 27 Steve W. Martinez, *The U.S. Food Marketing System: Recent Developments, 1997-2006 ERR-42* (Washington, DC: U.S. Department of Agriculture, Economic Research Service, 2007).
- 28 "Specialty Crops Terminal Markets Standards Reports," *U.S. Department of Agriculture*, accessed August 18, 2016. <https://www.ams.usda.gov/market-news/fruit-and-vegetable-terminal-markets-standard-reports>.
- 29 We count all supplier warehouse facilities as an unique location. For example, if a single company operates multiple warehouses, we count and analyze the location of each warehouse separately. Supermarket warehouse suppliers (vertically-integrated or independently-owned) were identified as those publicly listed on websites, annual reports and industry reports, as suppliers for the majority of supermarkets in each city. To identify warehouse suppliers operating in each city, we used public lists of warehouse suppliers from the city or state. For Los Angeles, we identified warehouse suppliers as all businesses classified as NAICS code 4244 (Grocery

- and Related Product Merchant Wholesalers) in the City’s Listing of Active Businesses dataset, which includes all businesses currently registered with the Los Angeles Office of Finance. For Madison, we identified warehouse suppliers as all businesses classified as “Food Warehouses” that are licensed by the Wisconsin Department of Agriculture, Trade and Consumer Protection. For New Orleans, we identified warehouse suppliers as all businesses classified as “Grocery and Related Products Wholesalers” in the City of New Orleans’ Grocery Stores database, which includes all general and specialized grocery stores (including warehouse suppliers) registered with the New Orleans Bureau of Revenue. For New York City, we took a more narrow approach, because of data limitations, and identified warehouse suppliers as all businesses that are approved registrants in food wholesale markets by the New York City Business Integrity Commission. This includes the wholesale businesses operating in Hunts Point, adjacent to Hunts Point, but not in the facility, in the Brooklyn Wholesale Meat Market and in the Gansevoort Meat Market. The data set for New York City may undercount warehouse suppliers because it only includes warehouse suppliers located in food wholesale markets. A more comprehensive list of warehouse suppliers is not publicly available. For comparison purposes, we also analyzed Dun and Bradstreet’s Hoover’s data on warehouse suppliers (all businesses classified as NAICS code 4244). In each city, the Dun and Bradstreet data included more warehouse suppliers than the public lists. However, a review of businesses found that the Dun and Bradstreet data also included food processing and manufacturing companies, food service businesses, headquarters of warehouse suppliers, as well as businesses that have may have closed or have been incorrectly classified. Due to these discrepancies, we used the public data for our analysis.
- 30 “Walmart takes collaborative approach to disaster recovery,” *PricewaterhouseCoopers*, September, 2013, accessed October 14, 2016. <http://www.pwc.com/gx/en/industries/capital-projects-infrastructure/disaster-resilience/walmart-disaster-response-strategy.html>.
- 31 “Supermarket Facts,” *Food Marketing Institute*, accessed November 3, 2016. <http://www.fmi.org/research-resources/supermarket-facts>.
- 32 The U.S. Department of Agriculture defines food deserts as census tracts with a substantial share of residents who live in low-income areas that have limited access to a grocery store or other healthy, affordable food retail stores. Paula Dutko, Michele Ver Ploeg, and Tracey Farrigan, *Characteristics and Influential Factors of Food Deserts, ERR-140* (Washington, DC: U.S. Department of Agriculture, Economic Research Service, 2012).
- 33 Flood and earthquake insurance generally covers physical damage to properties and inventory, but not financial losses. Business interruption insurance covers operating expenses and lost revenue.
- 34 Rodney C. Runyan, “Small Business in the Face of Crisis: Identifying Barriers to Recovery from a Natural Disaster,” *Journal of Contingencies and Crisis Management* 14 no. 1 (2006): 12-26.
- 35 Siddharta Mahanta, “New York’s Looming Food Disaster,” *Citylab*, October 21, 2013, accessed August 18, 2016. <http://www.citylab.com/politics/2013/10/new-yorks-looming-food-disaster/7294/>.
- 36 NAICS code 445110, Supermarkets and Other Grocery (except Convenience) stores, NAICS code 445120, Convenience Stores, and NAICS code 447110, Gasoline Stations with Convenience Stores.
- 37 C.A. Gundersen et al., *Map the Meal Gap 2016: Food Insecurity and Child Food Insecurity Estimates at the County Level* (Chicago, IL: Feeding America, 2016).
- 38 “FNS Disaster Assistance,” *U.S. Department of Agriculture Food and Nutrition Service, Office of Emergency Management*, accessed October 10, 2016. http://www.fns.usda.gov/sites/default/files/disaster_handout.pdf.
- 39 U.S. Department of Agriculture Food and Nutrition Service, *Disaster SNAP Guidance: Policy Guidance, Lessons Learned, and Toolkits to Operate a Successful D-SNAP* (2013).

- 40 “WIC During Disaster,” *U.S. Department of Agriculture Food and Nutrition Service, Office of Emergency Management*, accessed October 10, 2016. http://www.fns.usda.gov/sites/default/files/WIC_Disaster.pdf.
- 41 Jeff Thomas, *How to Run a Food Pantry* (End Hunger in America, 2007).
- 42 U.S. Department of Agriculture, *The Food Bank Response to Disasters* (2011).
- 43 Victoria L. Mayer, Amy Hillier, Marcus A. Bachhuber, and Judith A. Long, “Food insecurity, neighborhood food access, and food assistance in Philadelphia,” *Journal of Urban Health* 91, no. 6 (2014): 1087-1097.
- 44 In New York City, none of the 53 milk processing plants supplying New York State’s milk are located in “at risk” areas. In New Orleans, none of the 18 milk processing plants supplying Louisiana are located in “at risk” areas. In Los Angeles, 21 out of the 86 milk processing plants supplying California are located in “at risk” areas. ICIC analysis using the U.S. Food and Drug Administration 2016 Interstate Milk Shippers List.
- 45 City of Los Angeles Emergency Management Department, *Supply Chain Resilience-Grocery Sector: Implications for Post-Disaster Operations* (Los Angeles, CA: 2015).
- 46 “Whole Foods Market’s Southern Pacific Region opens new distribution center,” *Whole Foods Market*, October 7, 2015, accessed August 18, 2016. <http://media.wholefoodsmarket.com/news/whole-foods-markets-southern-pacific-region-opens-new-distribution-center>.
- 47 New York City Economic Development Corporation and New York City Mayor’s Office of Recovery & Resiliency, *Five Borough Food Flow* (New York, NY: 2016), 1.
- 48 PlaNYC, *A Stronger, More Resilient New York* (New York, NY: 2013), 222.
- 49 New York City Department of Transportation, *Traffic Rules* (New York, NY: 2016).
- 50 PlaNYC, *A Stronger, More Resilient New York* (New York, NY: 2013).
- 51 URS and Goodkind and O’Dea, Inc., *Hunts Point Truck Study* (New York, NY: n.d.).
- 52 PlaNYC, *A Stronger, More Resilient New York* (New York, NY: 2013).
- 53 Sarah Kaufman et al., *Transportation During and After Hurricane Sandy* (New York, NY: NYU Wager Graduate School of Public Services Rudin Center for Transportation, 2012).
- 54 PlaNYC, *A Stronger, More Resilient New York* (New York, NY: 2013), 18.
- 55 Regional Planning Commission, *Freight Facts and Figures: An Overview of the New Orleans Regional Freight Transportation System 2014* (New Orleans, 2014).
- 56 Jamie Padgett et al., “Bridge damage and repair costs from Hurricane Katrina,” *Journal of Bridge Engineering* 13, no. 1 (2008): 6-14.
- 57 G. Shen and S. G. Aydin, “Highway freight transportation disruptions under an extreme environmental event: the case of Hurricane Katrina,” *International Journal of Environmental Science and Technology* 11, no. 8 (2014): 2387-2402.
- 58 AWG Opens La. Warehouse,” *Supermarket News*, January 21, 2013, accessed October 29, 2016. <http://supermarketnews.com/associated-wholesale-grocers/awg-opens-la-warehouse>.
- 59 Larry Wasemann, Tijana Hamilton, Steve Tabaie, and Gerald Bare, “Cost-of-delay studies for freeway closures caused by Northridge earthquake,” *Transportation Research Record: Journal of the Transportation Research Board* 1559 (1996): 67-75.
- 60 For a list of vulnerable neighborhoods, please contact the authors of this report.
- 61 City of Los Angeles Emergency Management Department, *Supply Chain Resilience-Grocery Sector: Implications for Post-Disaster Operations* (Los Angeles, CA: 2015).

- 62 For a list of vulnerable neighborhoods, please contact the authors of this report.
- 63 Adrienne Mundorf, Amelia Willits-Smith, and Donald Rose, "10 Years Later: Changes in Food Access Disparities in New Orleans since Hurricane Katrina," *Journal of Urban Health* 92, no. 4 (2015): 605-610.
- 64 Adrienne R. Mundorf, Amelia Willits-Smith, and Donald Rose, *10 Years Later* (New Orleans, LA: Tulane Prevention Research Center, 2014).
- 65 "Walmart Re-opens Two New Orleans-area Supercenters." *Walmart*. News Release. March 29, 2006. <http://www.prnewswire.com/news-releases/Walmart-re-opens-two-new-orleans-area-supercenters-55574937.html>.
- 66 "Whole Foods Market Reopens New Orleans Unit," *Progressive Grocer*, February 1, 2006, accessed August 19, 2016. http://www.progressivegrocer.com/node/59972?sort_by=search_api_relevance.
- 67 Jeffrey E. Schwartz, "Making groceries: food, neighborhood markets, and neighborhood recovery in post-Katrina New Orleans." PhD diss. (Cambridge, MA: Massachusetts Institute of Technology, 2008).
- 68 Because of New York City's unique food retail landscape, some of the vulnerable neighborhoods have a higher share of supermarkets than the city average because the city average was very low. However, we defined them as vulnerable because they were underserved overall and the majority of their food retail stores were located in "at risk" areas. For a list of vulnerable neighborhoods, please contact the authors of the report.
- 69 Bridget Goldschmidt, "Key Food Reopens Store Closed Since Sandy," *Progressive Grocer*, April 8, 2014, accessed October 13, 2016. <http://www.progressivegrocer.com/industry-news-trends/regional-supermarket-chains/key-food-reopens-store-closed-sandy?nopaging=1>.
- 70 "Rebuilding the Rockaways After Hurricane Sandy: The Recovery," *Metropolitan Transportation Authority*, accessed September 2, 2016. <http://web.mta.info/nyct/service/RebuildingRockawaysAfter-HurricaneSandy.htm>.
- 71 Karen Frantz, "Rockaways still in need of food aid after storm," *TimesLedger*, April 2, 2013, accessed October 12, 2016. http://www.timesledger.com/stories/2013/13/foodaidgrant_all_2013_03_29_q.html.
- 72 Leslie Eaton and Joseph B. Treaster, "Insurance woes for Hurricane Katrina victims," *The New York Times*, September 2, 2007, accessed September 2, 2016. <http://www.nytimes.com/2007/09/02/business/worldbusiness/02iht-orleans.4.7353442.html>.
- 73 Mitch Weiss, "Special Report: Katrina—a tale of SBA failure," *USA Today*, August 25, 2010, accessed September 3, 2016. http://usatoday30.usatoday.com/money/smallbusiness/2010-08-25-katrina-sba_N.htm.
- 74 PlaNYC, *A Stronger, More Resilient New York* (New York, NY: 2013).
- 75 J.D. Harrison, "Disaster loan disaster: SBA much too slow to respond to Hurricane Sandy, probe finds," *The Washington Post*, October 27, 2014, accessed September 1, 2016. https://www.washingtonpost.com/business/on-small-business/disaster-loan-disaster-sba-much-too-slow-to-respond-to-hurricane-sandy-probe-finds/2014/10/26/5d6ce70c-5b1f-11e4-8264-deed989ae9a2_story.html.
- 76 New York City Department of Small Business Services, *NYC Hurricane Sandy: Business Loan & Grant Program FAQs* (New York, NY: 2016); "Governor Cuomo Announces Small Business Emergency Loan Fund to Provide Assistance to Businesses Affected by Sandy," *New York State Office of the Governor*, November 14, 2012, accessed October 14, 2016, <https://www.governor.ny.gov/news/governor-cuomo-announces-small-business-emergency-loan-fund-provide-assistance-businesses>.

- 77 City of New Orleans, *The Unified New Orleans Plan: Citywide Strategic Recovery and Rebuilding Plan* (New Orleans, LA: 2007), 28.
- 78 New Orleans Food Policy Advisory Committee, *Building Healthy Communities: Expanding Access to Fresh Food Retail* (New Orleans, LA: 2008).
- 79 Katherine Sayre, "Circle Food Store Opens Again After Eight-Year Struggle to Rebuild," *The Times-Picayune*, January 17, 2014, accessed August 19, 2016. http://www.nola.com/business/index.ssf/2014/01/circle_food_store_opens_again.html.
- 80 "Fresh Food Retailers Initiative," *City of New Orleans*, accessed February 13, 2016. <http://www.nola.gov/city/fresh-food-retailers-initiative/>.
- 81 C.A. Gundersen et al., *Map the Meal Gap 2016: Food Insecurity and Child Food Insecurity Estimates at the County Level* (Chicago, IL: Feeding America, 2016).
- 82 County of Los Angeles Department of Public Health, *Social Determinants of Health: Rising Food Insecurity in Los Angeles County* (Los Angeles, CA: 2014).
- 83 Susan Langenhennig, "Seeds and the City: Urban Lots Are Sprouting Farms Across New Orleans," *The Times-Picayune*, June 17, 2015, accessed September 1, 2016. http://www.nola.com/homegarden/index.ssf/2015/06/seeds_and_the_city_a_network_o.html.
- 84 Brent Tranchina, "Growing Support: Localism, Nonprofits, and Food Access in Post-Katrina New Orleans," Master's thesis (New Orleans, LA: University of New Orleans, 2012).
- 85 "Who We Help," *Los Angeles Regional Food Bank*, accessed August 18, 2016. <https://www.lafoodbank.org/learn/who-we-help/>.
- 86 C.A. Gundersen et al., *Map the Meal Gap 2016: Food Insecurity and Child Food Insecurity Estimates at the County Level* (Chicago, IL: Feeding America, 2016).
- 87 New York City Coalition Against Hunger, *Superstorm of Hunger* (New York, NY: 2013), 2-7.
- 88 "Our Programs," *Food Bank for New York City*, accessed October 13, 2016. <http://www.foodbanknyc.org/our-programs>.
- 89 "Fast Facts," *Food Bank for New York City*, accessed October 13, 2016. <http://www.foodbanknyc.org/newsroom/fast-facts/>.
- 90 Food Bank for New York City, *2012 Annual Report* (New York, NY: 2013).
- 91 Mona El-Naggar, "In Lieu of Money, Toyota Donates Efficiency to New York Charity," *The New York Times*, July 26, 2013, accessed October 13, 2016. http://www.nytimes.com/2013/07/27/nyregion/in-lieu-of-money-toyota-donates-efficiency-to-new-york-charity.html?_r=0.
- 92 C.A. Gundersen et al., *Map the Meal Gap 2016: Food Insecurity and Child Food Insecurity Estimates at the County Level* (Chicago, IL: Feeding America, 2016).
- 93 "About Us," *Second Harvest Food Bank*, accessed September 3, 2016. <http://no-hunger.org/about-us/>.
- 94 "FEMA Administrator Renews Partnership with Feeding America," *Federal Emergency Management Agency*, October 22, 2009, accessed September 2, 2016. <http://www.fema.gov/news-release/2009/10/22/fema-administrator-re-news-partnership-feeding-america>.
- 95 "Governor Cuomo Announces Replacement SNAP Benefits for New Yorkers Impacted by Hurricane Sandy," *New York State Office of Governor*, November 3, 2012, accessed October 13, 2016. <https://www.governor.ny.gov/news/governor-cuomo-announces-replacement-snap-benefits-new-yorkers-impacted-hurricane-sandy>.
- 96 Michael H. Saul, "City Limits Storm Aid," *The Wall Street Journal*, December 10, 2012, accessed October 16, 2016. <http://www.wsj.com/articles/SB10001424127887324478304578171743381491264>.

- 97 U.S. Government Accountability Office, *Hurricanes Katrina and Rita: Federal Actions Could Enhance Preparedness of Certain State-Administered Federal Support Programs*, GAO-07-219 (Washington, DC: 2007), 13.
- 98 “New York State Announces Easing of Requirements to Ensure WIC Recipients Receive Food or Infant Formula Benefits,” *New York State Department of Health*, November 8, 2012, accessed October 11, 2016. https://www.health.ny.gov/press/releases/2012/2012-11-08_nys_easing_wic_requirements.htm.
- 99 “Retailer Benefits,” *California Grocers Association*, accessed October 11, 2016. <http://www.cagrocers.com/members/retailer-benefits/>.
- 100 CalEMA, *Business and Utility Operations Center Administrative Policy – January 2013* (2013).
- 101 “Welcome to the Louisiana Retailers Association,” *Louisiana Retailers Association*, accessed October 11, 2016. <http://www.laretail.org/>. Data on food retailers, manufacturers and wholesalers provided by Louisiana Retailer’s Association on October 26, 2016.
- 102 “FAQ,” *Louisiana Business Emergency Operations Center*, accessed October 12, 2016. http://www.labeoc.org/public_forms/faq.aspx#Q1.1.
- 103 Representing the Grocery Industry of New York State,” *Food Industry Alliance*, accessed October 29, 2016. <http://www.fiany.com/>.
- 104 Federal Emergency Management Agency, *Big City Partnership-New York City Office of Emergency Management* (n.d.), 1.
- 105 New York State Disaster Preparedness Commission Human Services Branch, Human Services Branch Annex: Mass Care Support (2016), 32.
- 106 Executive Order 190 of December 2, 2012, Emergency Order Regarding Waiver of Building Department Permit Fees and Local Laws Related to Demolition, *The City of New York Office of the Mayor* (2012) http://www.nyc.gov/html/records/pdf/executive_orders/2012EO190.pdf.
- 107 “Summary of Hours of Service Regulations,” *Federal Motor Carrier Safety Administration*, accessed October 12, 2016. <https://cms.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations>.
- 108 Initiative for a Competitive Inner City, *Resilient Food Systems, Resilient Cities: Recommendations for the City of Boston* (Boston, MA: 2015), 12.
- 109 Only one of the 188 milk processing plants supplying Wisconsin’s milk is located in Madison. The state extension agency and a public-private partnership are also developing resilience plans for critical processing industries.
- 110 Madison Area Transportation Planning Board, *2035 Regional Transportation Plan Update* (Madison, WI: 2012).
- 111 There are 0.004 supermarkets or grocery stores per capita, which is higher than the national average of 0.003 per capita. ICIC analysis using 2016 Dun and Bradstreet Hoover’s Database and U.S. Census Bureau 2014 American Community Survey 5-Year Estimates.
- 112 For a list of the food vulnerable neighborhoods, please contact the authors of this report.
- 113 C.A. Gundersen et al., *Map the Meal Gap 2016: Food Insecurity and Child Food Insecurity Estimates at the County Level* (Chicago, IL: Feeding America, 2016).
- 114 “Our Impact,” *Second Harvest FoodBank of Southern Wisconsin*, accessed September 3, 2016. <http://www.secondharvestmadison.org/>.
- 115 *Hunger-Free Minnesota, A Future Beyond Hunger: 2011-2014* (2015).
- 116 “City of Madison Launches Healthy Retail Access Program,” *City of Madison*, August 3, 2015, accessed October 16, 2016. <https://www.cityofmadison.com/news/city-of-madison-launches-healthy-retail-access-program>.
- 117 Wisconsin Department of Agriculture, Trade and Consumer Protection, *Statewide Emergency Food Distribution: Bringing Stakeholders to the Table* (n.d.).

- 118 “The Top 17 Food Cities of 2015,” *Zagat*, December 15, 2016, accessed September 1, 2016. <https://www.zagat.com/b/the-top-17-food-cities-of-2015>.
- 119 There are 0.005 restaurants (defined as NAICS code 722 [Food Services and Drinking Places]) per capita in Portland and 0.004 restaurants per capita in San Francisco. ICIC analysis using 2016 Dun and Bradstreet Hoover’s Database and U.S. Census Bureau 2014 American Community Survey 5-Year Estimates.
- 120 U.S. Census Bureau ZIP Business Patterns (2008-2013).
- 121 City of Portland Economic Development Department, *State of Portland Economy* (Portland, ME, 2015).
- 122 Joshua Mason, *Brew Pub v. Taproom: Which Business Model is Right for You?* (The Bar Examiner, 2015).
- 123 U.S. Census Bureau Economic Census (2012); U.S. Census Bureau ZIP Business Patterns (2013). Portland’s food wholesalers and distributors are primarily for single products, including fish and seafood merchant wholesalers, beer and wine wholesalers, and other grocery products. Supermarket warehouse suppliers are located outside of city limits. Dun and Bradstreet Hoover’s Database (2016); Delhaize America (2016); UNFI (2016); C&S Wholesale Grocers (2016).
- 124 DPA, *Visitor Track Research: 2014 Calendar Year Annual Report* (Maine Office of Tourism, 2015).
- 125 U.S. Census Bureau ZIP Business Patterns (2003-2013).
- 126 City of Portland, *Economic Development Vision + Plan: Portland Maine* (Portland, ME: 2011).
- 127 U.S. Economic Development Administration, *Investing in Manufacturing Communities Partnership: Greater Portland Sustainable Food Production Cluster Manufacturing Community* (Washington, DC: 2014).
- 128 Peggy Grodinsky, “James Beard Award semifinalists include nine from Maine,” *Portland Press Herald*, February 17, 2016, accessed October 29, 2016. <http://www.pressherald.com/2016/02/17/nine-maine-restaurants-chefs-and-other-food-professionals-named-semifinalists-for-james-beard-awards/>.
- 129 Dun and Bradstreet Hoover’s Database (2016).
- 130 Meredith Goad, “Portland’s Harvest on the Harbor festival sold to new operators,” *Portland Press Herald*, February 24, 2016, accessed September 1, 2016. <http://www.pressherald.com/2016/02/24/harvest-on-the-harbor-sold-to-new-operators/>.
- 131 “Small and Independent Brewers Continue to Grow Double Digits,” *Brewers Association*, March 22, 2016, accessed August 17, 2016. <https://www.brewersassociation.org/press-releases/small-independent-brewers-continue-grow-double-digits/>.
- 132 Bart Watson, “The Craft Beer (Non) Bubble,” *Brewers Association*, September 20, 2013, accessed August 19, 2016.
- 133 U.S. Census Bureau ZIP Business Patterns (2007-2010); U.S. Census Bureau Economic Census (2007-2012).
- 134 U.S. Census Bureau ZIP Business Patterns (2007-2010).
- 135 Maine Department of Marine Resources, *Maine 2011-2015 Top Ten Ports by Value* (Augusta, ME: 2015).
- 136 George Lapointe, *Commercial Fishers: State of the Gulf of Maine Report* (Gulf of Maine Council on the Marine Environment, 2013).
- 137 Tom Bell, “Eimskip moves to bring more cargo ships to Portland,” *Portland Press Herald*, January 30, 2015, accessed August 18, 2016. <http://www.pressherald.com/2015/01/29/eimskip-moves-to-bring-%E2%80%A8more-vessels-to-portland/>.
- 138 Anna M. Henry and Teresa R. Johnson, “Understanding Social Resiliency in the Maine Lobster Industry,” *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science* 7 (2015): 33-43.

- 139 Jennifer Van Allen, “Despite good wages, lobster processing is a hard sell,” *Portland Press Herald*, October 26, 2014, accessed September 1, 2016. <http://www.pressherald.com/2014/10/26/despite-good-wages-lobster-processing-is-a-hard-sell/>; Maine Department of Marine Resources, *Maine 2011-2015 Top Ten Ports by Value* (Augusta, ME: 2015).
- 140 Rich Hewitt, “State, industry gear up to meet lobster crisis,” *Bangor Daily News*, October 24, 2008, accessed September 1, 2016. <http://bangordailynews.com/2008/10/24/news/state-industry-gear-up-to-meet-lobster-crisis/>.
- 141 Rich Hewitt, “State, industry gear up to meet lobster crisis,” *Bangor Daily News*, October 24, 2008, accessed September 1, 2016. <http://bangordailynews.com/2008/10/24/news/state-industry-gear-up-to-meet-lobster-crisis/>.
- 142 Jennifer Van Allen, “Despite good wages, lobster processing is a hard sell,” *Portland Press Herald*, October 26, 2014, accessed September 1, 2016. <http://www.pressherald.com/2014/10/26/despite-good-wages-lobster-processing-is-a-hard-sell/>.
- 143 Andrew J. Pershing et al., *The Future of Cod in the Gulf of Maine*, (Portland, ME: Gulf of Maine Research Institute, 2013).
- 144 Mercedes Delgado, Michael E. Porter, and Scott Stern, *The Resilience of Clusters: Evidence from the Great Recession*, Working Paper (2015).
- 145 Gretchen Bartlett et al., *Growing Maine’s Food Industry, Growing Maine* (The Maine Food Cluster Project, Harvard Kennedy School Mossavar-Rahmani Center for Business and Government, 2015).
- 146 Gretchen Bartlett et al., *Growing Maine’s Food Industry, Growing Maine* (The Maine Food Cluster Project, Harvard Kennedy School Mossavar-Rahmani Center for Business and Government, 2015).
- 147 Greater Portland Council of Governments, *Greater Portland Sustainable Food Production Cluster* (Portland, ME, 2014).
- 148 James McCarthy, “Portland waterfront to be site of New England ocean ‘cluster,’” *Maine Business Journal*, October 16, 2014, accessed September 1, 2016.
- 149 U.S. Census Bureau 2014 American Community Survey 5-Year Estimates.
- 150 Maine Department of Labor Center for Workforce Research and Information, *Labor Force Statistics by Geography* (Augusta, ME: 2016).
- 151 C. Gundersen et al., *Map the Meal Gap 2015: Overall Food Insecurity in Maine by County in 2013* (Chicago, IL: Feeding America, 2015).
- 152 Michael Rayder et al., *The Campaign to Promote Food Security in Cumberland County Coalition Report* (2010).
- 153 Tux Turkel, “Persistent hunger fuels sprawling food supply system for needy Mainers,” *Portland Press Herald*, January 24, 2016, accessed March 22, 2016. <http://www.pressherald.com/2016/01/24/persistent-hunger-fuels-sprawling-food-supply-system-for-needy-mainers/>.
- 154 “Mainers Feeding Mainers,” *Good Shepherd Food Bank of Maine*, accessed September 1, 2016. <https://www.gsfb.org/how-we-help/programs/main-ers-feeding-mainers/>.
- 155 Dana Gunders, *Wasted: How America is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill* (National Resources Defense Council, 2012).
- 156 “Frequently Asked Questions,” *U.S. Department of Agriculture*, accessed September 30, 2016. <http://www.usda.gov/oce/foodwaste/faqs.htm>.
- 157 “About the Food Waste Reduction Alliance,” *Food Waste Reduction Alliance*, accessed October 20, 2016. <http://www.foodwastealliance.org/about-us-page-2/>.
- 158 In 2015, the Protecting Americans from Tax Hikes (PATH) Act modified Section 170 of the Internal Revenue Code to allow all companies to earn an enhanced tax deduction for donating food. (See PricewaterhouseCoopers, *Enhanced Deduction for Charitable Contributions of Food Inventory Modified and Retroactively Made Permanent* [2016]).

- 159 Los Angeles Regional Food Bank, 2015 *Los Angeles Regional Food Bank Annual Report* (Los Angeles, CA: 2015).
- 160 Second Harvest Food Bank, *Annual Report 2015* (New Orleans, LA: 2015).
- 161 Food Bank for New York City, *Filling the Gap: 2014 Annual Report* (New York, NY: 2015).
- 162 Second Harvest Foodbank of Southern Wisconsin, *2015 Annual Report* (Madison, WI: 2016).
- 163 Good Shepherd Food Bank of Maine, *Good Shepherd Food Bank of Maine Annual Report 2015* (2015).
- 164 EPA's Food Recovery Challenge (FRC), established in 2011, asks organizations to commit to improving their sustainable food management practices, including reducing and recovering food waste. The Challenge is guided by the Food Recovery Hierarchy, which includes actions ranging from source reduction to incineration. Currently, 446 businesses and organizations, representing food manufacturers, warehouse suppliers, restaurants and retail stores, as well as other organizations such as schools, hospitals and governments, participate in the Challenge. Participants provide their food waste baseline, establish a reduction goal, take actions to decrease food waste, and record their progress over time. Sources: "Food Recovery Hierarchy," *United States Environmental Protection Agency*, March 31, 2016, accessed June 23, 2016. <https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy>. "Food Recovery Challenge," *United States Environmental Protection Agency*, April 25, 2016, accessed June 23, 2016. <https://www.epa.gov/sustainable-management-food/food-recovery-challenge-frc>.
- 165 United States Environmental Protection Agency Office of Resource Conservation and Recovery, *Case Study: Hannaford Supermarkets Move Towards Zero Waste* (2013).
- 166 Data provided by Hannaford staff on September 13, 2016.
- 167 James McCarthy, "Two Maine Companies Team Up to Convert Food Waste into Clean Energy," *Mainebiz*, January 11, 2016, accessed June 23, 2016. <http://www.mainebiz.biz/article/20160111/CURRENTEDITION/301069994/two-maine-companies-team-up-to-convert-food-waste-into-clean-energy>.
- 168 ReFed, *A Roadmap to Reduce U.S. Food Waste by 20 Percent* (2016).
- 169 Initiative for a Competitive Inner City, *Resilient Food Systems, Resilient Cities: Recommendations for the City of Boston* (Boston, MA: 2015).
- 170 City of Los Angeles, *Fact Sheet: The City's Solid Waste Policies and Programs* (Los Angeles, CA: n.d.).
- 171 Alexander Helou, *Food Scraps Diversion in the City of Los Angeles* (Los Angeles, CA: City of Los Angeles Bureau of Sanitation, 2014).
- 172 The City of New York, *One New York: The Plan for a Strong and Just City* (New York, NY: 2015).
- 173 PlaNYC, *Mayor's Food Waste Challenge to Restaurants* (New York, NY: n.d.).
- 174 "Food Waste Reduction Taskforce," *City of Madison*, accessed August 18, 2016. <https://www.cityofmadison.com/mayor/priorities/food/madison-food-policy-council/food-waste-reduction-taskforce>.
- 175 The Resilience Hub, *Portland Mayor's Initiative for Healthy & Sustainable Food Systems: Neighborhood Food Forum* (Portland, ME: City of Portland, 2015).
- 176 Portland Mayor's Initiative for a Healthy & Sustainable Food Systems, *Food Policy Assessment: Summary Findings and Recommendation* (Portland, ME: 2015).
- 177 A joint initiative of the Fondation Nicolas Hulot (FNH), the International Urban Food Network (IUFN) and the United Nations Environment Programme (UNEP). Alison Watson, Albane Gaspard, and Amandine Lebreton, *Food, Climate Change and the City* (FNH-IUFN-UNEP Climate Change Urban Food Initiative, 2016).

- 178 The final report, *Resilient Food Systems, Resilient Cities: Recommendations for the City of Boston*, can be accessed on ICIC's website (<http://icic.org/research/resilience/>) or by contacting the lead author, Kim Zeuli at kzeuli@icic.org.
- 179 Metropolitan Area Planning Council, Franklin Regional Council of Governments, Pioneer Valley Planning Commission, and Massachusetts Workforce Alliance, *Massachusetts Local Food Action Plan* (Massachusetts Food Policy Council, 2015).
- 180 "Assessing Flood Risk of Food Distribution Centers," *Thriving Earth Exchange*, accessed July 5, 2016. <http://thrivingearthexchange.org/project/boston-ma-mapc/>.
- 181 "Food System Resilience Vista," *AmeriCorps*, accessed July 5, 2016. <https://my.americorps.gov/mp/listing/viewListing.do?id=60502>.
- 182 "Hunts Point Resiliency," *New York City Economic Development Corporation*, accessed September 1, 2016. <http://www.nycedc.com/project/hunts-point-resiliency-implementation>.
- 183 New York City Economic Development Corporation. *Hunts Point Resiliency Report Back*. (New York, NY: December 2015).
- 184 The City of New York, *OneNYC: 2016 Progress Report* (New York, NY: 2016), 11.
- 185 "Cargo," *The Port of New Orleans*, accessed May 5, 2016. <http://portno.com/cargo>.
- 186 "New Orleans Cold Storage Dedicates \$40 Million Port Facility," *Louisiana Economic Development, News Release*, July 19, 2010, accessed May 26, 2016. [http://www.opportunitylouisiana.com/led-news/news-releases/news/2012/07/19/new-orleans-cold-storage-dedicates-\\$40-million-port-facility](http://www.opportunitylouisiana.com/led-news/news-releases/news/2012/07/19/new-orleans-cold-storage-dedicates-$40-million-port-facility).
- 187 The City of New York, *One New York: The Plan for a Strong and Just City* (New York, NY: 2015).
- 188 "Directory," *Food Policy Networks*, accessed June 27, 2016. <http://www.foodpolicynetworks.org/directory/>.
- 189 Rodney C. Runyan, "Small Business in the Face of Crisis: Identifying Barriers to Recovery from a Natural Disaster," *Journal of Contingencies and Crisis Management* 14 no. 1 (2006): 12-26.
- 190 New Orleans Regional Planning Commission. *Regional Planning Commission June 2013 Newsletter* (New Orleans, LA: 2013).
- 191 "Crisis Management," *Food Marketing Institute*, accessed October 29, 2016. <http://www.fmi.org/Industry-Topics/asset-protection/crisis-management/2016/09/28food-market-ing-institute-re-focuses-its-event-strategy>.
- 192 The pilot program was developed in partnership with PYXERA Global, an organization that facilitates partnerships between the public, private and social sectors to address complex social challenges.
- 193 2011 NY Assembly Bill A07516, A. A07516, 2011 Leg. (N.Y. 2011).
- 194 Emergency Management, S. 1288, 2016 Leg. (Fla. 2016).
- 195 "FRF Applauds Governor Scott for Signing SB 1288 – Post-Disaster Re-Entry," *Florida Retail Federation*, April 6, 2016, accessed June 27, 2016. <https://www.frf.org/index.php/media-relations/item/303-frf-applauds-governor-scott-for-signing-sb-1288-post-disaster-re-entry>.
- 196 "Gov. Scott Activates Emergency Bridge Loan Program for Small Businesses Damaged by Hurricane Matthew," *Florida Retail Federation*, October 10, 2016, accessed October 13, 2016. <http://www.frf.org/index.php/media-relations/item/350-gov-scott-activates-emergency-bridge-loan-program-for-small-businesses-damaged-by-hurricane-matthew>.

#Resilience
#FoodWaste

SUPPORTED BY:

