



Storm-Ready Cities

How Climate Resilience Boosts Metro Areas and the Economy

By Cathleen Kelly and Arpita Bhattacharyya

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Center for American Progress



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Introduction

In September 2013—just shy of the one-year anniversary of Superstorm Sandy—a catastrophic storm devastated Colorado’s front range, dumping a year’s worth of rain in about 24 hours. Roads in Boulder and nearby towns washed away, eight people were killed, and thousands of people fled; property damages are projected to total \$2 billion.²

Extreme weather events like these will become more frequent with warmer temperatures, as documented in the newly released fifth Intergovernmental Panel on Climate Change Assessment.³ Authored by roughly 859 scientists from around the world, this report offers conclusive evidence that humans are causing climate change—primarily by burning fossil fuels—and that rising temperatures will escalate drought, storm, sea-level rise, and other climate change trends.⁴ The reality of these events is jolting many city leaders into action to protect public health, safety, and the local economy.

Cities are centers of economic growth, innovation, and diversity. They are also home to the majority of people across the globe, and their ability to build resilience and achieve sustainable economic growth will have a profound impact on the quality of life in America, today and into the future. Cities face a host of challenges: growing income inequities, crumbling infrastructure, affordable housing shortages, struggling school systems, unfunded pension commitments, and diminishing budgets.⁵ These challenges are exacerbated by damages and health risks from extreme heat, storms, flooding, drought, and other impacts driven by a changing climate. City leaders increasingly recognize that if they do not manage these risks today, it will cost more to address them tomorrow.⁶

Many city leaders—such as those in New York City, Washington, D.C., Houston, and Miami—are developing innovative strategies to reduce the risks from extreme weather. These leaders recognize that increasing their cities’ resilience to climate change not only keeps people and businesses out of harm’s way, but also—if done right—drives economic growth and improves

“Around the world, city leaders are not wasting time debating the science of climate change or waiting around for international treaties to be signed; we are taking action. There’s simply too much to do and too much at stake.”

— New York Mayor
Michael Bloomberg
August 21, 2013¹

the quality of life in metro areas.⁷ These leaders are working to meet priorities such as upgrading public transit and other infrastructure, providing cleaner and more reliable energy, creating jobs, attracting new businesses, improving air quality, and expanding parks and green spaces.⁸ To adequately prepare our nation for the impacts of climate change, more metro areas must follow their lead.⁹

In his Climate Action Plan, President Barack Obama acknowledged the risks of climate change to families, businesses, infrastructure, and water supplies across the country.¹⁰ To help metro areas manage these risks, the president pledged to reduce flood damage by raising flood elevation standards for federally funded infrastructure projects, to support community resilience through existing federal grant programs, and to make climate change information more accessible, among other actions. But given the high cost of strengthening cities to withstand extreme weather—which the journal *Climate Policy* reports could rise to hundreds of billions of dollars per year by the middle or end of the century—and the even higher cost of inaction, urban and federal leaders must do more to increase metro-area resilience.¹¹

In this report, we identify climate change risks to cities, highlight metro areas that are taking the lead to build resilience in ways that support economic growth and help tackle other pressing challenges, and recommend local and federal actions to further support urban resilience and inclusive, sustainable economic growth. Our recommendations include:

- Increase infrastructure and community resilience in metro areas in ways that meet other priorities, such as:
 - Improving cost-effectiveness and productivity of infrastructure
 - Increasing access to jobs and clean and reliable electricity
 - Reducing air pollution
 - Improving quality of life in low income areas by expanding public transit and green spaces
- Increase federal investments in resilience to save billions of dollars in disaster response.
- Make resilience a core aspect of all federal infrastructure and disaster-recovery funding.
- Give city leaders ready access to necessary climate change risk information.
- Curb heat-trapping emissions in cities and nationally.

Cities at risk

A vast body of peer-reviewed science reveals that the climate is changing in ways that already impact cities in the United States and around the globe. The 12 hottest years on record all occurred in the past 15 years.¹² Last year was the warmest year on record for the United States, and melting ice and warmer ocean temperatures caused sea levels to rise to a record high, threatening coastal cities such as Boston, Miami, and New Orleans.¹³ Superstorm Sandy caused significant damage in New York City and its surrounding metro area, including Atlantic City, Hoboken, Jersey City, and Newark in New Jersey; Ocean City, Maryland; and Fairfield, Connecticut.¹⁴ More extreme weather like Superstorm Sandy is likely to strike communities along the Gulf Coast and eastern seaboard as ocean temperatures continue to rise.¹⁵ Widespread drought in 2012 impacted water supplies in metro areas such as Little Rock, Arkansas; Topeka, Kansas; Oklahoma City, Oklahoma; Kansas City, Missouri; and Atlanta, Georgia.¹⁶ As the planet heats up, more drought is expected.¹⁷

According to the draft National Climate Assessment, authored by 250 of the nation's top scientists, academics, and business leaders, "climate change and its impacts threaten the well-being of urban residents in all regions of the United States."¹⁸ A recent study of cities under threat from natural disasters, developed by the global reinsurance company Swiss RE, ranks the top 10 metro areas in North and Central America that face the highest value of working days lost from natural perils, nine of which are in the United States (see Box).¹⁹

Large populations and population density, high rates of poverty, and infrastructures that rely on other systems to function make cities particularly vulnerable to stronger storms, sea-level rise, heat waves, drought, and flooding.²¹

Top 10 metro areas in North and Central America with highest absolute value of working days lost due to natural disaster, as compared to all other cities globally²⁰

1. Los Angeles, California
2. New York, New York, and Newark, New Jersey
3. San Francisco, California
4. New Orleans, Louisiana
5. Mexico City, Mexico
6. Miami, Florida
7. Houston, Texas
8. Tampa, Florida
9. Washington, D.C., and Baltimore, Maryland
10. Boston, Massachusetts

Note: The above ranking captures earthquake, wind-speed, river-flood, and storm-surge risks. Los Angeles, San Francisco, and Mexico City are at high risk of earthquakes, which are not linked to climate change. These cities also face river flood- and storm-surge risks, which are growing as the global temperature rises.

Storm damage risk on the rise as cities grow

In the United States, metropolitan areas currently account for more than 80 percent of the U.S. population; by 2050, the percentage will increase to 89 percent.²² Urbanization can boost productivity, provide residents with more public resources, and lower per-capita carbon pollution.²³ Metro areas are the drivers of economic growth and innovation in most regions across the country. The New Jersey and New York metro area, for example, is one of the most important economic regions in the world and is home to a diverse array of industries, including finance, media, international trade, biotechnology, and others.²⁴ Nonetheless, with very large and dense populations, metro areas face greater risks, hardships, and damages from extreme weather and other climate change impacts.

Weak infrastructure is risky business for cities

Urban commercial activity cannot be sustained without reliable and well-maintained infrastructure. Yet, recent assessments reveal that infrastructures in metro areas are in desperate need of upgrade and repair and are less likely to withstand more extreme weather and other climate change impacts.²⁵ In addition, many aspects of urban infrastructure are interdependent, and thus vulnerable to outages when other systems shut down. Commuter trains and light rails, water treatment plants, hospitals, banks, and other critical services often cannot function when the power is out.²⁶ Superstorm Sandy caused substantial physical damage to infrastructure in New York, New Jersey, and other impacted states. With 25 percent of the cellular telephone sites out of service in the Sandy-affected region coupled with power outages that shut down transportation systems and made phone and computer charging and Internet access difficult, millions of people were unable to communicate or get to work and school.²⁷ The snowball effect of infrastructure outages caused by Sandy crippled the greater New York metropolitan economy, causing hundreds of thousands of businesses to close and a loss of between \$30 billion and \$50 billion in economic activity, in addition to the costs of physical damages.²⁸

Low-income families at risk in a warming world

Urban areas also have a larger share of low-income communities; poverty rates in U.S. cities are 20.9 percent relative to 11.4 percent in the suburbs.²⁹ A 2012 Center for American Progress analysis revealed that low- and middle-income communities were disproportionately harmed by devastating extreme weather in 2011 and

2012.³⁰ A more recent CAP report identifies the underlying factors that make low-income families among the most vulnerable to extreme weather and other climate impacts.³¹ A combination of poor housing and environmental conditions in low-income neighborhoods coupled with economic instability puts disadvantaged families on the front lines of flood waters, toxic-waste exposure, extreme heat, and other climate change risks without the means to buy insurance or cope with income losses or damage from more extreme storms. Power outages caused by Superstorm Sandy, for example, left many of New York City's low-income, elderly, and disabled residents stranded in public housing towers without backup generators or the means to travel elsewhere to secure alternative shelter. In addition, roughly 55 percent of Superstorm Sandy storm surge victims in New York City were low-income renters.³²

Extreme heat also disproportionately impacts low-income communities. In 2011 and 2012, record heat waves took more than 181 lives in the United States.³³ Low-income families that cannot afford air conditioning face a sweltering reality and higher risks of heatstroke in cities because densely built metro areas tend to be hotter than rural communities. The annual mean air temperature in a city of 1 million or more people can be up to 5.4 degrees Fahrenheit warmer than its surroundings.³⁴ In the evening, the difference can be as high as 22 degrees Fahrenheit. This phenomenon—called the heat-island effect—will drive up temperatures in urban communities even further as climate change continues to warm the planet.

Heat is also linked to an increase in crime rates and conflict. A recent University of California, Berkeley, study concludes that climate change could globally increase interpersonal conflict and crime rates by 16 percent and double conflicts among nations and ethnic groups by 2050.³⁵ A heat-fueled spike in crime would hit metro areas hard, particularly since urban crime rates in the United States are already double those in rural and suburban areas.³⁶

Many cities are up against the challenges of growing populations, weakening infrastructure, and growing income inequality, even as they are increasingly cash strapped and facing rising demand for public transport and other infrastructure and services.³⁷ While strengthening resilience to extreme weather is not cheap, failing to prepare communities and shore up critical infrastructure to withstand future superstorms and other climate impacts will cost even more in the long run.³⁸ Finding cost-effective ways to build resilience in cities will save on disaster aid and reduce damages and economic losses from future extreme weather.³⁹ A study by the Multihazard Mitigation Council found that every \$1 that the Federal Emergency Management Agency, or FEMA, invests in resilience saves the nation \$4 in disaster-recovery costs.⁴⁰

Learning from Superstorm Sandy

Recommendations from the Hurricane Sandy Rebuilding Task Force

In October 2012, Superstorm Sandy swept across the East Coast, causing more than 150 deaths and \$65 billion in damages and economic losses and destroying 659,000 homes. Power outages caused by the storm closed 200,000 small businesses, led to 2 million lost working days, and disrupted millions of lives. In the aftermath, federal and local leaders led a coordinated effort to rebuild the region to withstand more intense storms like Sandy in the future and other climate change impacts. The Hurricane Sandy Rebuilding Task Force, chaired by U.S. Housing and Urban Development Secretary Shaun Donovan, recommended 69 strategies to help metro areas and communities build resilience to withstand future extreme weather. Beyond the East Coast, Sandy served as a wake-up call for cities and communities throughout the United States to take action to prepare for and manage climate change risks. Many of the task force recommendations are already being implemented, including the following:

- New resilience guidelines that will be applied to all federal infrastructure investments in the region—and likely nationally—and increased coordination and federal support for infrastructure planning that cuts across key sectors and leverages private and state funds
- \$1.3 billion from the Federal Transit Administration to improve the resilience of transit systems in the region
- Actions to increase energy infrastructure resilience, such as a partnership among New Jersey, the Department of Energy, and the Hurricane Sandy Rebuilding Task Force to explore financing for microgrids, smart grids, distributed generation, and energy storage
- New federal efforts to provide decision makers in the Sandy-impacted region with the climate science and other information they need to rebuild resilient communities, including updating flood maps, sea-level rise tools, and other data on current and future climate change risks; this forward-looking information will improve community planning because local decision makers typically assess flood and other risks relying only on historical data, which tell only part of the story about what is likely to unfold in the future
- New federal investments and decision-making tools to support green infrastructure, including new guidelines that will allow states to use EPA state revolving loan funds for green infrastructure to improve storm-water management; such investments could include permeable pavement, green roofs, sand dunes, and tidal wetlands to protect against storm surge, among other strategies to reduce community flood risks
- Recommended building codes for states and cities to enhance resilience, and increased federal support for hazard mitigation planning

What is a resilient city?

City leaders are increasingly recognizing the need to strengthen infrastructure and community resilience. A 2011 survey showed that 58 percent of U.S. city managers are taking action to build resilience to future extreme weather events.⁴¹ Metro areas are resilient when their communities and infrastructure can withstand extreme weather and other climate change impacts and shocks, minimize disruptions, and recover quickly when disaster strikes.⁴² Increasing resilience requires looking across transportation, energy, storm and drinking water management, and other infrastructure systems and sectors to understand where cities are the most vulnerable

and to identify the best and most cost-effective strategies to manage climate change risks.⁴³ Without a cross-system approach to resilience, metro areas will likely continue to face the cascading disruptions of power and transit outages caused by extreme weather events that leave millions of people stranded and unable to get to work or school, seek medical care, or even leave their high-rise apartments.

Some city leaders are pursuing resilience strategies that also improve the local economy and quality of life. Strengthening grid resilience, for example, improves energy reliability, which reduces economic losses during storms and can lower emissions by increasing the availability of clean distributed power. Planting more trees and creating more parks reduces storm-water runoff while increasing property values, carbon storage, and quality of life. Creating diverse transportation and energy systems provide backups and alternatives that allow people to get to work, businesses to stay open, and the lights to stay on, and communities to stay safe, even when parts of these systems are damaged by a storm. These strategies can also raise living standards by improving access to employment opportunities and good schools. While increasing climate resilience is no panacea, if done well it can compliment efforts to tackle income inequality and other tough challenges facing metro areas. In fact, reducing income inequality should be a core aspect of all city resilience strategies because it would give families the economic means to afford insurance and bounce back in the wake of superstorms and other stresses.

Washington's "Sustainable D.C." plan maps out a set of climate actions that seek to create jobs, improve infrastructure and public health, promote diversity, and help meet other environmental goals. The District Department of the Environment, or DDOE, for example, is working with the Public Service Commission to identify opportunities for neighborhood-scale renewable energy. This effort aims to build 1,000 additional residential and commercial renewable energy projects by 2032 to diversify and improve electricity system reliability during extreme weather events. DDOE, along with local utility Pepco, is also exploring options to improve energy transmission and distribution reliability, including moving electricity infrastructure underground. The city is also considering a citywide rollout of smart meters and smart-grid technologies that would allow consumers and utilities to better understand and manage energy use and reduce power outage duration and cost.⁴⁴

In addition, the plan seeks to cover 40 percent of the District with a healthy tree canopy, expand green spaces, and provide parks within a 10-minute walk of all residents by 2032.⁴⁵ This green infrastructure will be designed to reduce the District's flood risks by improved storm-water management and cool city temperatures:

One healthy tree provides the same cooling as 10 room-sized air conditioners for 20 hours per day.⁴⁶ The city plans to plant 1,000 trees this fall and 5,000 trees per year over the next 5 to 10 years.⁴⁷ More parks and green spaces will also promote healthy living to combat obesity, heart disease, and diabetes and drive down health care costs. The District has already allocated more than \$1 million to plant trees, install green roofs, and support other green infrastructure and \$290,000 to develop a more detailed climate risk assessment and resilience plan.⁴⁸

The plan also seeks to improve air quality and reduce traffic congestion by cutting car and taxi travel to 25 percent of all commuter trips by 2032. New biking and walking paths and a more resilient transit system will give commuters more options to get to work and school, including when parts of the system are down after extreme weather events. The District Department of Transportation plans to add 30 additional Capitol Bikeshare stations and 10 to 15 miles of bike lanes per year to reach their 2032 goal.⁴⁹

The D.C. plan seeks to cut unemployment by 50 percent and increase green goods and services jobs fivefold by 2032. These actions will create jobs in energy auditing, monitoring, carpentry, landscaping, maintenance, and other areas. The city will support access to these jobs through training and tax credits to employers who provide on-the-job training.⁵⁰ While these resilience efforts alone will not solve the city's air quality, income inequity, and other challenges, they bolster other efforts to do so.

Other examples of how cities are increasing resilience in ways to support economic growth and other priorities are described below. An online interactive map, published by CAP as a companion to this report, reveals that at least 50 U.S. cities are taking meaningful steps to build resilience to climate change, including restoring wetlands and dunes, building sea walls and levees, and factoring climate change risks into infrastructure, building designs, and public health planning.⁵¹ To help more cities build resilience, in August 2013, the Rockefeller Foundation launched a 100 Resilient Cities Centennial Challenge.⁵² Winning cities will receive support to hire a chief resilience officer, create a resilience plan, and have a platform to share best practices and knowledge with others in the network.

How some cities are managing their climate risks

For more city actions, see CAP's online interactive map

Houston

In July 2012, Houston experienced a massive flood and subsequently launched Rebuild Houston, a city program for comprehensive street and drainage improvement. This initiative will create infrastructure jobs and protect Houston properties and businesses from damages from future storms.⁵³ Mayor Annise Parker also launched the Water Conservation Task Force in response to the 2011 drought, which prompted mandatory water-conservation measures. The Task Force aims to diversify Houston's water supply, reduce consumer's water bills, and ensure sudden mandatory water-conservations measure do not disrupt businesses and households in the future.

Los Angeles

Los Angeles plans to reduce extreme heat risks by upgrading building codes to promote 'cool' roofs and pavements made of materials that reflect sunlight and deflect heat and increase tree cover by creating new parks and open spaces to bring down city temperatures and provide new areas for recreation.⁵⁴ Recognizing drought risks and that extreme heat drives up energy and water demand, the city will create incentives for energy efficiency through customer rebates and will promote low-flow toilets, showerheads, and faucets to save water. In addition to increasing the city's climate resilience, these investments will save businesses and residents money on air-conditioning and water bills.

Miami

Miami is located at sea level and is surrounded by water on both sides, making it extremely vulnerable to sea-level rise, storm surges, and salt-water intrusion. In addition, many of Miami's key economic drivers are weather related, including agriculture, tourism, and other business development on the coast. Together, these factors make Miami's exposed property more vulnerable to flood risks than any other city in the world.⁵⁵ Flood and other losses from climate change for the city are projected to be \$3.5 trillion by 2070.⁵⁶

The Miami-Dade Board of County Commissioners and County departments have already adopted many policies and initiatives to prepare.⁵⁷ Miami-Dade County is working with the U.S. Geological Survey, U.S. Army Corps of Engineers, and the National Oceanic and Atmospheric Administration to map out regional sea-level rise and hazard-prone areas to help with planning and zoning. This will ensure that new and existing businesses and other developments can make informed decisions on where and how to build in order to prevent future floods and other damages to property. The county also has

several water-conservation efforts underway, including a five-year water-use efficiency plan that will preserve Miami's ecosystems while also saving consumers and companies money.⁵⁸

New York City

New York City is more at risk of storm surges than any other metro areas in the country and is the 10th-most vulnerable city in the world.⁵⁹ The devastation of Superstorm Sandy drove home the urgent need to prepare New York City for more intense storms and other climate impacts. The city's comprehensive rebuilding and resilience strategy, PlaNYC, identifies actions to rebuild and strengthen communities hit by Sandy and to increase infrastructure and building resilience, many of which will also support inclusive economic growth. In south Brooklyn, for example, Coney Island and Brighton Beach buffer nearby neighborhoods from flooding and storm surges. The city will work to restore these beaches and improve drainage on Coney Island to reduce flood risks to surrounding neighborhoods, allow businesses to open more quickly after storms, and ensure that residents can continue to enjoy these south Brooklyn recreational hotspots.⁶⁰

In addition, PlaNYC calls for actions to increase the resilience of the city's transportation system, including expanding bus services and adding bike and pedestrian paths to increase connectivity between transportation hubs and give commuters more options when the subway is down. The city will work with utilities and regulators to implement smart-grid technologies to enable real-time assessments of system outages. With public and private partners, the city will expand building efficiency, distributed generation, and micro grids. The city aims to reduce storm-water runoff and sewer overflows by expanding green infrastructure and installing new and upgrading existing sewers. PlaNYC will cost \$19.5 billion to implement with roughly half of the funds coming from the federal government.

Salt Lake City

In Salt Lake City, climate change is projected to decrease rainfall in the area and the city's drinking water supply, 90 percent of which comes from surface sources. This drop in rainfall means that forests will be drier and more susceptible to wildfires. To protect drinking-water supplies, the city plans to preserve an additional 10 percent of watershed lands and groundwater resources by 2015. The city will also invest in roads and trails in and around the watershed restoration projects, improving recreation and transportation opportunities for residents in the region.⁶¹

Recommendations

While many cities and the federal government are preparing for more intense heat, floods, droughts, and other climate change impacts, much more is needed to safeguard public health and economic prosperity in metro areas around the country.

Increase infrastructure and community resilience in metro areas

City officials and electric utilities should work together to build electricity-grid resilience by putting vulnerable power lines underground where it is cost effective, creating incentives for consumers to install smart meters, and distributing and decentralizing clean power around the grid so that communities are not as vulnerable to massive outages.⁶² Cities should also develop sound hazard mitigation and climate change resilience plans and update building codes to minimize future storm damage and keep people, homes, and businesses out of harm's way.⁶³ To support these steps, the president's Climate Action Plan directs the National Institute of Standards and Technology to develop disaster-resilience standards for buildings and infrastructure.⁶⁴

City officials should work closely with the private sector to develop infrastructure designs that are cost effective and boost productivity by integrating with other systems where possible.⁶⁵ A city's department of transportation, for example, could require the use of permeable pavement to upgrade roads and reduce pressure on storm-water systems. City leaders should also use infrastructure-planning timeframes that account for future extreme weather and other climate change risks. After Superstorm Sandy, for example, the state of New York extended its infrastructure-planning horizon to the year 2080.⁶⁶

Lastly, leaders in metro areas should look for opportunities to build resilience in ways that meet other priorities, such as increasing access to jobs and clean and reliable electricity, reducing air pollution, and improving quality of life in low-income areas by expanding public transit and green spaces.

Increase federal investments in resilience to save billions of dollars in disaster response

New sources of federal financing are needed to adequately build metro-area resilience.⁶⁷ By underinvesting in resilience today, we risk facing even higher disaster-relief and -recovery costs in the future. Congress and the administration should increase federal investments in smart resilience strategies before and after a disaster hits. Congress could offset an increase in federal resilience investments by eliminating unwarranted fossil fuel subsidies, establishing and using the revenues from a carbon tax, and increasing the royalty rate for private production of coal, oil, and natural gas on federal lands, among other options.⁶⁸

Make resilience a core aspect of all federal infrastructure and disaster-recovery funding

The federal government can also use existing federal funds to improve city resilience simply by strengthening existing grant programs. In his Climate Action Plan, President Obama directs federal agencies to “encourage and support smarter, more resilient investments, including through agency grants, technical assistance, and other programs, in sectors from transportation and water management to conservation and disaster relief.”⁶⁹ To make good on this commitment, the Department of Transportation, or DOT, the Department of Housing and Urban Development, or HUD, the Army Corp of Engineers, and the Environmental Protection Agency should only fund infrastructure project designs that can withstand more extreme heat, floods, and storms. HUD, for example, should ensure that the roughly \$3 billion available annually for Community Development Block Grants, or CDBG, support climate-resilient housing and other projects.⁷⁰ Similarly, DOT should ensure that the \$500 million available yearly for TIGER Discretionary Grants—which help to improve our nation’s infrastructure—support storm-ready roads, rails, transit systems, and ports.⁷¹

In addition, HUD should continue to apply and enforce its new resilience requirements for CDBG disaster-recovery assistance in areas hit hardest by Superstorm Sandy. DOT, the Army Corp of Engineers, and other agencies should also require that their disaster-recovery programs invest in resilient rebuilding projects that can withstand future extreme weather. Building on important Sandy Relief Act reforms to federal disaster assistance, Congress must further amend the Stafford Disaster Relief and Emergency Assistance Act to require all FEMA-funded

rebuilding projects to be climate resilient. As it stands, FEMA and other federal agencies rely primarily on the political will and initiative of federal disaster aid recipients to rebuild resilient communities and infrastructure.

Give city leaders ready access to the climate change risk information they need

The president's Climate Action Plan outlines federal steps to give local decision makers access to the information they need to manage extreme weather and climate change risks and keep people and property out of harm's way. Federal agencies will create a virtual toolkit that centralizes access to resilience tools and services.⁷² But more is needed. FEMA should accelerate its work to update flood maps nationwide to reflect increasing flood risks tied to sea-level rise, future superstorms, and other climate change impacts. Congress and the president must ensure that FEMA is given the resources it needs to do so. Despite the urgent need for accurate flood maps, FEMA's Flood Hazard Mapping and Risk Analysis budget was cut almost in half from \$181.6 million in 2011 to \$97.7 million in both 2012 and 2013.⁷³

Curb heat-trapping emissions on urban and national levels

City leaders should look for opportunities to implement cost-effective emission reducing actions that can help to meet other priorities. Increasing buildings' energy efficiency, for example, lowers consumer energy bills, reduces harmful air pollution, and helps to cut down electricity use during peak demand periods.⁷⁴ Metro areas can also develop long-range transportation and land-use plans that reduce auto emissions and traffic congestion while supporting more efficient and equitable growth and improving air quality and access to jobs.⁷⁵

The president's Climate Action Plan directs the U.S. Environmental Protection Agency, or EPA, to complete carbon-pollution standards for both new and existing power plants. The EPA unveiled its proposed carbon standards for new power plants in September and is expected to release existing plant standards in June 2014.⁷⁶ The administration should continue to move expeditiously to complete the carbon-pollution standard for existing plants by 2015 so that they can be implemented during this administration.⁷⁷

Conclusion

These and other actions to build resilient cities will help ensure that communities, families, and businesses are not left vulnerable to extreme weather damages and health risks. Investing in city resilience lowers future disaster-recovery costs and economic losses and can support economic growth, improve infrastructure and air quality, and help meet other city goals. More city leaders should take action to strengthen metro-area resilience, and Congress and the administration must increase federal resources available to allow them to do so.

About the authors

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Endnotes

- 1 Michael Bloomberg, "Bloomberg: Why Sandy forced cities to take lead on climate change," CNN, August 26, 2013, available at <http://www.cnn.com/2013/08/21/world/europe/bloomberg-why-sandy-force-cities/index.html>.
- 2 Boulder Office of Emergency Management, "9-19-2013 8:50 p.m. End-of-Day Figures," available at <http://boulder.oreoem.com/emergency-status/553-9-18-2013-8-50-p-m-end-of-day-figures> (last accessed September 2013); "Death toll in Colorado flooding rises to 8 as rescue crew scour rubble in search for missing," Fox News, September 16, 2013, available at <http://www.foxnews.com/weather/2013/09/16/colorado-braces-for-more-heavy-rain-deadly-floods/>; Keith Coffman, "Property losses from Colorado flood projected at about \$2 billion," Reuters, September 19, 2013, available at <http://www.reuters.com/article/2013/09/19/us-usa-colorado-flooding-idUSBRE98H1BA20130919>.
- 3 Intergovernmental Panel on Climate Change, "Climate Change 2013: The Physical Science Basis" (2012), available at http://www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf; Thomas C. Peterson and others, "Explaining Extreme Events of 2012 from a Climate Perspective," *Bulletin of the American Meteorological Society* 94 (9) (2013): 1–74, available at <http://www.ametsoc.org/2012extremeeventsclimate.pdf>.
- 4 A total of 259 authors and review editors were selected to produce the Working Group I report; they in turn enlisted the help of more than 600 contributing authors. Hundreds of expert reviewers provided comments to earlier drafts of the report, which draws on observations and model runs and cites more than 9,200 scientific publications. For the Fifth Assessment Report as a whole, a total of 831 authors and review editors were selected. Intergovernmental Panel on Climate Change, "Climate Change 2013."
- 5 Pew Charitable Trusts, "Cities Squeezed by Pension and Retiree Health Care Shortfalls," (2013), available at <http://www.pewstates.org/research/reports/cities-squeezed-by-pension-and-retiree-health-care-shortfalls-85899457960>; Pew Charitable Trusts, "30 Cities: An Introductory Snapshot" (2013), available at <http://www.pewstates.org/research/data-visualizations/30-cities-an-introductory-snapshot-85899380032>.
- 6 U.S. Global Change Research Center, "National Climate Assessment: Urban Systems, Infrastructure, and Vulnerability" (2013), available at <http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-chap11-urban.pdf>; JoAnn Carmin, Nikhil Nadkarni, and Christopher Rhie, "Progress and Challenges in Urban Climate Adaptation Planning: Results of a Global Survey" (Cambridge, MA: Massachusetts Institute of Technology, 2012), available at <http://web.mit.edu/jcarmin/www/urbanadapt/Urban%20Adaptation%20Report%20FINAL.pdf>; Daniel J. Weiss and Jackie Weidman, "Going to Extremes: The \$188 Billion Price Tag from Climate-Related Extreme Weather," Center for American Progress, February 12, 2013, available at <http://www.americanprogress.org/issues/green/news/2013/02/12/52881/going-to-extremes-the-188-billion-price-tag-from-climate-related-extreme-weather/>.
- 7 Carbon Disclosure Project, "Wealthier, Healthier Cities: How climate change action is giving us wealthier, healthier cities" (2013), available at <https://www.cdproject.net/CDPResults/CDP-Cities-2013-Global-Report.pdf>.
- 8 PlaNYC, "A Stronger, More Resilient New York" (2013), available at http://nytelecom.vo.llnwd.net/o15/agencies/sirr/SIRR_singles_HI_res.pdf; "Death toll in Colorado flooding rises to 8 as rescue crews scour rubble in search for missing"; ReBuild Houston: "5+5 Plan" (FY 2014-2023) Street and Drainage Improvements" (2013), available at http://www.rebuildhouston.org/images/pdf/5_5_plan_overview_07_30_13.pdf; City of Flagstaff, "Community Sustainability" (2012), available at <http://flagstaff.az.gov/DocumentCenter/View/41372>.
- 9 Carmin, Nadkarni, and Rhie, "Progress and Challenges in Urban Climate Adaptation Planning."
- 10 Executive Office of the President, *The President's Climate Action Plan* (The White House, 2013), available at <http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>.
- 11 Fran Sussman and others, "Climate Change Adaptation Cost in the US: What Do We Know?" (Washington: Climate Policy, 2013), available at <http://www.tandfonline.com/doi/full/10.1080/14693062.2013.777604#previuew>; PlaNYC, "A Stronger, More Resilient New York"; U.S. Global Change Research Center, "National Climate Assessment"; Carmin, Nadkarni, and Rhie, "Progress and Challenges in Urban Climate Adaptation Planning."
- 12 NASA, "GISS Surface Temperature Analysis," available at http://data.giss.nasa.gov/gistemp/graphs_v3/fig.A2.txt (last accessed September 2013).
- 13 Jessica Blunden and Derek S. Arndt, "State of the Climate in 2012," *Bulletin of the American Meteorological Society* 92 (8) (2013): S1–S258, available at <http://journals.ametsoc.org/doi/abs/10.1175/2013BAMSStateoftheClimate.1>; Stephane Hallegatte and others, "Future Flood Losses in Major Coastal Cities," *Nature Climate Change* 3 (2013): 802–806, available at <http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate1979.html>; Katie Valentine, "Government Acknowledges 2012 Climate Milestones Show We've Reached A New Normal," ThinkProgress, August 2, 2013, available at <http://thinkprogress.org/climate/2013/08/07/2403951/2012-climate-new-normal/>.
- 14 U.S. Department of Housing and Urban Development, "Hurricane Sandy Rebuilding Task Force Releases Rebuilding Strategy," Press release, August 19, 2013, available at http://portal.hud.gov/hudportal/HUD?src=/press/press_releases_media_advisories/2013/HUD-No.13-125.
- 15 U.S. Global Change Research Program, "Global Climate Change Impacts in the United States" (2009), p. 44, available at <http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>.
- 16 Jon Erdman, "Drought Disaster 2012 Status," The Weather Channel, August 16, 2012, available at <http://www.b.weather.com/news/drought/drought-disaster-update-20120816>; Economic Research Service, U.S. *Drought 2012: Farm and Food Impacts* (U.S. Department of Agriculture, 2012), available at <http://www.ers.usda.gov/topics/in-the-news/us-drought-2012-farm-and-food-impacts.aspx#UKCzhVPlnwl>.
- 17 U.S. Global Change Research Program, "Global Climate Change Impacts in the United States"; Economic Research Service, U.S. *Drought 2012: Farm and Food Impacts*.

- 18 U.S. Global Change Research Center, "National Climate Assessment."
- 19 Swiss Re, "Mind the Risk" (2013), available at http://media.swissre.com/documents/Swiss_Re_Mind_the_risk.pdf.
- 20 Ibid.
- 21 Ibid.
- 22 Center for Sustainable Systems, "U.S. Cities" (2012), available at http://css.snre.umich.edu/css_doc/CSS09-06.pdf.
- 23 Guanghua Wan, "Why Urbanization May Benefit the Environment," *Business Times Singapore*, January 23, 2012, available at <http://www.adb.org/news/op-ed/why-urbanization-may-benefit-environment>; Alexis Madrigal, "New Report Reveals Huge Variation Between Cities' Carbon Footprints," *Wired*, May 29, 2008, available at <http://www.wired.com/wiredscience/2008/05/cities-carbon-fi/>.
- 24 U.S. Department of Housing and Urban Development, "Hurricane Sandy Rebuilding Task Force Releases Rebuilding Strategy."
- 25 U.S. Global Change Research Center, "National Climate Assessment"; Keith Miller, Kristina Costa, and Donna Cooper, "How to Upgrade and Maintain Our Nation's Wastewater and Drinking-water Infrastructure" (Washington: Center for American Progress, 2012), available at <http://www.americanprogress.org/issues/economy/report/2012/10/11/41233/how-to-upgrade-and-maintain-our-nations-wastewater-and-drinking-water-infrastructure-2/>; Bracken Hendricks, Cathleen Kelly, and Adam James, "Infrastructure and Resilience: Forging a National Strategy for Reconstruction and Growth" (Washington: Center for American Progress, 2013), available at <http://www.americanprogress.org/issues/economy/report/2013/04/18/60960/infrastructure-and-resilience-forging-a-national-strategy-for-reconstruction-and-growth/>.
- 26 U.S. Global Change Research Center, "National Climate Assessment."
- 27 U.S. Department of Housing and Urban Development, "Hurricane Sandy Rebuilding Task Force Releases Rebuilding Strategy."
- 28 Ibid.
- 29 Alan Berube and Elizabeth Kneebone, "Parsing U.S. Poverty at the Metropolitan Level," *The Brookings Institution*, September 22, 2011, available at <http://www.brookings.edu/blogs/the-avenue/posts/2011/09/22-metro-poverty-berube-kneebone>.
- 30 Daniel J. Weiss, Jackie Weidman, and Mackenzie Bronson, "Heavy Weather: How Climate Destruction Harms Middle- and Lower-Income Americans" (Washington: Center for American Progress, 2012), available at <http://www.americanprogress.org/issues/green/report/2012/11/16/45135/heavy-weather-how-climate-destruction-harms-middle-and-lower-income-americans>.
- 31 Tracey Ross, "A Disaster in the Making: Addressing the Vulnerability of Low-Income Communities to Extreme Weather" (Washington: Center for American Progress, 2013), available at <http://www.americanprogress.org/wp-content/uploads/2013/08/LowIncomeResilience-3.pdf>.
- 32 Ibid.
- 33 Weiss, Weidman, and Bronson, "Heavy Weather."
- 34 Environmental Protection Agency, "Heat Island Effect," available at <http://www.epa.gov/hiri/> (last accessed September 2013).
- 35 Kathleen Maclay, "Warmer climate strongly affects human conflict and violence worldwide, says study," *US Berkeley News Center*, August 1, 2013, available at <http://newscenter.berkeley.edu/2013/08/01/climate-strongly-affects-human-conflict-and-violence-worldwide-says-study/>.
- 36 Elizabeth Kneebone and Steven Raphael, "City and Suburban Crime Trends in Metropolitan America" (Washington: The Brookings Institution, 2011), available at http://www.brookings.edu/~media/research/files/papers/2011/5/26%20metropolitan%20crime%20kneebone%20raphael/0526_metroplitan_crime_kneebone_raphael.pdf.
- 37 Elizabeth Kneebone and Jane Williams, "New Census Data Underscore Poverty's Persistence in 2012," *The Brookings Institution*, September 19, 2013, available at <http://www.brookings.edu/research/reports/2013/09/19-census-data-poverty-kneebone-williams>; "Brokest Cities in America: Los Angeles, Chicago, and more," *The Daily Beast*, July 23, 2013, available at <http://www.thedailybeast.com/galleries/2013/07/23/13-cities-in-financial-distress.html#e36539bb-a939-44eb-8d21-1aa778b8444c>.
- 38 Daniel J. Weiss and Jackie Weidman, "Pound Foolish: Federal Community-Resilience Investments Swamped by Disaster Damages" (Washington: Center for American Progress, 2013), available at <http://www.americanprogress.org/issues/green/report/2013/06/19/67045/pound-foolish/>.
- 39 Benefits are defined as "losses to society avoided" and include reduced direct property damage, reduced direct and indirect business interruption loss, reduced nonmarket damage—meaning environmental damage—reduced human losses, and reduced cost of emergency response. Multihazard Mitigation Council, "Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities" (2005), available at http://c.yumcdn.com/sites/www.nibs.org/resource/resmgr/MMC/hms_vol1.pdf.
- 40 Ibid.
- 41 U.S. Global Change Research Center, "National Climate Assessment"; Carmin, Nadkarni, and Rhie, "Progress and Challenges in Urban Climate Adaptation Planning."
- 42 Ibid.; NYS 2100 Commission, "Recommendations to Improve the Strength and Resilience of the Empire State's Infrastructure" (2013), available at <http://www.rockefellerfoundation.org/uploads/files/7c012997-176f-4e80-bf9c-b473ae9bbb3.pdf>.
- 43 U.N. Office for Disaster Risk Reduction, "The 10 Essentials for Making Cities Resilient," available at <http://www.unisdr.org/campaign/resilientcities/toolkit/essentials> (last accessed September 2013).
- 44 Sustainable DC, "Earth Day Baseline 2013" (2013), available at http://sustainable.dc.gov/sites/default/files/dc/sites/sustainable/page_content/attachments/SDC%20Actions%20First%20Year%20Focus_website.pdf.
- 45 Sustainable DC, "Sustainability DC" (2013), p. 76, available at http://sustainable.dc.gov/sites/default/files/dc/sites/sustainable/page_content/attachments/SDC%20Final%20Plan_0.pdf.

- 46 Ibid., p. 72.
- 47 Sustainable DC, "Earth Day Baseline 2013."
- 48 Ibid.
- 49 Ibid.
- 50 Ibid.
- 51 Mark Dennin, Cathleen Kelly, and Arpita Bhattacharyya "Cities that Are Building Resilience to Climate Change," Center for American Progress, October 22, 2013, available at <http://www.americanprogress.org/issues/green/news/2013/10/22/77656/cities-that-are-building-resilience-to-climate-change/>.
- 52 The Rockefeller Foundation, "How Resilient Is Your City?," available at <http://www.rockefellerfoundation.org/our-work/current-work/100-resilient-cities> (last accessed September 2013).
- 53 ReBuild Houston, "'5+5 Plan' (FY 2014-2023) Street and Drainage Improvements."
- 54 Los Angeles Office of the Mayor, "Adapt LA- Preparing for Climate Change" (2012), available at http://change.la/pdf/AdaptLA_Fact_Sheet.pdf.
- 55 R.J. Nicholls and others, "Ranking of the World's Cities Most Exposed to Coastal Flooding Today and in the Future" (Paris: Organisation for Economic Co-operation, 2007), available at <http://www.oecd.org/env/cc/39721444.pdf>.
- 56 Ibid.
- 57 Miami Dade County, "Miami-Dade County Sustainability-Related Legislation" (2012), available at <http://www.miamidade.gov/greenprint/planning/library/resolutions.pdf>.
- 58 Ibid.
- 59 Swiss Re, "Mind the Risk."
- 60 PlaNYC, "A Stronger, More Resilient New York."
- 61 Salt Lake City, "SLCgreen: Salt Lake City's Guide to a Sustainable City," available at <http://www.slcgov.com/slsgreen> (last accessed September 2013).
- 62 Richard S. Caperton and Adam James, "How to Keep the Lights On: More Reliable Electricity Will Require Smart Investments and Clean Energy Solutions," Center for American Progress, July 3, 2012, available at <http://www.americanprogress.org/issues/green/news/2012/07/03/11825/how-to-keep-the-lights-on/>.
- 63 Cathleen Kelly and Jackie Weidman, "Shelter from the Superstorm: How Climate Preparedness and Resilience Saves Money and Lives" (Washington: Center for American Progress, 2013), available at <http://www.americanprogress.org/issues/green/report/2013/07/01/68620/shelter-from-the-superstorm-2/>.
- 64 The White House, "Climate Change and President Obama's Action Plan," available at <http://www.whitehouse.gov/share/climate-action-plan> (last accessed September 2013).
- 65 Richard Dobbs and others, "Infrastructure Productivity: How to Save \$1 Trillion a Year" (New York: McKinsey Global Institute, 2013), available at http://www.mckinsey.com/insights/engineering_construction/infrastructure_productivity.
- 66 NYS 2100 Commission, "Recommendations to Improve the Strength and Resilience of the Empire State's Infrastructure."
- 67 Weiss and Weidman, "Pound Foolish."
- 68 Ibid.
- 69 The White House, "Climate Change and President Obama's Action Plan."
- 70 Congress appropriated \$3.5 billion, \$3 billion, and \$3.1 billion for this program in 2011, 2012, and 2013, respectively. U.S. Department of Housing and Urban Development, "Community Development Allocations and Appropriations," available at http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/budget (last accessed September 2013).
- 71 Congress appropriated \$500 million for TIGER grants in both 2012 and 2013. U.S. Department of Transportation, "TIGER Grants," available at <http://www.dot.gov/tiger> (last accessed June 2013).
- 72 The White House, "Climate Change and President Obama's Action Plan."
- 73 U.S. Federal Emergency Management Agency, *Fiscal Year 2014 Budget Request* (U.S. Department of Homeland Security, 2013).
- 74 "Report Ranks U.S. Cities' Efforts to Save Energy," American Council for an Energy-Efficient Economy, September 17, 2013, available at <http://aceee.org/press/2013/09/report-ranks-us-cities-efforts-save->
- 75 Amanda Eaken and Justin Horner, "A Bold Plan for Sustainable California Communities: A Report on the Implementation of Senate Bill 375" (Los Angeles: Natural Resources Defense Council, 2013), available at <http://www.nrdc.org/globalwarming/sb375/implementation-report/files/implementation-report.pdf>.
- 76 Eaken and Horner, "A Bold Plan for Sustainable California Communities."
- 77 Richard W. Caperton, Daniel J. Weiss, and Andrew Light, "10 Essential Pollution Reduction and Public Health Measures in President Obama's Climate Plan," Center for American Progress, June 25, 2013, available at <http://www.americanprogress.org/issues/green/news/2013/06/25/67963/10-essential-pollution-reduction-and-public-health-measures-in-president-obamas-climate-plan/>; Kelly and Weidman, "Shelter from the Superstorm."

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